



Proceedings of the



4th NATIONAL RESEARCH SCHOLARS MEET - 2023

**EVOLVING TRENDS AND CHALLENGES IN
MULTIDISCIPLINARY RESEARCH**



16th-17th March 2023

Organized By:

Sri Guru Granth Sahib World University, Fatehgarh Sahib

**In Collaboration with
Indian Science Congress Association (ISCA, Patiala Chapter)**

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SRI GURU GRANTH SAHIB WORLD UNIVERSITY

(Established under Punjab State Act 20 of 2008, Approved by UGC under Section 22 of UGC Act)

Fatehgarh Sahib - 140406

ABOUT THE UNIVERSITY

The establishment of Sri Guru Granth Sahib World University was announced on September 01, 2004 on the occasion of 400th anniversary of the 1st installation of the 'Adi (Guru) Granth at Sri Amritsar Sahib. The university has been established by Shiromani Gurdwara Parbandhak Committee, Sri Amritsar under Punjab State Act 20 of 2008. The University has a mandate to focus on intensive study, research and training in the areas of world religions, cultures and civilizations; eastern and western thought and other related disciplines of arts and humanities, social sciences, business management, pure and applied sciences. The university is running 28 departments under 11 faculties. In order to prepare the young men and women to be “ Global Professionals “, the University is simultaneously focusing on “ Emerging Technologies” including Food Processing Technology, Biotechnology, Information Technology as well as emerging disciplines like Environment, Human Rights, Empowerment of the Women etc. The university has prepared a curriculum where stress has been given on human moral and ethical values and concept of universal brotherhood to transform the raw, young students in to enlightened human beings and responsible citizens.



THE INDIAN SCIENCE CONGRESS ASSOCIATION

100 YEARS OF SERVICE TO THE NATION (ESTABLISHED 1914)

ABOUT INDIAN SCIENCE CONGRESS ASSOCIATION

The Indian Science Congress Association (ISCA) owes its origin to the foresight and initiative of two British Indian Chemists, namely Prof. J.L. Simonsen and Prof P.S. McMahon. The Association was formed with the following objectives:

- ◆ To advance and promote the cause of science in India
- ◆ To hold an annual congress at suitable place in India
- ◆ To publish such proceedings, journals, transactions and other publications as may be considered desirable
- ◆ To secure and manage funds and endowments for the promotion of Science including the rights of disposing off or selling all or any portion of the properties of the Association.
- ◆ To do and perform any or all other acts, matters and things as are conducive to, or incidental to, or necessary for the above objects. For detailed information kindly visit: www.sciencecongress.nic.in.

ISCA, PATIALA CHAPTER

One of the focal objectives of the Indian Science Congress Association (ISCA), a premier and the oldest scientific organization of the country, is to promote scientific temper among young scholars as well as mid-career scientists, and to encourage them for participating in various programmes relevant to fundamental, experimental and operational activities aimed at human welfare. Keeping in view, ISCA initiated opening of Regional Chapters since 1986-87 at various places in the country. The Indian Science Congress Association (ISCA) Patiala Chapter was started in 1996. In order to promote scientific temper, the Chapter has been regularly holding a seminar on the theme of the ensuing Indian Science Congress. Besides this, the chapter has been successfully organizing several kinds of activities like observation of National Science Day, World Environment Day, Environment Awareness Campaign, Science popularization activities, Workshops/ Seminars/Conferences, Exhibitions, etc.



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FATEHGARH SAHIB-140406 (PUNJAB), INDIA

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CHIEF PATRON
PROF. AJAIB SINGH BRAR, PRO-CHANCELLOR

FOREWORD

It is indeed a matter of great pride and honour for Sri Guru Granth Sahib World University, Fatehgarh Sahib to organize the **4th National Research Scholars Meet 2023** in collaboration with Indian Science Congress Association (ISCA) Patiala Chapter on the theme:

“Evolving Trends and Challenges in Multidisciplinary Research”

I extend a warm welcome to all the participants of the 4th National Research Meet. The conference aims to provide a forum for the exchange of ideas on the Emerging Trends in Sciences, Engineering and Social Sciences among researchers and practitioners in educational institutes and industries and to seek opportunities for multidisciplinary collaboration among the participants.

The endeavour made by the University will enable academicians, research scholars, students and all other related stakeholders to exchange ideas experiences and knowledge, develop contacts for further collaboration and suggest measures for meeting the evolving challenges.

My best wishes to all the participants for seeking this path towards gaining and spreading knowledge. I congratulate the organizers of this event and wish the conference a grand success.

Prof Ajaib Singh Brar
Pro Chancellor



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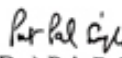
Message

It's a matter of privilege for Sri Guru Granth Sahib World University, Fatehgarh Sahib to organize **4th National Research Scholars Meet** in collaboration with **ISCA Patiala Chapter** on the theme **"Evolving Trends and Challenges in Multidisciplinary Research"** in blended mode. The theme of the conference has been selected keeping in view the multidisciplinary nature of the research.

Multidisciplinary research integrates data from different disciplines, incorporates different methodologies, and combines multiple perspectives and concepts to solve real world problems. Multidisciplinary research, therefore, requires either an individual researcher involve in two or more disciplines or two or more researchers bring together two or more different disciples or multidisciplinary teams assemble and create a platform for discovery and innovation.

Multidisciplinary research not only brings expertise together but also other limited resources in many contexts such as equipment, resources, time and motivation. Hence, multidisciplinary research leads to findings that exceed the possibilities of a uni-disciplinary research. The organizing committee of the conference has selected this timely theme in order to be on par with national and global trends and needs. This conference will allow the researchers, academics and students to share the novel findings of multidisciplinary research and development initiatives. This conference will also provide ample opportunity to the participants to share knowledge and collaborate and network with different experts from different parts of the country and the globe.

I wish this conference a huge success.


Prof (Dr.) Prit Pal Singh
Vice Chancellor



Message

I am delighted in acknowledging the *4th National Research Scholar Meet* on *“Evolving Trends and Challenges in Multidisciplinary Research”* organized by Sri Guru Granth Sahib World University, Fatehgarh Sahib. I appreciate the organizing committee for their keen interest in organizing a Multidisciplinary Conference and contributing new ideas and research findings.

I wish and congratulate them for their endeavours to spread knowledge.

Prof (Dr). IJS Bansal
President, ISCA (Patiala Chapter)
Former Dean Academic Affairs, Punjabi University, Patiala



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Message

It is a matter of pleasure that Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab is organizing 4th National Research Scholars Meet in collaboration with Indian Science Congress Association (Patiala Chapter) on March 16-17, 2023. Keeping the present scenario in mind, the theme of the meet is carefully selected as “Evolving Trends and Challenges in Multidisciplinary Research”. I hope that Research Scholars Meet will provide a good platform for scholars to make fruitful discussions and mature their ideas. Blessings of the almighty on the historic place of Fatehgarh Sahib will certainly grace the meet.

I hope for a good participation and success of 4th National Research Scholars Meet.

CO PATRON
PROF. (DR.) S.S. BILLING
DEAN, ACADEMIC AFFAIRS



Prof. Paramvir Singh
M.Sc. Ph.D

**Department Of Sports Science,
Punjabi University, Patiala**

(Established Under Punjab Act No. 85 of 1951)



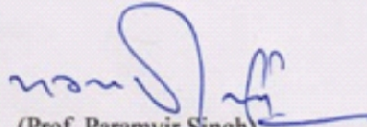
Dept. of Sports Science
Faculty of Medicine

Message

On the behalf of the Organizing team, it is matter of pleasure to invite all the great scientists, academicians, researchers and young students to 4th National Research Scholar Meet. This multidisciplinary conference which will provide a platform for the researchers to present the findings and exchange ideas and disseminate knowledge.

Multidimensional research is a pursuit of truth with the help of numerous specialized branches of learning which aims at achieving a common aim with the aid of knowledge of all other disciplines. Since current problems are complex in nature requiring knowledge of all its aspects such as economic, social, political, psychological etc. An effective interdisciplinary process is likely to require some softer Human Skills –Like Team work, leadership, tolerance of difference and ambiguity and selflessness. At the same time it can-not assert about its capability to solve all the problems. Therefore each and every discipline is bound to take the help of other discipline in order to reach at a suitable conclusion.

The organization of the conference in blended mode will facilitate participation beyond geographical boundaries of the nation.


(Prof. Paramvir Singh)

Convener ISCA (Patiala Chapter)



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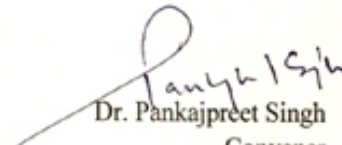
DR. PANKAJPREET SINGH, HOD, PHYSIOTHERAPY

Message

It's a matter great pride to welcome distinguished guests, invited speakers, delegates and students to 4th National Research Scholar Meet on the theme ***"Evolving Trends and Challenges in Multidisciplinary Research"*** to our prestigious institution Sri Guru Granth Sahib World University and to the spiritual city of Fatehgarh Sahib.

The conference will focus on the current factors and evolving research trends in dynamic scenario in several disciplines and envisages opening new vistas of thoughts through expert sessions, research paper presentations, professional development etc. and cascading in the form of publication to give a momentum to the seed of thoughts to further blossom in a concrete manner.

I would like to extend my gratitude to the ISCA Patiala Chapter, higher authorities of the university, organizing committee and other functional units of the university for extending their support for the organization of the event.


Dr. Pankajpreet Singh
Convener

Preface

This book is a written compilation of some scientific contributions presented in the 4th National Research Scholars Meet a conference organized by Sri Guru Granth Sahib World University, Fatehgarh Sahib in Collaboration with Indian Science Congress Association (ISCA) Patiala Chapter on 16th and 17th March, 2023 and revolves around the Evolving Trends and Challenges in Multidisciplinary Research. This convention has collectively drawn expertise from various disciplines in medical sciences, life sciences, physical and chemical sciences, mathematics, agriculture, social sciences and education, language and religious studies, commerce, management and law. We have received an overwhelming scientific contribution for the conference from diverse disciplines. Around 300 abstracts and over 100 full papers were received. After the initial submission the full papers were subjected to the review process and a total of 87 selected papers have been published as proceedings.

The proceeding is divided in to eight sections. The first section has three articles that have been contributed by the invited speakers. Second section includes eleven papers from biological and agricultural sciences. The third section draws twenty-nine articles from medical, physiotherapy and pharmaceutical sciences. Fourth section includes contributions from the discipline of physics, chemistry, mathematics and environmental studies in form of fifteen papers. Fifth section includes five papers from the discipline of engineering and technology. Eight papers contributed from social sciences and education have been compiled in the sixth section. Nine papers related to languages and religious studies are included in seventh section and at the end eighth section consists of seven papers from commerce, management and legal studies. Participation in this conference has helped delegates hone their skills and polish their ideas and strategies by meeting companions and colleagues. The participants also had the occasion to meet experienced faculty and share concepts and research findings with them. This event has entailed delegates to develop and challenge themselves with their ideas and proposals. The organizing committee is thankful to all the authors and participants for their contributions.

Dr. Supreet Bindra
Organizing Secretary

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Groundwater Contamination due to Uranium and Heavy Metals in Punjab State**Hardev Singh Virk***Professor of Eminence (Honorary), SGGS World University, Fatehgarh Sahib-140406*
hardevsingh.virk@gmail.com**Abstract**

Punjab State is facing a critical situation due to high levels of uranium (U) and heavy metals in groundwater of Punjab. Anomalous values of Uranium are reported in the nine districts of Malwa region of Punjab with U content higher than the WHO safe limit for drinking water. The origin of these anomalies is attributed to geogenic sources. High values of Arsenic (As) and Selenium (Se) are reported in the Majha and Doaba belts of Punjab, respectively. Groundwater quality has deteriorated due to presence of other heavy metals, such as iron, nickel, cadmium, chromium, aluminium, and lead. Health hazard effects of Uranium and other heavy metals are reported in this study. For sustainable development of Punjab State, mitigation measures have been proposed to get rid of Uranium and heavy metals like Arsenic and Iron.

Keywords: Punjab state, groundwater, uranium, heavy metals, mitigation.

Introduction

Punjab is facing a critical situation due to high levels of Uranium (U) and heavy metals in underground water table of Punjab (Virk 2017a-c, 2018, 2019 a-c, 2020). More than two dozen reports have been published in The Tribune (www.tribuneindia.com) during the last two decades concerning high toxicity of U in the waters of Punjab. The source of high concentration of U in groundwater of Punjab is still a matter of debate but its main source is attributed to be geogenic (Sahoo et al. 2021). According to the data compiled by the Central Ground Water Board (CGWB), the total number of villages affected by heavy metal contamination is 2420 in India, out of which 2139 fall in Punjab, 273 in Bengal, 7 in Assam and only one in Karnataka.

Our study is based on the data collected by field staff of Department of Water Supply and Sanitation (DWSS), Punjab during 2009-16 in three phases under the World Bank Project. Water samples were analysed using state of the art instrumentation including Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and Ion Chromatography in Regional Water Testing Laboratory (RTWL), Mohali.

Punjab is geographically divided into three regions: Malwa, Majha and Doaba. Our study reveals a pattern for distribution of Uranium (U) and heavy metals. Punjab has high levels of U in the groundwaters of the Malwa belt, namely, districts of Fazilka, Ferozepur, Moga, Barnala, Mansa, Sangrur, Patiala, and Bathinda. Arsenic contamination is found to be much higher than WHO safety levels in the Majha belt of Punjab, namely, Amritsar, Tarn Tarn and Gurdaspur districts. Selenium contamination is found to be high in the Doaba belt of Punjab, namely, districts of Jalandhar, Kapurthala and Hoshiarpur.

Uranium Anomalies in Groundwater

The total number of habitations (village or a cluster of houses) covered in DWSS survey is 6182 in 3 phases. To demarcate quality affected (QA) habitations, two limits have been set up by DWSS in the data table: 30 microgram/litre (ppb) is called Acceptable Limit (AL) and 60 microgram/litre (ppb) is shown as Permissible Limit (PL), which has been set by Atomic Energy Regulatory Board (AERB 2004) of Bhabha Atomic Research Centre (BARC), Mumbai (higher than limits set by all other countries). World Health Organisation (WHO) limit has been fixed at 30 ppb (WHO 2011). When we analyse the U data according to these limits, we get different results of QA habitations. If we use WHO limit of 30 ppb for safe drinking water, the percentage of QA habitations reaches 18 % of total habitations covered in Punjab survey. It is a matter of concern to supply safe drinking water to population of Punjab after removal of U from the groundwater. Figure 1 shows the district map of Punjab state.



Figure 1: Map of Punjab State showing District Boundaries (Courtesy Maps of India)

A large variation of U content has been observed from district to district and habitation to habitation depending upon the nature and profile of groundwater which may depend upon geomorphology and geo-hydrology of water table. Malwa belt of Punjab, namely, districts of Fazilka, Ferozepur, Moga, Barnala, Mansa, Bathinda, Sangrur and Patiala display higher U content in groundwater compared to districts of Majha and Doaba belt. However, the highest U content in ground waters of Punjab has been recorded in 15 habitations of Hoshiarpur district in the range of 2109 to 2277 ppb, which is almost 20 times the average value of U content (115 ppb) for the whole of Punjab as per AL criteria. Our calculation reveals that excess cancer risk for 2277 ppb U is 6.5 per 1000 persons, which is alarming! If we consider the average value of 115 ppb, the cancer risk for whole of Punjab is 3.3 per 10,000 persons. There is an urgent need to study the epidemiological effects of high U content in drinking water on public health.

Mitigation of Uranium: Several methods are available for the removal of uranium from drinking-water, although some of these methods have been tested at laboratory or pilot scale only. Coagulation using ferric sulphate or aluminium sulphate at optimal pH and coagulant dosages can achieve 80–95% removal of uranium, whereas at least 99% removal can be achieved using lime softening, anion exchange resin or reverse osmosis (RO) processes. DWSS recommended installation of RO system in rural areas of Punjab with U concentration higher than the Permissible Limit of 60 ppb. But after a decade of hit and trial, RO system has been discarded and become redundant in most of the villages of Punjab. Under the World Bank Project, DWSS has opted for utilization of canal water as the best alternative for the supply of potable water in the Malwa belt of Punjab.

Heavy Metals Contamination of Groundwater in Punjab

Iron content in Groundwater: The total number of habitations covered in DWSS survey is 4383 in 3 phases during 2009 to 2016. It has been reported that 539 habitations have higher content of Iron in groundwater than AL value of 1 mg/l (ppm), as a consequence, the population inhabiting these will suffer from overload effect of Iron. Normally, Iron deficiency in human body leads to anemia and fatigue. But an overload of Iron in the body produces toxic effects leading to *hemochromatosis*, a severe disease that can damage body organs. The highest number of QA habitations are reported in Amritsar and Ropar, followed by Gurdaspur, Patiala and Tarn Taran districts. An overload of 14.58 ppm, the highest value in Punjab, has been detected in the water drawn from a hand pump of Bagrian village in Amritsar district. The other high values are reported from Harijan Abadi (8.90 ppm) of Tarn Taran; Harijan Basti, village Mangarh (8.99 ppm) of Fatehgarh Sahib; Bolri (8.83 ppm) in Patiala; and Daulowal (7.03 ppm) in Hoshiarpur district. To get rid of excess Iron from potable water, RO system is most effective.

Nickel and Cadmium content in Groundwater: Nickel and Cadmium AL values have been fixed at 0.02 ppm and 0.003 ppm, respectively. According to DWSS report, 174 habitations are under QA category for Nickel and 165 for Cadmium, out of a total number of 6404 habitations covered in this survey. Patiala district has highest number of habitations with Cadmium overload. However, highest value of Nickel (0.33 ppm) is reported in groundwater of Lalton Kalan village in Ludhiana district.

Mercury and Chromium Content in Groundwater: The AL values for Mercury and Chromium have been taken as 0.001ppm and 0.05ppm, respectively. Mercury has been detected in 107 habitations out of a total of 6831 covered in this survey but the number of QA habitations is just 41. The highest value of Mercury (0.038 ppm) is reported in Hero Kalan village of Mansa district. Chromium content is widespread in Hoshiarpur, Ludhiana and Amritsar districts. However, the toxic effects of both these heavy metals need to be investigated epidemiologically for the safety of population in QA habitations.

Aluminium and Lead content in Groundwater: There are two limits set for Aluminium in groundwater of Punjab; Acceptable limit (AL=.03 mg/l or .03 ppm) and Permissible limit (PL = 0.2 mg/l or 0.2ppm). According to AL criteria, 3662 habitations out of a total of 6974 surveyed during 3 phases, show higher Aluminium content. If we consider the PL criteria, the number of QA habitations reduces to 1087. Aluminium contamination is highest in Hoshiarpur district with more than 150 habitations failing to qualify even under PL criteria. The highest value of Aluminium content (5.03 ppm) is reported for a tubewell installed in Balon village of SBS Nagar (Nawanshahar) district, which is 25 times the PL value.

Lead is another dangerous toxic heavy metal reported in Punjab. The AL for Lead has been set at 0.01 mg/l (0.01ppm). Out of 7009 habitations covered under Lead survey, 710 fail to qualify the safety limit. Gurdaspur district has maximum number of failed habitations (128) followed by Jalandhar (98). The maximum reported value of Lead content (0.467 ppm) has been found in a cluster of villages in Jalandhar district, namely, Dhuleta, Patti Kamalpur and Bara Pind.

Arsenic and Selenium content in Groundwater: A team of Punjab Agriculture University (PAU) scientists reported their findings in The Tribune, Chandigarh, of Jan. 2, 2010, blaming Arsenic content in groundwater of Malwa belt as one of the major causes of cancer (PAU 2010). A research report recently prepared by the Indian Council of Agriculture Research (ICAR) has reported Arsenic beyond safe limit in 13 districts of Punjab (ICAR 2011). However, DWSS survey report is more revealing and contradicts the findings of PAU team. According to DWSS report, with AL set at 0.01 mg/l (ppm) (WHO 1993), there are 2748 habitations out of 6884 surveyed in Punjab, which fall under QA category (40% nearly). Out of all QA habitations in Punjab, 60% fall in Majha belt of Punjab, namely, Amritsar, Tarn Taran and Gurdaspur districts. SAS Nagar and SBS Nagar districts are

relatively much safer with hardly any QA habitation. The source of Arsenic in ground waters of Majha belt needs to be investigated. However, it is well established that the strongest evidence for a *cancer risk* involves arsenic, which is *linked* to *cancers* of the liver, lung, bladder, and kidney.

Selenium is a non-metal and a very useful component in our diet. Selenium is a nutritionally essential element. People need selenium for healthy joints, heart and eyes. It plays a critical role in DNA synthesis, the immune systems and the reproductive system. It also helps fight cancer and other diseases. But its excess is dangerous for human health. Epidemiologic studies have shown that chronic exposure to selenium compounds is associated with several adverse health effects in humans (Vinceti et al. 2001).

Selenium AL is fixed at 0.01 mg/l (ppm) (WHO 2011). Following this criteria, DWSS survey reported 587 QA habitations out of 7009 surveyed in Punjab. The maximum number of QA habitations fall under Jalandhar (130), Ludhiana (70), Patiala (55) and Tarn Taran (50) districts. However, the highest reported value of Selenium (2.00 ppm) has been reported in the tubewell water of Passiana village in Patiala district, which is 200 times the safe limit (AL).

Mitigation of Arsenic and Iron from Groundwater: AMRIT Technology

Several technologies have been tried in the field and each of them has associated challenges (cost, complexity, efficiency and sludge). The acronym AMRIT stands for arsenic and metal removal by Indian technology. It has been developed by IIT Madras and it is very efficient (99%) for removal of Arsenic and Iron from groundwater. The main component of AMRIT is composed of nanoscale iron oxyhydroxide, prepared with a particle size less than 3 nm. The synthesis of nanoscale iron oxyhydroxide and its efficacy for removal of arsenic from water is described elsewhere [40, 41].

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Challenges Through Predatory Journals in Multidisciplinary Research

Asir John Samuel

Additional Professor cum Vice Principal, Yenepoya Physiotherapy College, Yenepoya (Deemed to be University), Naringana, Deralakatte, Mangalore-575018.

asirjohnsamuel@yenepoya.edu.in

Abstract

Predatory publishing is a real threat to science. Young scientists become easy prey to predatory publishing. Predatory publishers damage science more than anything else. They do not faithfully manage peer review, allowing questionable science to be published as if it had passed a strong peer review. They create real challenges in multidisciplinary research through predatory journals. public awareness about this growing menace is much more needed to stop this dreadful practice.

Keywords: Predatory publishing, predatory journals, fake journals

Publishing in a peer-reviewed indexed scientific journal has become important to get an academic reputation. Clinical work pressure and hardships in time management makes one to submit in a so-called predatory journal without recognizing the ill effects. Many of us might not have heard of the terms “predatory publishing” and “predatory journal.” Predatory publishing is simply defined as actively requesting publication without a legitimate peer-review process in exchange for money, usually in a nonindexed journal.¹ The concept of predatory publishing springs from open access and quick publication. It simply means research is published with online uploading or publishing costs/article processing charges (APC) and those articles are free to view, read, download, print, copy, and disseminate. “Predatory open access” is a term coined originally by Jeffrey Beall.²⁻⁴ These publishers promising fast peer reviews and acceptance by constantly spam the emails of the research scholars. The email addresses are usually obtained from legitimately published journals. The emails please the researcher by praising their earlier works and make them fall prey for their food of publishing by paying hefty money. The websites of these journals look authentic. Predatory publishing impacts the quality of research in every fields and thereby affects the quality of multidisciplinary research. The names of these journals usually have prefix like “world”, “international”, and “global”, giving an impression of high stature and repute.² Hence, Beall’s, Cabell’s, Manca’s, and Strinzel’s list should be consulted and confirmed before publishing.¹

Predatory publishers damage science more than anything else. They do not faithfully manage peer review, allowing questionable science to be published as if it had passed a strong and rigorous peer review. In having general assumption that peer review often results in papers being rejected for publication, researchers bypass the ideal peer review system in similar to bypassing the interview in standard recruitment process or the exam system and get themselves recruited or passed using unethical/substandard/fake means. Thus, novice researchers seek the business model of many open-access publishers, because they only want to generate as much revenue as possible by accepting all the received manuscript for hefty APC without rejection.

Ideal peer also helps authors to find and eliminate errors in the submitted manuscript which was either missed by the authors/supervisors before the final version of the scientific article is prepared and published. Peer review benefits authors and benefits science itself. It is well established fact that research is cumulative, and new research builds on the foundations established by previous research. When writing scientific articles, generally researchers first search the scholarly literature to discover what earlier research has been published on the similar research question they are researching. Because of predatory journals and their negligent/inadequate peer review management, at present many unscientific articles have been published and added to the science.

The scientific literature has become polluted, bringing the cumulative nature of research into doubt. When performing the literature searches, researchers should take care in deciding which articles to include, cite and which to ignore. If a scientific paper cites earlier articles published in predatory journals, then the base research itself becomes questionable. Unfortunately, some scholarly databases have not been careful and have included the content of predatory journals. One example is searching in Google Scholar. For those researchers wanting to avoid low-quality academic indexes, academic librarians could recommend high quality scholarly indexes and could seek help from them.

Academic evaluation has been affected by predatory journals. Now one can get their article published by paying publication fee/APC with pseudo-peer review. Most of the researchers prefer on number of publications rather than quality publications. They quickly publish several journal articles while honest colleagues publish a smaller number of articles but in higher quality journals with high impact factor reported by Journal Citation Report-Clarivate Analytics. Not all researchers who publish in predatory journals are exploiting the easy publishing. Even good research are getting published in bad journals, because predatory journals even fooled a honest researcher. Sometimes spam emails come at just the wrong time. As the top journals are selective, they frequently reject articles, even of genuine and good research. This causes a sense of frustration for the authors who might be on verge of high pressure to complete their

PhD or any research project which seek publication. So, finally the depressed researcher send their paper to the predatory journal, where it gets quickly published. But later the author regrets the bad decision and if they decide to withdraw from getting published, and it becomes impossible. They could charge twice for not publishing or might deny to withdraw, results in publishing the genuine research in so-called predatory platform.

The predatory publisher is happy because it has easily earned money from the researcher and even from the reputed funding agencies. Some medical researchers have been tricked by predatory journals that use graphic medical pictures to make themselves look legitimate. If you see a publisher website or receive a spam email that contains pictures of any treatment procedures, it might be a predatory publisher. Open-access journals with higher impact factors tend to charge higher fees to authors. This higher pricing may exclude researchers without funding from participating in scholarly publishing. However, there are some open-access journals that do not charge fees.⁵

The danger of paid publishing should not tarnish the career prospects of young aspirants, and hence caution is necessary when selecting a journal for submission of a scientific manuscript.⁶ Let us follow the recommendations provided by Jeffrey Beal^{3-5,7} to overcome the challenges to multidisciplinary research by predatory publishing in predatory journals.

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Biointensive integrated pest management: Springboard to sustainable agriculture

Ramesh Arora and Jaspreet Kaur

Department of Agriculture

Sri Guru Granth Sahib World University, Fatehgarh Sahib, India

The world population has been galloping upwards at an unprecedented rate during the last 50 years. The global human population has grown from 3.77 billion in 1971 to 7.91 billion in 2021. Thus, there has been more population growth during the last 50 years than during the entire period of more than a million years humans have inhabited the planet Earth. Despite this addition of more than 4 billion additional mouths to feed, modern agricultural technology has enabled us to largely keep pace with the increasing human population through increased productivity of major crops. However, in addition to causing environmental deterioration, it has also resulted in increasing losses by pests, pathogens and weeds. There is however a paucity of reliable data on the extent of food losses caused by these biotic agents, especially in developing countries. The limited data available indicate that arthropods may be destroying an estimated 18-20% of the annual crop production/potential production worldwide estimated at a value of more than US\$ 470 billion. Further, the losses are considerably higher in the developing tropics of Asia and Africa, where most of the future increase in world population is expected during the next 50 years. There is an urgent need to minimize these crop losses to achieve sustainability in agricultural production with an emphasis on developing countries (Arora and Sharma, 2021).

The widespread and intensive use of pesticides for crop protection has caused severe environmental and ecological problems. It is in this context that integrated pest management (IPM) emerged as a welcome alternative to synthetic pesticides for the sustainable management of insect pests (Metcalf and Luckmann, 1994). However, the adoption of IPM failed to curb the widespread use of pesticides.

This goal can be accomplished by adopting eco-friendly bio-intensive integrated pest management (IPM) strategies incorporating ecological and economic factors addressing concerns about environmental quality and food safety. Bio-intensive IPM (BIPM) is ‘A systems approach to pest management based on an understanding of pest ecology. It begins with steps to accurately diagnose the nature and source of pest problems and then relies on a range of preventive tactics and biological controls to keep pest populations within acceptable limits. Reduced-risk pesticides are used if other tactics have not been adequately effective, as a last resort, and with care to minimize risks.’ The benefits of implementing bio-intensive IPM can include reduced chemical input costs, reduced on-farm and off-farm environmental impacts, and more effective and sustainable pest management. Moreover, the high cost of discovering, developing and registering new synthetic pesticides and the rapid emergence of pest resistance have contributed to an increased interest in biopesticides and bio-intensive IPM which will focus primarily on biological knowledge of pests and their interaction with the crops and other components of the cropping system. Ideally, pest management interventions should take into account the extent of natural regulation and basic ecological information about pests and their crop environment which has become a prerequisite for efficient pest control. Consumer awareness of pesticide residues in food commodities has necessitated decreased usage of these chemicals and shifted the focus on the adoption of bio-intensive pest management practices in agroecosystems. Hence, research interest has shifted from pesticide management to a bio-intensive systems approach based on biological knowledge of pests and their interactions with crops. Biointensive IPM is thus a sustainable approach to manage pests utilizing cultural, host plant resistance, biocontrol (predators, parasitoids or pathogens), biorationals, biopesticides and molecular approaches to ensure favourable economic, ecological and sociological benefits (Sharma et al. 2016).

1.Pre-requisites for successful BIPM

The basic requirements for undertaking BIPM remain the same as in the case of IPM programmes. Since IPM is a knowledge-intensive system, a lot of background information on the pest, abiotic and biotic factors, agro-ecosystem and management tactics is required for taking decisions for the successful execution of any IPM programme. Some of these basic prerequisites are as under (Arora and Sharma, 2021).

Identification of insect pest(s)

Life history of the pest

Behaviour of the pest

Host range

Natural regulating factors

Need for control measures

Timing of control measures

Selection of suitable control measures

Pest surveillance and forecasting

2. Pest management tactics

The principles of IPM have been developed over the last six decades or more. However, there is a need to shift the IPM paradigm from focusing on pesticide management to a system approach relying primarily on knowledge of biology and interactions of the insect pest with the plant and other components of IPM (Dhaliwal and Arora, 2006, Arora et al., 2012, Arora and Sharma, 2021). A wide range of the strategies/tactics available for utilization in BIPM programmes are briefly introduced below:

2.1 Physical, cultural and mechanical control

Physical control methods involve the modification of the physical environment of the insects in such a way that they no longer pose a threat to the agricultural crop. This can be achieved by generating stress levels ranging from agitation to death or by using devices such as physical barriers that protect or skip plants against infestation. Many physical control methods target an ensemble of physiological and behavioural processes, whereas chemical methods have well-defined and limited modes of action. Physical control can be classified as passive (trenches, fences, organic mulch, particle films, inert dust, and oils), active (mechanical, polishing, pneumatic, impact, and thermal), and miscellaneous (cold storage, heated air, flaming and hot-water immersion).

Cultural practices refer to that broad set of management techniques or options that may be manipulated by agricultural producers to achieve their crop production goals, or the manipulation of the environment to improve crop production. Cultural control is the deliberate alteration of the production system, either the cropping system itself or specific crop production practices, to reduce pest populations or avoid pest injury to crops. The functional mechanisms include impediments to pest colonization of the crop, the creation of adverse biotic conditions that reduce the survival of individuals or populations of the pest, modifications of the crop in such a way that pest infestation results in reduced injury to the crop and enhancement of natural enemies by manipulating the environment.

2.2 Host plant resistance

Host plant resistance (HPR) is defined as the sum of constitutive or induced, genetically inherited qualities that result in a plant of one cultivar or species being less damaged than a susceptible plant lacking these qualities. The breeding for HPR to pests and pathogens was formalized after the discovery of Mendel's Laws of Heredity in 1900 and blossomed as a field of research during the first half of the twentieth century. Insect-resistant cultivars represent one of the most environmentally benign, economically feasible and ecologically sustainable options in pest management. Plant breeders have been striving to improve resistance traits in plants without any significant loss in crop productivity. Beginning in the 1920s, modern work on plant resistance to insects was pioneered by R.H. Painter and his colleagues at the Kansas State University, Kansas, USA. This paved the way for notable successes in developing pest and/or disease-resistant cultivars of wheat, rice, cotton, corn, sorghum, oats, sugarcane and other crops. The annual value of arthropod resistance genes currently deployed in global agriculture is greater than USD 2 billion. Wheat cultivars resistant to Hessian fly provided a 120-fold greater return on investment than pesticides. Insect-resistant cultivars of alfalfa, corn and beet fetched USD 320 for each \$ invested in research. Some of the major limitations in adopting host plant resistance for pest management are the lack of a high level of resistance against target pest in the germplasm, the long time required to develop resistant crop varieties and the prevalence of the pest complex at any given time against which multiple pest resistance may be lacking. In addition, the breakdown of resistance due to the development of virulent biotypes and secondary pest outbreaks has also restricted the wide-scale adoption of resistant varieties. Some of the recent developments (discussed in Section 2.7) in HPR including transgenic/GM crops, marker-aided selection (MAS), induced resistance and RNAi have helped to overcome these limitations in many cases (Arora and Sandhu 2017).

2.3 Biocontrol and bioinsecticides

Biointensive IPM seeks to strengthen the role of biological approaches for the management of insect pests. Some agricultural practices have the potential to enhance or decrease the functional biodiversity of biocontrol agents. Therefore, the practices that enhance the sustainability of these biocontrol agents should be promoted (Dhaliwal and Arora, 2006). Biological control refers to the destruction or suppression of undesirable insect pests by the introduction, encouragement, or artificial increase of biological control agents (BCAs) that include both macro- (predators, parasites, parasitoids) and micro-organisms. This control based upon naturally derived pest control processes that are more easily biodegradable, more target specific and eco-friendly is argued to be favourable to conventional chemical pesticides. Natural (biological control) is constantly active in all world terrestrial ecosystems and keeps most of the potential arthropod pests under control. Most of the potential arthropod pests (95%, 100,000 arthropod species) are under natural control; all other control methods used today are targeted at the remaining 5,000 arthropod pest species. The three basic strategies for the exploitation of biocontrol agents in insect pest management include importation or classical biological control, augmentation and conservation. Classical biological control involves the intentional introduction of exotic usually co-evolved

biocontrol agents to control a pest in an area where it has been accidentally or speciously introduced. Conservation biological control refers to the modification of the environment or existing practices to protect and enhance natural enemies or other organisms to reduce the effects of pests. Augmentation involves two approaches, viz inoculative and inundative releases, designed to increase the population of biocontrol agents by mass multiplication and periodic releases. These approaches have different applications depending on the adaptability of natural enemies and the environment in which they must operate. Classical biological control is applied on 350 million hectares, which is about 8 percent of land under culture, and has very high benefit-cost ratios of 20-500:1. However, augmentative, commercial biological control is utilized only on 16 million hectares, which is 0.4 percent of land under culture, and has a benefit-cost ratio of 2-5:1, which is similar to or better than chemical pest control (Arora and Shera 2014b).

Predators

Predators are those organisms that feed on other organisms for nutrition, energy and multiplication. Major groups that feed on pest insects are birds and predatory insects. Insectivorous birds are important in controlling the populations, behavior and evolution of their invertebrate prey. Insects form an integral part of various food chains, and thus can contribute significantly as biocontrol agents. The insects that prey on other insects and mites belong to Coleoptera, Neuroptera, Hemiptera, Odonata, etc. (Dhaliwal and Arora, 2006). Manipulation of predator complexes for biological control in cropping systems requires knowledge of predator taxonomy and biology, specificity and rates of predation.

Parasitoids

A parasitoid is a special kind of parasite which kills its host and requires only one host for development into a free-living adult. Eighty-six families belonging to six orders of insects have been reported to be dominated by parasitoid species, the most important ones being from Hymenoptera and Diptera. Tachinidae stand out as the most significant parasitoids amongst thirteen families of Dipteran order that are parasitic to arthropods. Parasitic wasps of the Braconidae family have been extensively utilized as endoparasitoids of aphids, larvae of Lepidopterans, and Coleopterans, eggs and larvae of Lepidoptera and Cyclorrhaphous Dipterans. Ten *Trichogramma* spp. have been mass-reared extensively for augmentative release against Lepidopteran pests of corn, sugarcane, cotton, vegetables and other crops.

Entomopathogens

Insect pathogens are important components of the natural enemy complexes with some groups such as microsporidia may not always maintain host densities below economic thresholds, but suppress the rapid increase of pest populations. This can be achieved by inoculative releases of the pathogen or by changing cultural practices to promote the multiplication of the pathogen.

The most broadly used biopesticide in pest management is *Bacillus thuringiensis* (Bt). The first commercial product ‘Sporeine’ was produced in France in 1938 but it was not until 1970 that it emerged as a successful biopesticide with the discovery of the potent strain HD1 of *B. thuringiensis* var *kurstaki*. The major drawback of Bt is the rapid photodegradation of foliar sprays on the crop and to overcome this problem, the delta-endotoxin genes have been inserted into many crop plants. Recent advances in molecular biology have provided the necessary tools for the genetic improvement of entomopathogens to overcome their major limitations (Arora, 2015).

Both the major groups (predatory arthropods, entomopathogens) of natural enemies suffer from certain limitations which have prevented their widespread use in IPM programmes. Many of these limitations of BCAs may however be overcome through genetic improvement. The genetic improvement involves directed purposeful genetic alterations to enhance the efficacy of natural enemies for biological control. This may be achieved by conventional approaches as well as through recombinant DNA techniques. The conventional methods include strain selection, serial passage, mutation, conjugation, transduction, selective breeding, hybridization, etc. whereas the genetic engineering approaches involve gene transfer utilizing various methods. Entomophagous insects may be improved for climatic tolerance, sex ratio, host-finding ability, host preference, increased host range, increased pesticide resistance, etc. The main objectives in genetically altering microbes are to increase host range, virulence and persistence. The cry genes from *Bacillus thuringiensis* have been cloned and expressed in a wide variety of organisms (baculoviruses to cyanobacteria) as well in plants in attempts to improve their delivery and efficacy against insect pests. Apart from *B. thuringiensis*, a binary toxin from different *B. sphaericus* strains has been expressed in different hosts like *Escherichia coli*, non or low-toxic *B. sphaericus* and crystal minus *Bt israelensis* as well as in *Caulobacter crescentus* or cyanobacterium *Anabaena* sp. Insect viruses especially baculoviruses are mostly specific viruses that can replicate only in hosts. The recombinant DNA technology has its current applications in inserting foreign genes into insect baculoviruses and achieving their rapid and efficient expression in the recipient host systems. Candidate genes for hyperexpression in the baculoviruses include those encoding insect-specific enzyme genes (juvenile hormone esterase gene); hormone genes (eclosion hormone gene; diuretic hormone gene) and insect-specific foreign toxic gene (scorpion venom toxin genes; predatory mite toxin gene; predatory spider toxin gene; parasitic wasp venom gene and Bt δ -endotoxin genes). It is worthwhile to mention that genetic engineering of BCAs is

potentially very promising and has led to the development of more effective entomopathogens with desired pathogenicity, virulence, broad host range and persistence, etc. providing a valuable tool for sustainable pest management (Arora and Shera, 2014b).

2.4 Semiochemicals

A complex web of chemically mediated conversation exists in the four trophic level system. Plants produce chemicals that inhibit the growth and development of other plants; attract, repel, or stimulate feeding and oviposition by herbivores and either attract or stimulate the activities of parasitic and predaceous insects. Herbivores produce chemicals that influence the other members of the same species, other herbivores, parasitic and predaceous insects and even hyper parasitoids. Semiochemicals have powerful biological activity and are highly specific and mediate interactions between organisms. These are subdivided into allelochemicals and pheromones depending on whether the interactions are inter-specific or intra-specific respectively.

Pheromones. A pheromone is defined as a chemical or mixture of chemicals that is released to the exterior by an organism and causes one or more specific reactions in a receiving organism of the same species. A dazzling variety of insect behaviour from sexual attraction and dispersal to caste determination is controlled by pheromones. It is thus natural that pheromones have attracted the attention of applied entomologists for exploitation in insect pest management. Pheromones have been extensively employed in IPM for monitoring, mass trapping, and for mating disruption. One of the first widely used monitoring systems that include an action threshold based on trap captures was established for a pea moth, *Cydia nigricana* Fabricius. More than one thousand pheromone compounds as well as their synthetic analogs have been identified, most of them in Lepidoptera, as also in other insect orders, particularly Coleoptera and Diptera. Control of insect populations with pheromones is achieved by mating disruption and mass annihilation. Mating disruption causes disorientation and communication disruption between the sexes and thus delays or reduces or prevents fertilization of females. Mass annihilation by mass trapping or attract and kill, relies on the attraction of one or both sexes to a lure in combination with a large capacity trap or an insecticide-impregnated target. The most widespread and successful applications of sex pheromones have been in detection and population monitoring and these have been used to mediate reproduction. Trimedlure, methyl eugenol and cue-lure are para pheromones serving as male attractants for various fruit fly species (Arora and Shera, 2014a).

Allelochemicals. These chemicals mediate inter-specific interactions. There are numerous avenues for their use in IPM programmes either directly against insect pests or through the enhancement of natural enemies. Plants play an important role in the post or pre-selection behaviour of entomophagous insects attacking herbivorous insects. Many of the toxic or repellent plant allelochemicals are attractive or stimulating to parasitoids. The presence of specific herbivore-induced plant volatiles may also serve as reliable clues for the presence of a specific host species or host stage. Interestingly, some egg parasitoids also respond to plant cues induced by larval feeding. Many studies have shown that damaged plants are much more attractive to natural enemies than undamaged plants.

2.5 Push-pull strategy

The term was first coined by Pyke *et al* in Australia for the use of repellent and attractant stimuli deployed in tandem, to manipulate the distribution of *Helicoverpa* sp in cotton. Push-pull strategies involve the behavioural manipulation of insect pests and their natural enemies via the integration of stimuli that act to make the protected resource unattractive or unsuitable to the pest (push) while luring them towards an attractive source (pull) from where the pests are subsequently removed. Push-pull strategies maximize the efficacy of behaviour manipulating stimuli through the additive and synergistic effect of integrating their use. This strategy is a useful tool for IPM programmes for reducing pesticide input. The strategies involve the combined use of inter-crops and trap crops, using plants that are appropriate for the farmers (Arora and Shera, 2014a).

2.6 Chemical Control

Biorational and reduced risk insecticides

Botanicals: Botanical pesticides are those compounds or materials derived from plants (excluding synthetic analogues) that demonstrate useful toxicity to pests involved in agriculture, animal husbandry, or human health problems. Major botanical products in use include pyrethrum, neem, rotenone and essential oils.

Microorganism-derived biorationals: These have been developed mostly from soil microorganisms by a fermentation process and have proved useful as reduced-risk pesticides for the management of insect pests. Common examples from this group include spinosyns, avermectins and pyrrole insecticides.

Insect growth regulators: The chemicals that affect the growth and development of insects are called insect growth regulators (IGRs). The IGRs include insect hormones and their analogues and chitin synthesis inhibitors (CSIs). Examples of hormonal analogues commercialized include Methoprene, Hydroprene, Fenoxycarb and Pyriproxifen, while diflubenzuron and Novaluron are the CSIs in common use.

Other biorationals: Examples of misc. biorationals in common use include pymetrozine, oxadiazines, phenyl pyrazoles, tetrone acid derivatives, tetramic acid derivatives and diamides.

2.7 Molecular approaches

Advances in molecular biology and genomics have opened new avenues to develop crop cultivars resistant to major biotic and abiotic stressors, as well as, to refine other pest management tools. Advances in crop, animal and microbial biotechnologies have all contributed to improved pest management tools.

Transgenic crops

The crops which carry one or more functional foreign genes are known as transgenic crops. Since the commercialization of biotech crops in 1996, the area under genetically engineered crops has increased with an unprecedented 100-fold increase between 1996 and 2012.

Bacillus thuringiensis toxins: A total of 31 insect resistance transgenes have been expressed in crop plants and are being deployed worldwide in different genetically engineered crops e.g. cotton, maize, soybean, potato, eggplant, poplar, cowpea, etc. alone or stacked with herbicide resistance genes. A majority of these are Bt genes including *cry1Ac*, *cry 1A*, *cry1 Ab-Ac*, *cry2Ab2*, *cry1Ab*, *cry1F*, *cry1Fa2*, *cry1C*, *vip3A(a)*, *vip3Aa20*, *cry9C*, *cry2Ae*, *cry1A*, *cry1A.105*, *mcry1F* (lepidopteran resistance), *cry34Ab1*, *cry35Ab1*, *cry3Bb1*, *cry3A*, *mcry3A*, and *mcry3Bb1* (coleopteran resistance) have been expressed in several crop plants (www.isaaa.org). Bt cotton was the first genetically engineered crop, approved by Genetic Engineering Approval Committee (GEAC) for commercial cultivation in central and south zones (2002) and north zone (2005) in India.

Plant defensive proteins: Plants have developed defense systems to combat various herbivores and pathogens throughout their life cycle. Many of these plant defenses have been characterized and the genes have been inserted in crop plants for protection against insects, usually synergistically with Bt toxins. Examples of such crop plants include tobacco, potato, tomato, rice, sugarcane, and oilseed rape which have been genetically transformed to express various genes of plant origin mainly protease inhibitors, α-amylase inhibitors, lectins and enzymes.

Pyramiding of genes: The effectiveness and durability of resistance in transgenic crops are likely to be greater if they are engineered with multi-gene, multi-mechanistic resistance. To increase the protective efficacy, the spectrum of activity and the durability of resistance, packages of two and more genes have been introduced in crop plants. This process is called the pyramiding or stacking of genes. Stacked Bt cotton with two transgenes (*cry 1ac*, *cry 2ab*) was developed to improve the efficacy against *Spodoptera* spp., *Helicoverpa armigera*, *Trichoplusia ni* and *Pseudoplusia includens*.

Gene stacking may also be undertaken to introduce two or more desirable traits in the same cultivar. Smartstax maize is the first ever eight-gene stacked cultivar. It incorporates six Bt genes- three for above-ground lepidopteran pests, three for below-ground coleopteran pests and two for herbicide resistance.

RNA interference: RNA interference (RNAi), a gene silencing technology involving down-regulation of the expression of specific genes, opened new vistas for the development of new generation insect-resistant transgenic crops through double-stranded RNA (dsRNA) directed against specific insect target genes. In China, pyramided cotton expressing a Bt protein and dsRNA (for RNAi) provided excellent control of target pests and also substantially delayed the development of resistance relative to using Bt alone.

Genetically modified insects

A genetically modified (GM) insect is an insect that has been genetically modified, either through mutagenesis, or cisgenesis. Genetic. The use of genetically modified insects is an innovative tool to address the issue of insect vectored diseases of humans and crop plants. Several insect species belonging to the orders Diptera, Lepidoptera, Coleoptera and Hymenoptera have been transformed by using different transposable elements. GM insects have been found useful for the management of insect pests of crops as well as of those in public health.

Conclusions

Agrochemicals have contributed significantly to improving agricultural productivity but, at the same time, the threat posed to the environment by their indiscriminate use should not be underestimated. IPM originated as a reaction to the overuse of insecticides and is now the dominant paradigm that guides the development of insect pest management technologies all over the world. Since its adoption as a cardinal principle of plant protection in India, many programmes have been designed and implemented encompassing a variety of crops. But, it is imperative to restrict and minimize the use of chemical pesticides in IPM programmes. In light of this, bio-intensive integrated pest management is considered as the desirable path to sustainability in agriculture. Unfortunately, the pesticide industry has a myopic view regarding the economic gains and does not give due consideration to the environmental and health impacts of chemical pesticides. There is also a need to strengthen research in strategic areas like genetically improved bioagents, biopesticides and pest-resistant transgenics. Molecular approaches can go a long way in overcoming the major limitations of conventional pest control. The advancements in the field of bio-intensive IPM will shape it into an environmentally benign alternative to chemical control for sustainable insect pest management. Moreover, BIPM in the future will emphasize biological and ecological knowledge for efficient management of pests vis-a-vis intensification of consumer awareness programmes regarding the environmental and health impacts of synthetic pesticides and their

regulation. Thus, bio-intensive management needs to be emphasized as an effective means of pest regulation with a priority of human and environmental safety issues to act as a springboard towards sustainability in agricultural production.

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Synergistic Gene Interactions of Angiotensin-Converting Enzyme I/D, Angiotensinogen M235T and Angiotensin II Type 1 Receptor A1166C Polymorphisms on Risk of Type 2 Diabetes Mellitus in North-West Indians

Rupinder Kaur*, Manpreet Kaur, Sarabjeet Kaur, Tarandeep Kaur

Department of Biotechnology, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab-140406, India.

drkdogra@gmail.com

Abstract

Introduction: The renin-angiotensin system (RAS) plays an important role in the pathogenesis of type 2 diabetes mellitus (T2DM). It is important to study the interactions of angiotensin-converting enzyme (ACE) I/D, angiotensinogen (AGT) M235T and angiotensin II type 1 receptor (AT1R) A1166C gene polymorphisms related to RAS pathway in association with T2DM from North-west India.

Methods: RAS gene polymorphisms were determined using polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) in a total of 300 subjects (150 T2DM patients and 150 controls) from North-west India. Traditional risk factors, ACE I/D, AGT M235T and AT1R A1166C gene polymorphisms were compared among patients and controls. Gene-gene interactions were also studied.

Results: Multivariate logistic-regression analysis determined that hypertension, retinopathy, nephropathy, cardiovascular disease, family history of diabetes, high BMI, ACE ID genotype, AGT 235MT genotype and AGT 235TT genotype were independent risk factors for T2DM. Multinomial logistic-regression analysis confirmed the synergistic interactions in genes related to RAS system contributing in the development of T2DM. Patients with ACE (ID+DD) and AGT 235 (MT+TT) combined genotype showed higher risk of T2DM (OR=1.9; 95% CI=1.2–3.1; $p<0.001$) than with ACE II and AGT MM combined genotype. Higher risk of T2DM was also shown by patients having ACE (ID+DD) and AT1R 1166 (AC+CC) combined genotype (OR=1.6; 95% CI=0.7–3.8; $p<0.001$) than with ACE II and AT1R AA combined genotype. However, AGT MT+TT showed significant interaction with AT1R 1166AA genotype in T2DM patients ($p<0.001$). **Conclusion:** AGT M235T and ACE I/D polymorphisms were independent risk factors for T2DM from North-west India. Significant synergistic interactions between ACE, AGT and AT1R genes of RAS pathway are strongly indicated.

Keywords: gene interactions; gene polymorphisms; North-west India; renin-angiotensin system; type 2 diabetes mellitus

Introduction

Type 2 diabetes mellitus (T2DM) is a heterogeneous and chronic metabolic disease characterized by elevated levels of plasma glucose caused by peripheral insulin resistance and impaired insulin secretion from pancreatic β -cells. The prevalence of T2DM is increasing over the world at an alarming rate (Kaveeshwar *et al.*, 2014). The global burden of T2DM for 2010 was 171 million people, which is projected to increase to 366 million in 2030. In case of India, the disease burden is estimated to increase from 31.7 million people in 2010 to 79.4 million in 2030 (Wild *et al.*, 2004). Increasing prevalence and incidence rates highlights the need to study the mechanism and risk factors underlying T2DM. The etiology of T2DM is complex and polygenic, with multiple genes located on different chromosomes contributing to its susceptibility. The analysis of genetic risk factors associated with T2DM is further complicated by several factors such as genetic heterogeneity, gene interactions and the modulating role played by the environment. The transition to modern diet along with decreased physical activity and sedentary lifestyles has led to increased insulin resistance altering the glucose levels in the body leading to increased prevalence of the T2DM. Previous studies have indicated that obesity, physical inactivity, and family history of the disease are major risk factors for T2DM (Kommoju and Reddy, 2011). Studies also suggest the association of renin-angiotensin system (RAS) in the etiology of T2DM and its complications. Activation of the RAS and enhanced production of angiotensin II (Ang II) has an inhibitory effect on insulin signal transduction pathway which results in insulin resistance, damage of the pancreatic β -cells and impairment of insulin secretion from the pancreas. If there is chronic exposure to high levels of glucose, it induces oxidative stress, inflammation and apoptosis with participation of Ang II through angiotensin II type 1 receptor (AT1R) in β -cells of pancreas, resulting in the development of T2DM (Rahimi *et al.*, 2014). The variants of RAS genes, viz. angiotensinogen (AGT), angiotensin converting enzyme (ACE) and angiotensin II type 1 receptor (AT1R) have been associated with T2DM in some populations (Ichikawa *et al.*, 2014; Lei *et al.*, 2012; Lin *et al.*, 2009; Maeda *et al.*, 2007; Mehri *et al.*, 2010; Osawa *et al.*, 2007; Rahimi *et al.*, 2014; Singh *et al.*, 2006; Thameem *et al.*, 2008; Thomas *et al.*, 2001; van Ittersum *et al.*, 2000; Yang *et al.*, 2010; Young *et al.*, 1998). It is important to study the etiological role of gene variants in different ethnic groups, including population from North-west India, since the prevalence of these gene polymorphisms will determine whether there are any pathogenetic associations between the gene polymorphisms and the disease. Ours is the first reported study which has evaluated the importance of synergistic interactions of ACE I/D, AGT M235T and AT1R A1166C gene polymorphisms on risk of T2DM in North-west Indians.

Materials and methods

Subjects

The sample size of this case-control study was determined using EPI INFO statistical package taking 80% power of the study, 95% confidence interval (CI) and assuming case: control ratio to be 1:1. The study included a total of 300 subjects consisting of 150 T2DM patients and 150 controls from Punjab, North India. The controls were random unrelated healthy subjects, matched with the patients with respect to the age, gender, geographical origin and ethnicity. None of the controls showed personal history of Diabetes. Diagnosis of T2DM was based on the American Diabetes Association (ADA, 2010) ie. Fasting plasma glucose ≥ 126 mg/dl or 2-h plasma glucose ≥ 200 mg/dl or random plasma glucose ≥ 200 mg/dl. The patients with Type I Diabetes and Gestational Diabetes were excluded from the present study. A detailed personal history was taken including demographic data (age and gender), socio-economic status (high / middle / low), lifestyle pattern (urban / rural), dietary pattern (vegetarian / non-vegetarian) and alcohol intake. Clinical data was recorded which included information on hypertension, family history of diabetes and history of chronic complications of diabetes. The present study was approved by Institutional Ethical Committee (IEC) of Sri Guru Granth World University, Fatehgarh Sahib, Punjab (SGGSWU/IEC/2015/03). All subjects provided written informed consent.

Individual weight and heights were obtained from the participants to calculate body mass index (BMI) using the formula, weight (kg) / [height (m)]². According to WHO Expert Consultation 2004, body mass index (BMI) was categorized as normal weight (18.5-22.9 kg/m²), overweight (23-27.5 kg/m²), obese (27.6-40 kg/m²), and morbidly obese (>40 kg/m²). Waist circumference and hip circumference were also obtained from the participants to calculate waist-hip ratio (WHR). Central obesity is defined as WHR ≥ 0.8 for males and ≥ 0.95 for females.

Genotyping

Venous blood was collected by venipuncture from all the subjects in tubes with 0.5 M ethylenediaminetetraacetic acid (EDTA) as anticoagulant. Genomic DNA was isolated from whole blood using the standard phenol-chloroform extraction method and ethanol precipitation (Green and Sambrook, 2012). Polymerase chain reaction (PCR) was used for genotyping *ACE* I/D polymorphism, using insertion-specific primer (Rigat *et al.*, 1992). To examine the *AGT* M235T and *AT1R* 1166A/C polymorphism, PCR-RFLP was performed using site specific restriction enzymes (Chang *et al.*, 2003; Young *et al.*, 1998).

Statistical analysis

Quantitative variables were presented as mean $\pm$ standard deviation (SD) while categorical variables were presented as absolute frequencies and percentages. The distribution of allele and genotype frequencies between patients and controls was determined by allele counting. Continuous variables were compared using independent two-tailed t test, and categorical variables were compared using chi-square test. The comparison of mean BMI and mean WHR among patients and controls was done using ANOVA and Bonferroni test. Deviation of allele frequencies from Hardy-Weinberg equilibrium (HWE) was performed using χ^2 test. Associations were expressed as odds ratio (OR) with 95% confidence interval (CI). Multivariate logistic regression analysis was used to determine the independent association of risk factors with T2DM. Multinomial logistic regression analysis was used to study synergistic effects of genetic polymorphisms on the occurrence of T2DM. Statistical significance was determined at $p < 0.05$. Data were analyzed with SPSS statistical program version 13.

Results

The general characteristics of the study participants is shown and compared in Table 1. Socioeconomic status, lifestyle pattern and dietary pattern were similar among both T2DM patients and controls. However, family history of diabetes was more frequent in patients than controls. These patients also had a high prevalence of diabetes-induced chronic complications. In addition, mean BMI and mean WHR was significantly higher in T2DM patients as compared to controls.

The genotype and allele frequency distribution of *ACE* I/D, *AGT* M235T and *AT1R* A1166C polymorphism in T2DM patients and controls is compared in Table 2. The frequency of *ACE* DD genotype, *ACE* ID genotype, *ACE* D allele, *AGT* TT genotype, *AGT* MT genotype and *AGT* T allele in the T2DM patients were significantly higher than controls showing that these genotypes and alleles are significantly associated with increased risk of T2DM. However, *AT1R* AA genotype, AC genotype and C allele were not associated with T2DM in our study population.

Factors which were significant in uni-variate analysis were assessed for multi-variate analysis to eliminate the effect of confounders. Multiple logistic regression analysis (Table 3) suggested that hypertension, retinopathy, nephropathy, cardiovascular disease, family history of diabetes, mean BMI, *ACE* ID genotype, *AGT* 235MT genotype and *AGT* 235TT genotype were independent risk factors for T2DM.

Multinomial logistic regression analysis was done to study the synergistic effect of gene polymorphisms of RAS pathway in the development of T2DM. The effect of the *AGT* 235 T allele (MT+TT genotypes) on the risk of T2DM was higher in *ACE* D allele (ID+DD) carriers (Table 4). Patients with *ACE*

(ID+DD) and *AGT* 235 (MT+TT) combined genotype showed significantly higher risk of T2DM than with *ACE* II and *AGT* MM combined genotype. *ACE* (ID+DD) and *AT1R* 1166 (AC+CC) genotypes also showed significant interactions (Table 5). Patients having *ACE* (ID+DD) and *AT1R* 1166 (AC+CC) combined genotype showed significantly higher risk of T2DM than with *ACE* II and *AT1R* AA combined genotype. However, *AGT* MT+TT showed significant interaction with *AT1R* 1166AA genotype in T2DM patients (Table 6). The above results strongly indicate significant synergistic interactions between *ACE*, *AGT* and *AT1R* genes of RAS pathway.

Table 1. General characteristics of the study participants

Characteristics		T2DM patients n=150 (%)	Controls n=150 (%)	OR (95% CI)	p value
Mean age (years)		53.5±11.5	53.7±11.2	-	-
Males		84 (56%)	84 (56%)	-	-
Hypertension		114 (76%)	51 (34%)	6.1 (3.7 – 10.2)	<0.001*
Retinopathy		63 (42%)	14 (9.3%)	7.0 (3.7 – 13.3)	<0.001*
Neuropathy		25 (16.7%)	8 (5.3%)	3.6 (1.5 – 8.2)	0.002*
Nephropathy		44 (29.3%)	16 (10.7%)	3.5 (1.9 – 6.5)	<0.001*
Cardiovascular Disease		38 (25.3%)	17 (11.3%)	2.7 (1.4 – 5.0)	0.002*
Non-vegetarian Dietary Pattern		47 (31.3%)	52 (34.7%)	0.9 (0.5 – 1.4)	0.539
Urban Lifestyle pattern		76 (50.7%)	69 (46%)	1.2 (0.8 – 1.9)	0.419
High SES		42 (28%)	51 (34%)	0.8 (0.5 – 1.2)	0.207
Family history of Diabetes		35 (23.3%)	21 (14%)	1.9 (1.0 – 3.4)	0.038*
BMI (kg/m ²)	Mean ± SD	26.2 ± 3.7	24.2 ± 3.8	-	<0.001*
	BMI >23	117 (78%)	85 (56.7%)	2.7 (1.6 – 4.5)	<0.001*
WHR	Mean ± SD	0.93 ± 0.03	0.91 ± 0.05	-	0.002*
	WHR ≥0.9, M	80/84 (95.2%)	74/84 (88.1%)	-	0.169
	WHR ≥0.85, F	63/66 (95.5%)	47/66 (71.2%)	-	<0.001*
	High WHR	143 (95.3)	121 (80.6%)	4.9 (2.1 – 11.6)	0.029*

* p < 0.05, significant

Table 2. Distribution of genotype and allele frequencies of RAS-related genes in T2DM patients and controls

Genotypes/Allele types	T2DM Patients n=150 (%)	Controls n=150 (%)	OR (95% CI)	p value
ACE I/D	II	56 (37.3%)	90 (60%)	<0.001*
	ID	83 (55.3%)	50 (33.3%)	
	DD	11 (7.3%)	10 (6.7%)	
	I allele	0.65	0.77	
	D allele	0.35	0.23	
AGT 1166A/C	MM	40 (26.7%)	68 (45.3%)	0.003*
	MT	47 (31.3%)	31 (20.7%)	
	TT	63 (42%)	51 (34%)	
	M allele	0.42	0.56	
	T allele	0.58	0.44	
AT1R 1166A/C	AA	126 (84%)	128 (85.3%)	0.749
	AC	24 (16%)	22 (14.7%)	
	A allele	0.92	0.93	
	C allele	0.08	0.07	

* p < 0.05, significant

Table 3. Multivariate logistic regression analysis to determine independent risk factors for T2DM

Risk Factors	OR (95% CI)	p value
Hypertension	5.4 (2.7 – 10.8)	<0.001*
Retinopathy	8.5 (3.5 – 20.9)	0.001*
Nephropathy	3.6 (1.5 – 8.7)	0.004*
Cardiovascular disease	2.6 (1.0 – 6.7)	0.049*
Family history of diabetes	2.9 (1.3 – 6.6)	0.01*
Mean BMI	-	0.001*
ACE ID genotype	3.7 (1.8 – 7.6)	0.001*
AGT 235MT genotype	9.2 (3.8–22.5)	0.001*
AGT 235TT genotype	5.9 (2.6 – 13.3)	0.001*

* p<0.05, significant

Table 4. Interaction between ACE I/D and AGT M235T polymorphisms on the occurrence of T2DM

ACE I/D genotype	AGT M235T genotype	T2DM Patients n=150	Controls n=150	OR 95% CI	p value
ID+DD	MT+TT	65 (43.3%)	43 (28.7%)	1.9(1.2 – 3.1)	<0.001*
ID+DD	MM	29 (19.3%)	17 (11.3%)	1.9(0.9 – 3.6)	<0.001*
II	MT+TT	45 (30%)	39 (26%)	1.2(0.7 – 2.0)	0.756
II	MM	11 (7.3%)	51 (34%)	1 (Reference)	-

* p < 0.05, significant

Table 5. Interaction between ACE I/D and AT1R A1166C polymorphisms on the occurrence of T2DM

ACE I/D genotype	AT1R A1166C genotype	T2DM Patients n=150	Controls n=150	OR 95% CI	p value
ID+DD	AC	14 (9.3%)	9 (6%)	1.6 (0.7 – 3.8)	<0.001*
ID+DD	AA	80 (53.3%)	51 (34%)	2.2 (1.4 – 3.5)	<0.001*
II	AC	10 (6.7%)	13 (8.6%)	1.2(0.7 – 2.0)	0.756
II	AA	46 (30.7%)	77 (51.3%)	1 (Reference)	-

* p < 0.05, significant

Table 6. Interaction between AGT M235T and AT1R A1166C polymorphisms on the occurrence of T2DM

AGT M235T genotype	AT1R A1166C genotype	T2DM Patients n=150	Controls n=150	OR 95% CI	p value
MT+TT	AC	21 (14%)	15 (10%)	1.5 (0.7 – 3.0)	0.953
MT+TT	AA	89 (59.3%)	67 (44.7%)	1.8 (1.1 – 2.8)	<0.001*
MM	AC	3 (2%)	7 (4.7%)	0.4 (0.1 – 1.6)	0.876
MM	AA	37 (24.7%)	61 (40.7%)	1 (Reference)	-

* p < 0.05, significant

Discussion

In the present study, T2DM patients had a high prevalence of diabetes-induced chronic complications, like hypertension, retinopathy, neuropathy, nephropathy and cardiovascular diseases, which is in concordance to previous studies (Yadav *et al.*, 2008). Family history of diabetes and high BMI were more prevalent in the T2DM patients than the controls. ACE I/D polymorphism emerged out to be an independent risk predictor of T2DM in our study which in concordance with the results of previous studies carried out from North-west India (Singh *et al.*, 2006), Gujarat (Dwivedi *et al.*, 2011), South India (Naresh *et al.*, 2009), Turkey (Arzu Ergen *et al.*, 2004), Bahrain (Al-Harbi *et al.*, 2015), Tunisia (Mehri *et al.*, 2010) and Taiwan (Hsieh *et al.*, 2000). Previous study from Tunisia (Mehri *et al.*, 2010), Brazil (Wollinger *et al.*, 2015) and India (Prasad *et al.*, 2006) have shown the importance of AGT M235T (rs699) in the risk identification for T2DM, which is concordant to our results. However, lack of association between AT1R A1166C with the risk of T2DM among Chinese (Thomas *et al.*, 2001; Yang *et al.*, 2010), Iranian (Moradi *et al.*, 2015) and Indian population (Prasad *et al.*, 2006) has been reported, which is similar to the observed results of our study.

The main effects of the individual loci may be too small to be observed, and but interactions among genes involved in the same biologic pathways, such as RAS-related genes, are directly correlated with susceptibility to the disease like T2DM (Mehri *et al.*, 2010; Rahimi *et al.*, 2014; Yang *et al.*, 2010). Our study showed significant gene-gene interactions in association with T2DM in North-west Indians which is in

consistent to several studies from Japan (Ichikawa *et al.*, 2014; Maeda *et al.* 2007), Tunisia (Mehri *et al.*, 2010), China (Yang *et al.*, 2010). Gene interactions among RAAS-related genes have also been associated with complications of T2DM in several populations (Lei *et al.*, 2012; Lin *et al.*, 2009; Osawa *et al.*, 2007; Thameem *et al.*, 2008; Thomas *et al.*, 2001; van Itersum *et al.*, 2000; Young *et al.*, 1998). It is likely that there are genetic interactions underlying the metabolic pathways, like RAS, which is implicated in the pathogenesis of T2DM.

In conclusion, our study shows that *AGT* M235T and *ACE* I/D polymorphisms are independent risk factors for T2DM in North-west Indians. Further, significant synergistic interactions between *ACE*, *AGT* and *AT1R* genes of RAS pathway are strongly indicated.

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Conflict of interest

None

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Association of REN -5312 C/T polymorphism and traditional risk factors with Type 2 Diabetes Mellitus in North Indians

Navneet Kaur, Rupinder Kaur*

Department of Biotechnology, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab-140406, India
drkdogra@gmail.com

Abstract

Introduction: Type 2 Diabetes mellitus (T2DM) is a multifactorial disease where both genetic and environmental factors contribute to its pathogenesis.

Aim: To explore the role of REN -5312 C/T gene polymorphism and traditional factors as predictors of T2DM.

Methods: We examined REN -5312 C/T gene polymorphism in 50 patients with T2DM and 50 age- and sex-matched unrelated healthy controls. REN -5312 C/T genotype was investigated using PCR-RFLP using *DdeI* enzyme. REN -5312 C/T genotype frequency, demographic characteristics (age, sex) and traditional risk factors (hypertension, retinopathy, cardiovascular disease (CVD), family history of T2DM, alcohol intake, socio-economic status, BMI and WHR) were compared among patients and controls to find their association with T2DM. Deviation of REN -5312 C/T allele frequencies from Hardy Weinberg equilibrium was analyzed. Multivariate analysis was also done to find independent risk predictors of T2DM. **Results:** In univariate analysis, retinopathy, family history of T2DM, high socio-economic status, alcohol intake, BMI and REN -5312 CT genotype were found to be associated with risk of T2DM. However, hypertension, CVD, dietary pattern and WHR were not found to be associated with T2DM in our study. REN -5312 C/T allele frequencies were present in Hardy Weinberg equilibrium. Factors which were significant in univariate analysis were put into multivariate logistic regression analysis with adjusted odds ratio to determine the independent risk factors of T2DM. Multivariate analysis showed that retinopathy (OR 11.89; 95% CI 2.71-53.19; $p=0.001$), family history of T2DM (OR 7.4; 95% CI 1.62-33.88; $p=0.01$), high socio-economic status (OR 4.41; 95% CI 0.51-38.5; $p=0.037$), BMI (OR 47.72; 95% CI 6.0-79.47; $p=0.001$) and REN -5312 CT genotype (OR 9.64; 95% CI 2.61-35.74; $p=0.001$) were significantly risk predictors of T2DM. **Conclusion:** Retinopathy, family history of T2DM, high socio-economic status, BMI and REN -5312 CT genotype were significant risk predictors of T2DM in the North Indians.

Keywords: North Indians; Polymorphism; REN; T2DM; Traditional risk factors

Introduction

Type 2 Diabetes Mellitus (Type 2 DM) is a complex and multifactorial disease involving interactions between many genetic and environment risk factors. Environment factors include increased age, physical inactivity, unhealthy food habits, sedentary life style, family history while genetic factors include candidate genes involved in renin-angiotensin-aldosterone system (RAAS), inflammatory and other pathways (Kommoju and Reddy, 2011). The pathophysiology of T2DM is characterized by peripheral insulin resistance, impaired regulation of hepatic glucose production, and declining β -cell function, eventually leading to β -cell failure (Kaveeshwar *et al.*, 2014). RAAS is a hormone system that regulate blood pressure and water balance. Any defect in this pathway can lead to the causation of hypertension, cardiovascular disease (CAD) and diabetes mellitus (Rahimi *et al.*, 2014). Renin catalyzes the first and rate limiting step of the cascade, the conversion of angiotensinogen to angiotensin I (Moore *et al.*, 2007). Angiotensin converting enzyme (ACE) converts angiotensin I (Ang I) to angiotensin II (Ang II). Ang II is capable of inhibiting the action of insulin in vascular and skeletal muscle tissue via. angiotensin II type 1 receptor (AT1R), interfering with insulin signalling through phosphatidylinositol 3-kinase (PI3K) and its downstream protein kinase B signalling pathway. This inhibition can result in decreased or no production of insulin in endothelial cells, increased vasoconstriction and decreased glucose transport in skeletal muscle (Moore *et al.*, 2007). REN -5312 C/T polymorphism is functionally related to the plasma renin activity (Konoshita *et al.*, 2014). Lack of data on the association of REN gene with T2DM in North Indian population prompted us to carry out the present study.

Therefore, we aim to study the association of REN -5312 C/T polymorphism and traditional risk factors in patients with Type 2 Diabetes Mellitus (T2DM) in North Indians.

Materials and methods

Subjects

The study included a total of 100 subjects consisting of 50 T2DM patients and 50 controls from Punjab, North India. The controls were random unrelated healthy subjects, matched with the patients with respect to the age, gender, geographical origin and ethnicity. None of the controls showed personal history of Diabetes. Diagnosis of T2DM was based on the American Diabetes Association (ADA, 2010) ie. fasting plasma glucose ≥ 126 mg/dl or 2-h plasma glucose ≥ 200 mg/dl or random plasma glucose ≥ 200 mg/dl. The patients with Type I Diabetes and Gestational Diabetes were excluded from the present study. A detailed personal history was taken including demographic data (age and gender), socio-economic status (high / middle / low), dietary pattern (vegetarian / non-vegetarian) and alcohol intake. Clinical data was recorded which included information on hypertension,

family history of T2DM and personal history of retinopathy. The present study was approved by Institutional Ethical Committee (IEC) of Sri Guru Granth World University, Fatehgarh Sahib, Punjab (SGGSWU/IEC/2015/03). All subjects provided written informed consent.

Individual weight and heights were obtained from the participants to calculate body mass index (BMI) using the formula, weight (kg) / [height (m)]². According to WHO Expert Consultation 2004, body mass index (BMI) was categorized as normal weight (18.5-22.9 kg/m²), overweight (23-27.5 kg/m²), obese (27.6-40 kg/m²), and morbidly obese (>40 kg/m²). Waist circumference and hip circumference were also obtained from the participants to calculate waist-hip ratio (WHR). Central obesity is defined as WHR $\geq$ 0.85 for males and $\geq$ 0.95 for females.

Genotyping

Venous blood was collected by venipuncture from all the subjects in tubes with 0.5 M ethylenediaminetetraacetic acid (EDTA) as anticoagulant. Genomic DNA was isolated from whole blood using the standard phenol-chloroform extraction method and ethanol precipitation (Green and Sambrook, 2012). REN -5312C/T was assayed by PCR-RFLP technique. Following primers (50) were used: sense oligo 5'-CGTAGTGCCATTTTATAGGA AC-3' and antisense oligo 5'-AACACCAAAGCAGGCTTAA-3'. PCR program consisted of 40 cycles of denaturation at 94°C for 40 s, annealing at 52°C for 40 s, and extension at 72°C for 40 s followed by a final extension at 72°C for 5 min. PCR products were incubated with *DdeI* overnight at 37°C. The PCR products were resolved on 3.0% agarose gels. Alleles were designated as C or T, indicating digestion by *DdeI* or not.

Statistical analysis

Quantitative variables were presented as mean $\pm$ standard deviation (SD) while categorical variables were presented as absolute frequencies and percentages. The distribution of allele and genotype frequencies between patients and controls was determined by allele counting. Continuous variables were compared using independent two-tailed t test, and categorical variables were compared using chi-square test. The comparison of mean BMI and mean WHR among patients and controls was done using ANOVA and Bonferroni test. Deviation of allele frequencies from Hardy-Weinberg equilibrium (HWE) was performed using χ^2 test. Associations were expressed as odds ratio (OR) with 95% confidence interval (CI). Multivariate logistic regression analysis was used to determine the independent association of risk factors with T2DM. Statistical significance was determined at $p < 0.05$. Data were analyzed with SPSS statistical program version 13.

Results

The general characteristics of the study participants is shown and compared in Table 1. Hypertension, cardiovascular disease (CVD), dietary pattern and WHR were similar among both T2DM patients and controls. However, retinopathy, high SES, alcohol intake, family history of T2DM and high BMI were more prevalent in patients than controls.

Table 1. General characteristics of the study participants

Characteristics		T2DM patients n=50 (%)	Controls n=50 (%)	OR (95% CI)	p value
Mean age (years)		47.1 ($\pm$ 10.6)	47.1 ($\pm$ 10.6)	-	-
Males		36 (72%)	36 (72%)	-	-
Hypertension		25 (50%)	22 (44%)	1.27 (0.58-2.8)	0.548
Retinopathy		26 (52%)	9 (18%)	4.94 (1.99-12.26)	0.001*
Cardiovascular Disease		12 (24%)	12 (24%)	1.0 (0.4-2.5)	1.000
Non-vegetarian Dietary Pattern		12 (24%)	12 (24%)	1.0 (0.4-2.5)	1.000
Alcohol Intake		17 (34%)	9 (18%)	2.35 (0.93-5.94)	0.048*
High SES		37 (74%)	29 (58%)	1.57 (0.36-6.81)	0.033*
Family history of T2DM		22 (44%)	11 (22%)	2.79 (1.17-6.66)	0.019*
BMI (kg/m ²)	Mean $\pm$ SD	26.29 ($\pm$ 4.74)	22.46 ($\pm$ 1.67)	-	0.001*
	BMI >23	32 (64%)	18 (36%)	-	0.001*
WHR	Mean $\pm$ SD	0.93 $\pm$ 0.03	0.91 $\pm$ 0.05	-	
	WHR $\geq$ 0.95, M	35/36 (97.2%)	32/36 (88.89%)	-	
	WHR $\geq$ 0.85, F	14/14 (100%)	14/14 (100%)	-	
	High WHR	49 (98%)	46 (92%)	1.2 (0.39-2.13)	0.829

* $p < 0.05$, significant

The genotype and allele frequency distribution of REN -5312C/T polymorphism in T2DM patients and controls is compared in Table 2. The frequency of REN -5312CT genotype and T allele in the T2DM patients were significantly higher than controls showing association with increased risk of T2DM. Chi-square values in

patients and controls were <3.84 which signifies that the C and T allele frequencies are present in Hardy Weinberg Equilibrium in our study population.

Table 2. Distribution of genotype and allele frequencies of REN -5312C/T polymorphism in T2DM patients and controls

Genotypes/alleles	T2DM Patients n=150 (%)	Controls n=150 (%)	OR (95% CI)	p value
CC	12 (24%)	37 (74%)		<0.001*
CT	38 (76%)	12 (24%)	10.2 (4.1-25.7)	
TT	0	1 (2%)		
C allele	0.62	0.86		
T allele	0.38	0.14	1.8 (1.0 – 3.4)	

* p < 0.05, significant

Factors which were significant in uni-variate analysis were assessed for multi-variate analysis to eliminate the effect of confounders. Multiple logistic regression analysis (Table 3) suggested that retinopathy, family history of T2DM, alcohol intake, high SES, mean BMI and REN -5312CT genotype were independent risk factors for T2DM.

Table 3. Multivariate logistic regression analysis to determine independent risk factors for T2DM

Risk Factors	Adjusted OR (95% CI)	p value
Retinopathy	11.89 (2.71-53.19)	0.001
Family History of T2DM	7.4 (1.62-33.88)	0.01
Alcohol intake	1.86 (0.46-7.57)	0.386
High socio-economic status	4.41 (0.51-38.5)	0.037
Mean BMI	47.72 (6.0-79.47)	0.001
REN -5312 CT genotype	9.64 (2.61-35.74)	0.001

* p<0.05, significant

Discussion

The development of diabetes is multifactorial and genetic predisposition has been anticipated to be an important factor in the development and progression of the disease (Kommoju and Reddy, 2011). Particular polymorphisms in genes related to renin–angiotensin–aldosterone system (RAAS) were recognized as risk factors for type 2 diabetes mellitus (T2DM) complications, including hypertension, cardiovascular disease (CVD), nephropathy and retinopathy (Rahimi *et al.*, 2014). Renin secreted by the juxtaglomerular apparatus cells and delivered to the renal interstitium and vascular compartment appear to be a most powerful controller for producing Ang I from Ang. To regulate the production of Ang II, renin is most important, because once Ang I is formed, conversion readily occurs as there are abundant amounts of Ang converting enzyme in circulation. In this regard, the genetic variants of REN gene may have a vital role in the regulation of the gene expression as well as the regulation of Ang II production (Purkait *et al.*, 2018). REN maps to chromosome 1q32, spans 12.5 kb in length and encodes 10 exons (Moore *et al.*, 2007). As the first and rate-limiting enzyme of RAAS, renin plays an important role in the regulation of sodium homeostasis and blood pressure (BP). Alterations in plasma renin activity have been associated with hypertension, salt sensitivity of BP and responsiveness to antihypertensive treatments (Sun *et al.*, 2011). Therefore, REN gene is a rational candidate for unravelling the genetic basis of essential hypertension, CVD as well as T2DM.

Several studies show the association of traditional risk factors and REN-5312 C/T polymorphism with T2DM, however, some studies do not show association. Previous findings show that renin gene polymorphisms have been associated with diabetic nephropathy, increased risk of vascular complications, plasma renin activity (PRA), susceptibility to hypertension, T2DM, and CRI in a variety of ethnic groups (Deinum *et al.*, 1999; Konoshita *et al.*, 2007; Konoshita *et al.*, 2009; Konoshita *et al.*, 2014; Lukitasari *et al.*, 2013; Mtiraoui *et al.*, 2011; Prasad *et al.*, 2006; Purkait *et al.*, 2018; Ramachandran *et al.*, 2009). Inconsistent results are there in the literature showing no association of REN gene polymorphisms with T2DM. The inconsistency may, in part, be related to genetic heterogeneity across populations and studying different genetic variants by different groups, or more likely, failure to control environmental factors, such as dietary salt intake and body posture that have great impact on blood pressure and glucose levels. In our study, retinopathy, family history of T2DM, high socio-economic status, BMI and REN -5312 CT genotype were significant risk predictors of T2DM in the North Indians.

In conclusion, retinopathy, family history of T2DM, high socio-economic status, BMI and REN -5312 CT genotype were significant risk predictors of T2DM in the North Indians.

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Conflict of interest

None

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To identify conserved regions in XPC, XPD, XPF and XPG proteins using multiple sequence alignment (MSA) for the construction of phylogenetic trees**Ramandeep Kaur*, Harpreet Kaur, Rupinder Kaur**

Department of Biotechnology, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab-140406

ramandeepkaur7111999@gmail.com, drkdogra@gmail.com**Abstract**

Damage to the cellular DNA is involved in mutagenesis and development of cancer. Endogenous damage occurs due to ROS, whereas exogenous damage arises due to mutagenic chemicals and exposure to ionizing radiations. Nucleotide excision repair (NER) is sophisticated pathway for repairing DNA photoproducts, intra-stand cross links and thymidine dimers formed due to exposure of UV radiations. Proteins involved in NER are XPA, XPB, XPC, XPD, XPE, XPF, XPG, ERCC1, RPA, RFC, RAD23A and RAD23B. XPC, usually bind to a protein hHR23B, which is also involved in damage recognition and in opening of DNA around a site of damage. TFIIH includes the XPB and XPD DNA helicases which is involved in local opening of DNA around a site of damage. The first incision, 20–22 nucleotides upstream (5') of the DNA damage is done by ERCC1-XPF protein complex while XPG cuts the strand 5–6 nucleotides downstream (3') of the DNA damage. It is important to study NER proteins including their structure and evolutionary conserved domains. For that purpose, multiple sequence alignment (MSA) plays an important role. BLAST P and Clustal Omega were used for MSA by aligning three or more amino acid sequences and phylogenetic trees were constructed using BLAST P, COBALT and Clustal Omega software. We found that human XPC, XPD, XPF and XPG protein sequences showed greater similarity with primate species as compared to non-primates.

Keywords: Conserved regions; MSA; Phylogenetic tree; NER; XPC; XPD; XPF; XPG**Introduction**

DNA damage is the alteration in chemical structure of DNA or a base missing from the backbone of the DNA. Each of the $\sim 10^{13}$ cells in the human body receives thousands of DNA lesions per day. These lesions block genome replication and transcription; if not repaired or repaired incorrectly, cause mutations (Jackson *et al.* 2009). Endogenous damage occurs due to reactive oxygen species (ROS) generated in the human body due to metabolic processes, whereas exogenous damage arises due to mutagenic chemicals and radiations (Lindahl, 1993). DNA damage include base modifications, single-strand breaks (SSBs), double strand breaks (DSBs) and DNA cross linking. Such DNA damages have been linked to cell death, tissue degeneration, aging, and cancer (Corrorchano *et al.* 2020). DNA repair mechanisms are an important system for maintaining the genome integrity. These include base excision repair (BER), nucleotide excision repair (NER), mismatch repair (MMR) and double strand break repair (including non-homologous end joining NEHJ and homologous recombination) (Sancer, 1995). NER is one of the important repair system which is mainly aimed at removal of DNA lesions that can be caused by UV radiation (Photoproducts) and 6,4- PP (6,4-Pyrimidine dimer) (Ambekar *et al.* 2017). Various proteins involved in global genomic NER are XPA, XPB, XPC, XPD, XPE, XPF, XPG, ERCC1, RPA, RFC, RAD23A and RAD23B. Site of damage occurs such as a UV-induced pyrimidine dimer causes local deformity of the helix. Lesions which are strongly disordered are recognized by XPC-RAD23B, which binds to the nondamaged strand opposite the lesion. TFIIH interacts with XPC-RAD23B and pries the DNA open with its XPB subunit allowing XPD to track along DNA until it hinder at the damage and verifies the chemical modification (bulkiness) of the lesion. XPD exhibit DNA dependent ATPase and helicase functions; XPD unwinds the DNA in the opposite direction 5'-3'. Stalling of XPD at the lesion allows for the formation of the preincision complex by recruitment of XPA, RPA, and XPG. Recruitment of ERCC1-XPF by interaction with XPA to the complex leads to incision 5' to the lesion 20-22 nucleotide upstream (5'). The endonuclease XPG protein then cuts the DNA strand 5–6 nucleotides downstream (3') of the DNA damage. The XPG and ERCC1-XPF factors are structure specific DNA nucleases and are responsible for cleaving on the 3' and 5'sides of a lesion, respectively. Initiation of the repair synthesis is done by Pol δ pol κ or Pol ϵ and its association factors, which follows the 3' incision by XPG. At last completion of repair synthesis and sealing of the nick by DNA ligase III /XRCC1 or DNA ligase I completes the process (Sacharer, 2013). When NER is defective, human develops rare autosomal disease such as xeroderma pigmentosum or Cockayne syndrome with symptoms ranging from high sun sensitivity and skin cancer risk to premature aging and neurological disorders (Zotter *et al.* 2006). It is important to study the structure, sequence and conserved domain of XP proteins. For this purpose, Multiple sequence alignment (MSA) is an essential and widely used computational tool (Daugelaite *et al.* 2013). It is an essential tool for protein structure and function prediction, phylogeny inference and other common tasks in sequence analysis. The aim of the study was to identify conserved regions in XPC, XPD, XPF and XPG proteins using multiple sequence alignment (MSA) for the construction of phylogenetic trees.

Material and Methods

Various bioinformatics tools were used to carry out the present study such as NCBI, BLAST, COBALT, CLUSTAL OMEGA. The National Center for Biotechnology Information (NCBI) is a center within the National Library of Medicine at the National Institutes of Health. Data that NCBI maintains has expanded enormously and can be generally grouped into six categories: Literature, Health, Genomes, Genes, Proteins and Chemicals. FASTA format is a text-based format for representing either nucleotide sequence or amino acid sequence. In which nucleotide or amino acids are represented using single-letter codes. Home page of NCBI (<http://www.ncbi.nlm.nih.gov/>) was opened. Protein (All databases) option was selected, name of protein was written (human XPC, XPD, XPF and human XPG). The list was obtained, from where specific protein sequence (XPC, XPD, XPF and XPG) was chosen. FASTA option was clicked. FASTA sequence file of the human XPC, XPD, XPF and XPG protein were downloaded.

The Basic Local Alignment Search Tool (BLAST) can be accessed at (www.ncbi.nlm.nih.gov/BLAST/). It is a sequence similarity search program for comparing biological sequences such as amino acid sequence of different proteins or the nucleotides of DNA sequences with sequence database or library sequences. The purpose of BLAST is to find regions of local similarity between the sequences. BLAST program was selected and BLASTp was clicked. FASTA file of human XPC, XPD, XPF and XPG protein sequences were pasted in the query box. Algorithm and the parameters of the algorithm for the search were selected. BLAST program was run and submission of the BLAST program was done by clicking the BLAST button at the end of the page.

Multiple Sequence Alignment (MSA) is generally the alignment of three or more biological sequence (Protein or Nucleic acid) of similar length. It can be carried out by BLASTp as well as Clustal Omega. BLAST P was used in the present study for multiple sequence alignment (MSA) for XPC, XPD, XPF and XPG proteins which was further used in the construction of phylogenetic tree. Sequences were selected from BLASTp. Multiple sequence alignment (MSA) option was clicked. MSA obtained and results were analyzed.

Constraint-based alignment tool (COBALT) possess familiar framework that can be implemented for multiple sequence alignment which associate pairwise sequences from different sources into a multiple alignment. Phylogenetic tree was constructed using BLAST P and COBALT as well as Clustal Omega software. COBALT was opened (www.ncbi.nlm.nih.gov/tools/cobalt/cobalt.cgi). Data from MSA was entered into COBALT. Phylogenetic tree was opened in COBALT.

Clustal Omega is the newest MSA algorithm out of the Clustal family. Clustal Omega is MSA program for aligning three or more sequences together in a computationally efficient and accurate manner. Home page of Clustal Omega was opened (<https://www.ebi.ac.uk/tools/msa/clustalo>). Sequences were pasted in the Clustal Omega and submit option was clicked. Multiple sequence alignment of the protein was made on the basis of sequence similarities. Phylogenetic tree was opened in Clustal Omega based on MSA of eight sequences of XPC, nine sequences of XPD, eighteen sequences of XPF and eleven sequences of XPG protein.

Results and Discussion

Multiple sequence alignment (MSA) by BLASTp

Identification of conserved regions in XPC, XPD, XPF and XPG proteins was carried out by MSA. Those species were selected for XPC protein whose % identity with *Homo sapiens* ranges from 76% to 100%. Eight species were *Homo sapiens*, *Nomascus leucogenys*, *Papio anubis*, *Carlito syrichta*, *Eptesicus fuscus*, *Rousettus aegyptiacus*, *Ursus maritimus* and *Vulpes lagopus*. Those species were selected for XPD protein whose % identity with *Homo sapiens* ranges from 97% to 100%. Nine species were *Homo sapiens*, *Pan troglodytes*, *Hylobates moloch*, *Pongo abelli*, *Microcebus murinus*, *Balenoptera musculus*, *Bos taurus*, *Sus scrofa*, *Ochotona curzoniae*. Those sequences were selected for XPF whose % identity with *Homo sapiens* ranges from 91% to 100. Eighteen species were *Homo sapiens*, *Gorilla gorilla*, *Pan troglodytes*, *Macaca mulatta*, *Theropithecus gelada*, *Nomascus leucogenys*, *Rhinopithecus roxellana*, *Chlorocebus sabaeus*, *Cebus imitator*, *Microcebus murinus*, *Saimiri boliviensisboliviensis*, *Lemur catta*, *Otolemusgarnettii*, *Equus caballus*, *Caviaporcellus*, *Dasyproctus novemcinctus*, *Melesmeles*, *Heterocephalusglaber*. Those sequences were selected whose % identity with *Homo sapiens* ranges from 89.55% to 100%. Eleven species were *Homo sapiens*, *Pan troglodytes*, *Macaca nemestrina*, *Theropithecus gelada*, *Chlorocebus abaeus*, *Papio Anubis*, *Trachypithecus francoisis*, *Rhinopithecus roxellana*, *Sapajus apella*, *Cebus imitator*, *Aotus nancymae*. MSA for XPC, XPD, XPF and XPG protein shows high degree of similarity for all the species selected from different species.

Phylogenetic tree by BLASTp analysis and COBALT software

Phylogenetic trees of XPC, XPD, XPF and XPG proteins were obtained by neighbor joining method using BLASTp and Cobalt Tool (shown in Figure 1). The phylogenetic tree for XPC protein was connected with fifteen nodes. The eight species were selected for phylogenetic tree. This tree is unrooted phylogenetic tree. In phylogenetic tree *Nomascus leucogenys* and *Papio anubis* species were closely related to *Homo sapiens* and less

matches were found with the non-primates species such as *Carlito syrichta*, *Eptesicus fuscus*, *Rousettus aegyptiacus*, *Ursus maritimus*, *Vulpes lagopus*. The result of sequence difference is 0.09 which is due to their relatedness with *Homo sapiens* according to percentage identity. XPC protein sequence shows less conservedness since the range of sequence identity is wide (100-76%).

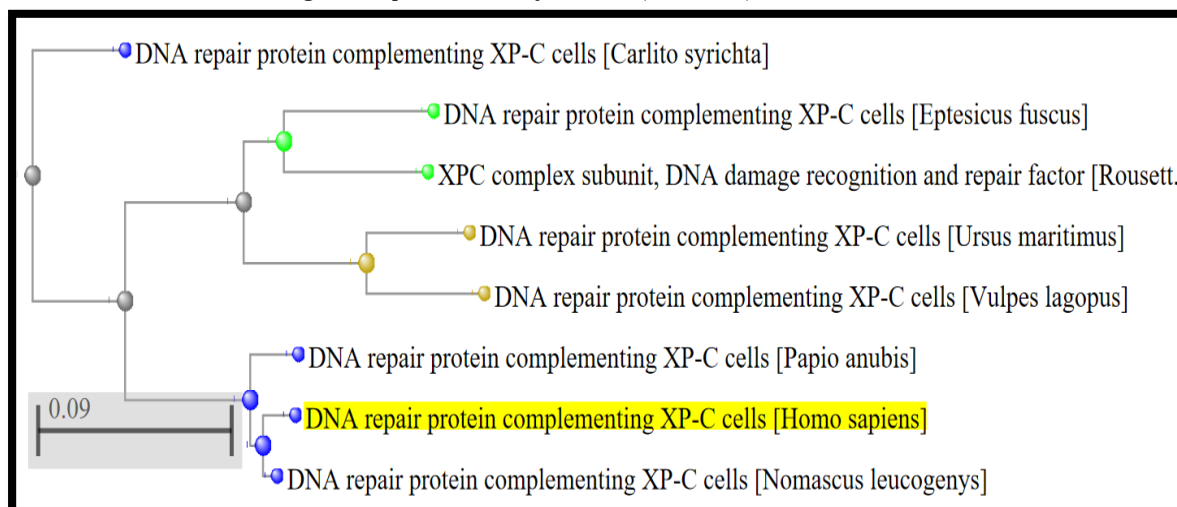


Figure 1. Phylogenetic tree for XPC protein by Cobalt tool

The phylogenetic tree for XPD protein was connected with seventeen nodes (Figure 2). The nine species were selected for phylogenetic tree. In phylogenetic tree, *Pan troglodytes*, *Pongo abelii*, *Hylobates moloch* species were closely related to *Homo sapiens* and less closely related with the non-primates such as *Pongo abelli*, *Microcebus murinus*, *Balaenoptera musculus*, *Bos taurus*, *Sus scrofa*, *Ochotona curzoniae*. The result of sequence difference is 0.008 which is due to their relatedness with *Homo sapiens*. XPD protein sequences are highly conserved between the species having 98-100% similarity.

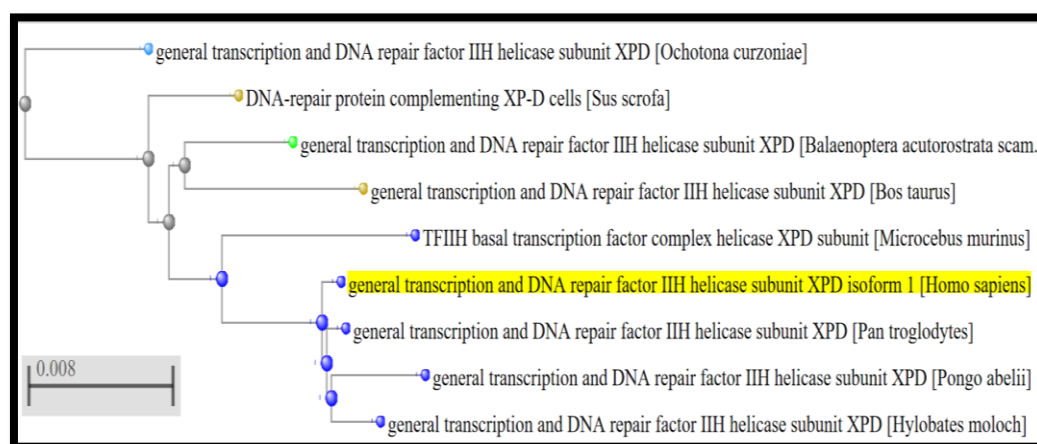


Figure 2. Phylogenetic tree for XPD protein by Cobalt tool

Phylogenetic tree for XPF protein was connected with thirty four nodes (Figure 3). Eighteen species selected for the phylogenetic tree. The closest matches were found with the primate species such as *Gorilla gorilla*, *Pan troglodytes*, *Namascus leucogenys*, *Macaca mulatta*, *Theropithecus gelada* and less matches were found with the non-primates species such as *Rhinopithecus roxellana*, *Chlorocebus sabaeus*, *Cebus imitator*, *Microcebus murinus*, *Saimiri boliviensis boliviensis*, *Lemur catta*, *Otolemus garnettii*, *Equus caballus*, *Caviaporcellus*, *Dasyus novemcinctus*, *Meles meles*, *Heterocephalus glaber*. The XPF protein sequence in *Homo sapiens* shows greater similarity with other primate species than non-primates. The sequence difference is 0.03 which is due to their relatedness with *Homo sapiens*. XPF protein species are highly conserved between the species having 91-100% similarity.

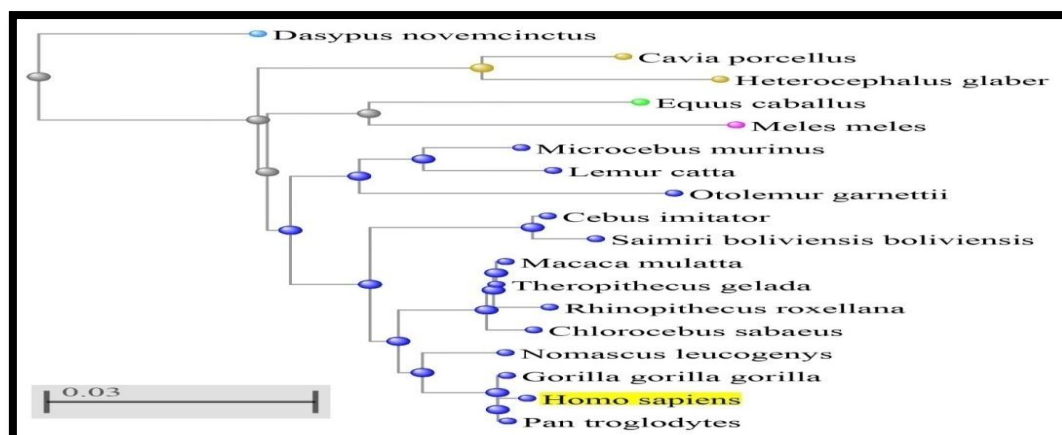


Figure 3. Phylogenetic tree for XPF protein by Cobalt tool

Phylogenetic tree of XPG proteins was obtained by neighbour joining method which was made carried using BLASTp. This tree is unrooted tree. Phylogenetic tree for XPG protein was connected with twenty one nodes (Figure 4). Eleven species were selected for phylogenetic tree. The closest matches were found with the primate species such as *Homo sapiens*, *Pan troglodytes* and less matches with non-primates such as *Macaca nemestrina*, *Theropithecus gelada*, *Chorocebus sabaeus*, *Papio Anubis*, *Trachypithecus francoisis*, *Rhinopithecus roxellana*, *Sapajus apella*, *Cebus imitator*, *Aotur nancymae*. The XPG protein sequence in *Homo sapiens* shows greater similarity with other primate species. The sequence difference is 0.03 which is due to their relatedness with *Homo sapiens*. XPG protein species are highly conserved between the species having 89.55- 100%.

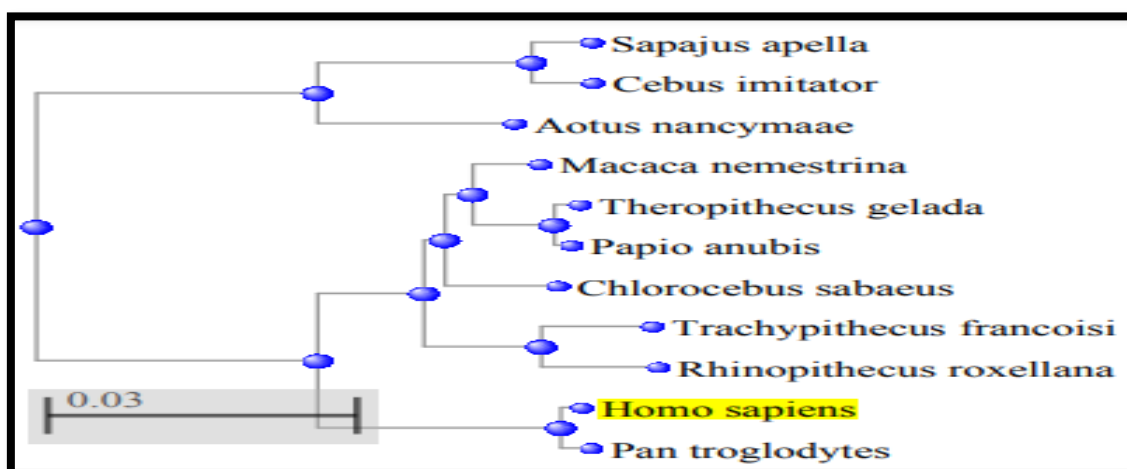


Figure 4. Phylogenetic tree for XPG protein by Cobalt tool

Multiple sequence alignment by Clustal Omega

Home page of Clustal Omega was opened. FASTA sequence of (eight species for XPC, nine for XPD, eighteen for XPF and eleven for XPG) protein were pasted in query box of Clustal Omega. The results of MSA for XPC, XPD, XPF and XPG proteins using Clustal Omega tool shows match/ identity, mismatch, colon and gap. Match/identity: An (*) asterisk indicates the positions which have a single, fully conserved residue. Mismatch: A (.) dot represent the residues in column which were not matched in species. colon: A(:) positions with conservation between amino acid groups of similar properties. Gap (-): A gap or space in the alignment simply means that one or more amino acid residues have been deleted from the sequence.

Phylogenetic tree construction by Clustal Omega

Figure 5. shows the cladogram diagram for XPC protein from eight species including, primates and non-primates. Which were carried out using Clustal Omega. In phylogenetic tree, *Nomascus lecogeny*, *Papioanubis*

and *Carlito syrichta* species were closest to *Homo sapiens* and less matches were found with the non-primates species such as *Eptesicus fuscus*, *Rousettus aegyptiacus*, *Ursus maritimus*, *Vulpes lagopus*. The XPC protein sequence in *Homo sapiens* shows greater similarity with primate species than non-primates.

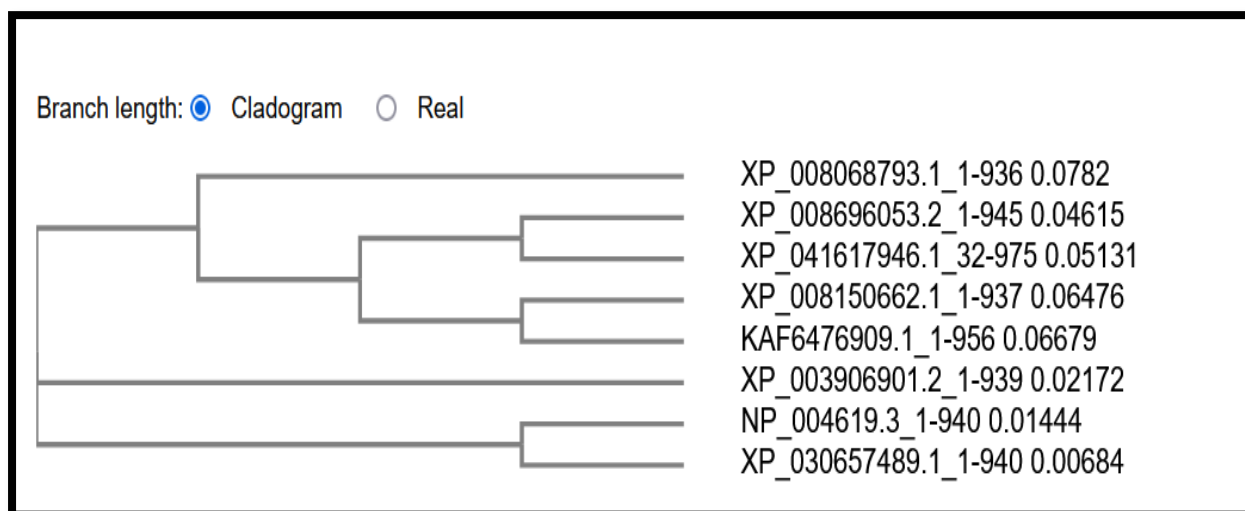


Figure 5. Construction of phylogenetic tree by Clustal Omega for XPC protein

Figure 6. shows cladogram which gives the evolutionary relationship between nine different primates and non-primates species for XPD protein. In phylogenetic tree, *Hylobates moloch* species, *Pongo abelii* were closest to *Homo sapiens* and less closely related species were *Microcebus murins*, *Balenoptera musculus*, *Bos taurus*, *Sus scrofa*, *Ochotona curzoniae*. The XPD protein sequence in *Homo sapiens* shows greater similarity with primate species than non-primates.

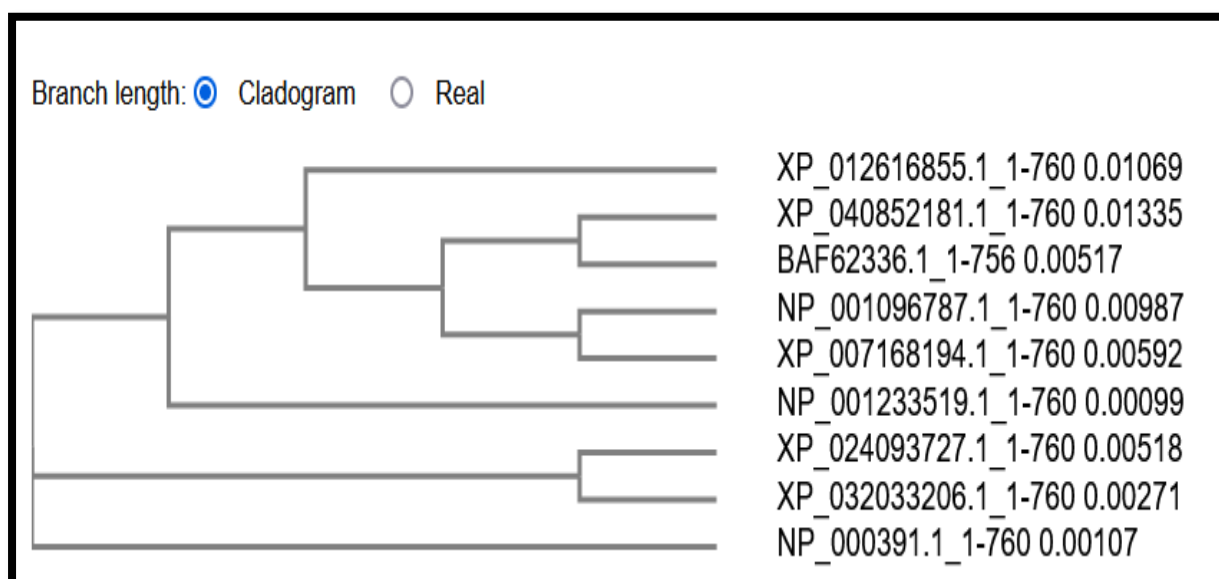


Figure 6. Construction of phylogenetic tree by Clustal Omega for XPD protein

Figure 7 shows the Cladogram diagram for XPF protein sequences from eighteen species including primates and non-primates. The closest matches were found with the primates species such as *Gorilla gorilla*, *Pantriglodytes*, *Namascus leucogenys*, *Macaca mulatta*, *Theropithecus gelada* and less matches were found with the non-primates species such as *Rhinopithecus roxellana*, *Chlorocebus sabaeus*, *Cebus imitator*, *Microcebus murinus*, *Saimiri boliviensis boliviensis*, *Lemur catta*, *Otolemus garnettii*, *Equus caballus*, *Cavia porcellus*, *Dasyus novemcinctus*, *Meles meles*, *Heterocephalus glaber*. The XPF protein sequence in *Homo sapiens* shows greater

similarity with primate species than non-primates.



Figure 7. Construction of Phylogenetic tree by Clustal Omega for XPF protein

Figure 8 shows the cladogram diagram for XPG protein from eleven species including primates and non-primates. Which were carried out using Clustal Omega. The closest matches were found with the primate species such as *Homo sapiens*, *Pan troglodytes* and less closely related sequences with non-primates such as *Macaca nemestrina*, *Theropithecus gelada*, *Choro cebussabaeus*, *Papio Anubis*, *Trachypithecus francois*, *Rhinopithecus roxellana*, *Sapajus apella*, *Cebus imitator*, *Aotur nancymae*. The XPG protein sequence in *Homo sapiens* shows greater similarity with primate species than non-primates.

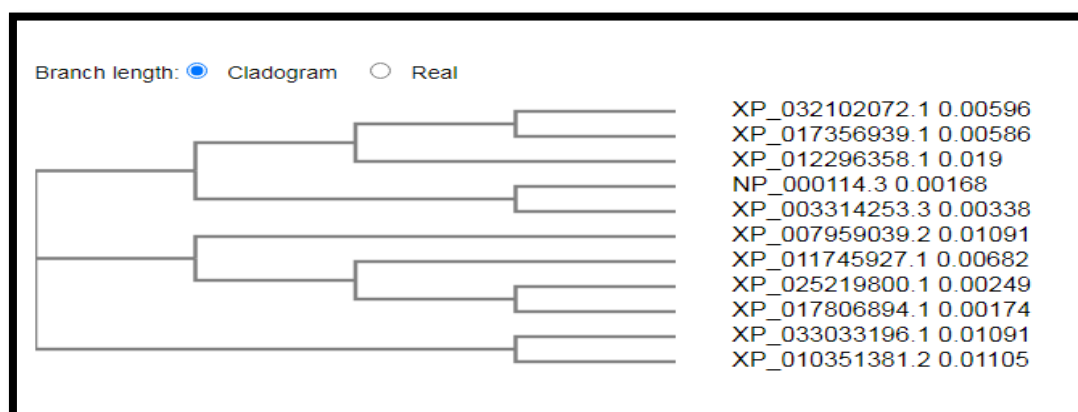


Figure 8. Construction of phylogenetic tree for XPG protein by Clustal Omega

Conclusion

Human XPC protein are less conserved showing 76% similarity with various primates while human XPD, XPF, XPG protein are highly conserved showing (98%, 99.56% and 99.49%) similarity with various primate species.

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Expression Profile of RAD51 in Multiple Cancer Cell Lines

Gurjasleen kaur, Yadvindra singh, C. Rajesh

Department of Biotechnology, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab, India-140406
gurjasleen21@gmail.com, yadvinderfdc@gmail.com, rajeshc@sggswu.edu.in

Abstract

Cancer is a common fatal disease and results from complex interactions between environmental and genetic factors. DNA repair systems are believed to maintain genome by overcoming threats posed by DNA lesions. Problems in DNA repair pathways may leave such lesions unrepaired or repaired incorrectly, leading to genomic instability or mutations that may contribute directly to cancer. The RAD51 protein encoded by RAD51 gene is necessary for the repair of DNA damage. Growing evidence indicates that RAD51 performs a key role in the maintenance of genomic stability and in the repair of DNA double strand breaks. Previously With the help of The Cancer Genome Atlas (TCGA) database and Gene Expression Profiling Interactive Analysis (GEPIA2) online tool, we have analyzed that elevated level of RAD51 in multiple cancers. Elevated expression of RAD51 paralogs was associated with poor overall survival in multiple cancers. Here, we have investigated the presence of RAD51 protein expression and various clinically significant polymorphisms in multiple cell lines, available in the cancer encyclopedia and other resources. This data will help to identify cancer cell line models that can be used to study the effect of RAD51 expression and polymorphisms on DNA repair. Investigation of this role will help design therapeutic tools to enhance cancer therapy. The overall regulation of RAD51 expression and function in cancer can be a novel combinatorial cancer-therapeutic approach to inactivate repair thereby minimizing chemoresistance.

1.Introduction

Cancer is a fatal disease and results from complex interactions between environmental and genetic factors (Chen et al., 2016). DNA in normal cells is exposed to a number of genotoxic agents which cause a variety of lesions, including abasic sites, missing bases, DNA strand break, DNA strand cross links and deletions and insertions on daily basis. In normal healthy cells DNA repair mechanisms coordinate to accurately repair DNA damage in a timely and efficiently manner. The main repair mechanisms for DNA double strand break (DSB) are homologous recombination (HR) and non-homologous end joining (NHEJ) (Liao et al., 2022). HR uses homologous sequences from chromosome or sister chromatid as template to repair the damage, in a conservative mechanism without loss of sequence. In normal cells the process of homologous recombination (HR) is tightly regulated and used for multiple types of repair of damaged DNA including double stranded break, single stranded gaps and strand cross links. Therefore, HR has a vital role in the maintenance of genome stability (Moynahan & Jasin, 2010).

Defects in DNA repair pathways are emerging hallmarks of cancer. RAD51 recombinase is a critical effector of homologous recombination, which is an essential DNA repair mechanism for double-strand breaks (Wang et al., 2022). The RAD51 protein encoded by *RAD51* gene is necessary for the repair of DNA damage. Growing evidence indicates that RAD51 performs a key role in the maintenance of genomic stability and in the repair of DNA double strand breaks (Thacker, 2005). Previously With the help of The Cancer Genome Atlas (TCGA) database and Gene Expression Profiling Interactive Analysis (GEPIA2) online tool, we observed that elevated level of RAD51 is associated with poor overall survival in multiple cancers like squamous cell carcinoma of the head and neck, colorectal cancer, pancreatic cancer, ovarian cancer, and breast cancer. We have analyzed RAD51 mRNA expression in multiple cancer cell lines by using cBioportal online tool, providing access to data from more than 5,000 tumor samples from 20 cancer studies, including microarray-based and RNA sequencing based mRNA expression (Cerami et al., 2012).

In this report, we analyse the expression of RAD51 protein in multiple cell lines using data available in the cancer encyclopedia (<https://sites.broadinstitute.org/ccle/>) and human protein atlas database (www.proteinatlas.org). This data will help us to identify cancer cell line models that can be used to study the effect of RAD51 expression on DNA repair. Investigation of this role will help design therapeutic tools to enhance cancer therapy. The overall regulation of RAD51 expression and function in cancer can be a novel combinatorial cancer-therapeutic approach to inactivate repair thereby minimizing chemo-resistance.

2. Methods

2.1 Databases

The data used in this study were collected mainly from two databases. First is the Human Protein Atlas database (HPA) that constitutes of data pertaining to protein localization and expression in human tissues and cells. Its unique antibody collection used for mapping the entire human proteome by immune-histochemistry and immuno-cytochemistry. By these approaches, more than 10 million images showing protein expression patterns at a single- cell level were generated and are publicly available (www.proteinatlas.org) (Thul & Lindskog, 2018)). Second database used is the Cancer Cell Line Encyclopedia (CCLE) a tumor genomics research project

led by the Broad Institute. It collects and sorts-out the omics data of 1,457 cell lines, which has been used to analyse expression levels of the RAD51 Protein in multiple cancer cell lines (Thul & Lindskog, 2018).

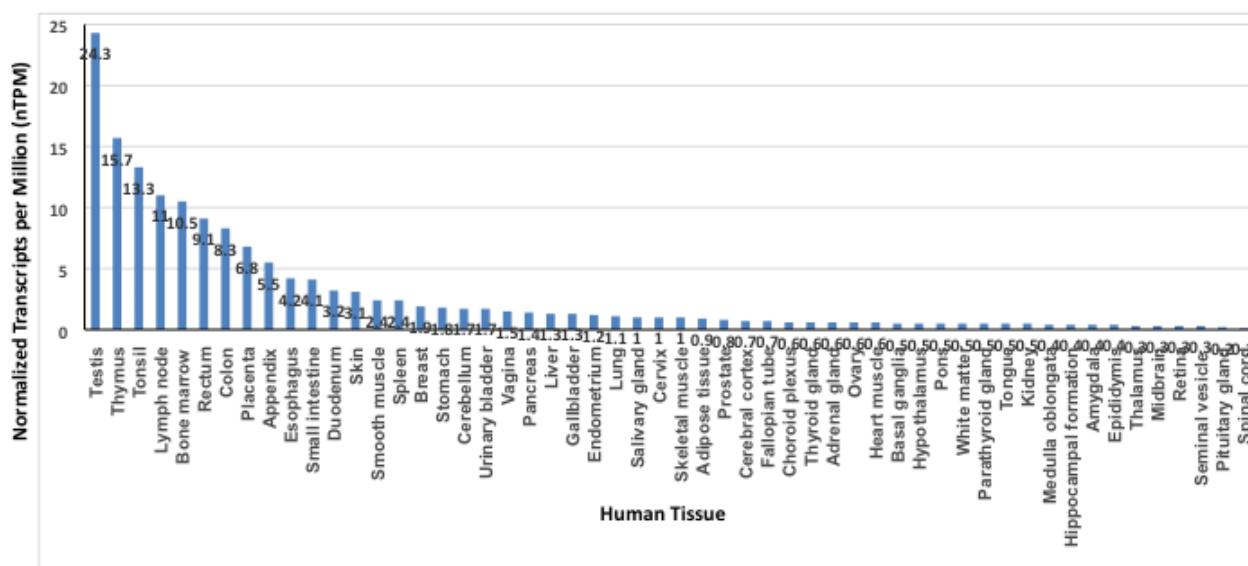
2.2 Analysis Tool

The analysis of data from the databases were done using the tool, cBioPortal for Cancer Genomics (<http://cbioportal.org>). It provides a Web resource for exploring, visualizing, and analyzing multidimensional cancer genomics data. The portal reduces molecular profiling data from cancer tissues and cell lines into readily understandable gene expression, and proteomic events (Gao et al., 2013).

3. Results

3.1. Rad51 Expression in Multiple Human Tissues

General Expression Of Rad51 Protein Is Analysed In Multiple tissues using The Human Protein Atlas (HPA) database. For RNA expression, the consensus dataset, which consists of normalized expression as normalized transcript per million (nTPM) levels for 55 tissues were used. The consensus nTPM value for each gene and tissue type represents the maximum nTPM value based on HPA (Figure 1). Testis tissue (24.3 nTPM) generally is observed to have very high expression of RAD51 as compared to other tissues. Extremely high expression is also observed in several other tissues such as thymus (15.7 nTPM), tonsils (13.3 nTPM), lymph node (11 nTPM), bone marrow (10.5 nTPM), rectum (9.1 nTPM), colon (8.3 nTPM), placenta (6.8 nTPM), appendix (5.5 nTPM), esophagus (4.24 nTPM), small intestine (3.23 nTPM), duodenum (2.42 nTPM), skin (2.42 nTPM), smooth muscle (2.42 nTPM), spleen (2.42 nTPM), breast (2.42 nTPM), stomach (2.42 nTPM), cerebellum (2.42 nTPM), urinary bladder (2.42 nTPM), vagina (2.42 nTPM), pancreas (2.42 nTPM), liver (2.42 nTPM), gallbladder (2.42 nTPM), endometrium (2.42 nTPM), lung (2.42 nTPM), salivary gland (2.42 nTPM), cervix (2.42 nTPM), skeletal muscle (2.42 nTPM), adipose tissue (2.42 nTPM), prostate (2.42 nTPM), cerebral cortex (2.42 nTPM), fallopian tube (2.42 nTPM), choroid plexus (2.42 nTPM), thyroid gland (2.42 nTPM), adrenal gland (2.42 nTPM), ovary (2.42 nTPM), heart muscle (2.42 nTPM), basal ganglia (2.42 nTPM), hypothalamus (2.42 nTPM), white matter (2.42 nTPM), parathyroid gland (2.42 nTPM), tongue (2.42 nTPM), kidney (2.42 nTPM), medulla oblongata (2.42 nTPM), hippocampal formation (2.42 nTPM), amygdala (2.42 nTPM), epididymis (2.42 nTPM), thalamus (2.42 nTPM), midbrain (2.42 nTPM), retina (2.42 nTPM), seminal vesicle (2.42 nTPM), pituitary gland (2.42 nTPM), spinal cord (2.42 nTPM).



nTPM). Multiple tissues such as oesophagus, small intestine, duodenum, skin, smooth muscle, spleen, breast, stomach, cerebellum, urinary bladder, vagina, pancreas, liver

Figure-1: RAD51 Protein Expression Levels in multiple Human tissues. The Human Protein Atlas database online tool was used to build Bar plot of mRNA expression as normalized transcripts per million (nTPM). The height of bar represents the median expression of RAD51 in multiple normal tissues. The various tissues are represented in Y axis while the expression levels represented as normalized transcripts per million and lungs have moderately high expression of RAD51 between 1 nTPM-5nTPM. Low expression of RAD51 (<1 nTPM) was observed in tissues as adipose tissue, prostate, thyroid gland, ovary, kidney, retina, spinal cord (Figure 1).

3.2 Cancer cell lines with high expression of RAD51

Expression of RAD51 in multiple cancer lines are studied using cBioPortal online tool using data of about 1739 samples available in the Cancer Cell Line Encyclopedia. It has been found that 21 cancer cell lines have extremely high expression of RAD51 with a value of above two z-score (Figure 2). This includes sixteen haematopoietic and lymphoid tissue cell lines, KOPN8, SUPT11, SUDHL10, SUDHL8, RS411, SUDHL5, KMS12BM, MHHCALL2, ALLSIL, BL70, MC116, NALM6, K562, DND41, JEKO1, DL40 cell lines. High expression is also observed in three soft tissue (Sarcoma) associated cell lines RH28, SCMCRM2 and SMSCTR. Breast cancer associated cell line MDAMB453 also show high expression as with aer-digestive tract cancer associated cell line, ECAPJ34CLONEC12 (Figure 2).

Around 77 cancer cell lines showed moderately high mRNA expression of RAD51 with a z-score between 2 and 1. These cancer cell lines also showed association with haematopoietic and lymphoid cancer such as MUTZ5, WSUDLCL2, ST486, JURKAT, BL41, CI1, HPBALL, MOLT3, SEM, U937, HL60, NALM19, P3HR1,

SUDHL6, PEER, RI1, SMZ1, SUPB15, RL, GA10 and SUPT1. Other cancer cell lines with moderate expression included RHJT, RH4, TE441T (soft tissue cancer), EPLC272H, NCIH1435, NCIH2030 (lung cancer), SKNFI, SKNDZ, NB1, NMB (autonomic ganglia), NCIH684, PLCPRF5 (liver cancer), DLD1, CW2, GP2D, SNUC1 (large intestine), 143B, TC106, SKNEP1 (bone cancer), BT20, HCC1937, BT474, CAMA1, HCC1954 (breast cancer), HA1E, 786O (kidney cancer), RT4, CAL29, RT112, JMSU1 (urinary tract cancer), SNU16, SNU520, MKN45 (stomach cancer), PANC0813, BXP3 (pancreas cancer), MS751 (cervix cancer), 22RV1 (prostate cancer), IGR37, COLO792 (skin cancer), PA1, COV644, JHOS4 (ovary cancer), SNU738, LNZ308 (central nervous system cancer), TE11, KYSE180, TE4 (oesophagus cancer), HEC151, HEC1A (endometrium cancer), NCIH28 (pleura cancer), JAR (placenta cancer), DETROIT562 (upper aero-digestive tract) (Figure 2)

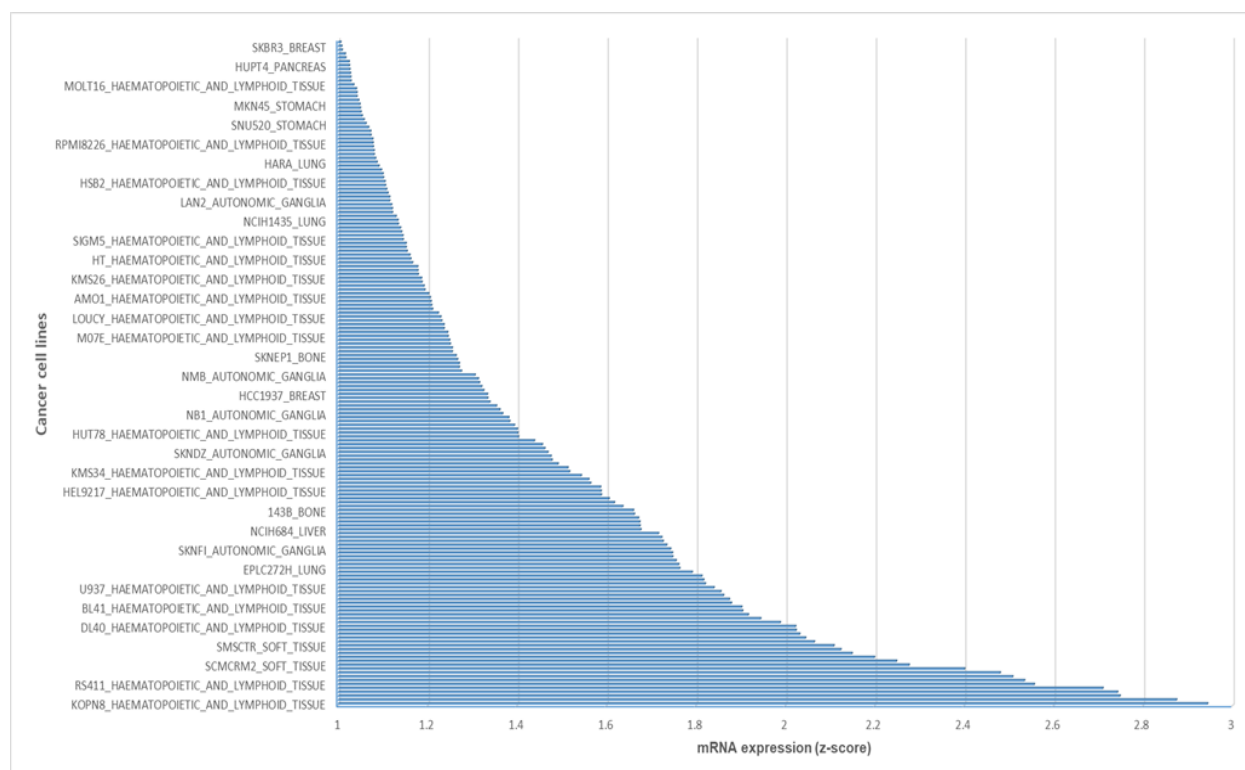


Figure-2. Enhanced expression of RAD51 protein in Cancer Cell lines. The mRNA expression expressed as z-score of various cancer cell lines were obtained from the Cancer Cell Line Encyclopedia (CCLE) dataset and plotted using the online tool cBioportal as discussed in the methods. The cancer cell lines with a z score over 1.00 are indicated in the left. The length of rows represents the expression of certain cancer cell lines.

3.3 Cancer cell lines with moderate to low expression of RAD51

Around 191 cell lines analysed demonstrated lower expression of RAD51 with the mRNA expression z-score below one (Figure 3). This included lung cancer cell lines as LK2, NCIH1648, SALE, LXF289, BEN, HCC44 and MERO48A. 49 cancer cell lines with low expression of RAD51 were associated with large intestine cancer as SNU61, COLO201, LS411N, SW837, SNU175, HT29, CACO2, HCT116, RCM1, SKCO1, SW1463, SW1116 and NCIH508. 31 cancer cell lines were associated with urinary tract cancer that included UMUC10, RT11284, HT1197, SCABER, UMUC4, 639V, UMUC5, UMUC7, 253J, UMUC6. 95 cell lines have low expression of RAD51 associated with haematopoietic and lymphoid cancer (JURLMK1, KMS20, HDLM2, EOL1, OCILY19, GDM1, KASUMI1, A3KAW). 44 cell lines have low expression of RAD51 associated with soft tissue sarcoma (RD, RH41, RKN, YAMATO, GCT, SKUT1, G401, TTC549, HT1080, KD, S117, RH36, SW982, JMURTK2, CHLA06ATRT, RH18). 7 cancer cell lines have low expression of RAD51 associated with prostate cancer (DU145, PC3, NCIH660, MDAPCA2B, VCAP, LNCAPCLONEFGC, PRECLH). 44 cell lines have shown lower expression of RAD51 associated with breast cancer (AU565, HCC70, HCC1428, JIMT1, HCC1143, T47D, CAL51, EFM192A, BT549, HCC1599, HCC1569, BT483, HCC1187, HMC18, HS274T, DU4475, HS578T, UACC812, CAL120, HMEL). 26 cancer cell lines have shown lower expression of RAD51 associated with endometrium cancer (RL952, HEC265, HEC50B, MFE319, HEC59, EN, TEN, JHUEM7, COLO684, MFE280, KLE, SNU685, SNGM, SNU1077, EFE184, HEC108). 30 cancer cell lines have shown lower expression of RAD51 associated with bone cancer (SJS1, EW8, HOS, A673, EWS502, CHLA9, SKES1, TC32, G292CLONEA141B1, COGE352, CBAGPN, CADOES1, CAL78, SKPNDW, CHLA57,

CHLA10, HS706T, MHES1, SW1353, CHLA32). 53 cancer cell lines have shown lower expression of RAD51 associated with ovary cancer (COV413A, SNU119, TOV21G, NIHOVCAR3, SKOV3, ONCODG1, RMUGS, COV362, OVCAR4, IGROV1, OCIC5X, OV17R, KURAMOCHI, OV56, RMGI, JHOM1, SCCOHT1, 59M, OVI5E, OVMANA). 45 cancer cell lines have shown lower expression of RAD51 associated with pancreas cancer (PACADD137, PACADD119, PANC1005, PK1, L33, PANC1, PANC0327, PATU8902, PANC0403, HUPT3, T3M4, HS766T, CFPAC1, KP4, PACADD159, HPAC, PACADD161, HPAFII, ASPC1, JOPACA1, SU8686). 53 cancer cell lines have shown lower expression of RAD51 associated with skin cancer (COLO800, IPC298, WM983B, WM1799, SKMEL30, K029AX, HS294T, HSC1, COLO829, SEKI, HSC5). 34 cancer cell lines have shown lower expression of RAD51 associated with stomach cancer (HUG1N, KATOIII, NUGC2, SNU601, MKN7, SNU668, MKN74, NUGC4, GCIY). 28 cancer cell lines have shown lower expression of RAD51 associated with oesophagus cancer (OE19, TE10, KYSE510, FLO1, JHESOAD1, ECGI10, COLO680N, KYSE30). 72 cancer cell lines have shown lower expression of RAD51 associated with central nervous system cancer (LN319, YKG1, KG1C, SNU489, D341MED). 17 cancer cell lines have shown lower expression of RAD51 associated with autonomic ganglia cancer (COGN305, CHLA15, CHP126, Y79, MHHNB11, GIMEN). 13 cancer cell lines have shown lower expression of RAD51 associated with thyroid cancer (SW579, 8505C, BCPAP, ML1, CAL62). 32 cancer cell lines have shown lower expression of RAD51 associated with kidney cancer (VMRCRCZ, TUHR10TKB, KMRC20, KMRC1, SLR20, VMRCRCW, CAL54, SNU1272). 7 cancer cell lines have shown lower expression of RAD51 associated with cervix cancer (HELA, SISO, DOTC24510, SW756). 35 cancer cell lines have shown lower expression of RAD51 associated with fibroblast cancer (HS229T, TO175T, RS5, DM3, HS737T, HS255T) (Figure 3).

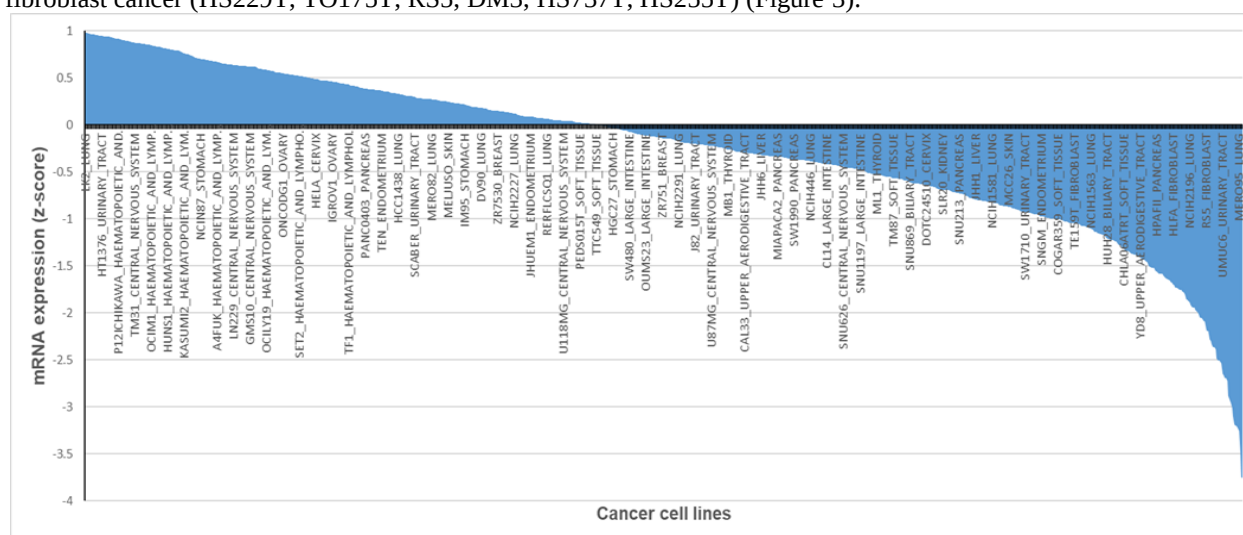


Figure-3. Moderate to Reduced expression of RAD51 protein in Cancer Cell lines. The mRNA expression expressed as z-score of various cancer cell lines were obtained from the Cancer Cell Line Encyclopedia (CCLE) dataset and plotted using the online tool cBioportal as discussed in the methods. The cancer cell lines with a z score of less than 1.00 are indicated in the left. The length of rows represents the expression of certain cancer cell lines in positive and negative range.

4. Discussion and Conclusion

Chemoresistance Represents A Relevant Clinically Unmet Need In The Treatment Of Multiple Cancer Types. Identification Of Molecular Markers Involved In Chemo-Resistance Response Could Help To Identify New Drugs As A Chemo-Sensitizer And Could Be Used As Predictive Biomarker Of Chemo Therapy Response (Masoudi-Khoram Et Al., 2020). Elevated Dna Repair Is A Key Mechanism Of Development Of Chemoresistance That Results In Repair Of Damage Induced By Chemotherapeutic And Radiotherapeutic Agents To Kill Cancer Cells (Li Et Al., 2021). Increased Levels Of Dna Repair Proteins As Rad51, A Key Protein In Hr Is One Of The Potential Biomarkers That Can Be Investigated For Its Role In Post Treatment Survival Of Cancer Patients (Gachechiladze Et Al., 2017). Previously, with the help of The Cancer Genome Atlas (TCGA) database and Gene Expression Profiling Interactive Analysis (GEPIA2) online tool, we analyzed that elevated level of RAD51 in multiple cancers. Elevated expression of RAD51 was associated with poor overall survival in multiple cancers (Manuscript under preparation; Singh, Y. et al.; 2023). In order to study the effect of elevated or reduced expression of RAD51 on DNA repair, it would be ideal to obtain cancer cell lines with differential expression of the protein.

In this study, we report the identification of model cancer cell lines that can be used in future for studying DNA repair. Bioinformatics analysis of expression of RAD51 in multiple cancer cell lines by using online tools and datasets like cBioportal, Human genome atlas and cancer cell line encyclopedia (CCLE) was performed. On the

basis of bioinformatics analysis we have selected cell lines that showed highest expression of RAD51 as well as lowest expression on RAD51 in various cancerous cell lines. The cell line expression is also correlated with respect to expression of RAD51 in normal tissues. Although the highest expression of RAD51 were seen in cancer cell lines associated with haematopoietic and lymphoid tissue as well as soft tissues the corresponding tissues also showed elevated expression (Figure 1 & 2). By correlating with the expression in cell lines and tissues in this data the ideal cell lines that can be used for higher expression include the breast cells, SKBR3 and HCC1937, Liver cell line, NCIH684, Lung Cell line, EPLC272H and NCIH1435(Holliday & Speirs, 2011). It is also noted that the expression of RAD51 in Cervical cancer cell line, HeLa, Urinary tract cell line, HT1376, CNS cell line TM31, LN229, GMS10 are all moderately high between the range of 0-1 z score and can be used for cell lines with elevated expression study due to the relatively lower expression in corresponding normal tissue (Figure 3)(Ruíz et al., 2018). For studying cells with lower RAD51 expression the cell lines that can be used on comparison with higher or normal expression in normal tissue include, Lung cancer cell lines, MER095, NCIH2196, NCIH1563, etc., Pancreatic cancer cell lines SNU213, breast cancer cell line, ZR751, ZR7530, stomach cancer cell lines as HGC27(Foertsch et al., 2019). More scuh cell lines can be identified using this work from the data available.

So models cell lines with high and low expression of RAD51 protein identified by this analysis can be used to study the effect of RAD51 expression on DNA repair. Investigation of this role will help design therapeutic tools to enhance cancer therapy. The overall regulation of RAD51 expression and function in cancer can be a novel combinatorial cancer-therapeutic approach to inactivate repair thereby minimizing chemoresistance.

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Analysis of Physico-Chemical Parameters of Wastewater Samples of Moga District, Punjab

***Charan Kamal Sekhon, *Monika Airi, **Pawanjot Kaur**

* Assistant Professor, **Research scholar Department of Zoology, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab.
 drcks31@gmail.com, monika_airi@yahoo.co.in, pawanjhajj69@gmail.com

Abstract

Water is essential natural resource on the earth. With urbanization and industrialization, chance of deterioration in quality of water are enhanced. Poor water quality is major threat to environment and human beings. The inadequate practice of discharge of wastewater into receiving water bodies alters physicochemical parameters, which ultimately disturbs the livelihood of aquatic flora and fauna. This study was carried out to investigate the physicochemical parameters of waste waters used to irrigate vegetable farmlands in Moga District, Punjab. Waste waters samples were collected from six different sampling sites during summer season (May, 2021). Now days, District Moga of Punjab is as a growing as industrial hub due to development of various small and large scales industries. With growing industry, large amount of industrial waste water is released into nearby agricultural lands. The collected samples have been analyzed for physicochemical parameters like pH, temperature, dissolved oxygen (DO), biological oxygen demand (BOD), carbon dioxide, total alkalinity, total hardness, phosphate, nitrate, sodium and potassium, calcium and magnesium etc. The results of parameters were compared with standard limits of water given by suggested by WHO. Results revealed that physicochemical parameters like pH, dissolved oxygen, BOD, nitrate were below the permissible limits, while Carbon dioxide, phosphate, potassium, magnesium values were above and hardness, alkalinity and calcium within the permissible limits as compared to control area. The higher values of the physicochemical parameters observed at the study areas indicate higher pollution level compared to the control area. Long- term use of wastewater for irrigation of vegetables promotes to public health. The higher values obtained for some physicochemical properties of waste water instructs that necessary mechanism should be put in place to monitor and evaluate periodically waste water content used for irrigation purposes in order to prevent potential risk to the receiving soil and subsequent transfer to vegetables grown on such sewage water irrigated soils.

Keywords: - Wastewater, Moga, Physico-chemical parameters, health.

Introduction

Water is absolutely necessary for all species to survive including human, food production and economic development. Since human welfare is strongly correlated with water quality, it is a crucial concern for humanity (Patil and Patil 2010). The quality of water is affected by human activities and is declining due to urbanization and agricultural development and practices etc. The effects of polluted water will impact upcoming generations. Researchers have observed that by 2025, more than half of the world population will be facing water-based vulnerability (Kulshreshtha, 2006). The availability of drinking water is limited and scarce in many developing nations, including India. There are significant environmental issues as a result of countries continuing development. Such water may be contaminated by discharging domestic waste, industrial water, agricultural activities, rainfall-runoff and erosion etc. They pollute the water bodies by physical, chemical and biological means and finally become unfit for human consumption and drinking purpose. Heavy metal pollutants are found in the wastewater produced by industrial activities. Due to growing human populations, industrialization, and the usage of fertilizers rendered the water unsuitable for use. Natural aquatic resources such as those found in agriculture and man-made activities are heavily and diversely polluting the aquatic environment, resulting in poor water quality and the extinction of aquatic life (Simpi et al., 2011). The source of wastewater is the combination of domestic, industrial, commercial or agricultural activities, surface runoff, sewer inflow or infiltration. The objective of the study is to analyses the physico-chemical characteristics of wastewater samples of Moga district, Punjab. The literature survey reveals that no water quality management studies are made in this region so far. Six wastewater sites and one groundwater site were selected from different localities in Moga district to determine the water quality and to ensure a safe environment for the sustenance of life.

Materials and Methods

2.1 Study Area

Moga is the 17th district of Punjab. The district of Moga is enveloped by the Ludhiana district in East, Jalandhar district in North, Ferozepur in the West and Sangrur in South. The coordinates for the area are 30.8° North and 75.17° East. It occupies a total area of 2230 km square. The average annual rainfall of the district was 234.5 mm. Moga district is divided into five blocks i.e. Block- 1(Moga- I), Block -2 (Moga -II), Block -3 (Baghapurana), Block -4(Nihal Singh Wala), Block-5 (Dharamkot). The different sampling sites along with their GPS locations are listed in Table 1.

Table.1: Different location site with GPS location

S.No.	Location Site (Block wise)	GPS Location
1.	Moga- I (Chauhar Chak)	N-30°46'45" E-75°21'34"
2.	Moga -II (Safuwala)	N-30°47'33.16" E-75°4'37.83"
3.	Baghapurana (Samad Bhai)	N-30° 35'55.74" E-75°90'57.36"
4.	Nihal Singh Wala (Ransih Kalan)	N-30°36'11" E-75°17'36"
5.	Dharamkot (Kokri Butran)	N-30° 52'30" E-75°28'38"
6.	Control site (Gholia Kalan)	N-30°39'56" E-75°12'02"

2.2. Sampling sites

The domestic wastewater samples were collected from six different sites of Moga district. Samples were collected in the month of December 2020 according to Standard procedures from American Public Health Association (APHA, 1989).

2.3. Sample collection

Wastewater samples were collected in labelled 1Litre polyethylene bottles from the sites where sewage water is being pumped into agricultural fields. The temperature of the samples was measured in the field at the time of sample collection. Collected samples were preserved with nitric acid. For the analysis of the samples in laboratory, samples were kept in refrigerator at 4°C.

2.4. Physico- Chemical Analysis

Analysis was carried out for various wastewater parameters such as pH, temperature, dissolved oxygen (DO), biological oxygen demand (BOD), total alkalinity (TA), total hardness (TH), carbon dioxide (CO₂), phosphate (PO₄³⁻), nitrate (NO₃), sodium (Na⁺), potassium (K⁺), calcium (Ca⁺), Magnesium (Mg⁺) using standard methods. The reagents used for the analysis were AR (Analytical reagents) grade and double distilled water used for the preparations of solutions (APHA, 2005)

2.4.1. Measurement of pH, temperature

Measurement of pH and temperature was done using a pH meter and ordinary thermometer which was calibrated before being used.

2.4.2. Determination of Dissolved oxygen, Biological oxygen demand, Total Alkalinity, Hardness, Nitrate and Phosphate

Titration method was used to determine Dissolved oxygen (Winker's method), Biological oxygen demand (Winker's method), total Alkalinity (APHA, 2005) and total Hardness (APHA, 2005)

2.5. Determination of nutrient content

Nutrient concentration is one of the important parameters in determining wastewater characteristics. The high nutrient content of wastewater increases the risk of eutrophication in the water body. The phosphate, nitrate, sodium, potassium, calcium and magnesium concentrations were measured in this study. All the parameters were analyzed using standard protocols standard methods for the examination of water and wastewater (APHA, 2005).

3. Results and Discussion

In the present study, comparative analyses of physico- chemical parameters of wastewater in Moga, Punjab were carried out during December 2020. The physico-chemical parameters under this study were pH, temperature, dissolved oxygen, biological oxygen demand, carbon dioxide, sodium, potassium, calcium, magnesium, nitrate and phosphate etc. determined. Each experiment was performed in triplicates. The data is shown in Table no 2.

3.1. Physical Parameters

pH

The term pH is a measure of the concentration of hydrogen ions in a diluted solution. The pH controls the chemical state of many nutrients, including dissolved oxygen, phosphate, nitrate, etc. According to World Health Organization (2007), health effects are related with pH of the water. Water with pH above 11 can cause skin, eye and mucous membrane irritation and the pH below 4 can cause irritation due to corrosive effects. The New York state department of health explains that load exposure can lead to different neurological and reproductive problems such as seizures, hearing loss and miscarriages. WHO has recommended maximum permissible limit of pH from 6.5 to 8.5 (De, 2002). pH value was found above the permissible limit in block 1(Moga-I), block-3 (Baghapurana), block-4 (Nihalsinghwa), block 5 (Dharamkot) while in block -2(Moga -II) and control site were within the safe limits prescribed by WHO. pH of collected wastewater samples ranged from 7.8 to 9.8 in all blocks. The analysis of wastewater samples showed alkaline nature.

Temperature

Temperature in all five blocks as well as in control site was within the permissible limits. Temperature in the study area ranged from 18.7°C to 26.4°C. The temperature also regulates the growth and existence of aquatic biota (Rozen-Rechels et al. 2019).

Total Hardness

Hardness is the property of water which increases the boiling points of water. Hardness of water mainly depends upon the amount of calcium or magnesium salts or both (Rao and Venkateswaralu, 2000). Total hardness was found in the samples of wastewater from 264±53.7 mg/L to 615±390.0mg/L which shows the values higher than the permissible limit prescribed by WHO. The hardness value in Moga-I, Moga-II, Nihalsinghwala, Dharamkot were found within the permissible limits while highest value (615±390.0) were recorded in Baghapurana and control site (78.3±1.49) below the permissible limit. According to some classifications, water having hardness up to 75mg/l is classified as soft, 76-150 mg/l is moderately soft, 151-300mg/l as hard and more than 300 mg/l as very hard (Saravanakumaran and Ranjith Kumar, 2011). The results show that all the samples were very hard except sample

Total Alkalinity

Alkalinity is also important parameter of water if high salt content water used for irrigation which cause the salinity of soil and adversely effects the salt intake efficacy of plants (Varale and Varale, 2013). Alkalinity values were ranged from 305mg/L to 1120mg/L. Results showed that values were found above the safe limits in Dharamkot (1120±547.40) and Moga-I (1053±412.3) while Moga-II, Baghapurana, Nihalsinghwala as well as control within the permissible limits.

3.2 Chemical parameters

Dissolved Oxygen

The amount of DO, which represents the concentration of chemical or biological compounds that can be oxidized and that might have pollution potential, can affect a sum of processes that include re-aeration, transport, photosynthesis, respiration, nitrification, and decay of organic matter. In this study area, results revealed that DO values in all five blocks were below the permissible limits. DO values in the study area ranged from 1.53±0.66mg/L to 5.7±3.04mg/L. The decreases of DO was mainly caused by the decomposition of organic compounds. Extremely low DO content ($DO < 2 \text{ mg O}_2/\text{L}$) usually indicates the degradation of an aquatic system (Wang *et al.*, 2017). but a lower DO value in water can disturb aquatic life by reducing the strength of immunity against various infections, affecting reproductive behavior, hampering swimming behavior, and making nourishment unstable, leading to the death of aquatic life (Papa *et al.*, 2012).

Table 2. Physico-chemical analysis of wastewater sample

Parameters	Permissible limits (WHO)	Sampling sites					
		Control	Moga-I	Moga-II	Baghapurana	Nihalsinghwala	Dharamkot
		Groundwater	Municipal wastewater	Municipal wastewater	Municipal wastewater	Municipal wastewater	Municipal wastewater
Ph	7.0-8.5	7.1±0.15	9.3±1.12	7.8±0.32	9.03±0.15	9.0±0.1	9.8±0.15
Temperature	45°C	22.7±1.1	18.7±1.11	24.3±1.09	23.2±3.55	23.7±0.57	26.4±0.49
DO (mg/L)	6.5-8	2.73±0.20	2.7±0.72	4.3±2.9	3.5±0.17	1.53±0.66	5.7±3.04
BOD (mg/L)	3.0	5.8±0.22	0.8±0.71	3.97±1.86	5.42±4.4	1.72±0.10	4.03±2.32
CO ₂ (mg/L)	10	25.4±0.15	66±44.6	52.8±55.1	33.7±13.4	3.7±4.5	15.4±2.2
Alkalinity (mg/L)	200-600	551±1.52	1053±412.3	605±11.7	305±48.3	586±185.0	1120±547.4
Hardness (mg/L)	100-500	78.3±1.49	289.3±59.74	264±53.7	615±390.0	379.3±97.9	346.7±167.5
Nitrate (mg/L)	45-200	21±0.0	3.6±1.44	4.7±2.57	1.18±1.36	2.73±0.86	1.6±0.45
Phosphate (mg/L)	1	4.88±0.03	2.45±0.93	BDL	3.93±2.05	2.71±0.86	1.59±0.45
Sodium (mg/L)	200	99.4±0.25	100±0.44	100.4±2.64	101.4±1.10	99.3±0.20	100.3±0.5
Potassium (mg/L)	12	75.1±0.45	3±0.11	99.7±2.64	100±0.55	99.6±0.38	99.7±0.33
Calcium (mg/L)	75-200	26.6±0.15	11.8±1.57	14±1.27	2.06±0.90	9.5±0.33	19.0±1.26
Magnesium (mg/L)	500	172.3±0.55	2.52±0.15	61.5±0.35	149.8±0.26	90.5±0.35	80.0±0.15

Mean± Standard deviation

Data based on 09 observations

Results compared with WHO (World Health Organization, 2007)

Biological Oxygen Demand

Biological oxygen demand refers to the amount of oxygen that would be consumed if all organic compounds in one litre of water were oxidized by bacteria and protozoa. The Maximum value of BOD were found in Baghapurana (5.42±4.4), Dharamkot (4.03±2.32), Moga-II (3.97±1.86) Whereas Nihalsinghwala (1.72±0.10) and Moga -I (0.8±0.71) were below the permissible limit and control were above the limit. The BOD values in wastewater samples were ranged from 0.8±0.71mg/L to 5.42±4.4mg/L. The high value of BOD may be due to extensive use of organic nutrients. Increase in BOD which reflects microbial oxygen demand leads to depletion of DO which may cause hypoxia conditions with consequent adverse effects on aquatic biota (Sukumaran *et al.*, 2008).

Carbon dioxide

In all collected wastewater sampler were high value of carbon dioxide than the permissible limits except sample Nihalsinghwal. The values were ranged from 3.7 ± 0.5 to 66 ± 4.6 in the study area. In 2016, J.L. campos reported that carbon dioxide may be increase due to burning fossil fuels, releasing chemicals into the atmosphere and industrial activities. High carbon dioxide increases acidity in water.

3.3. Nutrient analysis

Nitrate

The concentration of nitrate was recorded in the range of 1.1 ± 1.36 mg/L to 21 ± 0.0 mg/L. All the wastewater sampler was found below the permissible limit prescribed by WHO. The concentration of different forms of nitrogen gives a useful indication of the level of Micronutrients in the wastewater and hence their ability to support plant growth. High levels of nitrate and phosphate can lead to eutrophication, which increases algal growth and ultimately reduces dissolved oxygen in the water (NA *et.al.*, 2015)

Phosphate

Phosphate comes from fertilizers, pesticides, industry and cleaning compounds. Natural sources include phosphate containing rocks and solid or liquid wastes (Sangu and Sharma, 1987). The lowest value of phosphate was recorded as 1.59 ± 0.45 mg/L and highest value was 3.93 ± 0.205 mg/L. These values were above than the permissible limit.

Sodium and Potassium

Sodium is also main parameter for assessment of suitability for irrigation purpose. Sodium concentration was found below the permissible limits in all wastewater samples. While the phosphate content was found greater in all samples than the permissible limit of WHO except the wastewater sample of Moga-I. In 2009, Arienzo *et al.*, (2009) reported that wastewater contributes the potassium content. Therefore, when irrigating crops with wastewater the application of potassium fertilizer should be reduced.

Calcium and Magnesium

The Hardness is directly related to Calcium and Magnesium content. In the present study, the Calcium concentration ranged between 2.06 ± 0.90 mg/L to 19.0 ± 1.26 mg/L and found below the permissible limit of WHO. While Magnesium content in the wastewater samples was ranging from 2.52 ± 0.15 mg/L to 1.49 ± 0.26 mg/L which was found below the prescribed limit.

Conclusion

In conclusion, From the result of physico- chemical analysis of domestic wastewater effluents, it was concluded that pH, BOD, total harness, total alkalinity, carbon dioxide, phosphate and potassium showed higher values compared to the standards values prescribed by WHO, whereas the values of DO, nitrate, sodium, calcium and magnesium were below the permissible limit. Such effluent should not be discharged in to the nearby water body or soil without treatment. They are unfit for irrigation. Such effluent should be discharged only after treatment. Water of Moga district has been polluted due to leaching of various chemicals and heavy metals. The harmful substances present in the water were also found to be associated with a variety of health problems in the people living around this study area. The overall conclusion is that wastewater with a high domestic load has the highest negative impact on water quality in the study area. The higher values obtained for some physico-chemical properties of wastewater instructs that necessary mechanism should be put in place to monitor and evaluate periodically wastewater content used for irrigation purposes in order to prevent potential risk to the receiving soil and subsequently transfer to crops grown on such wastewater irrigated soils.

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Nutritional Evaluation of Most Commonly Used Fodder Species of Bilaspur, Himachal Pradesh**Monika Guleria, Radha**School of Biological and Environmental Sciences, Shoolini University of Biotechnology and Management Sciences, Solan -173229, (HP), India.
monikaguleria3031980@gmail.com**Abstract**

India leads the world in livestock production and employs more than 75% of the rural population. However, fodder production is not practised in our country, and animals eat naturally grown grasses and shrubs which are low in protein and energy availability. As a result, there is an urgent need to seek out new fodder resources that are both sustainable in nature and capable of covering our fodder deficit. The current study proposes to evaluate the most common fodder species of Bilaspur, Himachal Pradesh. Primary data on the most common fodder species were gathered through interviews with key informants, group discussions, and field observations. Ten most common fodder species fed to livestock locally are *Bambusa arundinacea*, *Bauhinia vahli*, *Berberis asiatica*, *Cassia catechu*, *Cassia fistula*, *Cyperus rotundus*, *Ficus carica*, *Grewia optiva*, *Morus nigra*, *Phoenix sylvestris*, and *Thalictrum foliosum*.

By using conventional lab methods, data were produced on leaf samples from 10 different species of fodder for a total of 7 nutritional variables. One-way analysis of variance using descriptive statistics was done in relation to the nutritional components. Nutritional analysis was performed on the ten most preferred fodder species in terms of moisture, ash, crude protein, crude fat, crude fiber, NDF, and ADF. The results revealed that *Grewia optiva* had highest amount of crude protein, *Morus alba* had lowest NDF value and *Cassia fistula* had lowest ADF value.

Keywords: Livestock, Fodder, Nutritional value, Rural people.

1. Introduction

India has the world's largest livestock population, accounting for approximately 15% of the total. The livestock sector's contribution to India's GDP has recently increased from 4.82 to 5.37 percent (Wangchuk et al, 2015). The term "growth" refers to the process of increasing the size of a population through the use of technology. The fodder trees provide nutritious feed to the livestock population of hill farmers (Diriba, 2014). Even landless labourers who keep small herds of animals rely on top feed resources from trees growing near habitats. The most common reason for this is that there are so many people. Fodder trees and grasses are one of the most common land use systems in the North-Western Himalaya, and they have always been used to feed livestock. Trees and grasses are becoming increasingly recognised as important components of animal feed, particularly as protein sources.

In the current situation, acute nutrient deficiency causes malnutrition, low productivity, and predisposes livestock to parasitism, epidemics, and breeding problems. The mismanagement of rangelands has harmed the ecosystem. The availability of high-quality fodder influences livestock productivity (Kohler et al., 2015). Forests provide 57 percent of India's total fodder requirement. Many studies on the chemical composition of browse species have been conducted in recent years, and the protein, mineral, and vitamin concentrations have generally been shown to be adequate for the grazing maintenance requirement (Rani et al, 2015). In consideration of the significance of fodder quality, a study was conducted to evaluate the nutritional content of fodder species in Bilaspur, Himachal Pradesh. The current study was carried out to determine the nutritional value of the most commonly used fodder species fed to livestock by rural residents of Bilaspur. This study will aid in learning the nutritive composition of local fodder species and to recommend composition in dietary supplements.

The purpose of this research was to determine the nutritional value of the ten most commonly used fodder species in Sunder Nagar. Because of their high use value, ten fodder plants were chosen for nutritional analysis in the current study. As a result, evaluating scientific documentation on fodder plants is critical.

2. Materials and Methods:

2.1 Study site



The current survey was carried out in the Bilaspur, Himachal Pradesh. Extensive field visits were undertaken in the study during 2021 to 2022. The most common fodder species in the study area, which are being used for feeding livestock locally, were collected during the month of July 2022. The fodder species consisted of *Bambusa arundinacea*, *Bauhinia vahli*, *Berberis asiatica*, *Cassia fistula*, *Cyperus rotundus*, *Ficus carica*, *Grewia optiva*, *Morus alba*, *Phoenix sylvestris*, and *Thalictrum foliosum*.

2.2 Sample preparation

The green leaves were rinsed in distilled water to remove dust and stored in a refrigerator to be freeze dried as soon as possible after collection. All the foliage was cut into small pieces so as to facilitate easy handling and uniform sampling for analysis. Samples were initially shade dried followed by drying in the hot air oven at 65 °C for 24 hrs. Samples were ground to pass through 0.5 mm sieve and stored in zip lock bags at room temperature.

2.3 Physiochemical analysis of fodder species

Proximate composition such as crude protein (CP), ether extract (EE), crude fibre (CF) and total ash (TA) were analysed by standard methods (AOAC, 2012). The fiber fractions viz. Neutral detergent fiber, (NDF) and Acid detergent fiber (ADF) were determined by Van Soest et al.

2.3.1 Determination of the Moisture

A clean container was dried in an oven at 105 degrees for one hour, chilled, and weighed (W1). The container was filled with a 2 g (W2) dry leaf sample, which was then dried in an oven at 105 °C. After cooling in a desiccator, the sample was weighed (W3) Sigel, 1978.

2.3.2. Determination of Ash

For one hour, a porcelain crucible was dried at 105 degrees, cooled, and weighed (W1).

After being deposited in the crucible, the 2 g of ground leaf sample was once more weighed (W2). In a muffle heating system, the crucible containing the plant samples was first ashed at 250 °C for an hour, then ashed at 550 °C for five hours. After cooling in a desiccator, the leaf sample was weighed once more (W3). Sigel, 1978.

2.3.3. Determination of Crude Fat

The 5g powdered sample was extracted in 100 mL diethyl ether and shaken in an orbital shaker for 24 hours. In a previously weighed beaker, the ether extract was collected (W1). After being equilibrated with 100 mL diethyl ether and shaken for 24 hours, the filtrate was collected in the same beaker (W1). After being concentrated to dryness in a steam bath, the ether was dried in an oven at 40-60 °C and the beaker was reweighed (W2) Adamu et al. 2013.

2.3.4. Determination of Crude Fiber

A dried leaf sample (2 g) was digested by boiling with 100 mL of 1.25% H₂SO₄ for 30 minutes and filtered under pressure. The remaining residue was then thoroughly cleaned with hot water. This procedure was repeated with 100 mL of 1.25% NaOH sol on the residue. The remaining filtrate was dried and weighed at 100°C (C1). It was then incinerated in a muffle furnace at 550 °C for 5 hours before being reweighed (C2) Aina et al. 2012.

2.3.5. Determination of Crude Protein

In a Kjeldahl flask, the powdered sample (2g) was digested by boiling with 20ml of concentrated H₂SO₄ and a digestion tablet until the mixture was clear. The digest was filtered and adjusted to the mark in a 250 mL volumetric flask before being distilled. The aliquot plus 50 mL of 45% NaOH solution was transferred into a 500 mL round bottom flask and distilled. 150 mL of distillate was collected into a flask containing 100 mL 0.1 N HCL. This was then titrated against 2.0mol/L NaOH using methyl orange as an indicator. A colour change to yellow indicated the end point.

Percentage of crude protein was obtained by multiplying the Nitrogen value by a factor of 6.25. Crude protein = Nitrogen in sample × 6.25.

2.3.6. Neutral Detergent Fiber

NDF was calculated using the following formula [60].

$$\text{NDF (\%)} = \frac{(\text{Weight of crucible} + \text{Fiber content}) - \text{Weight of empty crucible}}{\text{Weight of sample}} \times 100$$
 (6)

2.3.7. Acid Detergent Fiber

ADF was calculated using the following formula Nazir et, al. 2021

$$\text{ADF (\%)} = \frac{\text{Weight of crucible} + \text{Fiber content} - \text{Weight of sample}}{\text{Weight of sample}} \times 100$$

2.4. Statistical Analysis

Data was examined with SPSS Version 20.0. Results were determined as Mean $\pm$ SE of three repeat determinations.

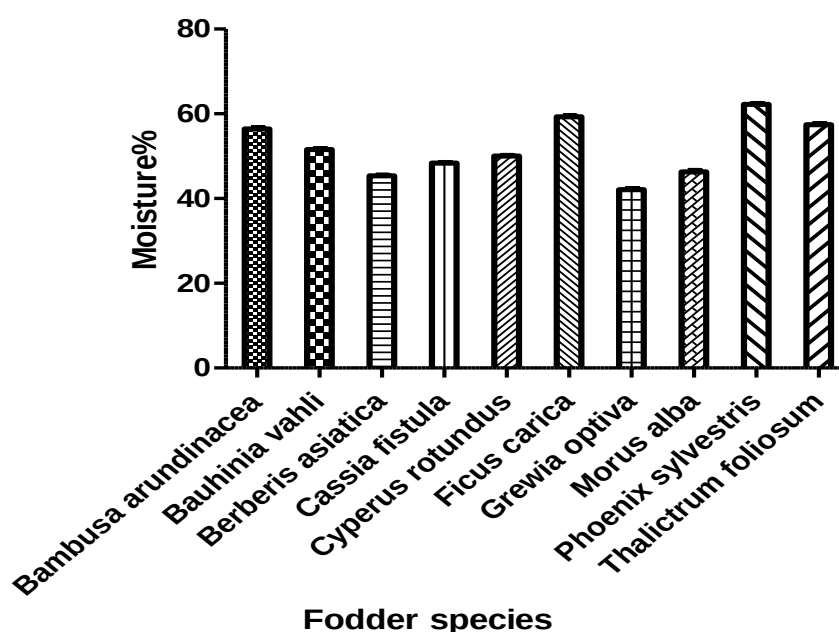
3. Result : Nutrient Composition

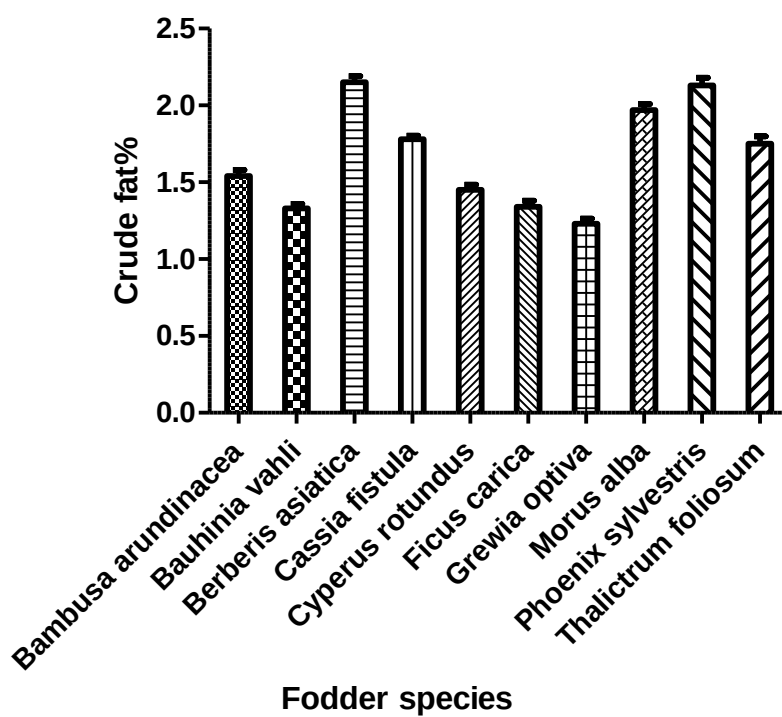
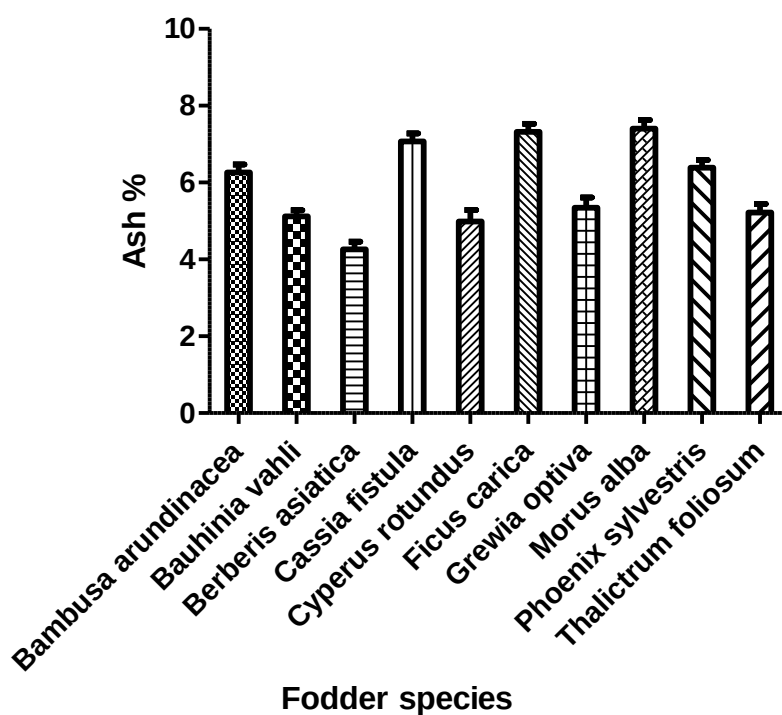
The nutrient was analyzed in 10 most commonly used fodder species collected from Bilaspur District of Himachal Pradesh.

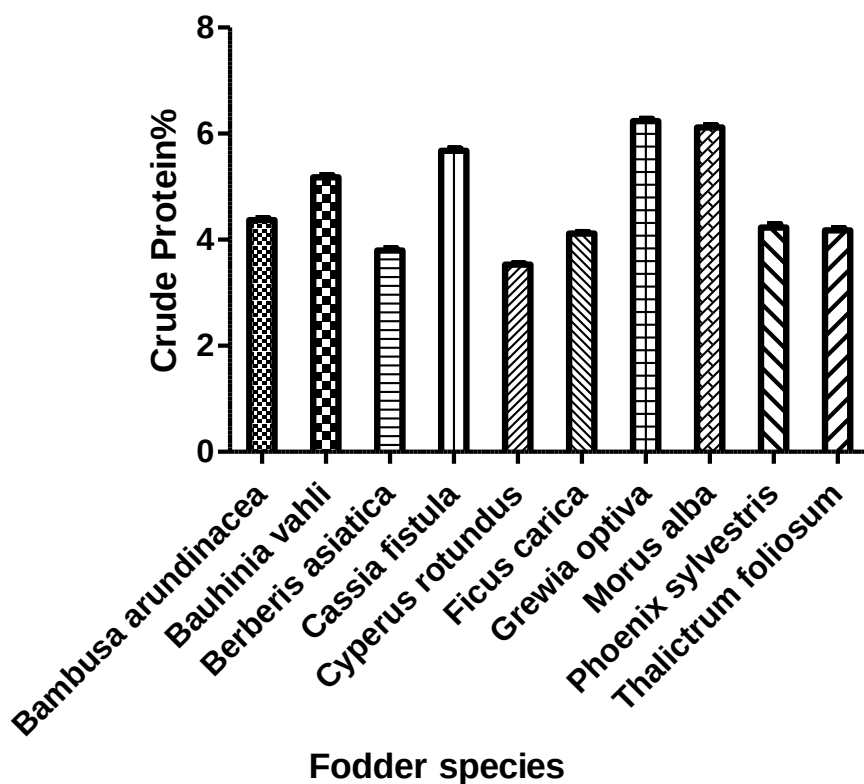
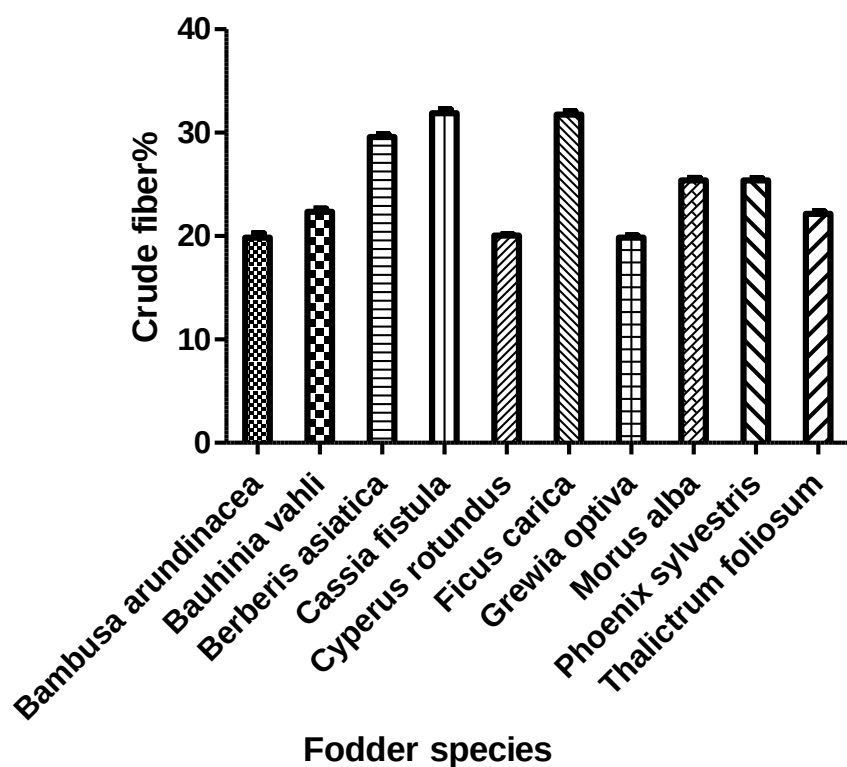
In the current study, moisture content was found to be highest in *Phoenix sylvestris* (62.22%) and lowest in *Grewia optiva* (42.08%) ; ash content was found highest in *Morus alba* (7.40%) and lowest in *Berberis asiatica* (4.26%) ; crude fat was found highest in *Berberis asiatica* (2.23%) and lowest in *Grewia optiva* (1.23%) ; crude fiber was highest in *Ficus carica* (31.76%) and lowest in *Bambusa arundinacea* (19.18%) ; crude protein was reported highest *Grewia optiva* (6.24%) and lowest in *Cyperus rotundus* (3.53%) ; NDF was found highest in *Berberis asiatica* (59.26%) and lowest in *Morus alba* (40.52%) ; ADF was highest in *Berberis asiatica* (53.04%) and lowest in *Cassia fistula* (40.02%) Table 1.

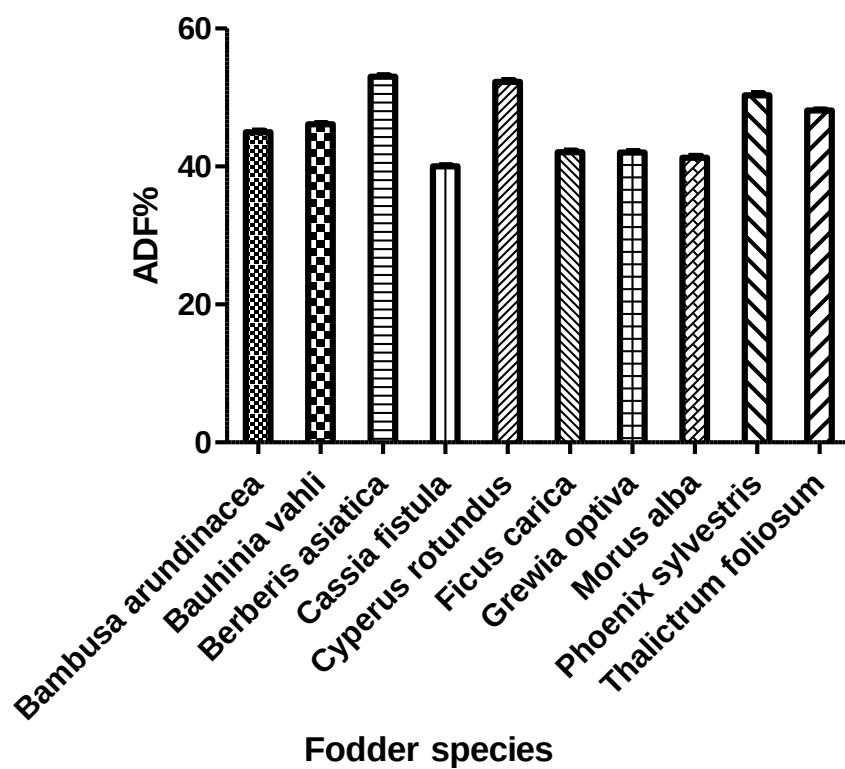
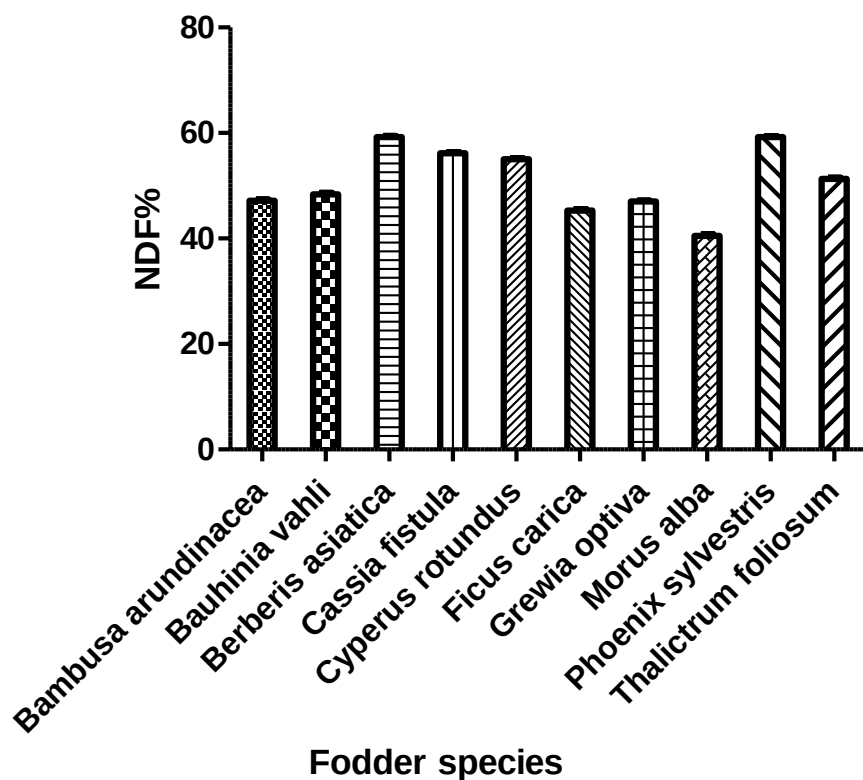
Table.1: Results of the study

S.No.	Species Name	Moisture%	Ash %	Crude Fat %	Crude Fiber %	Crude Protein %	NDF %	ADF %
1.	<i>Bambusa arundinacea</i>	56.4 $\pm$ 0.28	6.26 $\pm$ 0.20	1.54 $\pm$ 0.04	19.8 $\pm$ 0.41	4.37 $\pm$ 0.03	47.18 $\pm$ 0.0	44.9 $\pm$ 0.20
2.	<i>Bauhinia vahlii</i>	51.54 $\pm$ 0.24	5.12 $\pm$ 0.16	1.33 $\pm$ 0.03	22.3 $\pm$ 0.28	5.18 $\pm$ 0.04	48.38 $\pm$ 0.24	46.1 $\pm$ 0.12
3.	<i>Berberis asiatica</i>	45.3 $\pm$ 0.17	4.26 $\pm$ 0.20	2.15 $\pm$ 0.04	29.57 $\pm$ 0.27	3.80 $\pm$ 0.04	59.26 $\pm$ 0.19	53.04 $\pm$ 0.13
4.	<i>Cassia fistula</i>	48.36 $\pm$ 0.161	7.07 $\pm$ 0.21	1.78 $\pm$ 0.02	31.9 $\pm$ 0.35	5.68 $\pm$ 0.04	56.18 $\pm$ 0.19	40.02 $\pm$ 0.11
5.	<i>Cyperus rotundus</i>	50.05 $\pm$ 0.14	4.99 $\pm$ 0.30	1.45 $\pm$ 0.03	20.03 $\pm$ 0.12	3.53 $\pm$ 0.02	55.08 $\pm$ 0.22	52.26 $\pm$ 0.20
6.	<i>Ficus carica</i>	59.3 $\pm$ 0.19	7.32 $\pm$ 0.21	1.34 $\pm$ 0.04	31.76 $\pm$ 0.33	4.12 $\pm$ 0.02	45.32 $\pm$ 0.12	42.0 $\pm$ 0.16
7.	<i>Grewia optiva</i>	42.08 $\pm$ 0.22	5.35 $\pm$ 0.26	1.23 $\pm$ 0.03	19.84 $\pm$ 0.21	6.24 $\pm$ 0.04	47.02 $\pm$ 0.12	41.2 $\pm$ 0.24
8.	<i>Morus alba</i>	59.6 $\pm$ 0.16	7.40 $\pm$ 0.23	1.97 $\pm$ 0.04	25.39 $\pm$ 0.23	6.12 $\pm$ 0.04	40.52 $\pm$ 0.28	50.3 $\pm$ 0.22
9.	<i>Phoenix sylvestris</i>	62.2 $\pm$ 0.204	6.39 $\pm$ 0.20	2.13 $\pm$ 0.05	25.38 $\pm$ 0.21	4.23 $\pm$ 0.06	59.23 $\pm$ 0.168	52.1 $\pm$ 0.20
10.	<i>Thalictrum foliosum</i>	57.4 $\pm$ 0.25	5.22 $\pm$ 0.23	1.75 $\pm$ 0.04	22.1 $\pm$ 0.23	4.18 $\pm$ 0.04	51.29 $\pm$ 0.24	48.1 $\pm$ 0.12









Discussion

The physicochemical parameters studied will be used to characterize and standardize the experimental plants. A higher moisture content in the leaves explains the higher degree of fodder spoilage. The total ash content predicts the soluble and insoluble minerals in the sample and crude fiber helps in digestion. Proteins are the building blocks of cells and fat offer energy. Low NDF content has high ruminant intake and ADF value is inversely proportional to digestibility.

Conclusion

All of the fodder species had nutrient variations, and they are good sources of fodder for grazing animals. The livestock in the study area are fed these available fodder species.

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Evaluation of *Rheum Emodi* as an Ideal Candidate for Anthelmintic Preparation

Mansimar Kaur, Gurpreet Kaur*, Pardeep Kaur Sandhu*
gpreet.scorpio@gmail.com, pardeepkaur@matagujricollege.org

Abstract

Avitellina tapeworms have a worldwide distribution, and a great veterinary importance. In heavy infestation, *Avitellina* tapeworms may cause serious disorders, particularly in lambs, and calves under 1 year old. Thus, *Avitellina* tapeworms represent an economic point in animal industry. Many chemotherapeutics are used for the treatment of this infection, however, misuse and poor formulation of these products have led to development of anthelmintic resistance. In addition to it, these drugs are expensive and exhibits several adverse effects. The aim of present study is to investigate the anthelmintic effect of hydroethanolic extract of *Rheum emodi*. Phytochemical analysis of the extract was done by various qualitative tests to screen the secondary metabolites. Histological studies were done to monitor the morphological characteristics for the identification of parasites. Biochemical studies were carried out to investigate the effect of hydroethanolic extract of *Rheum emodi* on the acid and alkaline phosphatases. The phytochemical analysis revealed that the *Rheum emodi* extract consists of mixture of phytochemicals like Phenols, flavonoids, tannins, terpenoids and alkaloids. However, saponins were found to be absent in the hydroethanolic extract of *Rheum emodi*. Morphological studies indicated the presence of *Avitellina* tapeworms infection in sheep. Biochemical studies indicated that acid and alkaline phosphatase enzymes showed a marked decline in the *Rheum* extract treated parasites as compared to the normal control group. It was found that treatment of plant extract at all the concentrations caused a marked reduction in the levels of acid and alkaline phosphatases in the immature, mature and gravid segments of *Avitellina*. These diminished activities of the enzymes will lead to inhibition or reduced uptake of nutrients, leading to a loss of motor activity due to deprivation of energy source and thus culminating in paralysis and mortality in the parasite. Hence it can be concluded that hydroethanolic extract of *Rheum emodi* may be a potent option for anthelmintic activity.

Introduction

Helminth infections are quite common in animals and are essential to veterinary health. Their negative effects on health result in higher mortality, particularly among young stock, which lowers asset value. Numerous helminth diseases may be transmitted to man which is a matter of concern, and helminth infections also directly result in economic losses owing to decreased productivity. From the beginning of time, treatment of helminthiasis has been a huge problem in the biomedical field (Aashima *et al.*, 2016). Chemoprophylaxis has been the primary technique of deworming since the 1960s. However, all the chemotherapeutic drugs used for the cure of helminth infection possess several adverse effects and are rather pricey and frequently inaccessible to farmers in rural regions. Therefore, it is necessary to search for new treatment options which exhibit more protective efficacy with negligible toxicity. The effectiveness of many plants as anthelmintics has been investigated. Garlic, Wild ginger, Papaya, Indian mulberry, *Azadirachta indica*, *Ocimum sanctum*, and *Mallotus philippinensis* are already examined for anticestodal action (Jain *et al.*, 2009; Aashima *et al.*, 2016). The present study aims to evaluate the anthelmintic action of *Rheum emodi* against *Avitellina*. *Rheum emodi*, also known as rhubarb, is a perineal thick herb in the polygonaceae family that has been grown for its therapeutic benefits for more than 5000 years. The plant is widely used around the world and is sometimes referred to as "the miraculous medication" due to its numerous medical applications. It showed antibacterial, anticancer, immunomodulatory, antioxidant, wound healing, and antifungal properties (Bilal *et al.*, 2015; Malik *et al.*, 2016).

Materials and Methods

Preparation of Ringer solution

9 g of Sodium chloride, 4.2 g of Potassium chloride and 2.4 g of Calcium chloride were dissolved in 1 liter of double distilled water. The pH of the medium was maintained to 7.3. (Cook and Sharman., 1930)

Collection, processing and treatment of parasite

Live specimens of *Avitellina* were collected from small intestine of sheep in Ringer solution (pH 7.3) from freshly slaughtered hosts at local abattoir at Chandigarh, India. Parasites were washed 3-4 times with Ringer Solution and treated with hydroethanolic extract of *Rheum emodi* for two hours at 37°C. Parasites were divided into five groups. Group I served as untreated control, Group II was treated with Albendazole (25 mg/mL), Group III with hydroethanolic extract of *Rheum emodi* (25 mg/mL), Group IV with hydroethanolic extract of *Rheum emodi* (50 mg/mL), Group V with hydroethanolic extract of *Rheum emodi* (75 mg/mL).

Homogenate preparation

After treatment, parasites were again washed with PBS (Phosphate Buffer Saline). A 10% tissue homogenate was prepared in sodium acetate buffer (125 mM, pH 4.5) for acid phosphatase enzyme and in sodium glycine buffer (125 mM, pH 10.5), for alkaline phosphatase enzyme and centrifuged at 5,000 rpm for 20 minutes at 0 ± 2°C. Supernatant was stored in deep freezer (-20°C) until used for enzyme assays.

Plant Materials

The roots of *Rheum emodi* Wall. ex Meissn was procured from the hilly region of Western Himalayas, India. It was identified and voucher number (2007) of the same was collected from the Botany department, Mata Gujri College, Fatehgarh Sahib. The plant specimens were washed thoroughly with water and dried at room temperature and then powdered.

Preparation Of The Extract

Dried and powdered roots of *Rheum emodi* have been reported to be soluble in 70% ethanol. Thus hydro-ethanol extract was prepared by Soxhlet extraction method. Approximately 250 ml of 70% ethanol was added to 100 g dried and powdered plant specimens in a glass flask. The extract was concentrated under vacuum in a rotary evaporator. The residues obtained was lyophilized and stored at -4°C till further use.

Phytochemical Screening Of Plant Extracts

Qualitative tests were performed to detect various secondary components like alkaloids, saponins, tannins, phenols, diterpenes, triterpenes, flavonoids and glycosides (Anyasor *et al.*, 2013; Kaur *et al.*, 2021).

Estimation of Acid Phosphatase and Alkaline Phosphatase

The activity of Alkaline phosphatase and Acid phosphatase was measured by following the method of Bessay, (1946). All the experiments were carried out in triplicates. The results were expressed as mean $\pm$ standard error of mean.

Results and Discussion

In the present study, hydroethanolic extract of *Rheum emodi* was prepared through Soxhlet extraction and monitored its effect on the helminthic *Avitellina* sp. Phytochemical analysis of the extract was done by various qualitative tests to screen the secondary metabolites. Histological studies were done to monitor the morphological characteristics for the identification of parasites. Biochemical studies were carried out to investigate the effect of hydroethanolic extract of *Rheum emodi* on the acid and alkaline phosphatases.

Phytochemical Screening

The phytochemical analysis revealed that the *Rheum emodi* extract contained phytochemicals like phenols, flavonoids, tannins, terpenoids and alkaloids. Likewise, terpenoids, glycosides, alkaloids, flavonoids, saponins and phenols were also found in *Rheum emodi* preparations, according to Malik *et al.* (2018). However, saponins were found to be absent in the hydroethanolic extract of *Rheum emodi* in the current investigation. Singh and Chaturvedi, (2018) also showed the existence of terpenoids, glycosides, alkaloids, flavonoids, and phenols in addition to the absence of saponins.

Histological studies

In the present study, we investigated the *Avitellina* tapeworm's infection in sheep. Histological studies revealed the presence of Scolex with four suckers, and without hooks. Strobila is thin and narrow. Segments are wider than long. Genital pores are irregularly alternate. Ovarium are close to the uterus and there is single ovary per segment. There is no vitelline gland and shell gland visible. Eggs enclosed in egg-pouches (paruterine organ). Gravid paruterine organs lie centrally in one single line.

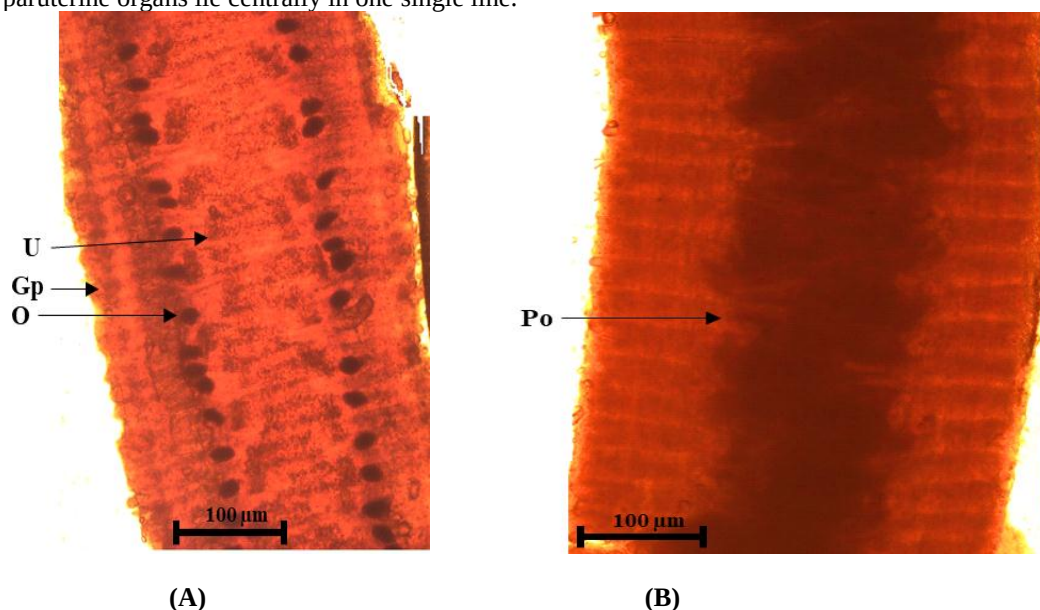


Figure 1. Staining of *Avitellina* spp. (A) Mature proglottid, (B) Gravid proglottid (Scale bar, 100 µm). Gp: Genital pore, Po: Paruterines organs, U: Uterus, O: Ovary

Biochemical Studies

The phosphatases assist directly in the absorption of nutrients and it has been suggested that their presence may be indicative of active transport and is related to extracellular digestion. In the present investigation, acid and alkaline phosphatase enzymes showed a marked decline in the *Rheum* extract treated parasites as compared to the normal control group. It was found that treatment of plant extract at all the concentrations caused a marked reduction in the levels of acid and alkaline phosphatases in the immature, mature and gravid segments of *Avitellina*. These diminished activities of the enzymes will lead to inhibition or reduced uptake of nutrients, leading to a loss of motor activity due to deprivation of energy source and thus culminating in paralysis and mortality of the parasite. Similar findings were made by Chopra *et al.* (1991), who observed that the trematode *Paramphistomum cervi*, a parasite of bovine hosts, was very sensitive to the extracts of *Butea monosperma*, *Embelia ribes*, and *Rottlesia tinctoria*. Similarly, ethanolic root extract of *C. baccans* demonstrated moderate phosphatase activity in the helminthes (Challam *et al.*, 2012). Similar modifications in the aforementioned enzymes have also been seen in *F. buski* after genistein therapy (Roy and Swargiary, 2009).

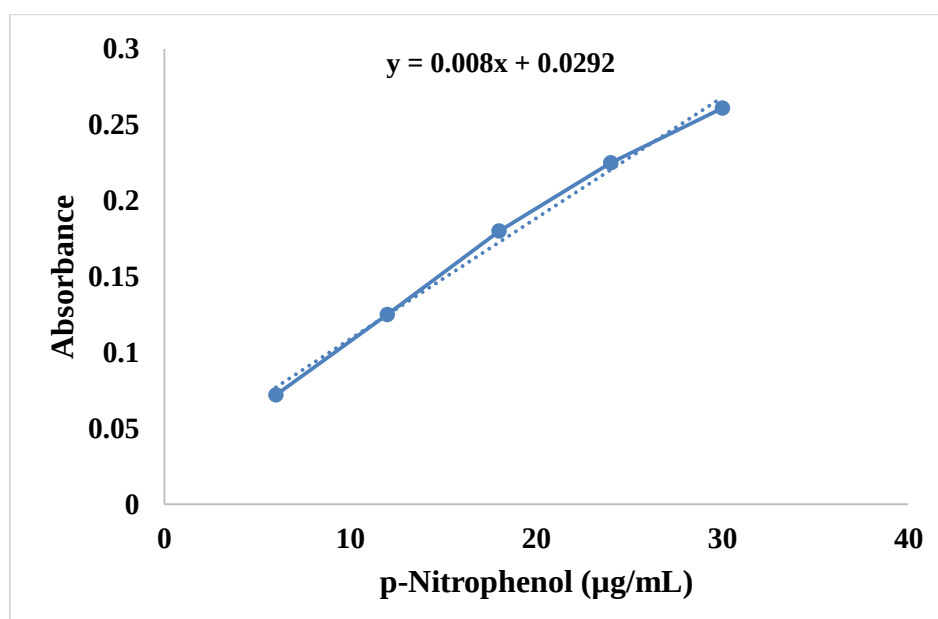


Figure 2. Calibration curve of p-Nitrophenol for acid phosphatase enzyme

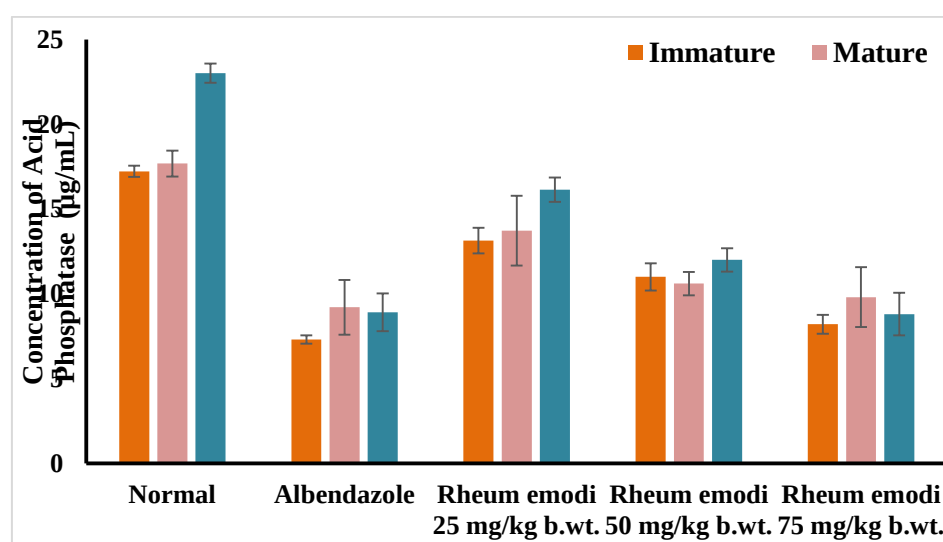


Figure 3. Concentration of acid phosphatase enzyme in the different proglottids of *Avitellina*

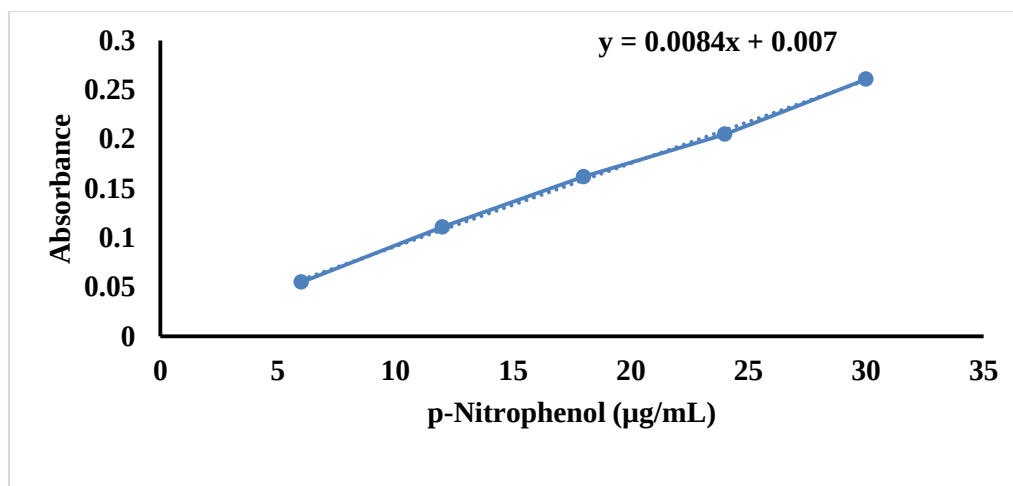


Figure 4. Calibration curve of p-Nitrophenol for alkaline phosphatase enzyme

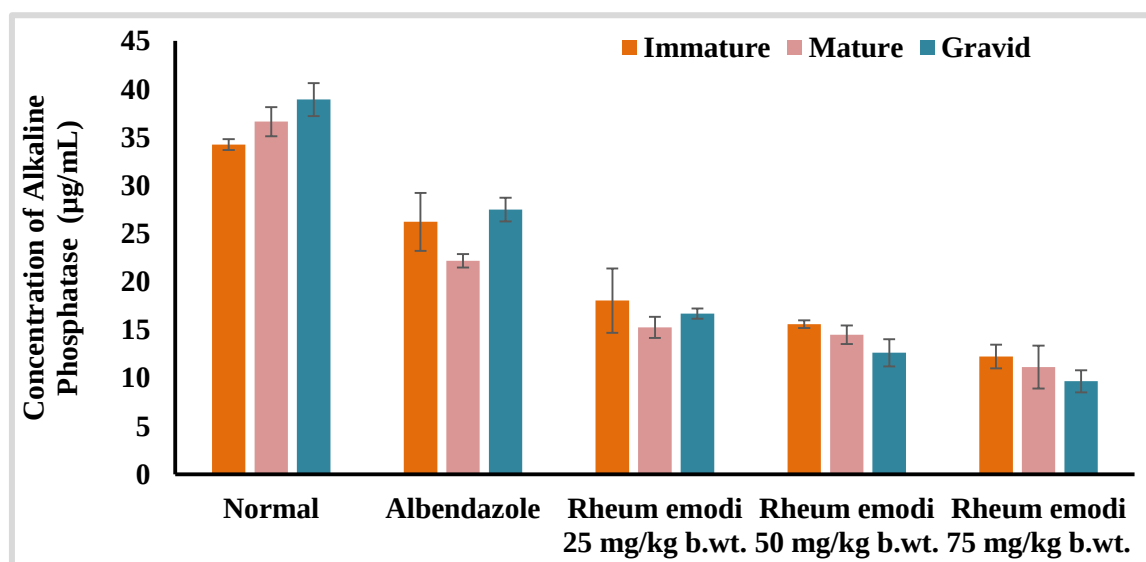


Figure 5. Concentration of alkaline phosphatase enzyme in the different proglottids of *Avitellina*

Conclusion

Rheum emodi might be a promising option for anthelmintic activity and it can be used for the development of new anthelmintic drugs. Further *in vivo* studies are required to authenticate the protective efficacy of *Rheum emodi* against the helminth infections.

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**Impact of Plant Growth Regulators on Physiological, Biochemical Traits and Shelf Life of Guava Fruit
cv. Punjab Pink at Ambient Condition****Mahabir Singh Sandhu, , Dilpeet Kaur, Amandeep Kaur, Prabhjot Kaur , Harpreet Kaur**Department of Agriculture, Sri Guru Granth Sahib World University, Fatehgarh sahib (140407), Punjab,
India mahabirsandhu90@gmail.com**Abstract**

The present investigation was conducted at the Laboratory of Horticulture, Department of Agriculture, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab during the second fortnight of February 2022, to find out the suitable treatment for extending the shelf life of guava. Cultivar Punjab pink, uniform-sized, disease and bruise-free fruits were picked randomly from all periphery of the plants with the help of secateurs at the physiological mature stage and collected in plastic baskets from the orchard of Punjab Agriculture University, Ludhiana, and were immediately transferred to the laboratory of Department of Agriculture, Sri Guru Granth Sahib World University, Fatehgarh Sahib. The experiment consists of 6 treatments, T₁ 2,4-D @ 100 ppm, T₂ Ascorbic acid @ 150 ppm, T₃ NAA @ 200ppm, T₄ IBA @ 100 ppm, T₅ Calcium chloride @ 2%, T₆ Control were used for application on guava fruits. Solutions of the coatings were procured and reportedly dissolved into a few drops of ethyl alcohol with distilled water to make the required concentration in separate beakers care was taken to disinfect the beakers in which the experimental solutions were dry stored. The fruits were dipped for 10 minutes in various plant growth regulators and were surface dried on qualitative filter paper. The coated guava fruits were stored at ambient storage conditions in corrugated fiber boxes filled with cushioning material. The experiment was laid out under **Randomized Block Design** with three replications. The fruits were analyzed after every 4 days at ambient storage conditions up to the last stage of the shelf life of fruits for different physical and biochemical constituents. On the basis of the result obtained in the present investigation, it is concluded that the application of various plant growth regulators may be used for extending the post-harvest shelf life of guava. The treatment T₁-2,4-D @100 ppm has been proven to be the best post-harvest treatment for the farmers to get a more profit by safe storage life of guava cv. Punjab pink with respect to minimum loss in physiological weight (1.06%), minimum decay (44.17%), and highly maintained the size of fruit (34.6 cm), Ascorbic acid (237.85 mg/100g), Further, this treatment also maintained the fruit quality in terms of maximum total soluble solids (9.64°Brix), Acidity(0.21%), total sugars (9.24%), reducing sugar (4.34%), and non-reducing sugar (5.11%) during storage up to 16th day of storage at the ambient room temperature. The treatment T₂ (Ascorbic acid @150 ppm) was found next best treatment in improving the shelf life and quality of fruit.

Keywords: Guava, Punjab pink, shelf life, Calcium Chloride, 2, 4-D, TSS, Vitamin C**Introduction**

Guava (*Psidium guajava* L.) belongs to the family Myrtaceae and fourth most important fruit crop of India. The origin of guava is tropical America and is well-grown in tropical and subtropical regions. Guava is native to tropical America where it occurs wild. According to the NHB of India, it was introduced in India in the seventeen century. It is also known as the “Apple of Tropics”. Different parts of the guava plant are used for different purposes (i.e., fruits and leaves). Manpreet *et al* (2015) Guava plant parts are used for the development of many pharmaceutical products because the guava plant also has medicinal value. Guava fruits are consumed either fresh or processed.

Fruits of guava are not only used for table purposes but are also used in the processing industry for making value-added fruits like jam, jelly, juice, candy, etc. Guava fruit is rich in Vitamin C and pectin content calcium and phosphorus. Guava is pectin enriched fruit that is highly desirable for making jelly. Guava jelly is very popular for its attractive purplish-red color, pleasant taste, and aroma. The puree can be used in juice, cakes, puddings, sauces, ice cream, jam, and jelly. Fruits can be preserved by canning as halves or quarters, with or without seed core (shells). Good quality salad can be prepared from the shell of ripe fruits. Kaur (2016).

India ranks first in guava production in the world followed by Pakistan. The other countries producing guava are Thailand, Indonesia, China, Mexico, Brazil, the Philippines, Bangladesh, and Nigeria. According to the National Horticulture Board of India (2019a), the production area of guava in India is 265 M hectares, and has a production of 4045 MT hectares in 2017-18.

In Punjab guava is mostly cultivated in central regions on a large scale in all districts. It ranks second in cultivation after citrus. The total area for the production of guava is 9580 hectares whereas annual production is 2.16 lakh Anon (2019b). Guava is a climacteric fruit crop. The districts of Patiala, Ludhiana, Sangrur, SAS Nagar, Ferozepur, Jalandhar, Muktsar, Bathinda, Amritsar, and Ropar are well-known for guava production.

2,4-Dichlorophenoxyacetic acid is a synthetic auxin, which is a class of plant growth regulators. It is absorbed through the leaves and is translocated to the meristems of the plant. Indole-3-butyric acid is a plant growth promoter, used to regulate and promote the growth development of flowers and fruit Boora. (2001). Ascorbic acid (AA) is an important antioxidant, it also appears to link flowering time, developmental senescence, programmed cell death, and responses to pathogens. Absciscic acid accelerates senescence. NAA has been shown to greatly increase cellulose fiber formation in plants. The benefits of applying calcium chloride in fruits include maintaining firmness

for extended periods, reducing the activity of the enzymes involved in the softening process, improving the quality decreasing storage breakdown and rots, extending shelf-life, and increasing vitamin C, Singh (1988).

2. Material and Method

The present study entitled “Impact of Plant growth regulators on physiological, bio-chemicals traits and shelf life of the guava fruit cv. Punjab pink at ambient condition” was conducted in the Horticulture Laboratory, Department of Agriculture, Sri Guru Granth Sahib World University, Fatehgarh Sahib during 2022. The details of an experiment conducted with respect to materials used and techniques employed have been described in this report. Punjab pink guava uniform-sized disease and bruise-free guava fruits were picked randomly from all periphery of the plants with the help of secateurs at the physiological mature stage and collected in plastic crates from the orchard of Punjab Agriculture University, Ludhiana, and were immediately transferred to the laboratory of Department of Agriculture, Sri Guru Granth Sahib World University, Fatehgarh Sahib. In the laboratory, the fruits were then sorted, graded, and washed with fresh water and thereafter the fruits were distributed into requisite lots for the experiment consisting of 6 treatments T₁ 2, 4-D 100ppm, T₂ Ascorbic acid 150ppm, T₃ NAA 200ppm, T₄ IBA 100ppm, T₅ CaCl₂ 2% and T₆ Control.

2.1 Preparation of PGRs solutions.

Treatment solutions were prepared of NAA, Ascorbic acid, 2,4-D, CaCl₂ 2, IBA and Hot Water at different concentrations on a percentage weight basis as per the method described by Gahukar (1996). The solution was prepared by adding 1000 ml of distilled water to NAA 200 ppm, Ascorbic acid 150 ppm, 2,4-D 100 ppm, CaCl₂ 2% and IBA 100 ppm of PGRs. An aqueous solution of different treatments was prepared by diluting the various PGRs and inorganic compounds using distilled water.

2.2 PGRs Coatings and storage of fruits.

In the present study, five types of PGRs and inorganic compound coatings viz. NAA, Ascorbic Acid, 2,4-D, CaCl₂ 2, IBA and Hot water were used for application on guava fruits. Coatings of the PGRs were procured and separately dissolved into distilled water to make the required concentration in separate beakers care was taken to disinfect the beakers in which the experimental solutions were stored.

Six treatments with replications of three for each were dipped for 5 minutes in various plant growth regulators and were surface dried. The coated guava fruits were stored at room temperature in ambient storage conditions. The whole experiment was planned as per factorial RBD (Randomized Block Design). The fruits were analyzed after every 4 days at ambient storage conditions up to the last stage of the shelf life of fruits for different physical and bio-chemical constituents according to the A O A C (2000).

4. Results and Discussion

4.1 Physiological parameters

4.1.1 Physiological Loss in Weight

In general, physiological loss in weight increases with the advancement of the storage period under ambient temperature as shown in Table no.1. In the present investigation, the minimum physiological loss in weight (1.06%) on the 16th day during storage was recorded with T₁ 2,4-D @ 100 ppm closely followed by T₂ Ascorbic acid @ 150ppm against the maximum (3.17%) physiological loss in weight under T₆ control. The possible reason for reduced weight loss by chemicals might be due to evaporation and transpiration processes. 2, 4-D extends the shelf life of guava fruit by maintaining their firmness and minimizing respiration rate, proteolysis, and tissue breakdown. It also acts as an anti-senescence agency preventing cellular disorganization by maintaining protein and nucleic synthesis. J.P. Singh, P.C. Singh, and Mitra *et al.* (2012) did similar research on organically grown guava.

Table no. 1: Effect of PGRs and micro nutrients on physiological loss in weight of guava cv. Punjab pink

Treatments	0 days	4 days	8days	12 days	16 days
T ₁ 2,4-D 100ppm	0	0.22	0.6	0.84	1.06
T ₂ ASCORBIC ACID 150ppm	0	0.26	0.63	0.88	1.32
T ₃ NAA 200 ppm	0	0.4	0.7	0.96	2.15
T ₄ IBA 100 ppm	0	0.43	1.61	1.97	2.39
T ₅ CaCl ₂ 2%	0	0.6	1.12	1.26	2.54
T ₆ HOT WATER	0	1.06	1.94	2.49	3.17
C.D.	0	0	0.15	0.01	0.28
SE(m)	0	0	0.05	0	0.09
SE(d)	0	0	0.07	0.01	0.13
C.V.	0	0.03	0.74	0.48	0.73

4.1.2. Spoilage %

The data presented in Table no. 2. indicated that the losses due to decay were observed from the 8th day onwards and found to be increased significantly up to the 16th day of storage. 2, 4-D significantly reduces the rate of fruit decay which is 44.17. Fresh fruit contains cannot replace carbohydrates or water after harvest. Respiration uses stored starch or sugar and will stop when reserves of these are exhausted; aging follows and the procedure dies and decays; 2,4-D has merit in reducing spoilage of guava fruit and have a positive role in delaying the senescence. Similar research was done by Manpreet Kaur and Bakshi (2019).

4.1.3. Fruit size

Fruit size decreases up to the 16th day. In T₁ 2, 4-D @ 100 ppm, the maximum rating on the 16th day is 34.5 which is the best overall treatment, while the minimum is 24.2 in T₅ CaCl₂ as shown in Table no. 10. In guava fruit size due to treatment with T₂ (2, 4-D 100 ppm) might be the effect of improved inner physiology during development which encouraged efficient utilization of various resources and dynamic compounds. while the minimum is 0 in T₅ (CaCl₂ 2%) and T₆ control. Similar research was done by Manpreet Kaur and Bakshi (2019).

Table no. 2: Effect of PGRs and micro nutrients on the spoilage of guava cv. Punjab pink

Treatments	0 days	4 days	8days	12 days	16 days
T ₁ 2,4-D 100ppm	0	0	0	13.42	44.17
T ₂ ASCORBIC ACID 150ppm	0	0	19.55	24.37	47.28
T ₃ NAA 200 ppm	0	0	21.44	34.56	51.84
T ₄ IBA 100 ppm	0	9.54	47.27	69.85	84.13
T ₅ CaCl ₂ 2%	0	15.22	63.86	100	100
T ₆ HOT WATER	0	12.74	51.35	76.1	100
C.D.	0	0.04	0.47	0.74	2.19
SE(m)	0	0.13	0.15	0.23	0.68
SE(d)	0	0.18	0.21	0.32	0.97
C.V.	0	0.34	0.75	100	1.67

4.1.4. Organoleptic rate

Organoleptic rating decreases up to the 16th day shown in Table no. 4. It involves the assessment of the odour, appearance, and flavor of the fruit. We observe the odorous and appearance of the fruit; the color changes from green to pale yellow and brownish; a foul smell develops on the 12th day. In T₁ 2,4-D @ 100 ppm, the maximum rating on the 16th day is 7.12 which is the best overall treatment. Similar results was observed by Hiwale, S S and Singh, S P (2003).

Table no. 3: Effect of PGRs and micro nutrients on fruit size of guava cv. Punjab pink

Treatments	0 days	4 days	8days	12 days	16 days
T ₁ 2,4-D 100ppm	38.1	37.8	34.6	35.81	34.55
T ₂ ASCORBIC ACID 150ppm	38.1	36.1	36.6	32.9	30.99
T ₃ NAA 200 ppm	38.1	36	36.2	34.8	34.6
T ₄ IBA 100 ppm	38.1	35	36.3	35.1	34.28
T ₅ CaCl ₂ 2%	38.1	34.5	36.5	28.2	24.24
T ₆ HOT WATER	38.1	37.3	0.27	35.3	34.32
C.D.	0	0.26	0.09	0.18	0.27
SE(m)	0	0.08	0.12	0.06	0.09
SE(d)	0	0.11	0.42	0.08	0.12
C.V.	0	0.38	36.5	0.29	0.46

4.1.5. Fruit color

The readings of fruits' color were taken as per the hedonic scale. The fruit color scale first inclined up to the 8th day and decreases up to the 16th day. The reason is that unripe fruits are green because of chlorophyll in their cells. As they ripen, chlorophyll breaks down and is replaced by orange carotenoids and red anthocyanin. But it remains highest in T₁ 2, 4-D 100 ppm which is 5.8 and is lowest in T₅ CaCl₂ 2% which is 0 shown in Table no. 12. Similar research was done by Mitra SK, Devi HL, Chakraborty I, and Pathak PK. (2012).

Table no. 4: Effect of PGRs and micronutrients on fruit color of guava cv. Punjab pink

Treatments	0 days	4 days	8days	12 days	16 days
T ₁ 2,4-D 100ppm	8.89	8.3	10.13	5.8	5.8
T ₂ ASCORBIC ACID 150ppm	8.89	7.82	9.34	4.92	4.92
T ₃ NAA 200 ppm	8.89	7.15	9.24	4.14	4.14
T ₄ IBA 100 ppm	8.89	6.23	9.17	0	0
T ₅ CaCl ₂ 2%	8.89	6.17	8.46	0	0
T ₆ HOT WATER	8.89	6.67	8.94	3.11	3.11
C.D.	0.07	0.06	0.12	0.29	0.29
SE(m)	0.02	0.02	0.04	0.09	0.09
SE(d)	0.03	0.02	0.05	0.13	0.13
C.V.	0.41	0.43	0.72	0.52	0.52

4.2. Biochemical parameters

4.2.1. TSS (Brix⁰)

Data in table no. 5. presented that TSS first increased and then start to decline in total soluble solids content during storage in all the treatments including control. Among treatments, T₁ 2, 4-D @ 100 ppm recorded maximum TSS content (9.64 °Brix), whereas minimum (0°Brix) under T₅ CaCl₂ @ 2% and T₆ control respectively at the end of the storage period. The increase in TSS may be attributed to the conversion of starches and other polysaccharides into soluble forms of sugar. Both the control and treated fruits showed a gradual decrease in respiration rate during the storage period, but the respiration rate in 2, 4-D treated fruits. The subsequent decrease in TSS at the advanced stage is owing to an increased rate of respiration. Similar research was done by Ajay Gangle and Pandey (2019) and Manpreet Kaur and Bakshi (2019). Similar improvement and retention of TSS have also been reported with Calcium nitrate by, Rajput *et al.*, (2008) in guava.

Table no. 5: Effect of PGRs and micro nutrients on TSS of guava cv. Punjab pink

Treatments	0 days	4 days	8days	12 days	16 days
T ₁ 2,4-D 100ppm	9.34	11.34	12.56	11.147	9.64
T ₂ ASCORBIC ACID 150ppm	9.34	10.94	11.75	10.94	9.45
T ₃ NAA 200 ppm	9.34	10.14	10.84	10.44	8.45
T ₄ IBA 100 ppm	9.34	10.07	9.68	9.23	8.11
T ₅ CaCl ₂ 2%	9.34	9.12	7.66	0	0
T ₆ HOT WATER	9.34	9.84	9.54	0	0
C.D.	0.12	0.06	0.07	0.04	0.38
SE(m)	0.04	0.02	0.02	0.13	0.12
SE(d)	0.05	0.03	0.03	0.18	0.17
C.V.	0.07	0.31	0.39	0.31	0.34

4.2.2. Acidity (%)

The data in table no. 5. indicated that a gradual and progressive decrease in acidity was observed under all the treatments during storage and this progressive decline might be due to the utilization of acid in metabolism. The maximum (0.21%) acidity during storage was observed in fruits treated in 2,4-D@ 100 ppm followed by T₂ Ascorbic acid @ 150 ppm (0.19%) and T₃ NAA @ 200 ppm (0.16 %) against the minimum (0%) under T₅ CaCl₂ and control. Similar research was done by Ajay Gangle and Pandey (2019) in guava. The decrease in acidity with calcium nitrate has also been reported by Sandeep Kaur and Imaret Kaur (2009).

Table no. 6: Effect of PGRs and micro nutrients on titratable acidity of guava cv. Punjab pink

Treatments	0 days	4 days	8days	12 days	16 days
T ₁ 2,4-D 100ppm	0.38	0.32	0.28	0.24	0.21
T ₂ ASCORBIC ACID 150ppm	0.38	0.31	0.26	0.23	0.19
T ₃ NAA 200 ppm	0.38	0.29	0.24	0.2	0.16
T ₄ IBA 100 ppm	0.38	0.25	0.18	0.15	0.11
T ₅ CaCl ₂ 2%	0.38	0.22	0.12	0	0
T ₆ HOT WATER	0.38	0.23	0.15	0	0
C.D.	0	0	0	0.01	0.06
SE(m)	0	0	0	0.03	0.02
SE(d)	0	0	0	0.04	0.03
C.V.	0.61	0.06	0.68	3.77	2.79

Table no. 7: Effect of PGRs and micro nutrients on TSS: Acidity of guava cv. Punjab pink

Treatments	0 days	4 days	8days	12 days	16 days
T ₁ 2,4-D 100ppm	24.75	35.52	44.85	46.45	45.9
T ₂ ASCORBIC ACID 150ppm	24.75	35.38	45.19	47.56	49.73
T ₃ NAA 200 ppm	24.75	35.07	45.16	52.2	49.7
T ₄ IBA 100 ppm	24.75	40.44	53.77	61.53	67.58
T ₅ CaCl ₂ 2%	24.75	42.99	63.6	0	0
T ₆ HOT WATER	24.75	41.67	63.83	0	0
C.D.	0.21	1.31	0.34	0.48	0.36
SE(m)	0.07	0.41	0.11	0.15	0.11
SE(d)	0.09	0.58	0.15	0.21	0.16
C.V.	0.46	1.84	63.83	0.75	0.55

4.2.3. TSS/Acid ratio

The data indicated in table no. 7. that the TSS/acid ratio increased with the advancement of the storage period up to the 16th day of storage. The minimum TSS/Acid ratio of 0 was observed with the treatment T₅ and T₆. The maximum TSS/Acid ratio of 49.73 was recorded in T₂ Ascorbic acid. These results are in accordance with the findings of Agnihotri *et al* (2013) in guava cv. Chittidar.

4.2.4. Total sugars (%)

Recent studies indicated that the total sugar increased till the 8th day with the storage time. This trend was seen in all the treated fruits of guava cv. Punjab pink also. The rise in total sugars may be due to water loss from fruits through evapotranspiration and inhibition of activities of enzymes responsible for the degradation of sugars. Sugars increased to the end during the storage period. Fruits treated with T₁ 2,4-D 100 ppm recorded the highest total sugar content (9.24%) and lower total sugar content (0%) observed in T₅ and T₆ on the 16th day of storage shown in table 4. This may be due to the slow hydrolysis of starch to sugars and the gradual build-up of sugars in 2, 4-D treated fruits may also be attributed to retarded ripening. Similar research was done by Ajay Gangle and Pandey (2019) and Manpreet Kaur and Bakshi (2019).

Table no 8: Effect of PGRs and micro nutrients on total sugar of guava cv. Punjab pink

Treatments	0 days	4 days	8days	12 days	16 days
T ₁ 2,4-D 100ppm	8.02	9.25	10.13	9.68	9.24
T ₂ ASCORBIC ACID 150ppm	8.02	9.26	9.34	9.15	9.12
T ₃ NAA 200 ppm	8.02	9.19	9.24	9.11	9.04
T ₄ IBA 100 ppm	8.02	9.13	9.17	9.06	8.83
T ₅ CaCl ₂ 2%	8.02	8.12	8.46	0	0
T ₆ HOT WATER	8.02	8.79	8.94	8.47	0
C.D.	0	0.05	0.12	0.23	0.29
SE(m)	0	0.02	0.04	0.07	0.09
SE(d)	0	0.02	0.05	0.01	0.13
C.V.	0	0.33	0.72	0.16	0.26

4.2.5. Reducing sugars (%)

The data indicated in table no. 9. that the different chemicals showed a significant effect on the accumulation of reducing sugar. The significantly maximum reducing sugar 9.24, 4.55, 4.62, 4.47, and 4.34 was observed with T₁ 2,4-D @ 100 ppm at 0,4,8,12 and 16 days of the storage period, respectively. Whereas, the minimum reducing sugars percentages of 0, 4.54, 3.29, 0, and 0 were recorded under T₅ CaCl₂ at 0, 4, 8, 12, and 16 days of storage, respectively. The increase of reducing sugar content by 2, 4-D application might be due to the less utilization of sugar in respiration and conversion of starch into sugar, while the subsequent decline was perhaps due to the onsite motion of sugar for respiration during storage. Similar findings had also been reported by Kaur Parambir (2016) and Jatinder *et al.*, (2017).

4.2.6. Non-reducing sugars (%)

The data indicated in table no. 10. that the non-reducing sugar was found to significantly maximum with T₂ NAA@ 200 ppm i.e. 5.3 percent on the 16th day of the storage period, respectively. The increase in non-reducing sugar during storage was due to the conversion of starch into sugar. The findings obtained in the present investigation can be compared to those obtained by Singh G (1988) did some research on guava.

Table no. 9: Effect of PGRs and micro nutrients on reducing sugar of guava cv. Punjab pink

Treatments	0 days	4 days	8days	12 days	16 days
T ₁ 2,4-D 100ppm	9.24	4.55	4.62	4.47	4.34
T ₂ ASCORBIC ACID 150ppm	9.12	4.43	4.58	4.33	4.07
T ₃ NAA 200 ppm	9.04	4.39	4.52	4.29	3.93
T ₄ IBA 100 ppm	8.83	4.37	4.48	3.82	3.74
T ₅ CaCl ₂ 2%	0	4.54	3.29	0	0
T ₆ HOT WATER	0	4.35	3.69	3.78	0
C.D.	0.29	0.02	0.04	0.23	0.29
SE(m)	0.09	0.01	0.01	0.07	0.09
SE(d)	0.13	0.01	0.02	0.01	0.13
C.V.	0.26	0.26	0.54	0.35	0.58

Table no. 10: Effect of PGRs and micro nutrients on non-reducing sugar of guava cv. Punjab pink

Treatments	0 days	4 days	8days	12 days	16 days
T ₁ 2,4-D 100ppm	4.65	4.92	5.74	5.43	5.11
T ₂ ASCORBIC ACID 150 ppm	4.65	5.52	4.98	5.03	5.24
T ₃ NAA 200 ppm	4.65	5.02	4.94	5.03	5.3
T ₄ IBA 100 ppm	4.65	4.97	4.91	5.43	5.27
T ₅ CaCl ₂ 2%	4.65	3.8	5.33	0	0
T ₆ HOT WATER	4.65	4.65	5.43	4.87	0
C.D.	0.04	0.05	0.05	0.01	0.04
SE(m)	0.01	0.02	0.02	0	0.01
SE(d)	0.02	0.02	0.02	0	0.02
C.V.	0.05	0.58	0.51	0.13	0.65

4.2.7. Ascorbic acid (mg/100g)

The data indicated in table no. 11 that the ascorbic acid content initially increases and starts to decrease under all the treatments with the advancement of the storage period. At the end of the storage period, the maximum (237.85 mg/100 g) ascorbic acid significantly decreased by the treatment T₁ 2, 4-D and the minimum (0 mg/100 g) ascorbic acid was observed in T₅ CaCl₂ and T₆ control. This might be a result of the continued synthesis of L- ascorbic acid from its precursor glucose- 6- phosphate and the additive effect of slow rate oxidation in the respiration process. Similar research was done Saha AK (1971).

Table no. 11: Effect of PGRs and micro nutrients on ascorbic acid of guava cv. Punjab pink

Treatments	0 days	4 days	8days	12 days	16 days
T ₁ 2,4-D 100ppm	244.6	258.87	267.49	262.74	237.85
T ₂ ASCORBIC ACID 150ppm	244.6	252.68	265.94	257.51	229.12
T ₃ NAA 200 ppm	244.6	249.61	257.35	248.74	218.65
T ₄ IBA 100 ppm	244.6	246.57	256.27	244.81	211.23
T ₅ CaCl ₂ 2%	244.6	249.19	205.31	0	0
T ₆ HOT WATER	244.6	242.49	253.43	209.97	0
C.D.	0.27	0.29	0.32	0.11	0.67
SE(m)	0.86	0.93	0.1	0.35	0.21
SE(d)	0.12	0.13	0.14	0.49	0.29
C.V.	0.61	0.64	0.71	0.29	0.24

Conclusion

The collected data on various parameters were statistically analyzed. The experiment was continued for 16 days from sample collection. In the case of different treatments for increasing shelf life, T₁ (2,4-D) gave the best performance for all the parameters studied compared to control Guava treated with T₁ (2,4-D) gave the lowest total weight loss (1.06 %), the highest TSS (9.64%) where control treatment gave the lowest performance with this regard. Considering shelf life, T₁ (2,4-D) showed the highest result 16 days where T₅ CaCl₂ showed only 12 days of shelf life. After T₁ 2,4-D, T₂ Ascorbic acid @150 ppm showed good performance where TSS (9.45%), acidity (0.19 %) and second highest total sugar (9.12%), physiological weight loss (1.32%), and other parameters. On the basis of the present investigation, it can be concluded that under ambient storage Conditions, T₁ 2,4-D @100 ppm showed a minimum physiological loss in weight. A quality parameter was also affected by the treatment and storage conditions. T₁ 2,4-D @ 100 ppm was desirable to maintain higher total soluble solids and total sugar. Maximum acidity was noted in 2,4-D @100ppm. The shelf life of stored fruits under ambient storage conditions was less than 15 days.

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Characterization of Transgenic Chickpea Populations For Cry1ac Presence and Their Agronomic Evaluation

Manisha Rani, Bhavya Prashar, Gurleen Kaur, Ajinder Kaur, Ruchika Bharti, Sarvjeet Singh, Shayla Bindra, Ravinder Singh

School of Agricultural Biotechnology, Punjab Agricultural University, Ludhiana 141004

manisha-2069021@pau.edu

Abstract

Chickpea (*Cicer arietinum* L.) is the third largest pulse crop consumed worldwide with high protein content. Its production is restricted by biotic factors, like gram pod borer *Helicoverpa armigera*, a lepidopteran insect, which is a highly polyphagous multivoltine insect and causes up to 90% of crop yield losses. It is challenging to control gram pod borer since chickpea germplasm lacks resistance against the insect or if the resistance is present in a related species, there is cross-incompatibility issue. Genetic transformation can be used to develop transgenic lines having genes for insect resistance, such as cry1Ac for resistance against pod borer; the transgene can later be transferred to elite cultivars through Marker Assisted Breeding. In this study, transgenic chickpea populations, viz., BC1F4, BC1F5, F6, and F7 populations derived from different cross combinations between commercial cultivars (PBG 7 and L 552) and pod borer resistant transgenic lines (BS 100B and BS 100E) were characterized for presence of cry1Ac gene. Out of 84 lines, 19 (9, 11, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 25, 40, 52, 69, 71 and 72) showed presence of cry1Ac gene and less pod borer damage as compared to the recipient parents PBG 7 and L 552. The populations were also assessed for different agronomic traits. On evaluation, sixteen lines (9, 11, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 25, 40 and 52) were found to be significantly better than both the parents for important traits, number of pods per plant and total seed yield, while the remaining three lines 69, 71 and 72 had significantly more number of seeds per 10 pods, 100- seed weight and total seed yield as compared to parents.

Introduction

Chickpea is a widely cultivated pulse crop throughout the world. It belongs to family Leguminosae. The crop is known as poor man's meat as its seeds contain high amounts of protein, calcium, iron and dietary fibre. Chickpea is a winter loving, herbaceous annual crop having multitude of uses, such as consumption as cooked whole seeds *daal*, split *daal*, green seeds, roasted seeds, flour or as feed to farm animals. Its production is affected by different biotic stresses, amongst which *Helicoverpa armigera* is the major pest of chickpea all over the world (Gayathri et al., 2021). It is a lepidopteran polyphagous insect that has migratory behaviour, adapt to different agro climactic conditions easily and develop resistance against insecticides (Kambrekar et al., 2009). The caterpillar feeds on tender leaves and developing seeds by making holes in the pods. In India, average yield losses due to gram pod borer were reported to be 10% to 60%, whereas under favourable weather conditions, 100% yield loss was recorded (Srivastva et al., 2002).

It is challenging to control gram pod borer since insecticides are not cost effective and conventional breeding is hindered as cultivated chickpea germplasm lacks insect resistance, and the related species possessing resistance are cross-incompatible with the cultivated species. In this situation, genetic transformation can be used to develop transgenic lines using pod borer resistance genes, such as *cry1Ac*; the transgene can later be precisely transferred to elite cultivars through marker assisted breeding (Kaur et al., 2022). Four transgenic chickpea populations (BC1F4, BC1F5, F6 and F7) derived from different cross combinations between pod borer susceptible commercial cultivars (PBG 7 and L 552) and *cry1Ac* carrying pod borer resistant transgenic lines (BS 100B and BS 100E: procured from Dr. BK Sarmah, DBT-Assam Agricultural University Centre, AAU, Jorhat) were available at Experimental Area of Pulses, Department of Plant Breeding & Genetics, PAU, Ludhiana. The populations were developed with the sole aim to transfer pod borer resistance in the commercial cultivars. The present study describes the characterization of transgenic populations for the presence of *cry1Ac* gene through PCR using gene specific primers along with assessment of PCR positive lines for agronomic traits.

Material and Methods

Plant Material

The plant material comprising of transgenic chickpea populations (91 lines in total) is given in Table 1.

Table 1: Different transgenic chickpea populations grown during *rabi* 2021

Line no.	Generation	Cross
1-10	BC ₁ F ₄	(PBG 7 × 100B) × PBG 7
11-48	BC ₁ F ₅	11-27: (L 552 × 100B) × L 552 28-48: (PBG 7 × 100B) × PBG 7
49-58	F ₆	PBG 7 × 100E
59-91	F ₇	59-64: PBG 7 × 100B
		65-67: L552 × 100E 68-91: (PBG 7 × 100B) × PBG 7

DNA Extraction and Quantification

DNA from young leaf twigs of three plants in each line was extracted using the protocol of Murray and Thomson (1980), and quantified using Nano drop spectrophotometer and 0.8% (w/v) agarose gel electrophoresis. The presence of clear amplicons showed good quality DNA, whereas, smear represented DNA degradation.

Foreground Selection for *cry1Ac*-Positive Plants

In order to identify lines carrying *cry1Ac* gene, DNA of these lines was subjected to foreground selection using *cry1Ac* specific primers (forward: 5'-TAT CTT TGG TCC ATC TCA ATG GG-3' and reverse: 5'-GTG TCC AGA CCA GTA ATA CTC-3'). PCR reaction mixture (13.0 µl) comprised of 2.0 µl template DNA, 1.0 µl of forward and reverse primer each, 6.0 µl of PCR master mix (Takara Bio Inc., Japan), 0.5 µl of BSA and PVP each and

2.0 µl of nuclease free water. Thermocycler conditions for amplification of the desired gene was programmed as per Kaur et al. (2022). The amplicons were visualized using 2.5% agarose gel electrophoresis.

Assessment of Important Agronomic Traits

Observations were recorded on days to 50% flowering, number of primary branches, plant height, number of pods per plant, number of seeds per 10 pods, total number of seeds per plant, 100-seed weight, total seed yield. The mean ± standard deviation was calculated for different traits; the lines performing significantly better than both the parents for different traits and showing no or minimal insect damage as compared to recurrent parent (PBG7 or L552) were identified.

Results and Discussion

Foreground selection was carried out on four transgenic chickpea populations (BC₁F₄, BC₁F₅, F₆ and F₇) through PCR using *cry1Ac* specific primers. The selection on BC₁F₄ population revealed the presence of *cry1Ac* gene in one (line no. 9) out of 10 lines (Fig. 1). The agronomic evaluation revealed that line no. 9 had significantly higher number of pods per plant, number of seeds per 10 pods, total number of seeds, 100-seed weight and total biological yield than both the parents, PBG 7 and 100B (Table 2). Gaur et al. (2018) also reported promising introgression lines developed through backcrossing that exhibited significantly higher yield than the parents and popular cultivars.

Foreground selection in BC₁F₅ populations derived from two crosses, (L 552 × 100B) × L 552 and (PBG 7 × 100B) × PBG 7, detected *cry1Ac* amplification in 13 (line no. 11, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 25) out of 17 lines, and one (line no. 40) out of 20 lines, respectively. The agronomic assessment displayed that these lines performed significantly better than the respective parents for important traits, like number of pods per plant and total seed yield (Table 2).

In F₆ population, out of 10 lines, one (line no. 52) tested positive for *cry1Ac* gene (Fig. 1) and was found to be significantly better than the parents, PBG 7 and 100E for number of pods per plant and total seed yield (Table 2). Kumar and Bahl (1992) also documented that 16 out of 250 F₆ chickpea lines significantly out yielded the parents and checks for different agronomic traits.

Three lines belonging to F₇ population [68-91: (PBG 7 × 100B) × PBG 7], namely line no. 69, 71 and 72, were found to be positive for *cry1Ac* gene (Fig. 1) and significantly better than the parents (PBG 7 and 100B) for number of pods per plant, number of seeds per 10 pods, total number of seeds, 100-seed weight and total biological yield (Table 2). Singh et al. (2005) documented that 22 introgressed chickpea lines belonging to BC₁F₅, F₆ and F₇ generations outperformed the parents for number of pods per plant and total seed yield.

It was also observed that the number of pods damaged due to pod borer attack was less in the

lines showing *cry1Ac* amplification as compared to number of pods damaged in parents, L 552 and PBG 7. Sanyal et al (2005) and Mehrotra et al (2011) also reported that the plants having transgene (*cry1Ac*) showed less pod and leaf damage as compared to non-transformed control plants. The identified lines are valuable source of resistance to pod borer and can be used in chickpea breeding programs.

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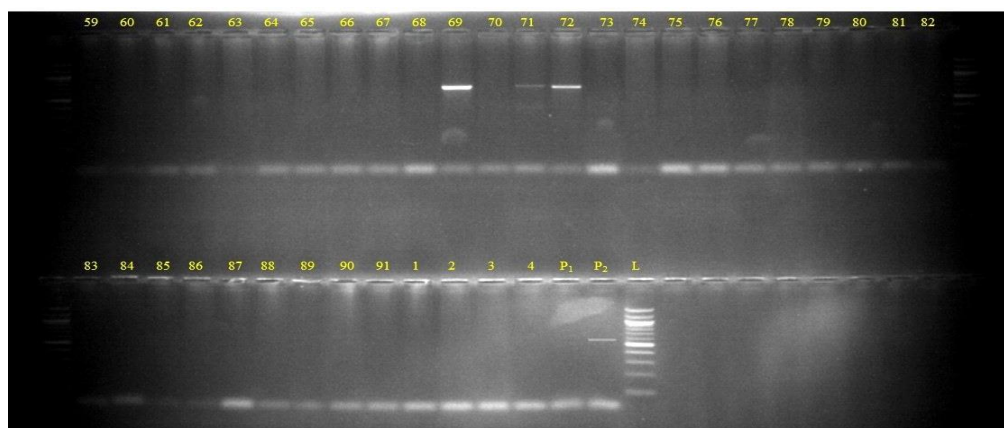


Fig. 1: Representative gel showing amplification of *cry1Ac* gene in F7 population derived from (PBG 7 × 100B) × PBG 7
Table 2: Agronomic traits of PCR positive transgenic chickpea populations derived from crosses between commercial chickpea cultivars and transgenic lines

S. no.	Line no.	Days to 50 % flowering	Number of primary branches per plant	Plant height (cm)	Number of pods per plant	Number of seeds per plant	100-seed weight (g)	Number of seeds per 10 pods	Total seed yield (g)
BC1F4 population derived from (PBG7 × 100B)									
1	9	119	4.00 ± 1.58	49.55 ± 1.12	106.20 ± 7.63	201.40 ± 20.49	11.28 ± 1.73	20.84 ± 1.13	24.97 ± 1.44
BC1F5 population derived from (L552 × 100B)									
2	11	120	4.50 ± 1.29	46.50 ± 2.34	95.75 ± 7.41	163.25 ± 49.46	12.48 ± 5.74	16.93 ± 4.27	20.37 ± 4.68
3	12	121	5.33 ± 0.58	50.40 ± 0.73	117.33 ± 2.52	234.00 ± 25.00	11.05 ± 6.19	19.92 ± 1.71	25.86 ± 5.2
4	13	116	3.20 ± 0.84	48.17 ± 1.59	95.40 ± 5.59	191.40 ± 12.40	12.73 ± 2.07	20.09 ± 1.19	24.37 ± 2.1
5	14	116	5.40 ± 0.89	47.19 ± 2.79	113.80 ± 7.73	227.60 ± 16.74	13.59 ± 1.78	20.00 ± 0.61	30.93 ± 1.59
6	15	119	4.33 ± 1.15	40.8 ± 1.56	110.67 ± 22.37	223.00 ± 51.47	12.13 ± 4.47	20.07 ± 0.65	27.05 ± 4.01
7	16	120	5.20 ± 0.84	48.56 ± 1.64	104.00 ± 5.34	205.40 ± 16.09	11.12 ± 2.29	19.74 ± 1.02	22.84 ± 2.19
8	19	115	5.80 ± 1.30	48.82 ± 1.45	124.20 ± 19.33	251.60 ± 23.27	13.84 ± 2.24	20.41 ± 1.43	34.82 ± 2.14
9	20	116	5.25 ± 0.96	50.51 ± 0.87	123.50 ± 14.82	238.75 ± 44.30	11.10 ± 3.81	19.23 ± 1.32	26.50 ± 3.55
10	21	116	6.00 ± 1.41	47.00 ± 0.26	96.50 ± 3.54	190.00 ± 7.07	12.44 ± 0.93	1.69 ± 0.01	23.64 ± 0.73
11	22	124	4.00 ± 1.73	49.55 ± 1.78	104.33 ± 10.02	209.33 ± 28.94	11.99 ± 3.04	20.01 ± 0.96	25.10 ± 2.92
12	23	120	5 ± 0	49.67 ± 0	124 ± 0	237.00 ± 0	11.86 ± 0	19.11 ± 0	28.11 ± 0
13	24	125	4 ± 0	50.84 ± 0	137 ± 0	279.00 ± 0	11.54 ± 0	20.36 ± 0	32.19 ± 0
14	25	125	5.00 ± 1.41	46.39 ± 1.73	112.00 ± 8.49	230.00 ± 15.56	12.95 ± 1.50	20.54 ± 0.17	29.78 ± 0.34
BC1F5 population derived from (PBG7 × 100B)									
15	40	129	6.25 ± 0.96	53.35 ± 1.01	114.00 ± 5.94	201.00 ± 13.64	12.31 ± 1.06	17.62 ± 0.52	24.74 ± 1.23
F6 population derived from (PBG7 × 100E)									
16	52	129	7.00 ± 1.00	52.61 ± 3.26	101.33 ± 12.74	198.67 ± 11.68	11.09 ± 0.70	19.92 ± 1.62	22.03 ± 0.91
F7 population derived from (PBG7 × 100B)									
17	69	123	4.00 ± 1.73	65.33 ± 1.55	74.67 ± 10.02	154.00 ± 14.18	13.30 ± 2.08	20.71 ± 1.13	20.48 ± 1.97
18	71	116	3.50 ± 1.29	60.66 ± 4.93	85.25 ± 11.35	163.50 ± 26.11	12.50 ± 2.46	19.14 ± 1.14	20.44 ± 2.31
19	72	116	3 ± 0	61.95 ± 0	87 ± 0	184 ± 0	11.43 ± 0	21.15 ± 0	21.03 ± 0
Parents									
20	PBG7	85	7 ± 1.22	56.2 ± 2.24	84 ± 11.52	149 ± 22.48	13.36 ± 2.50	19 ± 1.89	19.90 ± 2.1
21	100B	110	4 ± 1.53	38.6 ± 1.88	57 ± 9.81	65 ± 19.31	9.61 ± 2.90	9 ± 2.23	6.25 ± 2.4
22	L552	89	6 ± 0.99	51.3 ± 2.54	108 ± 10.27	122 ± 25.41	12.42 ± 2.14	17 ± 1.85	15.15 ± 2.34
23	100E	107	3 ± 1.48	41.7 ± 3.22	57 ± 13.57	72 ± 18.53	10.61 ± 3.1	10 ± 1.61	9.64 ± 2.8

Data on populations are based on three plants phenotypically similar to recurrent parent and presented as mean ± SD

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**Review on the Use of Indigenous Plants of North India for The Control of Pests of Genus
*Callosobruchus******Monika Airi, *Charan Kamal Sekhon, **Priyanka Khera****Assistant Professor, ** Research Scholar, Department of Zoology, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab**monika_airi@yahoo.co.in, drcks31@gmail.com, Priyankakhera500@gmail.com***Abstract**

In North India, where the bulk of crop is cultivated, stored and consumed, the store bruchid pests of genus *Callosobruchus* namely *Callosobruchus maculatus*, *Callosobruchus analis* and *Callosobruchus chinensis*, pose a major threat to the stored grains. To get rid of these pests, farmers mainly rely on the use of synthetic pesticides, but their indiscriminate use has led to several problems like, environmental degradation and health related issues. Therefore, now the focus has shifted to the use of various indigenous plants such as *Azadirachta indica*, *Nerium indicum*, *Allium sativum*, *Curcuma longa*, *Citrus sinensis*, *Piper nigrum*, *Brassica campestris*, *Citrus limon*, *Lycopersicum esculentum*, *Murraya koenigii*, *Eucalyptus* etc. against these pests. These plants and their products act as promising alternatives to chemical insecticides which contribute to the reduction in pesticide load in the environment and also reduce various health problems. These plant products in the form of extracts, powders and oils yielded best results for insecticidal activity, oviposition deterrence, feeding deterrence, adult emergence, ovicidal, larvicidal and pupaecidal activity. This article aims to provide comprehensive review of various North Indian plants that are being used as herbal toxicants against pest of genus *Callosobruchus* as they have potential to control their population to a significant level.

Introduction

Agriculture is major occupation of people living in North Indian plains of Arunachal Pradesh, Assam, Bihar, Haryana, Punjab, Rajasthan, Uttar Pradesh and West Bengal. The major part of harvested crops is stored either for transportation to other parts of country or for further utilization. During storage, the various factors such as seed quality, temperature, moisture content, crop variety, insect pests, bacterial and fungal infections etc. affect the quality of grains and thus cause heavy economic loss to the farmers. Among these factors, maximum damage to the store grains is caused by insect pests (GC 2006) of family bruchidae.

Among the members of family bruchidae, the species belonging to genus *Callosobruchus* of subfamily bruchinae are the major pests of store grains as they cause extensive damage to these grains and hence are responsible for great losses to farmers (Bhalla *et. al* 2008, Thakur *et. al* 2012 and Ojo *et. al* 2013). The most common species of genus *Callosobruchus* reported so far from India are *C. analis* (F.), *Callosobruchus cajanis*, *Callosobruchus chinensis* (L.), and *C. maculatus* (F.), *Callosobruchus phaseoli* and *Callosobruchus theobromae* (L.). Out of the six *Callosobruchus* species, three species namely *C. maculatus*, *C. analis* and *C. chinensis* are the serious pest of store grains in North India. They are commonly called as pulse beetles or beab beetles (Alam 1971, Pajni and Gupta 2012).

Their major hosts of these bruchids include wide species of legume plants viz., *Vigna unguiculata* L. (Cowpea), *Vigna radiata* L. (Moong), *Vigna Mungo* L. (Urd), *Vigna aconitifolia* (Moth), *Lablab purpureus*, *Cicer arietinum* L. (Chickpea), *Glycine max* (Linn.) Merrill (Soyabean), *Dolichos biflorus* Linn. (Kulthi), *Lens culinaris* Medik. (Masur), *Cajanus cajan* L. (Pigeon pea), *Phaseolus mungo* Roxb. (Black gram) etc.

Agriculture practices under green revolution depend largely on extensive use of chemicals pesticides and insecticides to limit the high level of damage caused due to these bruchid beetles. Although use of synthetic insecticides is considered to be cheaper and more effective than existing non chemical alternatives but the long-term exposure of these chemical pesticides and insecticides has lead to serious health hazards among consumers (Sharma and Meshram, 2006).

National Cancer Registry Programme 2002 (NCRP) and Department of Health & Family Welfare 2013 (DHFV) reported that due to excessive use of pesticides and insecticides like DDT, endosulfan, chlorpyrifos, malathion, monocrotophos and phosphamidon in Malwa region of Punjab, the people are highly prone to cancer disease and that is why Malwa region is now called as “Cancer capital of India”. Due to these outcomes, there is a necessity to look for cheap, safe, ecosystem friendly option of protecting store grains against *Callosobruchus* species.

Therefore, now a days more stress is being laid on use of botanicals for the control and management of store bruchids that serve as environment friendly and economically conceivable option. (Rajendra S., 2003, Mehta *et al.*, 2010, Pajni and Gupta, 2012; Prakash *et al.*, 2016 and Prasanthi *et al.*, 2017)

However, so many workers are investigating the efficacy of various plant products for the suppression of two out of three pest bruchids i.e. *C. maculatus* and *C. chinensis* and much less work is done on third species i.e. *C. analis*. Hence the present review is mainly focused on the use of various plants of north India for the control of *C. maculatus* and *C. chinensis*.

Control of Pest Population by Using Indigenous Plants

For the longest time, farmers, shopkeepers, households etc rely on the use of local plants for protecting the store grains. Although people are using conventional structures like using leaves, straw, branches etc. as insecticide, but the use of these botanicals in a scientific way started much later after the introduction of chemical insecticide. Keeping view the health hazards and ecological pollution caused by chemical insecticides, the work on the use of indigenous plants in scientific manner had started so as to replace chemical insecticide from the ecosystem. It is found that these botanicals can be used in various formulations like powders, extracts and oils instead of the conventional structures.

Use of plant products as powder

The most common and easy formulation in which the plant parts are bring used is the powder form. Many workers have tested effect of powders of different parts of North Indian local plants against *C. maculatus* and *C. chinensis*.

Yadav and Bhatnagar (1987) used powders of six plants namely, Darek (*Melia azaderach* Linn.), Neem (*Azadirachta indica*), Datura (*Datura metel* Nees), Ak (*Calotropis procera* Br.), Garlic (*Allium sativum* Linn.), Soapnut (*Sapindus trifoliatus* Linn.) against *C. maculatus* on cowpea. They observed that *Sapindus trifoliatus* shell at dose 11.4% and its seed powder at 5.5% produced 100% mortality as compared to other plant powders which gave 77.3% to 100% mortality. Singh *et. al* (1996) in Bihar observed the effect of neem saw dust on adult mortality of *C. chinensis* infesting black gram seeds. They found that dried neem powder mixed at concentration of 400mg/50gm was highly effective against this pest. Later in year 1998, Kumari *et. al* observed that black pepper (*Piper nigrum*), neem leaf (*Azadirachta indica*) and mangraila (*Nigella sativa*) powders were equally effective in reducing the number of eggs laid, adult emergence and ultimately damage caused to the moong bean by *C. chinensis*. In Varanasi, the Six plant powders *Syzygium cumini*, *Aegle marmelos*, *Eupatorium cannabinum*, *Murraya koenigii*, *Ammomum subulatum* Roxb., and *Citrus medica* were tested against *C. chinensis*. Out of these six plants, *Murraya koenigii* and *Eupatorium cannabinum* were found to be the most effective in reducing oviposition and causing the adult mortality at dose of 2% (Shukla *et. al* 2007). In Solan (Himacahal Pradesh) Kamaldeep Kaur *et. al* (2008) worked on powders of seven local plants viz., neem (*Azadirachta indica*), Camphor (*Cinnamomum camphora*), sweet flag (*Acorus calamus*), lemongrass (*Cymbopogon citratus*), eucalyptus (*Eucalyptus* sp.), wild marigold (*Tegetes minuta*) and drek (*Melia azadirachta*). They found that neem and sweet flag provided highest adult mortality and progeny reduction of *C. chinensis*. Ravinder Singh (2011a) conducted a laboratory experiment to investigate the bio efficacy of different plant products like black pepper, garlic, tulsi and turmeric against cowpea weevil, *C. maculatus* infesting chickpea. The result of their analysis showed that maximum oviposition deterrence was obtained with tulsi powder (53.77%) followed by rhizome powder, black pepper powder and garlic clove powder with 40.46, 38.54 and 36.98 per cent deterrence respectively. In same year in another study, Ravinder Singh (2011b) further investigated the insecticidal activities of seven plants viz., *Citrus sinensis*, *Occimum basilicum*, *Acacia nilotica*, *Capsicum frutescens*, *Zingiber officinale*, *Khaya senegalensis* and *Khaya senegalensis* against *C. chinensis*. Plant material efficacy was checked at dose 1g/20g cowpea seeds and was revealed that *Mahogany* wood ash was more effective in causing adult mortality and citrus leaf powder was found to be effective in inhibiting the adult emergence. In Churu (Rajasthan), Sharma *et. al* (2016) studied the efficacy of turmeric powder and revealed that the turmeric powder is very effective in controlling this bruchid even at the concentration of 3.5g/kg.). In Haryana, Kumari *et. al* (2022) tested the efficacy of neem, turmeric and custard apple powder against *C. Chinensis* and the results indicated that neem powder was found to be most effective with maximum adult moartlity.

Table 1 shows the compiled list of all plant powders that have been investigated by workers from North India. From the table is has been observed that most of the work is done on the efficacy of *Azadiachta indica* followed *Curcuma longa* in this region.

Table 1: List of most effective plant powders against *C. maculatus* and *C. chinensis*

Plant Used	Part Used	Pest	Host Plant	State	Reference
<i>Sapindus trifoliatus</i>	Seed	<i>C. maculatus</i>	<i>Vigna unguiculata</i> (Cowpea)	-	Yadava and Bhatnagar 1987
<i>Azadirachta indica</i>	Saw dust	<i>C. chinensis</i>	<i>Vigna mungo</i>	Bihar	Singh <i>et. al</i> 1996
<i>Piper nigrum</i> <i>Azadirachta indica</i>	Leaf	<i>C. chinensis</i>	<i>Vigna radiata</i>	Bihar	Kumari <i>et. al</i> 1998
<i>Murraya koenigii</i> <i>Eupatorium cannabinum</i>	-	<i>C. chinensis</i>	-	Varanasi	Shukla <i>et. al</i> 2007
<i>Azadirachta indica</i> <i>Acorus calamus</i>	-	<i>C. chinensis</i>	<i>Pisum sativum</i>	Himachal Pradesh	Kamaldeep Kaur <i>et.al</i> 2008
<i>Ocimum sanctum</i> (Tulsi)	Leaf	<i>C. maculatus</i>	<i>Vigna unguiculata</i> (cowpea)	Rajasthan	Ravinder Singh 2011
<i>Swietenia macrophylla</i>	Wood ash	<i>C. chinensis</i>	<i>Cicer arietinum</i>	Rajasthan	Ravinder Singh 2011
<i>Curcuma longa</i> (Turmeric)	-	<i>C. maculatus</i>	<i>Cajanus cajan</i> (Pigeon pea)	Churu	Sharma <i>et. al</i> 2016
<i>Curcuma longa</i> <i>Azadirachta indica</i>	Neem- leaf Turmeric – rhizome Custard apple- seed	<i>C. chinensis</i>	<i>Vigna radiata</i>	Haryana	Kumari <i>et. al</i> (2022)

Use of botanicals in the form of plant extracts

Though the use of plant powder is an easy process of pest control in small storages but now a days, the more refined form of the botanicals is coming into practice. So, the use of plant extracts as natural insecticide is increasing day by day. Various workers have evaluated various insecticidal activities of the extracts of different commonly grown from this region.

In Hisar, Sharma *et. al* (2003) evaluated the repellent activities of extracts made from local plants namely, *Dalbergia sissoo*, *Ricinus communis* and *Parthenium hysterophorus* against *C. chinensis* on chickpea grains and the results revealed that the highest repellency (95.0%) was recorded for *P. hysterophorus* extract. In Rajasthan, Ravinder Singh (2011) tested six plants viz., Kaner (*Nerium indicum*), Khejri (*Prosopis cineraria*), Neem (*Azadirachta indica*), Safeda (*Euclayptus globulus*), Tomato (*Lycopersicum esculentum*) and Mustard (*Brassica compestris*) for their oviposition deterrence activity against *C. maculatus* and found that maximum oviposition deterrence was recorded with neem leaf extracts (55.86%). In Assam, Nimbecidine (0.03% azadirachtin) of neem formulation was found to be effective for growth retardation, sterility, ovicidal, oviposition deterrent, adult mortality activities against pulse beetle, *C. chinensis* infesting moong (*Phaseolus aureus*) (Gopali Devi 2014). Rana Kiran *et. al* (2015) reported that the ethanolic extracts of seed kernels of dharek (*Melia azaderach* L.) is more potent as compared to the ethanolic extracts of worm's wood (*Artemisia roxburghii* L.), mint (*Mentha longifolia* L.) and marigold (*Tagetes erecta* L.) against *C. chinensis* infesting stored pea (*Pisum sativum* L.). In the study conducted by Chauhan *et. al* (2016), extracts made from aerial parts of *Calotropis procera* plant was found to be more effective for *C. maculatus*, as it showed significant level of insecticidal activity. Kosar and Srivastava (2016) worked on plant extracts of *Euphorbia hirta*, *Phyllanthus amarus*, *Jatropha gossypifolia* and observed that the oviposition by *C. chinensis* females was minimum with 25% of Di-ethyl ether and ethanol extracts of *Jatropha gossypifolia*. Later, in Uttar Pradesh, Ranjan *et. al* (2016) carried out work to screen certain formulations of aerial parts of *Lantana camara* against the bean beetle *C. maculatus* raised on seeds of mung bean (*Vigna radiata*) and their study infers that 5.0% methanolic extract is most efficient to protect seeds from pulse beetle. While investigating biopotency of ten indigenous plants viz., *Adhatoda vasica*, *Cassia tora*, *Vitex negundo*, *Withania somnifera*, *Lantana camara*, *Momordica charantia*, *Azadirachta indica*, *Gynendropsis pentaphylla*, *Acorus calamus* and *Alpinia galanga* against *C. chinensis*, BS Chandel (2017) observed that the extract of *A. calamus* is most effective among all these as it caused maximum inhibition to oviposition and adult emergence as compared to other extracts. In Uttar Pradesh, Saxena and Sayyed (2018) studied the insecticidal and repellent activities for petroleum ether extracts of various plants such as, *Azadirachta indica*, *Allium sativum*, *Curcuma longa*, *Citrus sinensis*, *Citrus limon*, *Murraya koenigii* and *Eucalyptus* against *C. maculatus* and found that *A. indica* shows highest insecticidal activity followed by *A. sativum* and *C. longa*, whereas the lowest activity is shown by *C. sinensis*. Again, in 2018, BS Chandel studied the bioefficacy of crude extracts of ten more plants viz., *Vitex negundo*, *Withania somnifera*, *Swertia chirayita*, *Tabernamontana devaricata*, *Jatropha curcus*, *Nyctanthes arbortristis*, *Lantana camara*, *Momordica charantia*, *Zingiber officinale* and *Saussurea lappa* against *C. chinensis* on *Cicer arietinum*, where he found that extracts of *L. camara* is most effective against store pest followed by *V. negundo* and *W. somnifera*.

The table 2 indicates the list of various plants of North India whose extracts have been tested against the store bruchid pests. From the table also it is clear that still most of the work on botanicals is restricted mainly to *Azadirachta* but slowly the workers are trying to check the efficacy of other commonly grown plants.

Table 2: List of most effective plant extracts of common North Indian plants used against *C. maculatus* and *C. chinensis*

Plant Species Tested	Part Used	Pest	Host Grain	State	Reference
<i>Dalbergia sisso</i> <i>Ricinus communis</i> <i>Parthenium hysterophorus</i>	-	<i>C. chinensis</i>	<i>Cicer arietinum</i>	Hisar	Sharma <i>et. al</i> (2003)
<i>Azadirachta indica</i> (Neem)	Leaf	<i>C. maculatus</i>	<i>Cicer arietinum</i>	Rajasthan	Ravinder Singh 2011
<i>Azadirachta indica</i> (Neem)	-	-	<i>Phaseolus aureus</i>	-	Gopali Devi 2014
<i>Melia azadrach</i> (Dharek)	Seeds kernels	<i>C. chinensis</i>	<i>Pisum sativum</i>	Solan	Rana Kiran <i>et. al</i> (2015)
<i>Calotropis procera</i> (Ak)	Root, stem, leaf	<i>C. maculatus</i>	<i>Vigna radiata</i>	Uttar pradesh	Chauhan <i>et. al</i> 2016
<i>Lantana camara</i> (Lantana)	Root, stem, leaf	<i>C. maculatus</i>	<i>Vigna radiata</i>	Uttar pradesh	Ranjan <i>et. al</i> 2016
<i>Jatropha gossypifoli</i>	Leaf	<i>C. chinensis</i>	<i>V. radiata</i>	-	Kosar and Srivastva 2016
<i>Acorus calamus</i>	Rhizome	<i>C. chinensis</i>	<i>C. arietinum</i>	Uttar pradesh	BS Chandel 2017
<i>Azadirachta indica</i> (Neem)		<i>C. maculatus</i>	<i>Cicer arietinum</i>	Uttar Pradesh	Saxena and Sayyed 2018

Use of botanicals in the form of oils

The other type of formulation in which the plant products can be used as insecticides is in the form of oils. These oils are either extracted from the different parts of plants in laboratory or they are available commercially. The practice of using oils for pest control is also very old as earlier mostly mustard oil was used by people in houses as they used to coat the pulses with few drops of oil. Now a days the focus has been shifted towards the search of more effective oils that have better insecticidal properties.

In 1990, when Singh *et. al* assessed the insecticidal activity of mustard oil along with other oils i.e. palm oil, coconut oil, ground nut and rape seed oil, they found the palm and coconut oils were more effective than other oils. Even ground nut and rape seed oil also gave better results than mustard oil. Pajni *et. al* (1991) found Citriodora oil of *Corymbia* and *Eucalyptus* oil is very effective against *C. maculatus* with LD-50 of 37.40 mg/100ml and 46 mg/1000ml respectively. The fumigant toxicity, ovicidal and oviposition-deterrent bioactivities of the essential oil of *Anethum sowa* was investigated by Tripathi *et. al* (2001) against the grain beetle, *C. maculatus*. The extent of grain damage and weight loss of green gram infested pulse beetle *C. chinensis* was analyzed after the use of edible and non-edible oils viz. Neem, Karanja, Sesamum, Castor, Palm, Mustard, Groundnut and Sunflower oil (Mishra *et al.*, 2013) in Odisha. It was observed that the most effective oil in managing grain damage and weight loss was Neem and Karanja oil. Chaubey (2014) found that the essential oil of *Allium sativum* caused both fumigant and contact toxicity to *C. chinensis* at variable concentrations and at low dosage, it also shows repellent and insecticidal activities. In Churu (Rajasthan), the biological activity of oil extracted from plants such as Neem, Mustard and Groundnut were investigated for oviposition, adult emergence, seed damage caused by *C. maculatus* on pigeon pea (Sharma *et. al* 2016). The experiment showed that Neem oil @10ml/kg completely inhibited oviposition, adult emergence and reduced seed damage due to which seed quality was not affected much as compared to other treatment. Khichi *et al.* (2017) checked the effect of various doses of groundnut oil, coconut oil, sesamum and neem oil on oviposition inhibition, egg hatching and adult emergence activities of *C. chinensis* in Rajasthan. They observed that Neem oil at 12ml/kg dose was highly effective in inhibiting oviposition, egg hatching and adult emergence. In 2022, Kumari *et. al* checked the efficacy of five plant oils namely, Neem, Mustard, groundnut, Mentha and Lemongrass was analysed at dose 10 ml per Kg where Neem oil was found to be most effective against bruchid pests.

Table 3 indicates the list of various oil whose efficacy has been listed against store bruchid viz., *C. chinensis* and *C. maculatus*. From the table it is evident that beside mustard other plant oils are also highly effective in controlling pest population.

Table 3: List of most effective plant oils against *C. maculatus* and *C. chinensis*

Plant Used	Part Used	Pest	Host Plant	State	Reference
Palm and Coconut	-	<i>C. chinensis</i>	<i>Cicer arietinum</i>	-	Singh <i>et. al</i> 1990
Citriodora oil of <i>Corymbia</i> and <i>Eucalyptus</i> oil		<i>C. maculatus</i>	-	Chandigarh	Pajni <i>et. al</i> 1991
<i>Anethum sowa</i> (Sowa)	Seeds	<i>C. maculatus</i>	<i>Cicer arietinum</i> (chick pea)	Lucknow	Tripathi <i>et. al</i> 2001
<i>A.indica</i>		<i>C. chinensis</i>	<i>Vigna radiata</i>	Odisha	Mishra S.N <i>et. al</i> 2013
<i>Allium sativum</i>	Bulb	<i>C. chinensis</i>	<i>Vigna unguiculate</i>	Churu	Mukesh Kumar Chaubey 2014
<i>Azadirachta indica</i> (Neem)	-	<i>C. maculatus</i>	<i>Cajanus cajan</i> (Pigeon pea)	Churu	Sharma <i>et. al</i> 2016
Camphor, marigold, eucalyptus, lemon grass, sweet flag	-	<i>C.chinensis</i>	<i>Pisum sativum</i>	-	Kumar <i>et. al</i> 2016
<i>A.indica</i>	-	<i>C. chinensis</i>	<i>Vigna unguiculata</i>	Rajasthan	Khinchu <i>et. al</i> 2017
Neem, mustard, groundnut, mentha and lemongrass	-	<i>C.chinenis</i>	<i>V. radiata</i>	Haryana	Kumari <i>et. al</i> (2022)

Conclusion

The application of plant products to store grain for suppression of pest population is a traditional method and utilized from hundreds of years for the security of stored grains against bruchid population. The easy availability and less adverse effect on environment has led to the increase interest of scientist in plant based insecticides or pesticides. Therefore, presently the researchers have started focusing towards the use of indigenous plant products as a replacement of synthetic chemical insecticides. The plant parts like stem, leaf, root, seeds, bud, roots etc contain various secondary metabolites and active phyto compounds that are generally safe for human consumption and provide better protection to grains against pests. The plant products and their phytochemicals have come up with various activities such as oviposition deterrence, repellent, antifeedant, ovicidal, larvacidal and pupacidal activity. Thus, the review indicates that beside traditional plants now more work has been started in other North Indian plants also. These commonly grown plants have also proved to be very effective in suppression of pest population. Thus, more plant derivatives can be explored so as to use them as effective, economical and eco friendly insect control agents for commercial use.

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Importance of studying conserved regions in XPA and XPB proteins by multiple sequence alignment for phylogenetic tree construction

Chahat, Rupinder Kaur

Department of Biotechnology, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab-140406
choprachahat78@gmail.com, drkdogra@gmail.com

Abstract

DNA damages could be repaired by various mechanisms: Direct repair, Base excision repair, Mis-match repair, double strand break repair and Nucleotide excision repair (NER). NER is of further two types: global genome repair (GGR) and transcription coupled repair (TCR). This type of repair involves various proteins, including replication proteins, transcription factors, Xeroderma Pigmentosum Complementation group A, B, C, D, E, F and G. Every protein and factor have their specific role in the NER process. XPA recognizes DNA lesion by recognizing sharply bent DNA; therefore, this proves the function of XPA at verification step. It can abort DNA incision at undamaged site. Also, it is able to bind to ssDNA, dsDNA and Y junction of damaged DNA. On the other hand, XPB functions in a 3' → 5' fashion. XPB also known as the excision repair cross-complementing rodent repair deficiency group 3 (ERCC3). It helps promoter opening during transcription initiation step. To identify the conserved regions of these proteins and their phylogenetic tree construction multiple sequence alignment is used. It is a series of algorithmic solution for the alignment of evolutionarily related sequences. It aligns three or more related sequences to achieve matching between them. Phylogenetic tree is a branching diagram or tree showing the evolutionary relationship among various biological species. There are several types of phylogenetic trees: rooted tree, unrooted tree, bifurcating tree, multi-furcating tree. It is important to study the structure, conserved domains, structure, structure-function relationship with evolution history of XP proteins. Therefore, aim is to identify conserved region in XPA and XPB by using multiple sequence alignment and phylogenetic tree construction. We found that both the XPA and XPB proteins showed high degree of conservation among both primates and non-primate species. Phylogenetic tree analysis showed that human XPA and XPB proteins showed greater sequence similarity with primate species than the non-primates.

Keywords: Conserved regions; MSA; phylogenetic tree; XPA; XPB

Introduction

DNA damage is any modification in physical and chemical structure of DNA resulting in an altered DNA molecule which is different from the original DNA molecule with regards to its physical / chemical or structural properties (Lewin, 2003). Damage caused by internal factors is called endogenous damage. These factors are present or produced inside the cell that lead to damage of the DNA. These are the aggressive agents produced at the time of cell's normal metabolism. It could lead to many types of damages like, conversion of one base to another, loss of nitrogenous bases due to hydrolysis, alkylation of nitrogenous bases, oxidation of nitrogenous bases (Gale, 1992). The damage which occur by the factors present external of the cell are called exogenous factors, such as those caused by Ultra Violet radiations. Exposure to UV can lead to dimerization, formation of bulky adducts in DNA, alkylation, free radical species, DNA breaks (single strand or double strand) (Thivianathan *et.al.* 2008).

Various DNA repair mechanisms include repair of precursor pool, Direct repair, Base excision repair, Mis-match repair, Double Strand Break Repair and Nucleotide excision repair (NER). NER involves removal of wide range of bulky adducts and DNA cross-links from the damaged DNA strand. It also recognizes diverse DNA-lesions. It is of two types: global genome repair (GGR) and transcription coupled repair (TCR).

DNA repair protein XPA is the key protein in NER, important for DNA damage verification and the recruitment of other NER proteins. It is of 31 KDA, 273 amino acids (Yang *et.al.* 2002). Primarily, it is found as homodimer. It consists of three domains; central globular domain, dynamically disordered N- and C-terminal domains. Central domain have C4 type zinc-finger motif, which is essential for function and stability of XPA protein. N-domain is important for nuclear localization signal. Both N & C terminal domains are responsible for interaction with multiple partners (Kuraoka *et.al.* 1996). XPA binds to both damaged and undamaged DNA through DNA binding domain (MBD 98-239). There are several functions of XPA. It recognizes DNA lesion by recognizing sharply bent DNA; therefore, this proves the function of XPA at verification step. It can abort DNA incision at undamaged site. Also, it is able to bind to ssDNA, dsDNA and Y junction of damaged DNA by direct interactions with evolutionary conserved positively charged domains (K168, K179, K221, K222, K224, K236). This domain forms clamp like structure with two linkers around it. It has both pre-incision as well as post-incision functions, it stabilizes pre-incision complex and bind to RPA (Topolska *et.al.* 2020). Xeroderma Pigmentosum Complementation group A (XPA) patients exhibit the most severe phenotype among all XP patients. In addition, XPA is unique among NER, as it is required by both GG-NER and TC-NER and is important for removal of all DNA lesions repaired by NER. That's why it is most targeted protein for cancer therapy (Belinsky *et.al.* 2012).

DNA repair protein XPB is an ATP- dependent DNA helicase in human that is a part of the TFIIH transcription factor complex. It form a tight core subcomplex. XPB functions in a 3' -> 5' fashion. XPB also known as the excision repair cross-complementing rodent repair deficiency group 3 (ERCC3). It is located at chromosome 2q21. It comprises 15 exons and a transcript length of 2,750 base pairs that encode a protein of 782 amino acids with molecular weight of 89 KDA (Fan, 2006).

Multiple sequence alignment (MSA) method is series of algorithmic solution for the alignment of evolutionarily related sequences, while taking into account evolutionary mutations such as, insertions, deletions and rearrangements under certain conditions. There are various tools to perform MSA: Emboss explorer tool, Clustal Omega, Clustal W, T-COFFEE, MAFFT, MUSCLE (Xiong,2006). In the present study, Clustal Omega and COBALT were used as MSA tool.

Phylogenetic tree are mathematical structures that represent the evolutionary history of group of organisms. It is a branching diagram or tree showing the evolutionary relationship among various biological species (Rokas,2011). There are several types of phylogenetic trees: rooted tree, unrooted tree, bifurcating tree, multi-furcating tree (Hillis et al. 1997).

Mutation in both XPA and XPB genes lead to number of autosomal disorders such as xeroderma pigmentosum, in which skin become sensitive to natural light and have scaly and dry texture. This disease leads to skin cancer (Jiang,1999). Mutation in XPA and XPB also leads to Cockayne syndrome. In this disease, premature aging starts, size of head of patient is very small and this leads to neurological disorder (Adair, 2005). Since, these proteins have clinical involvement, it is important to study the structure, conserved domains, structure, structure-function relationship with evolution history of XP proteins. Therefore, aim is to identify conserved region in XPA and XPB by using multiple sequence alignment for phylogenetic tree construction.

Materials and methods

National Centre of Biotechnological Information is the centre within the National Library of Medicine at National Institute of Health. It was used to obtain the FASTA sequence of the XPA and XPB proteins of humans. Firstly, visited home page of NCBI. Then, protein option was selected from All Databases. Name of protein (XPA and XPB) was typed and search button was clicked. After that, specific human protein was selected from the provided list. Following this FASTA option was clicked. FASTA sequence of XPA and XPB was downloaded.

Basic Local Alignment Search Tool is a sequence similarity search program for comparing biological sequences and find the similarity between sequences. There are four types of BLAST: BLASTP, BLASTN, BLASTX, TBLASTN. FASTA sequence obtained from NCBI was opened in BLASTP (as it is a protein sequence) for multiple sequence alignment (MSA). BLASTp was opened in BLAST program. FASTA file was pasted in the query box for both XPA and XPB. Then algorithm and parameters for search were set. After that, clicked on BLAST option to run the program.

Constraint Based Alignment Tool is associated for pairwise sequences obtained from different sources that stimulates alignment, phylogenetic studies, computational biology etc. Data obtained from BLAST was run in COBALT using various sequences as per the similarity seen among them and phylogenetic tree was created using this. COBALT was opened. Data obtained from BLAST was entered in query box for both XPA and XPB protein and Phylogenetic tree was opened.

CLUSTAL OMEGA is the newest MSA algorithm in CLUSTAL family. It aligns three or more sequences together. Similarly as COBALT, data obtained from BLAST was opened in CLUSTAL OMEGA and phylogenetic tree was created for both the proteins. For this, Home page of CLUSTAL OMEGA was opened. Selected sequences was pasted in query box and click on submit option. Multiple sequence alignment was obtained and Phylogenetic tree for XPA and XPB protein was opened.

Results and Discussion

Sixteen sequences were selected for XPA protein whose % identity with *Homo Sapiens* ranges from 99%-96% and their E-value was zero. The organisms selected were *Homo Sapiens*, *Gorilla Gorilla*, *Pan Traglodytes*, *Pongo Abeli*, *Nomascus Leucogenys*, *Popio Anubis*, *Hylobates Moloch*, *Theropithecus Gelada*, *Macaca Fascicularis*, *Piliocolobus Tephrosceles*, *Trachypithecus Francoisi*, *Rhinopithecus Roxellena*, *Cebus Imitator*, *Sapajus Apella*, *Aotus Nancymeol*, *Saimiri Bolivicensis*, *Callithis Jacchus*. Then Phylogenetic tree (figure 1) was constructed using Neighbor Joining method. It is an open-source standalone application that was mainly developed for rooted and unrooted tree visualization in 2D. The components of phylogenetic tree are roots, nodes and branches. Root represents the common ancestor of all the taxa represented on tree. The branches of the tree represent the ancestor- descendent relationships. Each leaf represents the organism. Each node represents common ancestor of all the organism s that branch out it. This tree was unrooted phylogenetic tree was connected with 32 nodes. The closest match was found between primates such as *Gorilla Gorilla*, *Pongo Abeli*, *Nomascus Leucogenys*, *Hylobates Moloch* and less matches were found with non- primate species such as *Popio Anubis* and *Theropithecus Gelada*. The maximum sequence difference is 0.85 which is due to the relatedness with *Homo Sapiens*.

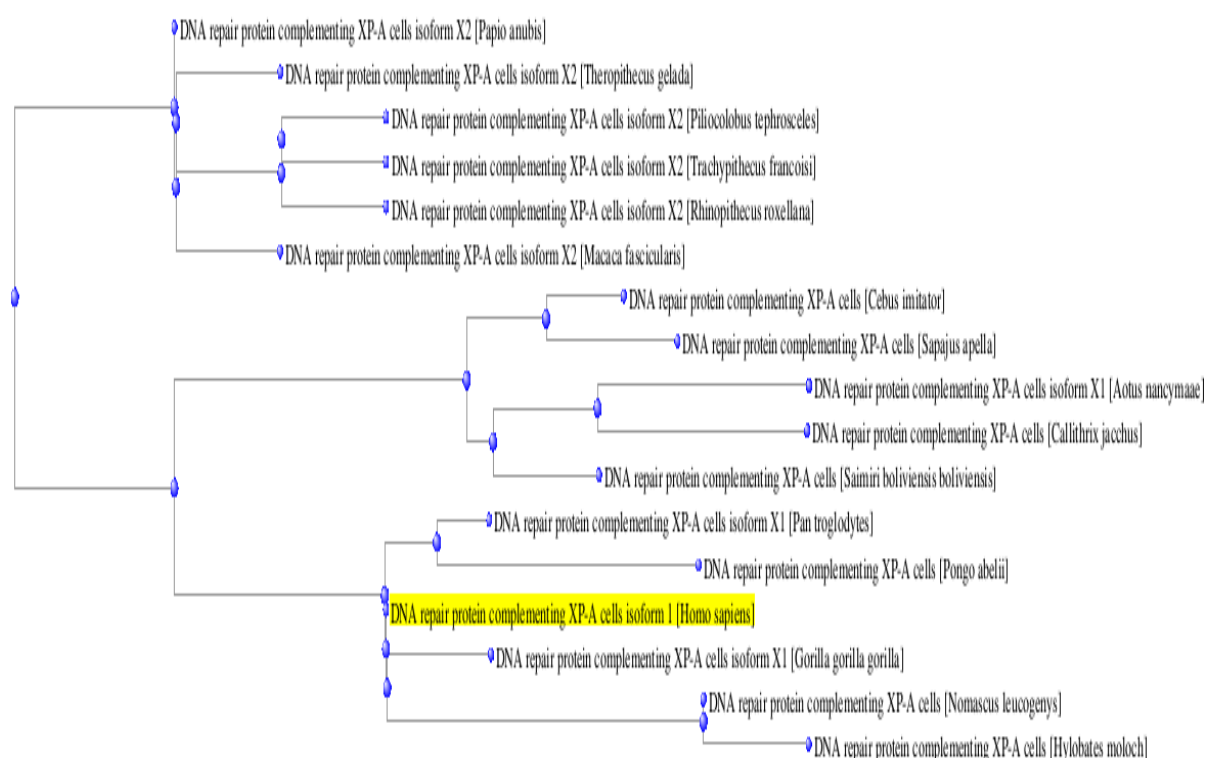


Figure 1: Phylogenetic tree of XPA protein using COBALT.

CLUSTAL OMEGA is a multiple sequence alignment tool which aligns three or more sequences in a computationally efficient and accurate method. FASTA sequences of sixteen species; *Homo Sapiens*, *Gorilla Gorilla*, *Pan Traglodytes*, *Pongo Abeli*, *Nomascus Leucogenys*, *Popio Anubis*, *Hylobates Moloch*, *Theropithecus Gelada*, *Macaca Fascicularis*, *Piliocolobus Tephrosceles*, *Trachypithecus Francoisi*, *Rhinopithecus Roxellana*, *Cebus Imitator*, *Sapajus Apella*, *Aotus Nancymeol*, *Saimiri Bolivicensis*, *Callithis Jacchus* were used to perform MSA for XPA protein. The alignment showed matches, mismatches and gaps in XPA proteins. An (*) asterisk identifies a region which have single, fully conserved residue that is a match. A (.) dot identifies a mismatch between species. A (:) colon represents a conversion between amino acids with similar properties and a (-) space identifies a gap that means a deleted amino acid.

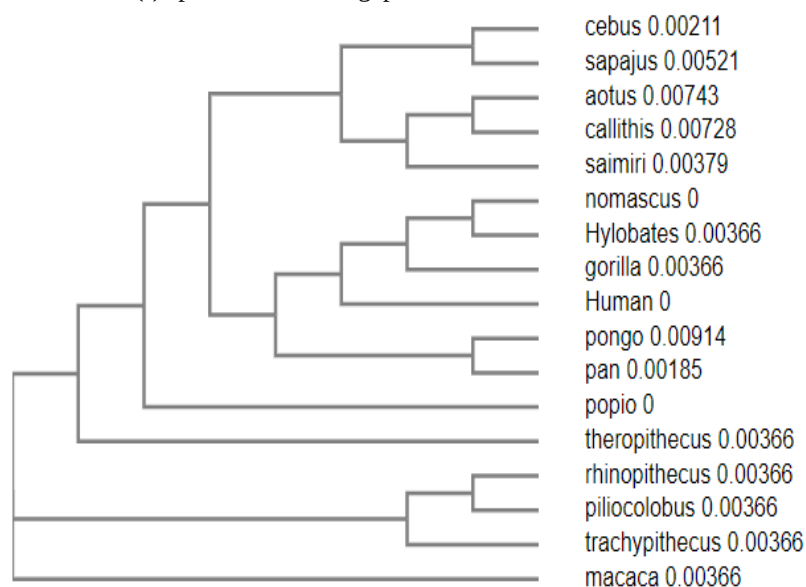


Figure 2: Cladogram for XPA protein using CLUSTAL OMEGA.

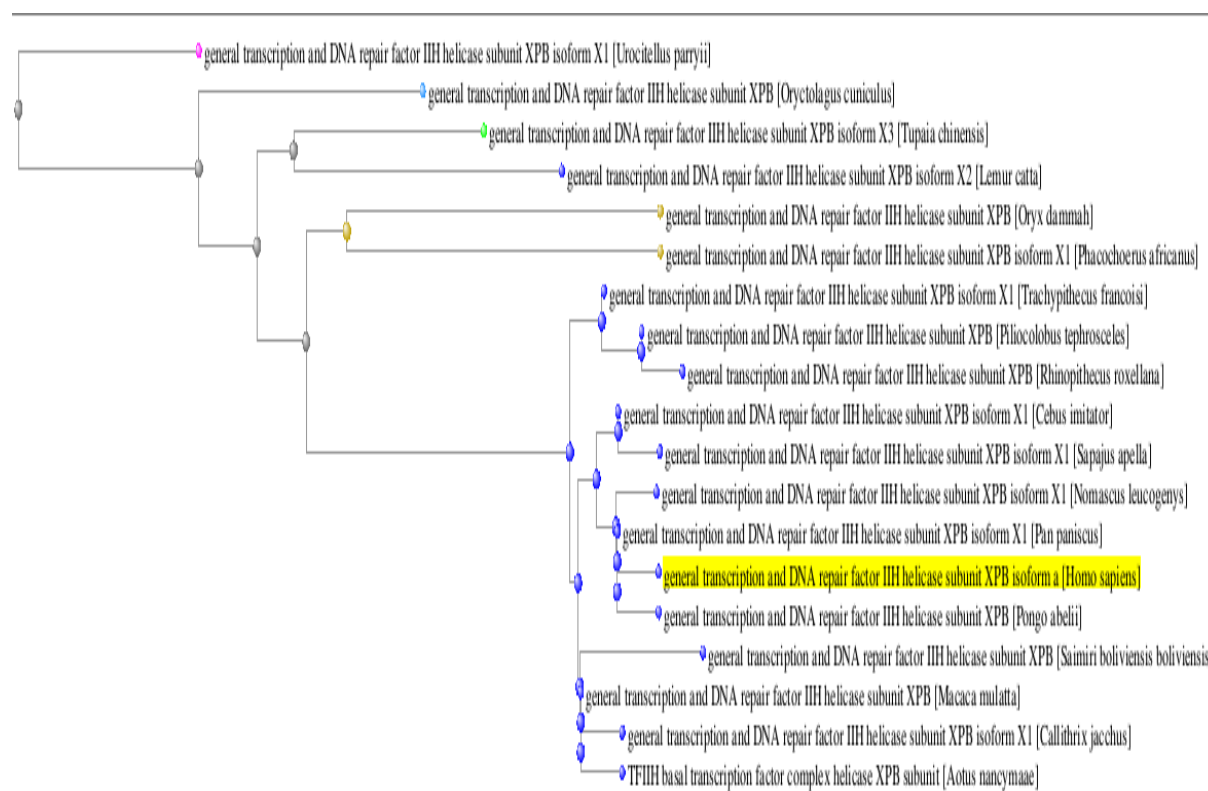
Figure 2 shows the cladogram diagram for XPA protein including *Homo Sapiens*, *Gorilla Gorilla*, *Pan Traglodytes*, *Pongo Abeli*, *Nomascus Leucogenys*, *Popio Anubis*, *Hylobates Moloch*, *Theropithecus Gelada*,

Macaca Fascicularis, *Piliocolobus Tephrosceles*, *Trachypithecus Francoisi*, *Rhinopithecus Roxellana*, *Cebus Imitator*, *Sapajus Apella*, *Aotus Nancymeol*, *Saimiri Bolivicensis*, *Callithis Jacchus*.

These species were selected due to their highest similarity with *Homo Sapiens* and their E- value was zero. These were first aligned with CLUSTAL OMEGA and then phylogenetic tree was created. The closest match with *Homo Sapiens* was found with *Gorilla Gorilla*, *Pongo Abeli*, *Hylobates Moloch* *Pan Traglodytes* and least closest match was found with *Macaca Fascicularis*, *Cebus Imitator*, *Trachypithecus Francoisi* and *Sapajus Apella*. The XPA protein in human show greatest similarity with primates than non- primates.

Nineteen sequences were selected for XPB protein whose % identity with *Homo Sapiens* ranges from 99%-97%. Species selected were *Homo Sapiens*, *Pan Paniscus*, *Macaca Mulatta*, *Nomascus Leucogenys*, *Pongo Abeli*, *Cebus Imitator*, *Trachypithecus Francoisi*, *Rhinopithecus Roxellana*, *Aotus Nancymeol*, *Callithis Jacchus*, *Piliocolobus Tephrosceles*, *Sapajus Apella*, *Saimiri Bolivicensis*, *Tupia Chinesis*, *Oryx Damah*, *Phacochorrus Ofrikanus*, *Ortyctologous Cuniculus*, *Lemur Catta* and *Urocitellus Parryii*. Then Phylogenetic tree (Figure 3) was constructed using Neighbor Joining method. This tree was unrooted phylogenetic tree was connected with 36 nodes. The closest match was found between primates such as *Pan Paniscus*, *Pongo Abeli*, *Nomascus Leucogenys*, *Saimiri Bolivicensis* and less matches were found with non- primate species such as *Urocitellus Parryii*, *Ortyctologous Cuniculus*, *Tupia Chinesis*, *Lemur Catta*. The maximum sequence difference is 0.85 which is due to the relatedness with *Homo Sapiens*.

Figure 3: Phylogenetic tree of XPB protein using COBALT.



CLUSTAL OMEGA is a multiple sequence alignment tool which aligns three or more sequences in a computationally efficient and accurate method. FASTA sequences of nineteen species; *Homo Sapiens*, *Pan Paniscus*, *Macaca Mulatta*, *Nomascus Leucogenys*, *Pongo Abeli*, *Cebus Imitator*, *Trachypithecus Francoisi*, *Rhinopithecus Roxellana*, *Aotus Nancymeol*, *Callithis Jacchus*, *Piliocolobus Tephrosceles*, *Sapajus Apella*, *Saimiri Bolivicensis*, *Tupia Chinesis*, *Oryx Damah*, *Phacochorrus Ofrikanus*, *Ortyctologous Cuniculus*, *Lemur Catta* and *Urocitellus Parryii* were used to perform MSA for XPB protein. The alignment showed matches, mismatches and gaps in XPB proteins. These species were selected due to their highest similarity with *Homo Sapiens*. These were first aligned with CLUSTAL OMEGA and then phylogenetic tree was created. The closest match with humans was found with *Pongo Abelli*, *Pan Paniscus*, *Nomascus Leucogenys*, *Cebus Imitator* and least closest match was found with *Phacochorrus Ofrikanus*, *Oryx Damah*, *Urocitellus Parryii* and *Tupia Chinesis*. The XPB protein in humans show greatest similarity with primates than non- primates.

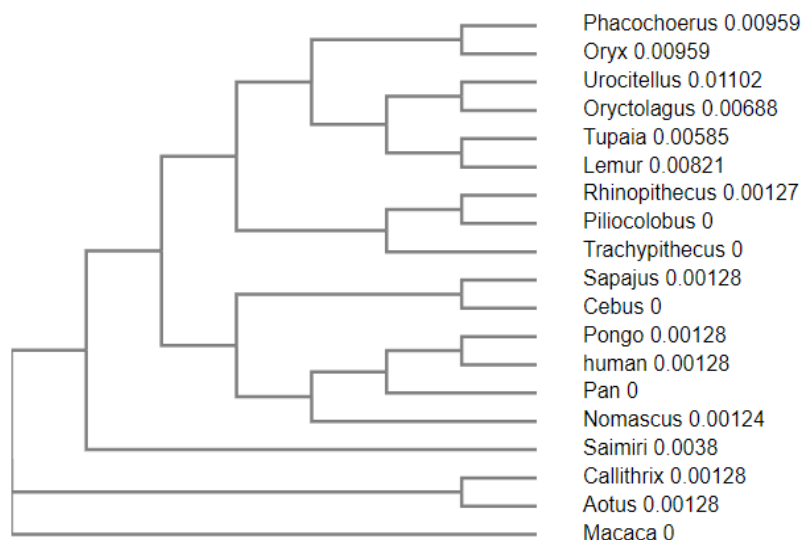


Figure 4 : Cladogram for XPB protein using CLUSTAL OMEGA.

Conclusion : Phylogenetic trees for XPA and XPB show that the primates have more closely related amino acid sequences with *Homo Sapiens* than non-primates. This means that protein sequence of XPA and XPB are conserved in primates.

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Prevalence of Musculoskeletal Disorders among Nurses

*Ishnoor Singh **Supreet Bindra

*BPT **Assistant professor, Physiotherapy, Sri Guru Granth Sahib World University, Fatehgarh Sahib
dr.ishnooranand@gmail.com

Abstract

Musculoskeletal disorders (MSDs) are widely known as the cause of severe long-term pain and physical disability that affect hundreds of millions of people worldwide and are common among health care workers. The nursing population constitutes about 33% of the hospital workforce are at particularly high risk and account for 60% of the reported occupational injuries which significantly affects their work ability and quality of life. Thus, a study with the objective to determine the prevalence of the musculoskeletal disorders, job risk factors, coping strategies and work ability among nurses at private hospital was conducted among 100 nurses using the socio-demographic, Nordic musculoskeletal and Work ability self-administered questionnaire. The 12-month prevalence of Work-related MSDs (WMSDs) was 92%. Neck pain (79%) was found to be the most prevalent disorder followed by pain in low back (67%). 95% of the respondents perceived working in same positions for prolonged time as a major risk factor leading to WMSDs. Most of the respondents had good work ability (32%). Work ability was significantly associated with age, experience, working hours and exercise habits. The commonly used coping strategies in order to prevent musculoskeletal discomfort were getting help to handle heavy patients (92%), and modifying nursing procedures (81%). Owing to the high prevalence of MSDs among nurses, they should be educated about risk factors and adequate training should be given for prevention of WMSDs.

Key words: Musculoskeletal disorders, Prevalence, Work ability, risk factors, coping strategies

Introduction

Musculoskeletal disorder (MSD) is described as a disease that causes muscular pain or injury due to sudden or constant contact, repeated exercise, or inappropriate postural movements (Tantway et al., 2019). Musculoskeletal disorders (MSDs) are widely recognized as the cause of chronic pain and physical disability that affects hundreds of millions of people worldwide (Akodu et al., 2019). MSDs such as neck and low back pain are more prevalent among the occupational disorders and affect most of the population. Nursing is an integral part of the health care system, that includes health promotion, disease prevention, and caring for the physically sick, mentally sick, and disabled of all ages, in all health care and other public settings (Bartz 2010). It involves personal and transdisciplinary care for people of all ages, families, groups and societies, the sick or fit and in all cases (Vandali 2017).

Numerous internal and external factors have been embroiled in the pathophysiology of WMSDs. Repeated movements, abnormal posture, and high energy levels as the three main risk factors associated with WMSD (Silverstein et al., 1987). Nurses are reportedly the hardest hit among health care professionals (Yasobant et al., 2014).

The prevalence of the Work-related Musculoskeletal Disorders (WMSDs) among the nurses varies among studies. Studies in Turkey 90%, Japan 85.5 %, Nigeria 84.4% Estonia 84%, and Australia 80% (Tezel et al., 2005; Smith et al., 2003; Tinubu et al., 2010; Freimann et al., 2013; Smith et al., 2003) have reported higher prevalence of MSDs with low back being the most commonly reported site. The studies among the nurses of Maharashtra 89.1% (Anap et al., 2017) and Gujarat 89.2% (Raithatha et al., 2016) have revealed higher prevalence of WMSDs and concluded lower back as the most affected site. The most of the studies have been conducted in western countries and we did not come across any study in North India, and thus the objective of the study was to determine the prevalence, risk factors, effect on work ability and coping strategies utilized by nurses for MSDs.

Materials and Methods

Nurses working in a private hospital in Haryana, India with more than 12 months of experience, both male and female, aged between 20-60 years of age were included in the study. Nurses who reported any congenital spine deformity, history of inflammatory/ infectious disease/disorder or history of surgery were excluded. Incomplete forms were also excluded. The aim and objectives of this study were clearly elucidated to the subjects, who were also assured of the concealment of their responses. Written informed consent was obtained from all subjects after explaining the objectives of the study in an interactive session with them.

A web-based self-administered questionnaire was circulated using a link through online platforms. The Nordic musculoskeletal questionnaire (Kuorinka et al., 1987) was used to obtain information about prevalence of MSDs. The work ability was determined using work ability questionnaire (Junior et al., 2011). The tool also consisted of the items reporting perceptions of job risk factors and coping strategies utilized by nurses for MSDs

Statistical Analysis

Data was analysed using SPSS windows version 26. Demographic data was analysed using descriptive statistics. Inferential statistics of the chi-square test were used to determine the association between variables at an alpha level of $p < 0.05$.

Result

The majority (69%) of the participants belonged to the age group of 20-30 years. 72% were female. 53% of subjects under study were married. 74% of the subjects under study had a degree in nursing whereas 2% were diploma holders. The majority (41%) of the participants had a work experience of 1-3 years in a current hospital. 87% of the nurses under study worked as fulltime nurses and 12% of the respondents worked as administrative supervisors. 61% of the respondents worked in the intensive care unit and 31% worked in the wards. The majority (74%) of the nurses under study had three-shift rotations (8 hours a day) as a work mode. 88% of the nurses under study worked for more than 8 hours. The work of majority (87%) of the subjects involved standing for the 4-8 hours/ day. 72% of the nurses under study had no habit of exercise.

The data on the 7 day prevalence of work related musculoskeletal disorders revealed that the majority (84%) of the respondents had pain in neck region followed by lower back (75%). Similarly the 12 month prevalence of MSDs was higher for neck (79%) followed by the lower back (69%) (Table 1).

Table 1: Distribution of 7 day and 12 month prevalence of MSDs among nurses

Have you had trouble at any time during the past days? (N=100)	7 day (n %)	12 month n %)
Region	Yes	Yes
Neck	84	79
One or both shoulders	57	46
One or both elbow	9	10
One or both wrist and hands	20	20
Upper back	56	45
Lower back	75	67
One or both hips/thighs	19	19
One or both knees	73	20
One or both ankle/foot	17	16

The majority of the participants (95%) perceived working in the same positions for long periods and bending back awkwardly (84%) as a major factor leading to MSD. Inadequate rest breaks (87%), work schedule such as over time and irregular shifts (80%), lifting or transferring heavy patients (78%), treating an excessive number of patients (73%), were some other perceived risk factors for MSDs (Table 2).

Table 2: Perceived Risk Factors for MSDs among nurses

What according to you has led to your pain? (N=100)	Yes (n %)
Working in the same positions for long periods [standing, bend over, sitting, kneeling]	95
Lifting or transferring dependent patients	78
Bending or twisting your back in an awkward way	84
Treating an excessive number of patients in one day	73
Carrying, lifting, or moving heavy materials or equipment {eg. Cpm}	25
Performing manual orthopaedic techniques	12
Not enough rest breaks or pauses during workday	87
Work scheduling [overtime, irregular shifts, length of work day]	80
Working in awkward and cramped positions	62
Continuing to work while injured or hurt	64
Reaching or working away from your body	55
Unanticipated sudden movement of fall by patient	25
Inadequate training on injury prevention	62
Working near or at your physical limits	61
Working with confused or agitated patients	39
Performing the same task over and over	41
Assisting patients during walking activities	18

Association of Demographic Characteristics with 12 month prevalence of MSD revealed that number of hours worked per day ($X^2=6.085$, $p= 0.048$) and exercise habits ($X^2= 14.327$ and $p= 0.0049$) were found to be significantly associated with 12- month prevalence of WMSDs (Table 3).

Table 3: Association of Demographic Characteristics with 12 month prevalence of MSD

Characteristics	Yes n (%)	Total N (%)	X ²	P value
Age (years)				
21- 30	63 (68.47)	69 (69)	0.483	0.785 ^{NS}
31- 40	24 (26.08)	26 (26)		
41- 50	5 (5.4)	5 (5)		
Total	92 (100)	100 (100)		
Gender				
Male	26 (28.26)	28 (28)	0.39	0.844 ^{NS}
Female	66 (71.7)	72 (72)		
Total	92 (100)	100 (100)		
Years of experience				
0- 5	64 (69.5)	70 (70)		
5- 10	21 (22.8)	23 (23)	0.655	0.721 ^{NS}
More than 10	7 (7.6)	7 (7)		
Total	92 (100)	100 (100)		
Years of experience in present hospital				
0- 1	26 (28.26)	28 (28)		
1- 3	37 (40.2)	41 (41)	2.467	0.651 ^{NS}
3- 5	25 (27.17)	26 (26)		
More than 5	3 (3.26)	4 (4)		
Total	92 (100)	100 (100)		
Work mode				
Fixed (6 hours a day)	13 (14.1)	14 (14)		
Three shift rotation (8 hours a day)	67 (72.8)	74 (74)	1.272	0.530 ^{NS}
More than 2 work mode	12 (13.04)	12 (12)		
Total	92 (100)	100 (100)		
Numbers of hours worked per day				
Less than 8	9 (9.78)	12 (12)		
8 and above	83 (90.21)	88 (88)	6.085	0.048*
Total	92 (100)	100 (100)		
Standing {hours/day}				
0-4	5 (5.43)	10 (10)		
4- 8	81 (88)	84 (84)	5.862	0.210 ^{NS}
>8	6 (6.5)	6 (6)		
Total	92 (100)	100 (100)		
Department type				
Wards	36 (39.1)	39 (39)		
Intensive care unit	56 (60.9)	61 (61)	0.008	0.928 ^{NS}
Total	92 (100)	100 (100)		
Job title				
Full time nurses	80 (87)	87 (87)		
Part time nurses	1 (1.1)	1 (1)	0.089	0.956 ^{NS}
Administrative supervisor	11 (11.9)	12 (12)		
Total	92 (100)	100 (100)		
Body weight {kg}				
<45	1 (1.08)	1 (1)		
45- 55	16 (17.39)	18 (18)		
55- 65	37 (40.2)	42 (42)	3.543	0.471 ^{NS}
65- 75	27 (29.34)	27 (27)		
>75	11 (11.9)	12 (12)		
Total	92 (100)	100 (100)		
Height {cms}				
<154	5 (5.43)	6 (6)		
155- 159	17 (18.47)	19 (19)		
160- 164	23 (25)	25 (25)		

165- 169	28 (30.43)	29 (29)	3.268	0.659 ^{NS}
170- 174	16 (17.39)	17 (17)		
>175	3 (3.26)	4 (4)		
Total	92 (100)	100 (100)		
Exercise habits				
None	70 (76.086)	72 (72)		
2-3 times a week	8 (8.69)	10 (10)	14.327	0.0049**
Daily	14 (15.2)	18 (18)		
Total	92 (100)	100 (100)		

*p<0.05 **p<0.01 ***p<0.001 Non Significant^{NS}

Table 4 depicts the association of demographic variables with work ability. The age ($X^2= 25.55$, $p= 0.001$), years of experience ($X^2=21.856$, $p=0.001$), work mode ($X^2=19.403$, $p=0.001$), and hours worked per day ($X^2= 6.485$, $p=0.011$) were found to be significantly associated with work ability and revealed nurses aged between 21-30 years (84.84%), had 0-5 years of experience (84.8%), worked for more than 8 hours (93.9%), and had three shift rotation duty of 8 hours per day (83.3%) had higher work ability. The ($X^2= 3.148$, $p= 0.076$) work ability was not found to be significantly associated with 12 month prevalence of work related musculoskeletal disorders.

Table 4.10: Association of Demographic Characteristics with Work Ability

Variables	Work Ability				
Characteristics	Low ability n (%)	Higher ability n (%)	Total N (%)	X ²	P value
Age (Years)					
21-30	13 (38.23)	56 (84.848)	69 (69)		
31-40	16 (47.05)	10 (15.15)	26 (26)	25.55	0.001**
41-50	5 (14.7)	0 (0)	5 (5)		
Total	34 (100)	66 (100)	100 (100)		
Gender					
Male	8 (23.52)	20 (30.3)	28 (28)	0.511	0.475 ^{NS}
Female	26 (76.47)	46 (69.6)	72 (72)		
Total	34 (100)	66 (100)	100 (100)		
Years of experience					
0-5	14 (41.17)	56 (84.8)	70 (70)		
5-10	14 (41.17)	9 (13.6)	23 (23)	21.856	0.001**
More than 10	6 (17.64)	1 (1.51)	7 (7)		
Total	34 (100)	66 (100)	100 (100)		
Work mode					
Fixed	12 (35.29)	2 (3.03)	14 (14)		
More than two work mode	3 (8.82)	9 (13.6)	12 (12)	19.403	0.001**
Three shift rotation { 8 hours a day }	19 (55.88)	55 (83.33)	74 (74)		
Total	34 (100)	66 (100)	100 (100)		
Hours worked per day					
Less than 8	8 (23.52)	4 (6.06)	12 (12)	6.485	0.011*
8 and above	26 (76.47)	62 (93.9)	88 (88)		
Total	34 (100)	66 (100)	100 (100)		
Standing hours per day					
0-4	4 (11.76)	3 (4.5)	7 (7)		
4-8	28 (82.35)	59 (89.39)	87 (87)	1.800	0.407 ^{NS}
>8	2 (5.88)	4 (6.06)	6 (6)		
Total	34 (100)	66 (100)	100 (100)		
Body weight (kg)					
<45	1 (2.9)	0 (0)	1 (1)		

45-55	6 (17.64)	12 (18.18)	18 (18)		
55-65	13 (38.23)	29 (43.9)	42 (42)	2.438	0.656 ^{NS}
65-75	9 (26.47)	18 (27.2)	27 (27)		
>75	5 (14.7)	7 (10.6)	12 (12)		
Total	34 (100)	66 (100)	100 (100)		
Height (cm)					
<154	2 (5.8)	4 (6.06)	6 (6)		
155-159	9 (26.47)	10 (15.15)	19 (19)		
160-164	8 (23.52)	17 (25.7)	25 (25)	2.959	0.706 ^{NS}
165-169	9 (26.4)	20 (30.3)	29 (29)		
170-174	4 (11.7)	13 (19.6)	17 (17)		
>175	2 (5.8)	2 (3.03)	4 (4)		
Total	34 (100)	66 (100)	100 (100)		
Exercise Habit					
None	28 (82.35)	44 (66.6)	72 (72)		
2-3 times a week	2 (5.8)	8 (12.12)	10 (10)	2.753	0.252 ^{NS}
Daily	4 (11.76)	14 (21.2)	18 (18)		
Total	34 (100)	66 (100)	100 (100)		

*p<0.05

**p<0.01

***p<0.001

Non Significant^{NS}

Table 5 depicts the data for the coping strategies adopted by nurses to prevent MSDs. The majority (92%) of the participants under study responded that they got someone to help them to handle a heavy patient. 81% modified their nursing procedure and those who modified patient's position were 78%. Only few (35%) warmed up and stretched before performing their nursing duties and only (30%) paused regularly to stretch and change posture.

Table 5: Distribution of coping strategies adopted by nurses under study

What are the strategies adopted by you to prevent your pain N=100	Yes (n %)
I get someone to help me handle a heavy patient	92
I modify my nursing procedure to avoid stressing an injury	81
I modify the patient's position/my position	78
I stop a treatment if it causes or aggravate my discomfort	49
I warm up and stretch before performing my nursing duties	35
I select techniques/procedures that will not aggravate or provoke my discomfort	73
I adjust plinth/ bed height so I can stretch and change posture	72
I use different parts of my body for ease in administering my nursing procedure	74
I pause regularly so i can stretch and change posture	30

Discussion

In this study we documented the prevalence of WMSDs among nurses. The response rate for this study was 100%, which is similar to that found by Jin et al., in 2011. The possible reason being that nurses were well informed about the MSDs prior to the conduct of the study. The 12 month prevalence of MSDs among was found to be higher which corroboration is with the studies performed on the nurses of Lagos state (94.4%), Japan (91.9%), Maharashtra (89.1%) (Akodu et al., 2019; Kondo et al., 2003; Anap et al., 2017) and prevalence was higher than that of Pakistan (31.5%); USA (35.1- 47%); Thailand (47.8%) (Rathore et al., 2017; Trinkoff et al., 2002; Thinkhamrop et al., 2017). These differences may be attributed to ethnocultural variations, variation in work loads, use of lifting shifting devices, and availability of nursing aids as a supporting staff. This study revealed that there were more female than male nurses who experienced WMSDs which is similar to the previous studies. The nurses aged between 21- 30 years had higher prevalence rate of MSDs and least in the age group of 41- 50 years. Previous studies reported that the nurses aged 26-30 years had higher prevalence of MSDs. (Ajibade et al., 2013; Attar et al., 2014). The reason might be because younger nurses have less refined nursing skills and less precise care actions, resulting in higher risk of musculoskeletal pain (Lin et al., 2020).

The present study revealed that most of the nurses experienced initial symptoms of MSDs in the first five years of their clinical practice and this result was in line with the results of Tinubu et al., 2010. According to the present study, working time for more than 8 hours is statistically significant for developing MSDs. There is a significant association of exercise habits with the development of WMSDs and the study revealed that the

prevalence was higher among the nurses who were not having habit of doing exercise. The study observed no significant association of age, gender, years of experience, standing hours, body weight and height with WMSDs which is similar with the finding of Munabi et al., 2013. In a similar context, Akodu et al., 2019 identified no significant association of demographic characteristics with development of WMSDs. Concerning the 12- month prevalence of MSDs the present study reported that most of the nurses had neck pain followed by lower back pain, shoulder pain, upper back pain, knee pain, wrist/ hand pain, hip/ thigh pain, ankle/ foot pain, elbow pain. Similar to the study, the higher prevalence of neck pain, lower back and shoulder pain was reported in previous studies (Lee et al., 2013; Lin et al., 2020). Most of the studies reported low back as the most affected region followed by the neck (Tinubu et al., 2010; Moreira et al., 2014; Rathore et al., 2017). It might be due to their excessive lifting of the patients and higher work loads and, in our population. In addition, the nurses had physical burden at all times, affecting prolonged static postures, and upper extremity strain.

Job related risk factors

Some of the previous studies reported that working in the same positions for prolonged periods, lifting or transferring dependent patients, and treating an excessive number of patients per day were the most perceived job risk factors precipitating WMSDs among the nurses (Tinubu et al., 2010). Similarly, the current study also highlights working in the same position for prolonged period, inadequate breaks during the working hours, work scheduling such as overtime and irregular shifts, and bending the back in an awkward way as the most perceived risk factors precipitating WMSDs. Chiwaridzo et al., 2018, reported overtime irregular length of the day, and inadequate breaks as the most perceived factors leading to WMSDs among nurses.^[31] Inadequate breaks, work scheduling such as overtime and irregular shifts, working near or at physical limits, and performing manual orthopaedic techniques were the risk factors closely related to the development of WMSDs. In the previous study, Wang et al., in 2011 revealed that the rest periods of 15 min could assure the recovery of the erector muscle of the spine and heart rate into the normal range.^[32] Therefore, adequate rest intervals are recommended for prevention of MSDs in nurses.

Work Ability of the nurses

The age, years of experience, work mode, working hours per day, and exercise habits are the variables that influence the WAI. In this study, 46% of the WAI score obtained (>37 points) of the subjects. The total WAI score found in this study was parallel to the former study on the nurses of Lagos state (47.40%). (Akodu et al., 2019) The present study revealed that most of the subjects perceived their work to be both physically and psychologically demanding and only few perceived it to be only psychologically demanding. The similar results were concluded in the study conducted on the nurses of Lagos state (Akodu et al., 2019). Furthermore, the outcomes of this study concluded that around one third of the respondents had very good work ability. On further analysis we found that there was no significant relationship of gender, department type, standing hours per day, body weight, height, exercise habits with work ability. In this study, a significant association between age, years of experience, work mode, hours worked per day, and work ability was observed. The work ability of the nurses was observed to decrease with the increase in age and years of experience. None of the subjects above 40 years of age and more than 10 years of experience had excellent work ability. On the contrary, the study conducted on the nurses of Lagos state concluded that age and years of experience did not influence work ability. The work ability was observed excellent in those who worked for more than 8 hours a day it might be due to their excellent work ability because of which they were able to do work for longer durations.

Coping strategies adopted by the nurses

The study revealed that getting help from someone to handle heavy patients, modifying nursing procedures to avoid stressing an injury, modifying patient's position, and using different parts of the body for ease in administering nursing procedure were the major coping strategies adopted by the nurses. These coping strategies seem similar to previous findings which concluded that getting assistance, modifying the nursing procedures, modifying patient's position as the top three coping strategies used to reduce the risk of WMSDs (Akodu et al., 2019; Tinubu et al., in 2010). Inadequate warm up and lack of adequate pauses may some of other factors lead to MSDs. This lack of warm up and pauses may be due to overburdened health care system on lack of awareness for proper warm up and breaks for prevention of MSDs. Thus, appropriate preventive programs are need to be organised that can contribute to work ability of nurses.

Conclusion

The prevalence of musculoskeletal disorders among nurses was more in females than males. Neck and lower back were the most affected body parts and simultaneously are at higher risk to develop MSDs. So, the nurses should be educated about the various risk factors and appropriate training should be given for prevention of WMSDs.

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A Literature Review on Neuromuscular Coordination and its association with BMI in children

*Nidhi Sharma**Manu Goyal

Ph.D. Scholar, Professor Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala, Haryana-133207, India.

sharmanidhiphysio@gmail.com

Abstract

Background: Neuromuscular coordination is the harmonious interaction between various segments of the body, where the neurological and musculoskeletal system works concomitantly for any kind of perturbations. BMI is an indicator of total body fat which is regulated by various physiological activities and musculoskeletal activity is one of them. **Objective:** To review the association between neuromuscular coordination and BMI among children. **Methods:** Databases such as PubMed, Google Scholar and PEDro have been searched with search terms including ‘coordination’, ‘body mass index’, and ‘children’ using Boolean operators AND, OR and NOT. Hand-picked articles were also included. All types of studies have been included except any kind of review, correspondence, commentaries, editorials or book chapters and standalone abstracts were excluded. Studies involving adult participants were also excluded. **Results:** 36 articles have been reviewed in which the gross motor and/or fine motor coordination and BMI were taken as variables. Secondary association has been analyzed with age and other anthropometric measurements. **Conclusion:** It has been concluded that motor coordination was negatively correlated with BMI. It was also found that younger overweight/obese children showed better coordination than that of older overweight/obese children. Greater waist circumference also affects the ability of the children to perform physical activity and found at a greater risk of falling into obese population and thereby affecting their neuromuscular coordination.

Keywords: Children, Coordination, Body Mass Index, Obesity, Overweight, Review

Introduction: Coordination is the harmony between musculoskeletal and neurological system, resulting in adjustment among intra-limb segments and inter-limb segments of the body. These adjustments are often rapid, accurate and balanced motor response to the perturbations received by the body. The motor responses are represented in the form of stability which may include static and dynamic balance, and locomotion, which together defined as gross motor coordination. These fundamental motor skills comprises of locomotor abilities which make the person’s walking and running efficient with more stability. (Fernandes *et al.*, 2016)

Motor coordination plays a vital role in the development and active life style during the growing age as it has been evident that children are more involved in physical activity who are having high level of motor coordination and vice-versa. Physical activity impacts the levels of motor skills and thereby the coordination. Numerous studies proved that there is an inverse relationship exists between physical activity and weight of the individual and hence, coordination and body mass index (BMI). (Lopes *et al.*, 2018; Andrade, Davidson and Santos, 2020) Studies showed that higher BMI results in physical inactivity and loss of coordination more frequently during the developing age. (Giuriato *et al.*, 2021)

According to World Health Organization (WHO), BMI more than 25 and 30, are considered as overweight and obese individuals respectively. As per the inferences drawn between the years 1975 and 2016, prevalence of overweight and obese children increased quadruple from 4-18% among the age group of 5-19 years across the globe. Not the developed countries, it is the developing countries which took the lead in having majority of overweight and obese children with the rate of increase is 30%. https://www.who.int/health-topics/obesity#tab=tab_1

All these data show that the body mass index plays a crucial role in determining the motor skills of an individual and in turn the coordination. It has been mentioned that the negative association is based on the biomechanical aspects, according to which the more is the body mass, more is the mechanical work required to perform the motor activity which require weight bearing such as during walking, jumping or running. Hence motor coordination is affected with greater body mass. (Chagas and Batista, 2016)

Hence, a literature review was conducted aimed to determine the association between neuromuscular coordination and the body mass index among children.

Methodology

Search Terms and Search Strategy: An extensive literature search was conducted using databases PubMed, Google Scholar, Web of Science, PEDro and Hand-picked articles (articles from the bibliographies of the articles and articles while searching the web) using search terms “coordination”, “neuromuscular coordination”, “motor skill”, “BMI”, “obesity”, “weight”, “children”, “pediatric”, “infants” using Boolean operators AND, OR, NOT. The articles were searched from inception to February 2023.

Selection criteria: All types of studies were included in this review such as Randomized Controlled Trial, Clinical Trials, Observational/ Cross-sectional studies, conducted on typical children or diseased pediatric population up to the age group of 17 years. Coordination or motor skill was taken as one of the variables to be assessed and Body Mass Index (BMI) was used as one of the determinants among these studies. Any kind of

book chapters/ books, stand-alone abstracts, opinion letters, editorials, correspondence or any kind of reviews were excluded.

Selection process and Data Extraction: All the databases were searched by one of the reviewers (NS) and imported all the selected articles into the Mendeley desktop. Characteristics of studies such as aim of the study, type of study, population, age group, intervention, outcome and inference drawn from the study were recorded. Second reviewer (MG) verified the extracted data from the selected studies.

Result and Discussion:

Synthesis: The data has been synthesized by NS and verified by MG on the basis of the objective of the review. The coordination outcomes and their relation with body mass index was analyzed in the articles included. Height and body weight were considered as the secondary outcomes of the review. Total 32 articles have been reviewed and inferences have been drawn from them. **(Table 1).**

Table 1: Studies on Neuromuscular Coordination and its association with BMI in children

Author/Year	Aim	Population	Intervention	Outcome measure	Inference
Gallotta et al./2022	To investigate the impact of living environment, geographical area, and gender on weight status, motor coordination, and physical activity (PA) level in Italian school-age children	(n=1549) Children aged between 8 and 13 years.	Anthropometric parameters were measured including standing height and body weight with which body mass index (BMI) was calculated. Gross motor coordination was assessed to compare the outcomes.	- Körperkoordinations Test für Kinder (KTK) - Italian version of the Physical Activity Questionnaire for Older Children (PAQ-C-It)	Lower motor quotient (MQ), lower PA level, living in a rural setting, and living in a car-dependent neighbourhood were all associated with a higher relative risk of obesity. The alarmingly high percentage of overweight and obesity in children, as well as motor coordination impairments, revealed the critical need for targeted PA interventions in the paediatric population.
Jarnig et al./ 2022	The purpose of this study was to look into the effects of COVID-19-related mitigation measures on the health and fitness of Austrian primary school children.	(n=303) Primary school children	Height, weight, and fitness measurements were taken prior to the COVID-19 pandemic and once annually for two consecutive years while the pandemic was active.	6-minute run (6MR) - Standing long jump 1 kg medicine ball throw (MB1kg) - Shuttle run test (4 x 10 SHR) - Side jumping (JS) - V sit-and-reach test (VSR) - Ruler drop test (RD)	Body mass index (BMI) alarmingly increased in the first year, and action speed and cardiorespiratory endurance (CRE) both experienced sharp declines. The BMI scores stabilised in the second year, and CRE scores improved, particularly in the subgroup of kids who were involved in sports.
Monacis et al./ 2022	The purpose of the current study was to examine differences in levels of physical activity, enjoyment, and self-perception in children according to gender and BMI and to ascertain the mediating roles of physical self-perception in the relationship between BMI and physical activity.	(n = 1029, M = 505, F = 524) 11–12-year-old secondary school going children.	Physical activity levels, physical self-perception, and enjoyment are evaluated with the help of different questionnaires.	- The Physical Activity Questionnaire for Older Children (PAQ-C) - The Physical Activity Enjoyment Scale (PACES) - The Physical Self-Efficacy Scale for Children	According to the findings, there were no significant differences in enjoyment between children who were normal weight, overweight, and obese (especially in girls).
Madrona et al./ 2021	This study's main goal was to compare the psychomotor growth of five-year-olds who were born full term versus preterm.	(n=672) 5-year-olds enrolled in the third year of early childhood education made up the sample.	In order to compare, physical-motor, perceptual-motor, socio-relational, and affective skills were evaluated.	- The Psychomotor Aspects Scale (PSAS) - The Perceptual-Motor Aspects Scale (PEAS) - The Emotional-Social Aspects Scale (ESAS)	The results demonstrate that premature children had lower levels of physical-motor skill development. In the perceptual-motor field, preterm children scored lower on measures of their body image and body schema, motor dissociation, and visual-motor coordination, as well as socio-relational and affective aspects. Conversely, there was no difference in lateralization,

					dynamic coordination, motor execution, tonic-postural control, or the development of balance.
Denyssh en et al./ 2021	The study's objective was to ascertain whether children in South Africa from low- and middle-income areas who performed below the 16th percentile on the Movement Assessment Battery for Children-2 had lower levels of health-related fitness than children who were typically developing (TD).	(n=146) children were included aged between 10 and 11 years based on their poverty classification.	Body mass index (BMI)-z, body fat (BF), and waist circumference were used to measure body composition. Children's anaerobic, aerobic, and muscular strength were measured.	- Bruininks–Oseretsky test of motor proficiency second edition (BOT-2) - Progressive Aerobic Cardiovascular Endurance Run (PACER)	Despite reports to the contrary, 10 to 11-year-old South African children living in rural areas do not (yet) have a higher risk of being overweight or obese than TD children (North West Province).
Battaglia et al./ 2021	This cross-sectional study looked at the relationship between weight status and motor coordination (MC) across early adolescence and childhood in a reasonably large sample of Italian elementary and middle school students.	(n=1961) School students (1,026 boys and 935 girls) were stratified into three successive age categories (6-7, 8-10, and 11-13 years) and four weight status categories (underweight, normal weight, overweight, and obese)	Body weight (kg) and height (m) were assessed with an electronic scale and a standard audiometer. BMI was calculated, and Cole's BMI index was used to segregate children in different weight categories.	Körperkoordinationstest für Kinder (KTK)	Age, gender, and weight status did not contribute to affect MQ levels. These findings highlighted the significance of designing targeted motor programmes that take these factors into account to improve MC performance by demonstrating the detrimental effects of higher weight status on MC performance according to age and gender.
Waal and Pienaar et al./ 2021	This study aims to identify the long-term effects of overweight on perceptual-motor proficiency (PMP) in South African primary school students in the North-West Province.	Primary school children (n=381) for period of seven school years (2010–2016).	Children's BMI was calculated and they were divided into 4 groups accordingly. strength, balance, and running speed and agility were used to assess PMP through BOT-2.	Bruininks Oseretsky Test of Motor Proficiency-2 (BOT-2) Short Form	Having a persistent weight problem has a negative impact on some aspects of motor competence, but losing weight can offset these effects.
Pereira et al./ 2021	This study looked into the relationships between biological and environmental factors and gross-motor coordination (GMC) in children and adolescents from Peru.	(n=7401) children and adolescents aged between 6 to 14 years	Age, sex, height, BMI, physical fitness, stunting, and maturational status were biological factors that were measured.	Körperkoordinationstest für Kinder	The findings revealed a high prevalence of GMC scores below average. These findings imply that reducing below-normal GMC among Peruvian children and adolescents requires early identification, as well as educational and paediatric care interventions.
Iijima et al./2021	The purpose is to determine whether obesity and neurocognitive impairment are related in childhood acute lymphoblastic leukaemia survivors (ALL)	Survivors of childhood ALL who were 8 years old or older and at least 5 years from their diagnosis (n=210)	Between the time of diagnosis and the end of treatment, fixed time points were designated for the collection of height and weight data, which were then used to calculate BMI. Examining executive function, attention, and processing speed were the main areas covered by neurocognitive assessments.	- Delis-Kaplan Executive Function System, - Wisconsin Card Sorting Test - Rey Complex Figure Test - Wechsler Abbreviated Scale of Intelligence - Conners' Continuous Performance Test - Grooved Pegboard Test.	During long-term follow-up, obesity was significantly linked to neurocognitive impairment, and this link prompted early ALL treatment. Patients who are at risk require novel early interventions to provide cognitive training and prevent weight gain.
Vandoni et al./ 2021	The study sought to determine the relationship between various fitness factors and children's levels of fatness.	Italian school going children.(n=485) aged between 7 to 12 years.	BMI and fat mass prediction model outputs were used as indicators of body fatness, and physical fitness (PF) was also measured.	9-item test battery which mainly focuses on these components:- explosive power, leg muscle power, arm muscle power, upper body power, coordination, agility, speed and endurance.	Findings emphasize the significance of examining children's and adolescents' levels of fatness in relation to various fitness components.
Gama et al./ 2021	to examine the ANS modulation during	(n=30) Children aged 8 to 12 were divided	Both groups were scrutinized for	Movement Assessment Battery for Children-2	During posture change, children with p-DCD had

	supine and standing postures, as well as stress and anxiety, using survey data from kids with likely DCD (p-DCD).	into two groups based on age, gender, peak oxygen uptake (aerobic power), and body mass index (BMI): p-DCD and typically developing (TD).	stress/anxiety assessment by questionnaire and spectral, symbolic, and complexity heart rate variability (HRV) studies during posture adjustments.	(MABC-2) 20 m Shuttle Run (20-MST) - Children Stress Scale (CSS) - RR interval data collection for Heart Rate Variability analysis	similar autonomic control function as TD children (supine to standing). Stress and anxiety symptoms caused by p-DCD had no effect on their ANS modulation.
Hoffman et al./ 2020	The study's objective was to investigate the associations between anthropometric traits and motor performance ability (MPA), district-level social environmental factors, and other potential health determinants in kindergartners.	Kindergartners (n=434) aged between 3 to 6 years.	Body measurements were calculated in relation to the IOTF's proposed international cut-offs for height, weight, and BMI and Waist Circumference (WC).	- Life situation index [LSI] - Modified Baecke Habitual Physical Activity Questionnaire (HPAQ)	The results suggest that measurements of motor performance ability (MPA) in kindergartners are correlated with waist circumference rather than BMI, and that there may be a separate relationship between MPA and the social environment of the neighbourhood where the kindergarten is located.
Pal et al./ 2019	The current study aimed to compare the motor function of school-age kids with normal birth weight (NBW) and low birth weight (LBW).	(n=471) school going children ages between 5 to 10 years	Using a pre-structured schedule questionnaire, various socio-demographic characteristics of the participants were examined. Multiple outcome measures were used to examine both gross and fine motor function.	- Ruler catching method - Standing Broad Jump Test - Vertical Jump Test (Sargent Jump Test)	Even after adjusting for the effects of age, gestational age, postnatal growth, and socioeconomic status, this study discovered a significant correlation between birth weight and motor skills in children of school age. It follows that infants with LBW have a propensity for neuro-developmental impairments during childhood.
Madrona et al./ 2019	The current study aimed to examine the psycho-motor performance of five-year-old children with various body mass indices (BMI).	(n=694) preschoolers of 5 years of age.	Using a standardized observation sheet, the performance in terms of motor, perceptual, and social-emotional skills was evaluated, and then their BMI was compared. Boys and girls were compared separately.	Checklist of Psychomotor Activities (CPA)	Results showed that the performance of the girl groups varied significantly across all motor and perceptual tasks as well as the social relationships subfactor of the social-emotional factor. Both laterality and visual-motor coordination significantly varied between boys and girls (favoring overweight boys).
Moreira et al./ 2019	The current study compares four ways to calculate the test's factorial score, including the exact sum of the scores, the sum of the standard scores, the weighted method, and the refined method. It also investigates the factor structure of KTK in a Brazilian sample.	(n=565) from 5 to 10 years of age.	Factor analysis of Körperkoodinationstests für Kinder was performed	Körperkoodinationstests Für Kinder (KTK)	The findings demonstrated that for the entire sample, by sexes, and by age groups, the KTK factor structure was suitable for the model. The invariance between sexes and age groups, however, was not supported by the results.
Majewski et al./2018	This study sought to determine the relationship between prematurity and motor development as well as the level of neuromotor function and somatic development in 6- and 7-year-old children born before the 30th week of pregnancy with that in full-term children at the same age.	(n=80) Prematurely born children of age 6 and 7 years with mean gestational age 27.8±1.6 weeks (n=40) Typically developing children with normal birth weight (>2500 g) (n=40)	The BMI index (kg/m ²), children's weight (kg), and height (cm) were all measured along with the neurological examination.	- Touwen neurological examination criteria. - Examining factors such as hand preference, laterality, synkinesis, and asymmetry were given particular attention.	When compared to their full-term peers, the prematurely born, non-disabled children have significantly worse average outcomes for hand function, walking quality, muscle tone, coordination, and diadochokinesis at ages six to seven.
Laukkane et al./ 2017	This research examined the relationships between physical	(n=64) children aged between 5 and 7 years.	Prevalent body weight and height were evaluated, and data on weight and height	- Körperkoodinationstest für Kinder (KTK) - Triaxial accelerometer	Middle childhood MC was found to be significantly correlated with age and

	activity (PA), motor coordination (MC), and early and middle childhood BMI.		during the early years was based on parental reports of the report cards on the child's medical care. BMIz scores that have been adjusted for age were determined using references to international growth curves.		MVPA. BMIz scores in boys did not exhibit any association with MC trend. According to this study, the relationship between childhood motor development and BMI may be influenced by sex-specific mechanisms.
Wentz et al./ 2017	To make a comparison between the children's metabolic profiles and body mass index (BMI) in for the purpose of investigating the prevalence of neurodevelopmental disorders in obese children.	Severely obese children (n=76) were recruited	Using interviews and questionnaires, neurodevelopmental disorders such as attention deficit/hyperactivity disorder (ADHD), autism spectrum disorder (ASD), and developmental coordination disorder (DCD) were evaluated.	- The Development and Well-Being Assessment (DAWBA) - The Five to Fifteen parent questionnaire - The Autism Spectrum Screening Questionnaire (ASSQ) - The Adult ADHD Self-Report Scale (ASRS)	One-third of obese children have a neurodevelopmental disorder, including aberrant motor skills, and these issues may worsen their body mass index (BMI)
Krause et al./ 2016	to study the relationships between children's weight, adiposity, and thyroid-related metabolic indicators.	(n=1203) children within the age of 5-18 years were sampled and divided into children without obesity (n=631) and with obesity (n=572)	Height and weight were measured to calculate BMI score and their blood was collected to evaluate the hormonal levels. A fraction (n=829) also had their fat mass measured using dual-energy x-ray absorptiometry.	- Thyroid-stimulating hormone (TSH) - Free thyroxine (FT4) - Lipid profiles including triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C) and total cholesterol (TC), and leptin	In addition to having a higher prevalence of abnormally high TSH, pediatric obesity is linked to higher TSH and lower FT4 concentrations. Through its effects on TSH secretion, leptin may help to partially explain how obesity affects thyroid status.
Joshi et al./ 2015	To determine whether there is a gender-specific difference in the relationship between BMI and waist size in adolescents with and without probable DCD (pDCD). (2) Investigate whether variations in physical exercise between kids with and without pDCD contribute to variations in BMI and waist circumference over time.	Children with probable DCD (pDCD) (n=2278), aged 9-10 years.	Motor coordination, body composition and physical activity were assessed. The first wave of data was gathered in the spring of 2005, and subsequent waves 2 through 7 were conducted in the autumn of 2005, the spring and fall of 2006, the spring and fall of 2007, the spring and fall of 2008, and the fall of 2009 (wave 8).	- Short form of the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP-SF) - Height, Weight, BMI, Waist circumference - Participation Questionnaire	Children with pDCD have higher BMI and waist circumference. In comparison to girls with pDCD, boys were found to experience a faster rise in BMI and waist circumference. The link between pDCD and measurements of body composition was not mediated or moderated by physical activity.
Moura-Dos-Santos et al./ 2014	To examine how a child's birth weight affected their motor skills and body composition	Typically developed children (n=483), aged 7 to 10 years	The execution of motor performance included gross motor coordination and various physical exercise components. Handgrip strength, muscular stamina, explosive power, flexibility, agility, running speed, and maximal oxygen consumption were used to gauge physical fitness. (VO2max). K�rper Koordination Test for Kids was used to assess children's gross muscle coordination. (KTK).	K�rperkoordination tests f�r Kinder (KTK)	Birthweight did not affect gross motor coordination, but it did substantially predict height, BMI, FFM, and performance in strength and velocity tests.
Olesen et al./ 2014	to identify gender differences in body mass index (BMI), motor skills (MS), and physical activity (PA), including PA patterns by day type and time of day in children aged 5 and 6 years.	Preschoolers (n=627), aged 5 and 6 years	Body Mass Index (BMI), motor skills (MS) and physical activity (PA) were used to establish gender variations.	- Movement Assessment Battery for Children (Second Edition) - Kiphard-Schilling body coordination test - K�rperkoordination Test f�r Kinder - Accelerometry	There is a significant between-preschool variation in PA, which suggests that girls are much more sensitive to the PA environment provided while attending preschool than boys.
Santos et al./ 2014	The purpose of this study was to examine	(n=483) children aged between 7-10	Gross motor coordination and various physical	K�rper Koordination Test f�r Kinder (KTK)	Although birthweight had no effect on gross motor

	how a child's birthweight affected their motor skills and body composition.	years.	fitness elements were used to systematise motor performance.	• Handgrip Dynamometer • Standing Long Jump • Curl ups • Sit and reach • 1 mile run/walk test • Square test • 20 meter sprint time • VO2max	coordination, it was a significant predictor of height, BMI, FFM, and performance in strength and velocity tests.
Hondt et al./ 2014	This study examined the correlation between children's weight status and their level of gross motor coordination over time, with baseline physical activity (PA) as a potential mediator.	(n=2517) children were recruited between the age of 5-13 years.	Basic anthropometric measurements were taken to calculate BMI, motor coordination and physical activity were also assessed at baseline and at the time of follow up.	• K��rperkoordinationstest f��r Kinder (KTK) • (BMI) z-scores • Flemish physical activity questionnaire (FPAQ)	The findings strongly imply that children's weight status has a negative impact on their level of gross motor coordination in the future and vice versa. Measures for prevention and intervention should take into account this reciprocal causal relationship over the course of development.
Fliers et al./ 2013	The current study investigated the Body Mass Index (BMI) in children with ADHD and its associations with age, gender, inhibitory control, developmental coordination disorder (DCD), sleep duration, and methylphenidate use. It also looked at the severity of the ADHD and comorbid symptoms.	(n=372) aged 5 to 17 years, Dutch children with combined types of ADHD.	BMI was calculated and categorized according to international age- and gender-specific reference values. gender, age, parent- and teacher-rated ADHD and comorbid scores, inhibitory control, sleep duration, motor coordination and methylphenidate were also measured to predict BMI-SDS values.	• Conners' parent and teacher rating scales • Parent and teacher Strengths and Difficulties Questionnaires (SDQ) • The Social Communication Questionnaire (SCQ) • Computerized Stop-signal task • Developmental Coordination Disorder Questionnaire (DCDQ)	Boys who have ADHD are more likely to be obese. Girls between the ages of 10 and 12 have the highest prevalence of obesity among girls with ADHD. Their likelihood of being obese is four times higher. Obesity does not affect sleep quality, motor coordination, or use of methylphenidate, but it is associated with increased oppositional and social communication issues.
Castetbon and Andreyeva/ 2012	To determine the relationship between obesity and motor abilities in children aged 4 and 6 in the US.	Preschooler children (n=5100), aged 4 years and Kindergarten children (n=4700), aged 5-6 years	Standardized procedures were used to objectively assess height, weight, fine and gross motor skills.	Categorical and continuous measure of body weight status were used including • BMI • BMI z-score	Obese young children showed no reduction in overall coordination or fine motor skills.
Lopes et al./2011	to examine the relationship between motor coordination (MC) and body mass index (BMI) in early adolescence and childhood.	Data were gathered from (n=7175) aged 6 to 14 (n= 3616 boys and n=3559 girls).	Body mass (kg)/height (m ²) was used to calculate BMI based on height and weight measurements.	• Kiphard-Schilling's body coordination test (KTK)	Along with early adolescence, motor coordination showed an inverse relationship with BMI in childhood. Early adolescence saw a decline in the strength of the inverse relationship, which had grown stronger during childhood. Both boys and girls who were overweight or obese showed significantly lower MC than those who were of a healthy weight. Children.
Sola et al./ 2010	To determine whether a physical activity-based intervention for obese and inactive children that is implemented in primary healthcare is feasible and has an impact on BMI and physical fitness.	(n=62) Children aged 6 to 14 who are not active physically and have an iso-BMI of 30 kg/m ²	a 40-week, physically intensive intervention programme with some lifestyle counselling for the overweight child and one parent.	• Body mass index (BMI) • Maximum oxygen uptake • Physical fitness in tests of running, jumping, throwing, and climbing	This one-year activity-based treatment for obese and inactive kids in primary care was successful because it raised cardiovascular and physical fitness levels and resulted in lower BMI in the participants. Dropout rates were high and were reliant on parents' attendance and compliance with physical activity.
Cairney et al./ 2010	The longitudinal development of relative weight and waist circumference in	2378 children with and without probable developmental coordination disorder	Height, weight was measured to calculate BMI. Measurement and identification of waist	• The Bruininks-Oseretsky test of Motor Proficiency (BOTMP)	Our research revealed that children with possible developmental coordination disorders had

	school-aged children with and without potential developmental coordination disorders was examined in the study.	(age group 9-10 years)	circumference and development coordination disorder was done respectively.		a higher risk of being overweight and obese than kids without the disorder. Throughout the research period, this risk did not decrease.
Toia et al./ 2009	In this study, pre-school aged overweight or obese children's motor skills were compared to their weight status.	Kindergarten children (n=1228)	Age, height, weight, and BMI are anthropometric measurements that were evaluated.	Modified Karlsruher Motor Ability Screening Test	The motor skills of preschoolers who were overweight or obese were no worse than those of kids who were of a healthy weight. But the high rate of overweight kids and motor deficits suggests that preventive measures ought to begin at this young age.
Graf et al./ 2005	This study compares the effect of intervention on BMI and motor abilities after a few months in 12 randomly selected primary schools to 5 randomly selected control schools.	Children (n = 651) who participated in the baseline and follow-up tests were considered.	The anthropometric data were evaluated, and the BMI was calculated. The coordination and endurance performance were analyzed.	- Lateral Jumping 6-minute run	Children who were overweight or obese performed extremely worse on coordination and endurance tasks than children who were normal weight or underweight in both IS and CS. To break this negative cycle, preventive intervention is crucial.

Coordination, BMI and Age

Across all ages, there are minimal to modest negative associations between motor coordination and BMI. Additionally, research shows that obese and overweight children of both sexes have significantly worse motor balance than children of normal weight (Castetbon and Andreyeva, 2012; Jose Antonio Ribeiro, 2015; Laukkanen *et al.*, 2017; Madrona *et al.*, 2019; Pal, Manna and Dhara, 2019; Battaglia *et al.*, 2021; Giuriato *et al.*, 2021; Pereira *et al.*, 2021) Overall, these findings are consistent with the majority of other research showing a negative association between childhood body mass index and different motor coordination measures. In the youngest age categories, the strongest inverse correlations were discovered. (i.e., 10 and 12 yrs). Both boys and girls in this study had typically stronger inverse relationships between motor coordination and BMI up until age 11, after which they started to wane. (Lopes *et al.*, 2012, 2018) Preterm children had worse motor and functional performance at preschool age than their full-term peers. In the scientific studies concerning motor development of preterm children, the incidence of motor impairment is reported to vary from 9.5 to 51% (Majewska *et al.*, 2018).

Coordination, BMI and Gender Difference

In comparison to children who are typically developing, children with coordination disorder have higher BMI and waist circumference, and this disparity widened over the five-year follow-up. While there was a comparable trend in the relationship between coordination disorder and BMI over time, it was not statistically significant ($p = .0577$) for waist circumference. In comparison to girls with coordination disorder, boys were found to have a higher overall increase in BMI and waist circumference. The association between coordination disorder status and waist circumference or coordination disorder status and BMI was not moderated or mediated by physical activity (Battaglia *et al.*, 2021; Giuriato *et al.*, 2021; Gallotta *et al.*, 2022; Monacis *et al.*, 2022). However, it had an independent and unfavorable relationship with waist size and BMI. At around 11 years old, boys with coordination disorder experience a sharp rise in BMI and waist size, which may be related to maturational changes. For instance, girls mature sexually and reach their peak growth rate sooner than boys (De Toia *et al.*, 2009; D'Hondt *et al.*, 2014; Olesen *et al.*, 2014; Gama *et al.*, 2021). Boys and girls have comparable amounts of muscular body mass and body fat during preadolescence. Girls experience a significantly greater rise in fat mass during adolescence than they do in lean body mass, whereas boys experience a greater increase in lean body mass. Early sexual maturation may have an impact on body composition through its impact on a boy's or girl's development (height and weight) (Olesen *et al.*, 2014; Joshi *et al.*, 2015).

Fine motor coordination and BMI

Neither obesity nor BMI values were found to be significantly correlated with fine motor abilities in children aged 4 to 6. The development of fine motor skills continues throughout childhood, so later on when these skills become more complex and diversified, differences in the skills of certain risk groups may become evident (Castetbon and Andreyeva, 2012; Pal, Manna and Dhara, 2019).

Gross motor coordination and BMI

Obese children were found to be less able to run as rapidly as their non-obese peers, demonstrating the relationship between a person's weight and athletic ability. These children's extra weight and compromised

musculoskeletal functions are likely directly related to their poor locomotor skills (Castetbon and Andreyeva, 2012; D'Hondt *et al.*, 2014; Pal, Manna and Dhara, 2019; Andrade, Davidson and Santos, 2020; Giuriato *et al.*, 2021; Pereira *et al.*, 2021; Gallotta *et al.*, 2022). Children between the ages of 4-6 with obesity and children of normal weight usually had similar levels of motor skill abilities, such as balancing, walking backwards, and catching. In order to avoid obesity-related variations in their gross motor abilities in late childhood and young adulthood, as well as for interpersonal relationships and the growth of self-esteem, it should be urged for obese kids to participate in activities that require such skills.(Castetbon and Andreyeva, 2012) Below average gross motor coordination scores were negatively correlated with developmental milestones (favoring those less progressed), nutritional condition (favoring normal weight), retardation (favoring non-stunted), and physical fitness (favoring higher levels). More precisely, nutritional deficiency and stunting are risk factors, whereas physical fitness is a protective factor, in terms of predicting gross motor coordination scores that are below average.(Castetbon and Andreyeva, 2012; D'Hondt *et al.*, 2014; Pal, Manna and Dhara, 2019; Andrade, Davidson and Santos, 2020; Giuriato *et al.*, 2021; Pereira *et al.*, 2021; Gallotta *et al.*, 2022)

Waist circumference, BMI and coordination

Waist circumference is an excellent indicator of intra-abdominal distribution of fat in children and teenagers, and the two together may lead to unfavorable health developments.(Hoffmann *et al.*, 2020) Increase in BMI and waist circumference that occur more quickly may be symptoms of a developmental coordination problem.(Cairney *et al.*, 2010; Joshi *et al.*, 2015; Lopes *et al.*, 2018; Hoffmann *et al.*, 2020; Denysschen, Coetzee and Smits-Engelsman, 2021) Regardless of whether they may have had developmental coordination disorder, the trajectories over this time were the same for both males and girls. The likelihood of overweight in kids with possible developmental coordination disorders was more than three times higher than it was in kids without the condition. Children who may have developmental coordination disorders had baseline mean BMI values that were higher than average, and they were more likely to be overweight and obese than children who did not have the condition.(Cairney *et al.*, 2010)

Coordination and weight

Poor motor performance was a consequence of persistent overweight and obesity, with the persistently overweight group showing noticeably lower perceptual motor proficiency when compared to other three BMI groups, particularly when compared to the never overweight group. Their perceptual-motor coordination even seemed to decline with age. When performing motor skills, children of normal weight performed better than their overweight classmates. The group with a normal body mass index demonstrated the greatest motor coordination, while the groups with overweight and obesity displayed the worst motor coordination.(Graf *et al.*, 2005; De Toia *et al.*, 2009; Cairney *et al.*, 2010; Lopes *et al.*, 2012, 2018; Castetbon and Andreyeva, 2012; Fliers *et al.*, 2013; Olesen *et al.*, 2014; Crocker *et al.*, 2014; D'Hondt *et al.*, 2014; Joshi *et al.*, 2015; Amanda J. Krause, Brittany Cines, Elizabeth Pogrebnik, Roya Sherafat-Kazemzadeh, Andrew P. Demidowich, Ovidiu A. Galescu, Sheila M. Brady, James C. Reynolds, Van S. Hubbard, 2016; Chagas and Batista, 2016, 2019; Laukkanen *et al.*, 2017; Madrona *et al.*, 2019; Moreira *et al.*, 2019; Pal, Manna and Dhara, 2019; Andrade, Davidson and Santos, 2020; Goldstein *et al.*, 2020; Hoffmann *et al.*, 2020; de Waal and Pienaar, 2021; Gil-Madrona, Romero-Martínez and Roz-Faraco, 2021; Iijima *et al.*, 2021; Battaglia *et al.*, 2021; Vandoni *et al.*, 2021; Gallotta *et al.*, 2022; Monacis *et al.*, 2022) As toddlers aged, BMI-related differences in gross motor coordination became more apparent. The effect of being overweight on motor ability appears to extend beyond just affecting activities like balancing, power driven, movement through space, or movement against gravity when obesity continues into later ages. These more obvious variations may be due to the ongoing interactions between childhood obesity, inactivity, and motor incompetence.(de Waal and Pienaar, 2021)

Coordination and anthropometry

Children who are overweight or obese fared worse than average in all major motor abilities such as endurance, strength, coordination, and flexibility, when compared to younger populations (first through tenth graders). Children with normal weight performed considerably better than overweight children in the motor ability tests. Children who were overweight, however, displayed noticeably greater flexibility during these tests. This might be as a result of the extra body weight giving an edge in the flexibility test because it interacts with gravity and passively improves flexibility. Large percentage of kids who are overweight or obese, in addition to having a lot of motor deficits.(De Toia *et al.*, 2009).

Coordination, BMI and health-related fitness

Children who are overweight or obese typically display poor physical fitness, with the exception of upper body strength and explosive force. On the other hand, children who were underweight performed poorly in terms of their musculoskeletal force and explosive strength. Body weight, fat mass, and BMI have all been found to have a positive correlation with explosive ability. Children with a healthy body composition (low BMI, body weight, and stature), on the other hand, performed well in the mobility tests. Since childhood obesity is linked to many chronic diseases in both the immediate and long-term, involving cardiovascular and metabolic disorders, it has actually grown to be a significant worldwide health issue. Adiposity encourages the clustering of cardiovascular risk, especially during puberty in children (Sola, Brekke and Brekke, 2010; Joshi *et al.*, 2015; Denysschen, Coetzee and Smits-Engelsman, 2021; Jarnig, Kerbl and Poppel, 2022). Additionally, adolescents who are

overweight or obese frequently have poor cardiorespiratory fitness, which is thought to be an early indicator of CVD risk factors. As previously mentioned, there is a connection between children's adiposity, muscular power, and cardiorespiratory fitness. BMI is typically regarded as a reliable indicator of the cardio metabolic risk. Subclinical cardiovascular changes are linked to fat mass, as determined by a novel prediction model based on straightforward anthropometric measurements. A moderate correlation has been found between body fatness and a number of fitness assessments (Sola, Brekke and Brekke, 2010; Pereira *et al.*, 2021; Vandoni *et al.*, 2021; Jarnig, Kerbl and Poppel, 2022). This reaffirmed the need to establish novel parameters for the early identification of decreased cardiorespiratory fitness and consequently potential cardiovascular risk. Obesity and overweight avoidance has undeniably positive effects on physical fitness and general health (Vandoni *et al.*, 2021).

Compared to typically developing children, children with poor motor skills are more likely to have poorer anaerobic and aerobic capacity as well as muscular power. These results suggest a connection between motor abilities, cardiovascular fitness, muscular power, and muscular endurance. Low motor skills cause people to engage in less physical exercise, which further reduces their health-related fitness and motor skills. If this downward trend in physical exercise involvement keeps up, it may have negative effects on health, including obesity and overweight (Denysschen, Coetzee and Smits-Engelsman, 2021).

Average height, body mass index, and free fat mass all showed a favorable correlation with birth weight. Accordingly, the odds of being overweight at age 7 are increased by 1.05 (95% CI 1.03-1.08) for every 100g rise in birth weight. Birth weight has an impact on later physical development, and high-birth-weight infants acquire more weight and are more likely to be overweight or obese than low- and normal-birth-weight babies. Postnatal growth spurts and high levels of fat accumulation in childhood and adolescence have been linked to a considerably higher risk of cardiovascular diseases in later life as well as a shorter life span. The body composition factors of children's bodies (height, excess fat mass, and BMI) were related to birth weight. Gross motor ability and birth weight did not directly correlate. The gross motor coordination measures, muscular strength, motion, agility, cardiovascular fitness, and free fat mass were all significantly correlated with current height, body fat percentage, and free fat mass (Marcos Andre Moura-Dos-Santos, Marcelus Brito De Almeida and Manhaes-De-Castro, Peter T Katzmarzyk, Jose Antonio Ribeiro, 2015)(Sola, Brekke and Brekke, 2010; Pereira *et al.*, 2021; Vandoni *et al.*, 2021; Jarnig, Kerbl and Poppel, 2022).

The review gives a clear vision that it is imperative to work outs and exercise regularly so that BMI should fall in normal weight category as any deviations from the normal weight results in different types of coordination disorders and other adverse effects on the cardiovascular system. All the ages are affected to a certain extent and both genders exhibit gross as well as fine motor coordination disorders. Physical fitness not only helps to maintain physiological functioning of the body but also found to be effective in improving mental health also.

Conclusion

Pre-term infants and pre-schoolers also found to have a tendency for the activity limitations and coordination deficits along with other full term and school going children and adolescence. It has drawn to a conclusion that children fall in the overweight or obese category i.e. 85-95 percentile of BMI scores, they tend to have poor motor coordination and thereby having other health-related issues which affect their quality of life.

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Understanding the Emerging Trend of SARS- CoV-2 Variants during Pandemic in India

Karashdeep Kaur^{1*}, Jaspreet Kaur Boparai¹, Ramanpreet Kaur¹

¹ Research Scientist, Virus Research and Diagnostic laboratory, Government Medical College, Patiala 147001, India

karashkk@yahoo.com

Abstract

A new worldwide public health catastrophe has emerged due to the rapid spread of the coronavirus disease 19 (COVID-19), which first appeared in Wuhan, China, in early December 2019. The coronavirus 2 associated with severe acute respiratory syndrome was named as the etiological culprit (SARS-CoV-2). SARS-CoV-2 pandemic has become major threat to mankind due to its evolving nature. SARS-CoV-2 has a high mutation rate, resulting in the emergence of multiple variants in a short period of time, beginning with the Wuhan strain during the first wave, followed by the Delta and Omicron strains during the second and third waves. The emergence of such variants has led to multiple pandemic waves, helping to sustain the number of infections, hospitalizations, and deaths to date despite the rapid development of vaccines. Since the majority of these mutations are concentrated on the Spike protein, a viral surface glycoprotein that is the primary target for most vaccines. The new corona virus' worrying global expansion was experienced. The current study sought to better understand the trend of emerging variants and risk factors of SARS-CoV-2 during pandemic.

Keywords: SARS-CoV-2 variant; SARS-CoV-2; mutation; Comorbidities; Case fatality rate; North India.

Introduction:

SARS-CoV-2, also known as novel CoV or nCoV, is a coronavirus that causes severe acute respiratory syndrome (Bchetnia et al. 2020). The virus was initially discovered in bats, and transmission to humans primarily occurs through direct, indirect, or close contact with infected people who have respiratory secretions, saliva, or respiratory droplets that are emitted by coughing, sneezing, or speaking (Cirrincion et al. 2020). SARS-CoV-2 is a member of the beta coronavirus genus, along with other SARS-CoVs and the Middle East respiratory illness coronavirus (MERS). The World Health Organization classified the early coronaviruses SARS-CoV and MERS as global epidemic outbreaks when they spread to 32 and 27 countries, respectively (WHO) (Kandi et al. 2021). Coronaviruses are members of a wide family of enveloped RNA viruses that have surface glycoprotein projections that resemble a crown (hence the name Coronaviruses). Their single-stranded positive-sense RNA genome is non-segmented (Devasena 2021). Coronaviruses can be divided into four primary subgroups: alpha, beta, gamma, and delta. Animals (including humans, bats, camels, rats, and others) are the gene sources for alpha and beta coronaviruses, while birds appear to be the sources of gamma and delta coronaviruses, according to genomic studies (Ye et al. 2020).

The RNA genome of SARS-CoV-2 is about 30 kb long and encodes structural proteins at the 3' ORFs and non-structural proteins at the 5' end. Spike, nucleocapsid, membrane, and envelope are among the structural proteins (Yadav et al. 2021). Among these, the non-structural proteins are involved in replicative and transcriptase activities, whilst the envelope, membrane, and spike proteins localized at viral surfaces are important in host binding capability. Spike protein is one of the structural proteins of SARS-CoV-2 that is essential for attachment to the human host's ACE2 receptor and subsequent infection. Spike protein's intricate structure with human ACE2 has been uncovered, revealing the key residues involved in the communication. In particular, the 253 amino acid long receptor binding domain (RBD) of the spike protein interacts structurally with the host ACE2 receptor to start the entry of the viral particle into the human host. There is growing evidence that the host's SNP in the ACE2 receptor and the genetic alterations in the SARS-CoV-2 RBD area have different dynamics of interaction (Calcagnile et al. 2021).

It has become one of the most significant dangers to humanity, with the potential to cause a coronavirus pandemic in 2020. Due to point mutations or single nucleotide polymorphism (SNP) variants, SARS-CoV-2 is constantly changing and has been rapidly spreading throughout the world (Zhu et al. 2021). Between 2020 and 2022, numerous novel mutations of SARS-CoV-2 isolates were discovered worldwide (Wang and Cheng 2022). The Omicron (B.1.1.529) is a new Variant of Concern (VOC) that was reported in 2021, replacing the primary variant known as Delta and Wuhan that was first discovered in India, during the second and first wave of 2021 and 2020 (Gao, Guo and Luo 2022).

Investigating the trends of variation and clinical outcome of SARS-COV-2 in the local community is crucial. As India is the second-largest SARS-CoV-2 infected nation which examined SARS-COV-2 variant trends and risk variables during the epidemic. It's crucial to comprehend the SARS-CoV-2 transmission dynamics and pathogenesis in order to stop the infection's progress and stop the pandemic from spreading further. Any age group can be affected by this disorder, and increased morbidity and mortality rates have been recorded in

individuals with co-morbid conditions such as diabetes, hypertension, cardiovascular disease, and cerebrovascular disease (Kissler et al. 2020). The majority of positive patients who were infected during the pandemic had symptoms like a fever, cough, stomach pain, and body aches, but some of them also had acute to severe respiratory illnesses. Due to various strains, patients' clinical outcomes vary depending on the community (Weng, Su and Wang 2021).

MUTATION AND SARS-CoV-2: The first wave began in India in January 2020, lasted for almost a year, and had a high fatality rate (Pandey et al. 2022). According to the findings, the Wuhan strain was predominated during the first wave, and there were few mutations in the SARS-CoV-2 virus's genome (Wolf et al. 2023). However, a shift in the variant from Wuhan to the delta was seen during the second wave and is a cause for concern (Kumar et al. 2022). Additionally, the second and third weeks of the third wave in the month of January 2021 were regarded as the pinnacle for COVID-19 positive subjects with Omicron as the most common Variant of Concern during this time. It was observed that during the third wave, the population experienced considerably fewer hospital admissions and fatalities (Ranjan 2022).

WUHAN STRAIN: In the Chinese city of Wuhan, where the epidemic was initially noticed, the SARS-CoV-2 virus was first discovered hence known as Wuhan-Hu-1/L strain (Puligedda et al. 2021). This virus is similar to the SARS-CoV virus which caused the Severe Acute Respiratory Syndrome (SARS) that struck South East Asia in 2002/2003 and resulted in the deaths of roughly 800 people over 9000 cases it was found to be prevalent in the region (Gupta, 2021). Several viral variations started to arise shortly after the original virus spread around the world, notably in the poorest nations where it was difficult to adopt public health measures like social distance and wearing surgical masks in public places. The S gene, which encodes for the Spike protein, a surface glycoprotein that facilitates the virus entry within the human cell through an interaction with the human ACE2 receptor, was the site of the majority of the genome changes that characterised these variants (Bakhshandeh et al. 2021). L strain first mutated into S strain and then consequently to V and G strain. To date strain G is the most widespread: it mutated into strains GR and GH at the end of February 2020 (Ko et al. 2021).

ALPHA VARIANT: The Alpha version of SARS-CoV-2 was the first to be classified as a VOC (B.1.1.7). B.1.1.7, sometimes referred to as the "English variety" because it was first discovered in the Kent region of the United Kingdom in November 2020, was thought to be more contagious than the original virus (Keller et al. 2021). It differs from the original Wuhan strain due to multiple significant alterations in the spike protein, which the virus utilizes to enter human cells. One is a mutation called N501Y that increases the spike protein's ability to connect to cellular receptors and makes the virus more infectious (Liu et al. 2022). Additionally, it has the P681H mutation, whose function is unknown but which has repeatedly appeared spontaneously, and the D614G mutation, which is likely to improve viral replication (Freer et al. 2021). The E484K mutation in an extra Alpha form, which may aid the virus in escaping the body's immune defences by avoiding neutralising antibodies produced by vaccination or prior infection, is being closely watched by the WHO (Beeraka et al. 2022). Clinical studies have also revealed that vaccine coverage (especially in those who had already finished the vaccination cycle) was still able to contain the impact of this variant on the sanitary system despite being more transmissible than other circulating viral strains and despite showing the first signs of reduced protection provided by vaccines, monoclonal antibodies, and convalescent sera (Bernal et al. 2021).

DELTA VARIANT: Delta is the second VOC emerged shortly after the discovery of the Alpha variation. The Delta variant was initially identified in India in May 2021 and has since been confirmed in 176 sites across the globe, quickly displacing other varieties to take the lead in several nations (Chen et al. 2022). The Delta variant (B.1.617.2), often known as the "Indian variant," quickly overtook the Alpha variant to become the predominant strain in the world because it was 97% more contagious than the original Wuhan virus (Chavda et al. 2022). With the less dangerous Alpha variant being replaced by the more dangerous Delta variant, the pandemic trend underwent a significant change in pace, adding to the burden on the healthcare system and, for the first time, posing a serious threat to the immunity provided by vaccines, convalescent sera, and monoclonal antibodies due to its improved ability to evade the immune response (Raman et al. 2021).

Delta has the D614G mutation as well as a number of other mutations that are absent from other variations of concern. These include a T478K mutation, which is thought to help the virus avoid recognition by the immune system, a L452R mutation, which is thought to increase infectivity and may help the virus evade destruction by immune cells, a P681R mutation, which is linked to an increased ability to cause severe disease (Cherian et al. 2021). A "Delta plus" form, which was first discovered in Nepal and has an extra K417N mutation, has also been mentioned in publications (Jayabal et al. 2022; Kunasekaran et al. 2021; Kumar et al. 2022).

OMICRON VARIANT: The Omicron variation (B.1.1.529), which was initially discovered in South Africa, has been flanking the Delta variant since November 2021 (Dejnirattisai et al. 2022). The spread of the SARS-CoV-2 virus was unprecedented due to the rise of the Omicron variant, which was fueled by a concurrent rise in transmissibility and immune evasion. There are many mutations in Omicron, some of which are unsettling. These include other mutations that have not yet been characterised as well as the N501Y, D614G, K417N, and

T478K mutations, which are also present in other variants of concern (Ponde 2022). Although investigations to determine this are still continuing, the nature of the mutations has also raised fears that it may be partially resistant to the COVID-19 vaccinations now on the market. The virus was able to defeat protection provided by the entire primary vaccination cycle and by the majority of neutralizing antibodies used in therapy, necessitating the introduction of a "booster dose" to restore the protective effect of vaccines to adequate levels (Chi et al. 2022).

Recently, the three novel recombinant SARS-CoV-2 variants Xd, Xe, and Xf were discovered in the United Kingdom. These variants are created by combining the genomes of three other prominent variants that are already in circulation: Delta, Omicron, and Omicron 2. The XE variety of these three novel viral strains, which results from the cross-pollination of the VOCs Omicron and Omicron 2, is thought to be 13–20% more contagious than the Omicron 2 variant (Thakur et al. 2022).

SYMPTOMS: SARS-CoV-2 appears to be exceedingly contagious and has spread swiftly over the world in a short of 3–4 months (Bchetnia et al. 2020), with a surprisingly wide range of impacts on diverse nations. Respiratory droplets made by asymptomatic or symptomatic patients sneezing or coughing are used to disseminate the infection. Patients may still be contagious during the incubation period, for as long as the clinical symptoms persist, and even after the clinical recovery (Rhee et al. 2021). During the 2-14 day incubation phase, the virus is primarily transmitted by inhaling droplets or touching infected surfaces, then coming into contact with the mouth, nose, and eyes (median 5 days). The primary clinical signs of the illness are fever, nonproductive cough, exhaustion, malaise, and shortness of breath (Mohan and Nambiar 2020). Elderly people and people with comorbid disorders including hypertension, respiratory and cardiac diseases, diabetes, cancer, etc. are more likely to experience severe illness and negative outcomes such pneumonia, acute respiratory distress syndrome, acute kidney injury, and mortality Co-morbidities like asthma have been linked to heightened the SARS-CoV-2 infection (Bello-Chavolla et al. 2020). A cytokine storm caused by an extremely high surge in inflammatory cytokines like interleukin-1 and TNF-alpha is what is causing the severe symptoms (Rowaiye et al. 2021).

FATALITY: Global infection was greatly spread due to evolution and dynamic alterations in the SARS-CoV genome. According to the WHO research, SARS-CoV-2 and MERS have higher fatality rates than other known SARS-CoV strains (Gussow et al. 2020). The primary issue with the COVID-19 epidemic is now the case fatality rate. The case fatality rate for the Covid-19 first and second wave was previously reported to be higher, particularly for the second wave. The third wave's rate was discovered to be relatively lower; however the male population of older age groups was nonetheless afflicted by this wave (Fan et al. 2021). The fact that the variation is less severe and the bulk of the population has received all recommended vaccinations is a second factor for the low case-fatality rate. Calculating the number of people who are infected with the virus was a significant issue. Patients with weak symptoms and asymptomatic instances can be overlooked, overestimating the CFR.

AGE/ GENDER wise Distribution: During pandemic it was observed that the age range of 21 to 40 years old (51.16%) had the highest infection rates. As a result of the state-wide lockdown, all schools, colleges, and companies were closed. According to numerous previously published studies, there is a favourable correlation between age and the infection (6-9). Middle-aged and older age groups were shown to have greater infection rates than younger age groups, which has been documented in numerous researches (Pshenichnaya et al. 2022). The risk could be adequately explained by concurrent comorbidities and potential contact with other infected individuals because of their unrestricted travel.

Men were statistically more likely than women to get SARS-CoV-2 infection. In earlier research, it was regularly noted that men had higher infection rates than women (13-16). In India, a statewide surveillance project discovered greater male positive rates as well as higher death rates (Jain and Dupas 2022). This could be as a result of the varied immunogenic reactions that different genders have to SARS-CoV-2.

Conclusion: The primary reasons for the rise in genetic variety among coronaviruses are their capacity for rapid genetic recombination and mutation as well as the vast range of animal hosts that they can infect.

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Reasons for Patronage of Bone setters in North India

***Pankajpreet Singh *Supreet Bindra **Paramvir Singh**

*Assistant Professor, Dept. of Physiotherapy, Sri Guru Granth Sahib World University, Fatehgarh Sahib. Punjab

**Professor, Dept. of Sports Sciences, Punjabi University, Patiala

drpankajpreetsingh@gmail.com

Abstract

Background: Traditional bone setting (TBS) methods contribute largely to the alternative treatments in developing countries. Despite the criticisms and complications of bone setting, the faith of people in bone setting cannot be ignored. **Objective:** Most of the studies on TBS have been conducted in Nigeria and there is dearth of data from India, and thus was the aim of the study. **Method:** A total of 110 subjects that had visited a TBS were interviewed using a questionnaire. **Results:** The study revealed that people from varied age groups, occupation and levels of socioeconomic status patronized bonesetters. Old patients that had already visited the TBS comprised the major source of contact with the TBS. Faith on TBS was found to be the major reason for approaching the TBS. More than half of the subjects had visited a hospital/doctor before visiting a TBS. No benefit from visiting a hospital/doctor, Side effect of medicine, high costs, fear of surgery, advice of relative, crowd and lack of attention by doctor, unnecessary investigations, non-availability of doctors immediately, misguidance by medical staff and faith on TBS comprised the reasons of withdrawing from hospital/doctor. **Conclusion:** The non reliable doctor patient ratio in rural population has led to the promotion of the TBS services and healing related complication have arisen with greater pace but up to date data is not available. Thus, revitalizing the science of TBS could be a great alternative, especially at primary levels of health care could be instrumental in reducing the burden on the existing health care systems.

Key words: Traditional Bone Setter (TBS), Patronage, North India, Health care

Introduction

A traditional bonesetter (TBS) is a practitioner of joint manipulation. The TBS can also be defined as the non-certified practitioner who takes up the practice of healing without having any formal education or training in the accepted medical procedures (Samuel, 1963 and Green 1999). A substantial amount of literature suggests that bone setting and massage have been extensively used as treatment methods among all human races across the globe since Neolithic period (the later part of the Stone Age) (Wells, 1920)

Despite the advances in the modern health care, the traditional methods largely contribute as an alternative in India, Africa and South America due to less developed health care resources. According to an estimate, 10 – 40% of the patients with fractures and dislocations in the world are managed by the unorthodox practitioners. It is believed that there are about 70,000 traditional healers and bonesetters in India and that they treat 60% of the all trauma (Church, 1988). Despite the criticisms of pain, mal union, joint stiffness, contractures, gangrene, compartment syndrome among patient's treated by TBS (Ikpeme et al, 2007; Dada et al, 2009; Memon et al, 2009 and Salati and Rather, 2009). Researches have revealed that bone setting can be efficient and effective (Hemmila et al, 2002 and Bassey et al, 2011). Most of the studies on bone setting have been conducted in Nigeria (Thanni, 2000; Aries et al, 2007; Idris et al, 2009; Bukar et al, 2009; Ngohi et al, 2009; Bassey et al, 2011; Aderibigbe et al, 2013 and Owumi 2013). We could find only one study on reasons for patronage with special reference to Puttur kattu bone setting treatment in Andhra Pradesh (Panda, 2011) and no such study was found in Northern India. Therefore the aim of the study was to find out the reasons of patronage of bone setting among population of Northern India.

Methodology

An epidemiological survey using a questionnaire designed for the study was conducted to collect data from subjects that have visited TBS. Both acute and chronic cases of musculoskeletal ailment and subjects willing to cooperate with the study were included. Subjects aged less than 10 years of age or more than 65 years of age, medico legal cases and pregnant women were excluded from the study. An informed consent was obtained and data was collected using interview schedule method which involved explanation of the questionnaire to the subject under study in the language best understood by them and filled by the interviewer.

Results

A total of 110 subjects from various districts of Punjab that had visited a TBS were interviewed. Descriptive statistics in the form of absolute number and percentages were used to analyze the data. The results are presented below:

Socio Demographic details of the Subjects visiting bone setters

The average age of the subjects visiting TBS was 44.57 ± 14.65 years (Fig. 1). The age wise distribution of the subjects revealed that subjects from almost every age group visited TBS. 68.18% of the subjects visiting TBS were male (Fig.2). 46.36% of subjects visiting TBS were educated up to high school or more followed by subjects educated up to elementary level (18.18%) and subjects educated up to primary level (10.90%). 24.54% of the subjects visiting TBS were illiterate (Fig 3). The results of the study revealed that despite being highly educated, close to half of the total subjects under study had visited a TBS. 56.36% of the subjects visiting TBS resided in rural areas (Fig.4). 40% of the subjects visiting TBS were government employees, 32.72% were employed in private settings and 27.27% were self employed (Fig.5). 34.54% of the subjects visiting TBS had an income of more than 10,000 Rs. Per month whereas 20.90% had an income of up to 5000 Rs. Per month (Fig.6). Old patients (50%) that had already visited the TBS comprised the major source of contact with the TBS, followed by direct contact (31.81%), middle man (14.54%), relative (2.72%) and referral by a doctor (0.90%) respectively (Fig.7).

Fig 1: Age wise distribution of the subjects (N=110) that had visited a bone setter

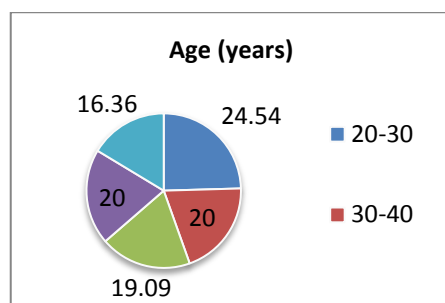


Fig 4: Place of dwelling of subjects visiting bone setters

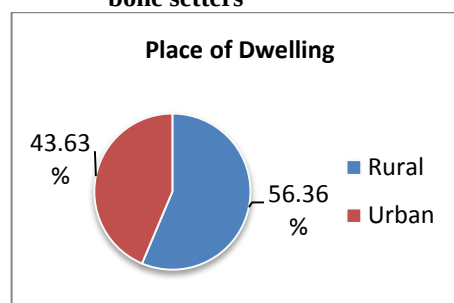


Fig 2: Gender wise distribution of the visiting bone setters

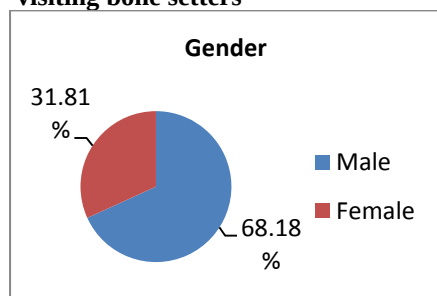


Fig 5. Occupation of the subjects subjects that had visited a bone setter

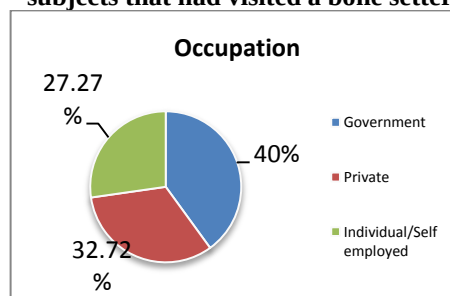


Fig 3. Level of Education of subjects that had visited a bone setter

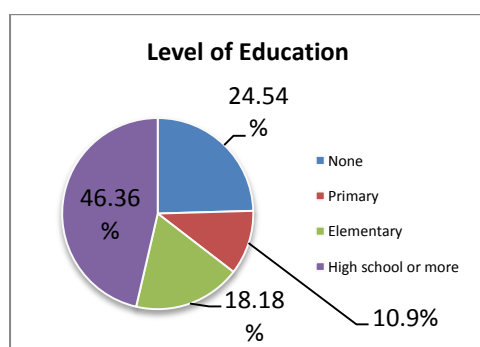


Fig 6. Family income per month

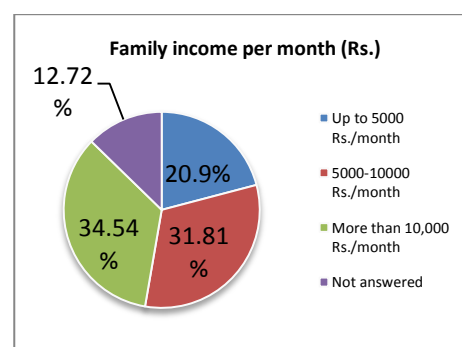
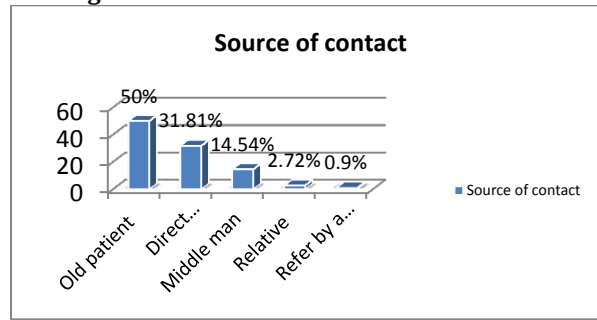
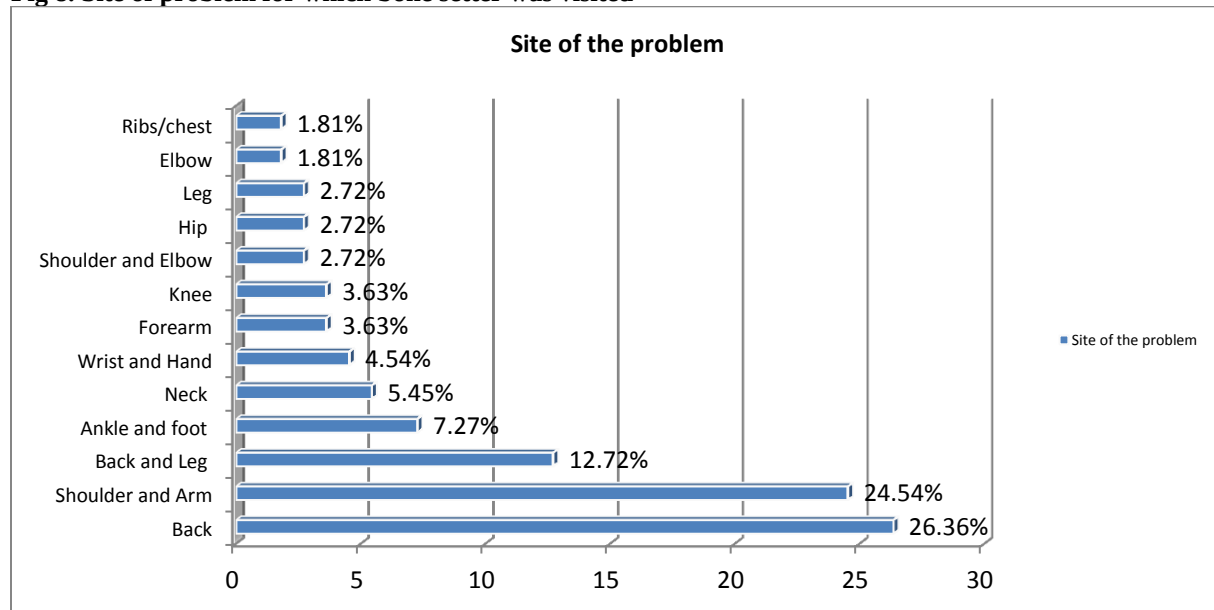


Fig 7. Source of contact with the bone setter**Nature of the problem for which bone setter was visited**

Problem in the back (26.36%) followed by problem in shoulder and arm (24.54%), back and leg (12.72%), ankle and foot (7.27%), neck (5.45%) were the commonest site of problem for which TBS was visited (Fig. 8). 50% of the subjects visited TBS for chronic problems. 9.09% subjects had visited a TBS on the onset of the problem (Fig.9). 18.18% subjects remained absent from work for less than a week, 20% for 1 week to 1 month and 13.63% for more than a month due to the problem for which TBS was visited (Fig. 10). Falls (29.09%) followed by Trauma or injury (19.09%), work (14.54%) was found to be the commonest perceived cause of illness for which TBS was visited.

Reasons for approaching the bone setter

Faith (79.09%) on bone setting was found to be the major reason for approaching TBS. Advice of a friend or relative (37.27%) followed by quick treatment (30%), cultural belief (5.45%), less fee (7.27%), ease of access (7.27%), delay in medical services (8.18%), fear of cast or amputation (3.63%) and relief from treatment (1.81%) were found to be some of the other reasons for approaching TBS (Fig. 12). 57.27% of the subjects had visited a hospital/doctor before visiting a TBS out of which 87.30% had visited an orthopaedician and 11.11% had visited a general practitioner prior to visiting a TBS (Fig 13). 36.36% of the subjects had visited a hospital/ doctor 1-5 times before visiting the bone setter. At the same time 40% of the subjects did not visit any doctor/hospital before approaching TBS (Fig.14). No benefit from visiting a hospital/doctor (27.27%), Side effect of medicine (24.54%), high cost of treatment (24.54%), fear of surgery (11.81%), advice of relative (9.09%), crowd and lack of attention by doctor (6.36%), unnecessary investigations (6.36%), non availability of doctors immediately (3.63%), mis guidance by medical staff and faith on TBS (1.81%) comprised the reasons of withdrawing from hospital/doctor (Fig. 15).

Fig 8. Site of problem for which bone setter was visited**Fig.9. Duration of the problem****Fig 10. Number of workdays lost due to musculoskeletal problem**

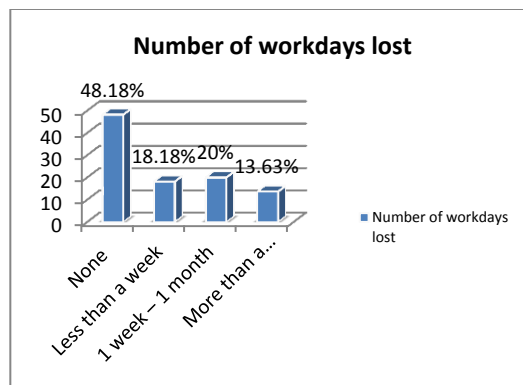
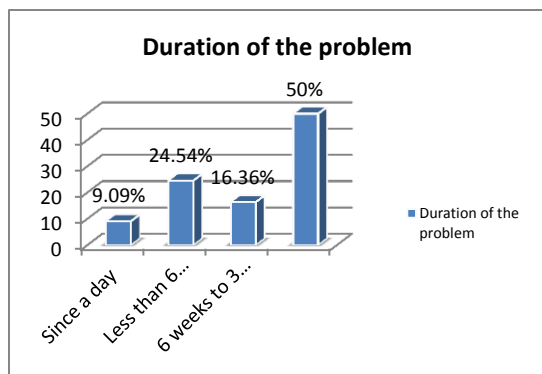


Fig 12: Reasons for approaching a bonesetter

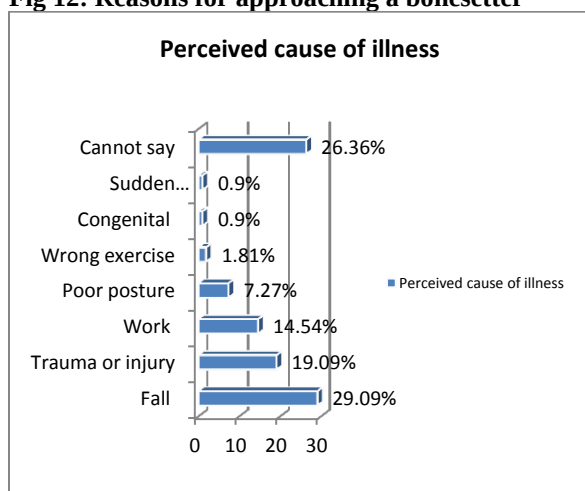


Fig. 11. Perceived cause of musculoskeletal ailment

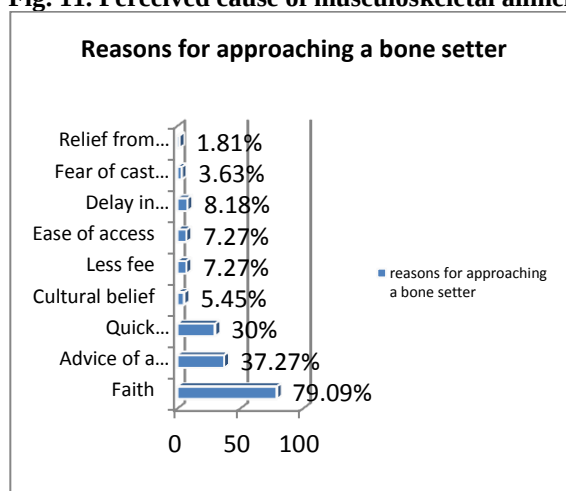


Fig 13: Consultation sought prior to visiting a bone setter

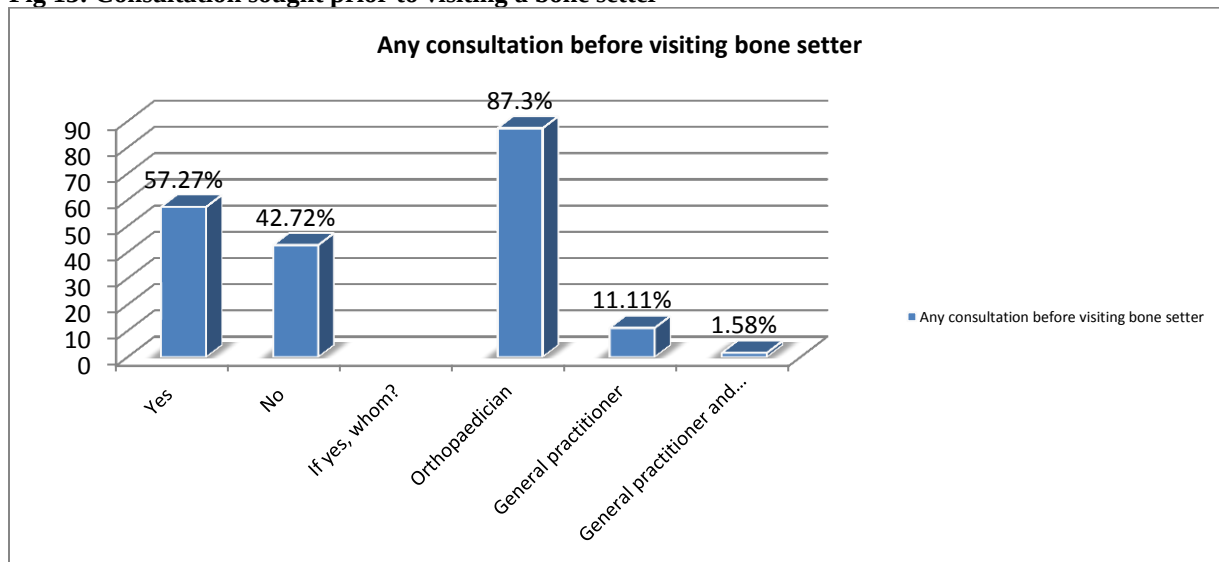
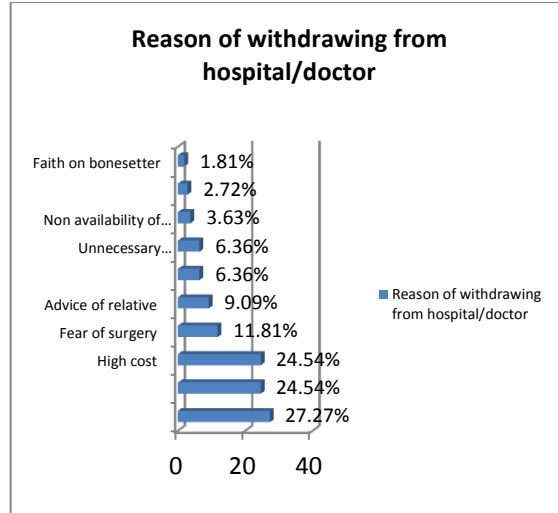
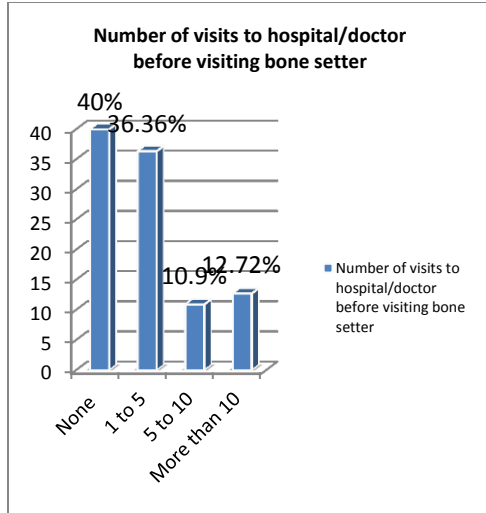


Fig 14: Number of prior visits to a hospital/doctor

Fig 15. Reasons for withdrawal from hospital/doctor



Discussion

The results of the study revealed that subjects from almost every age group visited TBS and the average age of subjects was 44.57 ± 14.65 years. More than two third of the subjects visiting TBS were male. Similarly, in a prospective study on patronage of TBS by people in Sudan, Idris et al, 2009 (Idris et al, 2009) reported the mean age of the subjects visiting TBS was 39.3 ± 0.82 years and out of them 66.3% were male. Udosen et al, 2006 in their study on role of TBS in Calabar, Nigeria interviewed owners of TBS and their clients and found that male /female ratio of the clients was 4:1. 54 of the clients were youths aged between 21-40 years. The level of education of the subjects visiting TBS was an important aspect to observe. The majority of subjects visiting TBS were educated up to high school or more. About one fourth of the subjects visiting TBS were illiterate. Our findings are in corroboration with findings of past studies that have observed that more educated people were patronising bone setting (Thanni, 2009 and Idris et al, 2009). More than 50% of the subjects visiting TBS resided in rural areas. One reason for this could be lack of medical services in rural and remote areas. On the contrary, Idris et al, 2009 reported that 3/4ths of the subjects visiting TBS resided in urban areas. Irrespective of the type of occupation, people with varied occupational settings visited the TBS which are in agreement to the findings of Idris et al, 2009. Irrespective of the level of socioeconomic status, subjects from low, medium of high-income groups had visited TBS. The income of subjects visiting TBS has been reported to be less than 15000 rupees in 30.4% of the respondents (Bukar et al, 2009).

Back was the commonest site of problem for which TBS was visited. A majority (50%) of the subjects had a problem for more than 3 months (chronic pain) before visiting the TBS. Falls followed by trauma or injury was found to be the commonest perceived cause of illness for which TBS was visited. At the same time more than one fourth of the subjects could not notify any perceived cause of illness. Owumi et al, 2013 reported road traffic accidents (85.7%) especially through a motor cycle to be the commonest cause of fracture. Ngohi et al, 2009 in their study on causes of bone injuries and patronage of TBS in Maiduguri, Nigeria identified road traffic accidents, falling from heights and gun shots as causes of bone injuries.

Old patients that had already visited the bone setter followed by direct contact comprised the major source of contact with the TBS in this study. Faith on bone setting was found to be the major reason for approaching the TBS. Advice of a friend or relative followed by quick treatment, cultural belief, less fee, ease of access, delay in medical services, fear of cast or amputation and relief from treatment were found to be some of the other reasons for approaching TBS. The faith of people in bone setting cannot be ignored and the fame enjoyed by TBS is so much that patients took voluntary discharge from orthodox hospitals to receive treatment from TBS (Oyebola, 1980). Idris et al, 2009 found that the decision to contact the TBS was a self decision in 31.9%, family (36.2%), relatives (21.7%) and friend's decision in 10.2% respectively. The reason why they went to TBS in 31.65% candidates was their beliefs (P value < 0.003), in 19.2% was low cost ($P < 0.05$) and in 16.7% was due to fear of cast or amputation. Udosen et al, 2006 reported that most of the clients preferred TBS because of poverty, ignorance and superstitious beliefs.

The results for visiting any hospital or doctor before approaching the TBS were surprising. More than half of the subjects had visited a hospital/doctor before visiting a TBS. A significant number of visits to the hospital or doctor

by the patient before visiting the TBS are also noteworthy. 36.36% of the subjects had visited a hospital/ doctor 1-5 times before visiting the TBS. On the contrary Omololu et al, 2008 had found that up to 85% of patients with fractures present first to the TBS before coming to the hospital. It was also reported that in spite of the complications, TBS continue to have patronage from highly educate to illiterate mainly due to culture and beliefs and other reasons include short supply of orthodox trained professionals.

No benefit from visiting a hospital/doctor, Side effect of medicine, high costs, fear of surgery, advice of relative, crowd and lack of attention by doctor, unnecessary investigations, non availability of doctors immediately, mis guidance by medical staff and faith on TBS comprised the reasons of withdrawing from hospital/doctor. Similar results have been found by Aderibigbe et al, 2013. Panda and Rout, 2011 in their study on Puttur kattu bone setting treatment in Andhra Pradesh found that more educated people patronized it, 23% took voluntary discharge from hospital, 44% opted it because of fear of pain, prolonged immobilization, surgery, heavy plaster and amputation. 71% of patients were satisfied with Puttur because of minimum complications.

The scarcity of availability of medical care in remote area has helped local non-qualified practitioners like TBS to promote their approach among the population. Eighty percent of the total population in India reside in rural areas where TBS have performed their services for the welfare of the society. The non reliable doctor patient ratio in rural population has led to the promotion of the TBS services and healing related complication have arisen with greater pace but up to date data is not available. Besides the complications, there is a great demand for TBS services, so much that some patients elect to leave orthodox hospitals in favour of treatment by a TBS. The possible reasons for this include cultural beliefs, ignorance, and third-party advice, short supply of trained orthodox man power in rural areas, quicker and cheaper services and the fear of amputation at an orthodox hospital (Ogunlusi et al, 2007). Thus, revitalizing the science of TBS could be a great alternative, especially at primary levels of health care could be instrumental in reducing the burden on the existing health care systems.

Conflict of interest: None

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Comparison of Spinal Mobilization Technique and Mechanical Vibration coupled with Spinal Mobilization in patients with Mechanical Low Back Pain- Randomized Control Trial Protocol

*Satnam Kaur,**Aksh Chahal

*PG student, **Professor, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Mullana
satnamkaur2903@gmail.com

Abstract

Background and Purpose: Inactivity and improper lifestyle lead to the Development of Mechanical Low Back pain (MLBP) which is a common condition in adult Population. The origination of Low Back pain (LBP) is due to any problem related to spinal Cord, disc or the surrounding structures and it is of different types i.e., mechanical, neural, Nociceptive and nociplastic. There are many treatments like electrotherapy, hydrotherapy and Exercise which had to be proven effective in LBP, among them vibration therapy is the one. However, no study has been conducted till now which showed a combined effect of vibration and Mobilisation in this condition. This study is going to conclude the effects of mechanical Vibration and spinal mobilization in patients with MLBP. **Method/Design:** After fulfilling the inclusion criteria we randomly allocate 40 Participants into two groups (Interventional and control group) with age of 18-28years. A Consent will be taken prior to the study. Interventional group will receive mechanical Vibration and spinal mobilization and control group will get spinal mobilization and sham Treatment. Outcome will be measured with the help of Numerical Pain Rating Scale (NPRS), Pressure Pain Threshold (PPT). **Discussion:** This study is randomized control trial which will be showing the combined Effects of mechanical vibration and spine mobilization in subjects with MLBP. Result will be Calculated on the basic of NPRS and PPT. The trial for this study is registered at Clinicaltrials.gov (CTRI/2022/10/046744).

Keywords: Nociceptive, Visual Analogue Scale, Lifestyle

Introduction

The pain which is specific or non-specific from origin is known as Mechanical Low back pain (MLBP). It is a common condition that arises due to any trauma which may be acute or accumulating. It may range from a gentle back twisting to road traffic accident. Nowadays, low back pain prevalence is 60-80% among which 84% of patients are affected by MLBP (Ganesan et al., 2017). They include 30% of adolescents and 50% of adults² and both sexes are equally affected (Ganesan et al., 2017). Lateral spinothalamic tract conducts its transmission. The tract originates from posterior root ganglia which forms the first order neuron. The fibers then enter to the grey matter of dorsal horn in the spinal cord. Most of the neuron that is second order cross to the opposite side to merge in lateral spinothalamic fibers and then ascends to terminate in the thalamus. Third order neuron originates from the thalamus and end in sensory cortex through internal capsule (posterior limb) (Carvalho et al., 2020).

Treatment for low back is divided into pharmacotherapy and non-pharmacotherapy treatment. Pharmacological treatment includes the drugs in MLBP are given according to the symptoms complained by the patient. The main drugs given in the treatment is non-steroidal and anti-inflammatory which may leads to vomiting. Drugs used for a longer time cause a lot of side effects like problems in gastric or intestinal region. Exercise therapy, Behavioural therapy, Manual therapies, Heat therapy, Functional training, Muscle relaxation, Manipulation and mobilization, Ergotherapy, Massage, acupuncture, vibration therapy and spinal mobilisation are some of the physiotherapy techniques that are used to reduce LBP (Guzmán et al., 2018).

Vibration is vibratory impulse which is either generated mechanically (vibrator) or manually by therapist and transmitted by soft tissue to muscles. It may be hindered by bony structures. Vibration can stimulate both group of muscles (agonist and antagonist). Vibratory tonic reflex is activated by vibration which stimulate muscle spindle, Increased temperature, increase excitability of corticospinal tract, muscular strength and cortical process that improve muscle function (Vats et al., 2021).

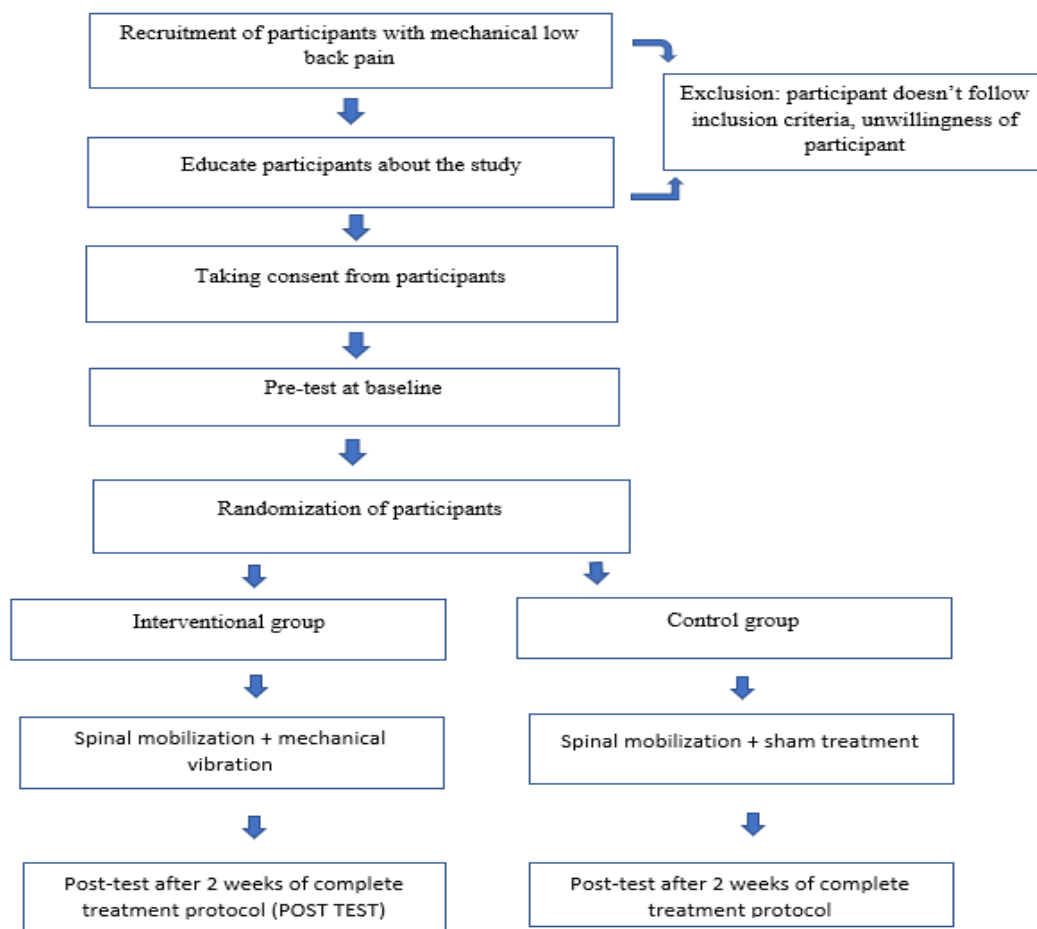
Mobilisation is a part of manual therapy with includes low velocity continuous movements with or within the joint range. It is used to treat pain and increase range of motion. This can be effective on both peripheral or spinal joints. Mobilisation is categorised into four grades in which lower two grades are used to reduce pain and higher grades are used to increase joint range. Red flags of mobilisation include fracture, cancer, joint fusion and open wounds.

Visual analogue scale is a pain scale in which there is a horizontal line with starting and ending point. It is having ten markings starting from zero to ten in which zero indicated the minimal pain and ten indicates the maximum level of pain. Visual analogue scale is a quick and easy method of application especially when it is connected with a laptop. It is a numeral scale in which patient give a particular number at scale according to their features or understanding to pain. Although, there are lot of benefits of NPRS but its reliability is still a controversial topic. It is a scale with single mode of decision whereas the comparative decisions are much better taken by human beings (Vats et al., 2021).

Modified Oswestry Disability Questionnaire is a scale consisting of ten items related to different functions of body. Some of them are sleeping, standing, lifting, walking, social life and sitting etc. Each of them consists of five items scoring from 0-5. The more the disability, the more the value. The total score is obtained by submission of patient's response divided by 50. In order to obtain percentage, the score obtained after dividing is multiplied by 100 (Vats et al., 2021).

Materials and methods

Fig 1. Flow chart of the study



Trial registration

Ethical clearance was obtained from Institutional Ethical Committee (IEC-2221). The trial for this study is registered at clinicaltrials.gov (CTRI/2022/10/046744).

Study design

The study is a two group pre-test post-test randomized controlled trial with single blinded participants. An Informed Consent Form (ICF) shall be obtained from all participants and subsequently maintained in participant's individual file and there will be no harm to the patients. Outcome measures to be included are; Numeric Pain Rating Scale (NPRS), Pain Pressure Threshold (PPT), and Modified Oswestry Disability Questionnaire (MODQ).

Recruitment of participants

Seventy-two participants will be recruited for the study according to the selection criteria using a Criteria based purposive sampling. Demographic data for name, age, gender, address, contact number will be taken in a pre-designed performa from the participants.

INCLUSION CRITERIA	EXCLUSION CRITERIA
1. Willingness to comply with any of the randomly chosen treatment program	1. Presence of radiculopathy or other damage to spine such as fracture, stenosis, and tumours.
2. Low Back Pain for at least three months	2. Non habitual exercise practitioners
3. Age 18-28years	3. Cardiovascular systemic disease
4. BMI- 18.5-24.9	4. Neurological deficits
	5. Presence of any psychiatric disorders which might affect the compliance and the assessment of symptoms
	6. History of spinal surgery
	7. Inflammatory, infections and malignant disease of vertebrae

Table.1: Inclusion and exclusion criteria of the participants

Randomization

The patients are randomized into two groups (group 1: intervention group and group 2: control group). A total of 72 patients were recruited in the study. Each group included 36 participants. The randomization is done using lottery methods. Allocation concealment is done using sequentially numbered, sealed, opaque envelopes.

Intervention

Individuals are recruited on the basis of inclusion criteria and then informed consent will be signed by the participants. Subjects selected then get a detailed information about the study and the procedure. Participants then scanned for MLBP and pre observational values will be taken using NPRS and pain pressure threshold.

Using randomization, the 72 participants will be separated into two groups i.e., Group 1 and Group 2. 36 participants in Group 1 will get spinal mobilization and mechanical vibration as a mode of treatment and Group 2 will get spinal mobilization and sham treatment. This procedure will be recorded by pre-outcome values and post-outcome values and participants will get the intervention three times for a week for two weeks.

Group	Procedure
Group 1 (Experimental Group)	Patient Position: Patient is in prone lying Therapist Position: Standing at the side of patient Procedure: Vibration is given using mechanical vibrator on lumbar region for 7 minutes and grade 1 and 2 mobilization for 30 seconds on each vertebral joint is given three sessions a week for 2 weeks
Group 2 (Control Group)	Patient Position: Patient is in prone lying Therapist Position: Standing at the side of patient Procedure: Grade 1 and grade 2 mobilization for 30 seconds on each vertebral joint is given with sham vibration is given three sessions a week for 2 weeks

Table 2. Interventions received by each group (conventional group and control group)

Outcome measures

The intensity of pain will be measured using the NPRS which is a horizontal line of ten centimeters with a range of 0 to 10 indicating the intensity of pain (low to high). In this scale patients must mark on the line according to the intensity of pain. The more the score the more is the intensity of pain. It has shown to have good reliability and validity.

Algometer is used to measure the pain pressure threshold (PPT).

Modified Oswestry Disability Questionnaire is a scale consisting of ten items related to different functions of body. Some of them are sleeping, standing, lifting, walking, social life and sitting etc. Each of them consists of five items scoring from 0-5. The more the disability, the more the value. The total score is obtained by submission of patient's response divided by 50. In order to obtain percentage, the score obtained after dividing is multiplied by 100.

Data monitoring

Researchers will be executing all data collection and statistical findings. Single physiotherapist will be going to perform treatment in both groups and monitor performance of both groups.

Follow up

The included participants were requested to follow up for the subsequent sessions for betterment of the patient.

Sample size calculation

Sample size is calculated using the formula $N = 2\{(z\alpha + z\beta)S/d\}^2$ with level of significance set at 0.05, power of study being 80%, minimal clinically important difference (d)= 6 and the standard deviation being (S)= 10.7. Total sample size is estimated 60 and with 20% dropouts it is 72 participants.

Data analysis

Data analysis will be done using IBM SPSS 20 (Chicago, IL). There will be independent rater which will complete the study. The normality of data will be tested using Shapiro Wilk as the data size is less than 50. After getting normality we will check descriptive statistics on basis of mean, median or standard deviation. Wilcoxon signed rank or paired t test will be applied to check within and between group comparison. Mann Whitney U test or independent t test will be used for the comparison for the comparison between the two groups. The p-value would be considered appropriate if it is equal or less than 0.05.

Discussion

The study will anticipate to reduce low back pain by using mechanical vibration coupled with spinal mobilization. We will anticipate that a combined therapy of both the protocol will have better results as compared to spinal mobilization in patients with mechanical low back pain. Previous studies have emphasized on the improvement of back pain through various measures individually however the effect of combined therapy is not yet proven and it is anticipated to have superior effects on mechanical low back pain. There will be a decrease in scoring of NPRS, MODQ. This study will also show significant reduction in algometer readings which is used to assess pain pressure threshold.

The primary goal of this clinical trial is to check the effect of mobilization in combination with vibration in the patients with mechanical low back pain.

The trial will acknowledge the clinical use of mobilization in combination with vibration in reducing symptoms of low back pain.

Limitations

Firstly, for the study the therapist could not be blinded. Secondly, the data was collected from a single area.

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Protocol For Test Retest Reliability of Reaction Time And Proprioception Using The Sensamove Sensbalance Miniboard Among Healthy Indian Young Adults

***Faraz Ali khan **Subashish**

*PG student, **Faculty, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Mullana
sheikhfaraz0007@gmail.com

Abstract

Introduction: Decreased mobility and response to stimulus can be caused by lack of balancing control. Reaction time and proprioception has been observed to be altered in individuals with balance impairment. An individual's ability to maintain balance or motor skill might be affected due to any pathologic changes like proprioception and reaction time. The Sensamove Sensbalance Miniboard is an instrument for sports training and rehabilitation since it can be easily adapted as per the user's needs and talents. **Objective:** To find the test-retest reliability of proprioception and reaction time using Sensamove Sensbalance Miniboard among healthy Indian young adults. The study will record major to minor neglected changes in balance. Therefore, it will help to analyse balance in a more accurate manner. **Methods and Materials:** Healthy Indian young adults aged 18 to 25 years will be recruited after fulfilling the selection criteria. The demographic data of the participants such as age (years), height (cm), weight (kg) will be taken. The participants will be assessed for reaction time and proprioception using the sensamove sensbalance Miniboard. For test-retest reliability, the measurement will be done in two sessions with gap of one week in-between first and second session. Each session will be for 30 to 45 minutes.

Keywords: Balance, Reliability, Reaction time, Proprioception.

Introduction

A continuum of postural stability, ranging from static to dynamic, has been described as balance, which is the capacity to manage the body's Centre of Gravity (COG) within a particular base of support. To analyse each person's ability to balance, it is crucial to examine the system's integrity (Ahmad et al., 2016). An adequate static or dynamic equilibrium is necessary for many tasks. Having the COG under control while the BoS is steady, such as when a person is standing, is referred to as static balance. The ability to change one's COG inside the BoS, for instance when walking, is referred to as dynamic balance. The coordination of several complicated sensorimotor systems is necessary for good balance (Klostermann et al., 2015). When a person is in balance, their weight is evenly distributed throughout the body, enabling them to stand and remain steady. The base of support is where the body makes contact with a surface, whereas the centre of gravity is where the entire mass of the body is concentrated. It is prevalent misconception that maintaining balance is a motor skill that might deteriorate with age or due to disease process (Ben et al., 2013).

The ability to perform kinaesthetic motions is known as proprioception, which is an innate perception of the relative placement of the body. A specific type of sensory modality known as proprioception includes the perception of joint position and movement. The perception of joint position is the active or passive reproduction of a pre-set joint angle (Ben et al., 2013).

In order to modulate neuromuscular movement, proprioception and muscular power are crucial components of balance regulation (Blackburn et al., 2000). Proprioceptive training causes cortical remodelling, supporting the idea that it is a successful strategy for 'enhancing sensorimotor function (Aman et al., 2015). The synchronised activation of the somatosensory, visual, auditory and vestibular system is necessary for postural control to maintain the functional balance. All of these systems influence how the body responds to its environment. The time it takes for a response to an external stimulus to occur is referred to as the reaction time, which is important for maintaining functional equilibrium (Aman et al., 2015).

Various studies have reported that with ageing, maintain balance becomes challenging for all age groups without presence of any pathological processes (Cook et al., 2006). There are several approaches to evaluate one's ability to balance ranging from questionnaires and performance instruments. However, it is always favourable to use an objective measurement method to eliminate subjectivity and bias (Singh et al., 2019). Each clinical assessment instrument must be reliable in order to give a solid evidence foundation, ensuring that measuring method being used is reliable and supports results. It must be reproducible and repeatable. Researchers are looking for measuring instruments that are affordable, user-friendly, portable, trustworthy and offer information that is generally correct (Hayen et al., 2007).

The Sensbalance MiniBoard, according to Sensamove®, is a practical, portable, and user-friendly instrument. In addition, it serves as an example of a piece of equipment that may be used to both train and assess balancing abilities. The tools might be useful in physical therapy and could be clinically relevant for both the evaluation and training of patients with balance interferences (Klostermann et al., 2015).

Therefore, the main purpose of the study is to determine the reliability of sensamove Sensbalance Miniboard in terms of reaction time and proprioception. The device might be beneficial in physical therapy and could be clinically relevant for both the evaluation and rehabilitation of the individuals with balance alterations.

Objective

The objective of the planned study is to find the test-retest reliability of reaction time and proprioception among healthy Indian young adults on sensamove Sensbalance Miniboard.

Hypotheses

H0: Sensbalance Miniboard may have significant Test-Retest Reliability of Proprioception and Reaction Time in Healthy Indian Young Adults

H1: Sensbalance Miniboard may not have significant Test-Retest Reliability of Proprioception and Reaction Time in Healthy Indian Young Adults.

Methods

Study design

The proposed correlation study will be conducted in the healthy Indian young adult between 18 to 25 years. An informed consent form (ICF) shall be obtained from all participants and subsequently maintained in participant's individual file.

Study population

Sixty participants will be recruited for the study according to the selection criteria using a convenience sampling. Demographic data for name, age, gender, address, contact number will be taken in a pre-designed performa from the participants.

Both male and female individuals between 18 to 25 years living a sedentary lifestyle, able to follow verbal commands will be included in the proposed study. Individual with history of fractures/injury, injuries related to upper and lower limb, neuromuscular disorders of lower limb and professional sportsmen and/or recreational players will be excluded.

Table 1. Selection criteria for the participants

Inclusion Criteria	Exclusion Criteria
Healthy Indian young adults	Recent fracture in lower limb
Age 18 to 25 years	Any type of visual disorder
Both male and female	Pathological or abnormal health condition which could influence the balance
No history of severe injury to back, hip, knees, ankles, and feet six months prior to participation	Being clear of any medications that may have impact on balance

Ethical aspects

The ethical clearance for this study was submitted and obtained from the Institutional Ethical Committee of Maharishi Markandeshwar (Deemed to be University), Mullana, Haryana. The study will be done in accordance with Helsinki Declaration revised in 2013 and National Ethical Guidelines for Biomedical Research involving Human participants. 2017. All participants will receive detailed information about the study objectives, risks and benefits involved in the procedures and will be recruited only after endorsing the Informed Consent Form.

Sample calculation

The sample size will be calculated using G power software (version 3.1) using alpha level 0.05, power 0.95 and effect size 0.49. With 20% dropout the sample size is estimated to be 54.

Data collection

Following recruitment based on the eligibility criteria, a written informed consent form will be taken from all the participants for their voluntary participation. All participants will be briefed for the procedures. The participants will be assessed for the reaction time and proprioception as per the user manual of the instrument. For test-retest reliability, the measurement was done in two sessions with a gap of one week in-between first and second session. Each session will last for 30 to 45minutes.

On the first testing day the participant will be personally introduced to the project followed by detailed explanation about the experiment. Before the first testing took place, a tape will be applied on the board to ensure consistent left and right foot placement. One stripe of tape behind the subject's heels, another in front of the great toes and a third

one on the medial sides of the feet. The participant will stand barefoot on the board with respect to the tape. Then the participants will be asked to tilt maximum in all the four directions (front, back, right and left). This will be done to make sure assessment for reaction time and proprioception will be recorded within this tilting angle. For each task, there will be a red ball seen on the screen of the computer. The sensors inside the board signalled the tilting angle of the Miniboard which is represented by the red ball. When the Miniboard is not tilted over any direction (tilting angle 00.0), the ball will be totally still and perfect balance will be achieved. Each task will start from neutral position with the ball centred in the disk on the screen. The assessor will calibrate the board before each task. The variable average angle tilt with the Miniboard to the front, back, right and left will be noted.

Data analysis

Statistical analysis will be performed using a statistical software. The independent researcher will complete observable investigations and datasets. Normality will be tested using the Kolmogorov-Smirnov test. Based on the normality, descriptive statistics data will be expressed as mean, standard deviation (SD) or median and interquartile range. To establish test-retest reliability, a correlation analysis between the variables within the tests from the initial test to the retest will be done. For the analysis p value will be set as equal to or less than 0.05 as significance.

Variables

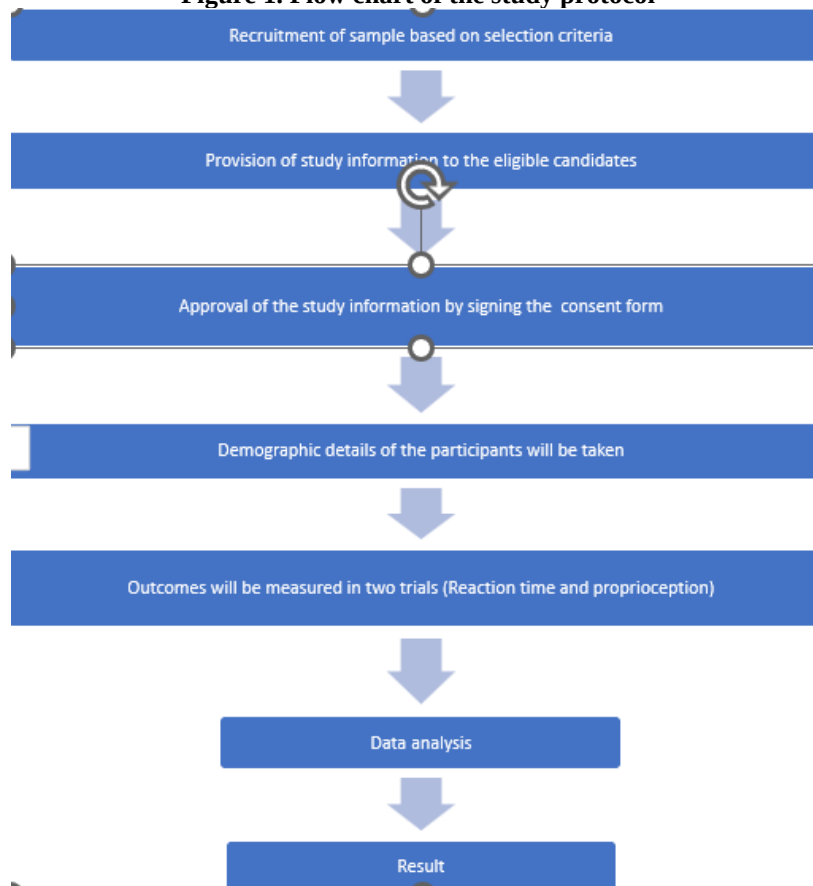
Outcome variable

Proprioception and reaction time

Primary outcomes

Proprioception and reaction time using Sensamove Sensbalance MiniBoard.

Figure 1. Flow chart of the study protocol



Author contributions

Khan FA participated in the study formulation, writing, design and analysis of the data for the study. Kaur S took part in the study design, analysis of the data, recommended for the final version after revisions. Agarwal P took part in the data collection and analysis of the data recommended for the final version after revisions. Chatterjee S took part in the conception, writing of the manuscript and critical review of the manuscript for the intellectual content, recommended for the final version after revisions.

Competing interests

No financial, legal, or political conflicts involving third parties (government, companies, and private funds, etc.) have been declared for any aspect of the submitted work (including, but not limited to grants and funding, participation in advisory council, study design, preparation of the manuscript, statistical analysis, etc.).

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Association of Hand and Pinch Grip Strength among High and Low Risk Adolescent Smartphone Users: A Cross-Sectional Study Protocol

***Puspangi Agarwal **Aksh Chahal**

*PG student, **Professor, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Mullana
puspangiag2330@gmail.com

Abstract

Introduction: Excessive smartphone use commissions the hand and wrist under repetitive stress leading to pain over the thumb, wrist, and fingers as a result of weakness and fatigue which have retarding impact on daily activities. **Objective:** To gather evidence and compare high and low smartphone usage for their hand and pinch grip strengths in adolescents (age group between 10 and 18 years). The study shall also provide opportunities to explore anthropometric factors of the subjects and look for their association with variations in hand and pinch grip strength. **Methods:** Protocol of a cross-sectional study with a total of one hundred and sixty participants between 10 and 18 years. Participants will be recruited after fulfilling the selection criteria. Hand measurements (hand length, hand width, palm length and maximum spread of hand) will be taken using a measuring tape. Hand and pinch grip strength measurements will be assessed using Baseline Hydraulic Handheld Dynamometer and Hydraulic Pinch Gauge. The comparison will be done by grouping the participants under two categories: high and low users using the Smartphone Addiction Scale (SAS)-Short version. Further thumb pain due to smartphone usage will be assessed using Visual Analog Scale (VAS). Outcome measures shall be Baseline Hydraulic Handheld Dynamometer, Hydraulic Pinch Gauge and Visual Analog Scale (VAS).

Keywords: Adolescent, Smartphone, Hand strength, Pain, Thumb, Motor skills

Introduction

In the current globalization era, mobile phone has become a necessity for all. It allows an individual to interact with others in the most convenient manner for verbal, visual and auditory communication, facilitating social, artistic and entertainment opportunities (Bickham et al., 2021). Following COVID-19 pandemic, data shows a 70% surge on internet users (Ahmed et al., 2021). Smartphone users increased by 9.3 percent globally in 2020 compared to 2019. According to researchers, rise in smartphone usage has being linked to an addictive behavior, particularly among adolescents (Osailan et al., 2021). With global expansion of COVID-19, government had to impose stay-at-home requirements and limitations limited people's physical interaction at the communal level. This in return led to exponential increase in the phone use (Ahmed et al., 2021).

Owing to the increasing usage of cellphones among young adults aged 10 to 18 years, who on an average spend 7 hours and 22 minutes on daily basis on them. Further research mentioned that excessive smartphone use can lead to musculoskeletal issues such as wrist and neck pain (Inal et al., 2015). Looking at literature long-term usage of cellphones has been associated with pain in thumb, wrist, and forearm as well as burning and tingling feelings around the thenar aspect of the palm (Berolo et al., 2011). Literature reveals musculoskeletal disorders associated with the increased use of smartphones ranging from neck and shoulder pain to the intrinsic pain in the hand and wrists (Zirek et al., 2020). In research comparing hand grip and pinch strength with smartphone usage time in a group of people over the age of 18, there has been some dissent (Radwan et al., 2020). There are just a few studies that measure hand grip and pinch grip strength and their relationship to increased smartphone usage (Bhamra et al., 2021).

According to literature, rise in smartphone usage is linked to addictive behaviour, particularly among adolescents (Bickham et al., 2021). Although smartphones give individuals social and interactive liberty, the adverse effects of smartphone usage are also to be kept under consideration (Ahmed et al., 2021). Extensive use of smartphones can cause musculoskeletal problems related to pain in the wrist and neck. Undue stresses on the hand and wrist can negatively impair the hand and pinch grip strength affecting the daily activities of the individual (Inal et al., 2015). Previous researches have shown musculoskeletal disorders associated with the increased use of smartphones ranging from neck to shoulder pain to the intrinsic pain in the hand and wrists (Bhamra et al., 2021). There is lack of evidence available that shows differences in gripping abilities due to undue stresses on the hand and wrist. Therefore, this trial will help to show the variance in the hand and pinch grip strength among the adolescent smartphone users.

Increased screen time duration for educational platforms, social development, and entertainment objectives is a cause of multiple musculoskeletal disorders (Adamson et al., 2014). Neck and shoulder pain along with wrist and thumb weakness have been reported in children and adults as a result of prolonged smartphone use (Zirek et al., 2020). However, there is lack of evidence available that evaluates the relationship between the hand and pinch gripping strength and screen time in adolescents (Bhamra et al., 2021).

Objective

The objective of the planned study is to compare hand and pinch grip strength among high and low adolescent smartphone users along with exploring anthropometric factors associated with variations in hand and pinch grip strength.

Hypotheses

H0: There is no significant effect on hand and pinch grip strength in high and low risk adolescent smartphone users.

H1: There is significant effect on hand and pinch grip strength in high and low risk adolescent smartphone users.

Methods

Study design

The proposed cross-sectional study will be conducted in an adolescent population between 10 to 18 years. Fig. 1 demonstrates an overview of the protocol. An Informed Consent Form (ICF) shall be obtained from all participants and subsequently maintained in participant's individual file.

Study population

One hundred and sixty participants will be recruited for the study according to the selection criteria using a convenience sampling. Demographic data for name, age, gender, address, contact number will be taken in a pre-designed performa from the participants.

Both, male and female individuals between 10 to 18 years living a sedentary lifestyle, regularly using Android/IOS mobile phone, able to follow verbal commands will be included in the proposed study. Individual with history of hand and wrist fracture/ injury, nerve injuries related to the upper limb, neuromuscular disorders of the upper limb and professional sportsmen and/or recreational players will be excluded.

Table 1. Selection criteria for participants

Inclusion Criteria	Exclusion Criteria
1. Sedentary lifestyle	1. History of hand and wrist fracture/ injury
2. Age 10 to 18 years	2. History of nerve injuries related to upper limb
3. Male and female	3. Neuromuscular disorders of upper limb
4. Able to follow verbal commands	4. Professional sportsmen and/or recreational players
5. Regularly using an Android/IOS mobile phone	

Ethical aspects

The ethical clearance for this study was submitted and not obtained from the Institutional Ethical Committee of Maharishi Markandeshwar (Deemed to be University), Mullana, Haryana. The study will be done in accordance with Helsinki Declaration revised in 2013 and National Ethical Guidelines for Biomedical Research involving Human participants. 2017. All participants will receive detailed information about the study objectives, risks and benefits involved in the procedures and will be recruited only after endorsing the Informed Consent Form.

Sample calculation

The sample size calculation will be calculated using a specific calculator (Kohn MA, Senyak J. Sample size calculators USCF CTSI 22 June 2022). The minimum sample is estimated to be 160 with the estimated correlation coefficient being 0.22, calculated using the formula, i.e., $[(z_{\alpha} + z_{\beta}/C)^2 + 3]$ where $z_{\alpha} = 0.05$, $z_{\beta} = 0.20$.

Data collection

Following recruitment based on the eligibility criteria, a written informed consent will be taken from all participants for their voluntary participation. Hand measurements (hand length, hand width, palm length and maximum spread) will be measured using a measuring tape as shown in Fig. 2.¹¹ Measurements will be taken in minimum clothing in upper limbs. All participants will be briefed for all procedures. Participant will be made to perform each test with their dominant hand.¹² Grip strength and pinch strength then, will be measured using Baseline Hydraulic Handheld

Dynamometer¹⁰ and Hydraulic Pinch Gauge respectively, thrice with a resting interval of 5 seconds between each trial. Participants will then be assessed for pain in thumb using Visual Analog Scale (VAS).



Figure 1. Flow chart of the study protocol

Hand grip measurement will be assessed using a Baseline Hydraulic Handheld Dynamometer. Participant will be made to sit upright on a chair with shoulders abducted, elbows flexed to 90 degrees and wrist kept in neutral position. Following, participant will be instructed to squeeze the handle as much as possible for three repetitions with a rest interval of 5 seconds between each trial. The average of three will be calculated.

Pinch grip strength will be assessed using a Hydraulic Pinch Gauge. The participant position will be similar to the position of hand grip measurement. Same hand will be used for performing the pinch grip assessment. Gauge will be placed between the tip of the thumb's pad and the radial side of the middle phalanx of the index finger. Participant will be asked to apply pressure on the pinch gauge to maximum. Three repetitions with a resting interval of 5 seconds between each trial will be allowed. Average from three trials will be calculated.

All participant will be asked to mark a point on a 10cm vertical line (0- no pain, 10- severe pain) to indicate the intensity of thumb pain using the Visual Analog Scale. The length will be measured by the investigator to evaluate the degree of pain.

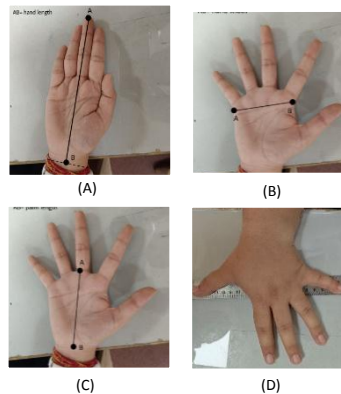


Figure 2. Hand measurements (A) hand length, (B) hand width, (C) palm length, (D) maximum spread of hand
 Smartphone addiction scale (SAS)-Short version is a 10 item self-report measure for smartphone addiction screening of adolescents. The measure utilizes a six-point Likert scale response format ranging from “1” (strongly disagree) to

“6” (strongly agree) with a maximum score of 60. Scores above 34 showing high risk while scores below 22 showing low risk to smartphone addiction. Based on this the participants will be grouped under high risk and low risk smartphone users.



Figure 3. Grip strength measurements (A) hand grip strength (B) pinch grip measurement

Data analysis

Statistical analysis will be performed using a statistical software. The independent researcher will complete observable investigations and datasets. Normality will be tested using the Kolmogorov-Smirnov test. Based on the normality, descriptive statistics data will be expressed as mean, standard deviation (SD) or median and interquartile range. To assess the relationship between smartphone usage and hand grip pinch grip strength, bivariate correlation using Pearson product-moment correlation for normal distribution and Spearman Rank correlation for non-normal distribution will be performed. For the analysis p value will be set as equal to or less than 0.05 as significance.

Variables

Predictor variable- Hand and pinch grip strength, thumb pain.

Outcome variable- High and low risk smartphone use.

Primary Outcomes

Baseline Hydraulic Handheld Dynamometer and Hydraulic Pinch Gauge

Author contributions

Agarwal P participated in the study formulation, writing, design and analysis of the data for the study. Kaur S took part in the study design, analysis of the data, recommended for the final version after revisions. Khan FA took part in the data collection and analysis of the data recommended for the final version after revisions. Chahal A took part in the conception, writing of the manuscript and critical review of the manuscript for the intellectual content, recommended for the final version after revisions.

Competing interests

No financial, legal, or political conflicts involving third parties (government, companies, and private funds, etc.) have been declared for any aspect of the submitted work (including, but not limited to grants and funding, participation in advisory council, study design, preparation of the manuscript, statistical analysis, etc.)

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Prevalence of Musculoskeletal Disorders among Dentists

*Annie Marwah, **Supreet Bindra

*BPT student, Assistant Professor, Dept. of Physiotherapy, Sri Guru Granth Sahib World University, Fatehgarh Sahib

anniemarwaha2012@gmail.com

Abstract

Introduction: Work related musculoskeletal disorders (WMSDs) are reported to significantly impact on quality of life, increase work resistance, transfer to another job. Health care professionals are at high risk for WMSDs. Musculoskeletal pain in dentists is due to constrained body postures for prolonged period of time Aim of the study: To evaluate the prevalence and identify the risk factors for musculoskeletal disorders among dentists. Objectives: This study determined the prevalence of the musculoskeletal disorders, job risk factors, coping strategies among dentists of government and private hospital. **Methodology:** The online survey was conducted among 104 dentists who were practicing in dental collage, government hospitals, primary health care centres, Patiala using the socio-demographic, Nordic musculoskeletal and self -administered questionnaire by online mode through the google forms. Both male and females having at least 1 year of experience were included and incomplete forms were excluded. Data was analyzed by entering data into SPSS version 26. **Results:** The 12- month prevalence of WMSDs was 95%. Low back (73%) was found to be the most prevalent disorder followed by pain in Neck pain (69%). 83% of the respondents perceived working in same positions for prolonged time as a major risk factor leading to WMSDs. Inadequate breaks, working overtime, bending or twisting back in awkward way were significantly associated with 12 month prevalence of WMSDs. The commonly used coping strategies in order to prevent musculoskeletal discomfort were modifying their chair for treatment (67%) getting help to handle heavy patients (54%). **Conclusion:** The study concluded that there is higher prevalence of WMSDs among dentists so they should be educated about the various risk factors and appropriate training and ergonomics practices should be given for prevention of WMSDs.

Key words: Work related musculoskeletal disorders, pain, Prevalence, risk factors, coping strategies.

Introduction

Musculoskeletal disorders (MSDs) are injuries or disorders of the muscles, nerves, tendons, joints, and supporting structures of the upper and lower limbs, that are caused by sudden exertion or prolonged exposure to physical factors such as repetition, force, vibration, or awkward posture (Maryia et al., 2021). Musculoskeletal disorders are considered to be work related when the environment and performance of work contribute significantly to the condition, the condition is made worse or persists longer due to work conditions, or both (Bernard 1997). General examples of work conditions that may lead to WMSDs include: routine lifting of heavy objects, daily exposure to whole body vibration, routine overhead work, work with the neck in a constantly flexed position, or performing repetitive forceful tasks (Bernard 1997). In dentistry, many cases of WMSDs are related to cumulative trauma, and are considered repetitive strain injuries. Risk factors for repetitive strain injuries among dental practitioners include gripping and using slender instruments in repetitive motions (such as for plaque removal and cavity preparation), and using vibratory instruments, such as hand pieces and ultrasonic scalers (Mickiewicz 1997 and Morse 2003). The work environment also poses a risk for developing WMSDs, as the nature of dental work requires that dental practitioners sustain awkward postures and non- neutral wrist positions. Furthermore, psychosocial factors, such as job satisfaction, level of support, and balance between work and private life have also been shown to be associated with WMSDs (Hayes 2012 and Ylipaa 1999).

Methodology

Study Design:

The online survey was conducted among 104 dentists who were practicing in dental collage, government hospitals, primary health care centres and private dental clinics. Out of these 4 incomplete forms were excluded. Dentists with more than 12 months of experience and those still actively practicing were included in the study. Dentists who suffered injuries during the past 12 months were not included in this study. Retired dentists and dental students were excluded from the study. The aim and objectives of this study were clearly elucidated to the subjects, who were also assured of the concealment of their responses. Data on subject's demographic variables such as age, weight, height, gender, qualification, years of experience, working conditions including- workplace, number of dental assistants, number of hours worked per day, standing hours per day, work setting, and number of days worked per week, duration of being in a bent position and using hand pieces was collected.

Research Setting

Government hospitals, Primary health care centres and private dental clinics, Patiala.

Inclusion and Exclusion Criteria

Both male and female dentists, having a minimum of 12 months of experience were included in the study and those who completed the forms were included. Those who had any history of injury, surgery in past and incomplete forms were excluded.

Development of Questionnaire

The data was collected using self-administered questionnaire produced using Google forms and circulated for completion using a link through online platforms (such as WhatsApp, Facebook, E-mails,) after explaining the motive and procedure to fill the questionnaire.

Data Analysis

The data obtained from this study were entered into the excel and were analysed using Statistical Package for Social Sciences (SPSS) windows version 26 and summarized using descriptive statistics of the bar chart, pie chart, frequency and percentages using tables. Inferential statistics of the chi-square test were used to determine the association between variables at an alpha level of $p < 0.0$.

Results

A total of 100 subjects were included in the study out of which 57% of the respondents were females and 43% respondents were males. The majority (55%) of the participants belonged to the age group of 21-30 years followed by 21% in the age group 31- 40 years and 13% in the age group of 41- 50 years and 11% in the age group 51-60 years. 51% of dentists were having 1-5 years of experience, 25% were having experience of 5-10 years and 24% were having experience of more than 10 years. The majority of dentists specialized as in oral surgeons (18%), endodontists (16%), orthodontists (9%), periodontics and prosthodontics (7%), pedodontics (2%). 59% of the subjects were postgraduate. 47% of dentists worked in an hospital, 31% in own clinic and 22% in academics. Majority (51%) of dentists reported that they were working for 4-6 hours per day and 70% worked for 3-6 days per week. Both sitting and standing type of dentistry was preferred by 75% of dentists. 42% of the dentists under the study exercise regularly (Table 4). Table 1 depicts the prevalence of musculoskeletal pain or discomfort felt in the last 12 months of the subjects under study. The majority of respondents (73%) had pain in the lower back followed by the neck (69%). Table 2 presents the 7-day prevalence of work-related musculoskeletal disorders. The majority (48%) of the subjects under study had pain in neck region followed by lower back (38%). The strategies adopted by dentists to prevent musculoskeletal pain are depicted in Table 3. The majority (67%) of the participants under study responded that they adjust their chair for treatment of patients. 54% of dentists took help of assistants for treatment and those who modified patient's position were 59%. Table 5 presents the association of perceived risk factors with 12-month prevalence of WMSDs. The 12-month prevalence of work-related musculoskeletal disorders was higher in the dentists who perceived working in the same positions, having lengthy workday and having no rest breaks for prolonged periods as the risk factor leading to musculoskeletal discomfort. Respondents who experienced WMSDs had perceived working in same positions for prolonged period (55.37%), bending or twisting back in an awkward way (65.75%). On further analysis working with pain or trouble ($X^2 = 57.85$, $p = 0.000$), not enough rest or pause breaks ($X^2 = 71.79$, $p = 0.000$), treating excessive number of patients ($X^2 = 71.98$ and $p = 0.000$), lengthy workday ($X^2 = 85.57$ and $p = 0.000$) were found to be significantly associated with 12-month prevalence of WMSDs and revealed that dentists who had perceived inadequate rest breaks, lengthy work scheduling, had higher prevalence of WMSDs.

Table 1: Distribution of 12-month prevalence of WMSDs among dentists under study using Nordic Musculoskeletal questionnaire.

Have you at any time during the last 12 months had pain, ache, discomfort in N=100	Yes (n%)	No(n%)
Neck	69	31
One or both shoulders	30	70
One or both elbow	12	88
One or both wrist and hands	48	52
Upper back	36	64
Lower back	73	27
One or both hips/thighs	11	89
One or both knees	24	76
One or both ankle/foot	25	75

Table 2: Distribution of 7 days prevalence of WMSDs among dentists under study using Nordic Musculoskeletal questionnaire.

Have you had trouble at any time during the last 7 days? (N=100)	YES (n%)	NO (n%)
Neck	48	52
One or both shoulders	23	77
One or both elbow	12	88
One or both wrist and hands	26	72
Upper back	22	78
Lower back	38	62
One or both hips/thighs	11	89
One or both knees	16	84
One or both ankle/foot	19	81

Table 3: Distribution of coping strategies adopted by dentists under study.

What are the strategies adopted by you to prevent your pain N=100	YES (n%)	NO(n%)
I took my assistant's help for treatment	54	46
I adjust height of my chair for treatment	67	33
I modify patients/my position for treatment	59	41
Regular warm ups and stretch breaks	38	62
I select techniques/procedures that will not aggravate my pain	37	63
Regular visits to allied health care professional regarding work related musculoskeletal disorder (E.g., physiotherapist, occupational therapist, chiropractor)	32	68
I took medications to relieve my pain	53	47

Table 4: Association of Demographic characteristics with 12- month prevalence of WMSDs

Characteristics	12-month Prevalence				
Age (years)	Yes n = 73 (%)	No n = 27 (%)	Total N=100 N (%)	X ²	P value
21- 30	28 (38.35)	27 (36.98)	55 (55)		
31- 40	21 (28.76)	0	21 (21)		
41- 50	13 (17.80)	0	13 (13)	30.262	0.000
51- 60	11 (15.06)	0	11 (13)		
Gender					
Female	43 (58.90)	0	43 (43)		
Male	30 (41.09)	27 (100)	57 (57)	27.902	0.000
Dental qualification					
BDS	30 (41.03)	11 (40.74)	41 (41)		
MDS	43 (58.90)	16 (59.25)	59 (59)	0.974	0.001
Total	73 (100)	27 (100)	100 (100)		
Years of experience					
1-5	27 (36.98)	27 (36.98)	54 (54)		
5-10	22 (30.13)	0	22 (22)		
>10	24 (32.87)	0	24 (24)	31.507	0.000
Your specialization					
Endodontists	0	16 (59.25)	16 (16)		
Periodontics	19 (26.02)	0	19 (19)		
Oral and maxillofacial surgery	7 (9.58)	0	7 (7)		
Orthodontics	9 (12.32)	0	9 (9)	59.538	0.000
Oral surgeons	9 (12.32)	0	9 (9)		
Pedodontics	0	0	0		
Prosthodontics	29 (39.72)	11 (40.74)	40 (40)		
Work setting					
Hospital	42 (57.53)	2 (2.73)	44 (44)		
Own clinic	31 (42.46)	0	31 (31)	90.314	0.000
Academics	0	25 (92.59)	25 (25)		
Numbers of hours worked per day					
1-3	0	12 (44.44)	12 (12)		

4-6	33 (45.20)	15 (55.55)	48 (48)		
7-9	34 (46.57)	0	34 (34)	47.679	0.000
>9	6 (8.21)	0	6 (6)		
Standing {hour/day}					
1-3	23 (31.50)	27 (100)	50 (50)		
4- 7	40 (54.79)	0	40 (40)	36.986	0.000
8-10	10 (13.69)	0	10 (10)		
Number of days worked per week					
1-3	1 (1.36)	9 (33.33)	10 (10)		
3-6	48 (65.73)	18 (66.66)	66 (66)	33.582	0.000
7 days a week	24 (32.87)	0	24 (24)		
Number of dental assistants					
1	3 (4.10)	9 (33.33)	12 (12)		
2-6	14 (19.17)	18 (66.66)	32 (32)		
6-10	9 (12.32)	0	9 (9)	60.046	0.000
NA	47 (64.38)	0	47 (47)		
Average number of patients					
1-5	19 (26.02)	0	19		
6-10	6 (8.21)	8 (29.62)	14		
11-15	26 (35.61)	0	26		
16-20	9 (12.32)	0	9	82.605	0.000
>20	32 (43.83)	0	32		
Time spent for patient (minutes)					
15	0	19 (70.37)	19 (19)		
15-30	46 (63.01)	6 (22.22)	52 (52)		
30-45	27 (36.98)	0	27 (27)	73.071	0.000
>45	0	2 (7.40)	2 (2)		
Type of dentistry					
Combination	48 (65.75)	27 (100)	75 (75)		
Sitting	9 (12.32)	0	9 (9)	12.329	0.002
Standing	16 (21.91)	0	16 (16)		
Exercise habits					
Yes	0	23 (85.18)	23 (23)		
No	42 (57.53)	0	42 (42)	82.025	0.000
Sometimes	31 (42.46)	4 (14.81)	35 (35)		
Usage of computers/laptop					
1 hour	52 (71.23)	21 (77.77)	73 (73)		
2-4	21 (28.76)	0	21 (21)	27.112	0.000
>4	0	6 (96.29)	6 (6)		

*p<0.05

**p<0.01

***p<0.001

Non Significant^{NS}

Table 5: Perceived risk factors leading to musculoskeletal pain/ WMSDs among dentists under study.

What according to you has led to your pain?	12 month prevalence		Total N (%)	X ²	P value
	Yes n=73 (%)	No n=27 (%)			
Working in the same positions for long periods [standing, bend over, sitting, kneeling]	73(100)	10 (37.03)	83 (83)	55.377	0.000
Not enough rest breaks or pauses during workday	65(89.04)	0 (0)	65 (65)	71.794	0.000
Bending or twisting your back in an awkward way	63	0(0)	63 (63)	65.753	0.000
Treating an excessive number of patients in one day	64 (87.6)	0 (0)	64 (64)	71.797	0.000
Lengthy work day	70 (95.89)	1 (3.703)	71 (71)	85.576	0.000
Work with pain or trouble	61 (83.56)	0 (0)	61 (61)	57.85	0.000

*p<0.05

**p<0.01

***p<0.001

Non-Significant^{NS}

Discussion

Prevalence of musculoskeletal disorders

In this study we documented the prevalence of WMSDs among dentists. The response rate for this study was 95%, which is similar to that found by Rambabu et al., 2021. The possible reason being that dentists were well informed about the MSDs prior to the conduct of the study. This study revealed that there were more female (58.9%) than male dentists who experienced WMSDs as females are more prone to osteoporosis and hormonal changes. The dentists aged between 21- 30 years (38.35) had higher prevalence rate of MSDs followed by (28.76%) in the age group of 31-40 years. Previous studies reported that the dentists aged 20-40 years had higher prevalence of MSDs (Jain., et al., 2020; Srinivasan et al., 2020). The reason might be because younger dentists have less refined skills and less precise care actions, resulting in higher risk of musculoskeletal pain (Lin et al., 2020).

In our study, Prosthodontists followed by Periodontists were most likely to report musculoskeletal pain due to the dental practise. The group least likely to report WMSD were orthodontists and maxillofacial surgeons. Likewise, Kanzancioglu et al., reported that oral maxillofacial surgeons do not have a higher risk of MSD compared to general dentists and other dental specialties. Periodontists were the speciality with the most reported MSD, using lightweight instruments with larger diameter for scaling and root planning (Rempel et al 2019).

The majority (65.75%) of dentists followed a combination of sitting and standing dentistry while treating their patients. Similarly, Kumar et al., 2020 reported that 65.6% of dental specialist followed combination type of dentistry. This pain could be due to static postures along with repetitive and forceful movements involved while treating patients.

Concerning the 12-month prevalence of MSDs the present study reported that most of the dentists (73%) lower back pain, (69%) had neck pain followed by wrist/ hand pain (48%), upper back pain (36%), shoulder pain (30%), ankle/ foot pain (25%), knee pain (24%), elbow pain (12%). hip/ thigh pain (11%), Similar to the study, the higher prevalence of lower back pain, neck, and shoulder pain was reported in previous studies (Rambabu et al., 2021; Singh et al., 2021). Most of the studies reported low back as the most affected region followed by the neck (Muralidharan et al., 2012; Kumar et al., 2013; Meisha et al., 2019).

Job related risk factors

The current study highlights that working in the same position for prolonged period (55%), inadequate breaks during the working hours (71%), work scheduling such as prolonged working hours (85%), and bending the back in an awkward way (65%) as the most perceived risk factors precipitating WMSDs. Muralidharan et al., 2012 reported that working in the same positions for prolonged periods, not enough rest breaks, treating excessive number of patients, working with pain or trouble and treating an excessive number of patients per day were the most perceived job risk factors precipitating WMSDs among the dentists. Hayers et al., 2021 found upper back to be commonly affected among dentists, whereas in this study it was found lower back was very common followed by neck, hand and wrist. Work related low back pain was found to be most common among WRMSD as mainly due to poor trunk postures. Meisha et al., 2019, reported overtime irregular length of the day, and inadequate breaks as the most perceived factors leading to WMSDs among dentists. Inadequate breaks ($p=0.000$), work scheduling such as prolonged working hours ($p=0.00$) and treating excessive number of patients ($p=0.000$) were found to be the risk factors closely related to the development of WMSDs.

Coping strategies adopted by the dentists

The study revealed that adjusting the height of chair (67%), getting help from assistant to handle heavy patient (54%), modifying patient's position (59%) were the major coping strategies adopted by the dentists. These coping strategies seem similar to previous findings which concluded that getting assistance, modifying patient's position as the top coping strategies used to reduce the risk of WMSDs (Sharma et al., 2021; Kumar et al., in 2019). Inadequate warm ups and lack of adequate pauses may some of other factors lead to MSDs. This lack of warm up and pauses may be due to overburdened health care system on lack of awareness for proper warm up and breaks for prevention of MSDs.

Conclusion

The prevalence of musculoskeletal disorders among dentists was more in females than males. Neck and lower back were the most affected body parts. Working in the same position for prolonged periods and work scheduling, inadequate breaks were the most perceived risk factors precipitating WMSDs. A higher prevalence of WMSD was found among those who do not exercise regularly and those who do cervical flexions for better vision during clinical work. Ergonomics practices that could decrease the odds of developing MSD include wearing dental loupes, ergonomic positioning of the chair, having sufficient lighting, having instruments within reach, and performing stretching exercises after clinical practice. So, the dentists should be educated about the various risk factors and appropriate training should be given for prevention of WMSDs.

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Effect of Matrix Rhythm Therapy in Lateral Epicondylitis

*Nitin Pruthi, **Supreet Bindra, **Pankajpreet Singh

*Research Scholar, Assistant Professor, Sri Guru Granth Sahib World University, Fatehgarh Sahib
pruthinitin686@gmail.com

Abstract

Lateral Epicondylitis or “Tennis Elbow” is an overuse syndrome of the common extensor tendon; most commonly the extensor carpi radialis brevis is involved. There are many studies which show significant results in the treatment of lateral epicondylitis like stretching and strengthening exercises, modalities like ultrasound therapy, transcutaneous electrical nerve stimulation (TENS), NSAIDs, corticosteroid injection etc. Matrix Rhythm Therapy (MRT), an emerging therapeutic physical modality is a cell biological therapy approach which is considered as a biological solution and works on the principle that all tissues in the body vibrate/oscillate with a frequency of 8-12 Hz which maintains the normal physiologic functions of the body. Despite of its evidence of usefulness very limited literature is available on MRT and the effectiveness of MRT in lateral epicondylitis is not established yet. Therefore, the **Aim of this study** was to evaluate the therapeutic efficacy of MRT in lateral epicondylitis. **Methodology:** It was an experimental study conducted on 30 subjects in the age group of 18-75 years. Pre and post outcome measures were taken using VAS, PRTEE, PFGS and SF-36. **Results:** It showed highly significant improvement in pre and post measures of VAS ($Z=4.541$, $p=0.0001^{**}$), PRTEE (t value= 7.066, $p=0.0001^{**}$), SF-36 (t value=6.687, $p=0.0001^{**}$) and PFGS (t value=7.936, $p=0.0001^{**}$). **Conclusion:** MRT was proven to be effective in reducing pain, improving grip strength and improving quality of life in patients with lateral epicondylitis.

Keywords: Matrix Rhythm Therapy, Lateral Epicondylitis, Tennis elbow

Introduction

Lateral Epicondylitis or “Tennis Elbow” is an overuse syndrome of the common extensor tendon; most commonly the extensor carpi radialis brevis is involved. Lateral epicondylitis usually occurs after 40 years of age, with equal prevalence in women and men (Levin et al, 2005). The probability of getting this disorder is between 1-3% in the general public and the average duration of a typical episode for this syndrome is reported to be between 6 months to 2 years (Smidt et al, 2003).

In clinical practice, it is not merely related to tennis players but it occurs often in repetitive upper extremity users such as computer operators, heavy weight lifters and people who use repetitive one arm movement such as gardeners, carpenters, and desk bound jobs (Walz et al, 2010). The high-risk people are between the ages of 35-40 years. Patients initially complain of activity related dull aching, lateral elbow pain and show weakness in gripping activities. While examination, the tenderness is present approximately 1 to 2 cm distal to the lateral epicondyle. Patients may experience pain with passive wrist flexion, resisted active wrist extension and during grasping or lifting (Page et al, 2010; Walz et al, 2010).

Lateral epicondylitis is considered as a chronic degeneration of the tendons of the extensor muscles of the forearm, also known as a tendinosis. It is described to start with a pretendinous inflammation, and thus referred as a tendinitis and it continuous with the presence of angiofibroblastic hyperplasia, which is the concentration of fibroblasts, vascular hyperplasia and disorganized collagen. When the rate of stretching the wrist extensor muscles overpasses the resistance of the tendon, a micro tear appears, and the accumulation of these microtears finally causes the tendinosis (Vicens et al, 2017)

Matrix Rhythm Therapy (MRT) is a new modality which uses the concept of vibromassage in rehabilitation centers (Taspinar et al, 2013). Matrix rhythm therapy was postulated by Randoll which works on the principle that all tissues in the body oscillate with a frequency of 8-12 Hz (which is considered as the same frequency range as the alpha rhythm of brain) which maintains the normal physiologic functions of the body (Naik et al, 2018).

MRT can be a promising physical modality in patient care but little is known about its therapeutic efficacy. Despite of its evidence of usefulness very limited literature is available on MRT and the effectiveness of MRT in lateral epicondylitis is not established yet it has become an important modality used for pain relief. Therefore, the need of this study is to evaluate the therapeutic efficacy of MRT.

Study Design and Methodology:

The study design was pre post experimental trial. On the basis of selection criteria, a total number of 30 participants were taken. The procedure, benefits and potential risks were explained to the subjects. Written informed consent was taken from the participants meeting the inclusion criteria and the willingness to participate. The subjects were given MRT for 30 minutes per session covering proximal forearm muscles (targeting extensor carpi radialis longus and brevis, extensor carpi ulnaris and extensor digitorum communis). A total of 5 sessions of intervention per week for 2 weeks were given to each subject.

Inclusion criteria

1. Both males and females between 18-65 years of age.
2. Patients having lateral elbow pain and also having tenderness over the lateral aspect of elbow.

Exclusion criteria

1. Generalized inflammatory arthritis such as rheumatoid arthritis.
2. Any referred pain from shoulder/neck.
3. Any wound or skin lesion on the lateral side of the affected elbow.
4. Neurological symptoms or abnormal neurological findings in the affected arm.
5. Pregnancy
6. Severe infection
7. Known malignancy
8. Bleeding disorder
9. Previous surgery to the elbow
10. Oral and/or topical NSAID in the previous 2 weeks
11. Local corticosteroid injection in the previous month.

Demographic information of subjects was collected using self designed questionnaire. The following outcome measures will be documented:

- 1) Visual analogue scale (VAS)
- 2) Pain free grip strength (PFGS)
- 3) The PRTEE, known as the Patient-Rated Forearm Evaluation Questionnaire (PRFEQ)
- 4) Short form-36 health survey (SF-36) for assessing quality of life.

Results and analysis

There were total 30 participants with 18 males and 12 females with mean age of 45. 43 years. Parametric paired t test was used to compare quantitative outcomes for normally distributed data. Non-Parametric Wilcoxon Signed Rank test was used to compare quantitative outcomes for not normally distributed data.

It showed highly significant improvement in pre and post measures of VAS ($Z = 4.541$, $p = 0.0001^{**}$), PRTEE ($t \text{ value} = 7.066$, $p = 0.0001^{**}$), SF-36 ($t \text{ value} = 6.687$, $p = 0.0001^{**}$) and PFGS ($t \text{ value} = 7.936$, $p = 0.0001^{**}$). The demographic characteristics and pre post mean difference of VAS, PRTEE, SF-36 and PFGS are explained in Table 1 and Table 2.

Table 1: Demographic characteristics of the subjects

		Frequency	Percent
Age	>35	6	20.00%
	36-45	7	23.30%
	46-55	7	23.30%
	55-65	10	33.30%
	Total	30	100.00%
	Mean	45.43	
	SD	12.32	
	Minimum	24	
	Maximum	63	
Gender	Male	18	60.00%
	Female	12	40.00%
	Total	30	100.00%

Table 2: Pre post mean difference of VAS, PRTEE, SF-36 and PFGS

VAS	N	Mean	Standard Deviation	Median	Quartile -1	Quartile -3	Wilcoxon Signed Rank (z)	p value
Pre Rx	30	7.13	1.33	7	6	8	4.541	0.0001**
Post Rx	30	3.17	2.29	2.5	2	5		
Difference	30	3.97	2.68	4	2	6		
PRTEE	N	Mean	Standard Deviation	Median	Quartile -1	Quartile -3	t-value	p value
Pre Rx	30	33.05	11.46	30.65	26	42.5	7.066	0.0001**
Post Rx	30	14.06	7.41	12	8	20		
Difference	30	19	14.73	15.75	5	34		
SF-36	N	Mean	Standard Deviation	Median	Quartile -1	Quartile -3	t-value	p value
Pre Rx	30	66.79	15.15	69.65	59.2	80	6.687	0.0001**
Post Rx	30	76.88	13.71	80.05	70	89		
Difference	30	10.09	8.26	7	5	12		
PFGS	N	Mean	Standard Deviation	Median	Quartile -1	Quartile -3	t-value	p value
Pre Rx	30	22.21	6.57	21.25	18	27	7.936	0.0001**
Post Rx	30	25.11	6.64	24	20	30		
Difference	30	2.9	2	2.85	1.6	4.5		

Discussion

This study evaluated the effectiveness of MRT in patients with lateral epicondylitis. The findings indicated a significant improvement in pain intensity, grip strength and quality of life in patients with lateral epicondylitis. Palekar et al also claimed that MRT was found to be effective in reducing myofascial pain in students using excessive smartphone. It was found to be highly significant, showing improvement in pain outcomes measured by VAS and pressure pain threshold algometer.

Naik et al, 2020 also found that both MET and MRT were effective in treating chronic lateral epicondylitis concerning pain, improving function, and strength. However, MRT was found to be more effective in pain reduction and improving functional activities. MRT has been proposed to improve the microcirculation thereby improving the energy production. The immediate effect can be seen as relaxation of tissue, muscle, and fascia. This relaxation remains longer and maintained as the metabolic process at cellular level are regulated and oxygen supply to cells is improved and henceforth healing and regeneration is set in motion (Shrivastava et al, 2015).

The role of MRT in enhancing blood circulation has also been documented. The mechanical vibrations mobilize the connective tissue, and muscular tension is released. The exchange of nutrients and metabolites is also strengthened, as well as transport of oxygen in the tissues, thereby normal function of muscle is restored (Taspinar et al, 2013).

The significant reduction in pain may be due to the optimization of altered cell logistics. MRT acts at a cellular level providing physiological frequency between 8-12 Hz to synchronize with the cells rhythm, thereby improving the quality of extracellular matrix which increases the oxygenated blood flow and helps in drainage of noxious substances. It also helps in ATP formation and thereby helps in tissue healing and improving function (Naik et al, 2018). Thus, it can be a promising modality for conservative management of lateral epicondylitis.

Conclusion

The results of the study have proved MRT to be effective in reducing pain intensity, improving grip strength and quality of life in patients with lateral epicondylitis. The paucity of literature on MRT in musculoskeletal conditions warrants further high- quality trials and comparison of MRT with other management strategies with greater sample size. The further studies are necessary to find out the biochemical changes in the muscle after application of MRT.

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Pattern of Injuries Among Female Sepak Takraw Players During All India Inter University Tournament

*Rakesh Kumar **Supreet Bindra

*Research Scholar **Assistant Professor, Department of Physiotherapy, SGGSWU, Fatehgarh Sahib, Punjab.

rkphysio@gmail.com

Abstract

Introduction: Sepak Takraw is considered Malaysia's national sport, and it has the combination of few elements from other sports such as Soccer, volleyball and Gymnastic. Sepak Takraw is a game where the ability to kick and juggle the ball around with the acrobatic moves of gymnasts are required. Therefore, due to its nature of acrobatic moves, Sepak Takraw players may be at risks of various musculoskeletal injuries. This study aimed to report the pattern of musculoskeletal injuries sustained among women All India Inter University Sepak Takraw players.

Materials and Method: Data was collected from Sepak Takraw players reported with musculoskeletal injury at medical desk during All India Inter University Sepak Takraw Women Championship for session 2022-2023 held at Panjab University Chandigarh. All injuries were recorded by the medical team present at competition venue. Descriptive statistics was used for analysis. **Result:** A total 176 women Sepak Takraw players participated and 70 injuries were reported during 3 days tournament. Injury to the hip, thigh and ankle were the commonest injuries reported, major reason being strain and overuse (46.4%) followed by fall and repetitive movements (31.1%). Players at Spiker position sustained more injuries (48.5%) compared to Tekong and Feeder players 24.2% and 27.1% respectively. **Conclusion:** The study suggests need of a guideline for injury prevention among sepak Takraw players.

Key words: Sepak Takraw, Tekong, Feeder, Spiker.

Introduction

Sepak Takraw is considered as Malaysia's national sport, and it has the combination of few elements from other sports such as Soccer, Volleyball, Gymnastic and the ancient sport of Sepak Raga (Adam et al., 2014). Sepak Takraw is a game where the ability to kick and juggle the ball around with the acrobatic moves of gymnasts is required. Lower extremities are used instead of upper extremities, and as in volleyball, there are passes, sets and spikes in play. However, players can utilize their head, chest, feet and thighs to propel the ball over the net. Whether a player is a Tekong, Spiker, or Feeder, they ought to have good aerial agility with precision, leg strength, timing and skills (Jawis et al, 2005). This sport has been included in the Asian Games since 1990 in Beijing. Moreover, the International Sepak Takraw Federation (ISTAF) is trying to introduce this sport in the Olympics.

Sepak Takraw is a skillful sport which consists of three different playing positions i.e. Spiker, Tekong and Feeder. The Feeder and Tekong were mainly restricted to receive and passing the ball, whilst the Spiker performed explosive jumps to block and spike the ball. Spiker involves a somersault- twisting and turning of the body to execute a powerful leg sweep at the ball in mid-air, and is often performed constantly during a rally (Kosni et al 2018).

The Association of Indian University (AIU) introduced Sepak Takraw in national university game for session 2017-2018. The 6th all India Inter University Women Tournaments held at Panjab University Chandigarh attracted 16 universities from all over's country, maximum participation from north east part of country. A total 174 athletes from 16 university participated in this tournament. Surveillance of injuries is important to ensure the health and wellbeing of athlete and team. However, there are very few reports available in literature that is related to injuries in Sepak Sakraw. The pattern of injuries, severity, anatomical area, type and mechanism of injuries has not been determined at a national level athlete. Therefore, the purpose of this study was to report injuries pattern in All India Inter University Women Sepak Takraw players.

Material and Methods

Data Collection

This was an Observational Study and Target Population was injured athletes during all India Inter university women sepak Takraw tournament held at Panjab University Chandigarh from 13/02/2022 To 15/02.2023. All Injuries were recorded by the Participating medical team (a medical officer and a physiotherapist) using a structured questionnaire. The questionnaire consisted of three sections. Section A was designed to collect demographic data and information about player's position (Tekong, Feeder and Spiker). The section B was designed to record the characteristic of injury and pattern. Section C gathered information about the situation resulting in an injury during match. The questionnaire was completed by the physiotherapist of medical team. The medical team was requested to indicate only

musculoskeletal injuries during Sepak Takraw matches. The injured player was examined by the medical team immediately after the incident.

Data analysis

A simple descriptive statistical analysis was used to explore the frequencies, percentages of demographic data and prevalence of the injury. Cross tabulations were used to compare the players positions related to injury. The data was recorded in numerical codes. The players' positions were assigned as 1 “Tekong,” 2 “Feeder,” and 3 “Spiker”. The injury mechanism option was from 1 to 4 (sudden, overuse, falling and others). The localization of injury was recorded in numerical, where it was coded up to 8 (Head and neck, shoulder and arm, elbow and forearm, wrist and hand, hip and thigh, knee and leg, ankle and foot, trunk).

Results

A total 176 women Sepak Takraw players participated in this tournament from sixteen Indian universities. The participants in the game were aged between 17-26 years, 45.7% were below 20 years while 54.3% were aged above 20 years. A total of 70 injuries were registered during three days tournament between 13/02/2022 to 15/02/2023.

Table 1 presents the demographic data including age, injury time, consequences of injury on game and type of management availed by the injured Sepak Takraw players. 80% injuries happened during tournament and only 20% during warm up session. 84.2% the injured players preferred physiotherapy as first line of treatment. 82.8% injured athletes returned to game after treatment.

Table 2 reports the pattern of musculoskeletal injuries based on anatomical location and player's playing position in the game. The distribution of injuries by body region was 24.2% in hip and thigh, foot and ankle (21.4%), head and neck (20%), in trunk, knee and leg share equal (8.5%). Few injuries were reported in upper extremity. Players at Spiker position reported more injuries as compared to other positions (Table 3). Strain and overuse were the commonest type of injury reported, irrespective of player position (Table 4).

Table.1: Demographic data of the female Sepak Takraw players

Variables	Frequency (n)	Percentage (%)
Age		
<20	32	45.7
>20	38	54.2
Injury Time		
Game	56	80.0
Warm up / cool down	14	20.0
Consequences		
Continued game after treatment	58	82.8
Discontinued game after injury	12	17.2
Treatment		
Medical	11	15.7
Physiotherapy	59	84.2

Table.2: Pattern of musculoskeletal injuries based on body parts and Players' playing position.

Location of Injury	Players' Position			Sum	%
	Tekong	Feeder	Spiker		
Head and neck	2	8	4	14	20
Trunk	4	2	0	6	8.5
Shoulder and Arm	0	4	0	4	5.7
Elbow and Forearm	1	0	2	3	4.3
Wrist and Hand	1	0	4	5	7.1
Hip and Thigh	2	5	11	18	25.7
Knee and leg	2	0	3	5	7.1
Ankle and foot	8	1	6	15	21.4
Total Injuries	20	20	30	70	100

Table III shows the musculoskeletal injury based on the mechanism of injury across the player's position in the game. Overall, (45.7%) of the injury mechanism was due to falling, 31.4% due to overuse and 8.5% sudden onset in nature. In relation to Players playing position Spiker sustained maximum no of injuries (48.9%), Feeder reported (27.14%) and Tekong reported least no of injury (24.2%).

Table.3: Pattern of musculoskeletal injuries based on mechanism of injury and players' position

Mechanism of Injury	Players' Position			N	Sum %
	Tekong	Feeder	Spiker		
Sudden	3	4	6	13	18.5
Overuse	12	8	2	22	31.4
Falling	2	6	24	32	45.7
Others	0	1	2	3	4.3
Total Injuries	17	19	34	70	100

Table.4: Pattern of musculoskeletal injuries based on type of injury and players' position

Type of Injury	Players' Position			N	Sum %
	Tekong	Feeder	Spiker		
Sprain	3	2	6	11	15.5
Strain	6	8	8	22	31.4
Overuse	12	6	4	22	31.4
Bruises/Laceration	2	4	6	12	17.1
Others	0	2	1	3	4.3
Total Injuries	23	22	25	70	100

Discussion

To the best of our knowledge, this is the first study to identify the musculoskeletal injuries pattern of university Sepak Takraw women players in India. The study found 42.5% injuries in 176 athletes in total 15 matches. A similar study conducted during 13th Asian games tournament in Thai national Sepak Takraw team, 53 injuries reported in 10 athletes during 3903 hours and 30 minutes of total exposure time, an incidence of 13.58 injuries per thousand players' hours (Jalayondeja W et al., 2000). These differences are attributed to the fact that study was conducted on smaller sample size and male subjects whereas in our study had a larger sample size and only female subjects as compared to the previous study.

This study also differed from other sports that had some activities similar to Sepak Takraw (soccer, volley ball and gymnastics). The incidence of Sepak Takraw was higher than soccer (Pulukian M et al., 1996) although soccer is a more aggressive sport. In Sepak Takraw there are total 13 players in a team out of which 10 players are substitutes but in soccer there are minimum 15 players in which 11 players participate and 4 are substitutes. Secondly Sepak Takraw has no time limit game but soccer is time bound game.

The rate of injuries and pattern of injuries in reported in previous studies on Volleyball (Shafle et al., 1990) and Gymnastics (Sands Aet al 1993) have been found to be less than our study. The difference may be attributed to inclusion of both male and female participants and the fact that Sepak Takraw is team event whereas Gymnastics is an individual sport.

In our study most of the injuries were sustained to lower limb especially ankle. The demand of acrobatic movement in this game and the landing forces as well as movement imposed on ankle joint during sports could explain why ankle was the most vulnerable site of injury (Kubo et al, 2016). The finding, however, is inconsistent with a previous study which reported knee to be the most commonest site of injury, reasons being a rapid change in movement, previous trauma to the knee, shoe and artificial surfaces (Jalayondeja, 2000).

Fall was the commonest type of injury among Sepak Takraw (45.7%), with most occurrences at the ankle and foot (21.4%) followed by wrist and hand (8.5%). This could be due to poor balance, proprioception and bad landing technique. The high repetitive impact loads that lead to an increase in ligament laxity in the ankle. Our study also revealed overuse to be the commonest mechanism of injury. Overuse could be related to endurance activity and repetitive performance during Sepak Takraw that can lead to chronic pain and worsening after completion of the tournament (Jessica, 2021). Players at Spiker position presented with the highest number of injuries. This study suggested that the high-speed acrobatic movements and landing could be the reason why injuries among Spiker were more Tekong than other positions. Meanwhile, we found that Tekong were more prone to repetitive injury at hip and thigh anatomical area and Feeder as their duration of playing in the field was longer than other players.

The mechanism of injury according to playing positions also varied among each position. The Spiker position, needing high acrobatic movements to smash a ball lead to various types of injury (Kerdsomnuk et al, 2015). A Tekong may also sustain hip and thigh injury due to repetitive movements like service action and lifting opponent's service ball. Feeder, however, were reported to be prone to get an overuse injury to the head and neck as a result of repetitive heading action to the ball to Spiker.

Injuries are a concern for Sepak Takraw players. As compared to high-risk sports (such as Soccer, Volleyball and

Gymnastic), the injury rate in Sepak Takraw appears to be higher. In our study, the most frequently reported injury occurred during summersault and led to injury at ankle and blocking with head causes neck injury which is in corroboration with previous study.

The current study presents a few limitations. This study has only female participants. In addition, more studies are needed to focus on other pertinent information of injury as it could be the basis for prevention measures to reduce the prevalence and incidence of injury among Sepak Takraw players. This study also did not focus on training hours, types of shoes, as well as types of artificial turf that may provoke risks of injuries.

Conclusion

The findings of our study indicate that overuse injuries to lower limb are common at hip and thigh, but more studies are required so that appropriate preventive strategies can be designed, owing to scarcity of available literature.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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A Study on Neck Disability Index and Forward Head Posture among University Students

* Megha Garg, *Priya Rayat, **Sonia Singh

*MPT Student, **Assistant professor, Department of Physiotherapy, Punjabi University, Patiala, India
priyarayat2810@gmail.com

Abstract

Background: As present time is witnessing FHP as commonest postural deviation among youth due to increased screen time reason being excessive use of phones and laptops. Generally, this leads to the serious effects on the physical and mental health of the individuals. The present study aims to determine FHP among the university students and its relationship with the factors like screen time and neck disability. **Methodology:** An Observational study was conducted from May 2020 to April 2021. 50 participants, of age between 17 to 30 years from professional courses, complaining neck pain were selected from Punjabi university, Patiala for the study. Forward head posture (CV Angle) was measured by using Kinovea software whereas pain and disability was recorded using Neck Disability Index. In addition to this, Screen time per day was also recorded. **Result:** The study revealed that the FHP is quite prevalent among the university (26%) students. 64 per cent of the students are having neck disability from which 56 per cent (mild), 6 per cent (moderate) and 2 per cent (severe). Additionally, the study indicates a significant relationship of FHP with screen time as well as pain and disability. **Conclusion:** The study concludes that FHP is prevalent among university students. Increase in screen time is a predisposing factor for FHP which ultimately leads to pain and disability. Thus, this study emphasizes that the students must be encouraged to adapt good postural habits and reduce their screen time.

Keywords: Forward Head Posture, CV angle, Kinovea, Neck disability, Screen time

Introduction

The tendency to remain seated for long period of time for usage of laptops, computer is increasing, thereby leading to faulty postural habits among individuals. This can cause changes in the alignment of spine, leading to abnormal posture, spatial change between line of gravity and spine causing overload on muscles and connective tissues (Kim et al., 2018).

Neck pain is one of the commonest problems reported in of modern society. About 70% of people experience neck pain at least once in their lives and about 10-50% of the elderly suffer from disability due to neck pain (Raoofi et al., 2018). Among various causes of neck pain mechanical neck pain is the commonest. It includes pains arising from habitual postures, poor ergonomics, and abnormal physiological loads on the neck. One of the most common abnormal postures in the head and neck area is forward head posture (FHP).

FHP has been identified as displacement of the head anteriorly with craniovertebral angle lesser than 50 degrees (Naz et al., 2018; Diab et al., 2012). Currently no particularly standard method is available for its measurement but photogrammetry method that involves analysis of the photograph captured in sagittal plane using postural evaluation software (Kinovea software) is most extensively used method for evaluation of CV angle or FHP (Fard et al., 2016). To determine CV angle, two reference point are used at tragus and C7 vertebrae i.e., one line need to be marked passing from tragus to C7 cervical vertebrae and other horizontal line is marked parallel to ground that passes from spinous apophysis of C7 vertebrae. An angle less than 50 degrees indicates FHP that depicts smaller the CV angle, greater the deformity (Izquierdo et al., 2020).

FHP has been found to be associated with text neck syndrome, which results in pain, stiffness and tenderness in neck and trapezius muscle, turning to be disabling factor amongst college going population in cervical and shoulder. It also contributes the problems like chest distress, sleep disorder, anxiety, confusion, and numbness in the arm (Mamania., 2018).

Though there are many factors that could contribute to development of Forward Head posture, screen time (which includes usage of computers, laptop, and smartphones) contributes highly in the development of FHP. The use of apps and internet services on a smartphone had doubled from 2015 to 2017 according to the recent Neilson data reported by Vizcaino et al., (2019). A high screen time not only leads to the development of faulty posture like FHP but also it has been associated with problems like low mood, irritability, poor social –emotional development thus leading to poor educational performance among students.

Knowing the ill effects of FHP and its increasing rate, the present study was done to see the prevalence of forward head posture and evaluate its relationship with the factors like screen time and neck disability among university students so that appropriate guideline can be provided to the students for their better postural health.

Methods

The Study was carried out in the University Campus of Punjabi university, Patiala. A sample size of 50 individuals with the age group 17 -30 years irrespective of the Gender having neck pain were selected from professional courses. Individuals with any history of shoulder fracture or trauma, cervical surgery, structural or functional scoliosis bone cancer and excessive kyphosis were excluded.

Procedure of Data Collection

A self-structured questionnaire was developed by the investigators to conduct the present study. The questionnaire was partially adopted from HELENA screen based sedentary Questionnaire (Lopez et al., 2011) and was modified to evaluate screen time usage and neck pain.

Neck Disability index was used to assess the neck disability among the participants. It is a 10 – items questionnaire which includes activities of daily living such as sleeping, reading, work, lifting, driving, personal care, recreational activities, pain intensity, concentration, and headache. Each question is measured on scale from 0 (no disability) to 5 and an overall score out of 100 is calculated by adding each item score together and multiplying it by 2. The higher NDI score indicates greater patient's or subject's perceived disability due to neck pain (Howell et al., 2011).

The CV angle was used to measure the FHP using Kinovea software. Kinovea is a free 2D motion analysis software that is used to measure the craniovertebral angle. The intra-rater and inter-rater reliability of software had an intraclass coefficient of 0.88 and 0.83 to 0.89 (Elwardany *et al.*, 2015). Two markers were placed on the ground separated by 1.5 m, where the smartphone and the subject were located. Reference markers were placed on the spinous process of C7 and in the tragus of the subjects' ears, which were identified through palpation. The researcher took a picture with a smartphone from lateral side and the image was obtained. The image was then uploaded onto a HP laptop for analysis with the Kinovea software through which the CV angle was measured. Angle less than 50 degrees is considered as forward head posture.

Results

Statistical Analysis

The data was analysed using spss version 22. Mean and standard deviations were analysed for demographic details, percentile and coefficient of correlation analysis was done to analyse the results. The criteria of statistical significance were set at $p \leq 0.05$.

Table 1. Distribution of population according to their age, weight, and height

Demographic characteristics	Mean $\pm$ standard deviation
Age (Year)	24.58 $\pm$ 2.711
Weight (Kg)	64.28 $\pm$ 11.190
Height (cm)	161.8 $\pm$ 7.599

Table 2. Distribution of population according to their knowledge about the correct posture

	NO (%)	YES (%)	Total students
Students	42(84%)	8 (16%)	50

Table 3. Distribution of population according to Frequent position of students while using screen devices

Frequent position while using screen devices	No. of students N=50	% Of students
Sitting	34	68%
Supine lying	9	18%
Standing	4	8%
Walking	3	6%

Table 4. Distribution of population according to the time spend on screen in a day

Hours of screen time	No. of students (% age) N=50
2-4 hours	0
4-6 hours	26 (52%)
Above 6 hours	24(48%)

Table 5. Prevalence of forward head posture among university students

Total no. of students	CV Angle less than 50 degrees (FHP) N (%)	No of student with CV angle greater than 50 degrees
50	13(26%)	37(74%)

Table 6. Distribution of population according to the intensity of pain experienced by them

Pain score	No. of students (%age) N=50
Mild pain (1-3)	32(64%)
Moderate pain (4-6)	16 (32%)
Severe pain (7-10)	2(4%)

Table 7. Distribution of population having neck disability

Interpretation of disability	No of students (%) N=50
No disability (0-4 score)	18(36%)
Mild disability (5-14 score)	28(56%)
Moderate disability(15-24score)	3(6%)
Severe disability (25-34 score)	1(2%)

Table 8. Relationship of Screen time, neck disability and pain with forward head posture

	R	P
Screen Time	-0.33*	0.019
Neck Disability	-0.295*	0.036
Pain	-0.3227*	0.022

(*p≤0.05) The table shows significant inverse relationship of CV angle with Screen time, neck disability and pain

Discussion

Before analysing the posture among the participants, their knowledge about the posture was checked by asking them what they mean by correct posture. Surprisingly, only a very small percentage of students (16%) have knowledge about correct posture. In context to the posture adopted using the use of screen devices the observations revealed that 68% students preferred sitting, 18% preferred supine lying, 8% preferred standing and 6% student preferred walking while using screen devices like laptop and smartphones. Further, in the study the FHP was examined for all the participants.

The observations of the current study in context to the prevalence of forward head posture among 50 Punjabi university students revealed that 26% of the students were having forward head (CV angle < 50). In line with our study some studies in the past have also evaluated the prevalence of FHP among students. In a Cross-sectional study done by Mamania and Anap (2018), prevalence rate of 70% was reported for forward head posture among physiotherapy students. The study showed that the students who were spending most of time on books, laptop and mobile are more prone to FHP. In another study conducted by Naz et al. (2018) among 197 students and faculty from 4 universities in Pakistan, the prevalence of FHP was reported to be 63%. They attributed their findings to the extensive computer usage and faulty posture during lectures. Comparatively a lower prevalence rate in the current study could be because of a small sample considered in the current study.

Screen time and pain among the participants were assessed using a self – structured questionnaire. The findings showed that 52% of the students daily spend 4-6 hours on screen devices, while 48% students spent more than 6 hours. According to the students they mostly spend their screen time for studying, making assignments, attending lectures and on social network sites.

In context to the pain the observations of the current study indicated that all the participants had pain either in the neck or shoulder. Among the participants, 70% students had neck pain, 8% had shoulder pain whereas, 6% had both neck and shoulder pain. Study done in past showed, the usage of small monitors of smart phones with the device held on the laps causes the individuals to position their head down, thereby increasing the muscle activity in the cervical extensors and eventually triggering muscle fatigue (Kang et al.,2012).

Further, Neck disability was assessed by NDI. The findings in context to the disability revealed that 56% students had mild disability, 6% had moderate disability, 2% had severe disability. Mild disability reported in the current study could be attributed to the duration of usage in terms of years as most of the students are using these devices only from few years.

The current study further attempted to find the relationship of forward neck posture with screen time, pain, and disability. A significant relationship between screen time usage of smartphones and computers with forward

head posture ($r=-0.33$, $p=0.0193$) was observed in the current study. The value of r shows an inverse relationship of screen time with CV angle (FHP) which suggests that with increase in screen time, there is significant decline in CV angle, thus increasing forward head posture. These symptoms are more prominent with increase of screen device usage among youth. In the long run with protrusion of head forwardly and shift of centre of gravity anterior will lead to posture imbalance and reduced motor control ability (Ramalingam et al., 2019) which is a point of concern. Therefore, proper postural guidance is very important aspect in screen device users. In addition, Studies by Kim et al., 2016, Kang et al., 2013, Mekhora et al., 2000 also reported a positive association between usage of computers, smartphones with forward head posture.

A significant and an inverse correlation of the degree of CV angle was also observed with the neck pain and disability ($r=-0.295$, $p=0.0369$). CV angle is a factor significantly influences pain in individuals with FHP (Ramalingam et al., 2019). The decreased CV angle (increased FHP) causes flexion of the cervical vertebrae in anterior position which if maintained for long duration, increases the load in muscle (by increasing the moment arm) and its surrounding connective tissue. Constant stress on extension muscle and connective tissue in the craniocervical area, leads to an imbalance in neck that induces pain (Yip et al, 2008). They also observed that people with more intense FHP had more disability. As a result, it can be stated that increasing the magnitude of the FHP intensifies the severity of pain and disability in the neck area.

The findings of the current study showed that using screen devices for prolonged duration could negatively affect posture, leading to FHP, neck pain and disability.

Conclusion

The study concludes that increasing screen time and faulty posture while using screen devices predispose the students to develop FHP, neck pain and neck disability. The current study emphasizes the importance to create awareness on the correct posture and consequence of forward head posture among the screen device users. Also, posture correction exercises in students must be encouraged.

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Efficacy of Neural Mobilization plus Balance-Gait Training on Balance and Gait Functions of Individuals with Subclinical Diabetic Neuropathy

***Shanika Sharma **Sandeep Singh *Simranpreet Kaur**

*MPT Student, ** Assistant professor, Department of Physiotherapy, Punjabi University, Patiala, India
 3390simran@gmail.com

Abstract

Introduction: Diabetic Neuropathy (DN), causing sensory alteration, predominantly in feet results in balance and gait impairment. Previous studies report that improvement in balance and gait functions can be achieved by promoting sensory recovery in diabetic neuropathic individuals. Neural mobilization is one such physiotherapeutic method that has beneficial effect on nerve health and hence on sensory function of nerve. So present study attempts to investigate whether neural mobilization administered with balance-gait training would help to improve lower limb sensation in Diabetic Neuropathic patients that would then enhance their balance-gait function. **Aim:** To examine the efficiency of neural mobilization along with balance training in improving balance-gait function of individuals with subclinical Diabetic Neuropathic. **Methodology:** 40 individuals (aged 50-75 years) having subclinical Diabetic Neuropathy with Vibration Perception Threshold (VPT) values between 15-25 volts were recruited in study. Participants were randomly equally assigned to two groups. Group A received Balance-Gait training with neural mobilization while Group B received only Balance-gait training. Outcome measures included Vibration Perception Threshold (VPN), Berg Balance Scale (BBS), Dynamic Gait Index (DGI) and Timed Up and Go (TUG) Test recorded at baseline and at the end of 4th week. **Result:** Highly significant differences existed in values of BBS, DGI and TUG for both groups while highly significant differences in pre -post VPT scores were observed only in Group A. Further, between group analysis revealed that highly significant differences existed in mean difference values of VPT scores while non-significant differences existed in mean difference value of BBS, DGI and TUG

Conclusion: Findings suggested that neural mobilization when integrated in balance-gait training of subclinical diabetic neuropathic individuals resulted in improved lower limb sensory function that translated to enhanced balance-gait functions.

Keywords: Diabetic Neuropathy, balance training, gait training, sensory function.

Introduction

(Almurdhi et al 2017; Aruin et al 2016) Individuals with diabetes mellitus have greater chances of developing Diabetic Peripheral Neuropathy (DPN) (Alam et al., 2017) and becoming more vulnerable to balance-gait impairments (Hewston and Deshpande., 2016). DPN affects sensory function of ankle and foot as it affects joint mechanoreceptors and leads to alteration of somatosensory input mainly proprioceptive (Jyoti et al., 2016; Lee et al., 2013), negatively affecting static and dynamic balance of diabetics making them prone to falls (Brown et al., 2015). Patients with DPN have five times more falls risk than patients without neuropathy (Brown et al., 2015).

Restoration of lower extremity sensations can have long term benefits in maintaining balance and postural stability and reducing number of falls and fall risks in diabetics. Presently effective pharmacological treatments for sensory restoration in DPN are unavailable and extensive research in this regard is in progress (Leonard et al., 2004; Powell et al., 2005) Some studies report that sensory changes due to DPN can be reversed with the use of a non-invasive medical device, the ATS (Anodyne Therapy System) in which Monochromatic near - Infrared Photoenergy (MIRE) was delivered (Carnegie et al., 2002; Harkless, 2006).

In physiotherapy, technique of neural mobilization (NM) is also postulated to improve the nerve health. NM is a non-invasive manual therapy technique which is used in pathological conditions producing pain through the disturbance in peripheral nervous system (Silva et al., 2015). It is hypothesized that neural mobilization can reverse the symptoms of neuropathy but in this regard there is paucity of studies in literature. Therefore in present study investigates effect of integrating neural mobilization in balance and gait training program during subclinical stage of neuropathy on sensory function and balance and gait performance of diabetic individuals.

Methodology

40 elderly, aged 50-75 years, suffering from Type 2 Diabetes Mellitus since last 10 years constituted sample of present experimental study, who were recruited using convenient sampling method. Diabetics having Subclinical Diabetic Neuropathy as assessed by Vibration Perception Threshold test were included. Individuals with foot ulcers, cognitive impairment, visual impairment, neuropathy or diminished sensations due to cause other than diabetes, having undergone any surgical procedure for lower limbs and back and using walking aids presence of any neurological or musculoskeletal injury that affects the balance and gait were also excluded. Approval of Departmental Research Board (DRB) to conduct study was obtained.

Participants were randomly allocated to two groups, i.e. Group A and Group B. The participants of both groups were homogenous in their anthropometric and balance-gait characteristics. Group A were administered neural mobilization along with balance-gait exercises while Group B received only balance-gait training. The interventions were administered for once a day for 5 days a week and in total for 4 weeks. The balance-gait training (Table 1) was introduced as group therapy, 2-4 participants were included in a group. Comprehensive balance-gait training protocol comprising of warm up (5min), followed by a circuit training (35 min) including various gait and balance exercises as well as cool down and relax period at the end was administered. Nerve mobilisation in present study was provided to tibial nerve bilaterally. Nerve mobilisation comprised of slider and tensioner technique. Slider technique was administered in supine position by holding lower limb with hip flexed at 45°, passively dorsiflexing ankle and eversion of foot followed by dorsiflexion of toes to slide tibial nerve distally. After a while dorsiflexion and eversion was released and ankle was plantar flexed to make tibial nerve slide proximally. For tensioner technique limb was moved to 45° along with ankle dorsiflexion and foot eversion followed by extension of knee joint (Shacklock, 2005). Nerve mobilisation was applied with 5 sets with 10 cycles with a rest period of 1 min in each set.

Table 1. Balance-Gait training program

	Week 1	Week 2	Week 3	Week 4
Warm up	1. Marching on the spot 2. Arm, neck and trunk movements 3. Jogging 4. One leg standing 5. Weight shifting 6. Brisk walking	1. Marching on the spot 2. Arm, neck and trunk movements 3. Jogging 4. One leg standing 5. Weight shifting 6. Brisk walking	1. Marching on the spot 2. Arm, neck and trunk movements 3. Jogging 4. One leg standing 5. Weight shifting 6. Brisk walking	1. Marching on the spot 2. Arm, neck and trunk movements 3. Jogging 4. One leg standing 5. Weight shifting 6. Brisk walking
Balance activities	1. Static stance, feet spread apart, arm close to body 2. Heel stand and toe stand with eyes open (with support)	1. Static stance, narrow BOS 2. Tandem stance (with/without support) 3. Heel stand and toe stand with eyes open. 4. Heel stand, toe stand with eyes close (with support) 5. Unilateral leg stance (with support) 6. Bipedal inversion and eversion with support	1. Standing with alternate heel touch forward and toe touch backward, forward reach and unilateral leg stance (with support) 2. Heel stand and toe stand without support. 3. Heel stand, toe stand with eyes close (without support) 4. Unipedal toe raises and heel raises	1. Unipedal inversion and eversion Ankle sway (laterally) 2. Hip sway (laterally) 3. Unilaterally leg stance (with/without support) 4. Perturbation exercises.
Gait activities	1. March in place, Semi tandem stance 2. Walking forward and backward, normal BOS	1. Static stance, feet spread apart, arms close to body and March in place 2. Walking forward and backward, narrow BOS 3. Gait with narrow BOS, eyes open wide or sharp turns to right and left side	1. Gait with sudden starts and stops 2. Squat down by bending at knees and keeping back straight 3. Stepping activities, tandem walk 4. Gait with narrow BOS; eyes open wide or sharp turns to right and left side	1. Forward reach gait with eyes closed with BOS progressively Narrowed, firm surface including negotiating uneven terrains and obstacles
Strengthening and endurance exercises	1. Heel raises, lunges, squats, pelvic bridging (bilateral and unilateral), sitting to standing	1. Lunges, squats, pelvic bridging (bilateral and unilateral), sitting to standing, walking up and down a slope	1. Lunges, squats, pelvic bridging (bilateral and unilateral), sitting to standing, walking up and down a slope walking up and down a slope, stair climbing	1. Lunges, squats, pelvic bridging (bilateral and unilateral), sitting to standing, walking up and down a slope walking up and down a slope, stair climbing

Table 1 Presents the exercises protocol for Balance-Gait training with weekly progression Adapted from Allet et al., 2009; Halvarsson et al., 2014; Khanna and Singh, 2014; Morrison et al., 2010; Richardson et al., 2001; Robertson et al., 2002.

Outcome measures included Berg Balance Scale (BBS), Timed Up and Go Test (TUGT), Dynamic Gait Index (DGI) and Vibration Perception Threshold (VPT) that were recorded at the baseline and at the end of 4th week. The Berg Balance Scale (Berg et al., 1992) is an objective measure of static and dynamic balance abilities and also a diagnostic test for predicting a participant's potential for falling. The BBS have a reported test-retest reliability of 0.95 (O'Sullivan et al., 2014) and has moderately good sensitivity, and high specificity (Zwick et al., 2000).

TUGT is quick measure of dynamic balance and mobility having good inter-rater (0.99) and intra-rater reliability (0.98) (O’Sullivan et al., 2014).

The Dynamic Gait Index having inter-rater reliability of 0.96 and test-retest reliability of 0.98, is designed to examine gait, balance and fall.

The Vibration Perception Threshold (VPT) measured by biothesiometer device can be used to easily and accurately identify at-risk diabetic patients, including those with early neuropathic deficits (Garrow and Boulton, 2006). The VPT values grade the neuropathy as mild (15-20v), moderate (20-25v), and severe (>25v). VPT is assessed by applying vibratory stimulus on various test sites of foot including great toe, 1st metatarsal, 3rd metatarsal, 5th metatarsal, instep, and heel (Medakkel and Sheela, 2018).

Microsoft Office Excel 10 Computer program was used to analyze the data. Paired ‘t’ test was used for within-group analysis while unpaired ‘t’ test was applied for between the group analysis.

Results

Table 2: Within-group comparison of VPT scores (both sides) for Group A

Variables	Group A			
VPT	Pre intervention (Mean ± SD)	Post intervention (Mean ± SD)	‘t’ value	‘p’ value
Left	17.77±2.48	16.74±2.60	7.57	0.0001***
Right	17.42±2.53	16.37±2.78	7.73	0.0001***

***p≤0.0001= very highly significant; t critical=2.09

Table 2 presents the within-group comparison of pre and post values of VPT (both sides) for Group A. Results showed that very highly significant differences were present between pre-post VPT scores.

Table 3: Within-group comparison of VPT scores (both sides) for Group B

Variables	Group B			
VPT	Pre intervention (Mean ± SD)	Post intervention (Mean ± SD)	‘t’ value	‘p’ value
Left	18.14±2.22	18.02±2.04	1.28	0.21 ^{NS}
Right	17.61±1.93	17.36±2.04	1.31	0.20 ^{NS}

^{NS}=non-significant, p>0.05; t critical= 2.09

Table 3 presents the within-group comparison of pre and post values of VPT (both sides) for Group B. Results showed that non-significant differences were present between pre-post VPT scores.

Table 4: Between-group comparison of mean difference scores of VPT

Variable	Group A (Mean ± SD)	Group B (Mean ± SD)	‘t’ value	‘p’ value
Mean difference VPT (Left)	4.10±2.48	0.12±0.43	7.06	0.0001***
Mean difference VPT (Right)	1.04±0.60	0.25±0.84	3.43	0.0015**

***p≤0.001= very highly significant; t critical=2.08 **p≤0.01= highly significant; t critical=2.03

Table 4 presents the between-group comparison of mean difference scores of VPT. Results showed that highly significant differences existed in VPT scores.

Table 5: Within-group comparison of scores of BBS, DGI and TUGT of Group A

Variables	Group A			
	Pre-intervention (Mean ± SD)	Post-intervention (Mean ± SD)	‘t’ value	‘p’ value
BBS	40.15±5.73	47.50±5.84	22.50	0.0001***
DGI	13.35±3.42	18.60±2.93	12.81	0.0001***
TUGT	18.60±4.58	15.20±3.37	7.37	0.0001***

***p≤0.001= very highly significant; t critical=2.09

Table 5 presents the within-group comparison of values of BBS, DGI and TUGT for Group A. Results showed that highly significant differences were present between pre-post scores of BBS, DGI and TUGT.

Table 6: Within-group comparison of scores of BBS, DGI and TUGT of Group B

Variables	Group B			
	Pre-intervention (Mean $\pm$ SD)	Post-intervention (Mean $\pm$ SD)	't' value	'p' value
BBS	39.55 $\pm$ 5.24	46.70 $\pm$ 5.24	27.04	0.0001***
DGI	13.60 $\pm$ 3.25	18.5 $\pm$ 3.69	13.27	0.0001***
TUG	19.50 $\pm$ 4.11	15.85 $\pm$ 3.65	8.35	0.0001***

***p $\leq$ 0.001= very highly significant; t critical=2.09

Table 6 presents the within-group comparison of values of BBS, DGI and TUGT for Group B. Results showed that highly significant differences were present between pre-post scores of BBS, DGI and TUGT.

Table 7: Between-group comparison of mean difference scores of BBS, DGI and TUG

Variable	Group A	Group B	't' value	'p' value
	(Mean $\pm$ SD)	(Mean $\pm$ SD)		
Mean difference BBS	7.35 $\pm$ 1.46	7.15 $\pm$ 1.18	0.47	0.63 ^{NS}
Mean difference DGI	5.25 $\pm$ 1.83	4.90 $\pm$ 1.65	0.63	0.52 ^{NS}
Mean difference TUG	3.40 $\pm$ 2.06	3.65 $\pm$ 1.95	0.39	0.69 ^{NS}

^{NS}=non- significant, p>0.05; t critical= 2.02

Table 7 presents the between-group comparison of mean difference scores of BBS, DGI and TUGT, Results showed that non-significant differences existed in BBS,DGI and TUGT scores.

Discussion

Present study intended to investigate if incorporating lower limb nerve mobilization along with balance and gait training would augment balance and gait performance of diabetics. The results of present study revealed after neural mobilization, VPT scores were significantly improved(Group A) while non-significant changes in VPT scores existed in Group B, indicating that neural mobilisation was beneficial in preserving the sensory functions in subclinical diabetic neuropathy.

Only two studies could be located in literature that has reported positive outcomes in nerve function after neural mobilisation (Kumar et. al., 2010; Singh et. al., 2012). The pilot study of Kumar et al. (2010) demonstrated significant improvements in VPT scores and in thermal sensation of diabetic neuropathy individuals, immediately and 15 minutes after application of nerve mobilization. Similarly Singh et.al, (2012) reported that nerve mobilization was helpful in reducing VPT scores in diabetic individuals. Both studies suggesting that neural mobilisation was helpful in preserving sensation of foot in diabetic neuropathy. Similarly other studies have reported that neuronal mobilisation had positive effects on other sensations such as two point discrimination, light touch and pain (Kavlak and Ugyar, 2011; Villafañe et. al., 2013). Findings of aforesaid studies and present study suggest that nerve mobilization is an effective technique in decreasing sensory impairment by improving the nerve health.

Mechanisms postulated in literature that sub serve the positive effects of neural mobilisation on sensitivity of the nerve include that neural mobilization alleviates intraneural oedema and decreases intraneural pressure, considered as one of the cause of the diabetic neuropathy (Brown et. al., 2011). Tensioning technique of neural mobilization is associated with relative motions between nerves and adjoining structures causes fluctuating effect on intraneural pressure which results in reduction of intraneural oedema (Butler, 2006). This effect of decreasing oedema may also helps in preventing the impairment of blood flow, another reason of diabetic neuropathy. Further, neural mobilization is considered to help in dispersion of toxic liquids, encourages incessant axoplasmic flow and improves vascularity of nerve (Villafane et al., 2013).

Within-group analysis of gait and balance measures (BBS, DGI and TUG) for both the groups revealed that post intervention scores BBS, DGI and TUGT were significantly improved from baseline scores in both groups (Group A and Group B). Further, between-group comparison of the mean difference (change scores) of BBS, DGI and TUGT revealed that non-significant differences existed between mean difference values of BBS, DGI and TUGT scores of both groups suggesting that inclusion of neural mobilisation in balance-gait training of diabetic neuropathic individuals could not produce much beneficial effect. But on closer observation it was found that improvement scores of BBS, DGI and TUG of Group A (balance gait training +neural mobilization group) were greater albeit statistically non-significantly than corresponding scores of Group B (balance-gait training group) suggesting that the

addition of neural mobilization to balance–gait training, to certain extent, augments the balance and gait performance, of individuals with diabetic neuropathy.

Though no study could be located that has documented the direct effect of neural mobilization on balance and gait performance by improving sensation in diabetic neuropathy individuals. But some interesting studies are available that have reported that improvement in balance was witnessed when sensory function was improved through other treatment techniques. (Lee et al., 2013; Leonard et al., 2005; Volkert et al., 2006).

The a study of Lee et al., (2013) reported balance function in persons with diabetic neuropathy improved when ankle joint position sense was enhanced through 6 weeks of intervention of that whole body vibration. The study of Leonard et. al., (2004) also demonstrated that improved sensation of feet and pain in patients with diabetic neuropathy through infra-red anodyne therapy system resulted increase in their balance function. Similarly, Volkert et al. (2006) demonstrated that monochromatic infrared photo energy (MIRE™) therapy when administered in combination with physical therapy was effective in decreasing pain and improving sensory function consequently improving balance in neuropathic individuals. Thus, the results of aforementioned studies and present study provides empirical evidence that improving sensory functions contributes positively in improving balance and gait functions and decreasing fear of falls in individuals with diabetic neuropathy.

The one interesting finding of present study is that no improvement in VPT scores of Group B participants was found but still improvement in their balance and gait performance was equivalent to balance-gait performance of Group A participants. So it can be inferred that without even applying any specific intervention to decrease sensory impairment, some improvement in sensory functions still occurs with the use of balance-gait training which may result in improved balance and gait performance of individuals with diabetic neuropathy. Balance-gait training increases muscle strength and firing from muscle mechanoreceptor, stimulation of cutaneous receptors of feet and joint proprioception also occur while performing balance-gait exercises (Gauchard et al., 1999; Morrison et al., 2010; Richardson et al., 2001). In present study though it was observed that neural mobilization produced significant improvements in VPT scores but it could not be translated to enhance efficacy of balance-gait training.

From the findings of present study it can be stated that definitive conclusion about the impact of neural mobilization in augmenting balance-gait training efficacy on diabetic neuropathy could not be arrived at. The experimental group showed increment in VPT scores as well as in values of BBS, DGI and TUG while on contrary despite no improvement in sensory function of control group, increment in values of BBS, DGI and TUG were observed. These confounding findings warrants more studies in this direction on larger sample size with rigorous methodology taking care of biases and cofounders in the study to drive affirmative conclusions.

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Effect of Training Turning Activities Along with Cognitive Task on Balance and Gait of Chronic Stroke Survivors

*Sandeep Singh, **Jagmeet Kaur*, ***Rupinder Kaur

*Assistant Professor, **Former MPT Student, ***MPT Student, *Department of Physiotherapy, Punjabi University, Patiala
rkrandhawa55555@gmail.com

Abstract

Introduction: Turning, a steering activity, poses greater challenge to stroke survivors that predispose them to risk of falling. Most of the balance training program presently undertaken for stroke survivors teaches single task or dual task in straight line but training specifically “steering” activity is lacking in them. Need is there to investigate the effect of teaching steering activity along with cognitive exercise so as to understand whether such training is efficacious in promoting balance and gait performances of stroke survivors. **Aim:** To investigate the effectiveness of steering (turning) activities along with cognitive task on balance and gait performances of stroke survivors. **Methodology:** 24 chronic stroke survivors, aged 48 to 63 years were randomly allocated to two groups. Group A(control group) received conventional balance and gait exercise program while Group B(experimental) received training of turning activity along with cognitive task plus balance and gait exercise program groups. Each group received intervention of 6 sessions in a week for about 8 consecutive weeks. Outcome measures used included Berg Balance Scale (BBS), Timed Up and Go Test (TUGT) and Dynamic Gait Index (DGI) to measure balance and gait functions recorded at baseline and at the end of 8th week of intervention. **Results:** Within group analysis revealed that pre-post scores BBS, DGI and TUGT were significantly different for both groups. Further, between group analysis revealed significant differences existed in post intervention scores of outcome measures (BBS, DGI and TUGT) **Conclusion:** Incorporating the training of steering(turning) activities along with cognitive tasks into balance and gait training program of stroke survivors proved to be more effective in promoting their balance and gait functions.

Keywords: Balance, gait, chronic stroke survivors, turning activities, cognitive task.

Introduction

The crucial deficit that ensues after stroke is lost postural and balance control that subsequently leads to numerous functional limitations in stroke. Individuals who sustained stroke are at a major risk of falls while they perform some functional task (Lamb *et al.*, 2003).

Though multiple factors have been implicated for falls but research shows that majority of falls occur due to altered balance (Silsupadol *et al.*, 2006; Shakuratova *et al.*, 2004). Decline in ability to maintain balance is further accentuated when an individual has to attend task requiring divided attention and one of such task is walking or turning in a crowd or on a busy road crossing (Bloem *et al.*, 2001).

Turning is fundamental component of mobility requiring highly cognitive and attention function necessary to make anticipatory postural muscles adjustment, decelerate the forward motion, coordinate the axial body segment, reorient to the new direction of travel and maintaining dynamic balance within the base of support while continuing the ongoing step cycle (Manaf *et al.*, 2012). Staggering during turning is predominantly identified in episodes of falls in stroke survivors. Turning and curved walking puts greater demands on the neural processes required control medio-lateral stability and forward progression than the requirement for straight walking. Turning becomes the major contributors of falls in stroke survivors when they perform turning while walking, navigating corners, passing through doorways, overcoming obstacles within base of support, (Courtine and Schieppati, 2003; Orendruff *et al.*, 2006).

Current approaches targeting balance and gait impairments in stroke, principally focus on difficulties during straight walking while skilled task such as steering or turning that require the ability to adapt basic walking pattern have not been addressed much. As turning is significant event in everyday mobility (Sedgman and Goldie, 1994) and there is associated risk of falls and injuries while turning (Hyndman *et al.*, 2002; Harris *et al.*, 2005), it is surprising that very little research has been conducted till date on methods to train capability to adapt to turning in ambulatory individuals with stroke.

Researchers have mainly focused on the measurement of kinematic and gait parameters during dual task activity in straight walking among stroke survivors. There is insufficient information and research about cognitive demands during turning event and its impact on balance and gait performance of stroke patients. Therefore, it is crucial to study the effects of cognitive task while turning on balance and gait parameters of stroke patients in order to improve effectiveness of balance and gait rehabilitation for them.

Methodology

Sample of present experimental study comprised of 24 chronic stroke survivors (aged 48 to 63 years, both males and females) having sustained stroke for more than six months. Self-ambulatory stroke survivors with a history of falls were recruited in study. Presence of musculoskeletal impairments, any lower limb injury or surgery, having any visual defect and marked difficulty in understanding and comprehension constituted exclusion criteria. Required approval from Departmental Research Board and Institutional Ethical Committee to conduct study was obtained. Participants were selected using convenient sampling method and their written informed consent was also obtained. They were randomly divided into two groups i.e. Group A(n=12) and Group B(n=12) using chit-pick method. Group A received conventional balance and gait training activities. Training commenced first with practice of simple tasks which were then progressed to more difficulty activities once the participant was able to perform the activities with ease. Both dynamic and static activities were included in training. Group B was administered training of turning activity along with cognitive task was administered in addition same conventional balance and gait training program as given to participants of Group A. The interventions were given with a frequency of 6 days a week for about 8 weeks. The outcome measures included Berg Balance (BBS), Dynamic Gait (DGI) Index, Timed Up and Go Test (TUGT) recorded at baseline and then at 8th week.

Results

Table 1: Within group comparison of pre and post value of BBS, DGI and TUGT, turn time and step number for both groups.

Variables	Group A (control group)			Group B (experimental group)			
	Mean	±	SD	Mean	±	SD	
	Pre		Post	Pre		Post	
			‘t’ value			‘t’ value	
BBS	33.75 ± 8.90		37.83 ± 6.68	2.63*	39.75 ± 3.58	46.25 ± 4.18	5.84*
DGI	8.5 ± 1.80		10.50 ± 1.5	5.13*	10.25 ± 2.71	14.08 ± 3.25	6.12*
TUGT	49.67 ± 7.03		44.83 ± 7.17	9.57*	44.5 ± 5.5	33.66 ± 6.27	14.50*
Turn time	10.08 ± 2.39		8.25 ± 1.83	5.69*	10.25 ± 1.68	6.58 ± 1.60	8.84*
Step no.	11 ± 1.91		9.33 ± 1.92	11.72*	11.08 ± 1.49	8.41 ± 1.55	9.38*

* $p \leq 0.05$ = significant; t critical= 2.20

Table 1 presents the within group comparison of values of BBS, DGI, TUGT, turn time and step number of Group A and Group B. Results revealed statistically significant difference existed in pre and post values of BBS, DGI, TUGT, turn time and step numbers in both groups.

Table 2: Between group comparison of post intervention scores for BBS, DGI, TUGT, Turn time and Step number between Group A and Group B

Variables	Group A	Group B	‘t’ value
	Mean ± SD	Mean ± SD	
BBS	37.83 ± 6.68	46.25 ± 4.18	3.54*
DGI	10.50 ± 1.5	14.08 ± 3.25	3.31*
TUGT	44.83 ± 7.17	33.67 ± 6.27	3.88*
Turn time	8.250 ± 1.83	6.583 ± 1.60	2.27*
Step no.	9.33 ± 1.92	8.417 ± 1.55	1.22 ^{NS}

* $p \leq 0.05$ = significant; t critical= 2.07

Table 2 presents the between group comparison of post intervention scores for BBS, DGI, TUGT, Turn time and Step numbers. Results showed statistically significant differences existed in all outcome measures except for step ($t=1.22$).

Discussion and Conclusion

Findings of study revealed that significant improvement in balance performance of stroke survivors took place in both groups as was evident from within-group analysis suggesting statistically significant improved Berg

Balance Scale scores of Group A ($t = 2.63$; $p \leq 0.05$) as well as of Group B ($t = 5.84$; $p \leq 0.05$) following 8 weeks of intervention. These results indicate that both interventions i.e., conventional balance and gait exercise program as well as balance - gait exercise program plus training of turning activity along with cognitive task proved to be effective in improving the balance of the stroke survivors.

Further between-group analysis carried out to compare the improvement observed in Group A and Group B, revealed statistically significant differences ($t = 3.54$; $p \leq 0.05$) existed in post-intervention scores of BBS among Group A and B. Thus, demonstrating that experimental program (inclusion of training turning activities along with cognitive task in balance and gait exercise program) proved to be more effective in enhancing of balance of the stroke survivors

The effectiveness of the conventional exercise program pertaining to the balance improvement could be attributed to the components of exercise included in the program. The activities like walking forward and backward, marching in place, semi-tandem walk, walk with narrow base of support, tandem walk, forward walk with crossing obstacles, walk sideways, stepping in all directions puts the patients into difficult situations which enhance their sensorimotor function for overcoming the balance difficulties. The balance training program improves proprioceptive inputs from the affected body side (Flor and Diers, 2009) which facilitates self awareness and spatial attention ultimately leading to improved balance and gait.

The greater improvement observed in balance in the experimental group could be attributed to the task specificity of the experimental group. Addition of turning activities and cognitive task to the other components of the conventional balance and gait training program makes it more effective in improving some tasks like turning 360 degree or to look behind in the. Further adding cognitive task like serial subtraction of 3, counting letters backward, narrating story in the experimental training program might have resulted in enhancement of degree of attention and focus of the participants in performing various tasks of balance. As most of the activities of daily living required a concurrent involvement of individual in multi tasks thus the cognitive tasks and turning training must be made an essential component of an effective balance training programs.

Findings of the present study, to certain extent, are in line with the results of the previous studies which suggest that dual task training exhibit unique effects on balance and gait (Song and Park, 2015). Repetitive turning activity along with cognitive task improves the balance to a significantly greater extent (Sharma and Singh, 2013). Walker *et al.* (2000), reported a significant improvement in the balance among stroke survivors with the addition of dynamic activities such as arm and trunk rotation exercises. Shumway *et al.* (1997) reported that multidimensional exercise such as coordinated movement strategies, anticipatory postural adjustment strategies, gait perturbations and stair climbing produced marked improvement in balance and gait control among the older adults. Jacqueline (2010), revealed effectiveness of task-oriented balance and gait exercise program over conventional program to improve balance and gait in sub-acute stroke survivors.

The gait function of stroke survivors in present study was evaluated using Dynamic Gait Index (DGI), Time Up GoTest, turn time and step numbers. The findings pertaining to gait functions of stroke survivors revealed significant improvement resulted after 8 weeks of both conventional (Group A) and experimental (Group B) training programs as was evident from within-group analysis. Significant changes in Dynamic Gait Index scores occurred after the training programs. Similarly, other parameters of gait i.e. TUGT, turn time and step numbers also showed statistically significant changes in both groups. These findings suggest that the balance and gait training program when given alone (Group A) or when given along with turning activity and cognitive task proved to be effective in enhancing gait performance of the stroke survivors.

Further, between-group analysis performed to compare the improvement observed in Group A and Group B using unpaired test on post-intervention scores of DGI, TUGT, turn time and step numbers of Group A and Group B, suggested statistically significant differences existed in the post intervention scores of DGI ($t = 3.31$; $p \leq 0.05$), TUGT ($t = 3.88$; $p \leq 0.05$) and turn time ($t = 2.27$; $p \leq 0.05$) between both Groups. The above findings reveals that though both the training programs are effective in improving the gait performance of the stroke survivors (DGI, TUGT, turn time) but the experimental program (balance and gait training along with turning activity and cognitive task) proved to be significantly more effective. However one parameter i.e. step numbers did not demonstrated any significant difference between the two Groups. Thus indicating that both the training programs are equally effective in decreasing the step numbers around 180 degree turn.

The improvement observed in the gait performance as revealed by Dynamic gait index, TUGT and turning time and step number in both the Groups could be attributed to the various elements of the exercise programs like walking forward and backward, march in place, semi-tandem walk, walk with narrow base of support, tandem walk, forward walk with crossing obstacles, walk sideways, stepping in all directions. Repetition of these activities may have enhanced the confidence, weight bearing and balance of the participants in both the groups (French *et al.*, 2010). However, the greater success of the experimental training program (turning activity along with cognitive task in addition to conventional balance and gait training program) could be attributed to the practice of turning activities

and cognitive task, addition of these activities is believed to enhance the neural reorganization, proprioception, improved motor control strategies and sensory recovery (Elshinnawy 2016). The turning activities added to the experimental program resulted in improved turning abilities and confidence of the participants while turning (Bowen *et al.*; 2001) which might have resulted in improvement in the turn time, further leading to improvement in TUGT scores. These changes could be attributed to specificity of training. Practicing turning activities may also be beneficial for maintaining balance, alignment and balance recovery during turning phase of gait cycle.

On the other hand the cognitive task given in the current study exposed the individuals to the situation where they are required to perform mental activity along with motor task. Performance of most of the daily motor task has integral cognitive component also required for planning organizing deciding steps and sequences of movements required to complete the task. Impairment in cognitive functional abilities have been found to make the stroke patients susceptible to falls (Patterson *et al.*, 2007; Yang *et al.*, 2007). Practicing such activities like cognitive task in the current study would have improved the capabilities of the stroke survivors to perform dual task with confidence thus ultimately leading to improvement in mobility and physical function among the participants (Chemerinski *et al.*, 2001). Kim (2014) reported improvement in gait and balance performances of stroke survivors after completion of dual task training (task specific and requirement based exercise) with cognitive task intervention. Cognitive tasks when added to conventional balance training program enhances the learning process (Faria and Teixeira-Salmela, 2009) and confidence which could play a crucial role in recovery of gait and balance among the stroke survivors. Also cognitive task given while practicing turning activities in present study could have helped to enhance the abilities of planning and execution of motor program by improving attention, alertness, responsiveness to multiple stimulus at a time thus subsequently building up the confidence levels, reduction of fear of falling and episodes of falls during turning or steering while walking (Yang *et al.*, 2008; Vivian *et al.*, 2014).

Findings of the present study help us to deduce that each intervention exerts a unique effect and concomitant use of these intervention bring about more positive and desirable effects depending upon condition, population group, for which the intervention is being administered. Thus, it can be concluded that training stroke survivors the steering(turning) activities with cognitive tasks along with balance and gait training greater improvement in their balance and gait functions can be achieved.

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Effects of Myofascial Stretch Dry Needling (MSDN) on the Irritability of the Myofascial Trigger Point in the Upper Trapezius muscle - A case report

*Priyanka Rajput, **Varun Kalia

Department of Physiotherapy, Lovely School of Allied Medical Sciences, Lovely Professional University, Punjab, India.

varun.26576@lpu.co.in, priyanka1602rajput@gmail.com

Abstract

Introduction: Painful musculoskeletal conditions, such as myofascial pain syndrome, are among the most common chronic problems encountered in clinical settings. A myofascial trigger point (MTrP) is a hyperirritable spot, usually, within a taut band of skeletal muscle that is painful on compression and can cause referred pain, and motor dysfunction. Non-invasive treatments for MTrPs include spray and stretch, transcutaneous electrical stimulation, physical therapy, and massage. Invasive treatments for MTrPs include injections with [local anaesthetics](#), corticosteroids, [botulism toxin](#), and [dry needling](#) (DN). Whereas the traditional DN procedure includes the insertion of a dry needle in the MTrPs followed by stretching of the targeted muscle. If clinicians will maintain the muscle in the stretched position and then do the DN procedure, it may give earliest results related to MTrP symptoms. Therefore, the present study aimed to evaluate the effect of the Myofascial Stretched Dry Needling (MSDN) procedure on MTrPs, and here we present a case with MTrPs in the Upper trapezius muscle that reported a pre-assessment score of 7 for the visual analogue scale, a pressure pain threshold of 1.32 Kg/cm², and a reduction in all cervical range of motions. **Result:** The study reported a beneficial effect of MSDN to improve pain, pressure pain threshold, and range of motion in the Upper trapezius muscle related to MTrPs. **Discussion:** The potential benefit of MSDN may be due to the early release of myofilaments as a result of its already maintained lengthened position during the dry needling technique in the targeted muscle. **Conclusion:** The clinical experience with the subject shows that the MSDN is effective to treat the symptoms related to MTrPs in the upper trapezius muscle. Although further research is needed.

Introduction

Painful musculoskeletal conditions, such as myofascial pain syndrome, are among the most common chronic problems encountered in clinical settings. A Myofascial trigger point (MTrPs) is a pea-like nodular area that is a hypersensitive or hyperirritable spot located in a taut band of skeletal muscle, which is painful to palpation. A “jump sign” appears when pressure is applied to an MTrPs, the subject's reaction comes with a verbal response or blink of an eye or leaps away from the examiner (Hanten *et al.*, 2000). MTrPs were categorized as either active or latent (Cummings and White, 2001). Active MTrPs are spontaneously painful nodules and they can refer pain or paraesthesia to more distant sites whereas latent MTrPs are clinically silent and do not cause local or referred pain and requires palpation or motion to induce pain (Ziaieifar *et al.*, 2014). However, both types of MTrPs can cause limited range of motion (ROM) and weakness of the muscles where it is located. In addition, MTrPs have been identified as a major source of musculoskeletal pain in 30-85% of subjects (Tough *et al.*, 2009). The upper trapezius (UT) muscle was determined to be often affected by MTrPs that leads to the production of neck pain (Hanten *et al.*, 2000; Fernández-De-Las-Peñas, Cuadrado and Pareja, 2007). Moreover, the literature reported a high prevalence (59.7%) of neck pain in university students. 51% of students reported neck pain because of MTrPs around the neck (Manoharlal *et al.*, 2016). Some authors believed that MTrPs may also result from trauma, overuse, mechanical overload, and postural faults (Treaster *et al.*, 2006; Fernández-De-Las-Peñas, Cuadrado and Pareja, 2007; Bron and Dommerholt, 2012; Kalichman, Bulanov and Friedman, 2017). Currently, many non-invasive and invasive interventions exist to resolve the MTrPs. Further, non-invasive treatments for MTrPs include spray and stretch, Transcutaneous Electrical Nerve Stimulation, and massage. On the other hand, invasive treatments for MTrPs include injections with anesthetics, corticosteroids, [botulism toxin](#), and [dry needling](#) (DN). But literature reported persistent pain and disability after six months follow up of physiotherapy management for neck pain related to MTrPs (Ortego *et al.*, 2022). That is why there is a need to introduce an effective treatment approach to treat MTrPs. Whereas, DN continuously gaining great interest from clinicians for the treatment of MTrPs in various clinical conditions in the last decade. DN procedure includes the insertion of a dry needle in the MTrPs followed by stretching of the targeted muscle. Again, literature reported that the traditional method of DN, requires a few sessions to resolve the symptoms related to MTrPs in various clinical conditions, and also long-term effects of DN is remained unclear (Liu *et al.*, 2018). So, there is a need to create some modifications to get the immediate and maximum benefit from the available DN technique. Authors believed that if we maintain the targeted muscle in the extremely stretched position and then introduce DN, it may induce maximum resolution of the symptoms related to MTrPs and the present study reported the effect of Myofascial Stretched Dry Needling (MSDN) to improve pain, pressure pain threshold (PPT), neck ROM and disability in subject with MTrPs in the upper trapezius muscle.

Case presentation

A 20 years old, right-handed female subject reported to the outpatient department of physiotherapy, at Lovely Professional University with severe pain in her right Upper trapezius muscle. Before the start of the study, the subject was informed about the study procedure and received written informed consent from her. This study was accepted by the Clinical Research Ethical Committee of Lovely Professional University, Punjab, India (LPU/IEC/2022/01/01).

Subject History

She had a history of pain from last more than one year, but now she reported severe pain and disability for the last nine days because of prolonged study hours and continuous usage of her laptop. She was engaged in typing tasks for the past many days for a continuous 8 hours/day, which in turn led to neck pain. She did not have any history of injury or trauma around the neck. No symptoms of neurovascular radiculopathy were reported such as paresthesia and anesthesia in either of the upper extremity. She underwent for detailed physiotherapy assessment and the therapist noted the presence of highly active MTrPs in her right upper trapezius muscle. She also reported pain towards the left side of the neck that is just because of radiation from the active MTrPs from the right side of the muscle. During the pre-assessment, she reported a neck pain score on the Visual Analog Scale (VAS) 7, and a pressure pain threshold over the most active trigger point as 1.32 Kg/cm². In addition, her active cervical ROM for flexion (0°-30°), extension (0°-25°), rotation right (0°-30°), rotation left (0°-25°), side flexion right (0°-20°), side flexion left (0-15 degree) were reduced.

Intervention

The subject underwent an MSDN procedure by using a solid monofilament sterile needle by Suzhou tianxie, 0.25 diameter x 25 mm in length. The subject was positioned in the prone lying. Then, the therapist gently stretched the right UT muscle and this position was maintained by placing a towel roll under the forehead. Then MTrPs were detected by using a flat palpation approach with appropriate pressure in the UT muscle followed by the insertion of DN and fast-in/out movement of DN was done to target various sensitive loci and looked for the local twitch response. The needle remained in the affected muscle for ten minutes. The needle was removed after 10 minutes, and the hemostasis was maintained. A sharps container was used to dispose of the needle.

Result

The subject underwent post-assessment, the same as pre-assessment immediately after the MSDN procedure and she reported a score of 3 for VAS, 3.05 Kg/cm² for PPT, and improved ROMs for the cervical such as flexion (0°-40°), extension (0°-40°), rotation right (0°- 45°), rotation left (0°-45°), side flexion right (0°-30°), side flexion left (0°-30°).

Discussion

The results of this study indicate that MSDN is effective immediately after the application to improve pain, pressure pain threshold, and cervical ROMs related to MTrPs of UT muscle. A review of the published reports indicated that with the use of different designs and testing procedures, several studies have assessed the effect of DN on MTrPs (Ilbuldu *et al.*, 2004; Ga *et al.*, 2007; Ziaefar *et al.*, 2014) but not even single study reported the use of MSDN technique.

It has been suggested that MSDN may influence the length of the myofibrils and their microcirculation. A change in inflammatory mediators has been reported after the insertion of DN in the UT muscle, which suggested increasing local blood flow to the MTrPs region (Cagnie *et al.*, 2012). It is thought that DN provides a mechanical localized stretch to the shortened sarcomeres and contracted cytoskeletal structures within the MTP and previously maintained stretch of the trapezius muscle also further helped to open up the contracted myofibrils. It may also stimulate the Aδ nerve fibers and activate the enkephalinergic inhibitory dorsal horn interneurons (Ziaefar, Arab and Nourbakhsh, 2016).

There are a growing number of studies report that DN of the UT muscle has beneficial effects on pain, cervical ROM, functions, and quality of life (Liu *et al.*, 2015). Also, few of the studies investigated the immediate effect of MTrP-DN while others investigated the efficacy of DN combined with other modalities or techniques on the UT muscle in the neutral position, later followed by stretching (Cerezo-Téllez *et al.*, 2016; Mayoral and Gröbli, 2017; Ziaefar *et al.*, 2016). Literature has not reported any immediate effect of DN on pain, pressure pain threshold, and cervical ROMs, but persistent symptoms even after ten treatment sessions of traditional DN are there (Gunn *et al.*, 1980). In this case report, our treatment for MTrPs showed positive results in improving pain intensity, pressure pain threshold, and ROM immediately after the treatment with the MSDN technique. The potential benefit of MSDN may be due to the early release of myofilaments as a result of its already maintained lengthened position during the DN technique in the targeted muscle. The results of this trial will assist in providing long-term outcomes examining the effectiveness of MSDN, which currently not existing in the literature. Further high-quality research is needed with large sample size to determine if MSDN is clinically beneficial independent of other therapeutic interventions.

Conclusion

The clinical experience with the subject shows that MSDN may improve cervical pain, pressure pain threshold, and ROM immediately after the treatment but there is a need to check its efficacy with a high-quality study on a larger sample size.

CRediT authorship contribution statement

PR: Conceptualization, Formal analysis, Writing - original draft,

VK: Design of the study, acquisition of data, analysis, and interpretation of data, drafting the manuscript, revising the manuscript critically for important intellectual content.

Declaration of competing interest

The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript.

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The Effect of Music on Anxiety, Motor Skills and Cognition in Music Learners and Non-Learners

*Sandeep Singh, **Arshdeep Kaur, **Aakriti Jain

*Assistant Professor, MPT Student, Department of Physiotherapy; Punjabi University; Patiala

aakritijain591@gmail.com

Abstract

Background: Nowadays, behavioral and stress problems in young children alarmingly on rise that are culminating into conditions such as schizophrenia, learning disabilities and hyperactivity. Health professionals, educators, and others are striving to find effective strategies to combat these. In this context music therapy has shown some promise of being effective intervention demonstrating its potential benefits on academic, emotional, and cognitive performance of children. Present study aimed to examine effect of music learning on Anxiety, Motor Skills and Cognition of young children. **Aim:** To compare the effects of music on Anxiety, Motor Skills and Cognition in music learners and non-learners. **Methodology:** 60 children aged 13 to 17 years were recruited in study. One group (Group A) included children who were learning playing music instruments while non-music learners were included in Group B. Anxiety, motor skills, and cognitive abilities of participants were assessed using the State-Trait Anxiety Inventory (STAI-Form-Y), the Nine Hole Peg Test (NHPT) and the Montreal Cognition Assessment Scale (Mo-CA) and compared between the groups. **Results:** Between group analysis revealed that significant differences existed STAI trait ($t=9.30$, $p=0.00$), NHPT scores ($t=2.19$, $p=0.03$) while non-significant difference existed ($t=1.31$, $p=0.19$) in Mo-CA values. **Conclusion:** Findings of study suggested that children who were involved in music learning had less tendencies of anxiety and greater motor skills while no difference in cognitive abilities of music learners and non-music learners was found. Present study is preliminary study, being conducted on Indian music further studies are imperative to be undertaken to establish exact effect of Indian music learning or listening on mental health and cognitive abilities of children.

Key words: Music, anxiety, motor skills, cognition, mental disorders

Background

Music is considered as a language-like form of human expression (Gilliam *et al.*, 2000) and is unique way of provoking and expressing emotions (O'Callaghan, 1996; Kneafsey, 1997; Ashida, 2000). Music is considered to be food for soul and is believed to replenish and rejuvenate mind and soul. Ancient Egyptians, Greeks, Arabs are believed to know the well-being impact of music, who utilized music in form of incantations for healing purpose (Maranto, 1993).

Following the lapse of long time period of recession in use and role of music for therapeutic purpose, a surge in interest of empirical investigation on medical effects of music is being observed over past one decade. Researchers, recently have started showing keen interest in exploring benefits of music in alleviating the manifestations in varied medical milieu.

Music is being used in intensive care units successfully to control anxiety level, heart rate, respiration rate of patients (Guzzetta, 1989; Chlan, 1998; Vickers and Cassileth, 2001). Listening music and lullabies by premature infants, had calming effect on them that decreased distressed behaviour, reduced caloric expenditure, enhanced weight gain and fasten hospital discharge (Collin and Kuck, 1991; Caine, 1991; Standley and Moore, 1995;). In oncology patients' psychological distress and anxiety were reduced and mood improved following music intervention (Cassileth *et al.*, 2003).

Besides the resurgence of interest in utilization of music in medical situations, there are many claims being made that music can influence intellectual, social and personal development of children. This, recent interest in use of music to influence child's development seems to reflect what series of early studies claimed that music has, 'Mozart Effect'. Research by Rauscher *et al* (1993) reported that listening to Mozart sonata music resulted in increased spatio-temporal reasoning in graduate students. The results of this study were widely propagated in popular media and press as "Mozart makes you smarter" and this effect of music on young and children came to be known as Mozart effect. Similar effect of music was observed on levels of social interaction, sense of well being, autobiographical memory, category fluency and other cognitive abilities in elderly and was called 'Vivaldi effect' (Rauscher and Shaw, 1998). These researches stirred the interest to explore effects of music on child's development. Rallying upon these research findings, music is being increasingly put in therapeutic use and named as 'music therapy'. Likewise, music therapy has become an effective therapeutic intervention for children having emotional and behavioral disturbances (EBD) as music activities provide an outlet for variety of positive outcomes and provides structure for socialization (Sausser and Waller, 2006). Music therapy, thus, is increasingly being used as an effective therapeutic intervention for behavioral programs and school counselling (Lemieux *et al*, 2008; Clark and Breman, 2009).

Till so far vast majority of the scientific studies on medical, socio-psychological, cognitive, behavioral effects of music and more importantly about effect on child's development have been conducted outside India. The effects of Indian music have not been studied scientifically, hence, there is need to carry out studies similar to contemporary western music research on Indian music also. Drawing upon these facts present study is designed with an intend to investigate effect of music learning on anxiety, motor skills and cognition in music learners and non learners.

Materials and Methods:

60 children of both genders, aged 13 to 17 years, who have been learning and playing Indian music instruments like Harmonium, Tabla, Sitar, Dholak etc for not less than one year were included in this study. Presence of musculoskeletal, neurological, emotional and behavioral problems such schizophrenia, depression, attention deficit hyperactivity disorders, autism and undergoing any medical treatment or any other intervention for anxiety, motor skills and cognition was exclusion criteria. Approval of Departmental Research Board (DRB) to conduct study was obtained

The written informed consent was also obtained from teachers/parents of students who were selected to participate in the study. Participants were assigned two groups i.e Group A and Group B with 30 participants in each group. Participants of Group A were music learners whereas participants of Group B were music non-learners. Prior to commencement of study one or two familiarization sessions were held with participants. Participants were explained the detail procedure of study and their anthropometric measurements were recorded. Thereafter, data was acquired from participant using outcome measure tests i.e., STAI- state, STAI-trait, MoCA and NPH tests. The STAI (The State-Trait Anxiety Inventory- Form Y) is a brief self-report assessment tool designed to measure and differentiate between two types of anxiety namely trait anxiety and state anxiety was used in present study. Nine Hole Peg Test (NHPT) was used to assess the fine motor skills of participants. The Montreal Cognitive Assessment (MoCA) is a brief, cognitive screening test of about 10 minutes duration that is administered in the clinical setting, covering broad range essential for adolescent cognitive assessment domains (executive function, attention, memory, language, and visuospatial), MoCA requires minimal user training, and is sensitive to detect mild cognitive deficits. These outcome measure tests were administered to to each participant on different occasions (no two tests were administered on same day). The STAI-trait, MoCA and NPHT tests were administered individually to each participant under supervision of researcher Figure.1. The STAI- state test was administered to students in groups as there was need to create a stressful situation for participants, this was done by asking teacher to announce sudden surprise subject exam test to group of participants. Immediately following announcement of test participants were handed over STAI- state test form and were requested to fill the form prior to exams. The participants were assisted to understand the instructions, statements and questions used in different test in language understandable to them. Data was analysed using Microsoft Office Excel 7 computer program. Unpaired 't' test used for between the group comparisons.



Figure 1: Represents the STAI form filled by student

Results

Table 1: Between-group comparison of Demographic and Anthropometric characteristics

Variables	Group A (Mean $\pm$ SD)	Group B (Mean $\pm$ SD)	't' value	p value
Age (years)	14.5 $\pm$ 1.00	14.2 $\pm$ 1.04	1.00	0.31 ^{NS}
Weight (kgs)	50.6 $\pm$ 3.94	50.7 $\pm$ 3.64	0.15	0.87 ^{NS}
Height (cms)	159.5 $\pm$ 2.85	159.1 $\pm$ 2.30	0.54	0.58 ^{NS}
BMI (kg/m ²)	20.0 $\pm$ 1.20	20.1 $\pm$ 1.08	0.21	0.83 ^{NS}

*p $\leq$ 0.05 = significant; ^{NS} = non-significant

Table 1 presents between –group analysis of Anthropometric characteristics of participants of both groups. Non-significant differences existed in Anthropometric parameters indicating homogeneity existed in participants of both the groups.

Table 2: Between-group comparison of values of STAI, NPHT and MoCA

Variables	Group A (Music Non- Learners) Mean ± SD	Group B (Music Learners) Mean ± SD	t' value	p' value
State Anxiety	52.56 ±4.84	39.23± 6.17	9.30	0.00**
Trait Anxiety	53.83± 6.08	41.66± 5.42	8.17	0.00**
NPH test	14.03 ±1.95	12.85 ±2.19	2.19	0.03*
MoCA	23.3 ± 3.38	24.4 ± 3.08	1.31	0.19 ^{NS}

*p ≤ 0.05 = significant; ^{NS} = non-significant

Table 2 presents between-group comparison values of and STAI (Trait and Anxiety), NPHT. and MoCA. Results revealed that significant difference existed in the values of STAI and NPHT but non-significant differences existed in the values of MoCA.

Discussion and Conclusion

The present study investigated effect of Indian music learning on parameters of anxiety, cognition and motor skills in children. Results of present study revealed that those students who were engaged in music learning demonstrated significantly lesser levels of state as well as trait anxiety. The highly significant differences in STAI- state scores ($t=9.30$; $p \leq 0.01$) and STAI- trait scores ($t=8.17$; $p \leq 0.01$) were observed between music learners and music non learners. Thus, finding of present study suggests that music learners were better placed than non music learners in facing situational anxiety (test anxiety in present study).

Many previous studies have demonstrated anxiolytic effect of music especially in clinical settings, such as on pre-operative anxiety (Lepage *et al.*, 2001), also in post-operative period after coronary bypass surgery (Barnason *et al.*, 1995) and even in medical procedures like bronchoscopy, colonoscopy, endoscopy and cystoscopy (Chan *et al.*, 2003; Hayes *et al.*, 2003).

Studies of Nguyen *et al.* (2010) and Robb *et al.* (1995) demonstrated that music reduced anxiety levels in children during medical procedures and before undergoing surgery, respectively. Lilley *et al.* (2014) reported that 5 minutes of calm background music listening was effective in reducing test anxiety and improving test performance of undergraduate students who were examined using the State-Trait Anxiety Inventory (STAI). Similarly, Lai *et al.* (2008) reported that 40 minutes session of lento music on students undertaking the exam showed a significant reduction in exam anxiety as well as state anxiety levels. Rastogi and Silver (2014) also examined the effect of music listening on test anxiety and exam grades, among high school students. Authors reported that students who spent more time on listening to music scored higher test grades and had lower anxiety scores.

Findings of present study pertaining to effect of music on anxiety states of children, to certain extends are in accord with results of aforementioned previous studies. However, direct comparison is not tenable owing to many differences in present and previous studies. Present study is first of its kind as it has observed effect of Indian music on anxiety states of children. Researcher could not locate any similar study conducted on Indian music. Moreover, most of studies have examined effect of music listening while in present study effect of Indian music learning has been studied. Further many of studies has seen effect on state anxiety but in present study effect on trait anxiety was also documented. Regardless, aforesaid discrepancies in present and previous studies, positive findings of present study on effect of Indian music can be looked upon as promising one and convincing for other researchers warranting more studies to establish role of Indian music in deriving health benefits.

Results of present study demonstrated that fine motor skills of Indian music learning students were significantly greater ($t=2.19$; $p=0.00$) than those of non-music learners. Motor skills of participants were measured using the Nine Hole Peg Test (NHPT) that assesses fine motor coordination, eye hand coordination and the ability to follow simple directions. The test also reflects the individual's instruction taking and learning skills. Though there are studies that have reported that musicians possess better fine motor skills (Hund-Georgiadis and von Cramon, 1999; Parlitz *et al.*, 1998) but studies that have compared the fine motor performance of musicians with non-musicians are not much available. Črnčec *et al.*, (2001) reported that 10 weeks of music training along with movement programme improved locomotor skills (galloping, horizontal jump, skipping) of children of 4-6 years. One study by Brown *et al.*, (1981) found that integrated music and physical education programme improved motor performance in pre-preschoolers. In

study by Costa- Giomi (2005), it was demonstrated that two years of piano training to school children who earlier had no formal music training resulted in significant improvement in their fine motor skills. Similar, findings were reported by Schlaug et al., (2005) that playing music instrument improves fine motor skills of children.

Findings of present study also demonstrates that musicians possess greater fine motor capabilities and lend one more evidence to scientific literature about positive impact of music on fine motor skills. It is considered that music training of children leads to increase in speed and accuracy of visual –motor association that the translates into improved motor skills (Brown et al., 1981; Orsmond and Miller, 1999). Biological explanations have also been extended to support findings that motor skills are improved through music training. Several studies have shown that structural changes occur in brain of musicians especially in children with music practice that could possibly be reason of better motor skills observed in musicians. The right primary motor cortex, anterior corpus callouses and cerebellum has been found to be larger in musicians than non-musicians (Schlaug,2001; Schlaug et al., 1995).

Results of study revealed that non significant differences existed between MoCA scores of ($t=1.31$, $p=0.19$) music learners and music non-learners. The effect music on cognitive abilities of children have been very much popularised as ‘*Mozart Effect*’ as outcome of study of Rauscher et al., (1993) that claimed spatiotemporal abilities of students improved after listening to music composed by Mozart. Though, subsequent studies replicated to authenticate claims about ‘*Mozart Effect*’ failed to demonstrate such effect. However, recent several studies report that music training has positive impact on cognitive development of child if music instruction commences before age of five (Bilhartz et al., 2000; Rauscher, 2002; Rauscher and LeMieux ,2003). There are studies available reporting that music lessons produced improvements in verbal memory and reading ability (Ho et al., 2003) and also enhances intellectual development (Schellenberg,2004). Studies however, have also demonstrated that children who participate in music education achieve higher academic scores than their peers (Morrison ,1994; Johnson and Memmott, 2006). Most recent and comprehensive meta-analysis by Chabris, (1999) and Hetland, (2000) confirm that music listening enhances cognitive abilities. On contrary, there are studies that report that music has little or even negative effect on cognitive abilities of children (Crncec et al, 2006; Hui,2006, Mckelvie and Low, 2002). Thus, findings about effect of music on cognitive abilities of children are equivocal. Most of studies undertaken have studied effect of music listening or background music on cognition of children. Present study is has examined effect of Indian music learning on cognitive abilities and findings of study also could not demonstrate difference in cognition of music learners and non learners. The contradictory findings in literature about effect of music on cognition can be ascribed to variation in type and duration of music studied, differences in sample and outcome measures used, hence it necessitates conduct of further more well controlled studies so that definitive conclusions can be deduced about music’s effect on cognition.

Findings of study can be looked upon as promising one, considering it being conducted on Indian music. Present study is preliminary and maiden study that has investigated impact of Indian music on anxiety, motor skills and cognition. Researcher believes that present study will help to revive the interest of scientists in Indian music that will pave way for future investigations on health benefits of Indian music. Positive finding of such studies and also of present study can have wider practical implication in India especially physiotherapy rehabilitation of neurological patients and children having emotional, behavioral disorders. In these scenarios Indian music can be blended or integrated with physiotherapy treatments to achieve maximum outcomes.

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Effect of Physical Therapy Protocol on Health- Related Quality of Life in Subjects with Post Dengue Fatigue Syndrome

*Gurleen Kaur **Ramesh Chandra Patra

*MPT Student, Department of Physiotherapy, Lovely School of Allied Medical Sciences, Lovely Professional University, Punjab, India

Abstract

Background: Chronic fatigue syndrome (CFS) is one of the most common and public health care concern in post dengue patients and characterized by chronic disabling fatigue and low quality of life. The main aim of this study was to evaluate the health-related quality of life in subjects with Post Dengue Fatigue Syndrome.

Methods: This was an experimental study with a randomized control trial design conducted from 20th June to 30th December 2022. We recruited 28 subjects of both genders, aged between 20 to 60 years, and who were clinically diagnosed with chronic fatigue syndrome after dengue infection. They were randomly divided through the lottery method into two groups: the control group and the experimental group. For the assessment of Health-Related Quality of Life (HRQoL) SF-36 questionnaire was used and the data was obtained before and after 4 weeks of treatment session. In this study, control group received conventional physiotherapy treatment, while the experimental group received physical therapy exercise protocol. Statistical analysis was carried out using Student's t-test via the Statistical Package for the Social Sciences software, version16. The level significant level was considered as $P < 0.05$ for the analysis of data. Institutional ethical approval and CTIRI registration were obtained before the data collection. **Results:** The experimental group showed significantly increased scores in all domains of the HRQoL ($P < 0.05$). In the control group, no improvement was observed in comparison with the experimental group. **Conclusion:** The results of this study indicate that the application of physical therapy protocol could improve Health Related Quality of Life in patients with chronic fatigue syndrome after dengue infection.

Keywords: Post-Dengue Fatigue Syndrome, Quality of Life, Exercise, Physical Therapy

Background: Chronic fatigue syndrome (CFS) is one of the most common and public health care concern in post dengue patients and characterized by chronic disabling fatigue and other symptoms which are not explained by an alternative diagnosis (Umakanth M, no date; Seet, Quek and Lim, 2007; Kularatne, 2015). Dengue is the widely spreading mosquito borne arboviral illness (Hasan *et al.*, 2016) caused by four different types of dengue viruses (DENV1, DENV2, DENV3, DENV4) (Sun *et al.*, no date) owned by Flaviviridae family found in tropical and sub-tropical areas during monsoon (Gubler, no date). On the report of its incidence and the mortality rate, (Li *et al.*, 2017) dengue ranked as the second most consequential vector-borne viral disease spreading worldwide, followed by malaria (Yang *et al.*, no date; Jing and Wang, 2019; Tsheten *et al.*, 2021). In other word's dengue is also known as “BREAKBONE FEVER” (Hasan *et al.*, 2016). However, one of its complications includes post dengue fatigue (Seet, Quek and Lim, 2007; Mallhi *et al.*, 2021). Post-dengue fatigue syndrome was found in approximately 25% of patients who have been hospitalized (Yang *et al.*, no date; Jing and Wang, 2019) with dengue infection and is defined as umbrella term used for group of symptoms, (Umakanth M, no date) mostly associated from muscular (Seet, Quek and Lim, 2007; Paliwal *et al.*, 2011; Verma *et al.*, 2011) and neurological characteristics (Koshy *et al.*, 2012; Li *et al.*, 2017). There are many studies which are available to manage chronic fatigue syndrome after chemotherapy, Post-COVID, Post-Viral infection etc. As per our best knowledge no study investigates the health-related quality of life in patients with post-dengue fatigue syndrome. Therefore, the main purpose of this study was to investigate the effectiveness of graded exercise health related quality of life in patients with post-dengue fatigue syndrome.

Materials and Methods

Design

This was an experimental study with a randomized control trial design. We recruited 28 subjects of both gender, age between 20 to 60 years, and who were clinically diagnosed with chronic fatigue syndrome after dengue infection. They were randomly divided through the lottery method into two groups: the experimental group (Group A) and the control group (Group B) and. For the assessment Health Related Quality of Life (HRQoL) SF-36 questionnaire was used and the data was obtained before and after 4 weeks of treatment session. In this study, control group received conventional physiotherapy treatment, while the experimental group received physical therapy exercise protocol. Statistical analysis was carried out using Student's t-test via the Statistical Package for the Social Sciences software, version16. The level significant level was considered as $P < 0.05$ for the analysis of data. Institutional ethical approval and CTIRI registration were obtained before the data collection.

Sample Size Determination

Sample size was calculated by using g-power software. The power was considered for the study 80% and the confidence interval was 95%. As per current study the effect size (d) was 0.5. The calculated value for the current study was 25 due to dropout (10%) chances we recruited 28.

Study setting

All the participant were informed about the study and signed the consent form before starting the study. Data for the study was obtained from Outpatient department (OPD), Department of Physiotherapy, Lovely Professional University campus, Punjab.

Patient recruitment

Participant were included in this study-

- Participants diagnosed with dengue by physician.
- Patients who having age between 20- 60-year both male and female.
- Participants those will be agreed with the purpose of this study and agree to sign in the consent form. The participants were excluded from the study those who were meeting in following criteria:
- Participants those who were not agreeing to sign the consent form.
- Patients with severe illness like cardiac, renal, neurological.
- Patients who were not affected with dengue or least affected with dengue syndrome.
- Patients who have already took physiotherapy rehabilitation for dengue.
- Patients who were above age of 60 years.

Intervention

Graded Exercise Therapy

The main objectives of GET are to improve a patient's functional ability to approach physical activity by counteracting/switching the overall physical inactivity of patient and exercise fluctuation associated to prolonged immobility. The baseline foundation of the GET is to improve the all-daily living activities of an individual facing chronic fatigue syndrome to make them independent to perform ADLs by their own. Main indications for GET are as follow- myalgia (muscle ache), pain in joints (more than 2 joints), Headache or to improve concentration level, improve sleep pattern (Umakanth M, 2017; Samuel *et al.*, 2019; Penna *et al.*, 2023).

Jacobson Relaxation Exercise

It is a therapy which emphasis on contracting and relaxing the specific muscle groups of body in a particular sequence. By engaging the specific muscle group patient participate more actively and it help in promoting good mental health and relieving the stress. It improves sleep as well and reduces blood pressure in patient with hypertension. It involves specifically feet, abdomen, and shoulder and neck muscle group.(Penna *et al.*, 2023)

Aerobic exercises

It involves exercises from low intensity to high intensity to improve overall ability of individual to make them independent. It generally involves large muscle groups like arm, forearm, and leg range of motion exercises. Aerobic exercises are also very helpful to increase stamina and strength. it is very helpful in making patient independent as well active.

Current rehabilitation programs focus not only on strengthening exercises but also on improving patient's dependent level (Dieli-Conwright *et al.*, 2018; Hu and Zhao, 2021).

Ethical approval

The ethical approval for the study was taken from the institutional research and institutional ethical committee (LPU/IEC/2022/01/19).

Clinical trial registration for the study was taken from the government of India in the month of august (registered on: 30/09/2022).

Clinical Trial Registry India no: CTRI/2022/09/046062

Data analysis

Kolmogorov-Smirnov test was used to identify the normal distribution of the data. Baseline a characteristic of categorical variables was evaluated through measured through chi-square test, a quantitative variable was evaluated through student t-test and a quantitative variable without normal distribution was measured through Mann-Whitney U test. Intragroup outcome measure was evaluated through pair t-test and intergroup outcome measure was evaluated through unpaired t-test.

Results

Study was conducted between conducted from 20th June to 30th December 2022 where we assessed 58 patients, after complete evaluation 28 patients were selected as per the inclusion criteria. The baseline demographic data was homogenous in both the group (Table-1). In Group A shown significant difference in all the domain of HRQoL measures in within the group comparison where group B shown non-significant except the domain of HRQoL (Table-2). Between the group comparisons shown that there was a statistically significant improvement in HRQoL group A as compare with group B (Table-3).

Table 1: Demographic characteristics (baseline data)

Variables	Group A	Group B	P-value
Age (years)	47.6 ± 15.2	46.0 ± 16.4	0.2
Sex (F/M, %),	71/29	57/43	0.28
BMI (kg/m ²)	25.9 ± 3.0	25.1 ± 4.1	0.37
PF (mean±sd)	58.67±9.00	58.91±9.87	0.44
RL-PH	36.49±19.18	35.81±16.18	0.42
RL-EH	34.07±24.31	32.37±25.56	0.68
ENERGY	51.89±8.27	48.94±12.03	0.42
EWB	62.91±6.50	60.97±7.95	0.57
SF	61.73±9.77	60.89±8.23	0.22
BP	44.29±9.01	43.59±12.06	0.34
GH	54.59±7.67	65.81±8.54	0.36

Note-SD= standard deviation, F/M=female/male, PF= Physical functioning, RL-PH= Role of limitation Physical health, RL-EH= Role of limitation emotional health, EN= Energy. EWB= Emotional well-being, SF= social life, BP= Body pain, GH= General health,

Table: 2. Comparisons of Health-Related Quality of Life (HRQoL) in within the group A and B

Group	Outcome	Pre (Mean± SD)	Post (Mean± SD)	p-value
Group A	PF	58.67±9.00	74.86±8.53	.001
	RL-PH	36.49±19.18	71.62±16.83	.001
	RL-EH	34.07±24.31	73.07±22.23	.001
	ENERGY	51.89±8.27	70.27±7.72	.001
	EWB	62.91±6.50	74.49±8.76	.001
	SF	61.73±9.77	73.37±11.56	.001
	BP	44.29±9.01	72.62±9.37	.001
Group B	GH	54.59±7.67	74.45±9.49	.001
	PF	58.91±9.87	64.67±06.06	0.171
	RL-PH	35.81±16.18	39.49±18.17	0.191
	RL-EH	32.37±25.56	38.07±25.21	0.110
	ENERGY	48.94±12.03	51.59±09.27	0.121
	EWB	60.97±7.95	58.91±16.50	0.301
	SF	60.89±8.23	57.73±13.77	0.121
	BP	53.59±12.06	54.29±12.01	0.441
	GH	65.81±8.54	64.59±08.67	0.449

Note- PF= Physical functioning, RL-PH= Role of limitation Physical health, RL-EH= Role of limitation emotional health, EN= Energy. EWB= Emotional well-being, SF= social life, BP= Body pain, GH= General health,

Table 3: Comparisons of Health-Related Quality of Life (HRQoL) between the group A and group B

Outcomes	Group A	Group B	P-Value
PF	74.86±8.53	64.67±06.06	0.001
RL-PH	71.62±16.83	39.49±18.17	0.001
RL-EH	73.07±22.23	38.07±25.21	0.001
ENERGY	70.27±7.72	51.59±09.27	0.001
EWB	74.49±8.76	58.91±16.50	0.001
SF	73.37±11.56	57.73±13.77	0.001
BP	72.62±9.37	54.29±12.01	0.001
GH	74.45±9.49	64.59±08.67	0.001

Note PF= Physical functioning, RL-PH= Role of limitation Physical health, RL-EH= Role of limitation emotional health, EN= Energy. EWB= Emotional wellbeing, SF= social life, BP= Body pain, GH= Generalhealth

Discussion

This was first study where we aimed to determine the effects of graded exercises on HRQoL in subjects with post dengue fatigue syndrome. The result of this study supports the hypothesis that the graded exercises under the supervision of physical therapist shows significant improvement in all domains of HRQoL. Many studies have proved that the graded exercises under the supervision of physical therapist along with mobilization, relaxation therapy, and massage therapy were beneficial to treat chronic fatigue syndrome after post COVID period or after chemotherapy. A study done by Dong X et al. (2019) on HRQoL, cardiorespiratory capacity and muscle strength in post-operative patients of breast cancer in China. Author chooses randomised controlled trial in which he took 60 patients who undergo breast cancer surgery followed by chemotherapy and radiotherapy. Patients divided into two groups each group had 30 patients age between 42-60 years old. Primary outcome measure used was QoL (quality of life) and secondary were muscle-strength and cardiorespiratory-capacity and SF-36(short-form 36). Intervention used. Intervention group used step-recording app in phone, patients were asking to complete specific target steps during specific period of exercise time that was 4 times/week and muscle training was given on face to face interaction via video calling that was 3times/week and by the help of social media additional knowledge was updated day to day on breast-cancer physical rehabilitation. The controlled group received conventional treatment and rehabilitation as per hospital guidelines. Results reveal that SF-36 showed significant improvement in CEIBISMS in the interventional group as compared to controlled group by 12th week. There was significant improvement seen in stand-up, sit-down chair test, and arm lifting test in patients with the combined exercise intervention based on internet and social media software. The result of the study supports our result although there are some limitations like, data was collected from single centre and the long term follow-up was not taken.(Dong et al., 2019)

Conclusions

The present study among the patients with post dengue fatigue syndrome showed an improvement in Group A which means the graded exercise in combination with relaxation technique could be better treatment method to manage patients with post dengue fatigue syndrome.

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Conflict of Interest

Author does not have any conflict of interest

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Shoulder Pain and Dysfunction: Adverse Effects of Covid Vaccine Administration

***Gurmanpreet Kaur **Supreet Bindra **Pankajpreet Singh**

*Research Scholar **Assistant Professor, Sri Guru Granth World University, Fatehgarh Sahib

gurmanshergill198@gmail.com

Abstract

Background: The Coronavirus disease (COVID-19), also known as Coronavirus pandemic, was first identified in an outbreak in the Chinese city of Wuhan in December 2019, is a contagious disease caused by a virus known as SARS-CoV-2. The emergence of COVID- 19 has led the world to an unprecedented public health crisis. To aid the return to normal life activities, one of the important key factors has been the COVID- 19 vaccines, which have been widely applied for immunization since early. Vaccination against COVID-19 disease has been reported to be an effective countermeasure and reduce serious illness, hospitalization, and mortality due to COVID- 19. However, there have been some adverse effects after the COVID- 19 vaccinations, which can be divided into local and systemic adverse effects. A shoulder injury and pain related to vaccine administration is one complication that begins 48 h following a vaccination. The structures reportedly involved have included the rotator cuff, labrum, capsule, bursa, deltoid muscle, and this included the diagnosis of bursitis, rotator cuff tears, adhesive capsulitis, chondral injury, nerve injury and infection. Current literature emphasizes on the etiology of shoulder pain, as well as on preventive strategies. However, still, there remains a lack of literature exploring the exact cause, pathophysiology, and diagnosis of shoulder pain induced by COVID-19 vaccination. So, this study aimed to document the evidence available on Shoulder pain after administration of COVID- 19 vaccination. **Methodology:** Electronic searches were performed using Medline, Embase, Google Scholar, Cinhal, PEDro, and the Cochrane Library. Systematic Reviews, Case Series, Case Reports, and studies done between 2019-2022 were reviewed, and documented. **Results and Conclusion:** The study documented various types of shoulder pathologies, type of vaccination, causes, risk factors, and preventive measures from the previous literature. Studies revealed that the most common condition associated with shoulder pain after COVID- 19 vaccine is Subacromial-Subdeltoid Bursitis followed by Adhesive capsulitis, Rotator cuff tendinopathy (Supraspinatus), Parsonage Turner Syndrome, and Calcific Tendinitis. The patients developed shoulder pain shortly after vaccination as the result of an incorrect COVID- 19 vaccination technique, possibly due to the vaccine being administered inadvertently higher than recommended. Also, when compared to the first dose, adverse reactions reported after the second dose were milder and less frequent. Health care providers, especially physicians and physical therapist should be aware that shoulder pain can occur after COVID- 19 vaccination, such patients should be identified and treated early. The results of the study cannot be generalized because few numbers of studies were conducted, thus warrants for further studies to be conducted in this direction. **Key words:** Shoulder pain, dysfunction, Covid- 19 vaccine, adverse effects.

Introduction

The Coronavirus disease (COVID-19), also known as Coronavirus pandemic, was first identified in an outbreak in the Chinese city of Wuhan in December 2019, is a contagious disease caused by a virus known as SARS-CoV-2. The emergence of COVID- 19 has led the world to an unprecedented public health crisis. The COVID- 19 pandemic has had a great effect on normal life activities worldwide. To aid return to normal life activities, one of the important key factors has been the COVID-19 vaccines, which have been widely applied for immunization since early 2020. Millions of doses of the Coronavirus 2019 (COVID-19) vaccine have been widely administered with efficacy in combating the COVID-19 pandemic (Polak et al., 2020). However, there have been some adverse effects after the COVID- 19 vaccinations, which can be divided into local and systemic adverse effects. Most of these effects usually spontaneously resolve within a few days after the vaccination. A shoulder injury related to vaccine administration (SIRVA) is one complication that begins 48 h following a vaccination, with the main symptoms of shoulder pain with limited range of motion. The pathogenesis of SIRVA is still uncertain, but a widely accepted theory is that injecting the vaccine into the subdeltoid bursa produces a prolonged inflammatory response (Macomb et al., 2020; Atanasoff et al., 2010; Hesse et al., 2020). SIRVA is a broad term encompassing atypical shoulder pain and dysfunction following deltoid IM injection. It is a well described preventable injury resulting from improper injection technique into anatomic structures adjacent to the deltoid muscle resulting in chemical and/ or mechanical trauma which may be augmented by an inflammatory immune response to the vaccine and/ or adjuvants. The most commonly reported cause of SIRVA is injection into the bursa which can lead to both subacromial and subdeltoid bursitis as well as Adhesive capsulitis. Adhesive capsulitis or Frozen Shoulder is severe shoulder dysfunction that takes more than a year to recover with a correct treatment, and 30- 40% of patients can have persistent mild to moderate symptoms at 2-3 years of follow up (Hand et al., 2008). But the data and discussion on Frozen shoulder

after COVID- 19 vaccination are virtually absent from the literature (Wiesal and Keeling, 2021). However, rotator cuff tears, chondral injury, septic arthritis, and nerve injuries have all been reported and are included under a diagnosis of SIRVA (Cagle, 2021). A center for Disease Control and Prevention report demonstrated that of 859 patients with SIRVA, 65% had pain lasting longer than 1 month, and 25% had pain for >30 months (Hibbs et al., 2020).

Current literature emphasizes the mechanism of SIRVA injury, as well as on preventive strategies. However, still, there remains a lack of literature exploring the exact cause, pathophysiology, and diagnosis of shoulder pain induced by COVID-19 vaccination, so this study was done to document the evidence available on Shoulder pain after administration of COVID- 19 vaccination, and the objectives of the study were to document various types of shoulder injuries which caused pain after the administration of COVID-19 vaccination, type of vaccination, clinical features, and its preventive measures which could be taken to prevent these pathologies.

Need of the Study

The relationship between vaccine injection into synovial tissue and inflammation of the structures underlying the deltoid muscle has been well established. In a setting, bursitis, adhesive capsulitis, and glenohumeral synovitis may occur with potential need for medical assistance due to severe prolonged pain and joint mobility restriction. Most patients with SIRVA seek treatment from the musculoskeletal specialists (Tatiana et al., 2020). Therefore, a clinical description and data regarding shoulder injury after the COVID- 19 vaccine is important for the education and awareness of Physicians and Physical therapists. Also, various types of shoulder injuries, and potential adverse effects related to global COVID-19 vaccination still need to be studied.

Methodology

Search strategy and Selection Criteria

Electronic searches were performed using Medline, Embase, Google Scholar, Cinhal, The Physiotherapy Evidence Database (PEDro), and the Cochrane Library. Systematic Reviews, Case Series, and Case Reports were reviewed using the COVID- 19 vaccine complications, shoulder pain, Frozen shoulder, Calcific Tendinitis, and subacromial bursitis either individually or in various combinations. Studies done between 2019-2022 with causes, clinical features, and management of Shoulder Pain induced by COVID-19 vaccine were documented. Articles including Shoulder injuries, and pain induced by COVID- 19 vaccine, age group 18-90 years, Systematic Reviews, Case Series, Case Reports, Full- texted published articles, and Studies published in the English language only were included in the study. Cross- sectional Survey, Unpublished articles and only abstracts, and studies with prior shoulder injury, and pain due to other causes like Diabetes Mellitus, Hyperthyroidism, any sport or accidental shoulder injury, and congenital causes were excluded from the study.

Results

Table 1: Documentation of Various types of Shoulder Pathologies occurred after COVID- 19 Vaccination

Author/ Year	Objective of the Study	Study Population / Type of Study	Methodology/ Clinical Presentation	Type of Vaccine	Results	Conclusion
Benjamin et al, 2021	The study was done to report a case on Shoulder injury related to COVID- 19 vaccine administration.	31 year- old man (Case Report)	The patient presented with left shoulder pain for 2.5 weeks after second administration of the COVID-19 vaccine. On injection, he noted the location of the injection site seemed unusually proximal in the deltoid, just distal to his acromion. Consistent with the researcher's protocol, the patient received radiographs and MRI of the left shoulder, following clinical exclusion of other shoulder diagnosis. A corticosteroid injection was given. In a standard sterile fashion, the left subacromial space was injected with 20 mg triamcinolone with 9cc	Moderna COVID- 19 Vaccine	The results showed marginal tendonitis of the Supraspinatus tendon and slight edema in the subacromial area, which is nonspecific yet often associated with subacromial bursitis. Six days after the subacromial corticosteroid injection, the patient reported complete resolve of the pain stemming from post-vaccine administration subacromial bursitis and rotator cuff tendonitis as a result of SIRVA. This included return of full active and passive shoulder ROM, as well as painless strength	The study concluded that SIRVA which is an ongoing issue that results from imprecise anatomic vaccine administration to the subacromial space instead of intramuscularly in the Deltoid muscle bulk. So, it is important that instances of imprecise vaccine administration leading to SIRVA are documented to promote understanding of possible causes of obscure shoulder pain after vaccine administration.

			of 1% Xylocaine without epinephrine.		scores of five in the empty can test and the external rotation test.	
Boonsri et al., 2021	The study was done to report the first case of combined subacromial-subdeltoid bursitis and supraspinatus tendon tear.	51- year old female/ (A Case Report)	The patient presented with severe right shoulder pain about 3 hours after receiving a COVID-19 vaccination. Ultrasonography showed combined subacromial-subdeltoid bursitis and supraspinatus tendon tear.	Oxford-AstraZenec a COVID-19 Vaccine.	The clinical symptoms gradually improved after treatment with an oral non-steroidal anti-inflammatory drug.	The study concluded that combined subacromial-subdeltoid bursitis and supraspinatus tear was associated with an improper injection technique, which was inserted too deeply, by using an incorrect landmark.
Chuaychoo sakoon et al., 2021	The study reported the first known case of SIRVA after a Sinovac COVID-19 vaccination.	52 year- old male (A Case Report)	A 52 year- old Thai male without prior shoulder pain had a Sinovac COVID- 19 vaccination at his right shoulder. Three days after receiving the vaccine, the patient began to have right shoulder pain with limited ROM and acute fever. A physical examination showed swelling at the right deltoid area, with limited range of right shoulder motion. He was admitted for an intravenous cefazolin (4000mg/day) for 3 days then changed to oral cefalexine (1000mg/day) for 7 days.	Sinovac COVID- 19 Vaccine	Anteroposterior and lateral radiographic images of the shoulder showed degenerative change without fracture. During admission, his clinical symptoms gradually improved. He had no fever after 1 day of admission. He could slowly increase movement in his right shoulder and was able to tolerate passive motion of his right shoulder after 23 days. The ultrasonography report which was done pre- treatment also showed fluid in the bursas compared with post- treatment ultrasonography.	The article reported a case of subacromial- subcoracoid-subdeltoid bursitis followed a Sinovac COVID- 19 vaccine injection. The study concluded that, this condition is rare, and usually related to an incorrect vaccination technique. To avoid this complication, nurses should identify the correct landmark, and to use an appropriate needle length, and point the needle in the correct direction.
Maliwankul et al., 2021	The study offered a series of seven SIRVA cases including clinical presentations, investigations, and treatment outcomes.	≥ 40 years (Case Series)	A retrospective chart review was performed for seven patients who developed SIRVA following a COVID- 19 vaccination between April 2021 and October 2021. All patients had no prior shoulder pain before their vaccination and then developed shoulder pain within a few days following vaccination, which did not spontaneously improve within 1 week.	Sinovac vaccination , and Oxford-AstraZenec a COVID-19 vaccine	In all the cases, the cause of the SIRVA was from an incorrect COVID- 19 vaccine administration technique. Two patients developed shoulder pain immediately following the injection, one patient about 3 h after the injection, and the other four patients within the next few days.	The study concluded that the most common cause of SIRVA was an incorrect vaccination technique, and not actually the vaccination.
Eric et al., 2022	The study was done to describe the clinical features in patients with SIRVA following Coronavirus 2019 vaccination.	Patients with age ≥18 years. (Observational study)	-	Pfizer-BioNTech or Sinovac-Coronavac	The most common diagnosis was adhesive capsulitis (63%), followed by bursitis (19%) and supraspinatus tear (19%). Mean symptom onset was 3.5 ± 2.5 days post- vaccination, and always occurred after the 2 nd or 3 rd vaccination, involving reduced shoulder range of motion.	The study concluded that it is important that clinicians are aware of SIRVA as a cause of new symptoms of shoulder injury and should ask the patient about recent vaccinations, including for COVID- 19.

Tatiane et al., 2022	The study reported a case of subacromial-subdeltoid bursitis after COVID-19 vaccination, related to the unintentional injection of vaccine solution into the bursa resulting in a robust immune-mediated inflammation reaction.	61- year old woman (Case report)	The patient presented with excruciating pain and tenderness at the injection site in her right shoulder within 30 min after receiving her first shot of COVID-19 vaccine. She voiced concern about vaccine administration, specifically that the injection had been administered “too high” in the arm. Informed consent was obtained from the subject described in this report. Photographs of the patient while receiving vaccine were taken and confirmation of the incorrect technique used was noticed. The injection was administered at the level of two fingerbreadths of the lateral border of the acromion, which is considered higher than the recommendation.	Oxford-AstraZeneca	Eight weeks after the vaccination, the patient was still experiencing persistent pain in the right shoulder and reduced ROM with inability to perform daily activities. Upon physical examination, there was mild swelling of the upper arm and localized shoulder tenderness around the top of the humeral head and deltoid. Shoulder MRI and Ultrasound 8 weeks after vaccination supported a diagnosis of subacromial-subdeltoid bursitis and rotator cuff tendinopathy. The fluid-filled subacromial-subdeltoid bursa was greater than is commonly seen for overuse bursitis caused by mechanical stress.	The study concluded that vaccine administration in the upper third of the deltoid area can have long-lasting consequences unrelated to the specific vaccine administered. Awareness of the potential for inducing a prolonged immune-mediated inflammatory reaction of a vaccine antigen is injected into synovial tissue structures underlying deltoid muscle should be emphasized, as well as careful consideration given for proper injection technique when administering shoulder intramuscular vaccination.
Jessica et al., 2022	The study aims to describe SIRVA in the current pandemic, increase clinician awareness, and offer considerations for prevention.	19- 90 years (Systematic review)	To identify the clinical characteristics of patients with post COVID-19 vaccination shoulder injuries, the researchers performed a systematic review of the cases of vaccination-related shoulder injuries reported in the literature and conducted a review of the public Vaccine Adverse Event Reporting System (VAERS).	Pfizer and Oxford-AstraZeneca	The research study identified 305 cases of SIRVA in the VAERS database and 28 cases of SIRVA in the setting of COVID-19 vaccination from the literature (n= 333). Most patients sought medical evaluation with 54 of the 305 VAERS cases reporting utilizing emergency services. Of patients with imaging confirmed SIRVA (n= 95), the most common diagnoses were Adhesive Capsulitis, and Bursitis, and the most common symptoms were pain (97.7%), and limited ROM (68.1%). Only 5 patients reported recovery after the treatment while 60 were not recovered.	The study concluded that clinicians must be aware of signs and symptoms of SIRVA as well as appropriate diagnostic modalities and treatment options. Additionally, standardization and proper education regarding injection technique and appropriate needle length is imperative to reducing harm.
Lisa et al., 2022	The study described the clinical and electromyographic features of 6 patients presenting with the clinical picture of Parsonage Turner Syndrome	>30 years	The researchers performed a retrospective analysis of patients referred to their facility for EDX investigation of pain and weakness of the upper extremity. All the patients underwent EDX studies following standard protocol in their laboratory. The EDX test	Pfizer-BioNTech vaccine, and Moderna COVID-19	The results stated that the symptom arose on the ipsilateral side to the injection site in 5 patients and in the contralateral side in 1 patient. The onset of symptoms occurred after the first dose of the vaccine in 2 patients, while 4 patients developed	The study concluded that physicians should be aware of the potential for development of PTS in patients who have experienced either COVID-19 infection or been vaccinated for this novel virus. Timely recognition and early treatment of this condition with corticosteroids and PT offer the best

	following COVID-19 vaccination.		focused on detecting focal demyelination, conduction block, axonal loss, and localizing the site of involvement by NCV and needle EMG.		symptoms after the 2 nd dose. Presenting symptoms include arm pain in 5 patients and shoulder pain in 3 patients followed by acute onset of muscle weakness in all patients.	outcome, although complete recovery may not always occur.
Sahu et al., 2022	The purpose of the study was to describe the clinical presentation and short-term follow-up of patients who developed Frozen Shoulder after COVID-19 Vaccination.	43-68 Years (Case Series)	10 patients (9 women and 1 man) with a mean age of 53 ± 8 years who presented to the shoulder surgeon's practice center with painful stiffness of the shoulder after COVID-19 Vaccination between June 1 and September 30, 2021, were retrospectively evaluated.	Pfizer-BioNTech vaccine	All 10 patients had normal radiographs and were diagnosed as Frozen Shoulder. Eight patients (80%) had a comorbidity during presentation (4 patients with Hypothyroidism, 3 patients with Diabetes Mellitus, and 1 patient with Prediabetes/Hyperglycemia). Symptoms developed immediately after the vaccination in 6 patients (60%), at 48 hours in 1 patient (10%), and at 10 days in 3 patients (30%). The mean pain VAS score was 6.5 ± 1.9 (range: 2.5-8), and both active and passive range of motion were limited in all the patients at the time of presentation.	The study concluded that Health Care Personnel who administer the COVID-19 vaccine needs to be educated about the importance of proper care, especially in subjects with pre-existing Shoulder pain. The Health care providers, especially Orthopedic surgeons, who will see patients with significant Shoulder pain and stiffness should be aware that Frozen Shoulder can occur after COVID-19 vaccination.
Ahmad et al., 2022	The article reported a case of a Shoulder injury related to Vaccine administration	52 year- old woman, and 38-year old male (Case report)	A 52 year- old woman experienced clinically significant pain in the left shoulder joint after receiving the first dose of a coronavirus disease 2019 vaccine. She neglected the shoulder pain, hoping that it would spontaneously improve without medical attention.	Oxford/ AstraZeneca COVID-19 vaccine	By examination, there was a marked decrease in passive and active abduction of the left compared with the right shoulder, and limited flexion, internal and external rotation of the left shoulder joint. MRI revealed synovial capsule thickening with mild Adhesive Capsulitis (Frozen Shoulder). The patient was diagnosed with SIRVA and was started on common NSAIDs and physical therapy, with satisfactory improvement achieved.	The study demonstrated the need to evaluate shoulder discomfort following immunization. The article stated that future research is needed to identify the vaccination standards (needle size and anatomical site of injection) that best prevent SIRVA. This is especially important when vaccinations are performed in mass.
Honarman et al., 2022	The article reported two cases of Shoulder injury related to vaccine administration (SIRVA) following mRNA COVID-19 vaccination	Case 1 with 42 year- old male and Case 2 with 38 year- old male (Case report)	Case 1: A 42 year- old male right-handed healthcare worker with no significant past medical history presented with severe left shoulder pain and severe limited range of motion. The symptoms developed within 2 days after receiving the first dose of Moderna's	Moderna's mRNA 1273 vaccine, and Pfizer-BioNTech COVID-19 vaccine	MRI of the left shoulder showed subacromial-subdeltoid bursitis. 1 course of oral Prednisolone was administered after which the pain subsided in few days. Follow-up MRI of the left shoulder 2 months later demonstrated	The study concluded that given the widespread COVID-19 vaccination, clinicians and radiologists should be familiar with potential musculoskeletal side effects of these vaccines.

			mRNA vaccine. A high injection site was reported by the patient at the time of vaccine administration. MRI of the left shoulder was performed. Case 2 A 38 year- old male right- handed healthcare worker with no significant past history presented with non-traumatic severe left shoulder pain. The symptoms developed 2 weeks after receiving the second dose of Pfizer-BioNTech vaccine leading to severe limited ROM. Ultrasound of the left shoulder was performed.		resolution of the bursitis in the Case 1. In the Case 2, the Ultrasound of the left shoulder showed subacromial-subdeltoid bursitis. The symptoms almost completely resolved by conservative management in less than a week.	
Paul et al., 2022	A systematic review of literature was performed to identify all the published accounts of SIRVA.	21-90 years old (Systematic Review)	Twenty- seven papers reporting one or more accounts of SIRVA were identified. Search results were completed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (PRISMA), and a PRISMA checklist was employed for analysis of the search results.	Oxford/ AstraZenec a COVID-19 vaccine	A total of 56 reported accounts of shoulder pain, injury or infection were identified following a reported vaccination event. The most common type of vaccination reported was influenza representing 61% of the cases. The second most common vaccination reported in five cases, but 3 of those cases presented within two weeks of vaccination representing 14%.	The study concluded that as patients who presented for treatment within three weeks of symptoms onset had overall good reported outcomes, a recommendation can be made that all patients who experience shoulder pain for greater than 14 days after a vaccination injection should seek immediate medical evaluation. In regards to needle length, a weight / BMI based scale should be utilized, and vaccination techniques must balance the need to avoid superior locations while minimizing axillary nerve risk.
Nakajima et al., 2022	The article reported a case of Calcific Tendinitis of Shoulder induced by an MRNA vaccine for COVID- 10	83 year- old woman (A Case Report)	After being diagnosed with calcification in her left shoulder 1 year ago, an 83 year- old woman had her first COVID- 19 vaccination in the deltoid muscle. The second injection was performed 26 days later an she experienced worse discomfort, swelling, and heat compared to the first injection, and the pain did not improve. According to radiographs, calcification in the left supraspinatus tendon had increased over previous year. In this study, the researchers diagnosed calcific tendinitis induced by COVID-19 vaccination and treated the patient with celecoxib on a regular basis and acetaminophen as needed.	Moderna’s mRNA 1273 vaccine, and Pfizer-BioNTech COVID- 19 vaccine	The results showed that on the 14 th day after the second vaccination, the pain and swelling in the shoulder tended to improve, and the calcification seen in the supraspinatus tendon on radiographs had almost disappeared, leaving only a small amount of calcification around the supraspinatus muscle. 2 months after the second injection, calcification had disappeared. The pain in her left shoulder improved, and the range of motion was 170 degree in flexion and abduction.	The article concluded that a case of calcific tendinitis caused by an mRNA vaccine for COVID-19 is resolved by medical therapy. During a pre- vaccination assessment, the presence of shoulder joint disease should be carefully asked. The puncture point should be chosen with the median point of the Deltoid muscle or the anterior-posterior axillary line as landmarks because the more cephalad the puncture position, the greater the chance of causing SIRVA.

Klabklay et al., 2022	The study was done to report the first case of a COVID-19 vaccination administration precipitating symptomatic calcific tendinitis from pre-existing, asymptomatic calcific tendinitis.	A 50- year old male/ (A Case Report)	The patient presented with left shoulder pain about 3 hours following a second dose of COVID-19 vaccination. He was sent for ultrasonography of his shoulder, which revealed calcific tendinitis of the subscapularis tendon.	Oxford-AstraZenec a COVID-19 vaccine	The injection technique was found to be correct, so other causes were considered, and following ultrasonography, the study found a linear calcification near a footprint of the subscapularis tendon, which immediately led to the probable diagnosis of the COVID-19 vaccination had precipitating the patient's formerly asymptomatic calcific tendinitis.	The study revealed that previously asymptomatic shoulder pathologies can be precipitated to symptomatic by a COVID vaccination.

Discussion

During the COVID- 19 pandemic, millions of vaccinations for the prevention of COVID-19 were administered to the adults worldwide (Ahmad et al., 2022). The present study documented various types of shoulder pathologies induced by COVID-19 vaccination, causes, risk factors, and preventive measures from the previous literature. A total of 15 research articles have been reviewed and documented in this study. Studies have suggested Adhesive capsulitis, Rotator cuff tendinopathy (Supraspinatus), Subacromial-Subdeltoid Bursitis, Parsonage Turner Syndrome, and Calcific Tendinitis as the most common manifestations of SIRVA (Tatiane et al., 2021; Honarmand et al., 2021; Ahmad et al., 2022). The SIRVA is a rare complication that can occur following a vaccination. Moderna's mRNA 1273 vaccine, Pfizer- BioNTech COVID- 19 vaccine, Sinovac vaccination, and Oxford-AstraZeneca COVID- 19 vaccines are the type of vaccinations which were administered during the pandemic.

The major symptoms of SIRVA reported in the reviewed literature were with COVID- 19 vaccine AstraZeneca, which may affect more than 1 in 10 people, were tenderness, pain, redness, swelling and stiffness at the injection site followed by other common systemic effects such as headache, fever, tiredness, myalgia, and fatigue beginning a few minutes to a few days after the vaccination which does not resolve by a week or so. This is different from the quite common local effect of a vaccination which is usually not severe and clears up in 2-3 days. The key factor in considering SIRVA was the absence of prior shoulder pain before the vaccination. The findings of one case series have revealed that all the included patients in their study have complained of difficulty in performing normal daily activities (Maliwankul et al., 2021). Majority of the research studies revealed that the common physical examination finding of SIRVA is pain while moving the shoulder with incidences of 55.9% and 85% (Atanasoff et al., 2010; Hesse et al., 2020). Arm pain due to vaccine injection usually resolves within few days with or without conservative treatment (Tatiane et al., 2021; Honarmand et al., 2021). Shoulder stiffness can be primary (idiopathic) or secondary (caused by other factors). It is referred to as secondary when a recognized precursor produces shoulder discomfort and eventual general stiffness (Ahmad et al., 2022). The possible cause of shoulder stiffness and pain in this case could be the injury due to incorrect needle penetration and/ or immunological response to the vaccine content. However, a definitive clinical study demonstrating a link between a vaccine antigen and an immune mediated shoulder inflammation causing a shoulder pain and dysfunction is still lacking. Also, the previously asymptomatic shoulder pathologies may be precipitated to symptomatic by a COVID vaccination.

The risk factors for shoulder pain during the pandemic documented from the previous literature search were BMI, sex, age, and type of vaccine. One study has reported that overweight patients had an increased risk of SIRVA (Maliwankul et al., 2021), while other studies have reported that SIRVA was associated more with incorrect injection techniques (Hesse et al., 2020; Boonsri et al., 2021; Chuaychoosakoon et al., 2021). The subdeltoid bursa is located between 0.8cm and 1.6 cm below the skin surface, a distance easily penetrable by the standard 1- inch (25 mm) needle (Jessica et al., 2020). It is well documented in the literature that a one- size- fits all approach should not be uniformly applied to all adult deltoid intramuscular vaccinations (Jessica et al., 2020). According to the literature studies, when compared to the first dose, adverse reactions reported after the second dose were milder and less frequent (Bancsi et al., 2019; Attanasoff et al., 2021). In one case report, the patient developed shoulder pain shortly after vaccination, possibly due to her vaccine being administered inadvertently higher than recommended (Tatiane et al., 2021; Attanasoff et al., 2021 Jessica et al., 2020). Attansoff and colleagues in their study reported that in 93% of the cases, shoulder pain occurred less than 24 h after vaccination and immediately following injection in 54% (Attanasoff et al., 2021). Majority of the previous research studies have concluded that proper Technique is likewise

an important factor in the avoidance of SIRVA. An injection that is too high risks injecting the subacromial bursa, injections placed too low can reach the radial nerve, and too laterally risks injury to the axillary nerve (Bancsi et al., 2019). Emphasis should be placed on choosing the correct syringe, needle gauge, and needle length. Increased attention should be placed on needle length, as a needle that is either too short or too long may lead to improper administration and possible complications if the needle penetrates too deeply. Needle placement during intramuscular administration is into the thickest portion of the deltoid muscle. Studies suggest that needle should be injected at a 90 degree, directly into the center of the deltoid muscle, approximately 2 inches (5.08 cm) below the acromion process, and just below the level of the armpit (Chelsey et al., 2022). This study demonstrated the need to evaluate the shoulder discomfort following immunization. Future research is needed to identify the vaccination standards (needle size and site of injection) that best prevent the adverse effects. Physicians and Physical Therapists should be aware of the potential for the occurrence of shoulder pain and dysfunction in patients who have been vaccinated for this novel virus. Timely recognition and early management of this with corticosteroids and Physiotherapy offer the best outcome.

Conclusion

Studies revealed that the most common condition associated with Shoulder pain after COVID- 19 vaccine is Subacromial-Subdeltoid Bursitis followed by Adhesive capsulitis, Rotator cuff tendinopathy (Supraspinatus), Parsonage Turner Syndrome, and Calcific Tendinitis. The patients developed shoulder pain shortly after vaccination as the result of an incorrect COVID- 19 vaccination technique, possibly due to the vaccine being administered inadvertently higher than recommended, or it could be possible that the patient is having a pre- existing asymptomatic pathology, and when vaccinated, the resultant inflammation triggered shoulder pain. The results of the study cannot be generalized because few numbers of studies were conducted, thus warrants for further studies to be conducted in this direction.

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Prevalence of Hypertension among Adults of Punjab and Associated Risk Factors-A Review

*Charan Kamal Sekhon, *Monika Airi, **Ramandeep Kaur

*Assistant Professor, **Research scholar, Department of Zoology, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab.

drcks31@gmail.com; monika_airi@yahoo.co.in; ramanpandher076@gmail.com

Abstract

Hypertension is one of the diseases of the 21st century, with a social dimension and is major public health problem in urban and rural areas. Being a “Silent killer”, it should be scrutinized as a part of initial examination, as maximum numbers of people are unaware of this problem. The thorough investigations of literature have revealed that hypertension is highly prevalent in Punjab. Some of the important factors associated with hypertension are waist circumference, waist to hip ratio, body mass index, sedentary lifestyle, increasing age, low level of education, anxiety, depression and marital status. The prevalence of hypertension among males and females in Punjab has shown a considerable upward trend over the time, yet awareness and control rates are comparatively low. It has been observed by various workers that, the younger the age of onset of hypertension, the greater is the reduction in life expectancy if high blood pressure is left untreated. Therefore, individuals who have no signs and symptoms of hypertension but observes fluctuating levels/ readings of blood pressure should pay more attention towards the prevention of hypertension. This paper gives a critical review about the same.

Key Words: Hypertension, Risk factors, Prevalence, Obesity, Lifestyle

Introduction

Hypertension is another name for high blood pressure and it is the biggest health challenge of 21st century. High systolic blood pressure (SBP) has been linked to around 10.8 million fatalities, making it a major cause of mortality worldwide in 2019 (GBD, 2019). According to reports from the World Health Organization (WHO, 2014), the Global burden of disease study (Farouzanfar *et al.*, 2017), and the Non-Communicable Disease Risk Factor Collaboration (NCD-RISC, 2017), hypertension prevalence is rising globally and more than 1 billion people currently have it (defined using the standard criteria as systolic blood pressure greater than 140 and/or diastolic blood pressure greater than 90 mm Hg). According to NCD-RISC study (2017), 594 million adults were observed with high blood pressure in 1975 and 1.13 billion adults had high blood pressure in 2015, with the majority of the rise occurring in low- and middle-income nations. According to the WHO Global Health Observatory 2016 data, about 12.8% (7.5 million) of total deaths that occurred worldwide were due to high blood pressure.

Hypertension being a “Silent killer” should be examined as a part of initial examination, as maximum numbers of people are unaware of this problem. It is a condition that arises when narrowing of arterioles causes the blood to exert excessive pressure against the walls of blood vessels and force the heart to work hard to maintain the pressure (Ondimu *et al.*, 2019). According to Grant and Borghei (2017), Hypertension is mainly primary (essential), but can be secondary caused by disease or even medication. Increased sodium consumption, excessive alcohol use, obesity, sedentary lifestyle, use of tobacco, nicotine products, aggressiveness, and poor stress coping skills were some factors associated with primary hypertension whereas secondary hypertension was caused by excessive use of oral contraceptives, hormone therapies as used in infertility, decongestants, non-steroidal anti-inflammatory drugs, appetite suppressants, antidepressants and corticosteroids.

The symptoms of hypertension can differ from person to person and resemble other illnesses exactly, making it worse silently. These symptoms include headaches, neck pain, impaired vision, ringing in the ears, and nosebleeds (Siregar and Siregar, 2022). The asymptomatic nature of hypertension in early phases of its onset begins in childhood or adolescent period and increases the chance of developing obstacles during adulthood. According to World Health Organization (2013), raised blood pressure if left uncontrolled and untreated can cause many complications like Heart and Renal failure, Retinal hemorrhage, Stroke, Visual Impairment, Peripheral Vascular disease and Dementia. A country-wide estimate of the prevalence of hypertension among adults (Anchala *et al.*, 2014), and the tribal population in India (Rizwan *et al.*, 2014) has already been reported in research however there is a dearth of data on hypertension in Punjab. We therefore sought to conduct a review of research to determine the prevalence of hypertension and its associated risk factors among adults of Punjab in order to cover this gap.

Objectives

This paper provides an updated review of available literature on hypertension by examining population-based studies in the last 18 years. The objectives of this review were to evaluate the changing trends in prevalence of hypertension and to study the risk factors of hypertension among adults of Punjab.

Methodology

Search strategy

Literature was searched from 2005 to 2023 on hypertension among adults using electronic search engines PubMed and Google Scholar and Web of Science. Cross references of all selected papers were also used to identify further relevant papers. We examined the first 15 pages (150 articles) in google scholar (search terms: “Punjab” AND “hypertension” AND “prevalence”) which did not give any new publication other than what we already found in PubMed and Web of Science. Published papers for the present review were selected from available published papers conducted in samples from India and restricted to English language. At first, the title of the paper and abstracts were reviewed for relevance, and then potential relevant full text papers or abstracts, where full texts were not available were extracted. Papers without full text where abstracts were also unavailable were excluded from the review.

Selection criteria

Articles included in the review were cross-sectional or cohort; studies conducted among adult populations (≥ 18 years old) published after year 2005. Articles on the prevalence of hypertension were searched first and were then segregated state-wise. The studies on risk factors of hypertension obtained were those published before or during the prevalence data of hypertension. Articles were excluded if they were letters, abstracts, conference proceedings, case series, case-control studies, reviews, and meta-analysis; not conducted on humans; not community-based studies, and not pertaining to regions with reported hypertension prevalence.

Study selection

The titles and abstracts of the initially identified studies were screened to determine whether they would satisfy the selection criteria. Any disagreements about selection were resolved through consultation. Full-text articles were retrieved for the selected titles. Reference lists of the retrieved articles were searched for additional publications. The retrieved studies were assessed again to ensure that they satisfied the inclusion criteria.

Data extraction

A data collection form was designed before the implementation of the search strategy. This form was used to extract the relevant information from the selected studies. The data collection form included questions on year of publication, study design, sample size, geographic origin and information on the reported exposure and outcomes (e.g., prevalence of hypertensive patients and risk factors of hypertension).

Table 1. The Joint National Committee (JNC) VII criteria gave following Categories of Hypertension:

Category	Systolic Blood Pressure (SBP)	Diastolic Blood Pressure (DBP)
Normal	≤ 119 mmHg	≤ 79 mmHg
Pre- hypertension	120-139 mmHg	80-89 mmHg
Stage-1-Hypertension	140-159 mmHg	90-99 mmHg
Stage-2-Hypertension	≥ 160 mmHg	≥ 100 mmHg

Results and Discussion

The PubMed and Google scholar search initially identified 150 references, and a total of 130 abstracts were screened by inclusion criteria. Full-text assessment of 125 articles on the prevalence of hypertension resulted in 40 relevant articles, from which the different districts of the state were identified. There were 36 full-text articles on prevalence of hypertension but potentially relevant articles were 20 in number.

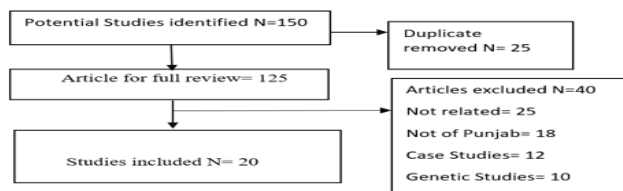


Figure 1. Flow chart providing the number of studies identified, excluded for various reasons and included in the review.

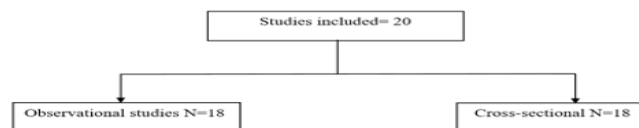


Figure 2. Flow chart providing the type of studies included in the review.

Prevalence of Hypertension in Punjab

The majority of recent papers revealed an increase in the prevalence of hypertension among adults throughout the world (Geldsetzer *et al.* 2018; Lee *et al.* 2022; Saju *et al.* 2020; Kumar and Misra, 2021; Singh *et al.* 2014). The increase in blood pressure in adults is mainly due to age and sedentary lifestyle (Singh *et al.* 2014; Badaruddoza and Kaur 2014; Goyal *et al.* 2017; Mitra *et al.* 2017; Tripathy *et al.* 2017; Kaur and Kochar 2019). Data from recent papers in adults reported the similar findings from Punjab also as well.

Sidhu *et al.* (2005) reported the overall prevalence of hypertension to be 20.15 percent among the adult females of Amritsar, Hoshiarpur, Ludhiana and Pathankot. In another paper Kaur and Sidhu (2012) found the overall prevalence of hypertension was 86.6 percent among adults aged between 18-69 yrs of Amritsar. Moreover, the prevalence was high among the females than males of Amritsar. A paper by Badaruddoza and Kaur (2014) showed that the prevalence of hypertension in females aged between 20-65 yrs of Amritsar and Gurdaspur was 33 percent. In Ludhiana, the prevalence of hypertension was 26.5 percent among adults aged between 30-71 yrs (Goyal *et al.* 2017). Another paper from Amritsar showed that the prevalence of hypertension was 35.9 percent in adults aged between 20-60 yrs (Singh *et al.* 2014). Thakur *et al.* (2016) found the overall prevalence of hypertension was 40.1 percent among the adults of Punjab. Moreover, the adult males were more prone to hypertension than the females aged between 18-69 yrs. Another study in the same district reported a prevalence of 32 percent and 34 percent of hypertension in the adult males and females aged between 18-69 yrs. The overall prevalence was 33.2% among the adults of district Amritsar. (Mitra *et al.* 2017). Tripathy *et al.* (2017) observed the prevalence of hypertension in Punjab was 40.1 percent. More prevalence was seen among adult males than females aged between 18-69 yrs. Another paper from the district Ludhiana showed that the prevalence of hypertension was 61.1% among the adults aged between 40-70 yrs. Moreover, the prevalence was higher among the males of Ludhiana than females i.e. 68.9 percent and 53.4 percent (Vikramaditya *et al.* 2017). A paper from Pathankot demonstrated the overall prevalence of hypertension among the adult females aged between 18-69 yrs was 42.8 percent (Vimesh *et al.* 2017). A paper from Punjab demonstrated the prevalence of hypertension was 24.3 percent among adults aged between 30-60yrs. (Jaacks *et al.* 2022).

However, the overall prevalence of hypertension in Punjab is unknown. However, some regional attempts have been made to understand the prevalence of hypertension in different districts of Punjab. The latest community-based paper from Punjab demonstrated the prevalence of hypertension was 24.3 percent among adults aged between 30-60yrs. (Jaacks *et al.* 2022). Studies that were conducted in Punjab demonstrated that the prevalence of hypertension was comparatively higher among adult males than in females (Kaur and Sidhu 2012; Singh *et al.* 2014; Tripathy *et al.* 2017; Vikramaditya *et al.* 2017; Thakur *et al.* 2016).

Table 2. Prevalence of Hypertension in Punjab:

Authors	Year	Age group	Area of study	Sample size	Overall%	Male %	Female %
Sidhu <i>et al.</i>	2005	20-60 yrs	Amritsar, Hoshiarpur, Ludhiana and Pathankot	2000	20.15%	-	20.15%
Kaur and Sidhu	2012	18-69 yrs	Amritsar	300	86.6%	88.2%	84.7%
Badaruddoza and Kaur	2014	20-65 yrs	Amritsar and Gurdaspur	455	33%	-	33%
Singh <i>et al.</i>	2014	20-60 above yrs	Amritsar	1089	35.9%	40%	30%
Thakur <i>et al.</i>	2016	18-69 yrs	Punjab	5127	40.1%	47.4%	31.5%
Goyal <i>et al.</i>	2017	30-71 above years	Ludhiana	2732	26.5%	-	-
Mitra <i>et al.</i>	2017	18-69 yrs	Amritsar	1000	33.2%	32.4%	34%
Tripathy <i>et al.</i>	2017	18-69 yrs	Punjab	5055	40.1%	46.1%	34.9%
Vikramaditya <i>et al.</i>	2017	40-70 above yrs	Ludhiana	324	61.1%	68.9%	53.4%
Vimesh <i>et al.</i>	2017	18-69 yrs	Pathankot	612	42.8%	-	42.8%
Mitra <i>et al.</i>	2021	18-69 yrs	Amritsar	500	33.60%	34.40%	32.80%
Jaacks <i>et al.</i>	2022	30-60 above years	Punjab	11,322	24.3%	-	-

Table 3. Risk Factors of Hypertension

Singh <i>et al.</i>	2014	20-60 above yrs	Amritsar	Cross-sectional	Higher levels of cholesterol and triglycerides were linked to a 1.5-fold increased risk of developing hypertension.
Badaruddoza and Kaur	2014	20-65 yrs	Amritsar and Gurdaspur	Cross-sectional	Both systolic and diastolic blood pressures had positive and significant correlation with body mass index, waist circumference and waist-to-hip ratio.
Thakur <i>et al.</i>	2016	18-69 yrs	Punjab	Cross-sectional	Tobacco, alcohol consumption, physical inactivity, overweight, obesity, salt intake and diabetes were highly associated with raised blood pressure among adults of Punjab.
Goyal <i>et al.</i>	2017	Above 30 yrs	Ludhiana	Cross-sectional	Sedentary activity, obesity and hypercholesterolaemia were the major risk factors associated with hypertension.
Mitra <i>et al.</i>	2017	18-69 yrs	Amritsar	Cross-sectional	There was significant increase in prevalence of hypertension in both urban and rural population with age and high body mass index.
Tripathy <i>et al.</i>	2017	18-69 yrs	Punjab	Cross-sectional	Age, marital status, alcohol consumption, obesity and salt intake were positively associated with hypertension.
Vikramaditya <i>et al.</i>	2017	40-70 above yrs	Ludhiana	Cross-sectional	Adults with hypertension or other cardiovascular events are more likely to have persistently elevated blood pressures.
Vimesh <i>et al.</i>	2017	18-69 yrs	Pathankot	Cross-sectional	Body mass index, family history and table salt intake were the major risk factors associated with hypertension.
Kaur and Kochar	2019	30-50 above yrs	Ludhiana	Cross-sectional	There was a significant increase in prevalence of hypertension among both males and females with increase in age.
Singh <i>et al.</i>	2019	18-60 above yrs	Punjab	Cross-sectional	Obesity and inadequate physical activity were more common factors among hypertensive females of Punjab.
Shergill <i>et al.</i>	2022	18-69 yrs	Fatehgarh Sahib	Cross-sectional	Patients with hypertension have increased rates of depression and anxiety, which are positively correlated with hypertension.

Risk Factors of Hypertension

A number of original research papers and population-based papers have demonstrated that there was a positive relationship between anthropometric measurements and blood pressures among adults. However, the major contributing factor for hypertension among adults is body mass index (Baddaruddoza and Kaur 2014; Mitra *et al.* 2017; Vimesh *et al.* 2017; Kaur *et al.* 2013; Mitra *et al.* 2021), waist circumference and waist-hip ratio (Kaur *et al.* 2013; Kaur and Sidhu 2012; Baddaruddoza and Kaur 2014). It was observed that obesity and overweight were one of the major factors that was highly associated with raised blood pressure and other coronary heart diseases (Kaur *et al.* 2013; Rana and Sidhu 2012; Thakur *et al.* 2016; Vikramaditya *et al.* 2017). Papers also demonstrated that the individuals with family history of hypertension were more likely to have elevated blood pressures than the ones without any history of hypertension (Vimesh *et al.* 2017). It was observed that adults with elevated blood pressure and family history of hypertension had high blood cholesterol and triglyceride levels (Singh *et al.* 2014; Thakur *et al.* 2016). A recent paper in Fatehgarh sahib demonstrated that the prevalence of anxiety and depression was high among the hypertensive women (Shergill *et al.* 2022). It was also observed that the rate of hypertension also depends on the stress levels and anxiety (Kaur and Kochar 2019; Mitra *et al.* 2021). Some papers reported that the age factor was also responsible for raised blood pressure. It was observed that prevalence of hypertension rises abruptly with age (Mitra *et al.* 2021; Singh *et al.* 2014; Tripathy *et al.* 2017; Sidhu *et al.* 2005). Some papers demonstrated that there is a high prevalence of hypertension among males than females of Punjab. (Kaur and Sidhu 2012; Singh *et al.* 2014; Tripathy *et al.* 2017; Vikramaditya *et al.* 2017; Thakur *et al.* 2016; Singh *et al.* 2019). While the others demonstrated that the prevalence of hypertension was more among females than males (Mitra *et al.* 2017). Other factors that were responsible for hypertension in adults of Punjab include sedentary lifestyle changes such as physical inactivity (Thakur *et al.* 2016; Mitra *et al.* 2021) and unhealthy dietary practices like low fruit consumption (Thakur *et al.* 2016), high fast food consumption (Mitra *et al.* 2021), tobacco and alcohol consumption (Mitra *et al.* 2021; Singh *et al.* 2014), sodium intake was also found to be very high among adults of Punjab (Thakur *et al.* 2016; Tripathy *et al.* 2021).

Conclusion

Higher prevalence rates were observed among males as compared to females. A significant increase in prevalence of hypertension over time was also noticed within different districts of Punjab. The dietary pattern and sedentary lifestyle of adults also played an important role for increasing incidents of obesity and associated hypertension in Punjab. There is a lack of awareness and control of hypertension in Punjab. There is a need for good quality studies focusing on hypertension and its treatment in Punjabi's to develop optimal strategies for hypertension management. Special guidelines for desirable levels of risk factors may be necessary for prevention of hypertension.

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Immediate Effect of Static Stretching and Muscle Energy Technique on Flexibility of Triceps Surae in Nurses

***Yukta Sharma**Supreet Bindra**

*Student, **Assistant Professor, Department of Physiotherapy at Sri Guru Granth Sahib World University, Fatehgarh Sahib.

Sharma4120yush@gmail.com

Abstract

Introduction: Muscle imbalance is the predisposing factor of reduced muscle flexibility, pain, decreased range of motion, and uncoordinated movements. Muscle imbalance results from a lack of stretching and strengthening of muscle. Reduced muscle flexibility of triceps surae causes problems while walking and jumping. To increase muscle flexibility different therapeutic interventions have been used which help in increasing muscle functioning. Static stretching is the conventional technique to lengthen a short muscle. Muscle energy technique is a type of osteopathic manipulation medicine designed to improve musculoskeletal function through mobilizing joints and stretching tight muscles and fascicles. **Aim of the study:** Aim of the study was to compare the immediate effect of static stretching and muscle energy technique on the flexibility of the triceps surae muscle in nurses. **Material and methods:** An experimental study in which 30 female subjects aged between 20-30 years were divided into 2 groups. 15 subjects in each group A and B were given with static stretching and muscle energy technique respectively. Flexibility of muscle following pre and post-intervention was analyzed by goniometer and weight bearing lunge test. Dependent and independent t-test was used to analyze the results statistically. **Result:** This study compared the immediate effects of static stretching (Group A) and muscle energy technique (MET) (Group B) on ankle range of motion and weight bearing lunge test. Pre and post-intervention measures of all outcomes for both groups were significantly different from each other. Between the group comparisons showed that the changes in all outcomes (Ankle Dorsiflexion, Ankle Plantarflexion, and Weight Bearing Lunge Test) were significantly greater in the MET group compared to the static stretching group, indicating a significant difference between the groups. **Conclusion:** This experimental study concluded that muscle energy technique is better than the static stretching technique for increasing muscle flexibility.

Key words: Triceps surae, Static stretching, Muscle Energy Technique, flexibility, weight bearing lunge test.

Introduction

Muscle flexibility is the ability of a muscle to lengthen, allowing a joint to move through a range of motion (ROM), while loss of muscle flexibility is a reduction in muscle capacity to deform, resulting in reduced range of motion for the entire joint (Bandy et al., 1997). Flexibility deficits in the triceps surae musculature are a common finding with loss of dorsiflexion, which can affect normal foot function by altering the way foot attenuates ground reaction forces (Brian et al., 2015). This is one of the fundamental issues addressed in physiotherapy to recover from immobilization or injured connective tissue. Shortened muscles can create joint imbalances and incorrect postural alignment, leading to injury and joint dysfunction (Kumar et al., 2018).

Stretching is defined as the act of applying tension to lengthen muscles and connective tissue (Adhye, 2018). Muscle Energy Techniques (MET) are used by practitioners from different professions and is recommended for interventions for muscle shortening, muscle weakness, joint restriction, and lymphatic drainage. In addition to using muscle strength to mobilize joints and tissues (Fryer, 2011).

The gastrocnemius and soleus share a single tendinous insertion in the calcaneus, so they perform the same function in the foot. Contraction of the triceps surae produces plantar flexion as well as adduction and medial rotation of the foot (Dalmau-Pastor et al., 2014).

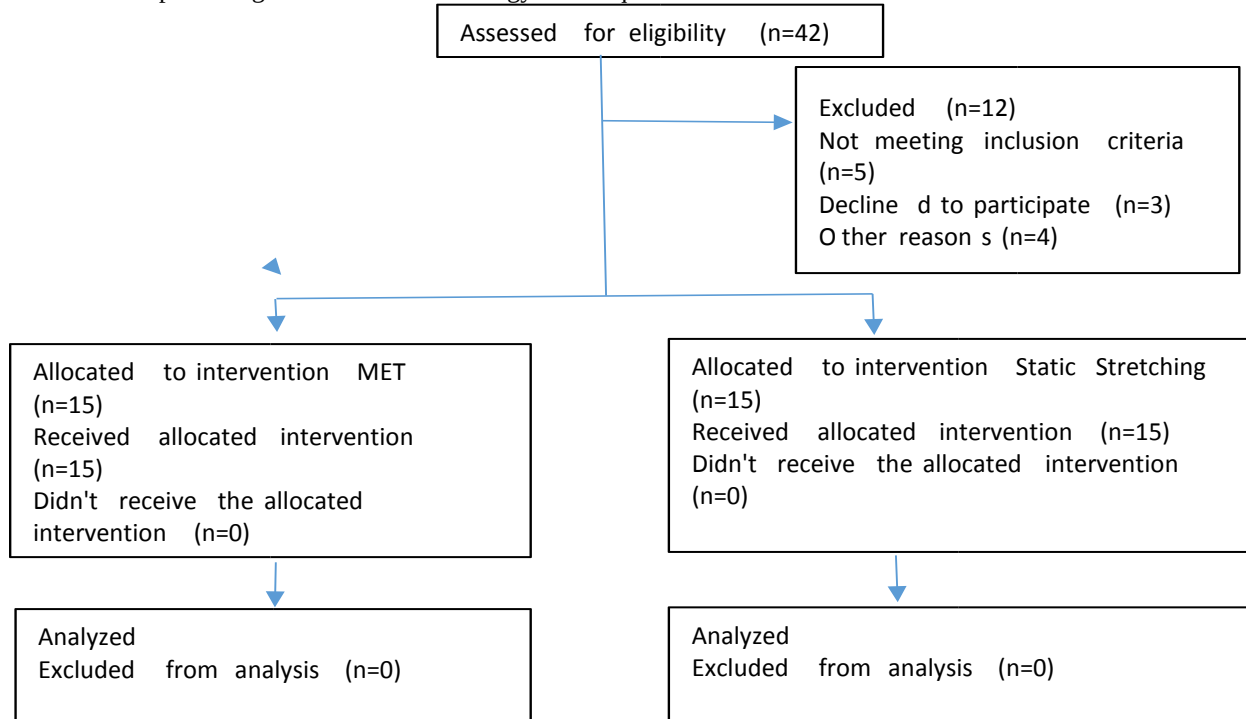
The triceps surae increases the propulsive force in the stance phase by reducing the vertical displacement of the COM and controlling balance. It also influences walking speed by controlling the anteroposterior distance between the COM and COP, and step length and speed. (Honeine et al., 2013). The risk factor for discomfort, balance problems, and restricted motion is diminished flexibility. The Triceps Surae's decreased flexibility causes a number of discomforts in daily life. Individuals whose work demand them to stand for long periods of time develop Triceps Surae tightness.

Apparently, both static stretching and muscle energy technique have role in improving extensibility of muscle. So, the aim of the study was to compare the immediate effect of static stretching and muscle energy technique on the flexibility of the triceps surae muscle in nurses. The objective of the study was to determine the immediate effect of static stretching and muscle energy technique on the flexibility of Tricep surae and to compare the immediate effect of static stretching and muscle energy technique on the flexibility of Tricep Surae.

Material and Methods

This research was conducted between November to December 2022. It was an experimental study conducted at the Department of Physiotherapy at Satguru Partap Singh Hospital, Ludiana. Initially, 42 female nurses were selected

for the experimental study, out of which 12 dropped out as did not fulfill the inclusion criteria. The sample size of 30 nurses between the age group of 20 to 30 years were taken. The subjects were allocated into 2 groups (Group A and Group B) using a simple sampling method. 15 subjects in each group, Group A was given Static Stretching whereas Group B was given with Muscle Energy Technique.



Inclusion and exclusion criteria

Female nurses with an age groups between 20 to 30 years, with inability to achieve 20° of active dorsiflexion were included. Subjects with Weight Bearing Lunge Test(WBLT) less than normal ranges(12.1cm-13.4cm for right and 12.7cm-13.9cm for left) (Gohil and Tilaye, 2022) were also included. Subjects with any lower limb fracture, any traumatic and infectious condition of a lower limb, and subjects with any neurological problem having radiculopathy pain and numbness were excluded.

Flexibility Assessment of Triceps Surae Muscle

The Triceps Surae muscle tightness leads to the decreased or reduced motion of the ankle. The reduced range of motion was measured with a universal goniometer. The Triceps Surae muscle flexibility was tested with the Weight Bearing Lunge Test. Before performing the intervention procedure, a consent form was explained to the subjects and was signed by the subjects. Demographic data were also filled out by subjects. The baseline measurement was taken with Universal Goniometer and Weight Bearing Lunge Test.

GROUP-A: Static Stretching

Subjects were positioned on the couch and stretch was given for 30-second hold of 3 repetitions. Stretching of the soleus was performed while the subject was supine lying on the couch with the knee in the slight flexion position. For gastrocnemius, the knee was kept in extension and the therapist dorsiflexed the ankle manually. The immediate effects of the procedure were recorded with a goniometer and weight-bearing lunge test.

GROUP-B: Muscle Energy Technique (MET)

Post Isometric Relaxation of Muscle Energy Technique (MET) was performed on the agonist muscle (Triceps Surae) with 10 seconds of muscle contraction duration with 3 repetitions. The subject was positioned supine lying on the couch with the knee in flexion position maintained with pillows under the knee for soleus whereas for gastrocnemius the knee was kept in extension. The therapist dorsiflexed the ankle while the subject inhaled and exerted 15% force with a hold of breath for 10 seconds toward plantarflexion. The immediate effects of the procedure were recorded with a goniometer and weightbearing lunge test.

Statistical Analysis

The pre-post-test scores collected from the subjects were tabulated and analyzed. Mean and standard deviation was used to assess all the parameters of the data using Statistical Package for Social Science (SPSS). In Tables 2 and 3 the unpaired (independent) t-test was used for Group-A and Group-B to get the Mean and Standard deviation. Levene's Test was used to get a significant p-value<0.001 was used to evaluate the results.

Results

The current study compares the effectiveness of two techniques: static stretching and the Muscle Energy Technique. For this study, 30 people were divided into A and B groups and given different techniques. Pre and post-test were taken using goniometer and WBLT before and after intervention.

Table below shows the results of a study comparing the effects of static stretching (Group A) and muscle energy technique (MET) (Group B) on ankle range of motion and weight bearing lunge test. The before and after intervention measures of all outcomes for both groups were significantly different from each other, as evidenced by the very low p-values (all less than 0.001). between the group comparison showed that the changes in all outcomes (ROM_AD, ROM_AP, and WBLT) were significantly greater in the MET group compared to the static stretching group, indicating a significant difference between the groups. The Muscle Energy Technique (MET) was more effective in improving ankle dorsiflexion and plantarflexion range of motion, as well as weight-bearing lunge test, compared to static stretching.

Table: Between the group comparison of before-intervention and after-intervention measures and their pvalue

Outcome Measures		Group A (static stretching)		p-value	Group B (MET)		p-value
		Before intervention Mean±SD	After intervention Mean±SD		Before intervention Mean±SD	After intervention Mean±SD	
ROM_AD	Right	20.80±3.25	24.93±2.76	0.000	20.20±3.96	26.33±1.98	0.000
	Left	21.67±2.96	25.53±2.61	0.000	21.13±3.04	27.40±2.13	0.000
ROM_AP	Right	31.53±2.77	35.53±2.92	0.000	31.60±3.31	39.13±2.56	0.000
	Left	32.66±2.89	35.40±3.79	.018	30.18±5.48	39.13±2.06	0.000
WBLT	Right	10.46±0.86	11.16±0.83	0.000	10.68±0.53	12.04±0.53	0.000
	Left	10.54±0.72	11.28±0.79	0.000	10.86±0.62	12.08±0.45	0.000

Abbreviations: SS-Static Stretching, MET-Muscle Energy Technique, ROM_AD-Ankle Dorsiflexion, ROM_AP-Ankle Plantarflexion, WBLT-Weight Bearing Lunge Test.

Discussion

The present study was undertaken to compare the immediate effect of static stretching and the Muscle Energy Technique on flexibility of triceps surae. Subjects for the study were divided into two groups. Subjects under group A were given Static stretching and subjects under group B were given muscle energy technique. Pre and post-ROM and WBLT (weight bearing lunge test) values were assessed. The study revealed that both intervention groups attained successful outcomes with significant results.

Muscle shortening based on trauma-mediated contraction and rigidity might result in muscle imbalance and poor posture. Joint and muscle rigidity reduce performance and raise the risk of musculoskeletal injuries. Maintaining proper flexibility is essential for maintaining balance, agility, and musculoskeletal health. To make the triceps surae muscles more extensible, all exercises should be preceded with stretching techniques (Kumar et al., 2018). Reduced flexibility of triceps surae muscle and Achilles tendon leads to decreased Ankle dorsiflexion range of motion. Several injuries of knee, foot and ankle are result of decreased ankle dorsiflexion which is secondary to triceps surae tightness. Conditions such as plantar fasciitis, Achilles tendinosis, and patellofemoral syndrome are linked to limited ankle dorsiflexion and more significantly due to tightness of triceps surae muscle (Russ and Olivencia, 2015).

Subjects under group A showed significant results, there was an increase in post-intervention Ankle dorsiflexion ROM ranges. There was an increase in muscle length and a decrease in muscular and connective tissue stiffness. Kato et al., 2010 concluded a result that static stretching increases muscle length, muscle viscoelasticity, and tendon length significantly (Kato et al., 2010). Whereas there was no significant increase in post-intervention ranges of Ankle plantarflexion. There was a significant increase in post-intervention ranges of WBLT. Static stretching itself enhances blood supply in joints and muscles, helping to warm them up, which improves functional performance during sports and activities of daily living (Medeiros et al., 2016; Bouvier et al., 2017).

Subjects in group B showed overall significant post-intervention results which show that the application of MET on a muscle or group of muscles significantly increases the flexibility of muscle. Moore et al., 2011 justified that a single application of MET results in increased post-treatment values right after treatment (Moore et al., 2011; Prasad Naik, 2015). There was an increase in Ankle plantarflexion along with Ankle dorsiflexion due to the property of active muscle involvement in MET i.e., involvement of agonist and antagonist's muscle at the same time during the application of MET. By stimulating descending neural pain inhibitory pathways and encouraging tissue fluid outflow for improved clearance of inflammatory neuropeptides, MET causes hypoalgesia via both central and peripheral processes (Fryer and Pearce, 2013).

On comparing group A (Static stretching) to group B (MET) it appears that there was a significant improvement in the range of motion (ROM) of the ankle joint, both in dorsiflexion and plantarflexion, as well as in the weight-bearing lunge test, for both the right and left sides, after the intervention. The mean values for the ROM of the ankle joint increased from baseline to after intervention, and this increase was statistically significant (p -value<0.000 for all measures), indicating that the intervention had a significant effect on improving the ROM of the ankle joint. suggest that the intervention was effective in improving the ROM and functional ability of the ankle joint. Kumar et al., 2018 stated that MET and Static stretching both tend to improve muscle flexibility, whereas MET shows more significant results as compared to static stretching (Kumar et al., 2018).

The results of group-A were less significant as compared to group B. But there is a variable change seen in post-intervention ROM values and WBLT values in both groups. This proves both techniques were beneficial in increasing muscle flexibility. But Muscle Energy Technique shows more significant results. Adhye, 2018 also concluded that MET has a greater effect than static stretching, suggesting that fewer repetitions of MET could have an equal or greater effect (Adhye, 2018; Vijayan, 2019; and Shadmehr et al., 2009). Compared to stretching exercises, patients treated with the muscle energy technique improved better in terms of reducing pain, increasing range of motion, and improving function (Ali et al., 2017; Majeed et al., n.d.). Thus, according to ROM values and WBLT values of group-B (MET) was more effective in increasing the flexibility of the Triceps Surae muscle with more significant values of post-intervention ROM value with $p=0.000$ and WBLT value with $p=0.000$.

Conclusion

This study evaluated the immediate effect of the Static Stretching and Muscle Energy Technique on the flexibility of the Triceps Surae muscle. Both techniques tend to reduce tightness and increase flexibility, whereas Muscle Energy Technique had the greater effect in increasing flexibility with significant results.

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A Study on Forward Head Posture Among Tailors

***Urvi Shahi * Ritika Aggarwal **Sonia Singh**

*MPT Student, **Assistant Professor Department of Physiotherapy, Punjabi University, Patiala, India
riti3116@gmail.com

Abstract

Background

Continuous activity in awkward posture, repetitive movement and unfavourable ergonomic working arrangements may contribute the tailors to musculoskeletal injuries and faulty posture. This may lead to certain disabilities like neck pain, muscular imbalance, restricted ROM and FHP. Therefore, this study was designed to understand the posture and its associated problems. **Methodology** An investigatory study was conducted from February 2022 to June 2022. 50 participants of age between 25 to 45 years, who worked as tailor with minimum 2 years of experience, were included for the study. Forward head posture (CV Angle) was measured by using Kinovea software whereas pain and disability was recorded by using NDI and Strength of cervical flexors, extensors and shoulder blade retractors were measured using Cable tensiometer. Furthermore, their results were recorded by visiting different tailor shops in Patiala. **Results** The FHP was found to be highly prevalent among Tailors (70%). 32 per cent of the tailors reported Neck pain and 42 per cent of the tailors had mild to moderate disability. In addition to this, the study indicates a significant relationship of the CV angle with Neck pain as well as working hour with cervical ROM (Flexion and Extension). **Conclusion:** The study concludes that poor work station ergonomics predispose the tailors to attain FHP which leads to neck pain, disability, reduced muscle strength and ROM. Thus, this study emphasizes that tailors must be encouraged and guided regarding workstation ergonomic and posture correction exercises.

Keywords: Forward Head Posture, Tailors, CVangle, Goniometer, Neck disability

Introduction

Forward Head Posture (FHP) is one of the most common postural changes seen among professions that involve long working hours with bended neck. Forward head posture is defined as the anterior positioning of the cervical spine (Worlikar and Shah, 2019) with respect to shoulders. It may include mechanical deformation of vertebrae and joints (Ha and Sung, 2020) and the muscle group that are involved in postural control. Forward head posture effect the length and power of connective tissue which leads to hyperextension of upper cervical whereas flexion of lower cervical spine (Naz *et al.*, 2018). Forward head posture is measured using Craniovertebral angle, an angle formed between C7 spinous process and tragus of ear. CV angle less than 50 degrees is considered as forward head posture.

Tailoring is one of an occupational group that may experience a high prevalence of work- related musculoskeletal injuries (Wang *et al.*, 2007). Among the various regions the neck region has been reported as the highest site for MSD's among tailors. This can be attributed to the unfavourable ergonomic working arrangements among tailors (Banerjee *et al.*, 2016).

Tedious, repetitive work specially in sitting position with upper back curved on sewing machine (Hassan *et al.*, 2017) predisposes tailors to the biomechanical stress on various structures in the cervical region. This can lead pains, weakness of muscles, and muscle stiffness in upper and lower back regions (Banerjee *et al.*, 2016). Multitask work like cutting, assembling, pressing and finishing that is performed in sitting working posture with neck bent forward and back curved over the sewing machine leads to development of the FHP among tailors

According to literature, the muscles that commonly become long and weakened due to FHP are deep cervical flexors (Longus capitis and longus colli- which results in chin poking), Erector spinae (Causing hunching forward of neck) and Shoulder blade retractors (which may contribute to hunched shoulders). On the other hand the muscles that become short and tightened are suboccipital muscles (Continually contracted to keep head tilted in upward position), Chest muscles and levator scapulae (Morrison, 2018). This weakening and shortening of neck muscles, reduces the strength and endurance capacity of the cervical spine (Dusunceli *et al.*, 2009) leading to pain and Disability.

With the increasing prevalence of FHP as occupational hazard among professions involving long working hours in constrained working posture it is important to understand its relation with its predisposing factors. Hence, the present study was designed to understand and evaluate the relationship of FHP with various factors like age, Working hour, Working experience, Neck pain and disability, Cervical ROM (Flexion and Extension), Cervical strength (Flexors and Extensors) as well as shoulder blade retractors among tailors.

Ethical Consideration

The Ethical approval to perform the study was taken from Institutional Ethical Committee of Punjabi University (16/35/IEC/PUP/2022), Patiala.

Procedure

The study was conducted on 50 tailors (male and female) between the age group of 25- 45 years, with minimum of 2 years of working experience. Participants with Congenital Deformity of neck and shoulder, any Surgery of neck and shoulder, suffering from cancer and pregnant female were excluded.

After explaining the aims and procedures of the study, a written consent was obtained from the participants. Demographic details, Working hour and Working Experience of the participants were recorded in the data collection form.

Forward head posture i.e CV angle was measured using Kinovea software. Two markers were placed on the ground separated by 1.5 m, where the smartphone (SM-M21) and the subject were located. Reference markers were placed on the spinous process of C7 and at the tragus of the subjects' ears, which were identified through palpation. The researcher took a picture with a smartphone from lateral side and the image was obtained. The image was then uploaded onto a HP laptop for analysis with the Kinovea software (Elwardant *et al.*, 2015).

Neck pain and disability: Neck Disability index was used to determine Neck pain and disability. It contains 10 questions including: pain intensity, personal work, lifting, studying, headache, concentration, working, driving, sleeping, and recreational activities (Wheeler *et al.*, 1999).

ROM: After that cervical range of motion (flexion and extension) was measured using Universal goniometer. To measure cervical flexion and extension range of motion, the subject was in sitting position with back well supported with chair, fulcrum of goniometer was placed over external auditory meatus and proximal arm perpendicular to ground where as distal arm was with the base of nares. Then subject was asked to move his neck in order to see his knees and ceiling respectively (Norkins).

Strength: cervical muscle strength for flexors and Extensors and Shoulder blade retractors was measured using cable tensiometer. The Subject was asked to sit on a chair with back straight. A head strap was secured tightly across the subject's head circumference. The subject was instructed about the movement they have to perform.

Cervical Flexor strength- A cable tensiometer from one end was held by therapist standing behind the subject whereas from other end hooked with the head strap. The subject was instructed to apply maximum isometric force in the forward direction while therapist held the cable tensiometer from behind.

Cervical Extensor cable tensiometer from one end was held by therapist facing the subject whereas other end hooked with the head strap. The subject was instructed to apply maximum isometric force in the backward direction while therapist held the cable tensiometer from front. The procedure was repeated 3 times and average was recorded.

Shoulder Blade Retractors: The subject was asked to sit on chair with back straight. Cable tensiometer from one end was held by therapist and other end was held tightly by the subject with shoulder in 90° of flexion and elbow straight. The subject was asked to exert a maximum pulling force on the cable tensiometer without flexing the elbow. The procedure was repeated 3 times and average was recorded.

Statistical Analysis: The data was analyzed using SPSS version 22. The demographic data like age, gender, working population, working hour, working experience and Neck Disability were calculated in the form of percentile. The coefficient of correlation was used to find relationship between forward head posture and factors like age, working hour, working experience, neck pain, neck disability, cervical range of motion (flexion and extension), cervical strength (flexors and extensors) and Strength of shoulder blade retractors. The criteria of statistical significance were set at $p \leq 0.05$

Results

Table.1: Distribution of Tailors according to Age

Age (years)	25 – 29	30 – 34	35 – 39	40 – 44	45 – 50
No. (%)	23 (46)	11 (22)	11 (22)	5 (10)	0 (0)

Table.2: Distribution of Tailors according to working hour and working experience

Working Hour						
Hours	5 - 7		8 - 10		11 – 13	14 - 16
No (%)	1 (2)		18 (36)		29 (58)	2 (4)
Working Experience (Years)						
Years	0-5	6-10	11-15	16-20	20-25	26-30
No (%)	10 (20%)	13 (26%)	16 (32%)	7 (14%)	2 (4%)	2 (4%)

Table.3: Prevalence of Tailors with FHP

CV =50-51 (Normal)	CV <50 (FHP)
15 (30%)	35 (70%)

Table.4: Percentage of Tailors with Disability and Pain

DISABILITY			
NPDI	NO	MILD	MODERATE
NO (%)	29 (58)	16(32)	5(10)
PAIN			
PAIN	Number of Tailors with Pain		Number of Tailors without Pain
%	16		34

Table.5: Relationship of Craniovertebral Angle (FHP) with Various Variables

FACTORS	r	P
Age	-0.1963	0.17
Working Hour	0.2753 *	0.05
Working Experience	-0.1463	0.31
Disability	-0.179	0.21
Neck Pain	-0.2745*	0.05
Cervical Flexion Rom	0.291 *	0.04
Cervical Extension Rom	0.4428 **	0.001
Cervical Flexors Strength	-0.1844	0.2005
Cervical Extensors Strength	-0.3541 *	0.012
Left Retractors Strength	-0.1623	0.261
Right Retractors Strength	-0.2325	0.105

*p≤0.05. The table shows significant inverse relationship with neck pain, cervical extensor strength and significant relationship of cervical flexion and extension range of motion.

Discussion

The study observed that 70% of the tailor participants had forward head posture. The changes could be attributed to their routine of long working hour with flexed or bended neck. As tailoring occupation requires a Static work attitude, like sitting and bending for long hours it predisposes them to the development of forward head posture (Sugianto *et al.*, 2020). A study done by Vakili *et al.*, (2016) found a high prevalence of 85.4% for FHP in academic dental staff who were expected to work with bended neck posture for long period of time.

In context to the neck pain and disability the observations of the present study indicated that 32% of the tailors had mild disability and 10% had moderate disability whereas, neck pain was reported by 32% of the tailors. In the same line Kazemi *et al.* (2018) reported prevalence of 49.7% for neck pain among tailors in Kermanshah, Iran. The neck pain and disability among the participants could be attributed to the disruption of function of the contractile and non-contractile structures which remains under constant forces during long working hours (Raoofi *et al.*, 2019)

The current analysis also investigated the relationship of forward head posture with Neck pain and disability. The observations, revealed a statistically significant inverse relationship between forward head posture and Neck pain indicating increased neck pain among the individuals having lower CV angle (FHP). The findings are in line with Raoofi *et al.* (2018) who also suggested an inverse relation between the degree of CV angle in sitting positions and the history of neck pain.

However, in context to the neck disability the findings of our study could not establish any significant relationship of forward head posture with neck disability. Similarly, Tanveer *et al.* (2018) also suggested an insignificant effect of neck disability on forward head posture.

In addition to this, aging results in progressive change in anatomical and physiological functions of the body which may lead to Disorders of musculoskeletal System, disability and a decreased quality of life. However, the study could not establish any relationship of Forward head posture with age in tailors. Similar findings have been reported by Rincon *et al.* (2009) who also suggested that there is no relationship between forward head posture and age in their study done on patients with carpal tunnel syndrome patients.

Moreover, the present study has established a relationship of forward head posture with hours and years of working. The findings indicated that there was statistically significant relationship between forward head posture and hours of working. However, there was no relationship found between forward head posture and years of working, which suggests that prolong working hour are the major contributor towards the forward head posture. We found 58% tailors work more than 13 hours a day where as 36% more than 8 hours.

Further, Cervical flexion ($r=0.291$) and extension ($r= 0.442$) range of motion were statistically significantly related to CVA. The observations could be related to the alteration in biomechanics related to the forward head posture. The forward head posture leads to the altered forces on the facet joints predisposing them to malalignment and hypomobility. This possibly explains the reduced cervical range of motion in flexion and extension range observed among participants with forward head posture in the current study. The finding is in accordance with the study done by Rincon et al., (2009) which revealed a low to moderate correlation between forward head posture and cervical range of motion for all directions in carpal tunnel syndrome patients. The author suggested that the forward head posture may lead to compression on the facet joints thereby affecting the biomechanics of head/neck, thus leading to decrease in cervical range of motion.

An inverse relationship between cervical extensors strength and Craniovertebral angle, whereas, no significant relationship was observed between cervical flexors and Craniovertebral angle. The significant positive relationship of forward head posture with the cervical extensors strength in the current study could be best explained by the postural changes in forward head posture which causes the increased activity and tightening of the cervical extensors group of muscles. Study done by Rayner and Smale (2016) indicated a high muscle activity of the neck extensor muscle in population with FHP, which works in tandem with the deep neck flexors to give posterior support for cervical lordosis and to avoid a forward head position.

In addition to the cervical muscles, the present study also investigated the relationship of FHP with shoulder blade retractors. According to basic literature of forward head posture, shoulder blade retractors become long and weakened (Morrison) with the FHP. A study by Mamania and Anap, (2018) discussed that reduced muscle activity of upper and middle trapezius, splenii and sternocleidomastoid, as well as head-on-trunk misalignment reduces muscle activity and causes alteration in force generating capacity and length-tension relationship leading to alteration of posture. However, our study could not establish any statistically significant relationship between Craniovertebral angle and shoulder blade muscles.

Conclusion

The study concluded that the tailors tend to attain faulty posture (FHP) because of their long working hour. They were not much aware about the changes taking place in their neck due to improper working environment, poor postural habits and long working hours which is predisposing them to neck pain, reduced mobility of neck and altered muscle strength and neck disability. These changes if persist for extended period may affect their physical as well as financial conditions. The current study emphasizes the importance to create awareness on the correct posture and consequence of forward head posture among tailors. It might be argued that good postural practice can help in preventing neck pain and disability. Also, posture correction exercises in Tailors must be encouraged.

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Non-Pharmacological Approaches in Intensive Care Unit for Pain: A Narrative Review

***Parul Sood, **Supreet Bindra**

*Research Scholar **Assistant Professor, Department of Physiotherapy, Sri Guru Granth Sahib World University, Fatehgarh Sahib

parulsood.sood@gmail.com

Abstract

Critically ill patients experience pain as a result of the accompanying disease process or the treatment procedures. Pharmacological interventions such as analgesics and opioids were routinely administered to manage their pain. It was intriguing that the consumption of opioids in an intensive care unit and the memory of a painful experience were associated with the development of post-traumatic stress disorder after ICU discharge. Therefore, it is beneficial to combine non-pharmacological interventions with opioids in order to reduce adverse effects and sustain analgesia. The side effects of pharmacological treatment would have a negative effect on the care and recovery of critically ill patients. This narrative review provides evidence on non-pharmacological interventions that can be used to prevent and reduce the intensity of pain in ICU-admitted critically ill patients.

Key Words: Pain, Critical illness, non-pharmacological interventions

Introduction

Pain is a common symptom of patients in the intensive care unit (ICU) (Dehghani et al., 2019), it is an unpleasant emotional and sensory experience caused by tissue damage. The majority of intensive care unit (ICU) patients continue to report persistent pain (Reardon et al., 2015). Between 45 and 82% of critically ill patients experience pain at varying intensities due to the stress response, physiological changes, and hemodynamic instability caused by elevated catecholamines and hormone secretion (Dehghani et al., 2019). Patients who are critically ill may also experience pain during rest and treatment procedures. In critically ill patients, untreated pain can affect treatment outcomes as well as the stability of hemodynamic parameters, hypercatabolism, hyperglycemia, infection, delirium, and post-traumatic stress. In critically ill patients, untreated pain can also cause anxiety and sleep disturbances (Practice et al., 2018). Critical care nurses must comprehend pain and pain management. Although there is an abundance of evidence regarding efforts to reduce pain complaints and their long-term consequences, there has been little progress in pain management over the past two decades. Optimal pain management in critically ill patients requires knowledge of pain physiology and pain aetiology assessment tools for all critically ill patients, as well as pharmacological and non-pharmacological pain treatment strategies (Reardon et al., 2015). In critically ill patients, pain management focuses on efforts to alleviate pain and provide comfort. Pain management with pharmacological therapy in critically ill patients and adults needs to be sparingly utilized. To effectively manage pain in critically ill patients, it is necessary to combine it with non-pharmacological therapies (Reardon et al., 2015) (Urden et al., 2016). Non-pharmacological therapy is an intervention that does not involve drugs and is a general nursing intervention. Non-pharmacological therapy administered by nurses aims to complement pharmacological therapy and can serve as an alternative treatment for disease symptoms, including pain complaints, in critically ill patients. Non-pharmacological therapy administered to critically ill patients can increase tolerance to disease- and procedure-related pain, reduce physical stress and physical weakness, and reduce the need for analgesic drugs (Khalil et al., 2018). Literature demonstrates unequivocally that non-pharmacological therapy is a pain-relieving intervention that can be administered to critically ill patients. For critically ill patients, it is recommended that nurses administer non-pharmaceutical treatment. This review aimed to determine which non-pharmacological treatments can be administered to critically ill patients. The review's findings can be utilised by nurses to determine the most appropriate non-pharmacological therapy for the treatment of acutely ill patients.

Methods

We conducted a narrative review on non-pharmacological approaches in Intensive care unit for pain because it is most useful for obtaining a broad perspective on that topic and because at present, there is limited evidence for the use of non-pharmacological interventions in addressing the issue of pain in ICU patients. Databases such as PubMed, Cochrane, Pedro were searched and relevant papers were searched using key terms: intensive care, acute pain, procedural pain, pain assessment in ICU, pain management in ICU, non-pharmacological interventions and were analysed.

Results

Table 1 Presents the overview of studies conducted in Iran, USA, Turkey, Egypt, Canada, Switzerland. The age range of study participants varied from 18 years to 65 years in the and included critically ill patients.

Table.1: Overview of the included studies by country of origin, study population and design and effects and usefulness of non-pharmacological interventions in ICUs

Author / yr	Country	Study design	Study population	Intervention	Findings	Outcome
Amidei et al. 2013	USA	Quasi-experimental within-subjects repeated measures design	30 MV ICU patients. Mean age 56.6 (SD=16.9) 60% males	Passive exercise program with 20 flexions and extensions	Passive exercise is feasible and reduces pain intensity	BPS
Aktas and Karabulut (2015) [17]	Turkey	Randomized, single-blind, experimental study.	Age 18 years, (ii) intubated and required endotracheal suction, (iii) level of consciousness 2 or 3 (using Ramsay Sedation Scale	The intervention group received music therapy for 20 min pre- and post-suction.	Critical Care Pain Observation Tool (CPOT) to assess pain, Ramsay Sedation Scale to determine the level of consciousness and form of physiological. Parameters' to assess the psychological status of participant	
Berning et al. 2016	USA	Quasi-experimental Design	50 ICU MV patients. Mean age 59 (SD=16) 56% male Mean 19.5 MV days (range 7-29)	Spiritual care assessment cards	Spiritual pain can be assessed with chaplain-led interventions. No significant change in physical Pain	VAS
Chiasson et al. 2013	USA	Case control study with pre and post assessment	100 ICU patients (50 intervention, 50 in control)	Harp music	Live harp music can be used to reduce pain in ICU patients.	VAS
Feeney et al. 2017	USA	Prospective feasibility study Cohort study	100 ICU patients (50 intervention, 50 in control)	Acupuncture		NRS/ VAS
Gelinas et al. 2012	Canada	A qualitative descriptive design	52 patients with median age 62 (range 20-89), 37% males	Review of interventions	The four most useful, feasible and relevant therapies were music therapy, distraction, simple massage and family presence facilitation.	
Golino et al. 2019	USA	Pre-test/post-test, within-subject, single-group design	52 patients with median age 62 (range 20-89), 37% males	Music therapy and relaxation	Relaxation makes more fall asleep. Music therapy reduces pain more	NRS
Jacq et al. 2018	France	Not randomised controlled stud	60 MV ICU patients. Intervention n=30, 37% males median age 78. Control n=30, 67% males, median age 65.	Music	Music reduces pain intensity and lowers time spent in pain during a nociceptive procedure.	BPS
Khalil et al. 2017	Egypt	Experimental study	50 ICU intervention age 56, SD=2.1, 62% males and 50 ICU controls (age 54, SD=2.1, 54% males	Ice Pack	Ice pack is feasible and able to reduce pain during venous puncture	VAS
Saadatmand et al. 2014	Iran	Randomized controlled clinical trial	(i) Adult mechanically ventilated patients in the ICU, (ii) age > 17 years, (iii) mechanical ventilation $\pm$ 48 h, (iv) conscious enough to participate, (v) GCS $\pm$ nine and able to communicate, (vi) stable hemodynamic status, (vii) can hear, understand, and respond quickly	In the afternoon, the intervention group received natural sounds therapy using foam-coated headphones to minimize noise and environmental stimuli and received standard care in the ICU	Listening to music reduces pain after 30 minutes and it declines further over 90 minutes. The pain increases after discontinuation of the intervention.	VAS
Patterson et al 1992	USA	Cohort study with pre and post treatment	30 burn ICU pain $\geq$ 5 (age 34.1, SD=9.1) 10 hypnosis, 10 attention/information, 10 controls	Hypnosis Attention and information control	Hypnosis reduced pain more successfully than attention and information and a control condition.	VAS
Berger et al 2010	Switzerl and	Case control experimental design	23 ICU patients with burn injury (compared to 23 from the medical records) Mean age 36 (SD=13) 61% males	Hypnosis	Hypnosis can address pain successfully.	VAS ESAS

BPS=Behaviour Pain Scale, ESAS= Edmonton Symptom Assessment System, NRS=Numeric Rating Scale, VAS=Visual Analogue Scale

Discussion

Massage Therapy

Massage therapy was a non-pharmaceutical treatment that can alleviate the pain experienced by critically ill patients. Boitor et al conducted a study in which they discovered that after cardiac surgery, massage with moderate pressure over the hands for approximately 20 minutes in a quiet, undisturbed environment can reduce pain intensity and mean pain. In addition, it was discovered that the patient appeared to experience a reduction in muscle tension after receiving pharmacological treatment to alleviate complaints and unpleasant symptoms in ICU patients following cardiac surgery. Another study by Ghezeljeh et al.⁷ founded that massage therapy can reduce the intensity of pain. The intervention was also be combined with music therapy to alleviate burn-related pain in critically ill patients. Massage therapy is a systematic, technique-specific intervention that results in the stimulation of sensory receptors in the skin, muscles, bones, and joints (Pados and McGlothen-bell, 2019). Massage therapy is a viable treatment option, particularly for palliative patients (Dehghan et al., 2018). In addition to reducing the intensity of pain, abdominal massage therapy can increase the volume of gastric residue and prevent abdominal distension (Dehghan et al., 2018) in patients with ventilator-associated pneumonia. Traditional massage therapy can increase oxygen absorption by touching the body and manipulating soft tissues, as well as calming the mind, providing comfort, and aiding in the healing of disease. Similarly, research by Papathanassoglou et al. Papathanassoglou et al., 2018 found that massage therapy combined with reflexology, music, and guided imagery therapy can alleviate pain in critically ill patients.

Acupuncture

Berger et al., 2010; Feeney et al., 2017; Patterson et al., 1992 concluded that acupuncture and hypnosis were found to be the non-pharmacological interventions able to reduce pain intensity in ICU patients most efficient. A 2.56-point reduction in pain intensity, as measured by a 0-10-point VAS, was found among general ICU patients from pre-treatment at baseline to the last post-treatment with acupuncture. According to Lewin (1974), "two therapeutic modes of acupuncture are used in practise today: (1) acupuncture used for the treatment of numerous diseases, and (2) acupuncture employed as an anaesthetic procedure (a more accurate term would be surgical analgesia)." Acupuncture can be used to treat a variety of ailments, with studies indicating that it is effective for allergies, anxiety and depression, chronic back, neck, or shoulder pain, hypertension, insomnia, migraines, morning sickness, strokes, and menstrual cramps. In addition, research indicates that it may also be beneficial for cancer and multiple sclerosis patients (Feeney et al., 2017). Acupuncture can assist with relaxation and pain management in addition to treating a variety of conditions. As an analgesic effect, acupuncture can be beneficial for patients who experience pain.

Cold therapy

Patients undergoing cardiac bypass surgery to remove a chest tube reported significantly less pain after receiving cold therapy ($p < 0.0001$). The combination of cold therapy and music therapy has been shown to be highly effective in reducing pain. As a result of its ability to reduce nerve excitability, cellular metabolism, tissue hypoxia, and oedema, cold therapy has been established as a useful intervention for managing pain. The effects of cold therapy have been studied before with conflicting findings (Huether et al., 2019; Solehati et al., 2018) Bayindir et al. also found that patients undergoing percutaneous coronary intervention who received cold therapy in the form of an ice bag application to the femoral area experienced significantly less pain during catheter removal ($p < 0.001$). Among non-pharmaceutical therapies, ice bag application has been shown to have a variety of effects on lowering pain intensity (Kirskey et al., 2015). This is because it can help increase the impact of pharmacological treatment by raising the pain threshold and slowing the conduction velocity of small nerves.

Topical Heat therapy

A study conducted by Mohammad pour et al. who showed that topical heat therapy effectively prevented and relieved chest pain in patients with the acute coronary syndrome (ACS). Topical heat therapy was given 2 h after the patient entered the cardiac care unit with a 75oC heat pack wrapped in a towel and placed directly on the patient's chest. There is a change in hemodynamic status in ACS patients, so local heat therapy is more recommended than non-pharmacological therapy for pain management in ACS patients. Topical heat therapy can be used as a non-invasive therapy because it can help relieve chest pain, improve vascular endothelial function, facilitate the process of angiogenesis, and promote recovery and rehabilitation.

Music Therapy

According to research by Hsu et al, 2015, music therapy can effectively reduce pain in burn patients treated in the ICU ($p = 0.02$), and there was a significant difference between patients who received music intervention on the first day of care and those who received it on the fourth day. However, there was no significant difference between these patients and those who received standard ICU care. A study conducted by Ghezeljeh et al. 2017, found that there was a statistically significant difference between the treatment group and the control group without music therapy in terms of the average score of changes in pain intensity during each session ($p < 0.001$). The use of music therapy on

patients with burns will relax the patient, thereby reducing sympathetic nerve activity and releasing endorphins, thereby reducing the intensity of pain in burn patients who are in critical condition. Liu and Petrini in 2015, conducted research on the effectiveness of music therapy on pain in post-thoracic surgery patients. They found that music therapy was effective in reducing pain scores and anxiety in post-thoracic surgery patients. According to Aktas and Karabulut's research, music therapy is effective at reducing pain scores significantly during endotracheal suctioning procedures in mechanically ventilated critically ill patients ($p < 0.001$). A similar study by Sajad Yarahmadi et al demonstrated that chest tube removal-induced pain can be alleviated by administering music therapy to patients. Nonetheless, music therapy was combined with cold therapy in this study ($p < 0.001$).

The researchers Papathanassoglou et al. also conducted a music therapy intervention designed to reduce the intensity of pain in critically ill patients. The statistical tests ($p < 0.001$) demonstrated that music therapy can alleviate pain in critically ill patients. Similarly, Saadatmand et al.²⁰ discovered that music therapy with natural sound listening techniques can reduce the pain intensity of critically ill patients who are connected to mechanical ventilators ($p < 0.05$). However, the intervention performed by listening to natural sound is distinct from other music therapies, such as those involving the sound of a musical instrument or a professional singer's voice. It turns out that natural sound is more aesthetically pleasing, calms the patient, and can be used as a distraction. The natural sound music therapy intervention is designed as a safe, easy, and straightforward method to help patients alleviate pain and anxiety.

Conclusion

Pain issues in critically ill patients can increase the use of analgesics and opioids in the intensive care unit (ICU) treatment process. Non-pharmacological therapy is required as an alternative therapy to reduce pain in critically ill patients brought on by the disease process and invasive and non-invasive procedures performed to aid in the healing process. Several non-pharmacological methods, such as music therapy, massage, reflexology, acupuncture, passive range of motion exercises, cold, and topical heat therapy, were identified in the review as potential options or alternative therapies for preventing and reducing the intensity of pain in critically ill patients. Effectively used to treat pain complaints, music therapy is an additional option for critically ill patients. The results of the review did not identify any harmful side effects of music therapy for critically ill patients. Similarly, massage therapy, reflexology, cold therapy, and topical heat therapy can be regarded as options or adjunct therapies for the management of pain in critically ill patients. To determine the most effective non-pharmacological intervention for preventing and treating pain in critically ill patients, additional research is required.

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Utilization of Outcome Measures by Physiotherapist for Low Back Pain

***Richa **Pankajpreet Singh **Dr. Supreet Bindra**

*Research Scholar, **Assistant Professor Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab
dr.richa.physio@gmail.com

Abstract

Background: Rehabilitation of patients with low back pain forms an important part of physiotherapy practice, then also rehabilitation outcomes often are poorly quantified. This study examined the use of outcome measures for low back pain by Indian Physiotherapists. **Methods:** A survey questionnaire was sent via social media like WhatsApp, Facebook, and email to all physiotherapists via google forms working either in private practice, government organizations, Physiotherapy colleges, free lancing. Link was accessed 125 times and 71 fully filled responses were analyzed. **Results:** The mail survey achieved a 56.8% response rate and showed that 52.9% physiotherapists used outcome measures. Improvement in person-specific functional activities is the preferred outcome measure used by physiotherapist. **Conclusion:** Half of the study sample of practitioners used outcome measures in their clinical practice. Therapists who were having a post graduate degree or more experience, were using more outcome measures than those who were having graduation degree or less experience. Further research is needed on how to convey to practitioners that the information they provide can be useful and can improve patient outcomes.

Key words: Low Back Pain, Outcome Measures, Physiotherapist

Abbreviations: LBP-Low Back Pain, PT- Physiotherapist

Introduction

Outcome measures are the tools for assessing and measuring the outcomes of health care services that are provided over time. For physiotherapists, the important outcomes include the improvement in patient impairments and disabilities, activity restrictions, participation limitations, and quality of life (APA, 2003) as assessed by patient self-report tools. For more than 20 years, outcome measures for low back pain (LBP) are used in research settings to evaluate the effectiveness of treatment techniques (Beattie et al., 2001; Schaefele, 2003).

Various studies throughout the western world (Canada, Scotland, England, New Zealand, United States of America, and Australia) (Cooperland, 2008) indicated that their use by physiotherapist in routine practice is limited. Moreover, there is increasing pressure on physiotherapist to use evidence- based practice and to clearly document the improvements in a person's health status.

Except from these burdens, there has been a gradual variation in health outcome philosophies that could have an impact on physiotherapy treatment or intervention and the choice of outcomes measured. The *International Classification of Functioning, Disability and Health* (ICF) (WHO, 2006) is a body that facilitates a more holistic approach of patient care, with the emphasis on enabling patients to mingle in society, in variation to the previous focus on pathology and impairments. For physiotherapists, this means a step away from focusing on pain and strength, toward a larger emphasis on the person's goal.

Low back pain is an increasing problem, especially in India, and a significant health care cost is incurred by the patients. In Indian health environment, subjects with LBP can sometimes directly access a physiotherapist without any referral, physiotherapist sometime have to deal with more acute problems but, the effectiveness of physiotherapy interventions for LBP is more often questioned due to less use of evidence-based measures. physiotherapist spend less time in reading clinical research and predominantly use techniques required during their entry level training a study done on Indian for the therapy practitioner revealed that 43% use their past experience to decide treatment strategy (Turner and Whiltfield, 1999). With a rise in medical tourism, changing health care delivery system and autonomy in decision-making it is important for therapist to include evidence-based practice.

Previously done research on the usage of outcome measures by physiotherapists was an important factor in the design of this study. A Study done in Canada (Cole et al.,1994) on physiotherapists, use of outcome measures during treatment was the first physiotherapy-based research in this domain. They stated that lack of knowledge, time constraints, and the perception that outcome measures is not meeting the needs of their patients were the main reasons for the failure by physiotherapists to use outcome measures in their treatment regime (Kay, T., 2001) following this research by Cole and colleagues, a resource book titled *Physical Rehabilitation Outcome Measures* was published; but, follow-up surveys after 6 years still identified a very low level of usage of outcome measures (Huijbregts et al., 2002). After that an Australian study was particularly relevant to this research, as Victoria, Australia has a state-run accident insurance scheme, the Transport Accident Commission (TAC), this research showed an increase in use of outcome measures, from 30% in the survey done in March to 66% in the September survey (Abrams et al., 2006).

A study done by Copeland and Taylor in New Zealand with a response rate of 65% showed that only 40% respondents were using outcome measures related to back. They concluded that subjects having master’s degree are more commonly using measures to assess outcomes.

This present study is focused to evaluate the beliefs and attitudes of Indian Physiotherapists relative to their use of outcome measures, specifically their use of 3 commonly used outcome measures: the Oswestry Low Back Pain Disability Index (OLBPDI) (Fairbanks et al, 1980) the Roland-Morris Disability Questionnaire (RMDQ) (Roland and Morris, 1983) and the Quebec Back Pain Disability Scale (QBPDS) (Kopac et al., 1995). A secondary aim was to find out whether the level of exposure to outcome measures that Indian physiotherapists have experienced over the past decade has in any way influenced their use of outcome measures, given changes that have occurred Bachelor’s, Master’s and Doctoral and changes in health outcome philosophy, in particular the ICF framework model, with its emphasis on activity and participation.

Methods

The present study was a cross-sectional study using qualitative and quantitative methods used for data collection. All of the participants included were physiotherapists working in India, and the research was limited to those physiotherapists treating patients with Low Back Pain. The mail survey, consent was presumed if the survey questionnaire was returned back. The study participants included physiotherapists working in public hospitals, private hospitals, free lancers, having own clinic, teaching in colleges or universities. Questions were included on whether physiotherapists are using outcome measures, the methods physiotherapists are currently using to measure outcomes and their level of satisfaction with the usage of these methods. Barriers to the use of outcome measures identified in the participants were incorporated into a 23-item questionnaire scored using 5-point Likert scales. Space was left following some questions for free-text comments so that the respondents’ can freely give attitudes regarding the use of outcome measures fully captured.

The survey questionnaire was sent to the physiotherapists through e-mails, whats app and other social media platforms via Google Forms. Data collection stopped 4 weeks after the final mailing. The information considered to be most relevant to the research question was whether physical therapists were using any of the standard LBP-related outcome measures.

Results

Of the 71 participants (47 female, 24 male) 45 were 20 to 29 years of age, 19 were 30 to 39 years of age and 6 were 40 to 49 years of age. Thirty-seven of the participants had completed master’s degree programme, 29 of the participants had completed bachelor’s degree program for their undergraduate training, and 5 of the participants were having a degree of doctor of philosophy.

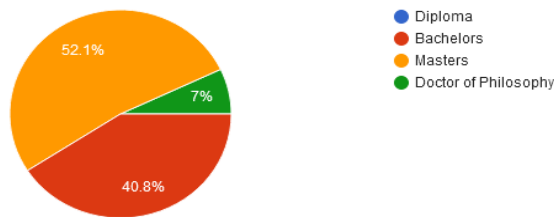


Fig:1. Education level of participant

84.3% felt that the use of clinical outcome measure was encouraged in their service area, however 15.7% felt that use of clinical outcome measure was not encouraged in their practice setting. 36 (52.9%) out of the 71 participants accepted that they often used outcome measures for low back pain and 43 (47.1%) said no or not sure, about the usage of outcome measure for low back pain. This showed a very less difference in those using outcome measures to those not using outcome measures.

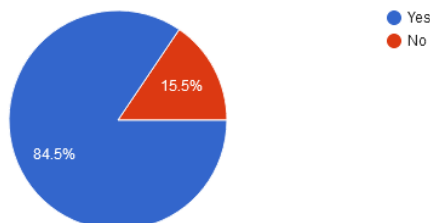


Fig:2. Use of outcome measures at therapist setting

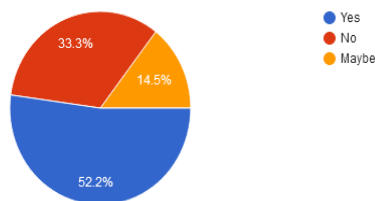


Fig.3. How often you use outcome measures for LBP

Out of these 36 who used outcome measures often, 28 participants used VAS as the outcome measure for Low back pain; 5 used Oswestry low back pain questionnaire; 3 used Ronald Morris disability questionnaire. Only 3 participants mentioned the usage of both Oswestry and Ronald Morris questionnaire. None of the therapist mentioned about the usage of Quebec back pain disability scale. When asked about individual outcome measure at different time of assessment, most of the participants feel that they rarely used Quebec back pain disability scale and Roland Morris disability questionnaire. However, Oswestry low back pain disability and VAS were the most commonly used measures in chronic LBP.

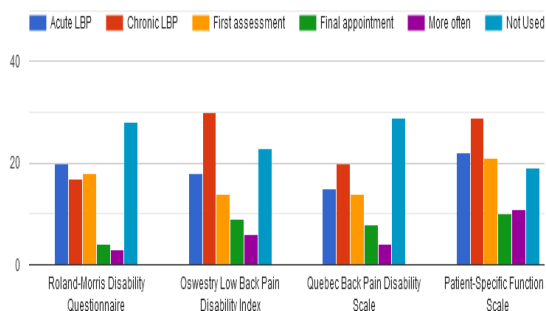


Fig.4: Use of different outcome measure at different assessment level

47.1% who were not sure or not used any outcome measures for LBP, confronted that time was the main barrier. Moreover, lack of knowledge was also a major issue, as most of them were having only bachelor's degree. Some therapist also felt that individual patient has individual set of outcomes so it was irrelevant to use outcome measures. Some therapists were not even aware about the correct spelling of outcome measures.

Discussion

The results showed that the usage of outcome measures by the physiotherapists for treating low back pain patients is less. There may be an association between having a post graduate or higher degree and knowledge of outcome measures. For a post graduate degree in physiotherapy or a doctor of philosophy degree in physiotherapy, a research project usually is undertaken, and if this involves any clinical area or domain, it is likely that outcome measures are supposed to be used to evaluate outcomes. This may result in a higher familiarity with outcome measures so that it becomes quite easy for the physiotherapist to integrate them into routine clinical practice. However, having a master's degree contributed an additional association with use of outcome measures, over and above knowledge, indicating that familiarity with the study process by itself was a factor that may explain the use of outcome measures (Cooperland et al., 2008).

Although an increased level of expertise or knowledge was an important factor determining the use of outcome measures, the survey confirmed that there was still a lack of knowledge and understanding of outcome measures used for low back pain. This is illustrated by some free-text responses in the mail survey:
 I don't know them or how to administer them.

Some physiotherapists think that by using the outcome measures, the assessment might be changed as some patients might not be able to understand the questionnaire and may interpret it wrongly or give wrong responses that might change the final diagnosis and thus the treatment. It could be that these concerns relate more to the individual physiotherapist's level of understanding and knowledge of outcome measures, thereby resulting in a misunderstanding of what outcome measures demonstrate.

The ability to interpret the results from outcome measures could be the reason of the knowledge variable that differentiates physiotherapists who really understand how to use them effectively and, therefore, to incorporate or include them in their practice from those who do not.

The other parameter that was widely discussed was usage of time. Time, as the reason for the failure to use outcome measures, has been identified in previous researches (Cooperland et al., 2008) and was frequently given by

the participants of the study as the reason for the failure to use outcome measures. If they are going to spend an additional time in getting questionnaire filled, then financial loss will be incurred by the therapist only as they have to attend the patients waiting also. This is mainly in private practice and private clinics or hospitals where the more clients you attend, the more money you are going to generate. They felt pressured to see as many patients as possible and did not want to engage in any activity that may have an impact on treatment time and thereby any financial loss or burden.

There is no inclusion of Physiotherapy services in insurance policies that are provided to the individuals in their health insurances by the companies in India. Had there been an insurance cover to the clients for their physiotherapy services, the documentation or paper work would have been stronger that would have included the usage of the outcome measures. Because the insurance companies are not covering physiotherapy services in health insurances, the pressure on the physiotherapists is not there to include paperwork. Their main aim is to treat the patient coming to them and makes him fine. An Australian study showed that the main factor influencing the routine use of outcome measures was a funding body's requirement for the mandatory reporting of outcome measures (Abrams et al., 2006).

Conclusion

The present study showed that the routine use of outcome measures for the treatment of Low Back Pain among Indian Physiotherapists is still low, despite more than a decade of exposure promoting reasons for their use. Although more than 50% of the participants indicated they had used LBP related outcome measures in the past 6 months, it is likely that the routine level of use is far low, and 47.1% pointed that they did not use any outcome measures for treating low back pain. It is identified that a lack of knowledge, understanding of outcome measures and a lack of time, respectively, as the reasons for failing to use them regularly. This result presents a huge challenge to the physiotherapy profession, which needs to inform to physiotherapists, how information obtained from outcome measures can be useful to them and can support improved outcomes for their patients. The physiotherapy profession does not require the diagnosis and treatment being prepared by other health care professionals and physiotherapists work left is to treat on their terms and directions. The profession is likely to have an important component of its practice like proper methodology to assess treatment outcome which is dictated by external sources.

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Different Measurement Instruments Used in Neck Muscles Isometric Strength Assessment: A Literature Review

***Daman Preet Singh **Pankajpreet Singh**

* Ph.D. Scholar, ** Assistant Professor, Physiotherapy, Sri Guru Granth Sahib World University, Fatehgarh Sahib
dpsingh.gmch@gmail.com

Abstract

Background: The importance of strengthening the neck musculature to reduce the risk of injury and alleviate neck pain has been well documented. Assessment of an improved neck muscles isometric strength is critical to an improved neck muscle function in both static and dynamic situations. Many measurement instruments (MI) for quantifying the neck muscles isometric strength (NMIS) are available. **Aim of the study:** To review the usage of different measurement instruments, their methodology, and protocols of assessment along with reliability and validity for quantification of the neck muscles isometric strength to find their practical applicability in its diagnostic or therapeutic use during the patient rehabilitation. **Methodology:** Literature review was done by searching online data base in Google Scholar followed by inclusion of 19 studies like a systematic review, meta-analysis, descriptive studies, literature review, cross-sectional, correlational analytical studies. **Conclusion:** There is no single, universally accepted method of neck muscles isometric strength measurement instruments. Isokinetic dynamometers, FFD, HHD amongst others offer reasonable solutions for testing the NMIS but with a limitation of normative data varying from one MI to the other. There is a need for the development of a novel NMIS measurement instrument considering its validity, applicability, feasibility, cost, and usefulness to aid in the adherence of established protocols enhancing inter-tester and intra-tester reliability thereby quantifying the neck muscle strength at all levels of rehabilitation.

Key words: Measurement instruments, Isometric neck muscle strength, Neck range of motion, Dynamometers, Isokinetic exerciser, Reliability and validity, randomized controlled trials, Reviews, Observational studies.

Introduction

Neck pain or cervicgia and altered cervical curvature is something which is being reported on a very frequent basis than ever before. According to the available statistics two-third of the population will have neck pain sometime in their lives. The common symptoms of localized or radicular pain are tenderness, muscle spasm, associated with functional disability. Neck pain may arise due to bad posture, muscular tightness in both the neck and upper back, and pinching of the nerves emanating from the cervical vertebrae (Ali et al., 2014).

The importance of strengthening the neck musculature to reduce the risk of injury and alleviate neck pain has been well documented (Berg et al., 1994). Neck exercises are commonly recommended to improve neck muscle function and thereby decrease pain or other symptoms associated with the neck in all patients be it a sports person, working professionals, an elderly, or a child. Evaluation of the neck muscle function like joint range of motion, muscle strength and endurance, etc., are critical to the complete assessment, diagnosis, treatment planning and successful rehabilitation of such patients. A general increase in the neck muscle strength with exercises increases the muscle static forces as well. Therefore, assessment of an improved neck muscles isometric strength is critical to an improved neck muscle function in dynamic situations. This may require measurement instruments/ devices that can be easily accessible, administered and meet certain standards for clinimetric properties (de Koning et al., 2018).

However, it is seen that in a routine clinical practice such exercises like neck isometrics are being prescribed with a subjective idea of resistance application with hands rather than as a percentage of actual quantification and subsequent noting of progression of the muscle strength during the follow-up period. This could be because of the lack of equipment available to quantify cervical flexion and extension strength safely and accurately (Jordan et al., 1999; Leggett et al., 1991). The study is therefore, aimed at to review the usage of different measurement instruments, their methodology, and protocols of assessment along with reliability and validity for quantification of the neck muscles isometric strength to find their practical applicability in its diagnostic or therapeutic use during the patient rehabilitation. The study will improve our understanding on the advantages and disadvantages of the existing such instruments and their viability in research and routine clinical practice.

Methodology

The empirical evidence published in English, open access, relevant to the literature review in this study was searched for its online data base in Google Scholar. Key words of, Measurement instruments, Isometric neck muscle strength, Neck range of motion, Dynamometers, Isokinetic exerciser, Reliability, validity, randomised controlled trials, Reviews, Observational studies, were used with a total of 878 displayed results. All were taken for screening by the authors independently in line with the purpose of the study. 19 studies were included in the final literature review which included both full length articles and abstracts. Systematic review, meta-analysis, descriptive studies,

literature review, cross-sectional, correlational analytical studies formed a part of this literature review. Data were extracted as follows: (1) Author, Year, study type, (2) Measuring Instrument or methodology used, (3) Objectives, Neck Muscles tested, (4) Results including Flexor-extensor ratio/ Reliability-reproducibility, (5) Conclusion

RESULTS

Table. 1: Data Extraction from the short-listed studies in the literature review

S.No .	Author/ Year/ study Type	Measuring Instrument or methodology used	Objectives, Neck Muscles tested	Results (Muscles strength, Flexor-extensor ratio/ Reliability-reproducibility)	Conclusion
1.	Vernon et al. (1992), Analytic survey.	Modified sphygmomanometer dynamometer (MSD).	Determine test-retest reliability, normative data, and clinical validity of isometric muscle strength	Pressure levels measured in kilopascals(kPa); flexion:3300, extension:5800, rotation:5200 and lateral flexion: 6200. Ratio of 0.57:1. High test-retest correlation coefficient for all ROM (.79-.97)	Reliable instrument for NMIS evaluation in normal and symptomatic subjects.
2.	Bussieres (1994), Literature review	Strain gauge dynamometers and modified sphygmomanometers	To assess the reliability, validity, and usefulness of outcome measures: cervical ROM, sagittal neck muscle strength measurement	Extensor muscles of the neck are approx40% stronger than the neck flexor muscles. Peak extension to flexion isometric force ratio range 0.58 - 0.71in normal subjects.	The cervical ROM device appeared to be well suited for clinical practice.
3.	Jordan et al. (1999), descriptive study (N=100 men and women)	Strain-gauge technology on a neck muscle training apparatus	Maximal isometric strength of the flexors and extensors.	Maximal isometric strength was approximately 20% to 25% higher in males than females in flexion-extension from the 3 rd to 6 th decades. In 7 th decade, the women's strength levels surpassed that of men in flexion and extension Flexion-extension ratios were 0.59 in both men and women Provides a convergent validity.	Men projected a decrease in maximal isometric strength with increasing age in both flexion and extension. Women maintained strength in the ages tested. Examiner strength may influence results may depend from position-position.
4.	Vasavada et al. (2001), Experimental design (16 men and women)	Hand Held Dynamometer (HHD)	Measured 3D-moments during maximum voluntary contractions of neck muscles	Extension (in Nm): (men:52±11; women:21±12); Flexion:(men:30±5; women:15±4); lateral bending (men:36±8; women:16±8); and axial rotation (men15±4; women,6±3)	3D-moments quantified about size and location along the cervical spine are important for biomechanical analysis of neck strength.
5.	Garces et al. (2002), Cross-sectional (N=94 healthy Men/ Women)	Kin-Com computerized dynamometer	Measured neck extensors and flexors at 0°,5°,10°.	30% - 40% more in men than women Ratio is 0.6	Intra-test and inter-test reproducibility are greater than shown by other dynamometers
6.	Chiu et al. (2002), Cross-sectional observational study (N=91 healthy men and Women)	Multi Cervical Rehabilitation Unit. 3-consecutive steady contractions as hard as possible, with a 10-second rest within each effort and a 2-minute rest between directions.	All movements were tested for group strength.	No significant difference for muscle strength in different age groups. No significant correlation between physical measurements and neck muscles isometric strength. Isometric strength in all directions in men was 1.2–1.7 times that in women (all $p < 0.028$)	Men have 20–70% greater strength than women. Both genders can maintain high levels of cervical muscle strength up to their 7 th decade.

7.	Chiu and Lo (2002), Cross-sectional study (Twenty-one patients with neck pain and 25 healthy volunteers)	Multi Cervical Rehabilitation Unit (Hanoun Medical Inc., Ontario). The measurement of isometric strength was taken after a 15-minute break following completion of the measurement of AROM.	Test-retest reliability and construct validity of cervical active range of motion and isometric neck muscle strength. 3 measurements were taken for each direction (flexion, extension, lateral flexions, and rotations). Three measurements were made for each of the six directions (flexion, extension, lateral flexions, protraction, and retraction).	Intraclass correlation coefficients (ICCs) ranging from 0.81 to 0.96. Very good to excellent reliability in isometric strength measurement (ICCs ranged from 0.92 to 0.99). Significant difference in isometric neck muscle strength ($p = 0.001$) and in AROM ($p = 0.034$) between the two groups.	Multi Cervical Rehabilitation Unit was found to be reliable and valid for testing the cervical active range of motion and isometric neck muscle strength for both normal and patient subjects.
8.	Seng and Lam (2002)	(Biodex, Corp., Shirley, NY).	Measuring neck isometric flexion, extension, and lateral bending torque.	Intratester repeatability testing of the device was good for all measured parameters.	The device can be useful as a practical tool for neck strength measurement, training, and rehabilitation purposes.
9.	DuToit et al. (2003), (N=81 school boys)	Isokinetic dynamometer with specially designed halo and stabilizing chair	Mean Peak torque (Nm) on day 1,2,3 was measured.	Lateral flexion (Dominant and Non-dominant in Nm): 55.88, 56.59, 56.26 and 53.84, 54.49, 54.81; Extension (Nm): 55.84, 56.49, 56.79; Flexion (Nm): 28.56, 29.2, 29.53	Proper alignment, body positioning and stabilization are crucial to eliminate lower extremity involvement.
10.	Suryanarayana and Kumar (2005); Correlation study design (N=39, age range of 18–30 years)	Force measuring device firmly bolted in the floor. Rotating metal tube was pivoted, adjustably counter weighted and attached to the device at 1 end and immovable object with a load cell in its path at the other.	Study aimed at quantifying cervical strength at neutral, 25%, 50% and 75% of flexion and extension. 2 sessions were recruited, (1 for flexion and 1 for extension)	Neck strength was found to be highest in the neutral posture for both flexion (19.8 N females and 31.4 N males) and extension (39.5N females and 45.1N males) and significantly decreased with an increasing angular deviation of the neck ($P < 0.01$). The overall flexion–extension ratio was 1:1.7 ($P < 0.01$).	Maximum force was directionally dependent with flexion less than extension and males were stronger than females. The findings may assist in targeting rehabilitation goals.
11.	Salo et al. (2006); Cross-sectional descriptive study	Solid frame attached to the wall for diagnostic and rehabilitation purposes	Mean maximal isometric strength of the flexor, extensor, and rotator muscles	73.8± 20.0N (30.5 - 327) flexors, 190.8±31.3N (95.9 - 327.0) extensors, 8.1±2.3Nm (2.9 - 15.6) towards right and 7.9± 2.3 (2.7 - 15.8) left rotation.	Women aged 20-59 years appear to have same absolute neck muscle isometric strength (NMIS)
12.	Cagnie et al. (2007), Cross-sectional. (N=96 healthy men and women in different age groups and N=30 with neck pain)	Biodex isokinetic dynamometer	To determine Intra-and interrater reliability, measurement of maximal isometric strength of flexors and extensors, develop age-sex based normative database and Evaluate gender differences in strength.	Mean peak torque for flexion and extension was higher in men (24Nm, 36.4Nm, respectively) versus women (16.6Nm, 26.5Nm, respectively) ($P < .001$) Peak torque for extension was lower in the patient group (22.3Nm) versus healthy female control group (26.5Nm) ($P = .003$). No significant differences in flexion strength between patient and female control group were found.	High degree of intra- and interrater reliability in measuring NMIS. Normative data for neck strength when evaluating patients with neck disorders needs to take sex into account.
13.	Rezasoltani et al. (2008), (N=20 Healthy women)	Fixed neck strength measurement system	Isometric force and torque measurement of extensor muscles at different levels of thoracic support.	Maximum isometric force and maximum isometric torque measurements of the extensor muscles vary with the length of the lever arm.	Fixed thoracic support may be used in follow-up and in interventions.

14.	Versteegh et al. (2015)	Hand-held dynamometer (MicroFET 2 force gauge). Used ipsilateral hand to apply isometric resistance over 3sec.	To assess intra-inter-session, test-retest reliability of maximum forces in cervical flexion, extension, side flexion, side flexion with rotation and pure rotation	Intraclass Correlation Coefficient values exhibited good to high inter-session reliability, ranging 0.87-0.95 for all tested directions.	5 test positions of the neck and upper-quadrant strength protocol can be performed using HHD with good to high reliability
15.	Catenaccio, E. et al. (2017), Cross-sectional study (N=157 healthy young adults)	Fixed Frame Dynamometry.	Measure normative neck strength data base with respect to flexion, extension, right and left lateral flexion. To evaluate the relationship of neck strength to anthropometric measurements	Strength ranged from 38-383 Newtons in men and 15-223 Newtons in women. Weight, BMI, neck circumference, and estimated neck muscle volume were found to be modestly correlated with neck strength in multiple directions (correlation coefficient of < 0.43).	HHD relies on tester to generate force to muscle contraction to assess NMIS and is more susceptible to tester-based error or bias.
16.	Vannebo et al. (2018), Research Article (58 Men and Women)	Hand Held Dynamometry.	Measurement of maximal isometric strength of neck flexion, extension, and right/left lateral flexion on 3 separate days.	With 95% confidence interval; In women, ICC for day 2-3 measures were 0.91,(0.82–0.95) for neck flexion, 0.88(0.76–0.94) for neck extension, 0.84(0.68–0.92) for right lateral flexion, and 0.89(0.78–0.95) for left lateral flexion. The corresponding ICCs in men were 0.86(0.72–0.93) for neck flexion, 0.93(0.85–0.97) for neck extension, 0.82(0.65–0.91) for right lateral flexion and 0.73 (0.50–0.87) for left lateral flexion.	Study protocol describes a reliable and easy-to-administer test for assessing maximal isometric cervical muscle strength
17.	Krause et al. (2019), compared the reliability and force outputs of 3 methods (30 participants)	HHD. “Make tests” for cervical were performed using lying push tests, sitting push tests, and sitting pull tests.	extension, flexion, and right and left side bending	All testing methods were found to be reliable. Lying push test had the greatest point estimate values (ICC, 0.89-0.95).	Force values between the 3 methods were significantly different, suggesting, consistent testing methods should be used. The minimum detectable change was most sensitive for the lying push method.
18.	Selistre et al. (2021), Systematic review and meta-analysis (31 studies)	Handheld Dynamometer	To evaluate reliability and validity of clinical tests for measuring cervical muscle strength or endurance in subjects with and without neck pain.	Moderate to good intra- and interrater reliability (intraclass correlation coefficients ranging from 0.64-0.90). Concurrent validity was measured by only 2 studies, which do not provide adequate evidence for a recommendation.	The flexor and extensor endurance tests, and HHD for measuring cervical strength has an acceptable inter-rater and intra-rater reliability.
19.	McBride et al. (2023) Experimental study (N=36)	VALD Force-Frame dynamometer. To examine test-retest and inter-rater reliability in assessing NMIS To compare male and female differences.	Peak isometric strength in flexion, extension, left and right-side flexion in a quadruped position.	Females: Ext (133 ± 34N), Flexors (130 ± 21N), LSF (100 ± 26N), RSF (96 ± 23N) Males: Extensors (269 ± 69N), Flexors (235 ± 43 N), Left SF (167 ± 51 N) and Right SF (163 ± 47 N) Males were stronger than females in all four directions. Significant effect for direction ($p \leq 0.05$):	Intra-rater reliability results were good-to-excellent for both males (ICC = 0.83–0.90) and females (ICC = 0.86–0.94)

Discussion

The literature review brings in clarity on many aspects critical to the understanding of the assessment of the neck muscle function in people with and without neck pain and different devices being used for their assessment and during rehabilitation.

Prevalence of neck pain and neck disability

Neck pain is a common but significant health problem in modern society, with the reported 1-year prevalence values in the world varying from 16.7% to 75.1% for adults, with a mean of 37.2% (de Koning et al., 2018). The incidence rates increase with age up to 40 to 60 years, and then decrease slightly and more common in women than men (Bot et al., 2004). Neck pain is the 4th leading cause of disability globally (Vos et al., 2012) with

an average one-year prevalence of 37% in the general population (Fejer et al., 2006). It has been estimated that 45-54% of all individuals will suffer from mechanical neck pain (MNP) during their lives (Fernandez et al., 2007).

Deviations from the normal sagittal alignment of the cervical curve, such as flattening of the cervical curve or cervical kyphosis, lead to pain and disability (Scheer et al., 2013). Even in the absence of the neurological symptoms, pain combined with cervical kyphosis may lead to functional disability (Etame et al., 2010)

Relation of Neck Muscle Strength with Pain and Disability

Patients with upper cervical pathologic abnormalities show reduced neck strength (Berg et al., 1994). It is estimated that the neck musculature contributes about 80% to the mechanical stability of the cervical spine, while the Osseo-ligamentous system contributes the remaining 20% (Panjabi et al., 1998). Neck muscle strength may modify risk for mild traumatic brain injury in sports and accidents (Collins et al., 2014). With every 1-pound increase in neck strength, the odds of sustaining a concussion decrease by 5%. The cervical muscles are related to development and progression of chronic postural neck pain (Ylinen et al., 2004; Gilchrist et al., 2015). One reason why chronic neck pain is thought to be more common among females is that they have lower muscle strength than males (Nakagawa and Schielzeth, 2013). Inadequate recovery of the cervical muscles after injury may lead to the chronicity of certain MNP dysfunctions (Mariam et al., 2018). Therefore, normative data on the neck muscles of healthy individuals seems warranted to establish appropriate values.

Measurement Instruments

Measurement instruments (MI) are the tools for measuring various aspects of a person's health status, such as impairments, activity limitations, participations, quality of life (De Vet et al., 2011). The use of MI, either self-reported or performance based, has been recommended for rehabilitation professionals in many clinical practice guidelines (Dent et al., 2017). Measures in general, are standardized in that they use close ended questionnaire formats or specific protocols for implementation, provide scores that allow quantitative assessment of the ability, and have been evaluated for their psychometric properties. One of the barriers for not using the MI by Physiotherapists' is problems relating to structural restrictions like lack of time, unavailability, and limited feasibility (Braun, 2018). Therefore, there is an urgent need for effective strategies to implement and facilitate the use of MI in Physiotherapy.

Routinely instituting the use of validated instruments in daily clinical practice and by modifying treatment protocols based on the results is extremely important to improve healthcare related aspects (Poolman et al., 2009). Some of the MI or tests used to assess the neck muscles function are; endurance tests for short neck flexors, cranio-cervical flexion test, manual muscle testing of neck musculature, dynamometry, two lifting tests, the PILE test (cervical progressive iso-inertial lifting evaluation) and the timed weighted overhead test (de Koning et al., 2018).

Dynamometers As Measuring Instruments to Check Neck Muscles Isometric Function

Manual muscle testing is flawed by subjectivity and bias, lack of uniformity and quantification. The structuring and implementation of an efficient and accurate method of evaluating the neck musculature will not only have financial implications, but will also provide healthcare professionals with improved assessment and rehabilitative methods in the clinical situation Du Toit et al. (2003).

Methods for measuring neck muscles isometric strength are not standardized. Various instrumentation, positioning, restraints, use of push or pull methods, and break or make tests have been used. Instrumentation for testing cervical muscle strength includes custom-made machines, isokinetic equipment, Biodex isokinetic dynamometer, Kin-Com computerized dynamometer, tension scales, strain gauge dynamometers, handheld dynamometer (HHD), modified sphygmomanometer dynamometer, Multi Cervical Rehabilitation Unit (MCRU), Fixed frame dynamometry (FFD) force measuring devices like Solid frame attached to the wall or floor as NMIS measurement system (Table 1.).

Vernon et al., 1992, determined test-retest reliability, normative data, and clinical validity of neck muscles isometric strength (NMIS) testing in the neck with a modified sphygmomanometer dynamometer (MSD). Pressure levels generated by subjects were measured in kilopascals (kPa): flexion:3300, extension:5800, rotation:5200 and lateral flexion:6200. The flexion/extension ratio was 0.57:1, indicating that in normal subjects, flexion was approximately 40% lower than extension. The MSD has been found to be a reliable instrument for the evaluation of NMIS in normal and symptomatic subjects. Jordan et al. (1999) in a descriptive study using strain-gauge technology on a neck muscle training apparatus in 100 healthy volunteers found maximal isometric strength to be approximately 20% to 25% higher in male subjects than female subjects in both flexion and extension with a weak reliability. The men demonstrated a significant decrease in maximal isometric strength with increasing age in both flexion and extension, whereas the women were able to maintain strength values in the ages tested.

In one study, the ratio of flexion to extension maximum isometric peak force has been estimated to range between 0.7–0.59 in normal subjects estimated with strain gauge dynamometers and modified sphygmomanometers. The extensor muscles of the neck are approximately 40% stronger than the neck flexor muscles (Bussieres, 1994). In another study using Multi Cervical Rehabilitation Unit, isometric strength in all directions in men was 1.2–1.7 times

that in women (all $p < 0.028$). Men have approximately 20–70% greater isometric neck muscle strength than women. Both men and women can maintain high levels of cervical muscle strength in six different directions up to their seventh decade (Chiu et al. 2002). Cervical strength was found to be highest in the neutral posture for both flexion (19.8 N females and 31.4 N males) and extension (39.5N females and 45.1N males) and significantly decreased with an increasing angular deviation of the neck ($P < 0.01$) using a FFD bolted to the floor. Males exerted significantly higher forces than females. The overall flexion–extension ratio was 0.59 in both the genders (Suryanarayana and Kumar, 2005).

Dynamometers have been proven as a reliable tool to objectively measure the functional improvement after the rehabilitation process in the patients with cervical pain (Garces et al., 2002). Maximal and mean isometric strength of the cervical musculature at 0°, 5°, and 10° of flexion and extension of the neck. Men showed approximately 30–40% more strength than women in flexion and extension at all angles and age groups. However, not much objective data is available on the type of improvements in neck muscle function in routine patients with orthopaedic and neurological conditions. There may have been 2 primary reasons for this paucity of data; Firstly, is the lack of instrumentation available to provide valid and reliable assessment of extensor and mainly flexor muscles of the cervical spine. Second, possibility is the previously held feeling among the clinicians that strength testing and training of the non-cord injured cervical spine could be dangerous, further aggravating the injury.

FFD is a technique where resistance to muscle contraction is against a dynamometer mounted to a fixed frame or a wall. This method uses a large wall or frame-mounted machine with a fixed base, which are expensive and generally impractical for most clinical settings (Versteegh et al., 2015). In contrast, HHD are relatively quick and easy for capturing objective strength values. Its advantages include affordability and portability (Krause et al., 2019). The results support the premise that HHD is a viable alternative to more costly modes of isometric strength measurements, provided the assessor's strength is greater than that of the specific muscle group being measured (Stratford and Balsor, 1994).

Literature demonstrated a significant effect for sex ($p \leq 0.05$): males were stronger in all four directions, and a significant effect for direction ($p \leq 0.05$): Extensors tested stronger (193 N) than Flexors (176 N), Lateral Side Flexors (130 N) and RSF (125 N) while using a VALD fixed frame dynamometer (McBride et al., 2023). Most studies have found highest isometric cervical strength for flexor and extensors at cervical neutral position. However, Jordan et al. 1999, relates the increase of maximal strength with the increase of the angle of flexion and extension. A review of the literature has shown a lack of neck-strength assessment protocols that evaluate side flexion and rotation along with flexion and extension. Neck strength has commonly been used for flexion and extension movements with few studies in neck rotation and that too with a small sample size (Salo et al., 2006).

Test conditions that led to variations in measurements were range of movement in which values were obtained, type of contraction or movement (concentric, eccentric, isokinetic, isometric, isotonic), pre-test procedures (warm-up and gravity-correction procedures, starting position, stabilization, axes alignment, lever arm length, preload, damp/ramp settings), test conditions (speed, test sequence, rest intervals, feedback), and type of data analysis (the data selected and how they are manipulated).

Clinimetrics In Existing Dynamometers Measuring Neck Muscle Strength

The use of validated instruments in a daily clinical setting has been shown to improve healthcare outcomes. Guidelines recommend that those practitioners who would like to improve patient care should assess patient using validated condition-specific instruments and focus on the functional aspects of the disease or injury secondarily (Poolman et al., 2009). A quality-criteria used to evaluate the methodological soundness of patient-reported outcome instruments include; content validity, internal consistency, criterion validity, construct validity, reproducibility (agreement and reliability), responsiveness, floor and ceiling effects, and interpretability.

Universal guidelines have previously defined Intraclass Correlation Coefficient's (ICC's) estimates of 0.000-0.39, 0.40-0.59, 0.60-0.74, and 0.75-1.00 as poor, fair, good, and excellent, respectively (Cicchetti, 1994). And SEM estimates for acceptable reliability range from 7.5-20% of the measured variable, with 15% being the most common cut-off (Shechtman, 2013). Data abstraction and Quality assessment is done for clinimetric properties like; intra-observer and inter-observer reliability, agreement, construct validity, responsiveness, and interpretability as per the criteria developed by the Scientific Advisory Committee of the Medical Outcome Trust (Scientific Advisory Committee Overview and Update, 1998) and partly of the check list developed by Bot et al. (2004).

Kin-Com computerized dynamometry is a reliable and reproducible tool which is used to study both flexion and extension isometric cervical strength (Garces, et al., 2002). Both intra-test and inter-test reproducibility are greater than that shown by other dynamometers. Using a Kin-Com computerized dynamometer to record peak isometric strength, reported a flexor to extensor ratio of 0.60. Jordan et al. (1999) using a neck exercise machine with a strain-gauge dynamometer, reported a ratio of approximately 0.59 flexion-extension in both the men and women participants. This compatibility of the ratios with others provides a convergent validity. However, whether

ratios decrease or increase with age is not known. Examiner strength can influence results and may also depend from position to position.

Neck strength has been consistently found to be higher in men than in women and inconsistently correlated with the factors including age, handedness, height, weight, body mass index (BMI), and neck circumference. Few studies have examined combinations of anthropometric measures that more closely model neck muscles volume as a surrogate of neck strength. Weight, body mass index, neck circumference, and estimated neck muscle volume were modestly correlated with neck strength in multiple directions (correlation coefficients < 0.4). In a multivariate regression model, weight in women and neck volume in men were significant predictors of neck strength (Catenaccio et al. 2017).

To investigate test-retest reliability of measurement of maximal isometric cervical muscle strength by HHD describes a reliable and easy-to-administer test for assessing maximal isometric cervical muscle strength (Vannebo et al., 2018). However, one of the challenges of using HHD to assess NMIS is that, it relies on a human tester to generate resistance to muscle contraction and so is more susceptible to tester-based error or bias (Versteegh et al., 2015; Catenaccio et al., 2017). In one study the Multi Cervical Rehabilitation Unit demonstrated very good to excellent reliability in isometric strength measurement with ICC's ranging from 0.92 to 0.99. Moreover, there was a significant difference in isometric neck muscle strength ($p = 0.001$) and in AROM ($p = 0.034$) between the two groups (Chiu and Lo, 2002). In another study using the MCRU correlations between physical measurements of height and weight with strength values were all insignificant in both genders. Chiu et al. (2002). However, here the study protocol used was different. Cagnie et al. (2007) showed a high degree of intra- and inter-rater reliability in measuring isometric neck muscle strength when using the Biodex isokinetic dynamometer. The use of normative data for neck strength when evaluating patients with neck disorders needs to take sex into account.

Both isometric torque and isometric forces are dependent on the level of the thoracic support. Variation in the position of the fulcrum may affect the repeatability of the measures and this has implications in the for the use of the strength tests as an outcome measure following rehabilitation and training programs (Rezasoltani et al., 2008). Proper alignment, body positioning and stabilization of the subjects are crucial in order to eliminate lower extremity involvement in the evaluation of the upper extremity and vice versa (Du Toit et al. 2003).

Though many NMIS measuring instruments show high intra and inter tester reliability but in the studies where different dynamometers protocols have been used to evaluate NMIS, comparisons of the results become difficult. The problem is even aggravated in the absence of a standardized evaluation protocol (Garces et al., 2002). Lack of literature published about cervical isometric dynamometry is an obstacle to obtaining valid conclusions. The reliability of the measurements using HHD devices is questionable, particularly when the strength of the tester is lower than that of the test subject. Isometrics of the neck strength measurement devices specifically built for this purpose seem to have good reliability. ICC ranged from 0.75 to 0.98 with different test equipment's (Salo et al., 2006). Because the results of the NMIS measurements are device dependent, it is necessary to obtain reference values with each type of device used.

Limitations In the Clinical Usage of Existing NMIS Measuring Instruments

Reliable methods of assessing NMIS do exist but with certain limitations. In many of the publications, the authors failed to provide sufficient detail for accurate replication of test procedures or for comparison with other studies. Effective development of normative data, formation of ratios, comparison of measurements across studies, and relating measurements with other performance criteria all require descriptions of variables relating to subjects and testing (Keating and Matyas 1996).

Strength measurements of the flexor and extensor muscles of the cervical spine studied using HHD have shown poor reliability as it may vary according to the strength of the investigator. However, clinical evidence points towards the efficacy of muscular strengthening in neck rehabilitation programs (Garces et al., 2002). The normative data obtained through the FFD resistance systems or HHD may not be comparable with the results of the MI used in other studies. Also, the data on maximal isometric contraction strength characterized exclusively may not be applicable to investigations examining other dimensions of neck muscle function including muscle endurance or rotational strength (Catenaccio et al., 2017). To minimize the inconsistencies provided by the site of thoracic support, a standard location for the support should be adopted in studies measuring the performance of cervical extensor muscles (Martire et al., 2017).

Many of the studies require large, expensive isokinetic equipment or FFD systems that are not practical for use in most clinics. Protocols that use HHD lack standardization and depend on the therapists being stronger than the patient. They also commonly rely on break tests that can cause apprehension, pain, and safety concerns for the subjects or patients (Versteegh et al., 2015). Literature review has evidenced for a lack of consistency in the methodology, description of the testing procedure and varying normative values. The number of articles reporting comprehensive strength measurements in all planes of the neck movements are also limited, with strengths in flexion

and extension noted majorly followed by side flexors with the difficulty in clinical assessment of neck rotation strength which has traditionally been limited to clinically inaccessible lab-based measurement equipment. None of the available searched literature showed studies on usage of MI in NMIS assessment on Indian population.

Limitations Of the Study

Only open access data base in the google scholar was referred to in the current study.

Future Recommendations

The Study Felt The Need Of Standardizing the assessment protocols and development of a novel NMIS measurement instrument which could eliminate these limitations and along with its easy accessibility for routine clinic-based diagnostics and prescribing evidence-based exercise therapeutic programs. Important issues to be considered are; validity, applicability, feasibility, cost, and usefulness of the tests.

Conclusion

There is no single, universally accepted method of neck muscles isometric strength measurement instruments primarily noting the flexion and extension strengths followed by side flexors and sometimes rotational that too in a lab-based technology. Standardizing the neck muscles isometric strength evaluation may help in diagnosing strength deficits and having baseline assessment for setting future goals of strengthening muscles during the rehabilitation. Isokinetic dynamometers, FFD, HHD amongst others offer reasonable solutions for testing the NMIS but with a limitation of normative data recorded on one MI may vary from that of the other MI, though the ratio of flexion and extension muscle strengths provides the convergent validity. Also, a need has been felt to develop a novel neck muscle isometric strength measurement instrument considering the important issues of validity, applicability, feasibility, cost, and usefulness leading to adherence of established protocols enhancing intertester and intratester reliability, making routine clinic-based diagnostics and prescribing evidence-based exercise therapeutic programs more efficient whose absence might be the reason for deficient literature with respect to its usage and neck muscle isometric strength quantification of normative data base of normal healthy population and patient's assessment and rehabilitation protocols in India.

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Epidemiology and Physiotherapy Management of Urinary Incontinence

*Retasha Soni **Supreet Bindra

*Ph.D. Scholar, ** Assistant Professor, Physiotherapy, Sri Guru Granth Sahib World University, Fatehgarh Sahib.
retashasingh@gmail.com

Abstract

Urinary incontinence (UI) is a major health problem that is prevalent in both males and females. It creates physical as well as psychological distress, which can thus have a negative impact on patients' quality of life. According to the International Continence Society (ICS) and International Urogynaecological Association (IUGA), UI is defined as “complaint of involuntary loss of urine.” UI is a condition that can affect all groups around the world. Various epidemiological studies state that UI affects around 5% to 70% of the population. Various risk factors of UI is ageing, obesity, chronic constipation, diabetes and smoking. There are extensive treatment methods available for reducing this problem which includes either conservative or surgical management depending upon the presentation. The conservative management including physiotherapy are usually the first line treatment modes preferred to manage urinary incontinence. The different modalities used by physiotherapist in treating urinary incontinence are pelvic floor exercises (Kegel's exercises), electrical stimulation, interferential therapy, biofeedback, and training with vaginal cones in females. The purpose of this review is to determine the current prevalence of UI in both males and females and the recent evidence-based literature regarding the effectiveness of physiotherapy interventions used in treating UI. The following electronic databases were searched: Google Scholar and PubMed. Observational studies and randomized control trials from January 2015 to December 2022 published in English language were included. We conclude that the reported prevalence of overall UI in females reported by most of the studies ranged between 12%–100% and for males it is about 14.2%-75.5%, though it increases with age in both males as well as in females. The reported prevalence of UI among males and females varies widely in different studies because of the use of the different definitions and the heterogeneity of the study designs. Pelvic floor muscle training and other physiotherapy techniques play an important role in decreasing the symptoms of UI. Therefore, it remains a key factor in the prevention and can be therefore considered as the first choice of treatment for UI. But still there is a need for more population-based studies of UI and high-quality randomised trial methods especially in men to show its long-term effectiveness.

Key words: Prevalence, Urinary incontinence, Physiotherapy, Pelvic floor muscle training, Biofeedback and Electrical stimulation

Introduction

Urinary incontinence (UI) is serious health problem that can affect people of all age groups. According to the International Continence Society (ICS) and International Urogynaecological Association (IUGA), it is defined as the “complaint of any involuntary loss of urine” (Haylen, 2010). UI is prevalent in both males and females though females are more affected than the males (Irwin et al., 2011 and Milsom et al., 2019). It creates physical as well as psychological distress and thus have a negative impact on patients' quality of life (QoL) (Singh et al., 2013). There are three main types of urinary incontinence: Stress, Urge, and Mixed. Stress urinary incontinence (SUI) is most common form of UI in women and it is defined as complaint of involuntary loss of urine during exertion or on coughing, sneezing, or laughing. Physical exertion increases intra-abdominal pressure which causes urine to leak. Urgency UI or Urge UI is also known as overactive bladder and it is associated with involuntary contractions of the detrusor muscles of the bladder at inappropriate times. It is the complaint of involuntary loss of urine associated with urgency. MUI is defined as the complaint of involuntary loss of urine associated with urgency and with effort or physical exertion or on sneezing or coughing (Haylen et al., 2012).

UI affects 6-10% of the population worldwide (Weber et al., 2020). The prevalence of UI in females is estimated to be between 25% and 45% worldwide (Aoki et al., 2017 and Minassian et al., 2003). Some studies have reported the prevalence rate of UI in women ranging from 5% to 69% (Cerruto et al., 2013 and Milsom et al., 2019). Prevalence of UI in middle aged females is about 30%-40% and about 50% in older women. The disparity in the reported prevalence of UI by the various studies is due to the different definitions used and because of the heterogeneity of the study designs (Milsom and Gyhagen, 2019; Mostafaei et al., 2020 and Moulin et al., 2008). The overall prevalence of incontinence in males is 3% to 11% with urge incontinence (40%-80%) being prominent in them (Litwin et al., 2012). Every year around 100 million adult men are affected by incontinence worldwide (Irwin et al., 2011). Estimated prevalence varies from 11% among those aged 60–64 years to 31% in older men (Milsom et al., 2013). In men SUI, accounts for less than 10% and is mostly due to surgical procedures in prostrate, trauma or neurological injury (Nitti, 2001). It has been reported that the prevalence of UI increases with age in both the sexes (Shamliyan et al., 2009).

Multiple factors are responsible for the etiology of UI. The anterior vaginal wall supports urethra and the bladder and therefore plays an important role in the maintenance of continence (Golomb et al.,2009). Damage to endopelvic fascia, pelvic floor muscles (PFM) that supports urethra, changes in the compliance, innervation and decreased function of detrusor muscle are the various factors that can lead to UI (Aoki et al.,2017). Age-related functional changes in the urinary tract (detrusor overactivity, impaired bladder contractility, decreased pressure in urethra closure, atrophy of urethral areas, and prostatic hypertrophy) may contribute to UI (Resnick et al.,2011). The various risk factors for UI in men include diabetes, prostate diseases, urinary tract infections, high body mass index, radical prostatectomy, neurological conditions, injury or damage to nerves or muscles from surgery etc. (Shamliyan et al.,2009). UI is common after radical prostatectomy in males with the reported prevalence rates of 2 to 57% (Abrams et al.,2021). Potential risk factors for UI in women include increasing age, parity, vaginal deliveries, obesity, pelvic surgery, diabetes mellitus, depression, constipation, and chronic respiratory problem (Aggarwal et al.,2017).

UI has a great impact on the activities of the daily living and thus reduce the QoL of a patient (Lim et al.,2018). It is also called as the ‘silent epidemic’ because most of the adult feel shy or are hesitant to talk about their problems (Yip and Cardozo,2007). It is usually one of the most neglected and under-reported areas of health as most of them are either hesitant to report about their symptoms or they take it as a normal part of aging process (Abrams et al., 2010) It may lead to anxiety, depression, sleep disturbances and even falls and fractures in such cases (Felde et al.,2012 and Tettamanti et al.,2013).

There are extensive treatment methods available for reducing this problem which includes either conservative or surgical management depending upon its presentation. The conservative management including physiotherapy are usually the first line treatment modes preferred to manage UI. The different modalities used by physiotherapist in treating UI are pelvic floor muscle training (PFMT) known as Kegel’s exercises, electrical stimulation, interferential therapy, biofeedback, and training with vaginal cones (Luginbuehl et al.,2021 and Khandelwal and Kistler,2013). PFMT have also been found to significantly improve the incontinence in males especially after radical prostatectomy (Newman and Wein,2013). PFMT and other physiotherapy techniques play an important role in decreasing the symptoms of UI in women and can be therefore considered as the first choice of treatment for UI in women (Dumoulin et al.,2017).

There are various reviews where the prevalence of UI and physiotherapy management have been reported in women (Batmani et al.,2021, Pizzol et al.,2020, Dhillon et al.,2016, Bialy et al., 2020 and Cacciari et al., 2019). Most of the reviews have either focused on PFMT or on biofeedback but reviews on overall physiotherapy management are very less (Alouini et al.,2022, Bialy et al.,2020 and Cacciari et al.,2019). There are very few reviews available where the prevalence of UI in males is reported. Similarly, very few studies are available where the effectiveness of physiotherapy interventions in males have been explored (Shamliyan et al., 2009). However, there is no systematic review available till date where the current evidence of prevalence of UI and physiotherapy management has been studied in both males as well as females. Therefore, this study will help in adding up to the existing literature by identifying the gaps in the prevalence and evidence-based physiotherapy on UI in both males and females. It is very essential to address these critical issues and bring the awareness by imparting knowledge regarding this. Hence, this review will help us to combat with such under- reported issues which has not only physical but also many psychological manifestations.

Methodology

Search Strategy

This systematic review reports the current evidence of the prevalence and the physiotherapy management of UI both in men and women. The conduct and the reporting of this systematic review were based on the PRISMA guidelines (Preferred Reporting Items for Systematic review and Meta-Analyses). Studies published in English language from January 2015 to December 2022 were included. The literature was searched on electronic databases using Google Scholar and PubMed. The search strategy involved entry of different key words such as prevalence, urinary incontinence, physiotherapy, pelvic floor muscle training, biofeedback and electrical stimulation. The Boolean operator words “AND”/ “OR” were used in order to search for maximum publications

Study selection and Criteria

Selection of the studies was based on the inclusion and the exclusion criteria. The studies reporting on the overall prevalence of UI in males and/ or females (Observational study/ cross-sectional study/ cohort study/ descriptive study) and the intervention studies (RCTs) of physiotherapy management in treating UI in males and/ or females were included.

For observational studies- Studies that addressed the prevalence of UI, including SUI, UII and MUI in men or women. Studies which had sample size of over 100 participants and age group above 18 years were considered. Studies were identified based on the screening of the title and full texts available. Abstracts were excluded.

For Randomized Control Trial- The inclusion and the exclusion criteria were based on PICOS (Population, Intervention, Comparator, Outcome and Study) format (Table-1).

Data extraction, Quality Assessment, Data Synthesis

The data extracted from the prevalence studies included the last name of the first author, year, country, type of study, study population, sample size, age, prevalence, predisposing risk factors and quality assessment of the study. Prevalence of different types of UI was also studied. Data extracted from the RCTs included the last name of the first author, year, sample size, age, outcome measures, intervention, duration of study and results of the study. Narrative synthesis was done after extracting data from the included studies.

For quality assessment of observational studies- The Newcastle-Ottawa Scale (NOS) is the quality assessment tool used for the evaluation of prevalence studies. It assigns up to maximum of nine points based on three quality parameters that include: selection, comparability and outcome. The studies were graded as high (<5 points), moderate (5-7 points) and low risk of bias (≥ 8 points) (Alpoim et al., 2012).

For quality assessment of randomized control trials- The Jadad scale allows the analysis of methodological quality of clinical trials; a point is assigned to each of these features in the study: randomization, blinding and description of exclusions and losses of the sample; if randomization and blinding are considered adequate, another point is summed up; if they are considered inadequate, a point is subtracted from each item. The Jadad scale varies from 0 to 5, the scores that are ≥ 3 represent adequate methodological quality of the studies (Jadad et al., 1996).

Criteria	Inclusion	Exclusion
Population	Men and women diagnosed with clinical diagnosis of UI Age- 18 years or older Postpartum women	Pregnant women Participants who underwent any type of surgery (prostatectomy, hysterectomy) Participants suffering from neurological disorders Participants having diabetes Less than 18 years of age Cystic fibrosis
Intervention	Physiotherapy interventions	Pharmacological interventions Surgical procedures Other interventions
Comparator	Placebo Any other physiotherapy comparator group	Pharmacological Surgical Other adjunctive.
Outcome	Any of the following- Muscle strength Endurance Quality of life Urinary incontinence	Any other clinical outcome
Study	RCT (Full texts)	Abstract Pilot study Case study Qualitative study Cohort study Observational study Review articles
Language	English	Any other language
Year	January- 2015- December-2022	Before January- 2015 and after December-2022

Table-1- PICO- Guidelines

Results

Total 2426 studies were searched, out of which of 1400 were prevalence studies and 1026 were RCT studies. Out of which 158 duplicate studies were removed and then after the screening the title as well as abstract of the remaining studies, 1860 studies were removed. 408 studies were retrieved for the detailed full- text review. Of these, 372 studies were excluded because they did not meet the inclusion criteria. Finally, a total of 36 studies were included in the systematic review (Fig-1). All studies underwent methodological quality assessment (Table-2 and Table-5).

Description of the available studies

The summary of the included studies is presented in the chronological order in Table-2 (prevalence studies) and Table-4 (RCTs). The 25 prevalence studies published from January 2015- December 2022 were included with a total of 23,339 subject population. The minimum age of the subject in the prevalence studies was 18 years and maximum age was 96 years. In 16 studies only females were the subjects, in 6 studies both males and females were included and in 3 studies only males were the subjects. The studies available were mainly cross-sectional in design (n=18). 10 studies were population-based studies, 6 studies were health centre- based, 3 studies were hospital- based, 3 were clinic- based, 1 study was institution -based and another study included the population from health wellbeing centre (Table-2). Most of the studies defined UI as “involuntary loss of urine or “involuntary leakage of urine (Table-3). For RCTs, 11 studies were included with total 2102 subjects. The size of the samples included in the review ranged from 30-625. All the RCTs included in the review were on females only (Table-4). No RCT on physiotherapy management in general population of males with UI from January 2015- December 2022 was found. The RCTs available on the databases of this duration on males were mainly with prostatectomy or with cystic fibrosis.

Prevalence and predisposing factors of UI

The overall prevalence of UI in the available studies from different countries ranged from 3.8%- 100%. The prevalence rates of UI reported in the studies varied widely (Table-2). The prevalence of UI in females in the studies were ranged from 12%-100% (Aggarwal et al., 2017 and Aniuliene et al., 2015). In males, highest prevalence of UI reported was 75.5% (Aniuliene et al., 2015) and lowest was 14.2% (Tamanini et al., 2018). 16 studies reported the prevalence of different types of UI (SUI, UII and MUI), 1 study reported only for SUI and UII but not for MUI and another did not report for UII and MUI. 6 studies did not mention its types separately. Most of the studies reported that SUI is the most common type of UI in females and UII in males (Table-3). The predisposing risk factors of UI were also studied (Table-2).

RCTs and types of intervention

All the RCTs available were on female population. The intervention period of most of the RCTs (n=5) was of 12 weeks (Table-4). The maximum study duration of the included RCTs was of 24 months (Hagen et al., 2020) and the minimum duration was of 5 weeks (Nagib et al., 2021). The most common outcome measure used in the different studies was urinary leakage and muscle strength. The different interventions included in the studies were PFMT, PFM+ abdominal muscle therapy, biofeedback, surface EMG, postural education, education regarding PFM and video-based education (Table -4).

Quality Assessment

Quality assessment of the included prevalence studies was done by NOS (Table-2) and of RCTs was done by Jadad scale (Table-5). Overall, 10 prevalence studies were reported of high quality, 11 studies of moderate quality and 4 studies of low quality. All the Cohort studies were of high methodological quality. (Table-2). According to the Jadad scale, 8 studies were of high quality (3/5) and 3 studies were of low quality (2/5). None of the RCT was double-blinded (Table-5).

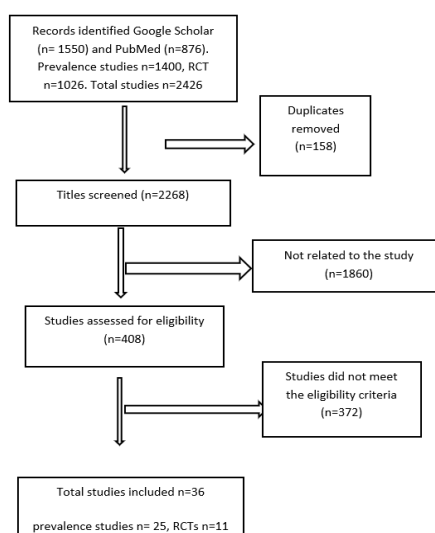


Fig- 1 The flow Diagram of the study selection process

Table.2: Summary of all The Included Prevalence Studies

Author (year)	Country	Type of study	Age	Study population	Sample size	Prevalence	Predisposing risk factors	Quality assessment
Aniulienė et al., 2015	Lithuania	Descriptive and Cross-sectional	41-88 years female, 42-88 years males	Males and females, primary health centres	172	100% in females and 75.58% in males	Age, married, pregnancy and mode of delivery, concomitant illnesses were significant risk factors for women with SUI and older age and menopause for UUI. The only risk factor for men UUI was aging.	Moderate
Cooper et al., 2015	United Kingdom	Cross-sectional	>21 years	Females, population-based	1415	40%	Aging, diabetes, high body mass index (BMI)	High
Dogan et al., 2015	Turkey	Cross-sectional	65-92 years.	Males and females, community-based	1000	43.9% in females and 32.9% in males.	Gender, low income, low education level, chronic diseases, chronic constipation, chronic cough, number of deliveries, benign prostatic hyperplasia, past genitourinary surgery and lower urinary tract symptoms	Moderate
Ge et al., (2015)	China	Descriptive	20-96 years	Females, community-based	3058	22.1%	Aging, lower education background, older age of menarche, menstrual disorder, pregnancy history, episiotomy, chronic pelvic pain, gynecological disease, other chronic diseases, constipation, fecal incontinence.	High
Kasikci et al., (2015)	Turkey	Cross-sectional	≥65 years	Females, health centre	1094	51.6%	BMI, smoking, constipation, UTI, family history, chronic diseases, chronic cough, hormone replacement therapy, urogenital operation.	Moderate
Linde et al., 2016	Netherlands	Cross-sectional	18-85 years	Males and females, population- based	1257	36.8%, 49% in females and 22.6% in males	Diabetes mellitus, fecal incontinence, and constipation were risk factors for UI. In women, obesity, vaginal hysterectomies, and vaginal parturition were also risk factors for UI, as was prostate surgery in men.	Moderate
Aggarwal et al., 2017	India	Cross-sectional	30-70 years	Females, population based	236	12%	Aging, parity, type of delivery, prolonged labour.	Low
Khan et al., (2017)	India	Cross-sectional	≥ 60 years	Females, community-based	149	46.3%	Parity, vaginal mode delivery, BMI, smoking, standard of living	Moderate
Pedersen et al., (2017)	Germany and Denmark	Descriptive	≥ 18 years	Females, population based.	1856	48.3% in Germany and 46.4% in Denmark	Ageing, BMI, vaginal delivery, chronic obstructive pulmonary disease, and having at least one co-morbidity	High
Townsend et al., (2017)	Mexico	Cross- sectional	≥ 60 years	Females, population based	1289	14%	Aging, smoking, larger waist-to-hip ratio, history of asthma, high blood pressure, or diabetes	Moderate
Boornema et	India	Cross-sectional	30-65	Females, hospital-	350	29.4%	Aging, less education	Low

al., 2018			years	based				
Tamanini et al., 2018	Brazil	Cohort	≥60 years	Males and females, health wellbeing centres	1413	14.2% for men and 28.2% in females	Diabetes, stroke, obesity, aging	High
Tkacheva et al., (2018)	Russia	Cross-sectional	≥ 65 years	Females, clinic-based	286	40.2%	Aging	Moderate
Helfand et al. 2018	America	Cohort	≥18 years	Males, health-centre	519	51%	BMI, anxiety, diabetes	High
Murukesu et al. 2019	Malaysia	Cohort	≥60 years	Females, community-based	814	16% in urban area and 23% in rural area	Ethnicity, chronic constipation	High
Al Kiyumi et al., 2020	Oman	Cross-sectional	20-50 years	Females, health centres	1070	34.5%	Age, marital status, BMI, employment, income, hypertension, long-term cough, constipation, mode of delivery.	Moderate
Akinlusi et al., 2020	Nigeria	Cross-sectional	25-67 years	Females, outpatient clinic	395	32.9%	Constipation, higher BMI, age	Moderate
Walaa et al., (2020)	Egypt	Cross-sectional	≥ 60 years	Females, hospital based	130	80%	Older age, functional impairment, multiparity, stroke, vaginal prolapse, and laxative use.	Moderate
Cheng et al., (2021)	Taiwan	Cross-sectional	≥40 years	Males, population based	4076	17.3%	Hypertension, BMI, smoking, alcohol.	High
Freire et al., 2021	Brazil	Observational and cross-sectional	≥18 years	Females, institute-based	63	36.5%	Genetics	Low
Turusheva, 2021	Russia	Cohort	≥65 years	Males and females, outpatient clinic	190	48%	COPD, history of stroke, sensory deficits, frailty and other geriatric syndromes.	High
Shim et al., 2021	Korea	Cross- sectional	≥30 years	Females, health centre	509	45.8%	Aging, childbirth	Low
Luo et al., 2022	China	Cross-sectional	≥65 years	Males and Females, population based	1279	46.8% overall UI. 56.3% in females and 35% in males	Poor physical function, poor quality of sleep, and fecal incontinence were common factors associated with UI in both women and men.	High
Najafi et al., (2022)	Iran	Cross-sectional	≥ 60 years	Females, health centre	369	24.9%	Age, BMI, constipation, history of caesarean section, hypertension.	High
Zaki et al (2022)	Egypt	Cross-sectional	≥ 60 years	Males, hospital based	350	50%	Older age, higher number of comorbidities, depression, functional impairment, pyuria, congestive heart failure, diabetes, osteoarthritis, chronic kidney disease, benign prostatic hyperplasia and chronic constipation	Moderate

Table.3: Definition of UI and prevalence of different types of UI in the study population

Author, year	SUI		UII		MUI		Definition of UI
	F	M	F	M	F	M	
Aniulienė et al., 2015	55%	9.2%	30.2%	60%	15.1%	30.7%	Involuntary leakage of urine
Cooper et al., 2015	24%	NI	7%	NI	20%	NI	Involuntary loss of urine
Dogan et al., 2015	12.5%	0%	25.5%	21.8%	16.5%	0.8%	Involuntary loss of urine
Ge et al., 2015	12.9%	NI	1.7%	NI	7.5%	NI	Involuntary loss of urine
Kasikci et al., 2015	39.3%	NI	44.1%	NI	34.2%	NI	Involuntary loss of urine
Linde et al., 2016	26.3%	2.9%	5.3%	5%	10%	0.9%	Any involuntary leakage of urine from past 6 months
Aggarwal et al., 2017	22%	NI	38%	NI	38%	NI	Involuntary loss of urine is objectively demonstrable and is a social and hygiene problem
Khan et al., 2017	7.7%	NI	Not mentioned		Not mentioned		The complaint of any involuntary leakage of urine
Pedersen et al., 2017	24.5%G/21.4%D	NI	10.7%G/11.7% NI		13.1G/13.2D	NI	Involuntary loss of urine
Townsend et al., 2017	Not mentioned		Not mentioned		Not mentioned		Involuntary loss of urine
Boornema et al., 2018	52.4%	NI	29.1%	NI	18.4%	NI	Involuntary loss of urine is objectively demonstrable and is a social and hygiene problem
Helfand et al 2018	NI	4%	NI 29%		NI mentioned	Not	No proper definition
Tamanini et al., 2018	Not mentioned		Not mentioned		Not mentioned		No proper definition
Tkacheva et al., (2018)	Not mentioned		Not mentioned		Not mentioned		No proper definition
Murukesu et al. 2019	Not mentioned		Not mentioned		Not mentioned		Involuntary leakage of urine
Al Kiyumi et al., 2020	49.3%	NI	26.3%	NI	23.8%	NI	Involuntary loss of urine
Akinlusi et al., 2020	7.3%	NI	18%	NI	7.6%	NI	Involuntary leakage of urine
Walaa et al., 2020	4.8%	NI	0.96%	NI	91.3%	NI	Involuntary leakage of urine
Cheng et al., 2021	NI 5.1%		NI 5.4%		NI 6.8%		Not defined properly

Freire et al., 2021	Not mentioned	Not mentioned	Not mentioned	Loss of involuntary urine associated or not with effort.
Turusheva, 2021	Not mentioned	Not mentioned	Not mentioned	Involuntary leakage of urine through urethra
Shim et al., 2021	33.6% NI	12.2% NI	Not mentioned	No proper definition
Luo et al., 2022	18.5% 0.9%	13.7% 33.2%	24% 0.9%	Involuntary loss of urine
Najafi et al., 2022	40.2% NI	32.6% NI	12% NI	Involuntary leakage of urine
Zaki et al., 2022	1.6% NI	38% NI	40% NI	Involuntary loss of urine

NI- Not included

Table.4: Summary of the included studies (RCTs)

Author, year	Age	Sample size	Outcome measure	Duration of study	Intervention	Results
Alves et al., 2015	52-80 years	30	sEMG, MOS, ICIQ UI-SF, ICIQ OAB, ICIQ-VS	6 weeks	CG- 12 fitness sessions for 60 mins (2 times/week). Instruction about the about PFM function and contraction without its training were given. IG- 12 fitness sessions for 60 mins (2 times/week) along with PFMT (8s hold-16s relax).	The PFM increased after PFMT, evaluated by sEMG ($p = 0.003$) and digital palpation ($p = 0.001$), accompanied by a decrease in urinary symptoms ($p < 0.001$ for ICIQ-OAB scores and 0.036 for ICIQ UI-SF) as well as anterior pelvic organ prolapse ($p = 0.03$)
Tosun et al., 2015	40- 62 years	130	IIQ-7, UDI-6, pad test, PERFECT scale, perineometer, oxford scale	12 weeks	CG- no treatment. IG- for 12 weeks 30 min sessions were given for 3times/week for the first two weeks. Received posture training for the first two weeks. Individual exercise schedules were designed according to PERFECT scheme data. At the end of the 12-week pelvic floor muscle training, patients whose pelvic floor muscle strength did not reach a level of 5 (according to the Oxford grading system) and who agreed to do so, continued the exercise program (required pelvic floor muscle strength of grade 5, in the standing position).	The pelvic floor muscle training group had significant improvement in their symptoms of urinary incontinence ($P=0.001$) and an increase in pelvic floor muscle strength ($P=0.001$, by the dependent t test) compared with the control group. All the symptoms of urinary incontinence were significantly decreased in the patients that had reached pelvic floor muscle strength of grade 5 and continued the pelvic floor muscle training ($P<0.05$).
Leong et al., 2015	More than 65 years	55	QoL (incontinence episodes)	12 weeks	Intervention Group- PFMT+ BT+ Education (received a 30-minute individual training session at a pre-decided time of the day, once weekly for the first 4 weeks; and then once bi-weekly for the remaining 8 weeks. A total of eight treatment sessions were given) This group received education about urinary incontinence, pelvic floor muscle training with manual palpation and verbal feedback, and behavioural therapy. Control group- given advice and received an educational pamphlet with information about management of UI.	There was significant improvement in urinary symptoms in the intervention group, especially in the first 5 weeks. Compared with the control group, participants receiving the intervention showed significant reduction in urinary incontinence episodes per week with a mean difference of -6.4 ($p<0.001$). The mean treatment satisfaction in the intervention group was 9.5 (standard deviation, 0.8) as measured by an 11-point visual analogue scale.
Ghaderi et al., 2016	40-65 years	60	ICIQ-UI-SF, ODIS, Oxford grading scale	12 weeks	CG- received routine physiotherapy modalities including transcutaneous	Functional disability and pain intensity were significantly decreased in control ($P < .05$) and

					electrical nerve stimulation (TENS), hot pack, and therapeutic ultrasound, and regular exercises. TENS was given to low back area for 20 minutes each session, 3 days a week (10 sessions), at a frequency of 110 Hz, with a pulse duration of 90 μ s, and at an intensity is comfortable tingling sensation. Therapeutic ultrasound was then administrated to the low back area for 10 minutes per session, at a frequency of 1 MHz, with an intensity of 1 W/cm ² and a duty cycle of 50%. Regular exercises including the strengthening and endurance exercises for the abdominal and paravertebral muscles 3 days/ week, 3 sets a day, and 10 repetitions of each exercise. The training group was identical to the control group, except that the patients performed the progressed stabilization exercises for the deep abdominal and lumbar muscles focusing on PFM at 30% of maximal voluntary contraction.	training groups ($P < .05$), with no significant difference between the groups after treatment. However, UI intensity was smaller for the training group ($P < .05$). Pelvic floor muscle strength and endurance, and transverses abdominis muscle strength were statistically increased in the training group compared with those in the control group ($P < .05$).
Sran et al., 2016	≥ 55 years	48	Urinary leakage, UDI, IIQ	12 weeks, 3 months and 1 yr FU	The physical therapy group received 12 individual sessions (first session was 60 min, subsequent sessions 30 min) of physical therapy for UI over 12 weeks (once per week) at the health center from a trained physical therapist. PFM retraining using electromyography (EMG) biofeedback; motor control exercises; functional PFM exercises; bladder habit retraining; dietary recommendations/changes (as needed); and audio tapes for home use. control group participants received a group osteoporosis education session (3 h), including information on physical activity, diet, and medications used in the prevention and management of osteoporosis.	After a 12-week course of PT once per week for UI, PT group participants had a 75% reduction in weekly median number of leakage episodes, whereas the control group's condition had no improvement. At 1 year, the PT group participants maintained this improvement, whereas the control group's incontinence worsened.
Vsconcelos et al., 2018	More than 18 years	132	MOS, ICIQ-UF-SF	8 weeks	PG-vaginal palpation ($n = 33$) bidigital vaginal palpation (3 series of 10 contractions with 6sec hold and 6 sec rest and 6 quick contractions at end); PTG-vaginal palpation with posterior pelvic tilt ($n = 33$); ESG-intravaginal electrical stimulation ($n = 33$) frequency of 50 Hz, pulse time of 200 ms, contraction time of 5 s, relaxation time of 10 s, for 20 mins and a CG ($n = 33$) that only received verbal instructions (home exercises).	Vaginal palpation with or without posterior pelvic tilt was the most effective intervention for facilitating voluntary PFM contraction in women, when compared with intravaginal electrical stimulation and a control group. Vaginal palpation was the most effective in improving urinary incontinence compared to the other interventions.
Wagg et al., 2019	60-75 years	625	Urinary leakage	24 weeks	Group 1-PFMT+ Education about the bladder health (60 min	A structured group-exercise intervention has the potential to

					of group exercises by physiotherapist done 2 times/week for 12 weeks, followed by 30 min of brisk walking. The exercises included both PFMT and mobility exercises. Group 2- without the physiotherapist-led training in, and practice of, PFMT and mobility exercises and without the home visit from the physiotherapist.	manage urinary incontinence in older women in communities largely outside the reach of pharmaceutical or surgical interventions.
Dumoulin et al., 2020	≥60 years	337	Urinary leakage	12 weeks, 6,9 and 1 year follow-up	women in both treatment groups received a 12-week PFMT program under the direction of an experienced pelvic floor physiotherapist, either in individual or group sessions. For both interventions, each weekly session lasted 1 hour and included a 15-minute educational period and a 45-minute exercise component. Participants in the group-based PFMT group who reported having difficulty with the PFM exercises were offered short private sessions with the physiotherapist. Participants in the individual PFMT group used intravaginal electromyographic biofeedback during each treatment session for 10 to 15 minutes. Women in both groups were expected to perform PFM exercises at home, 5 days/ week during the 12-week physiotherapy program, and subsequently 3 days per week for 9 months	Median percentage reduction in urinary incontinence episodes was 70% in individual PFMT compared with 74% in group-based PFMT. Individual PFMT and group-based PFMT had similar effectiveness for all secondary outcomes at 1 year. Results of the GROUP study suggest that group-based PFMT is not inferior to the recommended individual PFMT for the treatment of stress and mixed urinary incontinence in older women.
Hagen et al., 2020	≥18 years	600	Incontinence severity symptoms, endurance, PFM strength, QoL	24 months	Group1-PFMT+Biofeedback and Group2-PFMT. Participants completed questionnaires at baseline and at 6, 12, and 24 months.	At 24 months no evidence was found of any important difference in severity of urinary incontinence between PFMT plus electromyographic biofeedback and PFMT alone groups. Routine use of electromyographic biofeedback with PFMT should not be recommended.
Nagib et al., 2021	> 45 years	36	ICIQ UI-SF, Modified Oxford scale	5 weeks	Supervised group- Supervised PFME through game therapy - Recommendations on unsupervised PFME, (twice a week for 5 weeks). Un-supervised group- Recommendations for performing unsupervised PFME at home, (5 weeks).	Both groups showed improvement in urinary symptoms. Relief of urinary symptoms, PFMs power and endurance were significantly better in supervised group.
Mishra et al., 2022	Mean age-45.6	49	RUIS, IIQ 7	6 months (24 weeks)	Group 1- Video based education + supervised exercise sessions (once a week for the 1st month, twice a week for the 2nd month and once a month for the next three months). Group 2- Video based education about continence mechanisms + strengthening exercise illustration and receiving feedback to volunteers who performed exercises in the education session. Participants were instructed to complete a daily minimum of 30 repetitions	The mean standard deviation of RUIS (P = 0.84) and IIQ-7 (P = 0.55) scores was similar at baseline across the groups. The RUIS (P = 0.01) and IIQ-7 (P = 0.006) improved significantly; however, post hoc analysis revealed that both RUIS and IIQ-7 improved significantly only in the supervised group. Supervised exercise worked better than home-based exercises.

					of PFME with slow contractions (3 sets of 10 repetitions) with a hold lasting a count of 5 s every day. Along with this, they were also taught static abdominal exercises.	

PFMT- Pelvic Floor Muscle Training; ICIQ UI-SF- International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form; PERFECT- Power Endurance Repetitions Fast Contractions Every Contraction Timed; PFM- Pelvic Floor Muscle; PFME- Pelvic Floor Muscle Exercise; IIQ 7- Incontinence Impact Questionnaire; NA, Not Available; s EMG-surface electromyography; MOS- modified oxford scale; ICIQ-OAB- International Consultation on Incontinence Questionnaire-overactive bladder; UDI- Urogenital Distress Inventory; BT- Behavioural therapy; CG-Control group; IG- Intervention group; ICIQ-VS- International Consultation on Incontinence Questionnaire-Vaginal symptoms; QoL-Quality of life FU- Follow-up; ODIS- Oswestry disability index scale
 I-QOL- Incontinence Quality of Life; RUIS- Revised urinary incontinence scale

Table.5: Quality assessment of RCTs by Jadad Scale

Author, year	Randomization	Method of randomization	Double-blinding	Method of double-blinding	Withdrawals / drop-outs	Jadad score
Alves et al., 2015	1	1	0	0	1	3
Tosun et al., 2015	1	1	0	0	1	3
Leong, 2015	0	0	0	0	1	1
Ghaderi et al., 2016	1	0	0	0	1	2
Sran et al., 2016	1	1	0	0	1	3
Vsconcelos et al., 2018	1	1	0	0	1	3
Wagg et al., 2019	1	1	0	0	1	3
Dumoulin et al., 2020	1	1	0	0	1	3
Hagen et al., 2020	1	1	0	0	1	3
Nagib et al., 2021	1	1	0	0	1	3
Mishra et al., 2022	1	0	0	0	1	2

Discussion

The results of this review shows that UI is very common condition that affects millions of men and women and physiotherapy interventions play an important role in the conservative management of UI.

1.Prevalence and types of UI

In this review, overall prevalence of UI in females ranged from 12%-100% and in males from 14.2%-75.5%. Based on the results, the highest prevalence of UI in males and females were reported in Lithuania, where the prevalence in males was 75.5% and in females it was 100% (Aniulienė et al., 2015). One of the reviews of the population- based studies in Europe revealed that the prevalence of UI ranged from 14.1%-68.8% in females (Cerruto et al., 2013). Most of the studies included in this review were on older population (Table-2 and Table-3). Studies suggest a strong influence of age and gender on the prevalence of UI. UI is very common in older people in Turkey. The prevalence of female and male UI was 54.5% and 32.9%, respectively (Dogan et al., 2015). UI is common in men greater than 40 years of age, and is associated with reduced QoL in both the physical and mental health domains and decreases QoL (Cheng et al., 2021). Approximately one-third of women with UI were between 60 and 69 years while men were from 70 to 79 years. In a study conducted in Egypt, the prevalence of UI in elderly men was 50% (Zaki et al., 2022). Urinary incontinence was also prevalent in frail elderly females (Waala et al., 2020). Khan et al., (2017) found the overall prevalence of UI in older women around 46.3%. A study conducted in Iran reported the prevalence of 24.9% in older women. UI prevalence was 30% in people aged 80 years and older (Najafi et al., 2022). Aging is one of the important factors in developing UI. Due to aging bladder capacity decreases, pelvic floor muscles become weak and detrusor muscle contraction decreases (Alopim et al., 2012). UI is also found to be prevalent and occurs at a younger age in women (Aniulienė et al., 2015). Linde et al., 2016 found 17% of UI in 18–39-year-old men. Age group of 31-40 years recorded the highest number of UI (Akinlusi et al., 2020). In a study conducted in United Kingdom, the prevalence of 40% was reported in females over 21 years (Cooper et al., 2015). According to the study done by Helfand et al (2018), 32% of males suffer from UI (age ≥ 18 years) (Helfand et al., 2018). The prevalence of UI varies widely from study to study and these variations may be due to the different study populations, culture differences and different definitions reported for UI. The most prevalent type of UI in females was SUI and in males it was UUI. Dogan et al., 2015 revealed that UUI was the most common type of UI in the total population (23.7%) followed by MUI in both males and females. SUI was seen only in women (Dogan et al., 2015). Cooper et al., reported that peak age of SUI in females was 35-44 years (Cooper et al., 2015). Four studies reported that UUI was most prevalent in females (Aggarwal et al., 2017; Akinlusi et al., 2020; Dogan et al., 2015 and Kasikci et al., 2015). One study reported that MUI was the commonest type in males (Cheng et al., 2021) and another study reported the same in females (Zaki et al., 2022). Linde et al., 2016 found that men younger than 40 years of age had

SUI more frequent than UI (4.7% versus 2.3%, respectively). Systematic reviews have reported that SUI accounts for more than two-thirds of cases of UI in females (Milsom et al., 2019). The prevalence of UI is common in men as it is associated with bladder overactivity and/or bladder outlet obstruction due to enlargement of the prostate (Abrams et al., 2017).

2. Anatomical and physiological differences in urinary tracts of males and females and pathophysiology that may lead to incontinence

Continence is maintained by a coordinated effort between the bladder, urethra, pelvic muscles, and the surrounding connective tissue. The anatomy and the physiology of bladder is same but the urethra is different in males and females (Table-6). In female's bladder inferior surface lays on the pubic symphysis and the posterior wall is in contact with the vagina and uterus. In males, the inferior surface of the bladder lays over the pubic symphysis and prostate, posteriorly is the distal third of the rectum. The function of the lower urinary tract is to either store (storage phase) or expel (voiding phase) urine. During storage the detrusor muscle is relaxed and the sphincteric mechanism is active to prevent urinary leakage while the bladder becomes progressively distended. In the voiding phase the pelvic floor and external urinary sphincter relax, the detrusor muscle contracts and bladder emptying results. Thus, repetitive events depend on adequate detrusor muscle contraction and relaxation, competence of ureterovesical junctions and the urethral sphincter, as well as a complex central and peripheral neural control of both the smooth- and striated-muscle systems (Golomb et al., 2009). The detrusor muscle is thicker in men than women, as greater voiding pressure is needed to empty the bladder through the longer urethra of males. For urethral pressure, the circumferential smooth muscle of the bladder neck, the pelvic floor muscles (PFM) and coaptation of the elastic tissue of the mucosal walls and the vasculature of the urethra are responsible.

The pelvic floor muscles form the base of the group of muscles commonly called the ‘core.’ The floor of the pelvis is made up of layers of muscle and other tissue and they stretch like a hammock between the coccyx and pubis. They are normally firm and thick. A man's pelvic floor muscles support the bladder and bowel. The urethra and the anus all pass through the pelvic floor muscles. A woman's pelvic floor muscles support the bladder, bowel and uterus. The urethra, anus and vagina all pass through the pelvic floor muscle. When pelvic floor muscles contract, they lift the internal organs of the pelvis and tighten the openings of the vagina, anus and urethra. Relaxing the pelvic floor allows passage of urine and faeces. Pelvic floor muscles are also important for sexual function in both men and women. In men, it is important for erectile function and ejaculation. In women, voluntary contractions (squeezing) of the pelvic floor contribute to sexual sensation and arousal (Abelson et al., 2018).

The abnormal functioning of bladder may lead to many medical conditions in males as well as females. Urinary tract infections (UTI) are common in both men and women but women are more exposed to this problem due to shorter urethra in them (Simmering et al., 2017). Incontinence is another problem which is encountered by males and females. Urge incontinence occurs secondary to overactive detrusor muscle contractility. Stress incontinence is caused by weakening of the pelvic floor muscles and/or fascia and increased intra-abdominal pressure (Bo, 2012).

Table.6: Difference between male and female urethra

S.no.	Structure	Females	Males
1.	Length	Shorter (3.81cm)	Longer (18-20 cm)
2.	Connection	Bladder and urethra not connected to reproductive system.	It is connected to the reproductive system.
3.	Function	Female urethra is to transport urine from the urinary bladder to the external space	Urethra is involved in transporting urine from the bladder to the external space, as well as ejaculation of semen fluid through the urethra.
4.	Regions	Divided into 4 regions	No division
5.	Diameter	8-9mm	6mm

3. Risk factors of Urinary Incontinence

3.1 Age and Gender

Urinary incontinence is more common among women compared to men and its prevalence rates increase with age in both males as well females. With age, anatomical and physiological changes of the urogenital system such as muscle and axon degeneration, decrease in bladder capacity, increase in detrusor activity and consequent decrease in detrusor contractile strength occur and as a result women are prone to UI. Extension of prostates in men with increasing age can cause urinary retention. Menopause, as a risk factor, increased the risk of having UI symptoms more than 8 times as oestrogens loss contributes to the problem of UI by weakening pelvic muscles and causing vaginal atrophy and decrease in the supporting tissues around urethra in women (Aniulienė et al., 2015; Dogan et al., 2015; Turusheva et al., 2021 and Shim et al., 2021).

3.2 Delivery

Obstetric factors are reported to have an important role in development of urinary incontinence. In the studies, it is stated that vaginal delivery increases the risk of UI (Linde et al., 2016). Khan et al., 2015 observed that 41% of women reported for UI who had vaginal deliveries. 26% of the participants who had a history of caesarean section reported for UI (Najafi et al., 2022). SUI is related with pregnancy and delivery risk factors, two and more childbirth, vaginal childbirth method, rupture of perineum could be the explanation of why SUI occurs at a younger age. Birth giving the first child at an age less than 20 years, vaginal delivery of a large baby with an episiotomy and more than 3 pregnancies are SUI risk factors (Aniuliene et al., 2015).

3.3 Body Mass Index (BMI) and Obesity

Any case causing chronic increase of intraabdominal pressure poses a risk for development and exacerbation of urinary incontinence. Obesity is stated to be predisposing factors for stress incontinence (Cooper et al., 2015; Kaskici et al and Khan et al., 2017). Many epidemiological studies indicated that increased Body Mass Index (BMI) was a risk factor for UI and women with BMI greater than 30kg/m² are two times more prone to UI than the normal weight women. Linde et al., did not find any co-relation between UI in men and BMI (Linde et al., 2016).

3.4 Smoking and Chronic constipation

Frequent smoking causes cough in smokers, destruction in pelvic floor muscles, increase in intraabdominal pressure and deterioration of collagen synthesis. In the literature, UI prevalence of smokers is reported to be higher than non-smokers (Khan et al., 2017). It is suggested that constipation can cause dysfunction in pelvic muscles due to causing damages in pelvic nerves due to tension. In some studies, constipation was reported as one of the risk factors for UI in males and females (Al Khayumi et al., 2020; Akinlusi et al., 2020; Najafi et al., 2022 and Zaki et al., 2022).

3.5 Urinary tract Infection and enlarged prostate

UTI is frequently observed in women. Only one study reported that UTI is a risk factor for UI and significant relation was found between them (Kasikci et al., 2015). None of the study reported the incidence of UTI in males. Enlarged prostate can result in UUI as it causes abnormal bladder contraction (Dogan et al., 2015).

3.6 Co-morbidities and neurological disorders

Zaki et al., found that several co- morbid conditions such as the congestive heart failure, diabetes mellitus, osteoarthritis, benign prostatic hyperplasia, chronic constipation and chronic kidney disease associated with UI and were significantly higher in male participants with UI (Zaki et al., 2022). One of the studies also found a positive association between chronic obstructive pulmonary disease (COPD) and UI. COPD is associated with increased abdominal pressure when coughing and leads to SUI. UI was significantly associated with osteoarthritis, stroke, and vaginal prolapse in elderly women (Walaa et al., 2020). In a population- based study a significant relationship was reported between lung diseases and UI (Ge et al., 2015). The risk factors for UUI include various neurological disorders like stroke (Turusheva et al., 2021).

3.7 Drugs

The use of some drugs and UI have been reported by many studies. Drugs could cause incontinence by lowering bladder outlet resistance and/or by increasing intravesical pressure, which disrupts the normal pressure relationship between the bladder and urethra and leads to urinary leakage. Other possibilities include disturbances of the central nervous control of voiding or an overproduction of urine (Najafi et al., 2022). Increased risk of UI among men using diuretics, antidepressants and laxatives was also seen (Zaki et al., 2022).

3.8 Pelvic surgery

In males, radical prostatectomy or transurethral resection of prostate can lead to SUI. The main pathophysiology of SUI in men is due to the dysfunction of the urethral sphincter complex or change in the urethral axis. The prevalence of UI increases after the prostate surgery. Vaginal hysterectomies increased the risk incontinence in females, while abdominal hysterectomies did not (Linde et al., 2016).

4. Physiotherapy Interventions

PFMT is effective and most commonly mode of physiotherapy intervention for the treatment of UI. PFMT has been included in the 10 RCTs out of 11 studies included in this review and proven to be an effective treatment approach (Table-4). Some studies have used PFMT with biofeedback and the combination of both has shown better results in reducing UI (Dumoulin et al., 2020; Hagen et al., 2020 and Sran et al., 2016). Hagen et al., reported that use of biofeedback for 24 months did not show much improvement in the symptoms of UI than PFMT alone (Hagen et al., 2020). PFMT reduces the symptoms of UI in women of 52-80 years of age group after 6 weeks of training session. PFMT involves repetitive contraction of the pelvic floor muscle, which builds strength and improves the muscle tone of the pelvic floor muscle and increases perineal support (Alves et al., 2015). The sample size used in this RCT was very small (n=30) and thus this questions its generalization onto the larger population and moreover no follow-up was done. According to Tosun et al., the UI symptoms disappeared in 94.1% of the patients with PFMT. Most of the symptoms were greatly reduced when the pelvic floor muscle strength of grade 5 was achieved in 12 weeks. The study demonstrated that PFMT is effective in reducing UI symptoms and increasing PFM strength in women with

stress and mixed urinary incontinence (Tosun et al., 2015). Group exercise programme along with a home exercise plan for 24 weeks in older women in villages of Bangladesh was successful in decreasing urinary incontinence. No follow-up was done. More improvement in quality of life in the group that included the group exercise classes was seen (Wagg et al., 2019). Similarly, group-based PFMT was shown to be noninferior to the standard individual PFMT at 1-year post-randomization for the treatment of urinary incontinence in older women (Dumoulin et al., 2020).

The effectiveness of a standardised urinary continence physiotherapy programme was seen in for older Chinese women of more than 65 years of age with stress, urge, or mixed urinary incontinence. The intervention in this study was given for 12 weeks. This could optimise the effect of the neural adaptation (recruitment of efficient motor units and frequency of excitation) and muscle hypertrophy and thus decreasing the symptoms of UI. The combination of PFMT and BT has shown better results and improved the QoL (Leong, 2015). Sample size of this study was small (n=55), follow-up was not done and convenient sampling method was used which might not be representative of the whole population suffering from UI.

Another study aimed to investigate the effectiveness of supervised PFMT game-therapy and PFMs function in women with more than 45 years of age group having UI when compared with an unsupervised protocol. Game-therapy protocol provided not only the relief of incontinence symptoms but also a significant increase in PFMs function. It consisted of the PFM contraction at the time of exercise practice using virtual games with the training focused on PFM contraction for 5 weeks. Both the groups showed improvements but the supervised training program using game-therapy also improved PFMs power and endurance (Nagib et al., 2021). Sample size of the study was very less (n=36) and no follow-up was done to see the long-term effects. The effectiveness of supervised versus home-based PMF training in the management of UI among women was seen. The exercises were given for 24 weeks. Home exercises could not achieve the results (Mishra et al., 2022). Again, this study included a small sample and no follow-up was done to see the effects of the exercise in the long run.

A RCT was undertaken to assess the effectiveness of physical therapy UI intervention in postmenopausal women with osteoporosis. The protocol was given for 12 weeks and follow-up was done at 3 months and then at 1 year. The PFM training using EMG biofeedback found to be effective in the treatment of UI when compared with no treatment. After a 12-week physical therapy program for UI, participants had a 75% reduction in the weekly leakage episodes, whereas no improvement was found in the control group. At 1 year follow-up, PFM training group showed maintained this improvement. Abnormal spine position in osteoporosis increases intra-abdominal pressure which decreased with PFMT (Sran et al., 2016). Sample size of the study was small (n=48). Therefore, larger RCT is required (wide range of ages) to generalize the study results. Stabilization exercises focusing on pelvic floor muscle improves stress UI as well as LBP in women with chronic nonspecific LBP. The possible mechanism behind the effectiveness of the stabilization exercises focusing of PFM on UI might be associated with coactivation of transverse abdominis muscle and PFM that might lead to an improvement in UI (Ghaderi et al., 2016). The intervention was given for 12 weeks and sample size was small, which again questions the generalizations of the results. Vsconcelos et al., did a RCT which included only women who were unable to voluntarily contract their PFM and proved that vaginal palpation with or without posterior pelvic tilt is most effective in treating UI when compared to electrical stimulation and control group. Vaginal palpation is a proprioceptive stimulus that can be used as a method to promote learning and facilitation of the correct voluntary contraction of PFM. Posterior pelvic tilt with vaginal palpation can result in higher PFM tonic activity. The intervention was given for 8 weeks with no follow up (Vsconcelos et al., 2018).

This may be the first review which had included both the genders to assess the current status of the prevalence and physiotherapy management. Current evidence proves that UI is very much prevalent in both males as well as females but the percentage of prevalent females are more than the males. The results of this review emphasize the need of more population-based and low risk bias studies in order to find out the true prevalence rates in the community. Different sample size and definition of UI was used by most of the studies which thus resulted in the heterogeneity of the studies. Different physiotherapy interventions such as PFMT in group form or individual form, biofeedback, vaginal palpation with or without posterior pelvic tilt, abdominal muscle exercises, and postural education are effective treatment modes in reducing the symptoms of UI. But PFMT has been found to be most effective and first line of treatment choice in such cases. Most of the studies had small sample size and did not do the follow-up of the interventions to see its long-term effects (Table-2). Only two studies done the follow-up (Dumoulin et al., 2020 and Sran et al., 2016). Thus, much generalization of the results cannot be done. Double-blinding was not done in even a single RCT which again questions the methodological quality of the included RCTs. However, better quality RCTs are needed to prove the effectiveness of the physiotherapy interventions in UI. As this systematic review focused on the current evidence-based physiotherapy practices in UI in both males and females, very less literature is available and not even a single RCT in males was found according to the designed PICOS

guidelines of this review. Though it has been under-reported issue in males as well as females but it requires prodigious attention as UI is a serious health issue.

Limitations

The limitation of this review is that looked for citation only on two databases (google scholar and PubMed). Only full texts were reviewed. No authors were contacted for the missing data.

Conclusion

High prevalence rates of UI are present in men and women around the world. SUI is common in women and UI is common in males. As age advances the prevalence of UI increases. More population-based prevalence studies are required. Heterogeneity in study designs was present. PFMT and other physiotherapy interventions are the first choice of treatment of UI. Its efficacy in females is there but more trials with high methodological designs are required. Current evidence of physiotherapy interventions in males with UI is missing and RCTs are required to fill these gaps. UI is a common problem worldwide and by timely introduction of appropriate rehabilitation protocols such problems can be abated.

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Effects of Prolonged Sitting on General Health of Office Workers

***Harshdeep Kaur,**Supreet Bindra**

*BPT Student **Assistant Professor, Department of Physiotherapy at Sri Guru Granth Sahib World University
jagalharshu312@gmail.com.

Abstract

Introduction: Office workers spend most of their time sitting, leading to sedentary behaviour. It is well known that sedentary lifestyle poses various health risks such as diabetes, obesity, cardiometabolic problems. Recent researches have observed that high volume sitting time or frequent sitting episodes irrespective of physical activity may contribute to increased risk of developing multiple chronic conditions. **Aim of the study:** The aim of the study was to evaluate the effects of prolonged sitting on general health of office workers. **Material and Methods:** An online survey was conducted using google form as a tool in order to find out health related issues among office workers. The questionnaire requested demographic details, duration of sitting, health issues such as MSDs, other related comorbidities and their self-reported general health. A total of 184 responses were collected from office workers of various fields such as bank employees, accountants, clerks, call centre employees etc. **Results:** The results reported that majority of the office workers were scheduled to sit for >5 hours and among them 77% suffered musculoskeletal discomfort and fatigue. Only minority of them suffered from other health related comorbidities. **Conclusion:** The prevalence of fatigue and discomfort were high among office workers and breaks to interrupt prolonged sitting with incorporation of height adjustable workstation is recommended. **Keywords:** prolonged sitting, office workers, general health, sedentary lifestyle

Introduction

Prolonged sitting is the most common sedentary behaviour, characterized by low energy expenditure, a seated body posture, and static loading. Modern workplaces have shifted from active to sedentary, with office-based workers spending between two-thirds and three-quarters of their working hours sitting (Church et al., 2011). Sedentary and sitting behaviour in office workplaces is a risk factor for cardio-metabolic diseases, musculoskeletal disorders, type 2 diabetes, obesity and premature death. It is also associated with biomarkers of cardiovascular disease (Thorp et al., 1996-2011). The findings of some studies indicate that for each two-hour increment in sitting time, the risk of obesity and diabetes increases by 5% and 7% respectively (Hu et al., 2003).

Regular MVPA (moderate to vigorous physical activity) is essential for regulating weight and reducing obesity and associated diseases, but it may not be enough to offset excessive sitting time (Katzmarzyk et al., 2019). In many working populations work related musculoskeletal disorders are responsible for morbidity and is known as an important occupational problem with huge compensation and health costs, decreased productivity and lower quality of life (Karwowski et al., 2017). Musculoskeletal disorders especially in the neck, shoulders, and lower back regions are common among office workers worldwide, due to absence of physical activity, lack of movement as well as the adopted sedentary behaviour (Shariat A., 2016). A study in Qatar found that episodes of low back pain were associated with psychological distresses such as somatization, depression and anxiety in those who attended primary health care centres (Bener et al., 2013). During the last decade poor self-reported general health has increased markedly in all age groups and education groups in working population in Sweden (Blom et al., 2020). Thus, the aim of the study was to evaluate the effects of prolonged sitting on general health of office workers.

Material and Methods

A survey was conducted among 184 subjects with prolonged sitting jobs. The tool used for survey was an online self-administered questionnaire produced using a google form and circulated for completion using a link. The questionnaire included an informed consent for voluntary participation of office workers. The questionnaire included total 21 multiple choice questions that evaluated the effects of prolonged sitting on general health of office workers. The questionnaire was divided into 2 sections. First section included the demographic details such as age, gender, education level, work experience, smoking habits, height and weight. The second section comprised of questions regarding awareness about hazards of prolonged sitting, hours of sitting at work, physical activities, health related issues, knowledge of adjustable workstations and general health.

Inclusion and Exclusion criteria

Office workers with prolonged sitting jobs and at least one year of experience, between the age group of 20 and 60, were included. Participants with history of inflammatory arthritis, neuromuscular skeletal disease and any deformity of musculoskeletal system, were excluded. Nonresidents of India were also excluded.

Statistical Analysis

The data was analysed using Microsoft excel descriptive statistics in form of percentage and chi square test were formulated. Chi square test was done to identify any association in the data, and significance level was kept at 0.05.

Results

Demographic characteristics of the subjects under study

The demographic details of the participants are presented in table 1. The total number of respondents were 184 (57.6% males, 42.4% females). The results revealed that majority of the participants were in the age group of 20- 29 years (50%). Among participants 33.6% had 1- 3 years of work and 43.6% had experience of more than 5 years. Results revealed that 60.3% office workers had normal BMI and 36.4% were overweight and obese.

Table 1: Demographic characteristics of participants.

Parameters	N= (184)	%
Gender		
Female	78	42.4%
Male	106	57.6%
Age(years)		
20-29	92	50%
30-39	54	29.5%
40-49	25	13.5%
50-60	13	7%
Education level		
College graduate and more	168	91.3%
High school	16	8.7%
Current smoker		
Yes	10	5.4%
No	174	94.5%
Years of experience		
1-3 years	62	33.6%
3-5 years	42	22.8%
>5 years	80	43.4%
BMI		
Underweight (below 18.5)	6	3.2%
Normal weight (18.5- 24.9)	111	60.3%
Overweight and obese (≥ 25)	67	36.4%

Comorbidities among Office Workers

Table 2 presents the comorbidities among office workers. Out of 184 participants, 7.6% of participants suffered from Hypertension, 3.8% had raised cholesterol levels, 1.8% had Diabetes, 17.9% reported headaches, 8.6% had digestive issues. Back (37.5%), followed by neck (23.3%) and shoulder (6.5%) were the common musculoskeletal regions affected.

Table 2: Comorbidities among Office Workers.

Do you suffer from any of the following problems?	N= 184	%
Hypertension	14	7.6%
Raised cholesterol levels	7	3.8%
Diabetes	3	1.6%
Headache	33	17.9%
Digestive problems	16	8.6%
Heart disease	1	0.5%
None	110	59.7%
Others	2	1%
Most affected region of the body		
Neck	43	23.3%
Back	69	37.5%
Shoulder	12	6.5%
Wrist	1	0.5%
Hips	5	2.7%
Knees	6	3.2%
Legs	6	3.2%
None	42	22.8%

Sitting Behaviour and Physical Activity among participants.

The data on perspective of sitting behaviour and physical activity among participants revealed that 36.9% of participants who had >5 hours of sitting reported greater frequency of musculoskeletal discomfort (n= 57) as compared to others ($\chi^2= 23.798$, $p= 0.00$). 43.4% of participants who took 1- 2 breaks presented greater discomfort. Regardless of participation in physical activity such as gym workout, yoga, aerobics, the participants reported musculoskeletal discomfort ($\chi^2= 41.454$, $p= 0.00$).

Table 3: Sitting behaviour and Physical Activity among participants.

Parameters	Total no. of participants (N=184)	With discomfort n= 142	Without discomfort n= 42	Chi square value (χ^2)	Significance value (p value)
Hours of sitting per day?					
1-3 hours	65 (35.3%)	49 (75.3%)	16 (24.6%)	23.798 ^a	.000
3-5 hours	51 (27.7%)	36 (70.5%)	15 (29.4%)		
>5 hours	68 (36.9%)	57 (83.8%)	11 (16.1%)		
No. of breaks from sitting.					
0	17 (9.2%)	14 (82.3%)	3 (17.6%)	12.712	.013
1-2	80 (43.4%)	61 (76.2%)	19 (23.7%)		
3-4	50 (27.1%)	37 (74%)	13 (26%)		
>5	37 (20.1%)	30 (81%)	7 (18.9%)		
Type of physical activity					
Gym	31 (16.8%)	26 (83.9%)	5 (16.1%)	41.454	.000
Aerobics	2 (1%)	2 (100%)	0 (0%)		
Walking/ jogging/ running	90 (48.9%)	66 (73.3%)	24 (26.7%)		
Yoga/ asanas	8 (4.3%)	8 (100%)	0 (0%)		
Outdoor games	5 (2.7%)	3 (60%)	2 (40%)		
None	47 (25.5%)	36 (76.6%)	11 (23.4%)		
Others	1 (0.5%)	1 (100%)	0 (0%)		

Discussion and Conclusion

Sedentary behaviour is a probable independent predictor for certain health outcomes. Research on sedentary behaviour, defined as “those that involve sitting and low levels of energy expenditure” (Owen et al., 2010). Our study revealed that majority of the participants had sitting for > 5 hours (36.9%) and only took 1-2 breaks from their work; but most of them were engaged in different physical activity therefore it cannot be stated that they had inactive lifestyle.

Back, neck and shoulder were the commonly reported regions for musculoskeletal pain. Our findings are corroborated by Shariat et al., 2016 who reported that musculoskeletal disorders especially in the neck, shoulder and lower back regions are common among office workers worldwide, due to absence of physical activity, lack of movement as well as adopted sedentary behaviour.

Our results indicated that there was association between BMI and Musculoskeletal discomfort, as 36.4% of overweight and obese individuals out of which 79% were suffering from musculoskeletal disorder. Nilsen et al., 2010 in their study revealed that increased BMI has been identified as an independent risk factor for development of symptoms of musculoskeletal discomfort.

Out of the 25.5% of workers who did not engage in any activity, 76.6% reported experiencing musculoskeletal pain. While 16% of individuals who worked out at the gym, 83.9% reported experiencing musculoskeletal discomfort as well, therefore this states that, regardless of any physical activity participants presented with discomfort from prolonged sitting. A study stated that although a weekly minimum accumulation of moderate intensity (150 minutes) to vigorous intensity (75 minutes) physical activity (MVPA) is considered a well-established key determinant for regulating weight and reducing risks of obesity and associated diseases, regular structured episodes of purposeful MVPA alone may not be enough to offset excessive sitting time (Katzmarzyk et al., 2019). This suggests that more breaks should be taken when sitting, along with posture instruction and other ergonomic workplace initiatives.

Our study revealed that majority of the participants reported their total sitting time was > 5 hours which was substantially related with musculoskeletal pain in those people. 83.8% of them reported feeling uncomfortable. A study by Healy et al., 2008 revealed that in addition to the total sitting time, the high frequency of prolonged sitting reported by this sample poses an additional health risk (independent of sedentary time and physical inactivity).

Our study revealed that 7.6% of individuals had hypertension, 3.8% had high cholesterol, just 1.8% had diabetes, 17.9% experienced headaches, 8.6% had digestive issues, 0.5% and 1% had heart ailments, among other issues; however, the majority of participants did not suffer from any chronic condition. Our data showed that these comorbidities were significantly less common than MSDs (77%), which may be related to the small sample size. A similar study with sample size of 447 showed that 6.3% of the studied workers suffered from hypertension, 3.8%

reported diabetes and 10.8% reported digestive diseases (Daneshmandi et al., 2017). Larger-scale research is therefore required to evaluate these issues among office workers.

Majority of the workers believed that workplace was committed to support their health and well-being but still reported discomfort this could be due to their lack of knowledge about the ergonomic interventions which could be done in workplace. A study stated that there is lack of implementation of available guidelines and recommendation on workstations causing serious ergonomic deficiencies in the workplaces (Shikdar and Al-Kindi., 2021).

21.7% of participants always suffered from fatigue after prolonged sitting, 53.8% participants experienced fatigue sometimes and majority of the participants thought that height adjustable workstation would help to offset the fatigue due to prolonged sitting. Nevala et al., 2013 stated that the use of height adjustable workstations has caused office workers to sit less (46- 66 fewer minutes per day); symptoms of musculoskeletal disorders in the upper limb among users was reduced, while their precision of duty, productivity, mood and moral sense improved. Increasing the number of working posture variations while using height adjustable workstations decreases the symptoms of MSDs caused by prolonged sitting and repetitive motion, reduces swelling in the legs, decreases exhaustion and increases energy expenditure among office workers (Roelofs and Straker., 2002). In our study BMI, sitting time, and taking less breaks from sitting were all identified as risk factors associated with musculoskeletal pain in office workers but the findings of this study cannot be generalized because of the small sample size. Studies with large sample size with major focus on ergonomic factors need to be designed. Therefore, the need of height adjustable workstation and breaks in sitting are recommended.

Limitation of the study

- The study had relatively small sample size.
- Data was obtained using self-report methodology, participants may have provided answers that did not accurately characterize their health condition, which may have led to reporting bias.
- Ergonomic evaluation of workstation was not done.

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Impact of Covid 19 on the Learning Style and Health of Physiotherapy Students

***Karanveer Kaur, ** Supreet Bindra**

*BPT, **Assistant Professor, Department of Physiotherapy, Sri Guru Granth Sahib World University, Fatehgarh Sahib

karanveerkaur11@gmail.com

Abstract

The onset of the COVID 19 pandemic and the public health response required to minimise the catastrophic spread of the disease led to a complete lockdown around the globe. In this backdrop one of the principal measures taken during lockdown has been closure of schools, educational institutes and activity areas. Physiotherapy schools are currently facing the biggest challenge, “training medical students within limitations of social distancing” especially in the preclinical phase due to suspension of practical/lab sessions. The transition in education has led to changes in the learning styles, attitudes, gaining capacities and general health of physiotherapy students. Therefore, it is important to access these changes and the impacts that e-learning has put on physiotherapy education. An online survey was conducted to evaluate the usability of online learning methods, and to determine their feasibility and adequacy for physiotherapy students. The questionnaire requested demographic details, mode of education opted, understanding, learning, practical skills and general health in the pandemic. The results revealed that majority of respondents were unable to gain their attention towards the studies and develop practical skills. Poor student teacher interaction and difficulty in collaborating the theoretical with practical knowledge were some other hindrances of e learning. Almost one third of the students suffered from some physical and psychological issues during online learning system. The COVID 19 pandemic has turned the ways of learning upside down which resulted in deteriorating education experience and needs to be addressed wisely.

Keywords: Physiotherapy, pandemic, e-learning, understanding, general health.

Introduction

The emergence of Corona Virus disease (COVID-19) has led the world to an unprecedented public health crisis (Saha et al., 2020). On these grounds, since January, 2020, various countries started implementing regional and national containment measures or lockdowns. In this backdrop one of the principal measures taken during lockdown has been closure of schools, educational institutes and activity areas (Shweta et al., 2020). This rapid evolution at such a large scale has influenced the students of all age groups (Hasan et al., 2020).

COVID-19 has led to a disruption in medical education process and healthcare systems worldwide (Woolliscroft et al., 2020). The highly contagious nature of the virus and its variants has made it difficult to continue lectures as usual, thus influencing the medical education process, which is based on lectures and patient-based education (Sklar et al., 2020). Physiotherapy students learn practical work through integration of theoretical, practical, tactic and situational knowledge in a socialisation process (Hikka et al., 2020). With no time for extensive training on online teaching and learning and no possibility to change the course contents, physiotherapy lecturers are facing a challenge of effectively teaching core skills to entry-level physiotherapy students online, assuring the same competence level gained by their predecessors (Plummer et al., 2021). Many felt that they would be lacking in clinical skills upon return (Hannah et al., 2020). Moreover, changes in daily routine including lack of outdoor activity, disturbed sleeping patterns, social distancing have affected the mental well-being of the students (Cao et al., 2020).

Therefore, it is vital to know the impact of e-learning on the Physiotherapy students to find out the merits and setbacks in this system and ascertain ways to furnish the learning styles. This study is conducted with the objectives of determining the influence of the COVID 19 on learning style and its effect on general health of Physiotherapy students in the lockdown period.

Materials and Methods

Sample and Study Design

The online survey was conducted amongst physiotherapy students across India during the COVID-19 lockdown period in the month of May 2021 and June 2021. Physiotherapy students pursuing undergraduate and postgraduate degrees from India were included. Students from any other medical profession were excluded. Physiotherapy students who were not willing to spare time for filling the survey questionnaire, who did not have an account in social networking sites were excluded from web-based open E-survey.

Development of Questionnaire

The tool used for the study was a web-based self-administered questionnaire produced using Google forms and circulated for completion using a link. The questionnaire included an informed consent for the voluntary participation of physiotherapy students and participants were not offered any incentives.

The questionnaire included total 35 multiple choice questions to evaluate the impact of COVID 19 pandemic on learning style and general health of physiotherapy students. The questionnaire was divided into 4 sections. The first section included the demographic details of the participants such as age, gender, level of education and place of dwelling. The second section comprised of the questions regarding mode of education and learning in the pandemic. The third section consisted of the questions related to learning, understanding and practical skills in online education system. The last section had questions related to the general health in online learning environment during the pandemic. The questionnaire included a mixture of Likert style questions, multichotomous, dichotomous and two open-ended questions. The questionnaire was designed to ensure participants remained anonymous and the results were strictly confidential.

Validation of the Questionnaire

A draft of the web-based open E-survey questionnaire was distributed amongst 3 individuals including a professor in Physiotherapy, an expert in Occupational therapy and Community medicine. The questionnaire was validated with both the authors having looked into it and removing the errors which may cause bias.

Administration of the Survey

The execution of the study was done by sharing an online link to the Physiotherapy students through various online mediums. In case of no response within 2 weeks, a reminder survey link was sent to the students.

Ethical Declaration

The web-based open E-survey research was performed according to the principles laid by, declaration of Helsinki (Revised 2013), Council for International ethical guidelines for health-related research involving humans (2016). The purpose of study, introduction and statement for consent was added within the survey questionnaire.

Statistical Analysis

The data was analysed using Microsoft excel. Descriptive statistics in form of percentage, average and chi square test were formulated. The key findings were presented in a tabular form. Chi square (χ^2) test was done to identify any association in the data and the significance level (p) for the study was kept at 0.05.

Results

The total number of respondents was 522 (36.7% males, 63.1% females), 88.5% Undergraduates, 11.5% Postgraduates and 58.8% Urban, 41.2% Rural students [Table 1]. The data on mode of education and learning [Table 2] revealed that 90% of students resorted to online education; mobile phone being the most preferred gadget (86.8%). Online platforms such as Google meet, zoom was the main source of learning (83.9%). 46.5% of the students spent 4-6 hours/day in online learning ($\chi^2 = 6.7261$, $p = 6.7261$) and 75% faced network issues.

The perspectives of students on learning, understanding and practical skills in online education [Table 3] revealed that 79.2% of the undergraduate and 50% post-graduate students were unable to gain their attention towards the subjects ($\chi^2 = 24.7618$, $p = <0.00001$). 61.1% students felt that there were no group discussions possible during the online learning system. 86.4% students rated the Teacher-Student interaction during online classes as poor ($\chi^2 = 7.4951$, $p = .006187$) and they have difficulty concentrating in online lectures ($\chi^2 = 5.4635$, $p = .019418$). Almost 60% students felt that the pandemic conditions are unfavourable for the preclinical students. The shift to online learning due to the pandemic has hampered the development of practical skills in 88.3% ($\chi^2 = 4.5408$, $p = .033097$) of the students and has led to decline of confidence in 81.2%.

85.4% students reported that less than 50% clinical learning was possible in the pandemic conditions; 95.4% perceived that direct interaction with the patient is must for clinical learning. About 70% students were not able to learn with their maximal intellectual capability during the lockdown. The mode of examination opted by most of the students was online (64.2%, $\chi^2 = 4.6003$, $p = .031966$); 82.4% of the students perceived that the online examination couldn't appropriately evaluate their knowledge and more than 60% were unsatisfied with the evaluation. When asked about attending an e-workshop, 48.1% had attended an e-workshop, though majority of them (70.5%) felt that these workshops were not as effective as offline workshops. More than 80% respondents had difficulty in adopting the e-learning system effectively and easily. Regardless of the educational level, 74.3% students were incapable of collaborating the theoretical and practical knowledge ($\chi^2 = 5.4077$, $p = .020048$). 62.3% of the students felt that online learning system would put a worsening impact on their clinical careers; a majority rated online learning as poor. Half the respondents (50%) opined that offline learning will be fruitful for learning in the post pandemic period, whereas, nearly 40% had opinion that a blended learning would turn out to be an excellent option.

The data for health issues during online learning revealed that males had higher preponderance of fatigue, neck and back pain. Nearly 70% of male students reported psychological stress and burden during the online learning ($\chi^2 = 9.2938$, $p = .002299$) which manifested as anxiety and irritable behaviour during the lockdown. [Table 4]

Table 1: Demographic data of the subjects

Variables	Number of respondents n= 522	Percentage (%)
Age group		
15-20 years	165	31.6%
20-25 years	331	63.4%
25-30 years	26	5%
Gender		
Male	192	36.7%
Female	330	63.1%
Type of student		
Undergraduate	462	88.5%
Postgraduate	60	11.5%
Place of dwelling		
Urban	307	58.8%
Rural	215	41.2%

Table 2: Mode of Education during online learning

Variables	Number of respondents n= 522 n(%)	Undergraduate n= 462 n(%)	Postgraduate n=60 n(%)	Chi square value (χ^2)	Significance value (p)
Mode of education during pandemic					
Online	477(91.4%)	423(91.6%)	54(90%)	0.1637	.68575 ^{NS}
Device used for online study					
Mobile phone	448(86.8%)	396(85.7%)	52(86.7%)	0.5665	.753314 ^{NS}
Tablet	17(3.2%)	16(3.5%)	1(1.6%)		
Laptop	57(11%)	50(10.8%)	7(11.7%)		
Source of learning in pandemic					
Recorded lectures	21(4%)	20(4.3%)	1(1.7%)	8.4992	.01427*
Online lectures through platforms like zoom, google meet, etc.	438(83.9%)	379(82%)	59(98.3%)		
Available study material on internet	63(12.1%)	63(13.7%)	0(0%)		
Did internet services pose an issue in online learning					
Yes	401(76.8%)	350(75.8%)	51(85%)	2.5475	.110472 ^{NS}
Hours spent in online learning					
1-2 hours	60(11.5%)	53(11.5%)	7(11.7%)	6.7261	.03463*
2-4 hours	219(42%)	185(40%)	34(56.7%)		
4-6 hours	243(46.5%)	224(48.5%)	19(31.6%)		

*p<0.05

**p<0.01

***p<0.001

Non-significant^{NS}**Table 3: Effect of Online Education on Learning, Understanding and Practical skills of students**

Variables	Number of respondents (%)	Undergraduate (462)	Postgraduate (60)	Chi square value (χ^2)	p value
Were the online lectures able to gain your attention towards the subject?					
No	396(75.9%)	366(79.2%)	30(50%)	24.7618	<0.00001***
Were group discussions possible in online lectures?					
No	319(61.1%)	280(60.6%)	39(65%)	0.4314	.5113 ^{NS}
Rating of teacher-student interaction in online classes					
Poor	451(86.4%)	406(87.9%)	45(75%)	7.4951	.006187**
Were you able to concentrate well on your lectures online while being at home?					
No	451(86.4%)	405(87.7%)	46(76.7%)	5.4635	.019418*
How often did you attend offline practical classes in this period?					
2-3 times a week	137(12.8%)	116(12.8%)	21(13.3%)	2.6843	.101342 ^{NS}
Not at all	385(73.8%)	346(74.9%)	39(65%)		
Were the pandemic conditions unfavourable for preclinical students?					
Yes	304(58.2%)	267(57.8%)	37(61.7%)	0.3278	.566981 ^{NS}
Did you feel practical skills have been developed during online teaching at home?					
No	461(88.3%)	413(89.4%)	48(80%)	4.5408	.033097*
What you think is better for clinical learning?					
Direct interaction/ contact with patients	498(95.4%)	441(95.5%)	57(95%)	0.025	.874333 ^{NS}
Online training	24(4.6%)	21(4.5%)	3(5%)		
What percentage of clinical learning was possible during lockdown?					
Less than 50%	446(85.4%)	390(84.4%)	56(93.3%)	3.3949	.065399 ^{NS}
Did the pandemic situation put a negating impact on your confidence in practical skills?					
Yes	424(81.2%)	374(81%)	50(83.3%)	0.1974	.656818 ^{NS}

Mode of examination taken during pandemic					
Online	335(64.2%)	289(62.6%)	46(76.7%)	4.6003	.031966*
Did the online examinations correctly evaluate the knowledge of students?					
No	430(82.4%)	379(82%)	51(85%)	0.3216	.570626 ^{NS}
Was the online examination evaluation satisfactory					
No	338(64.8%)	305(66%)	33(55%)	2.8241	.092859 ^{NS}
Did you attend any e-workshop during this period of pandemic?					
Yes	251(48.1%)	220(47.6%)	31(51.7%)	0.3485	.554956 ^{NS}
Do you think the e-workshops can be equally beneficial as offline workshops?					
No	368(70.5%)	321(69.5%)	47(78.3%)	2.001	.15719 ^{NS}
Were you able to easily adapt the e-learning system?					
No	429(82.2%)	376(81.4%)	53(88.3%)	1.7509	.18577 ^{NS}
Were you able to collaborate the theoretical and practical knowledge through online education?					
No	388(74.3%)	336(72.7%)	52(86.7%)	5.4077	.020048*
Rating of the online learning system					
Poor	431(82.6%)	377(81.6%)	54(90%)	2.6021	.106722 ^{NS}
Did you find online learning better than offline?					
No	469(89.8%)	411(89%)	58(96.7%)	3.4565	.063005 ^{NS}
Do you feel the online learning will put a deteriorating effect on your clinical career?					
Yes	325(62.3%)	287(62.1%)	38(63.3%)	0.0332	.855408 ^{NS}
What according to you will be fruitful for learning in post pandemic period?					
Online learning	55(10.5%)	52(11.2%)	3(5%)	2.2671	.321894 ^{NS}
Offline learning	261(50%)	230(49.8%)	31(51.7%)		
Mixture of online and offline learning	206(39.5%)	180(39%)	26(43.3%)		

*p<0.05

**p<0.01

***p<0.001

Non-significant^{NS}**Table 4: Health problems faced by students during online learning**

Variables	Number of respondents n (%)	Male (192)	Female (330)	Chi square value (χ ²)	p value
Did you face any health issue during the online learning period?					
Yes	231(44.3%)	93 (48.4%)	138(41.8%)	2.1558	.142033 ^{NS}
Did you feel any physical issue or fatigue during online learning?					
Yes	305(58.4%)	119(62%)	186(56.4%)	1.5758	.209363 ^{NS}
Did you suffer from neck pain or backache during online classes?					
Yes	364(69.7%)	136(70.8%)	228(69.1%)	0.1746	.676059 ^{NS}
Did you feel any psychological burden during online learning systems?					
Yes	317(60.7%)	133(69.3%)	184(55.8%)	9.2938	.002299**
Have you suffered from anxiety or irritation during this period?					
Yes	346(66.3%)	135(70.3%)	211(63.9%)	2.206	.137478 ^{NS}
Were you able to learn with a maximal intellectual capacity during the lockdown?					
No	377(72.2%)	140(72.9%)	237(71.8%)	0.073	.787008 ^{NS}

*p<0.05

**p<0.01

***p<0.001

Non-significant^{NS}

Discussion

The study aimed at evaluating the impact of the COVID 19 on the learning style and health of Physiotherapy students. The results revealed that the pandemic period has significant impact on learning, understanding and practical skills of the students. The most pertinent finding of the study is that majority of students had a declined concentration level, unable to focus on the subjects with complete attention and incapable of learning with their maximal intellectual capacity in the e-learning system, major reasons being lack of interest among students and the change of teaching style. A sense of boredom and lack of motivation during e-learning had led to lack of interest for attending lectures, poor Student-Teacher interaction in online classes and lack of real-life verbal and nonverbal communication which could result in a passive form of learning. Our findings have been corroborated by a study Liang et al., 2020 which has reported that online learning minimise the chances of building a better mentoring relationship between faculty and students. Other significant finding of the study is that most of the students felt that the shift from conventional to online mode of teaching had been inappropriate for the development of practical skills, building their confidence and there was no clinical learning as direct interaction with the patients, which wasn't possible in the pandemic. The lack of hands-on training and clinical placements has negative effect on Physiotherapist's skills which was evident by Sahi et al., 2020 that mentioned the importance of bedside teaching with a live patient for getting first-hand experience of seeing a patient's clinical findings and understanding it. Another important result from our study was the students' greatest concern regarding online examination affecting their performance and evaluation. The greatest difficulty of online examination for students is the home environment (Hannah et al., 2020). A recent study also revealed internet connectivity as a major issue encountered in E-exams during the COVID-19 pandemic among students (Bisht et al., 2020). The students reported of the incapability of a

theoretical and practical collaborative learning due to inability of clinical exposure to what they are learning, which in turn makes the students unable to collaborate the knowledge. This led the students to rate the online learning system as poor and their hiked preference for offline education. The results revealed that a greater number of students suffered from fatigue, neck pain and back pain during online learning out of which proportion of male students was higher. Social isolation is significantly associated with physical activity, so individuals staying isolated during pandemic were less physically active and more likely to report several health issues (Shankar et al., 2011). A huge number of participants also mentioned about the psychological issues such as stress, anxiety and irritability. Previous studies showed that disease outbreaks impacted individual mental health and well-being (Taylor et al., 2008). These psychological responses are more likely to occur and worsen due to the lack of interpersonal communication during the social distancing (Xiao et al., 2020). Evidence from the literature indicates that the experience of stress impairs efforts to be physically active (Kmietowicz et al., 2020). The COVID 19 pandemic has completely changed the ways of learning which had put a negating impact of education. This issue needs to be addressed with valid solutions to avoid disruption in education of physiotherapy students. By providing appropriate clinical training while keeping in mind the safety of students and teachers in coronavirus spread is a must for preventing any disruption in education and a brighter future of Physiotherapy. Having a blended approach with online lectures and electronic resources combined with face-to-face practical classes in health professional programs should be kept in mind for future pandemics. Further provisions in the area of technology, infrastructure and counselling are must at college/university level to support the physiotherapy students during the pandemic and beyond.

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Barriers to Interdisciplinary Research

Supreet Bindra

Assistant Professor, Physiotherapy, Sri Guru Granth Sahib World University, Fatehgarh Sahib

Physio.supreet@gmail.com

Abstract

There is need for an interdisciplinary education and research to prepare future managers, scientists and leaders to solve complex socio-environmental problems, however many academic institutions still address the critical topic areas through discipline bound approaches and interdisciplinary research (IDR) is not popular among researchers. There is dearth of studies identifying such barriers amongst the faculty and research scholars of universities and thus was the topic of interest. Data from the research scholars and faculty members of an institute was collected using a self-reported questionnaire. 37.93% of the respondents were involved in IDR out of which majority belonged to applied sciences and engineering. Inadequate space, teaching areas and research labs, poor career structures, tradition in academic institutions, difficulty in funding were some of the institutional barriers. Culture of different disciplines, difference in research methods and difficulty in clarifying problem were some of the epistemological barriers identified. Geographic differences in terms of travel, lack of time and effort, lack of cooperation, low tolerance and resistance to learn from other disciplines were barriers to teamwork. Lack of opportunities to publish research and discrimination by referees were barriers to research translation. 54.02% of the respondents were novice and had less than 5 years of experience as a researcher and teacher. Low response rate, small sample size and data from a single institute were some of the limitations of the study making it difficult to generalize the findings. Therefore, studies with larger sample size are required so that adequate recommendations can be made.

Key Words: Barriers, Interdisciplinary Research

Introduction

Integrated research commonly refers to a process of coordinated, collaborative or combined inquiry in to a common problem with sharing, creation and synthesis of knowledge among disciplines and researchers (Klein, 1996, Clark et al., 1999). The research integration typology includes a core spectrum of disciplinary, multidisciplinary, interdisciplinary and transdisciplinary research (Morse et al., 2007). Interdisciplinarity is a type of academic collaboration in which specialists drawn from two or more academic disciplines work together in pursuit of common goals. True interdisciplinarity occurs when researchers from two or more disciplines pool their approaches and modify them so that they are better suited to the problem at hand whereas transdisciplinary connotes a research strategy that crosses many disciplinary boundaries to create a holistic approach. In multidisciplinary, researchers from two or more disciplines work together on a common problem but without altering their disciplinary approaches or developing a common conceptual framework. Interdisciplinary programs draw from two or more academic disciplines that work together to create a powerful learning experience and emphasize integrative learning, critical thinking and creative problem solving (Majumdar, 2019). Many academic and scientific institutions now recognize the need for an interdisciplinary education to prepare future managers, scientists and leaders to solve complex socio-environmental problems, however many academic institutions still address the critical topic areas through discipline bound approaches and IDR is not popular among researchers. Lack of funding, lack of historical interdepartmental or cross disciplinary cooperation, extended time requirement's, differences in methodologies and disciplinary norms (Majumdar, 2019) are some of the barriers that have been identified to limit expansion beyond traditional disciplinary structures, but there is dearth of studies identifying such barriers amongst the faculty and research scholars of universities and thus was the topic of interest.

Methodology

Electronic searches using a combination of words were performed in Google Scholar. The bibliography of the included studies was also reviewed. The key terms searched were a combination of words such as interdisciplinary research, barriers, scope of interdisciplinary research, challenges. Thereafter a questionnaire on barriers for interdisciplinary research was prepared. Data was collected from research scholars and faculty members of a university using questionnaire designed for the same.

Results

Questionnaire was distributed to 135 research scholars and faculty members of a university. 42 (31.11%) respondents did not respond, 4 (2.96%) refused to cooperate and 2 (1.48%) submitted incomplete forms yielding a response rate of 64.44% (n=87). 33 out of 87 (37.93%) were involved in interdisciplinary research. Out of 37.93% respondents, the majority of the respondents that were involved in interdisciplinary research belonged to applied sciences (62.5%) followed by engineering and technology (56.25%); social sciences, education and information sciences (42.85%); commerce management and legal studies (33.33%); and biological sciences (16.66%) (Fig.1). None of the respondents from faculty of medical sciences and languages was involved in interdisciplinary research.

Out of institutional barriers inadequate space, teaching areas and research labs (60.6%), poor career structures for academic interdisciplinary researchers (57.57%); tradition in academic institutions of organizing research and teaching activities by discipline -based departments (51.51%); lack of or difficulty in getting funding for research (51.51%); Lack of cooperation by department (42.42%) and untrained faculty (36.36%) were some of the barriers that were identified (Fig. 2).

Culture of different disciplines (75.75%); Difference in research methods (63.63%); Difficulty in clarifying problem definition and integrating objectives (57.57%) and lack of common language (36.36%) were some of the epistemological barriers for interdisciplinary research perceived by the respondents (Fig. 3).

Geographic differences in terms of travel required for research (63.63%); Lack of time and effort (57.57%); Lack of cooperation by other researchers (54.54%); Low tolerance and resistance to learn from other disciplines (54.54%); Peer inhibition (42.42%); Lack of good interpersonal and team building skills (42.42%); Low esteem of interdisciplinary research by monodisciplinary colleagues (39.39%) and Lack of confidence (36.36%) were the barriers to teamwork perceived by the respondents (Fig. 4).

Lack of opportunities to publish research results in high ranking refereed journals (42.42%) and Discrimination by referees against interdisciplinary research proposals and publications (45.45%) were barriers to research translation perceived by the respondents (Fig. 5).

Out of the total respondents, more than 54.02% had less than 5 years of experience as a researcher and teacher, whereas only 2.29% respondents had an experience of more than 10 years as a researcher and 9.19% as a teacher (Fig. 6 and 7).

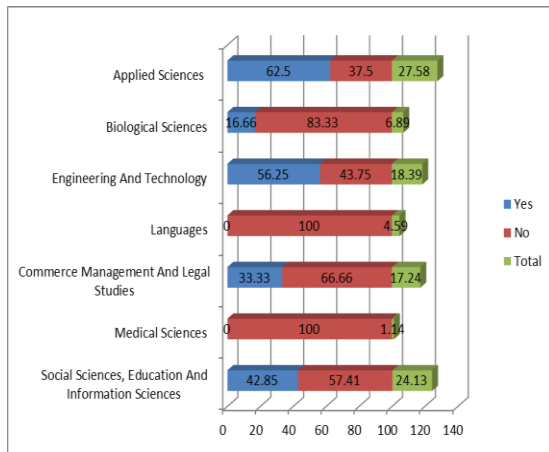


Fig. 1: Have you been involved in Interdisciplinary Research

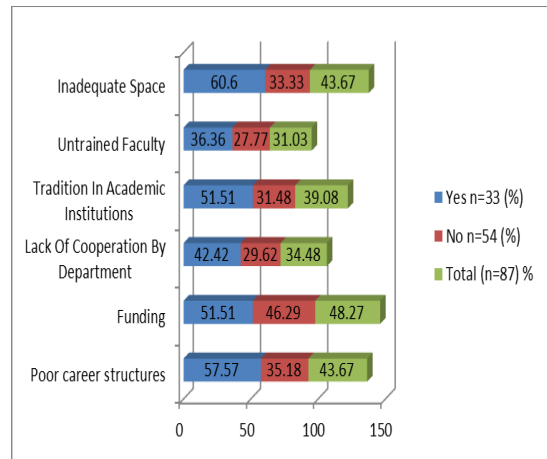


Fig. 2: Institutional Barriers for Interdisciplinary Research

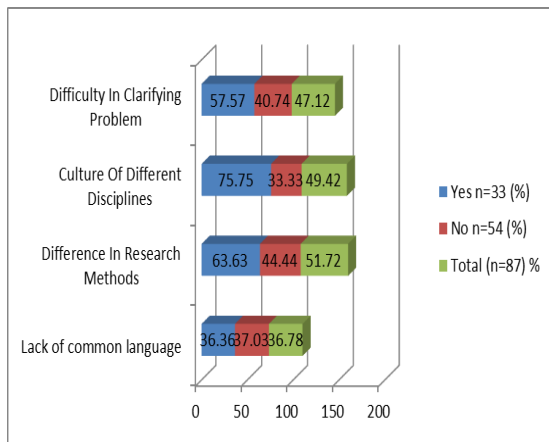


Fig. 3: Epistemological Barriers for Interdisciplinary Research

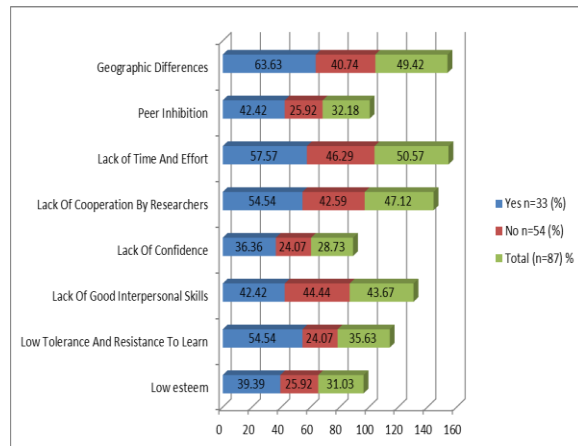


Fig. 4: Barriers to teamwork for Interdisciplinary Research

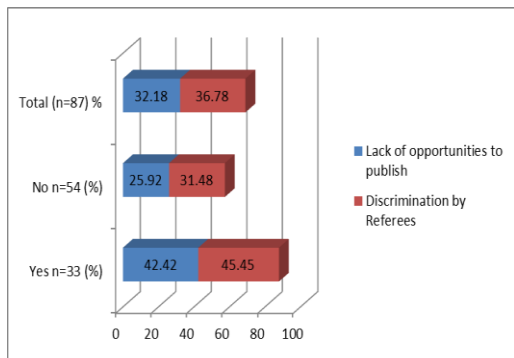


Fig. 5: Barriers to Research Translation perceived by respondents

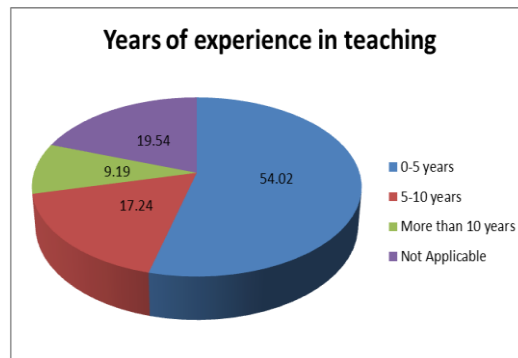


Fig.6: Years of experience in Teaching

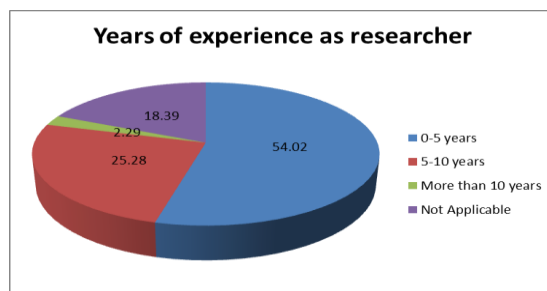


Fig.7: Years of experience as a Researcher

Discussion and Conclusion

The biggest challenge to IDR is the support and favour of current academic system towards an independent investigator. Single discipline research had encountered a bottle-neck and more than one discipline needed to make a breakthrough (Majumdar, 2019). The majority of disciplines house researcher's in accordance with their disciplines by tradition whereas IDR requires an amalgamation of researchers from varied disciplines. Moreover, a research of interdisciplinary nature requires interdisciplinary peer review. In addition, IDR requires the researchers to learn other discipline's vocabulary, methodology and techniques which necessitate investment of lot of effort and time. Open mindedness, tolerance, cooperation, trust, readiness to learn and exchange ideas and knowledge pertaining to disciplines are required to overcome individual barriers. This will not work if one discipline is perceived as superior to the other.

Difficulty in getting funding for research, inadequate infrastructure in terms of space and labs required, poor career structures are some of the institutional barriers that needed to be overcome for IDR. A reward system that appreciates and acknowledges the time and effort in IDR would be instrumental in facilitating IDR.

Newer applications of IDR in new medical, scientific and technological problems like biotechnology, nano technology, space science, networking, developing sensor webs, computer webs and social webs, complex systems and their interaction over time, environment, machines, people, society and cultures will motivate young scientist to take IDR (Majumdar, 2019).

The Policies for IDR should favour dissemination of knowledge gained and application of laboratory findings to real world. Creation of policies and opportunities for research translation in terms of publication of IDR in high ranking refereed journals will favour IDR among research scholars. Low response rate, small sample size and data from a single institute were some of the limitations of the study making it difficult to generalize the findings. Therefore, studies with larger sample size are required so that adequate recommendations can be made.

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A Study to Compare the Effect of Muscle Energy Technique and Craniocervical Flexion Exercises on Pain, Cervical Range of Motion and Disability among Patients with Cervicogenic Headache

***Yash Partap, **Deepak Sahotra**

*Associate Professor, D.A.V Institute of Physiotherapy and Rehabilitation Jalandhar **M.S. Orthopaedics
manupratap.physio@gmail.com

Abstract

Background: Cervicogenic headache (CGH) is regarded as a preferentially unilateral headache that initially may be remitting but tends to become chronic over time. Pain exacerbations generally start in the neck/occipital area and then spread to the forehead. Cervicogenic headache can influence the quality of life of patients in addition to a loss of functions as compared to other groups of headaches. **Aim of the Study:** To compare the effect of Muscle Energy Technique and Craniocervical Flexion Exercises on Pain, Range of Motion and Disability among patients with Cervicogenic Headaches. **Study Design:** Quasi Experimental Design Comparative in nature. **Methodology:** The duration of the study was 1 year. Subjects were assessed for the neck pain using NPRS; neck disability with the help of NDI; neck ROM using universal goniometer as well as the readings of cranio-cervical flexion test were also carefully recorded. 45 subjects who met the inclusion criteria were selected for the study between the age of 18-45 years and divided into 3 groups—Group A, Group B, Group C with 15 subjects in each group. Group-A received (Hot Pack, TENS + Static Stretching), Group-B (Hot Pack, TENS + Muscle Energy Technique) and Group-C (Hot Pack, TENS + Cranio-cervical Flexion Exercises). In total 10 treatment sessions were given to each subject that is 5 times a week for 2 weeks. The data was recorded on 1st session (pretreatment) and subsequently at the end of 5th session and 10th session. **Results:** The result of our study showed that Group- A, B and C were found statistically significant within group analysis in terms of pain, functional disability and ROM. The result of intergroup analysis found significant improvement in all the three groups that is group A, B, and C in terms of pain, cervical ROM, and functional disability. **Conclusion:** The result of this study concluded that both techniques were equally effective in decreasing pain, disability and improving cervical range of motion in patients with cervicogenic headaches. **Keywords:** Cranio-cervical Flexion Exercises; Cervicogenic Headache; Muscle Energy Technique

Background

Cervicogenic (CGH) headache is considered as a preferentially unilateral headache that originally could be remitting however that tends to become chronic over time. It's of moderate intensity, most often seen in females, and is related to symptoms and signs relating it to the neck (Merskey et al., 1994). The international headache society in their international classification of headache disorders second edition, described fourteen different types and sub classifications of headaches. The 2 main classes of classification are primary headache and secondary headaches (Bogduk et al., 1994). Cervicogenic headaches, originate within the areas innervated by the cervical spine nerves (C1– C3). It starts within the neck and over a time migrates upwards from the nuchal lines to the cephalic or facial regions. Researchers have additionally confirmed belittled strength and endurance of the deep neck flexors in CGH patients. the foremost vital diagnostic finding in CGH is impairment of C1-C2 (Atlanto -axial) motion (Sjaastad et al., 1998). Globally more or less 47% of the population suffers from a headache and around 15-20% of those are cervicogenic in nature (Nilsson et al., 1995). The successful treatment of cervicogenic headache usually requires a multifaceted approach using pharmacologic, non-pharmacologic, manipulative, anaesthetic, and surgical interventions (Biondi et al., 2005). Osteopathic manipulative techniques like strain counter strain, and muscle energy techniques are particularly very well suited for the management of cervicogenic headache. Therapeutic modalities are generally better tolerated when initiated with gentle muscle stretching (Jull et al., 2008). Cranio-cervical flexion exercises are used for activating the deep-seated neck flexors in patients with chronic cervical pain (Goodridge et al., 1981). Muscle energy technique is a manual therapy intervention that can be used to lengthen or stretch muscles and fascia that lack flexibility (Ylinen et al., 2003). Literature has numerous studies explaining the effect of Mulligan technique and MET, effect of MET and static stretching, effect of deep neck flexors training etc., on cervicogenic headache. However, there is a scarcity of evidences on the effect of MET as well as on the effect of Cranio-cervical flexion exercises amongst patients with cervicogenic headache. So, the purpose of the study was to compare the effect of Muscle Energy Technique and Cranio-cervical Flexion Exercises on Pain, Cervical Range of Motion and Disability among patients with Cervicogenic Headaches, and the objectives of the study was to evaluate the effect of muscle energy technique on pain, range of motion, disability among patients with cervicogenic headache, and to evaluate the effect of cranio-cervical flexion exercises on pain, range of motion, disability among patients with cervicogenic headache.

Methodology

A Quasi Experimental, comparative in nature which was done in the Out- Patient Department of DAV Institute of Physiotherapy and Rehabilitation, Jalandhar and its affiliated hospitals with a total duration of one year. A total of 45 subjects were selected with the convenient sampling and divided into 3 groups with 15 subjects in each group. Subjects aged 18-45 years, both male and female participants who gave written informed consent, and subjects with tightness of unilateral or bilateral upper trapezius, levator scapulae and scalene muscles were included in the study. Subjects with Cervical radiculopathy, recent trauma/ surgery of head and neck, any congenital anomalies (Torticollis, Sprengel shoulder), any inflammatory disorders of spine (Rheumatoid Arthritis, Ankylosing Spondylitis), any neurological disorder (epilepsy, psychosomatic disease), and subjects having ENT/ EYE diseases were excluded from the study. Independent variables for the study were Static stretching, Intensity and Duration of T.E.N.S. (Transcutaneous Electrical Nerve Stimulation), Muscle Energy Technique, Cranio-cervical Flexion Exercises. Dependent variables for the study were Pain (Numeric pain rating scale (NPRS)), Range of Motion (Universal Goniometer), Disability (Neck Disability Index (NDI)), Cranio-cervical Flexion Test Instruments (Universal Goniometer, Pressure Biofeedback Unit, Hydrocollator unit). The parameters were assessed at Day-1 Pre-intervention, Day-5 Post intervention, and at Day-10 Post intervention.

Protocol

A total of 10 treatment sessions were given to each subject that is 5 times a week for 2 weeks.⁹

Group-A (N=15) Control Group (hot pack, TENS and Static Stretching): Hot pack was given over the neck region in comfortable position according to the subject's preference for 10 minutes. TENS was applied in prone position, pulsed current with rectangular monophasic shape, pulse duration of 10-15 milliseconds with a frequency of 40-70 Hz. The duration of treatment was 20 minutes. Static stretching of the upper trapezius, levator scapulae and scalene muscle individually was held for 10-30 seconds and was repeated for 3-5 times.¹¹

Group B (N=15) Experimental Group-1 (hot pack, TENS and Static Stretching, and MET): MET for upper trapezius and levator scapulae and scalene muscle (3 times in a week).¹² MET was applied to Upper trapezius, Levator scapulae and Scalene muscles. Following the 7-10 seconds isometric contraction and complete relaxation of all elements, the stretch was maintained for 20-30 seconds. The effort and the counter pressure kept modest and painless. The process was repeated 3-5 times.¹³

Group C (N=15) Experimental Group-2 (hot pack, TENS and Static Stretching and CCFEx)

Cranio-cervical flexion exercises along with conventional treatment. In this programme, emphasis was placed on first attaining the correct cranio-cervical flexion action, with minimal activity of the superficial cervical flexor muscles. The cranio-cervical flexion action involves a specific cranio-cervical movement of the head such that it remains in contact with the supporting surface. Once the correct action had been achieved, instructions were imparted to the participants in the use of the pressure biofeedback unit to guide the training of the CCF muscle contraction at various incremental levels of pressure (22 to 30 mmHg, progressively inner range positions).

Data Analysis

Data analysis was carried out after collecting the data of three outcome measures of all three groups. Data analysis was performed using SPSS software version 16.0. Between group and within group comparison were done.

Repeated measure ANOVA was done for within group analysis. For the between group analysis, one- way ANOVA and Post Hoc analysis was done using Tukey 's method. In all the statistical comparisons, $p < 0.05$ was used as the criterion for statistical significance.

Comparison Between the Groups

Table 4.1: Between Group Comparison of NPRS

NPRS	Group	Mean	SD	N	F	p- value	Result
Day 1	A	7.93	1.58	15	0.917	0.407	Non- Significant
	B	7.4	1.183	15			
	C	7.27	1.486	15			
Day 5	A	6.93	1.668	15	8.335	0.001	Significant
	B	5.8	1.207	15			
	C	5.0	0.926	15			
Day 10	A	6.07	1.58	15	40.09	0.000	Significant
	B	3.47	1.06	15			
	C	2.2	0.862	15			

Table 4.2: Post Hoc Comparison of Mean Between Groups for NPRS at Day

Group	Day 10 Mean± SD	p-value	Result
Group A vs Group B	6.07 ± 1.58 3.47 ± 1.06	0.000	Significant
Group B vs Group C	3.47 ± 1.06 2.2 ± 0.862	0.017	Significant
Group A vs Group C	6.07 ± 1.58 2.2 ± 0.862	0.000	Significant

Table 4.3: Between Group Comparison of NDI

NDI	Group	Mean	SD	N	F	p- value	Result
Day 1	A	53.4	17.582	15	1.375	0.264	Non- Significant
	B	44.87	13.768	15			
	C	44.07	19.422	15			
Day 5	A	37.8	14.163	15	3.455	0.041	Significant
	B	27.73	9.852	15			
	C	25.07	17.019	15			
Day 10	A	22.93	17.347	15	8.806	0.001	Significant
	B	10.4	6.01	15			
	C	6.6	6.021	15			

Table 4.4: Post Hoc Comparison of Mean Between Groups for NDI at Day 10

Group	Day 10 Mean± SD	p-value	Result
Group A vs Group B	22.93 ± 17.347 10.4 ± 6.01	0.010	Significant
Group B vs Group C	10.4 ± 6.01 6.6 ± 6.021	0.623	Non- Significant
Group A vs Group C	22.93 ± 17.347 6.6 ± 6.021	0.001	Significant

Table 4.5: Between Group Comparison of Flexion

Flex	Group	Mean	SD	N	F	p- value	Result
Day 1	A	51.67	10.635	15	0.078	0.925	Non- Significant
	B	53.47	19.752	15			
	C	51.2	17.877	15			
Day 5	A	54.13	11.012	15	0.154	0.858	Non- Significant
	B	56.53	19.179	15			
	C	57.4	18.677	15			
Day 10	A	53.73	13.885	15	1.003	0.376	Non- Significant
	B	60.07	19.118	15			
	C	62.67	19.729	15			

Table 4.6: Post Hoc Comparison of Mean Between Groups for Flexion ROM at Day 10

Group	Day 10 Mean± SD	p-Value	Result
Group A vs Group B	53.73 ± 13.885 60.07 ± 19.118	0.596	Non- Significant
Group Bvs Group C	60.07 ± 19.118 62.67 ± 19.729	0.915	Non- Significant
Group Avs Group C	53.73 ± 13.885 62.67 ± 19.729	0.362	Non- Significant

Table 4.7: Between Group Comparison of Extension

Ext	Group	Mean	SD	N	F	p-value	Result
Day 1	A	48.67	8.55	15	4.913	0.012	Significant
	B	57.27	10.653	15			
	C	58.13	8.017	15			
Day 5	A	50.87	9.156	15	5.664	0.007	Significant
	B	59.13	10.842	15			
	C	61.6	7.049	15			
Day 10	A	52.73	9.215	15	6.241	0.004	Significant
	B	61.13	10.921	15			
	C	64.47	7.707	15			

Table 4.8: Post Hoc Comparison of Mean Between Groups for Extension ROM at Day 10

Group	Day 10 Mean± SD	p-value	Result
Group Avs Group B	52.73 ± 9.215 61.13 ± 10.921	0.047	Significant
Group B vs Group C	61.13 ± 10.921 64.47 ± 7.707	0.597	Non- Significant
Group Avs Group C	52.73 ± 9.215 64.47 ± 7.707	0.004	Significant

Table 4.9: Between Group Comparison of Left Side Rotation

LRot	Group	Mean	SD	N	F	p-value	Result
Day 1	A	52.0	11.619	15	0.956	0.393	Non- Significant
	B	56.0	15.278	15			
	C	58.67	12.709	15			
Day 5	A	53.87	11.313	15	1.805	0.177	Non- Significant
	B	58.13	14.899	15			
	C	63.13	13.653	15			
Day 10	A	55.8	10.884	15	2.158	0.128	Non- Significant
	B	59.8	15.134	15			
	C	66.13	14.784	15			

Table 4.10: Post Hoc Comparison of Mean Between Groups for Left Side Rotation Rom At Day 10

Group	Day 10 Mean ±SD	p- value	Result
Group Avs Group B	55.8 ± 10.884 59.8 ± 15.134	0.707	Non- Significant
Group Bvs Group C	59.8 ± 15.134 66.13 ± 14.784	0.424	Non- Significant
Group Avs Group C	55.8 ± 10.884 66.13 ± 14.784	0.111	Non- Significant

Table 4.11: Between Group Comparison of Right- Side Rotation

RROT	Group	Mean	SD	N	F	p- value	Result
Day 1	A	50.33	11.387	15	1.651	0.204	Non- Significant
	B	56.2	16.045	15			
	C	59.07	12.366	15			
Day 5	A	52.2	11.085	15	2.434	0.100	Non- Significant
	B	58.33	14.898	15			
	C	62.6	12.671	15			
Day 10	A	54.0	10.516	15	3.098	0.056	Non- Significant
	B	59.47	15.236	15			
	C	65.93	13.53	15			

Table 4.12: Post Hoc Comparison of Mean Between Groups for Right side Rotation ROM at Day 10

Group	Day 10 Mean± SD	p-value	Result
Group Avs Group B	54.0 ± 10.516 59.47 ± 15.236	0.496	Non- Significant
Group Bvs Group C	59.47 ± 15.236 65.93 ± 13.53	0.378	Non- Significant
Group A vs Group C	54.0 ± 10.516 65.93 ± 13.53	0.044	Significant

Discussion

In group A, within group analysis for NDI showed significant difference. From, our study it was noted that hot pack; TENS and static stretching are effective for reducing disability and Hydrocollator packs are used to reduce pain, muscle spasm and also helps to Improve ROM due to its effect on metabolic and hemodynamic activity.¹⁴

Group B within group analysis the findings of our study revealed that there was a significant improvement in the NDI. The results obtained for pain in MET group were in consensus with the previous study in which pain intensity was reduced following the MET over the neck area.¹⁵

Within group C the findings of our study revealed that there was a significant improvement in NDI. Low load Cranio-cervical flexion exercise can train deep neck flexors effectively even in early stages of rehabilitation and thus gradually reduces the symptoms and increases the CROM significantly.¹⁶

Conclusion

The result of our study showed that Group- A, B and C were found statistically significant within group analysis in terms of pain, functional disability and ROM. The result of intergroup analysis found significant improvement in all the three groups that is group A, B, and C in terms of pain, cervical ROM, and functional disability. However, all the three groups showed a statistically not significant improvement in flexion and left rotation when compared between the groups. Intergroup analysis between Group B and C were equally effective in reduction of pain and functional disability and increase in cervical range of motion. Thus, our study supports the null hypothesis.

Limitations of the Study

The sample size for the study was small, and No long term follow up was taken.

Future Scope of the Study

The study will aid to the literature for future studies.

The study can be done with a large sample size.

Long term follow- up studies could be done to observe the long- term effects.

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Yogic Practices in Maternal Depression: A Review

*Jagmeet Kaur **Supreet Bindra **Pankajpreet Singh

*PhD Scholar, **Assistant Professor, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab

jagmeet2595@gmail.com

Abstract

Background: Mental health problems such as depression and anxiety during pregnancy and after childbirth are very common worldwide. Up to 20% of women may develop a depressive disorder at some point during pregnancy. Maternal depressive symptoms are associated with adverse perinatal outcomes such as low birth weight, preterm delivery and small for gestational age. Yoga, an unconventional therapy has swiftly become a popular form of exercise and relaxation for pregnant women during the last decade. **Objective:** The objective of the current study is to know the effect of yogic practices in maternal depression. **Methods:** The literature search was administered in the subsequent databases: PubMed, Web of Science, Scopus, CINAHL, Google Scholar. Literature studies were extracted on effects of yoga in maternal depression. **Key Findings:** No serious adverse effects were reported. Studies conducted for examining effects of yoga on maternal depression is scarce but represents significant result. Yoga-based interventions are promising non-pharmacological modality in the management of maternal depression during pregnancy. It helps in improving psychological health of expectant mothers, benefits pregnancy and fetal outcomes. As currently available studies had small sample sizes, larger randomized, controlled, prospective trials including patients with varying severity of symptoms are required to confirm the benefits of yoga-based interventions for perinatal depression.

Keywords: “therapeutic yoga”, “maternal depression” and “effect of yoga on depression”

Introduction

Depression and anxiety are the most common mental health disorders. In developing countries, one in every 3-5 pregnant women and mothers of newborns has significant mental health problems. This rate is about one in ten in developed countries (Alipour et al., 2011). Antenatal depression (AD) and postpartum depression (PPD) are common, with a prevalence of 18% and 19%, respectively (Aghajafari et al., 2018). Some studies have shown elevated fear and anxiety in the third trimester of pregnancy. This fear, which may be present during the entire course of pregnancy, can complicate labor and finally lead to postpartum depression and a troubled mother-infant relationship (Rouhe et al., 2008).

Antenatal depressive disorders are undetected in many cases because of the overlap between depressive symptoms and symptoms of normal pregnancy such as sleep disturbances, weight gain, disturbances in appetite and fatigue (Marcus et al., 2003). Adverse consequences of antenatal depression, an important risk factor for postpartum depression, are experienced even after childbirth, which include a lower likelihood of initiating and maintaining breastfeeding (Mukherjee et al., 2016). Additional risk factors include lack of social support, marital dissatisfaction, discriminatory work environments, history of domestic abuse and unplanned or unwanted pregnancy (Biaggi et al., 2015).

Antidepressant medications or a wide range of psychological therapies like cognitive-behavioural therapy, interpersonal therapy and supportive group therapy are frequently used as conventional treatment for depression. Multiple treatment courses, on the other hand, require a significant amount of time, money, perseverance and tolerance for possible side effects and are implausible to be pursued by many people suffering from major depression. As a result, it is critical to develop novel and effective intervention strategies for depression which are safe, affordable, widely accepted and easily accessible (Prathikanti et al., 2017).

Antidepressant use in first trimester pregnancy has been estimated at 2.0-10.0 % (Wemakor et al., 2014). Selective serotonin-reuptake inhibitors (SSRIs) are the most frequently used antidepressants during pregnancy, and their use is increasing (Kieler et al., 2014). Maternal exposure to antidepressants may be associated with a significantly increased risk for spontaneous abortions (Hemels et al., 2005).

Yoga, an unconventional therapy that has long been used in Eastern cultures to strengthen the mind-body connection, is now being researched for its potential to help those with depression. Meditation, poses and breathing methods are all part of yoga. This triad promotes body and mental balance and relaxation (Mehta et al., 2010). It is likely that the increase in strength and fitness as well as the perception of stress reduction underlies all the benefits of yoga for pregnant women (Babbar et al., 2016). The objective of this study was to know the effects of yogic practices in maternal depression.

Purpose of review

The health benefits from yoga are said to be myriad and include reduction in perceived stress, anxiety, depression, chronic back pain, migraines and may have a benefit in conditions such as hypertension and diabetes. The purpose of this paper is to review literature within the last 20 years on the efficacy of yogic practices in relieving maternal

depression. This review encompasses the studies done to find out the effect of yogic practices in maternal depression.

Methodology

Electronic searches using a combination of words were performed in PubMed, Web of Science, Scopus, CINAHL, Google Scholar. Bibliography of the included studies was also reviewed. The key terms for search were “therapeutic yoga”, “maternal depression” and “effect of yoga on depression”. RCT’s articles and review articles were included related to effects of yoga in maternal depression. The results are summarized in table.

Author	Objective of the study	Study design	Sample size	Methodology	Results and Conclusion
Mitchell et al., 2012	To determine the effects of yoga on prenatal depression.	Pilot study	24	Women in their second and third trimesters of pregnancy were randomly assigned to a yoga treatment group (n=12) and a parenting education control group (n=12). Women in yoga group participated in yoga classes two times a week for a period of 12 weeks. The control group received 12 parenting education sessions on the same schedule. Center of Epidemiological Studies- Depression Scale (CES-D) was administered at the beginning (20 weeks gestation) and at the end of the treatment period (32 weeks gestation).	Yoga reduced depressive symptoms to subclinical levels in 55% of participants compared to 11% in the control group. The yoga group showed greater decrease on the depressed affect.
Muzik et al., 2012	To demonstrate that mindfulness yoga may be an effective treatment alternative to pharmacotherapy for pregnant women at high risk for psychopathology.	Pilot study	18	A 10-week mindfulness yoga intervention was given to psychiatrically high-risk, 12-26 weeks pregnant women as an alternative to pharmacological treatment. Each 90-min session focused on a variety of poses given once per week. Edinburgh Postnatal Depression Scale (EPDS), Beck Depression Inventory -II (BDI-II), Five Facet Mindfulness Questionnaire (FFMQ-Revised) and Maternal Fetal Attachment Scale (MFAS) were assessed before and after mindfulness yoga.	Findings suggest that mindfulness yoga was feasible, acceptable and effective. Symptoms of depression were significantly reduced (p=0.025), while mindfulness (p=0.007) and maternal-fetal attachment (p=0.000) were significantly increased.
Field et al., 2013	To explore the effects of tai chi/yoga routine on prenatal depression, anxiety and sleep disturbances.	Comparative study	92	Depressed pregnant women at an average of 22 weeks gestation were randomly assigned to a tai chi/yoga treatment (n=46) and a waitlist control group (n=46). Tai chi/yoga group participated in a 20 min session per week for a period of 12 weeks. Waitlist control group participated in tai chi/yoga classes at the end of treatment period. Structure clinical interview for depression (SCID), Center for Epidemiological Studies-Depression scale (CES-D), State Anxiety Inventory (STAI) and sleep disturbance questionnaire were conducted at the beginning of the treatment period (22 weeks gestation) and at the end of the treatment (34 weeks gestation).	Tai chi/yoga group had lower depression (CES-D) scores (yoga group SD=9.0, control group SD=11.4), lower anxiety (STAI) scores (yoga group SD=7.9, control group SD=11.4) and lower sleep disturbances scores (yoga group SD=19.5, control group SD=18.4). Yoga has contributed positive effects for pregnant women including reduction in depression, stress and anxiety.
Field et al., 2013	To compare the effects of yoga (physical activity) versus social support (verbal activity) on prenatal and postpartum depression.	Pilot RCT	92	Subjects were randomly assigned to a yoga (n=46) and a social support control group (n=46) at 22 weeks gestation. Yoga group participated in a 20 min group session (only physical poses) once per week for 12 weeks. Social support group (a leaderless discussion group) met on the same schedule. Assessments were conducted at the beginning of the intervention period (22 weeks gestation), at the end of the intervention period (34 weeks gestation) and again postpartum (at 1-3 weeks	At the end of the last session the yoga group and the support group both had lower depression (CES-D), anxiety (STAI), and anger (STAXI) scores and improved relationship scores. In addition, cortisol levels decreased for both groups following each session. At the postpartum follow-up assessment depression and anxiety levels were lower for

				post-birth) using scales such as Center for Epidemiological Studies Depression Scale (CES-D), Edinburgh Postnatal Depression Scale (EPDS), Profile of Mood States (POMS), State Anxiety Inventory (STAI), State Anger Inventory (STAXI), Structured Clinical Interview Depression (SCID) and Relationship Questionnaire.	both groups.
Satyapriya et al., 2013	To study the effect of integrated yoga on anxiety, depression and wellbeing in normal pregnancy.	RCT	96	96 women between 18-20 weeks of gestation were randomized to yoga (n=51) and control group (n=45). Yoga group practiced integrated yoga and control group did standard antenatal exercises for 1 hour daily from 20th to 36th weeks. Pregnancy Experiences Questionnaire (PEQ), State Trait Anxiety Inventory (STAI), Hospital Anxiety Depression Scale (HADS) were administered at the beginning and termination of intervention period.	Pregnancy related experience (PEQ) reduced in yoga by 26.86%, State (STAI I) anxiety (decreased 15.65% in yoga, increased 13.76% in control), Trait (STAI II) anxiety (decreased 8.97% in yoga, increased 5.02% in control) and Depression (HADS) (decreased 30.67% in yoga, increased 3.57% in control). There was significant reduction in depression scores in the yoga group as compared to control group.
Bershadsky et al., 2014,	To evaluate the immediate effects of a prenatal yoga session on cortisol and affect at two gestational ages and to evaluate the effects of prenatal yoga practice on Antepartum depression and Postpartum depression symptoms.	RCT	51	Women practicing yoga during pregnancy (yoga group) n=38 and women who did not practice yoga or other relaxation techniques during pregnancy (control group) n=13 were recruited. Yoga group participated in Prenatal Hatha yoga lasting 90 minutes once weekly for 10 weeks. Women completed assessments in early and midpregnancy and within two months postpartum. Saliva collection and Cortisol assay, Center for Epidemiological Studies Depression Scale (CES-D). Depressive symptoms were assessed in pregnancy and postpartum.	Yoga group participants showed fewer postpartum (p<.05) but not antepartum depressive symptoms than control group participants. Findings indicate that prenatal Hatha yoga may improve current mood and may be effective in reducing postpartum depressive symptoms.
Newham et al., 2014	To compare maternal anxiety, specifically fear of childbirth and depression in low-risk, primiparous women randomized to treatment-as-usual (TAU) or an 8-week program of antenatal yoga.	RCT	59	Participants were randomized to receive an 8-week course (weekly 90 min sessions) of antenatal yoga (n=31) or Treatment as Usual (TAU) (n=28). Assessments were done using (Edinburgh Postnatal Depression Scale (EPDS), State Trait Anxiety Inventory (STAI), Wijama Delivery Expectancy Questionnaire (WDEQ) before randomization (baseline) and after interventions.	There was no significant difference in the STAI-S, STAI-T or EPDS scores recorded at the two time points in the TAU or yoga group. However WDEQ scores tend to be greater in the yoga than the TAU group. Antenatal yoga seems to be useful in preventing increase in depressive symptomatology.
Battle et al., 2015	To examine the acceptability and feasibility of a gentle prenatal yoga intervention, as a strategy for treating depression during pregnancy.	pilot trial	34	A 10-week prenatal yoga program (weekly 75-min sessions) for antenatal depression was given to 12-26 weeks pregnant women. Edinburgh Postnatal Depression Scale (EPDS), Quick Inventory of Depressive Symptomatology (QIDS), Five Facet Mindfulness Questionnaire (FFMQ) were used for assessment. Participants completed assessments at baseline and endpoint (10 weeks).	No yoga-related injuries reported. Significant decrease in depression severity at the end of study period, based on observed-rated and self-report depression assessment measures.
Buttner et al., 2015	To examine the efficacy of yoga for postpartum depression.	RCT	57	Subjects were randomly assigned to a yoga (n=28) or wait-list control (n=29) group. Yoga group consisted of 16 classes over 8 weeks. Patient Health Questionnaire (PHQ-9), Hamilton Depression Rating Scale (HDRS),	Yoga group experienced significantly greater rate of improvement in depression, anxiety, and HRQOL relative to the control group with moderate to large effects.

				health-related quality of life (HRQOL), Inventory of Depression and Anxiety Symptoms (IDAS) were used for assessment.	78% of women in the yoga group experienced clinically significant change.
Davis et. al., 2015	To examine the feasibility and preliminary outcomes of a yoga intervention among pregnant women with symptoms of depression and anxiety	RCT	46	Subjects were randomly assigned to an 8 week yoga intervention n=23 (weekly 75min sessions) and treatment-as-usual (TAU) n=23. Edinburgh Postnatal Depression Scale (EPDS), State Trait Anxiety Inventory (STAI), Positive And Negative Affect Schedule-Negative Subscale (PANAS-N) were assessed before and after intervention.	Yoga reduced depression and anxiety symptoms in pregnant women. Compared to treatment-as usual, negative affect was significantly improved. (b=0.53, SE=0.20, p=.011).
Shahtaheri et al., 2016	To compare the effectiveness of mindfulness-based cognitive therapy and metacognition therapy on reduction of symptoms of depression, core self-evaluation and emotion regulation difficulties in pregnant women with depression.	Quasi experimental	36	Subjects were randomly put into three groups experiment group number one (n=12; under metacognition treatment), experiment group number two (n=12; under cognitive therapy treatment based on mindfulness) and control group (n=12). Participants completed the questionnaires of depression (Hamilton Depression Scale), core self-assessment and emotion regulation difficulties in three stages of basic line, after intervention and follow up.	Findings indicate that mindfulness-based cognitive therapy in group led to improvement of symptoms of depression, core self evaluation and emotion regulation difficulties among pregnant women after intervention and two months of follow up.
Uebelacker et al., 2015	To compare a prenatal yoga intervention to perinatal focused health education in pregnant women with depression	Pilot RCT	20	12–26 weeks pregnant women were randomized into prenatal yoga program (PYP) n=12 or a perinatal health education control condition, mom-baby wellness workshop (MBWW) n=8. Women were invited to attend classes weekly for 9 weeks. Subjects participated in yoga were given weekly 75 min sessions and mom baby wellness workshop for 9 weeks. Edinburgh Postnatal Depression Scale (EPDS), Quick Inventory of Depressive Symptomatology (QIDS) were assessed at baseline, 3 weeks, 6 weeks, and 9 weeks (endpoint).	No yoga-related injuries were reported. Although changes were not statistically different between prenatal yoga program and mom-baby wellness workshop, prenatal yoga program was favoured with a difference between groups of 0.48 standard deviation units for the QIDS and 0.4 standard deviation units for the EPDS.

Discussion: Women in the yoga group improved at a significantly faster rate on measures of depression, anxiety, well-being and health-related quality of life (HRQOL) relative to the control group. The results of this study suggest that yoga is a beneficial non-pharmacological intervention in the management of maternal depression. The above table shows details of 12 studies which shows the effects of yoga on maternal depression. Results suggest that yoga is a feasible, safe and acceptable intervention for pregnant women with symptoms of depression and anxiety. It also helps in improving psychological health of expectant mothers, benefits pregnancy and fetal outcomes. The safety, accessibility and low cost of yoga make it an appealing choice to patients and clinicians.

Conclusion: Limited evidence is available to address the efficacy of yogic practices on maternal depression. As currently available studies had small sample sizes and recruited only patients with mild depressive symptoms. Larger randomized, controlled, prospective trials including patients with varying severity of symptoms are required to confirm the benefits of yoga-based interventions for perinatal depression. Future research should include large-scale replication studies that involve a follow-up period of substantial length (e.g., 12 months).

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A Posteriori error estimates for Hughes stabilized SUPG method for three dimensional singularly perturbed problems

Brehmit Kaur*, Vivek Sangwan**

*Sri Guru Granth Sahib World University, Fatehgarh Sahib

**Thapar Institute of Engineering and Technology, Patiala-147004, Punjab, India.

Abstract

The main aim of the present work is to propose a posteriori error estimates for singularly perturbed convection-diffusion problem in three-dimensions. It has been observed that for small singular perturbation parameter, the problem under consideration displays nonphysical oscillations in the small subregions of the boundary layers. Hughes stabilization strategy along with the Streamline upwind/Petrov-Galerkin (SUPG) method has been proposed to approximate the solution of the problem. Reliable a posteriori error estimates in energy norm on anisotropic meshes have been developed for the proposed method.

Keywords: Convection-diffusion equation, Streamline upwind/Petrov-Galerkin (SUPG) method, Hughes stabilization, singularly perturbed problems, a posteriori error estimation, finite element method.

1. Introduction

Many important mathematical models governing various physical phenomena occurring during the analysis of biological systems, heat transfer process, mass transfer process, etc., are represented by partial differential equations [14, 16]. Very few researchers have developed finite element strategies for simulating three-dimensional partial differential equations. To name a few, Branco et al. [1] proposed three-dimensional finite element technique to analyse the shape evolution of fatigue cracks. Numerical tests have been performed and it has been shown that the numerical result agree with the experimental findings. Mola et al. [13] developed Streamline upwind Petrov-Galerkin (SUPG) technique for approximating unsteady three-dimensional non-linear water waves arising due to ship hull advancing in water based on semi-Lagrangian framework. SUPG projection has been considered to recover accurate estimates of position vector and potential gradients on free surface. The proposed technique results in stabilization of the transport dominated terms and robust adaptation of the spatial discretization on unstructured quadrilateral grids. Zhai et al. [17] analysed three-dimensional time fractional convection-diffusion equation by proposing an implicit compact finite difference scheme which uses fourth-order Padé approximation for spatial discretization and central difference scheme for time discretization. Mohanty and Setia [11] developed high order compact finite difference scheme for approximating three-dimensional quasi-linear elliptic partial differential equation. In the present paper, we will focus on proposing the Hughes stabilized SUPG finite element technique for solving the singularly perturbed problems.

Consider the three-dimensional SPP given by

$$-\nabla \cdot \epsilon \nabla u + \mathbf{b} \cdot \nabla u + cu = f \quad \text{in } \Gamma, \quad (1.1)$$

$$u = 0 \quad \text{on } \partial\Gamma_D, \quad (1.2)$$

$$\frac{\partial u}{\partial n} = g \quad \text{on } \partial\Gamma_N, \quad (1.3)$$

where $\Gamma \subset \mathbb{R}^3$ is a bounded domain with Lipschitz-continuous boundary $\partial\Gamma$ and ϵ is singular perturbation parameter satisfying $0 < \epsilon \ll 1$. We assume that $\partial\Gamma = \partial\Gamma_D \cup \partial\Gamma_N$ with $\partial\Gamma_D \cap \partial\Gamma_N = \emptyset$, and $\mathbf{b}$, c and f are analytic. $\partial\Gamma_D$ and $\partial\Gamma_N$ represent the Dirichlet and Neumann boundaries of the domain respectively. The considered problem is comprised of two basic phenomena-convection and diffusion. For the case when $\epsilon \ll \|\mathbf{b}\|$, the above problem becomes convection dominant in nature. This results in singularities, such as shocks, interior and boundary layers which deteriorate the accuracy of numerical solutions obtained by various numerical schemes. Therefore, it becomes essential to obtain some reliable and efficient error estimates for the computed numerical solution to rely on.

Broadly, error estimates are of two different types, namely, a priori error estimates and a posteriori error estimates. It is seen that a priori error estimates provide crude information only about the asymptotic behavior of the solution and involves regularity conditions which are very difficult to achieve in case of singularities whereas a posteriori error estimates provide quantitative information of the computed numerical solution. Therefore, it is more expected to derive some reliable a posteriori error estimates based on the data of the problem and the computed numerical solution. Stephansen [5] proposed robust a posteriori error estimates for convection-diffusion-reaction problems based on weighted interior-penalty discontinuous Galerkin methods. Lazarov [10] derived residual based a posteriori estimates for convection-diffusion-reaction equations using finite volume element approximations. Carstensen et al. [3] proposed residual-type explicit error estimators and averaging techniques for steady convection-diffusion-reaction problems using finite volume method. Further, the authors proposed adaptive mesh refining strategy and considered numerical examples to test the theoretical findings.

It has been seen that Streamline upwind/Petrov-Galerkin (SUPG) method provides good approximate solution in the region where there is no sharp change in the solution but fails badly in the small subregions of sharp boundary layers appearing in the sol. of singularly perturbed problems. It has been observed that occurrence of these nonphysical oscillations in the region of sharp boundary layers in discrete solution of SUPG method is based on the fact that this scheme is not monotonicity preserving. To overcome this hurdle, in the present work, an effort has been made by using Hughes stabilization strategy [6] alongwith Streamline upwind/Petrov-Galerkin (SUPG) method. This corresponds to addition of one more term in the SUPG discretization of the considered convection-diffusion problem. A posteriori error estimates have been obtained for the developed technique.

The paper is organised as follows:

In Section 2, some notations and standard norms have been discussed. Then the variational formulation and Hughes stabilized Streamline upwind finite element approximation of the continuous problem have been discussed. Section 3 deals with some important tools which are essential for deriving reliable error estimates. In Section 4, residual based a posteriori error estimates have been derived on anisotropic meshes. In the last Section 5, concluding remarks have been made.

2. Hughes stabilized SUPG technique

Let $W^{1,\infty}(\Gamma)$ and $L^\infty(\Gamma)$ denote the usual Sobolev space and Lebesgue space respectively. We will use the notation $(\cdot, \cdot)$ for inner product $(\cdot, \cdot)_\Gamma$.

We assume that

$$-\frac{1}{2}\nabla \cdot \mathbf{b} + c \geq c_0 > 0 \quad \text{on } \Gamma.$$

For any open and bounded subset $T \subset \Gamma$, let $H^1(T)$ be the standard Sobolev space.

Let

$$V_0 = \{w \in H^1(\Gamma), w = 0 \quad \text{on } \partial\Gamma_D\}.$$

Since, our objective is to bound the global error $w - w_h$ in energy norm, so we define the energy norm on any bounded subset $T \subset \Gamma$ as

$$\|w\|_T^2 = \epsilon \cdot \|\nabla w\|_T^2 + c_0 \cdot \|w\|_T^2. \quad (2.1)$$

The finite element weak formulation of (1.1) is given as:

Find $v \in H^1(\Gamma)$ such that

$$\text{where} \quad B(v, w) = (F, w), \quad (2.2)$$

$$\begin{aligned}
 B(v, w) &= \epsilon(\nabla v, \nabla w) + (\mathbf{b} \cdot \nabla v, w) + (cv, w) \\
 < F, w > &= (f, w) + (g, w)_{\partial \Gamma_N}, \quad \forall w \in V_0.
 \end{aligned} \tag{2.3}$$

The existence and uniqueness of solution of above weak formulation (2.2) can be confirmed using the Lax Milgram lemma. Let $F = \{\Gamma_h\}$ denote the family of triangulations of Γ . Let Γ_h be triangulation of domain Γ consisting of tetrahedrons in three-dimensions, assuming only admissible and shape-regular triangulation in Γ_h . For any tetrahedron T with face E , we define $n_{T,E} = (n_x, n_y, n_z)$ to be the unit out-ward normal vector for face E of the tetrahedron T . Let n_E be the normal vector for face E obtained from $n_{T,E}$ by fixing any of two normal components.

2.1 SUPG method

We define $V^h = \{w_h \in H^1 : w_h|_T \in P_1(T), \forall T \in \Gamma_h\}$, where $P_1(T)$ is the space

of linear polynomials over tetrahedron T and $V^h = \{w_h \in V_0^h : w_h|_{\partial \Gamma} = 0\}$. The

SUPG method [2] for problem (1.1) is given by Find $v_h \in V^h$ such that

$$\mathbf{B}_\rho(v_h, w_h) = < F, w_h > \quad \forall w_h \in V_0^h, \tag{2.1.4}$$

$$\text{where } \mathbf{B}_\rho(v_h, w_h) = \mathbf{B}(v_h, w_h) + < R_h(v_h), \rho \mathbf{b} \cdot \nabla_h w_h > \text{ and } < R_h(v_h), \rho \mathbf{b} \cdot \nabla_h w_h > =$$

$\sum_T \rho(-\epsilon \Delta_h v_h + \mathbf{b} \cdot \nabla_h v_h + cv_h - f, \mathbf{b} \cdot \nabla_h w_h)_T$, ρ is nonnegative stabilization parameter, $\mathbf{B}(v, w)$ and $< F, w >$ are defined in (2.3).

2.2 Hughes stabilized SUPG technique

As is well known that convection dominated problems exhibit nonphysical oscillations at layers as ϵ decreases, the solution of singularly perturbed problem displays boundary layers. Since the Streamline upwind/Petrov-Galerkin (SUPG) method results in good approximate solution in the region where there is no sharp change in the solution but fails drastically in the subregions of sharp boundary layers, in the trial to overcome this hurdle, we propose Hughes stabilization technique [7] to SUPG method. It results in an addition of the term $< R_h(v_h), \sigma \mathbf{b}_h \cdot \nabla_h w_h >$ in the SUPG finite element discretization of the convection-diffusion equation where

$$\mathbf{b}_h = \begin{cases} \frac{\mathbf{b} \cdot (\nabla v_h) \nabla v_h}{|\nabla v_h|^2} & \text{if } |\nabla v_h| \neq 0 \\ 0 & \text{if } |\nabla v_h| = 0, \end{cases} \tag{2.2.1}$$

and σ is nonnegative stabilization parameter. This additional term increases the robustness of SUPG method in the boundary layer region by controlling oscillations. Using Hughes stabilization technique to SUPG finite element method, Eq.(1.1) is discretized as follows:

Find $v_h \in V^h$ such that

$$B_{\rho, \sigma}(v_h, w_h) = < F, w_h > \quad \forall w_h \in V^h. \tag{2.2.2}$$

Here $B_{\rho, \sigma}(v_h, w_h) = \mathbf{B}(v_h, w_h) + < R_h(v_h), \rho \mathbf{b} \cdot \nabla_h w_h > + < R_h(v_h), \sigma \mathbf{b}_h \cdot \nabla_h w_h >$

and $< R_h(v_h), \sigma \mathbf{b}_h \cdot \nabla_h w_h > = \sum_T \sigma_T (-\epsilon \Delta_h v_h + \mathbf{b} \cdot \nabla_h v_h + cv_h - f, \mathbf{b}_h \cdot \nabla_h w_h)_T$. Let ρ_T and σ_T be stabilization parameters over each element T . The existence and uniqueness of the finite element solution v_h obtained using SUPG finite element discretization has been proved by Roos et al. [15]. The stabilization parameter ρ_T satisfies

$$0 \leq \rho_T \leq \frac{1}{2} \min\{c_0 \|c\|_{\infty, T}^{-2}, (h_{min}^T)^2 \epsilon^{-1} \vartheta^{-2}\} \tag{2.2.3}$$

where h_{min}^T is minimal length of element T and the constant ϑ satisfies the inequality

$$\|\nabla \cdot \nabla v_h\|_T \leq \vartheta (h_{min}^T)^{-1} \|\nabla v_h\|_T \quad \forall v_h \in V_0^h \tag{2.2.4}$$

It can be observed that $\nu = 0$ for piecewise linear functions in V^h . Therefore, the above bounds reduces to $0 \leq \rho_T \leq \frac{c_0}{2} \|c\|_{\infty, T}^{-2}$.

For easiness, we will use $c \approx d$ to denote that there exists a positive constant A independent of c, d, Γ_h and ϵ such that $c \leq Ad$. Further, we assume that

$$\rho_T \leq h_{min}^T \|b\|_{\infty, T}^{-1} \quad \forall T. \quad (2.2.5)$$

3. Some auxiliary tools

Since the considered singularly perturbed problem displays abrupt changes in the solution when Peclet number becomes very large as clear from (3.2), in such situations, elements with large aspect ratio i.e. anisotropic meshes are preferred. Therefore, in the present work, anisotropic mesh has been considered for domain discretization. In the present Section, some notations on anisotropic meshes have been discussed which will be used in later Sections.

Notations: Consider an arbitrary tetrahedron $T \in \Gamma_h$ with $Q_0 Q_1$ as longest edge (see Fig.1). Represent three orthogonal vectors by $q_{i,T}$ with lengths $h_{i,T} = |q_{i,T}|$, where $q_{1,T}$ is taken along the longest edge.

From Fig. 1, it can be confirmed that $h_{1,T} > h_{2,T} \geq h_{3,T}$. Define $h_{min}^T = h_{3,T}$. These $q_{i,T}$'s correspond

to three anisotropic directions. Define an orthogonal matrix as $C_T = (q_{1,T}, q_{2,T}, q_{3,T}) \in R^{3 \times 3}$. Let α_T be scaling factor defined by

$$\alpha_T = \min\{c_0^{-1/2}, \epsilon^{-1/2} \cdot h_{min}^T\}. \quad (3.1)$$

We denote tetrahedron by T or T^j or T_i , and its faces by E . Denote its height over face E by

$$h_{E,T} = 3 \frac{|T|}{|E|},$$

where $|T|$ represents the volume of the tetrahedron and $|E|$ represents the area of the face E . Let w_E be the bounded domain formed by using two tetrahedrons with common face E and w_T to be the domain consisting of tetrahedron T and its face neighbouring tetrahedra. We denote the local mesh Peclet number as

$$Pe_T = \frac{\|b\|_{\infty, T} h_{min}^T}{2\epsilon} \quad (3.2)$$

where h_{min}^T is minimal length of element T . Let $Pe_{w_T} = \max_{T' \in w_T} Pe_{T'}$,

be mesh Peclet number on the domain w_T . For an interior face $E = T_1 \cap T_2$, define

face based parameters $h_E = (h_{E,T_1} + h_{E,T_2})/2$, $h^E = (h_{min}^{T_1} + h_{min}^{T_2})/2$ and

$$\alpha_E = (\alpha_{T_1} + \alpha_{T_2})/2.$$

For boundary face $E \subset \partial T \cap \partial \Gamma$, we define $h_E = h_{E,T}$, $\alpha_E = \alpha_T$. we assume

$$h_{i,T} \sim h_{i,T'} \quad \forall T, T' \text{ with } T \cap T' \neq \emptyset, i=1,2,3,$$

and number of tetrahedra with node y_j is bounded uniformly.

4. Interpolation

Till now, very few researchers have proposed different a posteriori error estimates on anisotropic meshes for three-dimensional singularly perturbed problems. Since the focus is to obtain reliable upper error bounds, therefore, a suitable estimate or function called matching function [8] has been defined to measure alignment of

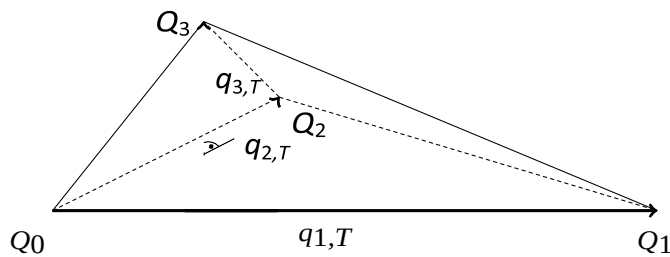


Figure 1: Tetrahedron T

anisotropic mesh Γ_h and anisotropic function.

Matching function: Let $v \in H^1(\Gamma)$ and $\Gamma_h \in F$ be triangulation of Γ . Then $M_1: H^1(\Gamma) \times F \rightarrow \mathbb{R}$ is defined as

$$M_1(v, \Gamma_h) := (\sum_{T \in \Gamma_h} (h_{min}^T)^{-2} \cdot ||C_T^T \nabla v_T^2||)^{\frac{1}{2}} / ||\nabla v|| \quad (4.1)$$

where $C_T \in \mathbb{R}^{3 \times 3}$ has been defined earlier.

In order to derive reliable error estimates in energy norm, we define Clément interpolation operator I_c [4] for $v \in H^1(\Gamma)$.

Lemma 1: Let $v \in H^1(\Gamma)$ and α_T be the scaling factor defined by (3.1). Define

Clément interpolation operator $I_c : H_0^1(\Gamma) \rightarrow V_0^h$ as defined in [4,9]. Then it satisfies

$$|||I_c v||| \approx M_1(v, \Gamma_h) \cdot |||v||| \quad (4.2)$$

$$\sum_{T \in \Gamma_h} \alpha_T^{-2} \cdot ||v - I_c v||_T^2 \approx M_1(v, \Gamma_h)^2 \cdot |||v|||^2 \quad (4.3)$$

$$\epsilon^{1/2} \sum_{E \in \Gamma} \alpha_E^{-1} \|v - I_c v\|_E^2 \approx M_1(v, \Gamma h)^2 \cdot \|v\|^2. \quad (4.4)$$

Proof: The proof of the Lemma has been discussed in [9].

4.1 Residual error estimates

In the present Section, first we will discuss exact and approximate residuals. Then, residual error estimator based on residuals has been defined to estimate error in energynorm. Further, reliable error bounds for the proposed scheme Hughes stabilized SUPG finite element method has been proposed on anisotropic meshes.

Exact residuals: Let R_T and R_E denote the exact element residual and exact face residual over a general tetrahedron element T respectively and are defined as

$$R_T = f - (-\epsilon \Delta u_h + \mathbf{b} \cdot \nabla u_h + c u_h) \quad \text{on} \quad T,$$

$$R_E(x) = \begin{cases} \lim_{s \rightarrow 0+} [\partial n_E u_h(x + s n_E) - \partial n_E u_h(x - s n_E)] & \text{if } EC \Gamma / \partial \Gamma, \\ g - \partial_n u_h & \text{if } EC \partial \Gamma N, \\ 0 & \text{if } EC \partial \Gamma D, \end{cases}$$

where $n_E \perp E$ is unitary normal vector for face $E \subset \Gamma - \Gamma_N$ and $n \perp E \subset \partial \Gamma_N$ is

outer unitary normal vector.

Approximate residuals: Let Q be approximation operator, used to approximate the element residuals and the face residuals i.e.

$$r_T = Q(R_T) \in P^0(T) \quad \forall T \in \Gamma_h, r_E = Q(R_E) \in P^0(E) \quad \forall E,$$

where r_T denotes the approximate element residual and r_E denotes the approximate face residual. Since the numerical solution u_h is linear on E , therefore,

$$r_E = R_E \quad \forall E \subset \Gamma \setminus \partial \Gamma_N.$$

Residual error estimator: Residual error estimator η_T and the approximation term ζ_T over any tetrahedron T are defined as

$$n_T^2 = \alpha_T^2 \|r_T\|_T^2 + \epsilon^{-\frac{1}{2}} \alpha_T \sum_{EC \partial T \setminus \partial \Gamma D} \|r_E\|_E^2$$

$$\varepsilon_T^2 = \alpha_T^2 \|r_T - R_T\|_T^2 + \epsilon^{-\frac{1}{2}} \alpha_T \sum_{EC \partial T \cap \partial \Gamma N} \|r_E - R_E\|_E^2$$

where α_T be scaling factor and $\alpha_T = 3\alpha_T$. Global error estimates are defined as

$$n^2 = \sum_{T \in \Gamma_h} n_T^2 \quad \text{and} \quad \varepsilon^2 = \sum_{T \in \Gamma_h} \varepsilon_T^2 \quad (4.1.1)$$

Before proposing reliable error upper bounds, we will prove the following two lemmas which will be used in the results to follow:

Lemma 2: Let $v \in H_0^1(\Gamma)$ be the exact solution and $v_h \in V_0^h$ be numerical solution obtained by the proposed scheme. Then the bilinear form $\mathbf{B}_{\rho, \sigma}(\cdot, \cdot)$ satisfies the bounds

$$\mathbf{B}_{\rho,\sigma}(v - v_h, w - I_c w) \approx [(\sum_{T \in \Gamma_h} \alpha_T^2 \|R_T\|_T^2)^{\frac{1}{2}} + (\sum_{E \in \Gamma \setminus \partial \Gamma_D} \epsilon^{-\frac{1}{2}} \alpha_E \|R_E\|_E^2)^{\frac{1}{2}}] \cdot M_1(w, \Gamma_h) \cdot \|w\|.$$

Proof: Using Clement interpolation operator I_c , we can write the bilinear form $\mathbf{B}_{\rho,\sigma}(\cdot, \cdot)$ as

$$\mathbf{B}_{\rho,\sigma}(v - v_h, w) = \mathbf{B}_{\rho,\sigma}(v - v_h, w - I_c w) + \mathbf{B}_{\rho,\sigma}(v - v_h, I_c w). \quad (4.1.2)$$

Now, integrating by parts and using exact element residual R_T and face residual R_E , the bilinear form $\mathbf{B}_{\rho,\sigma}(v - v_h, w)$ can be written as

$$\mathbf{B}_{\rho,\sigma}(v - v_h, w) = \sum_{T \in \Gamma_h} (R_T, w)_T + \sum_{E \in \Gamma \setminus \partial \Gamma_D} (R_E, w)_E \quad \forall w \in H_0^1(\Gamma).$$

Using the above expression for bilinear form, the middle term (4.1.2) can be expressed as

$$\begin{aligned} \mathbf{B}_{\rho,\sigma}(v - v_h, w - I_c w) &= \sum_{T \in \Gamma_h} (R_T, w - I_c w)_T + \sum_{E \in \Gamma \setminus \partial \Gamma_D} (R_E, w - I_c w)_E \quad \forall w \in \\ &H_0^1(\Gamma). \end{aligned}$$

Using Cauchy Schwarz inequality, we get

$$\begin{aligned} \sum_{T \in \Gamma_h} (R_T, w - I_c w)_T &\leq ((\sum_{T \in \Gamma_h} \alpha_T^2 \|R_T\|_T^2)^{\frac{1}{2}} \cdot (\sum_{T \in \Gamma_h} \alpha_T^{-2} \|w - I_c w\|_T^2)^{\frac{1}{2}})^{1/2}, \\ \sum_{E \in \Gamma \setminus \partial \Gamma_D} (R_E, w - I_c w)_E &\leq ((\sum_{E \in \Gamma \setminus \partial \Gamma_D} \epsilon^{-\frac{1}{2}} \alpha_E \|R_E\|_E^2)^{\frac{1}{2}} \cdot (\sum_{E \in \Gamma \setminus \partial \Gamma_D} \epsilon^{\frac{1}{2}} \alpha_E^{-1} \|w - I_c w\|_E^2)^{\frac{1}{2}})^{1/2}. \end{aligned}$$

Further, Using Lemma 1, we get

$$\begin{aligned} \sum_{T \in \Gamma_h} (R_T, w - I_c w)_T &\leq ((\sum_{T \in \Gamma_h} \alpha_T^2 \|R_T\|_T^2 \cdot M_1(w, \Gamma_h)) \cdot \|w\|), \\ \sum_{E \in \Gamma \setminus \partial \Gamma_D} (R_E, w - I_c w)_E &\leq ((\sum_{E \in \Gamma \setminus \partial \Gamma_D} \epsilon^{-\frac{1}{2}} \alpha_E \|R_E\|_E^2 \cdot M_1(w, \Gamma_h)) \cdot \|w\|). \end{aligned}$$

Therefore, the term $\mathbf{B}_{\rho,\sigma}(v - v_h, w - I_c w)$ is bounded by

$$\mathbf{B}_{\rho,\sigma}(v - v_h, w - I_c w) \leq [\sum_{T \in \Gamma_h} \alpha_T^2 \|R_T\|_T^2 + (\sum_{E \in \Gamma \setminus \partial \Gamma_D} \epsilon^{-\frac{1}{2}} \alpha_E \|R_E\|_E^2)^{\frac{1}{2}}] M_1(w, \Gamma_h) \cdot \|w\|.$$

Lemma 3: Let $v \in H_0^1(\Gamma)$ be the exact solution and $v_h \in V_0^h$ be approximate solution, Then the Clement interpolation operator $I_c: H_0^1(\Gamma) \rightarrow V_0^h$ satisfies the inequality

$$\mathbf{B}_{\rho,\sigma}(v - v_h, I_c w) \leq 2(\sum_{T \in \Gamma_h} \alpha_T^2 \|R_T\|_T^2)^{\frac{1}{2}} \cdot M_1(w, \Gamma_h) \cdot \|w\|.$$

Proof: For any mesh function $v_h \in V_0^h$, using (2.2.4) and scaling arguments, we can get

$$||\nabla v_h||_T \leq (h_{min}^T)^{-1} ||v_h||_T$$

From energy norm def.(2.1), we have

$$||v_h||_T \leq (c_0)^{-\frac{1}{2}} ||v_h||_T.$$

$$\rightarrow ||\nabla v_h||_T \leq (h_{min}^T)^{-1} (c_0)^{-\frac{1}{2}} ||v_h||_T. \quad (4.1.3)$$

Again from energy norm, we get

$$||\nabla v_h||_T \leq (\epsilon)^{-\frac{1}{2}} ||v_h||_T. \quad (4.1.4)$$

$$\rightarrow ||\nabla v_h||_T \leq \min\{(h_{min}^T)^{-1} (c_0)^{-\frac{1}{2}}, \epsilon^{-\frac{1}{2}}\} ||v_h||_T. \quad (4.1.5)$$

On simplification, inequality (4.1.5) reduces to

$$||\nabla v_h||_T \leq \min\{(h_{min}^T)^{-1} (c_0)^{-\frac{1}{2}}, \epsilon^{-\frac{1}{2}}\} ||v_h||_T = (h_{min}^T)^{-1} \alpha_T ||v_h||_T \quad \text{for } v_h \in V_0^h.$$

(Using Eq.(3.1))

$$\begin{aligned} \mathbf{B}_{\rho,\sigma}(v - v_h, I_C w) = & \langle \nabla v, \nabla I_C w \rangle + \langle \mathbf{b}, \nabla v, I_C w \rangle + \langle cv, I_C w \rangle - \{ \langle \nabla v_h, \nabla I_C w \rangle + \langle \mathbf{b}, \nabla v_h, I_C w \rangle \\ & + \langle cv_h, I_C w \rangle + \sum_T \rho_T (R_T, \mathbf{b}, \nabla I_C w) + \sum_T \sigma_T (R_T, \mathbf{b}_h, \nabla I_C w) \}. \end{aligned}$$

Now based on the Galerkin orthogonality property and standard scaling results, the above equation can be rewritten as

$$\begin{aligned} \mathbf{B}_{\rho,\sigma}(v - v_h, I_C w) = & - \sum_T \rho_T (R_T, \mathbf{b}, \nabla I_C w) - \sum_T \sigma_T (R_T, \mathbf{b}_h, \nabla I_C w) \\ & \leq \rho_T ||R_T||_T ||\mathbf{b}||_{\infty,T} ||\nabla I_C w||_T \\ & + \sigma_T ||R_T||_T ||\mathbf{b}_h||_{\infty,T} ||\nabla I_C w||_T \\ & \leq \rho_T ||R_T||_T ||\mathbf{b}||_{\infty,T} ||\nabla I_C w||_T \\ & + \sigma_T ||R_T||_T ||\mathbf{b}_h||_{\infty,T} ||\nabla I_C w||_T. \end{aligned}$$

Using Lemma 1, we get

$$||I_C w|| \leq M_1(w, \Gamma_h). ||w|| \quad \forall w_h \in H_0^1(\Gamma).$$

Thus, we have

$$\begin{aligned} \mathbf{B}_{\rho,\sigma}(v - v_h, I_C w) \leq & (\sum_{T \in \Gamma_h} \rho_T^2 ||R_T||_T^2 ||\mathbf{b}||_{\infty,T}^2 (h_{min}^T)^{-2} \alpha_T^2)^{1/2} \cdot M_1(w, \Gamma_h). ||w|| \\ & + (\sum_{T \in \Gamma_h} \sigma_T^2 ||R_T||_T^2 ||\mathbf{b}_h||_{\infty,T}^2 (h_{min}^T)^{-2} \alpha_T^2)^{1/2} \cdot M_1(w, \Gamma_h). ||w||. \end{aligned}$$

It may be noted that the effect of nonlinear term $\mathbf{b}_h$ in the L_∞ norm will be bounded by that of the term $||\mathbf{b}||_\infty$ as shown below i.e.

$$\mathbf{b}_h = \frac{(\mathbf{b} \cdot \nabla v_h) \nabla v_h}{|\nabla v_h|^2}, \quad |\nabla v_h| \neq 0$$

$$\mathbf{b}_h \leq \frac{(|\mathbf{b}| |\nabla v_h|) \nabla v_h}{|\nabla v_h|^2} \quad \{Using Cauchy Schwarz inequality\}$$

$$||\mathbf{b}_h|| \leq \frac{(|\mathbf{b}| |\nabla v_h|) |\nabla v_h|}{|\nabla v_h|^2}$$

$$\leq ||\mathbf{b}||$$

From relation (2.2.5), we get

$$\rho_T \leq h_{min}^T / ||\mathbf{b}||_{\infty, T} \quad \forall T \in \Gamma_h,$$

$$\sigma_T \leq h_{min}^T / ||\mathbf{b}_h||_{\infty, T} \quad \forall T \in \Gamma_h.$$

Therefore,

$$\mathbf{B}_{\rho, \sigma}(v - v_h, I_C w) \leq [(\sum_{T \in \Gamma_h} \alpha_T^2 ||R_T||_T^2)^{\frac{1}{2}} + (\sum_{T \in \Gamma_h} \alpha_T^2 ||R_T||_T^2)^{\frac{1}{2}}] M_1(w, \Gamma_h) \cdot |||w|||$$

$$\leq 2(\sum_{T \in \Gamma_h} \alpha_T^2 ||R_T||_T^2)^{\frac{1}{2}} M_1(w, \Gamma_h) \cdot |||w|||.$$

Theorem: (Residual error estimation) Let $v \in H_0^1(\Gamma)$ be the exact solution and $v_h \in V_0^h$ be the Hughes stabilized SUPG finite element solution of (1.1)-(1.3). Then the error in energy norm is bounded above globally by

$$|||v - v_h||| \leq M_1(v - v_h, \Gamma_h) \cdot [n + \varepsilon].$$

Proof: We know that

$\mathbf{B}_{\rho, \sigma}(v, v) \geq |||v|||^2 \quad \forall v \in H_0^1(\Gamma)$. Using this result, we get

$$|||v - v_h||| \leq \frac{\mathbf{B}_{\rho, \sigma}(v - v_h, w)}{|||v - v_h|||} \quad (4.1.6)$$

where $w = v - v_h$. Putting $a_T = 3\alpha_T$ and using Lemma 2 and Lemma 3 in Eq.(4.1.2), the above equation reduces to

$$|||v - v_h||| \leq [(\sum_{T \in \Gamma_h} \alpha_T^2 ||R_T||_T^2)^{\frac{1}{2}} + \sum_{T \in \Gamma_h} \epsilon^{-\frac{1}{2}} \alpha_E ||R_E||_E^2]^{\frac{1}{2}} \cdot M_1(w, \Gamma_h).$$

$$(4.1.7)$$

Using triangle inequalities

$$||R_T||_T^2 \leq ||r_T - R_T||_T^2 + ||r_T||_T^2,$$

$$||R_E||_E^2 \leq ||r_E - R_E||_E^2 + ||r_E||_E^2,$$

Substituting these inequalities in Eq.(4.1.7), we get

$$\|v - v_h\| \leq M_1(v - v_h, \Gamma_h) \cdot [n + \varepsilon],$$

where n^2 and ε^2 are defined in Eq.(4.1.1).

5 Conclusion

In the presented work, reliable a posteriori error estimates have been proposed for singularly perturbed convection-diffusion problem in three-dimensions. Hughes stabilization technique under SUPG finite element framework has been proposed to approximate the solution of singularly perturbed problems. Anisotropic meshes have been considered for the domain discretization. At the end, residual based error estimates in energy norm on anisotropic meshes have been developed.

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Correlation among optical properties and photon interaction parameters of some phosphate glasses for radiation shielding and sensing applications***Preet Kaur, *Navneet Kaur, **Devinder Singh, *Tejbir Singh**

*Department of Physics, Sri Guru Granth Sahib World University, Fatehgarh Sahib 140407, India

**Department of Physics, Shri Guru Teg Bahadur Khalsa College, Sri Anandpur Sahib, India

navneetsaggu17@gmail.com; preetkaur_020@yahoo.com**Abstract**

Sm³⁺ and Gd³⁺ co-doped lead alumino phosphate glasses with composition (58.2-2x)PbO-40P₂O₅-1.8Al₂O₃-xSm₂O₃-xGd₂O₃ (where x= 0.4, 0.6, 0.8, 1.0, 1.2, 1.4 mol%) were synthesized using melt quench technique. The optical and photon interaction properties of prepared glass samples have been observed using UV-Vis and Gamma Rays spectroscopy respectively. An effort has been made to visualize the effect of weight fraction of PbO and rare-earth metals on optical and photon interaction properties for the prepared glass samples. Also, correlation among various optical and photon interaction properties have been studied to establish the feasibility of prepared glass samples in radiation shielding and sensing. Refractive index is observed to be a function of polarizability and optical band gap.

Keywords: Rare earth doped glass; Structural Properties; Optical Properties; Photon Interaction Properties**1. Introduction**

Phosphate glasses have numerous applications in various fields such as bone transplantation [1], high energy lasers [2], medical applications [3], optical filters [4] and nuclear waste containment [5]. These applications are owing to their high thermal expansion coefficient, low transition temperature, low optical dispersion, high gain density due to high solubility of lanthanide ions and good electrical conductivity [6,7]. However, chemical durability of phosphate glasses is very poor. Their chemical stability can be dramatically improved by the addition of appropriate additives like PbO [8]. Besides imparting stability to the glass network, PbO helps in reducing the fabrication temperature during glass formation from its constituents. Lead-phosphate glasses possess high density and effective atomic number, and consequently, find potential applications in radioactive waste encapsulation [8]. Lead phosphate glasses are capable of incorporating high contents of rare earth ions and transition metals. Addition of rare earth oxides to lead phosphate glasses impart enhanced optical properties. As a result, these glasses show strong absorption in ultra-violet region. Moreover, these glasses exhibit good radiation shielding properties which make them potentially useful for shielding of gamma rays [9]. In continuation to our previous work [9] which deals with gamma-rays shielding and sensing properties of Sm³⁺ and Gd³⁺ co-doped lead phosphate glasses; an effort has been made in the present work to find the effect of weight fraction of PbO and rare earth oxides on optical (energy band gap (E_g), refractive index (n), polarizability (α_m), intensity of luminescence (I)) and photon interaction properties (effective atomic number (Z_{eff}), electron density (N_e), exposure buildup factor (EBF), energy absorption buildup factor (EABF)) of the mentioned glass samples. Further, correlation among optical properties and photon interaction parameters have also been explored.

2. Materials and Methods

Sm³⁺ and Gd³⁺ co-doped lead phosphate glasses with composition (58.2-2x)PbO-40P₂O₅-1.8Al₂O₃-xSm₂O₃-xGd₂O₃ (where x= 0.4, 0.6, 0.8, 1.0, 1.2, 1.4 mol%) were synthesized by melt-quenching technique. Detail of experimental procedure and methods used to obtain physical, optical, photon interaction properties are given elsewhere [9]. The structural characterization of the prepared glass samples was performed by X-ray diffraction (XRD) studies through powder method using Rigaku Miniflex Table Top spectrometer with Cu-Kα line of width λ= 1.5418 Å at a slow scanning rate of 2°/min and the range of diffraction angle 2θ was taken from 10° to 99.98°. Nickel metal was used as beta filter. The results were presented in the form of intensity versus 2θ position. XRD spectra of some of the prepared samples are presented in Fig 1. Chemical composition and various measured properties of glass samples considered for establishing the correlation are presented in **Table 1** and **Table 2**. Effective atomic number (Z_{eff}) is an energy dependent parameter and has varied values for the same material at different energies. The average value of Z_{eff} for Sm³⁺ and Gd³⁺ co-doped lead alumino phosphate glass samples is taken to establish the correlation.

Energy absorption buildup factor (EABF) and exposure buildup factor (EBF) values are taken at 662 keV of photon energy at 40 mean free paths (mfp).

3. Results and Discussion

Typical XRD pattern for glass samples 0.4R.E., 0.8 R.E. and 1.2 R.E. is shown in **Fig. 1**. A broad hump (between 20 and 32°) and non-existence of any sharp peak in entire 2θ range establishes glassy nature of sample.

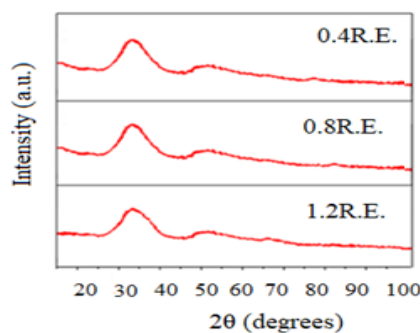


Fig. 1: XRD pattern of some of the samples

As reported earlier [8, 9], the prepared glass samples are shown to have semiconducting behavior. Samples composition has been taken from our previous work [9].

Table 1. Chemical composition and optical properties of synthesized glass samples [9]

Sample Name	Chemical Composition (in weight fraction)						Optical Band Gap (E_g) (eV)	Refractive Index (n)	Polarizability ($\alpha_m \times 10^{-24}$ (cc))	Intensity of Luminescence ($\times 10^6$) (a.u.)
	O	Al	P	Sm	Gd	Pb				
0.4 R.E.	0.276	0.010	0.175	0.003	0.003	0.533	2.63	2.506	8.847	2.738
0.6 R.E.	0.276	0.010	0.175	0.005	0.005	0.529	2.57	2.524	8.855	3.555
0.8 R.E.	0.277	0.010	0.175	0.007	0.007	0.525	2.46	2.561	8.969	3.063
1.0 R.E.	0.277	0.010	0.175	0.009	0.009	0.522	2.18	2.662	8.755	4.126
1.2 R.E.	0.277	0.010	0.175	0.010	0.010	0.518	2.37	2.590	9.149	2.449
1.4 R.E.	0.277	0.010	0.175	0.012	0.012	0.514	2.31	2.613	9.259	0.886

Fig. 2 represents the variation of various optical and photon interaction properties for the synthesized Sm^{3+} and Gd^{3+} co-doped lead aluminophosphate glass samples with weight fraction of Pb. Weight fraction of various elements present in the glass samples has been provided in **Table 1**. Among different properties; energy band gap (E_g),

effective atomic number (Z_{eff}) and electron density (N_e) increases with the increase in weight fraction of Pb. Whereas, refractive index, polarizability and buildup factors (EBF as well as EABF) decreases with the increase in weight fraction of Pb. Further, variable trend has been observed in intensity of luminescence with increase in weight fraction of Pb. The maximum value of intensity of luminescence from the excitation spectra in the wavelength domain 200-500 nm (at emission wavelength of 600 nm) of the glass samples is considered for the observation. The contribution of sample 1.0 R.E. has not been considered in the present variation as it has lowest energy gap among all the samples. This is due to its highest density among all the samples. As the density increases, a greater number of atoms (charge carriers) per unit volume would be available for conduction. It leads to an increase in the donor centers in the glass matrix and consequently, E_g decreases. Otherwise, the optical band gap generally increases with increase in weight fraction of lead in the synthesized samples. It might be due to the introduction of point defects during synthesis in the structure of synthesized glass systems with increasing concentration of Pb, resulting in higher carrier concentration, which has increased the E_g of the samples.

Moreover, the addition of Pb to the glass network causes de-polymerization of the glass chain which results in shortening of the average oxygen bonds chain length. It also leads to opening of chain by breaking some oxygen bonds. In this way, there is an increase in the amount of non-bridging oxygen (NBOs) with increasing concentration of Pb. This phenomenon results in the change in absorption characteristics of glass samples and hence, E_g increases. The variation of E_g with weight content of Pb is in good agreement earlier reported results [10]. The increase in Z_{eff} and N_e for Sm^{3+} and Gd^{3+} co-doped lead aluminophosphate glass samples with the weight percentage of Pb indicates that the probability of photon interaction increases with higher Pb content. Also, the probability of transmission of gamma rays decreases with increasing amount of Pb. Therefore, synthesized glass samples are found to have potential applications in the field of radiation shielding and detection.

Table 2: Physical and Photon Interaction Properties of synthesized glass samples [9]

Sample Name	Density (ρ) (g/cm^3)	Effective Atomic Number at 662 keV	Electron Density at 662 keV ($\times 10^{23}$) (e/g)	Average Effective Atomic Number (Z_{eff}) _{avg}	EABF (at 662 keV and 40 mfp)	EBF (at 662 keV and 40 mfp)
0.4 R.E.	5.419	21.85	3.404	66.38	352.41	235.84
0.6 R.E.	5.463	21.82	3.403	66.29	353.45	236.63
0.8 R.E.	5.475	21.79	3.400	66.2	354.49	237.42
1.0 R.E.	5.801	21.76	3.398	66.15	355.53	238.21
1.2 R.E.	5.447	21.73	3.396	66.02	356.58	239.01
1.4 R.E.	5.435	21.69	3.391	65.93	357.61	239.81

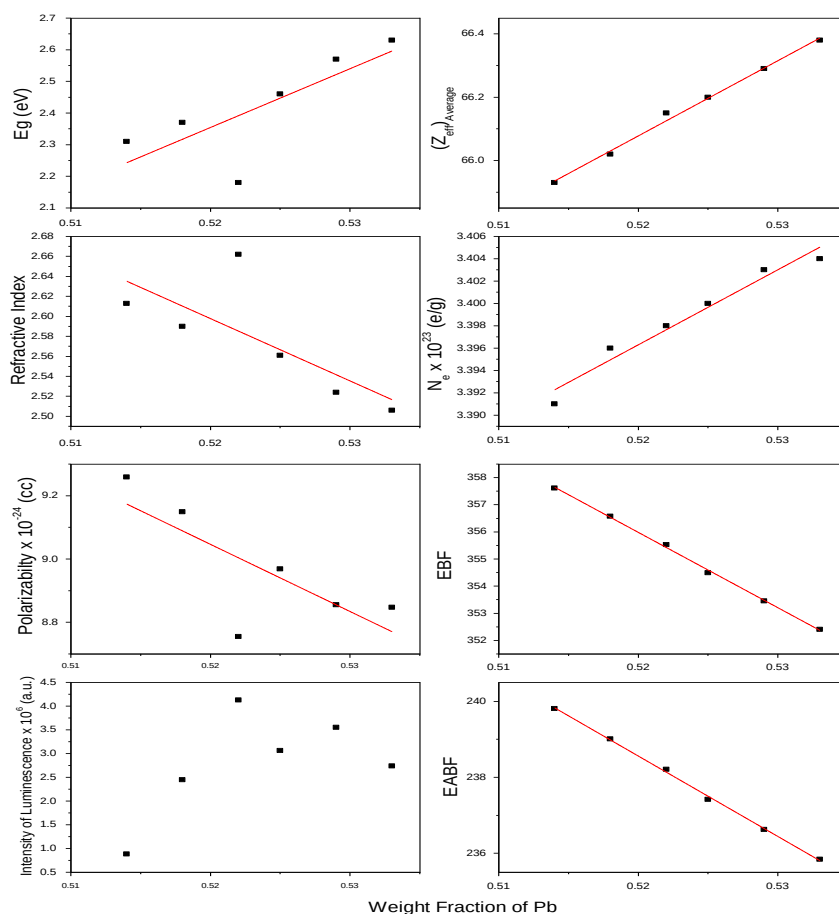


Fig. 2. Variation of optical and photon interaction properties with weight fraction of Pb

3.1 Correlation among various optical properties:

Fig. 3 represents the variation of polarizability with refractive index of the Sm^{3+} and Gd^{3+} co-doped lead alumino phosphate glass samples. It is observed that in the present glass samples, refractive index rises non-linearly with increase in polarizability of oxide ions as a consequence of increase in the number of NBOs to the bridging oxygen. These findings indicate that the refractive index of a material is proportional to its polarizability as reported by J. Seo et al. [11]. Sample 1.0 R.E. shows lowest value of polarizability among all the synthesized glass samples for the reason explained above. The variation of intensity of luminescence of the prepared glass samples with polarizability is shown in **Fig 3**. The intensity of luminescence is observed to decrease non-linearly with increase in polarizability of the glass samples. The refractive index of the prepared glass samples is found to decrease with E_g . The optical band gap determines the threshold energy for absorption of photons in a semiconducting material. The refractive index in the semiconducting material is a measure of its transparency to incident spectral radiation. The decrease in refractive index with increase in optical band gap is in agreement with literature [12].

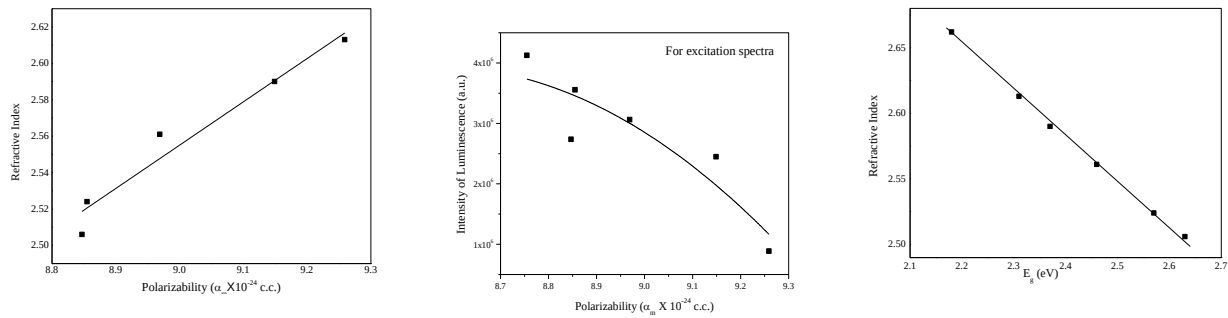


Fig. 3. Correlation among various optical parameters for Sm^{3+} and Gd^{3+} doped glass samples

3.2 Correlation among various photon interaction parameters:

Fig. 4. represents correlation among photon interaction parameters. Effective atomic number Z_{eff} and electron density N_e are the photon interaction parameters that contribute significantly in designing high energy electromagnetic shielding and sensing material [13]. It is seen that the Z_{eff} increases almost linearly with increasing value of N_e . Hence, any of these parameters can be taken to observe the behavior of the present glass systems for shielding and detection of gamma rays. However, N_e has very high values, so it is usually preferable to take effective atomic number. The variation of Energy Absorption Buildup Factor (EABF) and Exposure Buildup Factor (EBF) of the synthesized Sm^{3+} and Gd^{3+} co-doped lead alumino phosphate glass samples with average value of effective atomic number is shown in **Fig 4**. The buildup factor values are taken at a penetration depth of 40 mfp. The buildup factor values are seen to decrease remarkably with increasing $(Z_{\text{eff}})_{\text{avg}}$. Similar trends are observed for other mfp and energy. Consequently, smaller EABF and EBF values can be associated with materials having higher $(Z_{\text{eff}})_{\text{avg}}$. As Z_{eff} is a chemical composition dependent parameter, it is therefore evident that the chemical compositions of the samples play an important role in the buildup of gamma ray photons within the synthesized rare earth co-doped glass samples. Moreover, while moving from lower to higher values of $(Z_{\text{eff}})_{\text{avg}}$, the photons are more readily absorbed by the photoelectric absorption, which results in complete removal of photons and hence, buildup factor reduces. With proper knowledge of the buildup of photons, energy absorption can be carefully controlled.

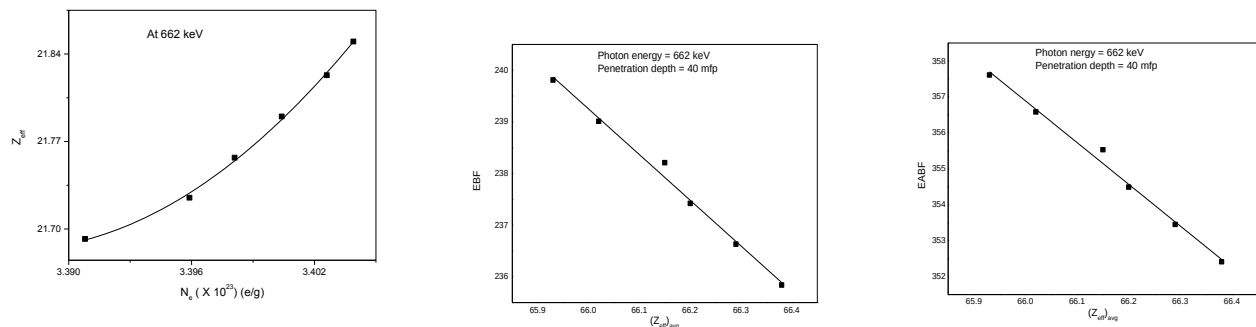


Fig. 4. Correlation among various photon interaction properties for synthesized glass samples

3.3 Correlation among optical and photon interaction parameters:

In this section, an attempt has been made to visualize the correlation among optical and photon interaction parameters of Sm^{3+} and Gd^{3+} co-doped lead alumino phosphate glass samples. The variation of optical band gap (E_g) of synthesized glass samples with effective atomic number $(Z_{\text{eff}})_{\text{avg}}$ is shown in **Fig 5**. It is observed that E_g increases in general with increase in $(Z_{\text{eff}})_{\text{avg}}$. This behavior is explained by taking into consideration the variation of E_g and $(Z_{\text{eff}})_{\text{avg}}$ with weight fraction of Pb (**Fig 2**). Both $(Z_{\text{eff}})_{\text{avg}}$ and E_g are observed to increase linearly with

increase in weight percentage of Pb. This indicates the presence of proportionality between $(Z_{\text{eff}})_{\text{avg}}$ and E_g of the synthesized glass samples. It is therefore concluded that the optical energy gap of Sm^{3+} and Gd^{3+} co-doped lead alumino phosphate glass samples is a function of average value of effective atomic number. The variation of polarizability and $(Z_{\text{eff}})_{\text{avg}}$ of prepared glass samples is shown in **Fig 5**. It is observed from the graph that the polarizability decreases with increase in $(Z_{\text{eff}})_{\text{avg}}$ of synthesized glass samples. It is due to the decreasing number of NBOs in the glass system as $(Z_{\text{eff}})_{\text{avg}}$ of the samples increases. NBOs have high tendency to polarize as compared with bridging oxygen [14]. Since the amount of bridging oxygen that has a low polarizability is more than amount of NBOs that has high polarizability, the synthesized glass systems tend to be less polarized. The refractive index in the semiconducting material is a measure of its transparency to incident spectral radiation. The refractive index of the synthesized glass samples is observed to decrease with $(Z_{\text{eff}})_{\text{avg}}$. It indicates relation between refractive index and $(Z_{\text{eff}})_{\text{avg}}$ of the synthesized glass samples.

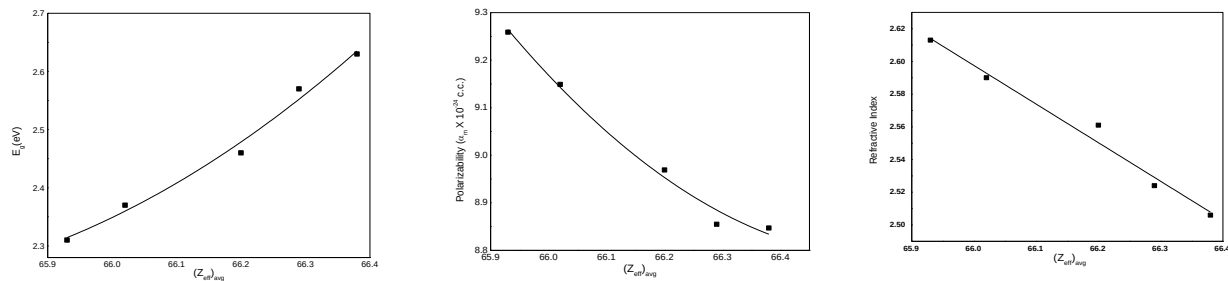


Fig. 5. Correlation among optical and photon interaction parameters

Conclusion

Some correlations are established among optical and photon interaction properties for the Sm^{3+} and Gd^{3+} co-doped lead alumino phosphate glass samples; which are as follows:

- Optical band gap increases with content of Pb due to an increase in the amount of NBOs with increasing concentration of Pb.
- Optical band gap increases almost linearly with $(Z_{\text{eff}})_{\text{avg}}$.
- Polarizability decreases with increasing $(Z_{\text{eff}})_{\text{avg}}$ of the synthesized glass samples.
- Refractive index of synthesized glass samples decreases with $(Z_{\text{eff}})_{\text{avg}}$.
- Further, Refractive index is a function of polarizability and optical band gap.
- Intensity of luminescence has been found to vary non-linearly with polarizability of the glass samples.
- Chemical compositions of the glass samples play an important role in the buildup of gamma ray photons within the synthesized rare earth co-doped glass samples.
- Moreover, increase in effective atomic number (Z_{eff}) and electron density (N_e) with increasing Pb content confirmed high photon interaction probability of the prepared glass samples at higher concentration of Pb.

It can be concluded that Sm^{3+} and Gd^{3+} co-doped lead alumino phosphate glass samples have potential application in the field of radiation shielding and sensing.

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Evaluation of Gamma-Ray Interaction Parameters for Some Oxides of Lanthanides

Jaswinder Singh^{*}, Yogesh K. Vermani[†], Tejbir Singh

Department of Physics, Sri Guru Granth Sahib World University, Fatehgarh Sahib-140407, Punjab, INDIA

yugs80@gmail.com, jaswindersingh7478@gmail.com

Abstract

The photon interaction and sensing properties namely mass attenuation coefficient (MAC), mass-energy absorption coefficient (MAC_{en}) and effective atomic number (Z_{eff}) were investigated for some oxides of rare-earth lanthanides: La_2O_3 , Sm_2O_3 , Eu_2O_3 , Er_2O_3 , Yb_2O_3 , and Lu_2O_3 . These photon attenuation parameters were calculated using the online *Py-MLBUF* program. Constituent rare-earth lanthanides are found to significantly affect gamma-ray attenuation parameters with respect to incident photon energy. Among the lanthanide oxides investigated, lutetium oxide (Lu_2O_3) is found to possess better photon attenuation and photon absorption properties particularly in the Compton scattering energy regime 100 keV - 1.0 MeV.

Introduction

There is seen immense growth and advancement in the nuclear radiation technology largely in the field of imaging techniques, diagnostics, radiation therapy and food safety. At the same time, these highly energetic and penetrating gamma radiations pose threat to human beings, animals and plants due to long exposure times [1]. The unnecessary over dose of gamma radiations can lead to fatal conditions such as cancer, skin burns, cell mutations and genetic diseases *etc* [2]. It is, therefore, very important to devise efficient shielding and sensing materials to attenuate gamma radiations [3].

In last few decades, various aggregates of concrete, metallic alloys, oxides of lead and numerous rare earth co-doped glasses have been used as radiation shielding blocks. Rare-earth (RE) based lanthanides elements which are relegated to the bottom margin of the actinides possess electronic structure characterized by 6s, 5d and 4f subshells. Samarium oxide (Sm_2O_3) has been used in infrared absorbing glasses. Yb_2O_3 has been utilized to produce the permanent magnetic materials, ceramics and coloring agents [4]. Europium oxide (Eu_2O_3) has been used as an activating-ion for color television phosphors, as control rods in the liquid metal fast breeder reactors and in vacuum deposition. Neodymium oxide co-doped glass has been used as lasing material for photonic applications [5]. Oxides of these lanthanides may also bear prospective radiation shielding and sensing properties [6]. Presence of these lanthanide oxides in alloys, glasses, and glass ceramics may provide special material properties. Moreover, the chemical stability and versatility in chemical composition allows use of these RE oxides in various high efficiency energy converters and glasses to improve shielding performance [7].

It is worth interesting to investigate photon interaction parameters viz. effective atomic number (Z_{eff}), mass attenuation coefficient (MAC), and mass energy-absorption coefficient (MAC_{en}) for oxides of rare-earth (RE) lanthanides in order to develop efficient sensing and shielding materials [8]. The mass energy-absorption coefficient is used to estimate the absorbed dose which is a measure of incident photon energy translated into the kinetic energy of the charged particles as a result of interaction of photons with atoms of the absorber material [9]. J. H. Hubbell calculated the mass energy absorption coefficient for H, C, N, O, Ar and seven other mixtures from 0.1KeV to 100MeV [10]. Attenuation of gamma photons while interaction with the material also depends upon the effective atomic number (Z_{eff}) of the absorber material and it can be calculated from atomic number (Z_i) of the constituent elements weighted according to the different partial photon interaction processes [8]. Jackson and Hawkes calculated the effective atomic number (Z_{eff}) by fitting data over incident photon energy and atomic number [11].

In the present manuscript, we shall report mass attenuation coefficient (MAC), mass energy-absorption coefficient (MAC_{en}) and effective atomic number (Z_{eff}) obtained for selected lanthanide oxides: La_2O_3 , Sm_2O_3 , Eu_2O_3 , Er_2O_3 , Yb_2O_3 , and Lu_2O_3 using *Py-MLBUF* software available online [1, 12].

Computational Work

The law of exponential is appropriate to determine the intensity of the transmitted gamma-ray beam through the sample of thickness ‘x’ positioned in the propagation path [13]:

$$I = I_0 \exp(-\mu x). \quad \text{Eq. (1)}$$

Here, I_0 represents the intensity of incident beam, I is the transmitted intensity of gamma-ray beam and μ is the linear attenuation coefficient. The parameter $MAC = \mu/\rho$ is the mass attenuation coefficient that gives the probability of interaction of the gamma photons with the sample.

For a compound or mixture, mass attenuation coefficient is obtained using a mixture rule:

$$(MAC)_{compound} = \sum_i \omega_i (MAC)_i \quad \text{Eq. (2)}$$

Here, ω_i and $(MAC)_i$ are, respectively, the weight fraction and mass attenuation coefficient of the i^{th} constituent element. The mass energy-absorption coefficient $(MAC)_{en}$ is related to mass energy-transfer coefficient $\left(\frac{\mu_{tr}}{\rho}\right)$ by the relation given below [14]:

$$(MAC)_{en} = \left(\frac{\mu_{tr}}{\rho}\right) \cdot (1 - G) \quad \text{Eq. (3)}$$

where, G is the fraction of energy of charged particle lost in radiative processes mainly by Bremsstrahlung effect. Using mixture rule, the mass energy-absorption coefficient of compound can be calculated as [15]:

$$(MAC)_{en} = \sum_i \omega_i (MAC_{en})_i \quad \text{Eq. (4)}$$

where ω_i is the weight fraction of i^{th} constituent element of the compound.

The mass attenuation coefficients values are further used by computer program to determine the effective atomic number (Z_{eff}) as follows [9]:

$$\sigma_m = MAC \frac{\sum_i n_i A_i}{N} \quad \text{Eq. (5)}$$

$$\sigma_a = \frac{\sigma_m}{\sum_i n_i} \quad \text{Eq. (6)}$$

$$\sigma_e = \frac{1}{N} \sum_i \frac{f_i A_i}{Z_i} (MAC)_i \quad \text{Eq. (7)}$$

$$Z_{eff} = \frac{\sigma_a}{\sigma_e} \quad \text{Eq. (8)}$$

Here, N is the Avogadro's number. A_i and Z_i are, respectively, the atomic weight and atomic number of i^{th} constituent element present in the compound. f_i is the fractional abundance of the i^{th} element. σ_a and σ_e represent the total atomic and electronic cross-sections, respectively.

Results and Discussion

The variation of mass attenuation coefficient (MAC) and effective atomic number (Z_{eff}) with photon energy is shown in Fig. 1. These parameters are plotted for photon energy variation in the range 1keV-10⁵MeV. The variation of these parameters with respect to photon energy can be explained on the basis of absorption cross-sections of mainly three processes namely photoelectric absorption, Compton scattering and pair production.

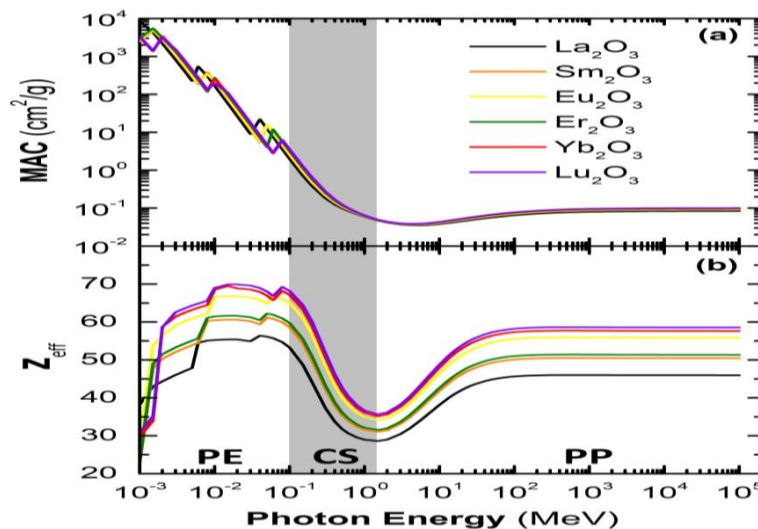


Figure 1. Variation of (a) Mass attenuation coefficient (MAC), and (b) Effective atomic number (Z_{eff}) with photon energy.

The photoelectric absorption of photons dominates the scenario at lower energies ($E_\gamma \leq 0.2 \text{ MeV}$). This results in sharp decline in MAC values with photon energy. Higher Z_{eff} values achieved for lanthanide oxides in this domain is due to photoelectric absorption cross-section depending upon the atomic number as Z^{4-5} and inversely on the photon energy ($\propto 1/E_\gamma^{3.5}$). This region is clearly characterized by three sharp peaks in MAC curves due to presence of absorption edges of lanthanide elements.

The intermediate photon energy region from 0.2 MeV-1MeV indicates moderate variation of MAC due to Compton absorption of photons. The cross-section for Compton scattering of photons varies inversely with photon energy E_γ . Beyond photon energy 2MeV, pair-production process dominates and the MAC values display an increasing trend. This gradual increase in MAC occurs due to cross-section for the pair-production process varying as $\propto Z^2 \cdot \log E_\gamma$. The maximum values of mass attenuation coefficient and Z_{eff} are shown by Lu_2O_3 ; while the lowest values are obtained for La_2O_3 as displayed in Fig. 1. This analysis clearly depicts that Lu_2O_3 possesses comparatively better gamma-ray attenuation and sensing

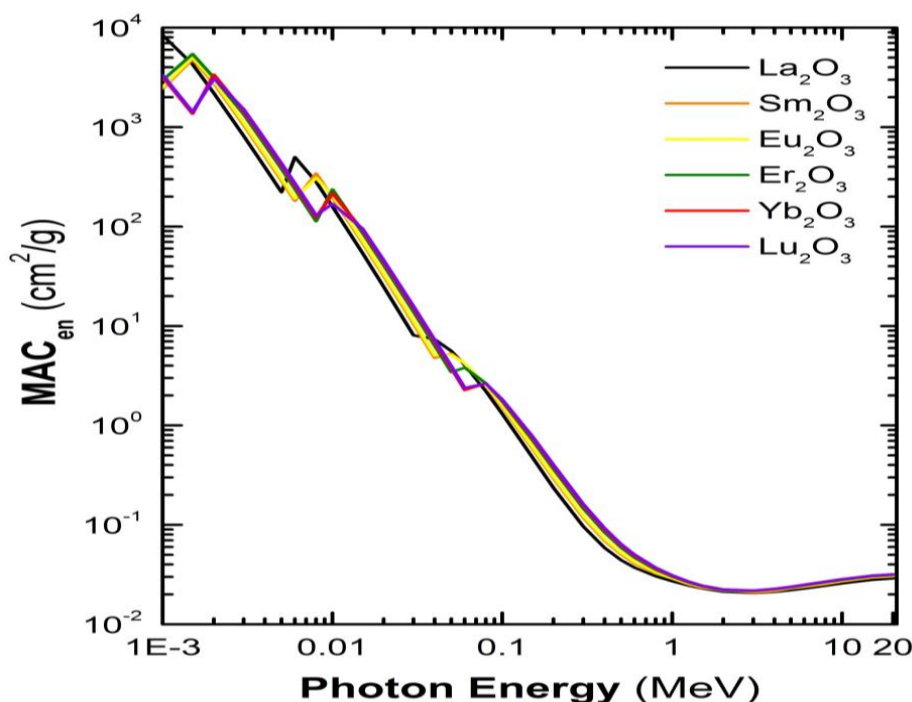


Figure 2. Variation of mass-energy absorption coefficient (MAC_{en}) with incident photon energy in the range 1 KeV to 20 MeV.

characteristics among the lanthanide oxides studied. Next, we display variation of mass energy-absorption coefficient (MAC_{en}) of these lanthanide oxides with photon energy in Fig. 2. Lanthanide oxides possess higher values of MAC_{en} at lower tail of photon energy and mass-energy absorption coefficient values decrease rapidly with increase in photon energy upto 1MeV. With further increase in photon energy, the MAC_{en} values increase gradually due to dominant pair-production phenomenon. Overall, lutetium oxide (Lu_2O_3) is observed to have highest mass energy-absorption coefficient values.

Conclusion

In the present paper, we investigated gamma-ray attenuation and sensing parameters for various oxides of selected rare-earth lanthanides. Mass attenuation and mass energy-absorption coefficient values were computed using the Py-MLBUF online platform. Among the lanthanide oxides investigated, lutetium oxide (Lu_2O_3) is found to possess maximal values of mass attenuation and mass energy-absorption coefficients. Similarly, higher effective atomic number (Z_{eff}) values are also exhibited by Lu_2O_3 particularly in the Compton scattering energy regime. This study reveals that Lu_2O_3 could be promising choice for the gamma-radiation attenuation and sensing devices.

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Impact of Bi_2O_3 on the optical properties of Al_2O_3 - B_2O_3 - Sm_2O_3 Glasses

Kamal Bansal, Sukhpal Singh

Department of Physics, Punjabi University, Patiala, Punjab, India

sukhpal@pbi.ac.in

Abstract: A glass series of composition $10\text{Al}_2\text{O}_3$ - $(89-x)\text{B}_2\text{O}_3$ - $x\text{Bi}_2\text{O}_3$ - $1\text{Sm}_2\text{O}_3$, where $x= 15, 20, 25, 30, 35$ mol% were fabricated via melt quenching technique. The Optical properties such as penetration depth signify the loss in transparency, and fermi energy (E_F) refers to amelioration in the semiconducting behaviour of prepared glass with the addition of Bi_2O_3 . Optical conductivity discloses the absorbance nature and creation of levels in the forbidden gap as heavy metal oxide is introduced.

Keywords: Transparency, Penetration depth, Fermi energy.

Research in the field of glass science and technology has been ongoing for many decades with the focus of either solving an existing problem or improving the quality of the materials. Glasses are amorphous and exhibit a glass transformation region. Based on their work, these are categorized into three components: glass formers, glass modifiers and glass intermediates [1].

Several glass formers like silicate, germanate, borate, phosphate, tellurite, and fluoride glasses have been extensively studied. Currently, boron oxide (B_2O_3) is being studied due to its low melting temperature, wide range of optical transmission, easy glass fabrication, better transparency etc. features. The borate network exists in the gathering of BO_3 and BO_4 units to form diborate, triborate and tetraborate stable borate groups [2]. Al_2O_3 is embedded as a modifier that helps to enhance the ability of glass formation, sufficient strength, reduction in hygroscopic nature and chemical durability of the glass system [3]. Amid the rare-earth ions, the trivalent rare-earth ions Sm^{3+} are considered the best activator amongst the most effective ones, exhibiting very attractive photonic and optical properties, which makes them very promising materials for optical communication, visible lasers, solar cells, display devices etc [4].

Bismuth oxide decreases the melting temperature and increases the UV absorption of the material [5]. Zhao et al. found the B_2O_3 - TeO_2 - Bi_2O_3 glasses have great interest in optical devices that is because low melting point and higher refractive index [6]. Shanmugavelu et al. studied the influence of bismuth oxide in borate glasses on third-order nonlinear optical properties by conventional and the Z-scan methods [7]. Opera et al. examined the optical properties of a binary system by considering bismuth and boric oxide [8].

The present work intends to describe the optical properties of the Al_2O_3 - B_2O_3 - Bi_2O_3 - Sm_2O_3 glass system by investigating various parameters such as absorption coefficient, fermi energy, optical conductivity and penetration depth.

EXPERIMENTAL DETAILS

The glass samples of composition $10\text{Al}_2\text{O}_3$ - $(89-x)\text{B}_2\text{O}_3$ - $x\text{Bi}_2\text{O}_3$ - $1\text{Sm}_2\text{O}_3$, where $x= 15, 20, 25, 30, 35$ mol% were prepared by melt quenching method. The starting material powders boron oxide (B_2O_3), aluminium oxide (Al_2O_3), bismuth oxide (Bi_2O_3) and samarium oxide (Sm_2O_3) were weighted by an electric balance with an accuracy of 1 mg, then mixed in mortar and pestle. This mixture was melted in a crucible at 1050°C and rapidly cast in a graphite mould. After quenching, the glasses were annealed into a muffle furnace at 425°C for 3 hours.

The optical measurements were carried out on Cary 5000 Spectrophotometer in the wavelength range of 200–800 nm.

THEORY

The absorption coefficient (α) is a measurement of the amount of incident energy absorbed in a unit length, determined by the relation [9]

$$\alpha = 2.303 \frac{A}{t} \quad (1)$$

where t is the thickness of the sample and A is the absorbance of material.

Penetration depth (δ) is defined as the thickness where optical photon density becomes $1/e$ of the value at its surface. This parameter is also known as skin depth (δ) and is determined by the relation [10]

$$\delta = \frac{1}{\alpha} \quad (2)$$

The optical conductivity measures the frequency response of the material when irradiated with light that is generated due to the motion of the charge carriers by the incident electromagnetic wave electric field having relation to refractive index (n) and the speed of light (c), which can be seen in the following expression [11],

$$\sigma_{\text{optical}} = \frac{nc\alpha}{4\pi} \quad (3)$$

The extinction Coefficient is a measurement of the absorption or reflection of light at a particular wavelength per unit length in a medium. It depends upon the absorbance and material length that can be calculated by the following relation [12]

$$k = \frac{\alpha\lambda}{4\pi} \quad (4)$$

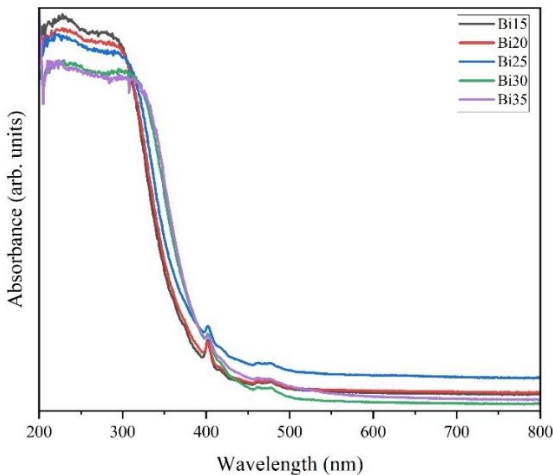
The Fermi level energy (E_F) is calculated from the extinction coefficient by using a Fermi–Dirac distribution function [13],

$$k = \frac{1}{1 + \exp\left(\frac{E - E_F}{k_B T}\right)} \quad (5)$$

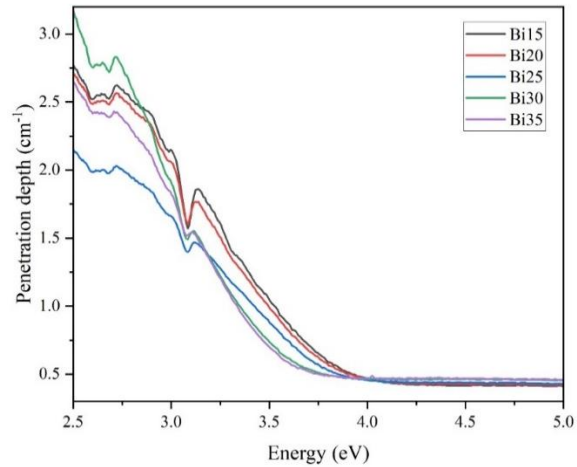
where k is the extinction coefficient that refers to the maximum absorption at the UV edge, E_F is the Fermi energy, E is the incident photon energy, k_B is the Boltzmann constant and T is the absolute temperature.

RESULTS AND DISCUSSIONS

Optical properties provide information about the optically induced transitions and absorption of materials. The UV–Visible spectroscopy was carried out in the wavelength range of 200–800 nm and absorption edge has been observed in the UV region (at 225 nm) which can be seen in Figure 1(a). The oxygen bond strength affects the absorption characteristics, especially the absorption edge of the glass samples. Moreover, the broad edge implies the amorphous nature of the glass samples.



(a)



(b)

FIGURE 1. (a) Absorption spectra of the prepared glass systems (b) Penetration depth spectra of prepared oxide glasses.

The penetration depth decreases as the energy of the incident photon increases, which can be seen in Figure 1(b). It is also noticed that it follows decreasing pattern as the Bi_2O_3 content is added. This insinuated the reduction in the transparency of the glass sample [14].

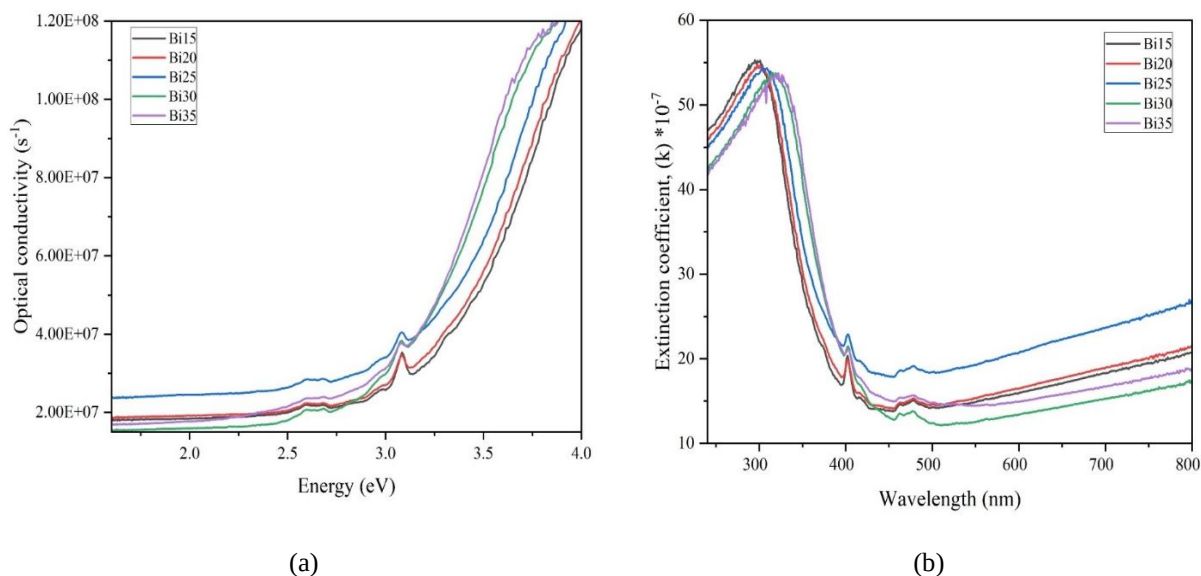


FIGURE 2. (a) Optical conductivity spectra of bismuth oxide doped glass (b) The correlation of extinction coefficient, k with wavelength.

Fig. 2(a) demonstrates the optical conductivity increases with photon energy which signifies the presence of absorbance nature of the material or due to the excitation of electrons by the photon energy. As σ_{optical} increases with the introduction of bismuth oxide, this indicates the creation of levels in the band gap. Thus, more electrons will acquire a chance to transfer from the valence band (VB) to near lying levels of the conduction band (CB). As a result, the optical bandgap will decrease and correspondingly σ_{optical} will increase [15].

From Figure 2(b), it can be seen that the extinction coefficient decreases as the wavelength of the incident photon increases, indicating the fraction of light lost due to a decrement in scattering and absorbance [16]. Mott and Davis [17] have mentioned a similar trend for many amorphous semiconductors.

There is a reduction in E_F values with the introduction of Bi_2O_3 concentration (can be seen in Table1), this implies the semiconducting nature of the material [18].

TABLE 1. Fermi energy (E_F) values of prepared samples.

Sample code	Fermi Energy (eV) ± 0.001
Bi15	4.154
Bi20	4.110
Bi25	4.035
Bi30	3.876
Bi35	3.804

Conclusion

In the present paper, the following points have been concluded:

- In absorption spectra, at 225 nm absorption edge occurred.
- Transparency of the glass is reduced with more concentration of bismuth oxide.
- Optical conductivity confirmed the creation of levels in the bandgap.
- Semiconducting nature of the glass samples increases as Bi_2O_3 is introduced into it.

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Comparative Analysis of Photon Interaction Parameters for Some Rare Earth Doped Glasses

Samarvijay Singh Deol, Harjot Kaur, Preet Kaur and Tejbir Singh

Department of Physics, Sri Guru Granth Sahib World University, Fatehgarh Sahib – 140407, Punjab, India

samarvijaysinghdeol.work@gmail.com, dr.tejbir@gmail.com

Abstract

Five best compositions from different rare earth doped glass series were selected for comparative analysis on the basis of photon interaction parameters. The basic photon interaction parameters include mass attenuation coefficient (MAC), mean free path (mfp), half value layer (HVL), tenth value layer (TVL), effective atomic number (Z_{eff}) and electron density (N_e). All these parameters were computed in the wide energy range from 1 keV to 100 GeV. The results so obtained were analyzed on the basis of photon energy and chemical composition of the selected glass samples.

1. Introduction

Rare Earth (RE) doped glasses are providing tremendous application in the fields of active media of lasers, display devices, radiation sensing [1-2]. These RE doped glasses are also useful in shielding purpose from interacting hazardous X-rays and Gamma radiations [3-4]. The visibility of RE doped glasses is an additional advantage over traditional shielding materials (lead, concrete and stainless steel); which attracts many researchers to explore the feasibility of different glass compositions in radiation shield design [5-8].

The participation of host matrix is remarkable in shielding and sensing properties of a glass [9]. The glasses of different elements such as phosphate, silicon, borate, germanate, arsenate etc. are using as protection material from gamma radiation and X-rays. The selection of Co-doped Sm_2O_3 and Gd_2O_3 glass is more beneficial due to its traits such as high fluorescence intensity, huge stimulated emission, larger absorption cross section and many more, which build a strong material that helps in sensing the interaction rays. Phosphate glasses have its own applications due to higher gamma radiation absorption coefficient, lower preparation temperature (glass transition). The most considerable point for these Co-doped compound glasses is its energy spectrum is ranged between UV to Visible and then in IR of EM spectrum [10]. Furthermore, the excellent luminescent properties of Europium (Eu^{3+}) ions are making this lanthanide element more appealing. It is an effective dopant due to high quantum efficiency and structural variations in Eu^{3+} crystalline vicinities [11]. The involvement of Al_2O_3 enhances the chemical durability and optical response.

Moreover, characteristics of oxides namely mechanical strength, thermal stability and chemical stability make alumino-phosphate oxide function as host matrix. Besides, the addition of Bi_2O_3 and PbO (heavy oxides) to phosphate glasses escalates its density, refractive index and effective atomic number that is worthy to make this glass a suitable shielding as well sensing material. The bismuth ions occupy network former and modifier units and act as polyhedral unit (BiO_n $n=3, 6$) [6]. Apart from Bi_2O_3 and PbO , some oxides like CdO , Er_2O_3 , Gd_2O_3 and Ga_2O_3 are also utilized for many applications. The properties viz. chemical stability, high density, favorable optical properties and better radiation protection shielding drive $\text{SiO}_2\text{-Li}_2\text{O-CdO-Gd}_2\text{O}_3\text{-Er}_2\text{O}_3$ a useful glass which may use for many purposes. Borate (B_2O_3) and phosphate (P_2O_5) based glasses are performing remarkable application in many fields due to its useful features [12-13].

There is an interesting element called as Tellurite, which is more in analysis because of its properties as lower melting temperature, higher dielectric properties, better chemical resistance, lower crystallization, higher thermal stability and transmission qualities from infrared rays. This material requires other ingredients for the formation of glass. The participation of heavy metal oxides with tellurite may provide this glass system chemically stable and devitrification [14]. The glasses of borate-tellurite as a host matrix are in consideration and many investigators reported its properties. Some other Yb^{3+} doped bismuth based glasses were also explored for radiation shielding [15].

For better shielding properties; it is mandatory for the glass to possess higher values of mass attenuation coefficient, effective atomic number, electron density and minimum values of mean free path, half value layer, and tenth value layer. All these parameters were helpful in determining the ability of a glass in the prospectus of radiation shield designing.

In this present work, five different glass compositions doped with different rare earth metal oxides were selected for comparative analysis on the basis of photon interaction parameters. Among the selected compositions, three glasses

belong to phosphate, one belongs to silicate and one belongs to tellurite group. The results are presented in graphical and tabular form for better understanding of the comparative analysis.

2. Selection of Material

The following five best compositions of different glass series were selected for comparative analysis:

S. No.	Sample Name	Density (g/cm ³)	Reference
1.	1.5Al ₂ O ₃ -20Bi ₂ O ₃ -0.5Eu ₂ O ₃ -58P ₂ O ₅ -20PbO	4.76	[6]
2.	57.4PbO-40P ₂ O ₅ -1.8Al ₂ O ₃ -0.4Sm ₂ O ₃ -0.4Gd ₂ O ₃	5.42	[10]
3.	47.50B ₂ O ₃ -20P ₂ O ₅ -10LiF-10PbO-10Bi ₂ O ₃ -0.5Er ₂ O ₃ -2Yb ₂ O ₃	3.89	[15]
4.	50Si ₂ O ₃ -30Li ₂ O ₃ -1Gd ₂ O ₃ -17CdO-2Er ₂ O ₂	3.51	[13]
5.	4Er ₂ O ₃ -20ZnO-76TeO ₂	4.47	[14]

3. Methodology

The photon interaction parameters were defined along with mathematical expressions, which were used to compute the parameters for the selected glass samples.

3.1 Mass attenuation coefficient:

It measures the probability of interaction of radiations with the matter, independent of its density. It can be experimentally found by Lambert-Beer's law [9], which is given below:

$$I(t) = I_0 e^{-MAC \cdot t} \quad \dots (1)$$

Where t - thickness density of the matter ($x \times \rho$), ρ - density of the matter and MAC - mass attenuation coefficient.

A computer software named WinXCom [16] was used to obtain the value of MAC, which is based on the mixture rule. The MAC values for all glass samples were obtained for energy ranging from 1 keV-100 GeV which is quite vast range [9]. It is measured in cm²/g.

3.2 Mean Free Path:

The mean distance travelled by a photon before it gets interacted within the material is called mean free path. It is measured in cm [6]. It can be calculated from mass attenuation coefficient as:

$$mfp = \frac{1}{MAC \cdot \rho} \quad \dots (2)$$

3.3 Half value layer:

It is the thickness where the intensity of the radiation is reduced to half, as compared to its initial value in the absence of any shielding material. For efficient shielding, it must possess a lower value. It is also measured in cm [6].

$$HVL = \frac{0.693}{MAC \cdot \rho} \quad \dots (3)$$

3.4 Tenth Value Layer:

It is the thickness of interacting material where the intensity of the radiation is reduced to 1/10th of the initial intensity. It is measured in cm [6].

$$TVL = \frac{2.303}{MAC \cdot \rho} \quad \dots (4)$$

3.5 Effective Atomic Number:

In terms of physical significance, it is analogous to atomic number assigned to mixtures/compounds to visualize their equivalence during interaction with photon beam. However, it is energy dependent parameter. It can be computed using ratio of two types of cross-section values as discussed below:

The molecular cross-section can be calculated by the relation

$$\sigma_m = (MAC)_{glass} \frac{M}{N_A} \quad \dots (5)$$

where M is the molar mass of the substance, and N_A is the Avogadro's number.

The atomic cross section can be calculated by dividing the molecular cross section by the total number of formula units as follow

$$\sigma_a = \sigma_m \frac{1}{\sum_i n_i} \quad \dots (6)$$

The electronic cross section can be calculated by the relation

$$\sigma_e = \frac{1}{N_A} \sum \frac{f_i A_i}{Z_i} (\text{MAC})_{\text{glass}} \quad \dots (7)$$

where $f_i = \frac{n_i}{\sum n_i}$ is the fractional abundance of i^{th} element w.r.t. total number of atoms.

The effective atomic number for the glass sample can be calculated by the relation [6]

$$Z_{\text{eff}} = \frac{\sigma_a}{\sigma_e} \quad \dots (8)$$

3.6 Electron Density:

It is the number of electrons per unit mass of the interacting material. Its higher value means, the higher chances of photon interaction [6]. It is measured in no. of electrons per gram (e/g).

$$N_e = \frac{\text{MAC}}{\sigma_e} \quad \dots (9)$$

4. Results and Discussion

4.1 Mass attenuation coefficient (MAC)

The MAC is a fundamental property of the material which provides information about the probability of interactions of photon beam with the material. The higher MAC values signify more chances of photon interaction; which definitely leads to photon attenuation from the transmitted photon beam and hence better shielding capabilities. The variation in MAC values for the glass samples over a wide photon energy range from 1 keV to 100 GeV has been shown in **Fig. 1** (left panel). The variation in MAC with respect to photon energy can be explained on the basis of different photon interaction processes. Photoelectric effect dominates at lower photon energy (for energy less than 450 keV), Compton effect at medium energy (450 keV to 6 MeV), and pair production effect dominates at higher energies (above 6 MeV). In photoelectric dominance (PE) region, cross section varies strongly with energy as $1/E^{3.5}$. Hence, the MAC values decrease sharply with photon energy in this energy regime and MAC values falls from $10^4 \text{ cm}^2/\text{g}$ to about $10^{-1} \text{ cm}^2/\text{g}$. Further, some discontinuities were also observed in MAC values in this energy domain; due to the appearance of absorption edges of different constituent elements of glass samples. The cross section for Compton Scattering decreases linearly with energy. The value of MAC decreases slowly from $0.1 \text{ cm}^2/\text{g}$ to $0.03 \text{ cm}^2/\text{g}$. Moreover, this interaction process being independent of atomic number shows almost same MAC values even for different glass samples. Beyond 6 MeV, pair production dominance (PP) region starts and the cross-section for this process varies directly with energy as $\log E$. The values of MAC increase slowly from $0.03 \text{ cm}^2/\text{g}$ to $0.1 \text{ cm}^2/\text{g}$. Above 400 MeV, MAC becomes saturated, and hence remains constant. Among different glass samples, S2 has the highest values for MAC at most of the photon energies with few exceptions corresponding to absorption edges where S5 sample shows better results.

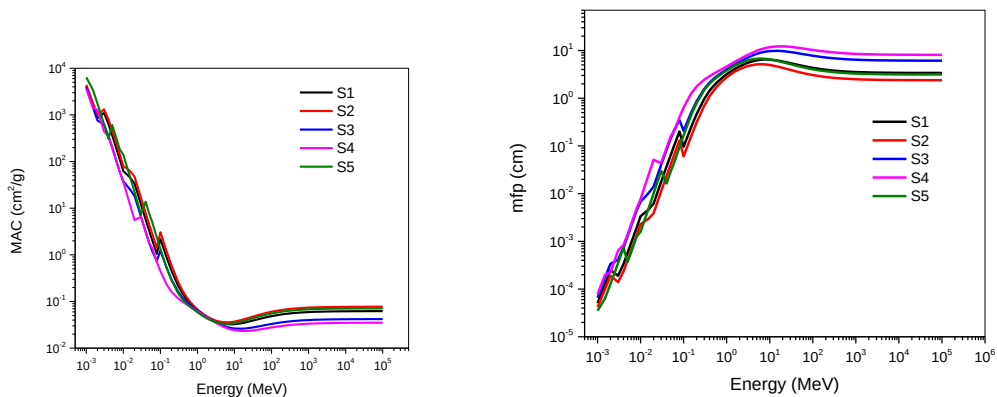


Fig. 1 Variation of MAC and mfp with energy for different glass samples

4.2 Mean free path (mfp)

The mfp is an average distance a photon travel inside the material among two successive interactions. For efficient attenuation of photons, photon must be attenuated from thin/compact layers of material. Hence, lesser value of mfp (in cm) means better shielding capabilities. The mfp possesses inverse relation with MAC. **Fig. 1** (right panel) shows the variation of mfp values for different glass samples with energy. At lower photon energy, minimum thickness of glass sample (of μm size) is sufficient for photon interaction; which increases with an increase in photon energy. In photoelectric region i.e. upto 450 keV, mfp values lie between $0.3 \mu\text{m}$ to 2.5 cm . There is very slow increase in Compton region (CE) (450 keV to 6 MeV). The variation in mfp values is very less significant

here. Above 6 MeV, Pair Production process dominate. The mfp values decrease slightly and become constant over 400 MeV. The values vary in between 14 cm to 2 cm. Among the selected glass samples, the lowest mfp value is observed for S2 glass sample followed by S5; whereas S4 offers maximum mfp value. The relative difference between mfp values of S2 and S4 samples is less at lower energies, but increases significantly as we go to higher energies.

4.3 Half value layer (HVL) and Tenth value layer (TVL)

These two are the thickness normalizing parameters. HVL tells us the thickness of the sample after which the radiation intensity will remain $\frac{1}{2}$ of the initial value. TVL gives us the thickness value where radiation intensity remains $\frac{1}{10}$ th of the incident value. **Fig. 2** shows the variation of HVL (left panel) and TVL (right panel) with energy. In lower energy / PE dominant region, the HVL value varies from 0.2 μ m to 2 cm and TVL varies from 0.8 μ m to 5 cm. In intermediate region of Compton dominance, the variation of HVL increases linearly with energy from 0.9 cm to 7.5 cm and TVL value varies from 2.8 cm to 23 cm. In higher energy of pair production dominance, HVL value lies in between 3.3 cm to 10 cm and TVL values lies in between 11.5 cm to 29 cm.

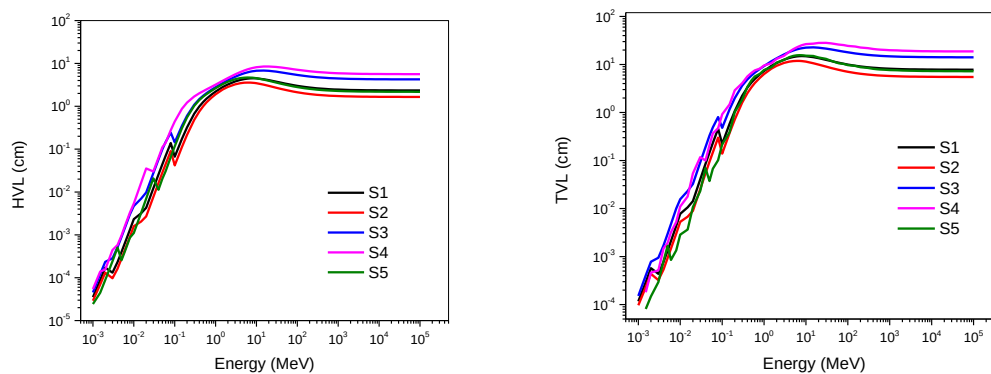


Fig. 2. Variation of HVL and TVL with energy for some glass samples

4.4 Effective atomic number (Z_{eff})

The atomic number of an element gives us idea about the shielding strength of the element. But in mixtures and compounds, we have a number named Z_{eff} which tells us about the shielding ability of the compound / material. The variation of Z_{eff} vs. Energy is shown in **Fig. 3** (left panel). The maximum values for Z_{eff} is observed in lower energy region / PE region (22-64). The minimum values are observed in CS region (11-24). The intermediate values are observed in PP dominant region (14-41). The maximum value of Z_{eff} is observed for glass S2 followed by S5.

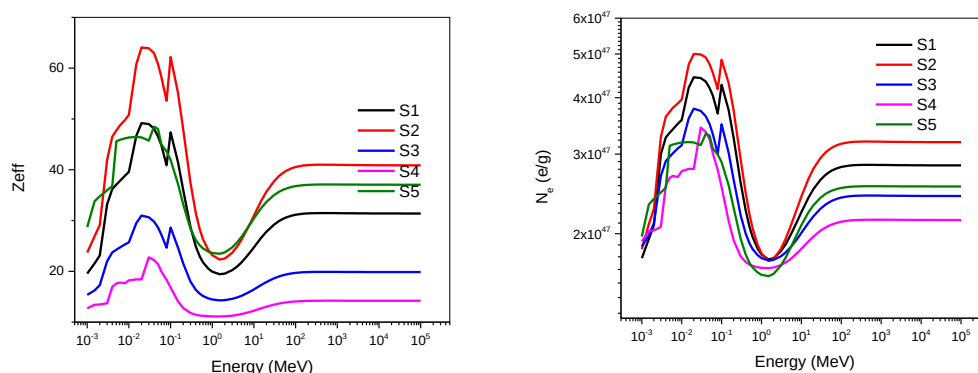


Fig. 3 Variation of Z_{eff} and N_e with photon energy for different glass samples

4.5 Electron Density (N_e)

It provides information about the number of electrons per unit mass of the glass. For larger number of electrons available per unit mass in a glass sample; higher will be the probability of photon interaction and hence higher radiation attenuation. The variation of N_e with energy is shown in **Fig. 3** (right panel); which is very similar to the

variation of Z_{eff} with energy as Z_{eff} also provides similar information of equivalent positively charged particles (protons) in the glass sample.

CONCLUSION

- All the selected glass samples were of high density ranging from **3.51-5.42 g/cm³**.
- Among the selected glass samples; S2 with the highest density value (5.42 g/cm³) also provides higher values for MAC, Z_{eff} , N_e and lowest values for mfp, HVL, TVL.
- Among the selected glasses, the compact dimensions of S2 will offer better radiation attenuation and can replace the traditional shielding materials with an additional advantage of monitoring inside due to its transparent nature.

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Combinatorics of Third Order Mock Theta Function $\omega(q)$

* Yadavindra, Department of Science
 Punjabi University Guru Kashi Campus, Damdama Sahib
 Talwandi Sabo, India
 E—mail: sharma_stary2k@yahoo.co.in

Abstract

In this manuscript, we investigate the combinatorics of third order mock theta function $\omega(q)$. This function was introduced by Watson while studying modular transformation laws for third order mock theta functions of Ramanujan. In order to understand its combinatorics, we use n -color partitions introduced by Agarwal and Andrews and generalized Frobenius partitions introduced by Andrews.

Keywords: Mock Theta Function, Generalized Frobenius Partitions, n -Color Partitions.

MSC 2020: 05A17, 05A19, 11P81

1 Introduction

Srinivasa Ramanujan, who lived his life in poverty, was so rich as a mathematician that even in his deathbed letter to Hardy he introduced the concept of mock theta functions. Such is the profoundness of the theory of mock theta functions that mathematicians are engaged in unfolding its secrets for almost 100 years now. Gordon and McIntosh [3] have given a detailed account of the enormous work done on mock theta functions. This author in a joint work with M. Rana has published a series of papers [5, 6, 7, 8, 9] on the combinatorial interpretations of many mock theta functions. In this manuscript, we are investigating the following third order mock theta function combinatorially:

$$\omega(q) := \sum_{n=0}^{\infty} \frac{q^{2n(n+1)}}{(q; q^2)_{n+1}^2}.$$

This function was introduced by Watson while studying modular transformation laws for third order mock theta functions of Ramanujan. We interpret $q\omega(q)$ in terms of n -color partitions and generalized Frobenius partitions.

n -color partitions were introduced by Agarwal and Andrews [1] and are defined as:

Definition 1.1. A n -color partition (also called a partition with “ n copies of n ”) is a partition in which a part of size n , $n \geq 0$, can occur in n different colors denoted by $n_1, n_2, \dots, n_n$.

Definition 1.2. The weighted difference of two parts $(a_i)_{b_i}$ and $(a_j)_{b_j}$ ($a_i \geq a_j$) in a n -color partition $(a_1)_{b_1} + (a_2)_{b_2} + \dots + (a_p)_{b_p}$ such that $(a_1)_{b_1} \geq (a_2)_{b_2} \geq \dots \geq (a_p)_{b_p}$, is $a_i - b_i - a_j - b_j$ and denoted by $(w.d)_{i,j}$.

In [2], Andrews introduced the concept of generalized Frobenius partitions or simply F-partitions.

Definition 1.3. A generalized Frobenius partition of a positive integer ν is a two-rowed array of non-negative integers

$$\begin{pmatrix} c_1 & c_2 & \dots & c_p \\ d_1 & d_2 & \dots & d_p \end{pmatrix}$$

such that integers are arranged in a non-increasing order in each row and

$$\nu = \sum_{i=1}^p (c_i + d_i + 1).$$

2 Interpretation of $q\omega(q)$

$$q\omega(q) = \sum_{n \geq 0} \frac{q^{2n^2+2n+1}}{(q; q^2)_{n+1}^2} = \sum_{n \geq 1} \frac{q^{2n^2-2n+1}}{(q; q^2)_n^2}.$$

Each exponent ν of q in the series expansion of $q\omega(q)$ is of the form

$$n^2 + (n-1)^2 + (\alpha_1 \times 1 + \alpha_2 \times 3 + \dots + \alpha_n \times (2n-1)) + (\beta_1 \times 1 + \beta_2 \times 3 + \dots + \beta_n \times (2n-1)),$$

where $\alpha_i, \beta_i \geq 0, 1 \leq i \leq n$.

Each exponent ν can be partitioned as a generalized Frobenius partition satisfying

$$\begin{aligned} c_n &= \alpha_n, \quad d_n = \beta_n, \\ c_i &= 2(n-i) + \alpha_n + \alpha_{n-1} + \dots + \alpha_i + \beta_n + \beta_{n-1} + \dots + \beta_{i+1}, \\ d_i &= 2(n-i) - 1 + \alpha_n + \alpha_{n-1} + \dots + \alpha_{i+1} + \beta_n + \beta_{n-1} + \dots + \beta_i, \end{aligned}$$

for $1 \leq i \leq n-1$. Now, define

$$\delta_n = c_n, \quad \delta_i = c_i - d_{i+1} - \delta_{i+1}, \quad 1 \leq i \leq n-1.$$

Therefore, $\delta_n = \alpha_n$ and

$$\delta_i = \begin{cases} 2 + \alpha_i & \text{if } n-i \text{ is odd,} \\ 1 + \alpha_i & \text{if } n-i \text{ is even,} \end{cases} \quad 1 \leq i \leq n-1. \quad (2.1)$$

Similarly, we define

$$\theta_n = d_n, \quad \theta_i = d_i - c_{i+1} - \theta_{i+1}, \quad 1 \leq i \leq n-1.$$

Therefore,

$$\theta_i = \begin{cases} 1 + \beta_i & \text{if } n-i \text{ is odd,} \\ \beta_i & \text{if } n-i \text{ is even,} \end{cases} \quad 1 \leq i \leq n-1. \quad (2.2)$$

Thus, the coefficient of any exponent ν of q in the series expansion of $q\omega(q)$ counts the number of generalized Frobenius partitions of ν satisfying $\delta_n, \theta_n \geq 0$,

$$\delta_i \geq \begin{cases} 2 & \text{if } n-i \text{ is odd,} \\ 1 & \text{if } n-i \text{ is even,} \end{cases} \quad 1 \leq i \leq n-1. \quad (2.3)$$

and

$$\theta_i \geq \begin{cases} 1 & \text{if } n-i \text{ is odd,} \\ 0 & \text{if } n-i \text{ is even,} \end{cases} \quad 1 \leq i \leq n-1. \quad (2.4)$$

The above conditions are obtained by using the equations (2.1), (2.2) and the fact that $\alpha_i, \beta_i \geq 0$. Now, to interpret the exponents in terms of n -color partitions we map each column $\begin{pmatrix} c_i \\ d_i \end{pmatrix}$ of generalized Frobenius partition to a single part $(a_i)_{b_i}$ of n -color partition in the following manner:

$$a_n = c_n + d_n + 1, \quad b_n = d_n + 1,$$

$$a_i = c_i + d_i + 1, \quad b_i = d_i - c_{i+1} - d_{i+1} + \cdots + (-1)^{n-i}(c_n + d_n) + \lambda_i,$$

for $1 \leq i \leq n-1$ and $\lambda_i = \begin{cases} 1 & \text{if } n-i \text{ is odd,} \\ 2 & \text{if } n-i \text{ is even.} \end{cases}$

This mapping provides the following relation:

$$(w.d)_{n,n+1} = \delta_n, \quad (2.5)$$

$$(w.d)_{i,i+1} - (w.d)_{i+1,i+2} + \cdots + (-1)^{n-i}(w.d)_{n,n+1} = \begin{cases} \delta_i - 2 & \text{if } n-i \text{ is odd,} \\ \delta_i - 1 & \text{if } n-i \text{ is even,} \end{cases} \quad (2.6)$$

for $1 \leq i \leq n-1$. Similarly,

$$b_n = \theta_n + 1, \quad b_i = \begin{cases} \theta_i + 1 & \text{if } n-i \text{ is odd,} \\ \theta_i + 2 & \text{if } n-i \text{ is even,} \end{cases} \quad 1 \leq i \leq n-1. \quad (2.7)$$

Using (2.3)-(2.4) and $\delta_n, \theta_n \geq 0$ in (2.5)-(2.7), we obtain the following conditions on n -color partitions generated by the exponents of q in series expansion of $q\omega(q)$:

$$b_i \geq 2, \quad (w.d)_{i,i+1} - (w.d)_{i+1,i+2} + \cdots + (-1)^{n-i}(w.d)_{n,n+1} \geq 0, \quad 1 \leq i \leq n-1.$$

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Theory of Tribonacci Sequence with Its Respective Matrix

* Priyanka, **Pushwinder Kumar

*Assistant Professor, COE-CSE, Chandigarh Group of College, Landran, India, 140307 2

** Research Scholar, Department of Mathematics, Punjabi University, Patiala, India, 147002

Sethiprk@gmail.com, pushwindershelly@gmail.com

Abstract

The Tribonacci sequence, the sequence of numbers, with the advanced known of initial three numbers, is derived with the sum of trailing three consecutive numbers. The representation of Tribonacci sequence is in the form of, $S_n = S_{n-1} + S_{n-2} + S_{n-3}$, by taking three necessities $S_0 = 1, S_1 = 1, S_2 = 1$. Thus, some numbers of this sequence are 1, 1, 1, 3, 5, 9, 17, 31, 57, 105, 193, 355, 653, 1201, 2209, ...We are considering a square matrix of order 3 and with some properties of eigenvalues to obtain Binet-type formula. These are also associated with Generalized Tribonacci sequence and this will provide important results and limit of Tribonacci sequence.

Keywords: Generalized Tribonacci sequence, Binet-Type formula, Limit of Tribonacci sequence.

Introduction

The Tribonacci sequence is like of Fibonacci sequence (in general). These both have same characteristics. The Fibonacci sequence is sequence that defined after taking first two predetermined numbers, by adding up the two trailing numbers. Like this way, Tribonacci sequence is formed, after taking first three starting terms, by adding up the three trailing numbers.

[1] Bruce, Finding some terms of Tribonacci sequence which is defined as $S_n = S_{n-1} + S_{n-2} + S_{n-3}$, with first three initial numbers were taken as $S_0 = 1, S_1 = 1, S_2 = 1$ then 1, 1, 1, 3, 5, 9, 17, 31, 57, 105, 193, 355, 653, 1201, 2209, 4063, 7473, 13745, 25281 ...

(1)

In 1914, Agronomof, introduced this above sequence. After that, Charles Rebert Darwin used this sequence for origin in spices. After that, his son, Sir George Howard Darwin, provided the calculation for the growth of elephants with the use of this series.

[9] As in the Fibonacci sequence there is an important term which is Golden Ratio that is the ratio of any two successive terms of the sequence, the ratio has value approximate 1.6103399 This Golden ratio is used to resolve many problems in nature, like animal breeding, construction of building, growth of plants, number of petals in flower, many pine cones have the structure of Fibonacci Spirals that is formed by Golden rectangle. Like this similar way, the ratio of the Tribonacci Sequence is approximate 1.6180339887 A rectangle is also formed by Tribonacci sequence, that has similar facts but, it is not apparent as Golden rectangle. So, it is called Silver rectangle.

Application of Tribonacci sequence [5] that followed De moivre-type identities and important result on Tribonacci numbers in terms of binomial and trinomial coefficients[6] with some applications on Tribonacci sequence.

Consider the sequence $\{S_n\}$ and $S_1 = S_2 = S_3 = 1$, the following Recurrence relation holds for the $\{S_n\}$ for odd and even terms are

$$S_{2n} = S_{2n-1} + S_{2n-3} \quad (2)$$

$$S_{2n+1} = S_{2n-1} + S_{2n-2} \text{ for } n > 2 \quad (3)$$

Above two sequences gives

$$1, 1, 1, 2, 2, 3, 4, 6, 7, 11, 13, 20, 24, 37, 44, 68, 81 \dots \quad (4)$$

We have two properties of the Tribonacci sequence $\{T_n\}$ are

$$S_{2n+5} = S_{2n+3} + S_{2n+1} + S_{2n-1} \quad (5)$$

$$S_{2n+6} = S_{2n+4} + S_{2n+2} + S_{2n} \quad (6)$$

Now,

Generating function of the number of the sequence is

$$S(x) = 1 + \sum_{n=1}^{\infty} S_n x^n = 1 + S_1 x + S_2 x^2 + S_3 x^3 + \dots + S_r x^r + \dots$$

The generating function for the Tribonacci sequence divide into two sequences that is odd sequence $\{S_o(x)\}$ and even sequence $\{S_e(x)\}$, where $S_o(x) = S_1x + S_3x^3 + S_5x^5 + S_7x^7 + S_9x^9 + S_{11}x^{11} + \dots$ and $S_e(x) = 1 + S_2x^2 + S_4x^4 + S_6x^6 + S_8x^8 + S_{10}x^{10} + \dots$

For odd sequence

Multiplying the above series $-x^2, -x^4, -x^6$, we get following equations

$$\begin{aligned} S_o(x) &= S_1x + S_3x^3 + S_5x^5 + S_7x^7 + S_9x^9 + S_{11}x^{11} \dots \\ -x^2S_o(x) &= -S_1x^3 - S_3x^5 - S_5x^7 - S_7x^9 - S_9x^{11} \dots \\ -x^4S_o(x) &= -S_1x^5 - S_3x^7 - S_5x^9 - S_7x^{11} \dots \\ -x^6S_o(x) &= -S_1x^7 - S_3x^9 - S_7x^{11} \dots \end{aligned}$$

Summing up above

$$\begin{aligned} (1 - x^2 - x^4 - x^6)S_o(x) &= S_1x + (S_3 - S_1)x^3 + (S_5 - S_3 - S_1)x^5 + (S_7 - S_5 - S_3 - S_1)x^7 + (S_9 - S_7 - S_5 - S_3)x^9 \\ &\quad + \dots \end{aligned}$$

$(1 - x^2 - x^4 - x^6)S_o(x) = x$, by using (4), (5) and (6) all other terms become zero

$$S_o(x) = \frac{x}{(1 - x^2 - x^4 - x^6)}$$

For even sequence

Multiplying above series with $-x^2, -x^4, -x^6$, we get following equations

$$\begin{aligned} S_e(x) &= 1 + S_2x^2 + S_4x^4 + S_6x^6 + S_8x^8 + S_{10}x^{10} + \dots \\ -x^2S_e(x) &= -x^2 - S_2x^4 + S_4x^6 + S_6x^8 + S_8x^{10} + \dots \\ -x^4S_e(x) &= -x^4 - S_2x^6 + S_4x^8 + S_6x^{10} + \dots \\ -x^6S_e(x) &= -x^6 - S_2x^8 + S_4x^{10} + \dots \end{aligned}$$

After summing above equations, we have left with

$(1 - x^2 - x^4 - x^6)S_e(x) = 1 - x^6$; by using (4), (5) and (6) all other terms become zero

$$\text{So, } S_e(x) = \frac{1 - x^6}{(1 - x^2 - x^4 - x^6)}$$

The generating function of Tribonacci sequence is

$$S(x) = S_o(x) + S_e(x)$$

$$S(x) = \frac{x}{(1 - x^2 - x^4 - x^6)} + \frac{1 - x^6}{(1 - x^2 - x^4 - x^6)}$$

$$S(x) = \frac{1 + x - x^6}{(1 - x^2 - x^4 - x^6)}$$

Thus we get the generating sequence of the Tribonacci sequence.

1. Generalized Tribonacci Sequence

Now, we considered the Generalized Tribonacci Sequence given as

$$G_n = G_{n-1} + G_{n-2} + G_{n-3}, G_0 = 3, G_1 = 1, G_2 = 0 \quad (7)$$

The sequence

$$G_0 = 3, G_1 = 1, G_2 = 0, G_4 = 4, G_5 = 5, G_6 = 9, G_7 = 18, G_8 = 32, G_9 = 59, G_{10} = 109 \dots$$

The Characteristics Equation of (7) with recurrence relation is $g^3 - g^2 - g - 1 = 0$, (8)

Let three characteristics roots of the above equation is α, β, γ .

Consider, U a square matrix of order 3 as

$$U = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \quad (9)$$

2. Results of Generalized Tribonacci Sequence of considering matrix U

Define a vector

$$H_{n-1,n,n+1} = \begin{bmatrix} G_{n+1} \\ G_n \\ G_{n-1} \end{bmatrix}, \text{ for } n \geq 1$$

Note this,

$$UH_{0,1,2} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} G_2 \\ G_1 \\ G_0 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \\ 3 \end{bmatrix} = \begin{bmatrix} 4 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} G_3 \\ G_2 \\ G_1 \end{bmatrix}$$

$$UH_{1,2,3} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} G_3 \\ G_2 \\ G_1 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 4 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 5 \\ 4 \\ 0 \end{bmatrix} = \begin{bmatrix} G_4 \\ G_3 \\ G_2 \end{bmatrix} \text{ and so on}$$

by this proceeding, we get

$$UH_{n,n+1,n+2} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} G_{n+2} \\ G_{n+1} \\ G_n \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} G_{n+2} \\ G_{n+1} \\ G_n \end{bmatrix} = \begin{bmatrix} 5 \\ 4 \\ 0 \end{bmatrix} = \begin{bmatrix} G_{n+3} \\ G_{n+2} \\ G_{n+1} \end{bmatrix}$$

We have

$$UH_{n-1,n,n+1} = \begin{bmatrix} G_{n+2} \\ G_{n+1} \\ G_n \end{bmatrix} \quad (10)$$

Now aim to get

$$U^n = \begin{bmatrix} G_{n+1} & G_n + G_{n-1} & G_n \\ G_n & G_{n-1} + G_{n-2} & G_{n-1} \\ G_{n-1} & G_{n-2} + G_{n-3} & G_{n-2} \end{bmatrix}, \text{ for } n \geq 3 \quad (11)$$

Proved with induction,

$$\begin{aligned} U^3 &= \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \\ &= \begin{bmatrix} 2 & 2 & 1 \\ 1 & 1 & 1 \\ 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \\ &= \begin{bmatrix} 4 & 3 & 2 \\ 2 & 2 & 1 \\ 1 & 1 & 1 \end{bmatrix} \\ &= \begin{bmatrix} G_4 & G_3 + G_2 & G_3 \\ G_3 & G_2 + G_1 & G_2 \\ G_2 & G_1 + G_0 & G_1 \end{bmatrix} \end{aligned}$$

Thus, Result hold for $n = 3$,

Assume that (11) holds for $n \leq k$

$$\begin{aligned} \text{Here, } U^{n+1} &= U^n \cdot U = \begin{bmatrix} G_{n+1} & G_n + G_{n-1} & G_n \\ G_n & G_{n-1} + G_{n-2} & G_{n-1} \\ G_{n-1} & G_{n-2} + G_{n-3} & G_{n-2} \end{bmatrix} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \\ &= \begin{bmatrix} G_{n+2} & G_{n+1} + G_n & G_{n+1} \\ G_{n+1} & G_n + G_{n-1} & G_n \\ G_n & G_{n-1} + G_{n-2} & G_{n-1} \end{bmatrix} \end{aligned}$$

Thus, equation (11) is true $\forall \mathbb{N}$

To find the characteristic values of matrix U , we will find

$$f(\mu) = |U - \mu I| = \begin{vmatrix} 1-\mu & 1 & 1 \\ 1 & -\mu & 0 \\ 0 & 1 & -\mu \end{vmatrix} = -\mu^3 + \mu^2 + \mu + 1 \quad (12)$$

As taking $f(\mu) = 0$, we get three roots, namely μ_1, μ_2 and μ_3 that are as follows

$$\begin{aligned} \mu_1 &= \frac{1}{3} \left(\sqrt[3]{19 + 3\sqrt{33}} + \sqrt[3]{19 - 3\sqrt{33}} + 1 \right) \approx 1.839286755 \dots \\ \mu_2 &= \frac{-1}{6} \left(\sqrt[3]{19 + 3\sqrt{33}} + \sqrt[3]{19 - 3\sqrt{33}} - 2 \right) + \frac{\sqrt{3}}{6} i \left(\sqrt[3]{19 + 3\sqrt{33}} - \sqrt[3]{19 - 3\sqrt{33}} \right) \\ \mu_3 &= \frac{-1}{6} \left(\sqrt[3]{19 + 3\sqrt{33}} + \sqrt[3]{19 - 3\sqrt{33}} - 2 \right) - \frac{\sqrt{3}}{6} i \left(\sqrt[3]{19 + 3\sqrt{33}} - \sqrt[3]{19 - 3\sqrt{33}} \right) \end{aligned}$$

These are also the characteristic values of the recurrence relation of Generalized Tribonacci sequence defined in (8)

These characteristic values also satisfied the properties:

1.	$-\mu^3 + \mu^2 + \mu + 1 = 0; \quad \text{for } \mu = \mu_1, \mu_2, \mu_3$
2.	$\mu_1 + \mu_2 + \mu_3 = 1$
3.	$\mu_1 \mu_2 \mu_3 = 1$

4.	$\mu_1\mu_2 + \mu_2\mu_3 + \mu_3\mu_1 = -1$

Table 1: properties of characteristics values (μ_1, μ_2, μ_3)

For finding characteristic vectors (X_i) corresponding to each characteristic values (μ_i) are: ($i = 1, 2, 3$)

We know

$$UX_1 = \mu_1 X_1$$

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \mu_1 \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

This gives

$$x_1 + x_2 + x_3 = \mu_1 x_1 \dots (i)$$

$$x_1 = \mu_1 x_2 \dots (ii)$$

$$x_2 = \mu_1 x_3 \dots (iii)$$

Take $x_3 = 1$ in (iii)

$$x_2 = \mu_1(1)$$

$$\Rightarrow x_2 = \mu_1$$

From (ii)

$$x_1 = \mu_1 x_2$$

$$\Rightarrow x_1 = \mu_1^2$$

Thus, $X_1 = \begin{bmatrix} \mu_1^2 \\ \mu_1 \\ 1 \end{bmatrix}$ is characteristic vector for characteristic value μ_1

As this similar way, $\begin{bmatrix} \mu_2^2 \\ \mu_2 \\ 1 \end{bmatrix}$ and $\begin{bmatrix} \mu_3^2 \\ \mu_3 \\ 1 \end{bmatrix}$ are the characteristic vectors for characteristic values μ_2 and μ_3 respectively.

$$\text{Consider a matrix } D = \begin{bmatrix} \mu_1^2 & \mu_2^2 & \mu_3^2 \\ \mu_1 & \mu_2 & \mu_3 \\ 1 & 1 & 1 \end{bmatrix}$$

$$\text{Then } |D| = (\mu_1 - \mu_2)(\mu_2 - \mu_3)(\mu_3 - \mu_1) = \rho \quad (13)$$

$$\text{Now find } D^{-1} = \frac{1}{\rho} \begin{bmatrix} \mu_2 - \mu_3 & -(\mu_2 - \mu_3)(\mu_2 + \mu_3) & \mu_2\mu_3(\mu_2 - \mu_3) \\ \mu_3 - \mu_1 & (\mu_1 - \mu_3)(\mu_1 + \mu_3) & -\mu_1\mu_3(\mu_1 - \mu_3) \\ \mu_1 - \mu_2 & -(\mu_1 - \mu_2)(\mu_1 + \mu_2) & \mu_1\mu_2(\mu_1 - \mu_2) \end{bmatrix}$$

Now, for diagonalizable U

$$D^{-1}U^n D = \begin{bmatrix} \mu_1^n & 0 & 0 \\ 0 & \mu_2^n & 0 \\ 0 & 0 & \mu_3^n \end{bmatrix} \text{ for } n \geq 0$$

$$U^n = \frac{1}{\rho} \begin{bmatrix} \mu_1^2 & \mu_2^2 & \mu_3^2 \\ \mu_1 & \mu_2 & \mu_3 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} \mu_1^n & 0 & 0 \\ 0 & \mu_2^n & 0 \\ 0 & 0 & \mu_3^n \end{bmatrix} \begin{bmatrix} \mu_2 - \mu_3 & -(\mu_2 - \mu_3)(\mu_2 + \mu_3) & \mu_2\mu_3(\mu_2 - \mu_3) \\ \mu_3 - \mu_1 & (\mu_1 - \mu_3)(\mu_1 + \mu_3) & -\mu_1\mu_3(\mu_1 - \mu_3) \\ \mu_1 - \mu_2 & -(\mu_1 - \mu_2)(\mu_1 + \mu_2) & \mu_1\mu_2(\mu_1 - \mu_2) \end{bmatrix}$$

$$= \frac{1}{\rho} \begin{bmatrix} \mu_1^{n+2} & \mu_2^{n+2} & \mu_3^{n+2} \\ \mu_1^{n+1} & \mu_2^{n+1} & \mu_3^{n+1} \\ \mu_1^n & \mu_2^n & \mu_3^n \end{bmatrix} \begin{bmatrix} \mu_2 - \mu_3 & -(\mu_2 - \mu_3)(\mu_2 + \mu_3) & \mu_2\mu_3(\mu_2 - \mu_3) \\ \mu_3 - \mu_1 & (\mu_1 - \mu_3)(\mu_1 + \mu_3) & -\mu_1\mu_3(\mu_1 - \mu_3) \\ \mu_1 - \mu_2 & -(\mu_1 - \mu_2)(\mu_1 + \mu_2) & \mu_1\mu_2(\mu_1 - \mu_2) \end{bmatrix} \text{ for } n \geq 0 \quad (14)$$

Equating matrix U^n in (11) and the outcomes of the above matrix U^n in (14) after simplifying, Then we get (I)-(VI) results

$$(I) \quad G_{n+1} = \frac{1}{\rho} \{ \mu_1^{n+2}(\mu_2 - \mu_3) - \mu_2^{n+2}(\mu_1 - \mu_3) + \mu_3^{n+2}(\mu_1 - \mu_2) \}$$

$$(II) \quad G_n = \frac{1}{\rho} \{ \mu_1^{n+1}(\mu_2 - \mu_3) - \mu_2^{n+1}(\mu_1 - \mu_3) + \mu_3^{n+1}(\mu_1 - \mu_2) \}$$

$$(III) \quad G_{n-1} = \frac{1}{\rho} \{ \mu_1^n(\mu_2 - \mu_3) - \mu_2^n(\mu_1 - \mu_3) + \mu_3^n(\mu_1 - \mu_2) \}$$

$$(IV) \quad G_{n-2} = \frac{1}{\rho} \{ \mu_1^n \mu_2 \mu_3 (\mu_2 - \mu_3) - \mu_1 \mu_2^n \mu_3 (\mu_1 - \mu_3) + \mu_1 \mu_2 \mu_3^n (\mu_1 - \mu_2) \}$$

$$= \frac{1}{\rho} \{ \mu_1^{n-1}(\mu_2 - \mu_3) - \mu_2^{n-1}(\mu_1 - \mu_3) + \mu_3^{n-1}(\mu_1 - \mu_2) \}$$

$$(V) \quad G_{n-3} = \frac{1}{\rho} \{ \mu_1^{n-2}(\mu_2 - \mu_3) - \mu_2^{n-2}(\mu_1 - \mu_3) + \mu_3^{n-2}(\mu_1 - \mu_2) \}$$

By using, properties of characteristics value which is product of characteristics value i.e. $(\mu_1 \mu_2 \mu_3) = 1$

$$(VI) \quad G_n + G_{n-1} = \frac{1}{\rho} \{ -\mu_1^{n+2}(\mu_2 - \mu_3)(\mu_2 + \mu_3) + \mu_2^{n+2}(\mu_1 - \mu_3)(\mu_1 + \mu_3) - \mu_3^{n+2}(\mu_1 - \mu_2)(\mu_1 + \mu_2) \}$$

To verify this relation holds, use conditions from above (II) and (III):

Adding (II) and (III), we have

$$\begin{aligned} G_n + G_{n-1} &= \frac{1}{\rho} \{ \mu_1^{n+1}(\mu_2 - \mu_3) - \mu_2^{n+1}(\mu_1 - \mu_3) + \mu_3^{n+1}(\mu_1 - \mu_2) \} + \\ &\quad \frac{1}{\rho} \{ \mu_1^n(\mu_2 - \mu_3) - \mu_2^n(\mu_1 - \mu_3) + \mu_3^n(\mu_1 - \mu_2) \} \\ &= \frac{1}{\rho} \{ \mu_1^n(\mu_2 - \mu_3)(\mu_1 + 1) - \mu_2^n(\mu_1 - \mu_3)(\mu_2 + 1) + \mu_3^n(\mu_1 - \mu_2)(\mu_3 + 1) \} \end{aligned}$$

By (A) of Table 1: properties of characteristics values (μ_1, μ_2, μ_3)

$$\begin{aligned} &= \frac{1}{\rho} \{ \mu_1^n(\mu_2 - \mu_3)(\mu_1^3 - \mu_1^2) - \mu_2^n(\mu_1 - \mu_3)(\mu_2^3 - \mu_2^2) + \mu_3^n(\mu_1 - \mu_2)(\mu_3^3 - \mu_3^2) \} \\ &= \frac{1}{\rho} \{ \mu_1^{n+2}(\mu_2 - \mu_3)(\mu_1 - 1) - \mu_2^{n+2}(\mu_1 - \mu_3)(\mu_2 - 1) + \mu_3^{n+2}(\mu_1 - \mu_2)(\mu_3 - 1) \} \end{aligned}$$

Again by (2) of Table 1: properties of characteristics values (μ_1, μ_2, μ_3)

$$= \frac{1}{\rho} \{ -\mu_1^{n+2}(\mu_2 - \mu_3)(\mu_2 + \mu_3) + \mu_2^{n+2}(\mu_1 - \mu_3)(\mu_1 + \mu_3) - \mu_3^{n+2}(\mu_1 - \mu_2)(\mu_1 + \mu_2) \}$$

So, equation (VI) holds

In similar way, (VII) and (VIII) hold

$$(VII) \quad G_{n-1} + G_{n-2} = \frac{1}{\rho} \{ -\mu_1^{n+1}(\mu_2 - \mu_3)(\mu_2 + \mu_3) + \mu_2^{n+1}(\mu_1 - \mu_3)(\mu_1 + \mu_3) - \mu_3^{n+1}(\mu_1 - \mu_2)(\mu_1 + \mu_2) \}$$

$$(VIII) \quad G_{n-1} + G_{n-2} = \frac{1}{\rho} \{ -\mu_1^n(\mu_2 - \mu_3)(\mu_2 + \mu_3) + \mu_2^n(\mu_1 - \mu_3)(\mu_1 + \mu_3) - \mu_3^n(\mu_1 - \mu_2)(\mu_1 + \mu_2) \}$$

The sequence $\{G_n\}$ in Binet type formula

$$\begin{aligned} G_n &= \frac{1}{\rho} \{ \mu_1^{n+1}(\mu_2 - \mu_3) - \mu_2^{n+1}(\mu_1 - \mu_3) + \mu_3^{n+1}(\mu_1 - \mu_2) \} \\ &= \frac{1}{(\mu_1 - \mu_2)(\mu_2 - \mu_3)(\mu_3 - \mu_1)} \{ \mu_1^{n+1}(\mu_2 - \mu_3) - \mu_2^{n+1}(\mu_1 - \mu_3) + \mu_3^{n+1}(\mu_1 - \mu_2) \} \end{aligned}$$

3. Ratio of the successive Generalized Tribonacci Sequence and its limit

As we know, the limit of ratio of two successive Generalized Fibonacci numbers becomes golden ratio and its value is 1.6180339887 It is denoted by Greek letter Phi φ . The positive characteristic values of also justified Generalized Fibonacci sequence and the matrix corresponding to the characteristics vectors.

This connection also holds in Generalized Tribonacci Sequence. Now we proceed to find the ratio of two successive Generalized Tribonacci numbers and its limits:

Let's define the sequence $f_n = \frac{G_{n+1}}{G_n}$ for $n \geq 0$, $G_0, G_1, G_2 \geq 0$,

Now we have assume that limit of f_n exist and let it be l i.e. $\lim_{n \rightarrow \infty} f_n = l$

$$\begin{aligned} \text{Now the sequence } f_n &= \frac{G_{n+1}}{G_n} \\ &= \frac{G_n + G_{n-1} + G_{n-2}}{G_n} \\ &= \frac{G_n}{G_n} + \frac{G_{n-1}}{G_n} + \frac{G_{n-2}}{G_n} \\ &= 1 + \frac{G_{n-1}}{G_n} + \frac{G_{n-2}}{G_n} \\ &= 1 + \frac{G_{n-1}}{G_n} + \frac{G_{n-1}}{G_{n-1}} \cdot \frac{G_{n-2}}{G_n} \\ &= 1 + \frac{G_n}{G_{n-1}} + \frac{G_{n-1}}{G_{n-2}} \cdot \frac{G_n}{G_{n-1}} \\ &= 1 + \frac{1}{f_{n-1}} + \frac{1}{f_{n-2}} \cdot \frac{1}{f_{n-1}} \end{aligned}$$

Define $\lim_{n \rightarrow \infty}$ on both sides

$$\lim_{n \rightarrow \infty} f_n = \lim_{n \rightarrow \infty} \left(1 + \frac{1}{f_{n-1}} + \frac{1}{f_{n-2}} \cdot \frac{1}{f_{n-1}} \right)$$

$$\Rightarrow l = 1 + \frac{1}{l} + \frac{1}{l^2}$$

$$\Rightarrow l = \frac{l^2 + l + 1}{l^2}$$

$$\Rightarrow l^3 = l^2 + l + 1$$

$$\Rightarrow l^3 - l^2 - l - 1 = 0$$

$$\Rightarrow l = \frac{1}{3} \left(\sqrt[3]{19 + 3\sqrt{33}} + \sqrt[3]{19 - 3\sqrt{33}} + 1 \right) \approx 1.839286755 \dots$$

This is one positive characteristic value of generalized Tribonacci sequence and the matrix that have considered.

Thus, the limit of the ratio of the two successive Generalized Tribonacci number is

$$\lim_{n \rightarrow \infty} f_n = \lim_{n \rightarrow \infty} \frac{G_{n+1}}{G_n} \approx 1.839286755 \dots$$

This number is called Tribonacci constant and denoted by Tri-Phi (φ_3).

Thus, the limit of the ratio of every two adjacent numbers is approximate this Tri-Phi (φ_3) = 1.839286755

Conclusion

This paper was to obtain further important and interesting properties on the Tribonacci sequence. It includes the result or properties based on the considering matrix that associate with the Generalized Tribonacci sequence. It also includes Binet-type formula of the Tribonacci sequence based on that matrix. The results and methods that had discussed in this paper can be useful for further research purpose in many ways.

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Production of Ethanol from Corn

Gouri Dutt*, Vidhi Gaba, Naveen Verma, Manish Sudhakar Khodwe

Department of Chemical Engineering, Chandigarh University, Punjab, India

duttgouri02@gmail.com*, sgaba6672@gmail.com, nv9631847@gmail.com, manish.e10170@cumail.in

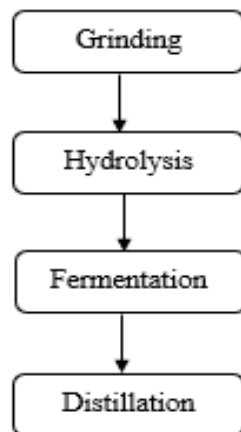
Abstract

There is growing interest in alternative energy sources globally due to the impending depletion of the world's energy supply. The current global economy is heavily reliant on fossil fuels like oil, coal, natural gas, etc. which are used to produce gasoline, and other products. Over the last decades, excessive use of fossil fuels, particularly in big cities, has led to the increased greenhouse gases of significantly high level of pollution. Growing research and development efforts have been focused in recent years on commercial ethanol production, the most promising biofuel made from renewable resources. Fuel ethanol is mostly produced from starchy materials, particularly like corn, potato, rice etc. Initially, 200gm corn in powdered form is mixed in 800ml distilled water then autoclaved at 10 psi for 30 minutes. pH level of 6 is maintained by the addition of HCl acid. Sodium hydrogen carbonate (baking powder) is used as an enzyme and fermentation at room temperature is done. Solution is covered properly and left undisturbed for 2 weeks. Rotary vacuum evaporator is used for distillation at 30 rpm. At 70-85°C ethanol as distillate is obtained. Yield of the obtained product is 7.8 g/mL. Results and analysis are done by comparing quality tests between bioethanol and obtained product. UV spectroscopy, absorbance, refractive index, and density were found to be 1.34, 0.061, 1.34 and 0.67 g/mL respectively. This research has examined the possibility of corn as a potential feedstock for ethanol production. To obtain ethanol, it is observed that the micro-organisms used and the environments in which they thrived are critical and should be maintained properly for better results.

Keywords: Renewable resources, Biofuel, Fermentation, Distillation, Absorbance, UV Spectroscopy

There is growing interest in alternative energy sources globally due to the impending depletion of the world's energy supply (Lin et al. 2005). The current global economy is heavily reliant on fossil fuels like oil, coal, natural gas, etc. (Uihlein A, Schbek L. 2009). which are used to produce gasoline, energy, and other products. Growing research and development efforts have been focused in recent years on commercial ethanol production, the most promising biofuel made from renewable resources. Generally, ethanol production consists of three types those are: beverage ethanol that is about 17%, fuel ethanol- 73% and industrial ethanol of about 10% from the produced global quantity (Sanchez, O., Cardona, C. 2008). Ethanol production is commonly based on material with high sugar content, starch, and lignocellulosic materials (Quintero et al. 2008). The energy output/input ratio of the ethanol production from corn is about 1.25. About 40% of the biodegradable material is cellulose and hence the study can prove to be effective as lignocellulos is considered the promising fuel for ethanol production. There is wide range of factories that use ethanol to produce a commercial product, for example, paints and inks has the biggest market use of ethanol. Not just for cleaning and beverages, ethanol is also used as a fuel. Hence, the need for ethanol is not limited to just one sector but there is a broad range of sectors where it can be used (Balat M, Balat H 2009). For the same the need for the production of ethanol has increased, it's a matter of fact that humans can't depend on fossil fuels such as oil and coal to produce gasoline. There must be some other renewable alternate fuels that can be used to replace the non-renewable sources of fuel (Itelima J et al. 2013).

Ethanol can be made by fermentation of sugars using yeasts or artificially using petrochemical processes like ethylene hydration. As an antiseptic and disinfectant, it has uses in medicine (Pohorecky et al. 1988). A volatile, flammable, colorless liquid known as ethanol has a distinctive wine-like odor and bitter flavor. It is a psychotropic substance used for recreational purposes and the key component in alcoholic beverages. After reading research papers the most common approach that came up to produce ethanol is:

**Fig.1**

Grinding: This step involves conversion of corn kernels into powder form. Uneven pieces are sieved out or grinded again to obtain powder (B. P. Lamsal et al. 2011).

Hydrolysis: Addition of water in obtained powder to form a slurry. Helps in breaking down of chemical bonds (Del Campo et al. 2006).

Fermentation: Anaerobic breakdown of organic compounds and carbohydrates into alcohols, organic acids, gases, etc. with the help of micro-organisms or enzymes. (S. Nikolic et al. 2009)

Distillation: Distillation is the process of separating two components by heating up the mixture. Ethanol rises through a tube, gathers, and condenses into another container because it evaporates more quickly than water.

Ethanol can be produced by using different materials i.e., Softwood, Potato Peel Waste, Fruit Waste, Rice Straw, Corn (Maurice et al. 2011) Maize (S. Schwietzke et al. 2009) etc. Concerns about the environment and the scarcity of fossil fuels have stoked interest in the use of renewable, environmentally friendly fuels like ethanol. Researchers are concentrating their efforts on the use of wastes and by-products as raw materials to produce ethanol in an effort to reduce the competition between the production of fuels and food. Large amounts of household food waste are created and managing them can be difficult (Neves and Marco Antonio 2007). Additionally, their disposal may result in serious environmental problems (for example emission of greenhouse gasses). On the other hand, they have substantial amounts of soluble and insoluble sugars and can be used as a raw material to make ethanol (N. Kumar et al. 2013).

Materials and Methods:

Materials used:

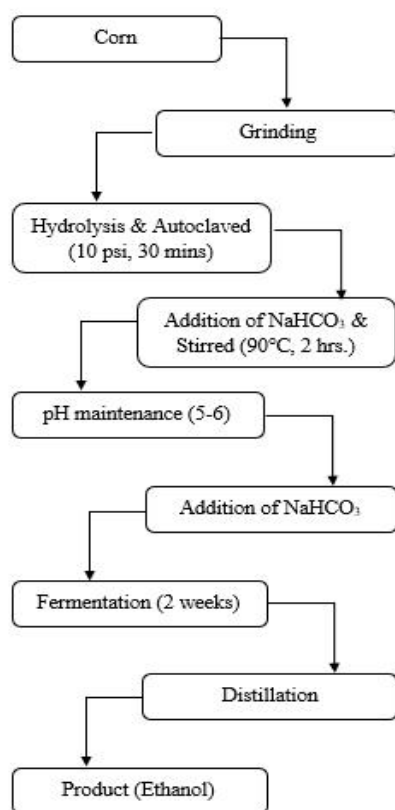
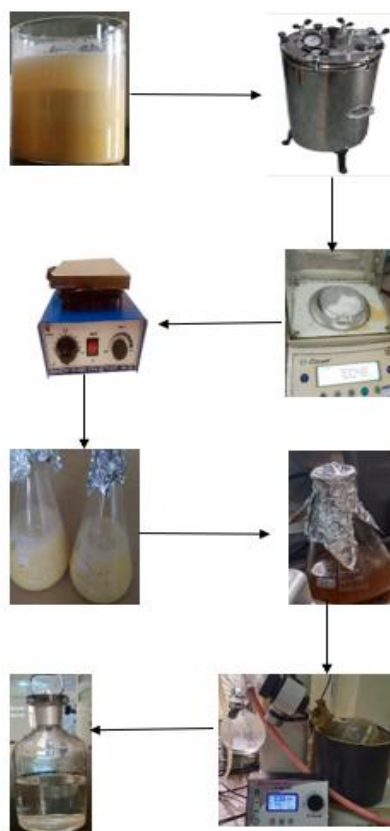
Starchy material: Corn was obtained from the local market. By fermentation and saccharification, starch is transformed into sugar. Nowadays, fermentation and saccharification are carried out concurrently. High purity starch from corn is rather simple to obtain.

Detailed Process:

Corn is first grinded and converted into powder form. Further it is sieved, and large particles are separated out from the powder. 200 gm of corn is weighed and put into flask with the addition of 800 ml distilled water. Sample is covered properly and then is put into autoclave for 30 minutes at 10 psi. This process is used to kill all the harmful bacteria, fungi etc. that are present in the sample, under specific pressure. Sample is taken out after 30 minutes and again 100 ml water is added to the solution. Instead of enzymes, microorganism that is sodium hydrogen carbonate

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(baking powder) is used during the fermentation process. 7 gm of baking powder is weighed and is put into the solution and the sample is put on the magnetic stirrer for 2 hours at 90°C. Sample must be properly covered, and the mixture is rotating instead of standing still. After 2 hours sample is taken off the stirrer and again about 7 gm of baking powder is weighed, mixed in the sample, and stirred properly. During the addition of baking powder, the pH is maintained at 5-6. Again, sample is covered properly in an anaerobic condition, that is not exposed to air and is left for fermentation at room temperature. Sample is left undisturbed for 2 weeks for better fermentation (Rastogi et al. 2017). After fermentation two layers in the sample are noticed those are fermented ethanol and the residue which is of no use. With the help of filter paper residue and the fermented form of sample are separated out. Next step is distillation. For this rotatory vacuum evaporator is used at 30 rpm and the heat is supplied for increasing the water temperature. When temperature is reached around 70-85°C sample is distilled and product as ethanol is obtained which is further collected in a closed beaker. Purity and other analysis of obtained ethanol is done with methods like UV Spectroscopy, this indicated the absorbance of the product. Refractive index, pH value and density are also calculated in comparison with bioethanol.

Block Diagram:**Fig. 2****Fig 3**

Results and Analysis:

UV Spectroscopy: Impurity Analysis: To check for contaminants, the absorbance spectrum of an ethanol sample is employed. With water serving as a reference sample, a UV-Vis spectrophotometer is employed at a wavelength range of 200-800 nm. The absorbance of the product ethanol and bioethanol are tested as reference and the peak was observed. Below are the obtained graphs.

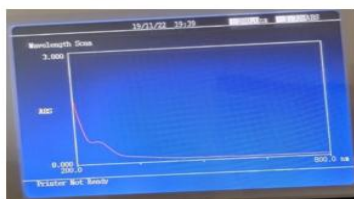


Fig. 4: Absorbance of obtained Ethanol.



Fig. 5: Absorbance of bioethanol.

Refractive Index: Analysis on the basis of refractive index is done with the help of refractometer. For better clarification refractive index of both obtained ethanol as well as the bioethanol is obtained and are found to be 1.34 and 1.36 respectively. The reason this analysis is done is to check purity and the concentration of the ethanol so that it can be analyzed based on its purity.

Based on pH: As mentioned before the pH of the sample throughout the process was maintained between 5-6. pH is one of the important analyses as high and low pH can destroy the purpose of the whole project, so the pH value is considered of extra care. Even before and after fermentation pH is maintained. Comparison between pH of bioethanol and obtained ethanol is done and are found to be 6 that is exactly which is desired.

Based on Density: As reference to the bioethanol density is calculated of the obtained product with the help of density bottle. The density of the bioethanol is 0.798 g/mL. While the density of the obtained ethanol is found to be 0.67 g/mL.

Result Table:

Parameters	Obtained Ethanol	Bioethanol
Enzyme	Baking Powder	-
Temperature (°C)	70-85	-
pH	5-6	6
Refractive Index	1.34	1.36
Density (g/mL)	0.67	0.798
Yield (g/mL)	7.8	9.8
Absorbance	0.061	0.07

Table 1

Conclusion:

Various research has investigated the possibility of corn as a potential feedstock for ethanol production because of the presence of carbohydrates that is basically starch. For the production of ethanol, it is discovered that the microorganisms used and the environments in which they thrived were critical. The yield of ethanol is observed under the ideal pH value, particle size, and substrate concentration conditions. Microorganism that is used in this research is sodium hydrogen carbonate (baking powder) and at temperature between 70-85°C, ethanol is obtained, pH checked is at 5, absorbance under UV spectroscopy is found to be 0.06, refractive index obtained is of 1.34 and yield obtained is found to be 7.8 g/mL. Fermentation is discovered to be more effective, and results indicate that bioethanol can significantly reduce greenhouse gas emissions that poses threat to our environment. It has potential to reduce global warming, which helps to protect the ozone layer. The current investigation is attempted to know the alcohol concentration in corn by fermenting it with the use of regular baker's yeast. After distillation, anticipating that re-distilling the finished product can provide higher alcohol content. Alcohol with a higher content can be used as a biofuel as an alternate for various non-renewable sources. A regular person may create this procedure and produce it at an industrial scale because it is inexpensive and leaves no hazardous leftovers behind. Hence a promising fuel of high potential that poses no threat to environment.

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Exploring Potential Use of Bi-Sn-Zn Alloys in Radiation Shield Designing***Deepak Malik, *Renu Sharma, **Tejbir Singh****Department of Physics, Maharishi Markandeshwar (Deemed to be University) Mullana, Ambala, India***Department of Physics, Sri Guru Granth Sahib World University, Fatehgarh Sahib (Punjab), India**deepakmalik7005@gmail.com, dr.tejbir@gmail.com***Abstract**

Five alloys compositions of Bi₆₀Sn_xZn(40-x); where $x=0,10,20,30,40$ wt % were prepared using melt quench technique. The gamma radiation shielding parameters such as linear attenuation coefficient (LAC), optimum thickness range (x_{opt}) and equivalent atomic number (EAN) for prepared alloys has been calculated theoretically in the energy range of 15 keV to 15 MeV. LAC has been computed with the help of density values of the selected alloys and WinXCom attenuation coefficient database. The optimum thickness range was obtained from the product of the LAC and thickness of the alloy sample that lies in the range of $0.5 \leq \mu t \leq 0.7$. For experimental measurement in the energy range of 122 keV-1332 keV; optimum thickness range for the selected alloy samples lies between 0.02 cm – 1.45 cm. Among the selected alloys; Bi₆₀Sn₄₀ has the highest LAC and EAN, whereas Bi₆₀Zn₄₀ has the lowest LAC and EAN. Hence the Bi₆₀Sn₄₀ is the better option for the replacement of traditional shielding materials such as lead, mercury, and concrete in the energy range of 15 keV to 15 MeV.

Keywords: Gamma-rays, WinXCom, attenuation coefficient, optimum thickness, alloys.

1. Introduction

In the recent years, nuclear and solar energy have been emerged as alternate sources of energy due to the deficiency of natural fossil fuels. The nuclear power plants released gamma radiations many kilometers in the surrounding medium due to high penetrating power. A long time contact with these radiations can cause skin irritation, nausea, tumors, anemia, and even death. Beside the harmful effect on healthy living tissues and organs, gamma rays have been many useful applications in many fields including space exploration, medical diagnosis, radiotherapy, food processing, and many more. If we want to uses of gamma radiation in many fields; we needed to shield them. A shielding material must have high densities (ρ) and high atomic numbers (Z). The traditional shielding materials like Concrete, lead (Pb), mercury (Hg) etc. are utilized in radiobiology and nuclear reactors [1]. To achieve radiation shielding qualities, lead has been widely employed as an additive in construction material like concrete [2]. Due to the toxicity of lead, it is rarely employed in the nuclear diagnostic sector nowadays. A long time contact with lead exposure can result in kidney tumors, harms the brain, the delicate organs of body and the reproductive systems of males and females [3]. Nowadays, lead-free materials such as alloys [4–7], polymers [8–9], glasses [10–12] and composites [13–14] are under focus for the shielding purpose due to the toxicity of highly dense lead metal. The structure and attenuation coefficients of Bi-Pb-Sn fusible alloys were examined by Kamal et al. [15]. These Bi-based alloys were discovered to have a lower melting point, a higher elastic modulus, and improved hardness. Instead of employing conventional lead-containing alloy systems, bismuth alloy has been investigated as an eco-friendly shielding material [16–17]. Keeping in view the importance of lead free alloys as a radiation shielding materials; the present work deals with alloys with varying weight % compositions of the elements: bismuth (Bi), tin (Sn), and zinc (Zn). Bi-Sn-Zn alloys in different compositions were prepared and radiation shielding characteristics were evaluated and analyzed in terms of linear attenuation coefficients, optimum thickness range and equivalent atomic number.

2. Materials and Methods

The pure elements of Bi, Sn and Zn in granule form of AR grade were procured from Bi (Loba Chemie Pvt. Ltd.), Sn (Nice Chemicals) and Zn (Molychem), India. All the elements of required weights were mixed and heated in stir casting muffle furnace upto 500 °C for ten minutes. The melt was poured in cast iron mould and cooled at room temperature. The chemical compositions of the prepared alloys in weight fraction of constituent elements were listed in **Table 1**.

Table 1. Chemical composition of prepared alloy sample.

Alloy Sample	Chemical Composition	Weight Fraction		
		Bi	Sn	Zn
S1	Bi ₆₀ Sn ₄₀	0.6	0.4	0.0
S2	Bi ₆₀ Sn ₃₀ Zn ₁₀	0.6	0.3	0.1
S3	Bi ₆₀ Sn ₂₀ Zn ₂₀	0.6	0.2	0.2

S4	Bi60Sn10Zn30	0.6	0.1	0.3
S5	Bi60Zn40	0.6	0.0	0.4

The density of prepared alloys was measured experimentally using Archimedes' principle and also calculated theoretically using eqⁿ (1):

$$\text{Volume of the alloys} = \sum_{i=1}^n \frac{\text{weight fraction of } i^{\text{th}} \text{ element}}{\text{density of } i^{\text{th}} \text{ element}}$$

$$\rho = \frac{\text{Total mass of alloy}}{\text{volume of alloy}} \quad \dots (1)$$

The experimentally as well as theoretically density values for the prepared alloys along with percentage error is listed in **Table 2**.

Table 2. Experimental and theoretical density of prepared alloy samples.

Alloy Sample	Experimental density (g/cm ³)	Theoretical density (g/cm ³)	Error (%)
S1	8.7720	8.9495	1.98
S2	8.8030	8.9863	2.03
S3	8.9638	9.0649	1.10
S4	8.9876	9.1297	1.50
S5	9.0395	9.2004	1.70

The linear attenuation coefficient (LAC) is calculated by the use of mass attenuation coefficient, the mass attenuation coefficient (MAC) value is calculated by using of WinXCom database [18]

$$\text{LAC} = \text{MAC} \times \rho \quad \dots (2)$$

Where MAC is mass attenuation coefficient and ρ is the density of the alloys samples.

Linear attenuation coefficient was further used for finding the value of optimum thickness range of shielding materials. The minimum and the maximum value of the product of linear attenuation coefficient and thickness that lies between the 0.5 and 0.7 [19].

$$\text{Optimum thickness range} = \left(\frac{0.5}{\text{LAC}} \text{ Minimum} \right) \frac{Z_1 (\log R_2 - \log R) + Z_2 (\log R - \log R_1)}{\log R_2 - \log R_1} \quad (3)$$

The ratio of mass attenuation coefficient (MAC) for Compton process to the total mass attenuation coefficient (MAC) at that photon energy is computed and termed as R. This R value is further used for the calculation of the equivalent atomic number (Z_{eq}). The equivalent atomic number is a factor comparable to atomic number of elements and used for visualizing the radiation properties of materials. The equivalent atomic number for the alloys samples can be calculated by using the interpolation formula [20]:

$$Z_{\text{eq}} = \dots (4)$$

Where R is the ratio of mass attenuation coefficient (MAC) for Compton process to the total mass attenuation coefficient (MAC) at that photon energy, and Z_1 and Z_2 are atomic number corresponding to R_1 and R_2 .

3. Results and Discussion

In this section, we shall present the shielding parameters for the lead free alloy samples. The shielding parameters such as LAC values, x_{opt} , and EAN are analyzed on the basis of the photon energy and the composition of the alloys.

3.1 Linear attenuation coefficient

The linear attenuation coefficient is calculated by the product of the mass attenuation coefficient and the density of the alloy. The value of linear attenuation coefficient is maximum for the alloy sample S1 (Bi60Sn40) and minimum for the alloy S5 (Bi60Zn40). The manner in which the linear attenuation coefficient for the selected alloys varied with the incident gamma ray energy was plotted in **Fig. 1 (left panel)**. K-absorption edges of the Bi appear at the energy (100 keV). It has been found that initially at 15 keV, the value of linear attenuation coefficient for the all chosen alloys show maximum values, which decreases quickly with the increase in incident energy up to 80 keV in the photoelectric region. At 100 keV the value of the linear attenuation coefficient shows the peak due to the K-absorption edges of Bismuth. Above 100 keV, the values of the linear attenuation coefficient decreases slowly with the incident photon energy and similar pattern are followed up to 3 MeV for different alloys in the Compton scattering region. And above 3 MeV, the linear attenuation coefficient value start increasing and become almost constant in pair production region.

3.2 Equivalent atomic number

The Z_{eq} is calculated in the energy range from 15 keV to 15 MeV and the results are shown graphically in Fig. 1 (right panel). Initially, the value of the equivalent atomic number is increasing and then almost constant up to 60 keV and at energy 80 keV, the value of equivalent atomic number the value decreases sharply due to K-absorption edge of Bi. In a limited energy range from 100 keV to 1 MeV, the Z_{eq} value becomes almost constant

and above 1.0 MeV the value decreases slowly. The value of the equivalent atomic number is maximum for the alloy sample S1 and minimum for the alloy S5.

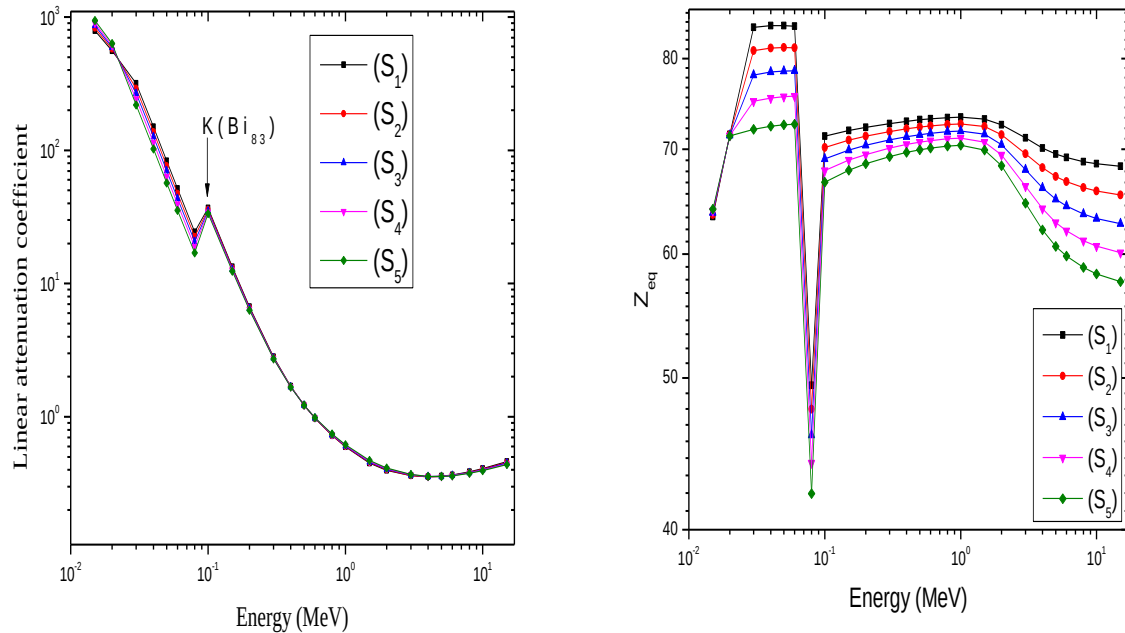


Fig. 1. Variation of linear attenuation coefficient (left panel) and equivalent atomic number (right panel) with energy of different alloy samples.

3.3 Density and Optimum Thickness Range

The density of prepared alloys was calculated theoretically as well as measured experimentally. With an increase in Zn composition, the density of alloy is increasing; it may be due to the reason that atomic size of the zinc is lesser than tin and bismuth. Hence, the Zinc filling the interstitial sites and not occupying extra space/volume. The optimum thickness range of the material is greatly influenced by the density of material. The optimum thickness range defines the thickness for the accurate measurement of the mass attenuation coefficient experimentally. The density of the prepared alloys along with optimum thickness at selected energies is listed in

Table 1.**Table3.** Optimum thickness range of prepared alloy samples at selected photon energies.

Alloy Sample	Photon Energy (keV)	Density (ρ) (g/cm ³)	LAC (cm ⁻¹)	Optimum Thickness (cm)
S ₁	122	8.9495	22.2996	0.0224 – 0.0314
	356	8.9495	2.0615	0.2425 – 0.3396
	511	8.9495	2.0615	0.2425 – 0.3396
	662	8.9495	1.1898	0.4202 – 0.5883
	1250	8.9495	1.1898	0.4202 – 0.5883
	1332	8.9495	0.8748	0.5716 – 0.8002
			0.5021	0.9959 – 1.3943
S ₂	122	8.9863	21.7854	0.0230 – 0.0321
	356	8.9863	2.0436	0.2447 – 0.3425
	511	8.9863	1.1871	0.4212 – 0.5897
	662	8.9863	0.8762	0.5706 – 0.7989
	1250	8.9863	0.5059	0.9883 – 1.3836
	1332	8.9863	0.4860	1.0289 – 1.4405
S ₃	122	9.06495	21.3650	0.0234 – 0.0328
	356	9.06495	2.0349	0.2457 – 0.3440
	511	9.06495	1.1898	0.4203 – 0.5884
	662	9.06495	0.8818	0.5670 – 0.7939
	1250	9.06495	0.5122	0.9762 – 1.3667
	1332	9.06495	0.4921	1.0161 – 1.4226
S ₄	122	9.1297	20.9021	0.0239 – 0.0335
	356	9.1297	2.0226	0.2472 – 0.3461
	511	9.1297	1.1905	0.4200 – 0.5880
	662	9.1297	0.8859	0.5644 – 0.7901
	1250	9.1297	0.5177	0.9659 – 1.3522
	1332	9.1297	0.4974	1.0052 – 1.4072
S ₅	122	9.2004	20.4437	0.0245 – 0.0342
	356	9.2004	2.0112	0.2486 – 0.3480
	511	9.2004	1.1919	0.4195 – 0.5873
	662	9.2004	0.8906	0.5614 – 0.7860
	1250	9.2004	0.5235	0.9550 – 1.3371
	1332	9.2004	0.5032	0.9937 – 1.3912

Conclusion

- The optimum thickness range for the prepared alloys lies between 0.02cm – 1.45 cm in energy range of 122 keV–1332 keV.
- The values of linear attenuation coefficient and the values of equivalent atomic number depend strongly on the chemical composition of the materials and it depends upon the chemical composition in the intermediate energy region.
- Among the prepared alloys; Bi60Sn40 has the highest value for LAC and EAN, whereas Bi60Zn40 has the lowest value for LAC and EAN. Hence, Bi60Sn40 is the better option for the replacement of traditional shielding materials such as lead, mercury, and concrete.

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Progression in the field of Catalysts in Biodiesel Production: A Review

***Suchi Sharma, Nadeem Sharma, Poonam Rani, Sonia**

*PhD Scholar, Department of Chemistry, MMEC, Maharishi Markandeshwar (Deemed to be University),
Mullana, Ambala, Haryana, (India)-133207.

sharmasuchi119@rediffmail.com

Abstract

Despite the tremendous demand for energy in the industrialized world and the pollution issues brought on by the widespread use of fossil fuels, there is a rising need to develop renewable energy sources that have less of an impact on the environment. Biodiesel production is enduring quick and substantial technological changes in enterprises and research. The system employed and the feedstock cost have the most impact on the price of biodiesel production. Increasing the effectiveness of the catalyst being used can also lower the total cost of production. As a result, this review article aims to provide an overview of current catalyzed transesterification trends as well as the benefits and drawbacks of enzymatic, heterogeneous and homogeneous acid/base, and Nano catalytic transesterification. A perfect catalyst can be created with focused research and development for the best biodiesel production that is fiscally viable and environmentally safe for a better future. The amount of alcohol, reaction time, reaction temperature, and catalyst concentration are the primary variables affecting the yield of biodiesel.

Keywords: transesterification, biodiesel, homogeneous catalyst, heterogeneous catalyst, nanocatalyst, and enzyme catalyst.

1. Introduction

Understanding the necessity of looking for alternative, sustainable, and renewable means to produce fuel has grown due to the depleting supply of conventional energy resources and the associated environmental issues. As a fossil fuel replacement, bio-fuel output is now increasing. Due to its advantages for the climate, biodiesel has recently gained popularity and appears to be a suitable alternative fuel for the future. It is produced using biodegradable materials like veggies and animal oils. It has minimal emission profiles, is non-toxic and biodegradable, and is also helpful to the environment (Talha 2016).

Biodiesel itself acts as fuel or as an additive in the modification of fuel composition for transportation. Fatty acid methyl esters is elementary the chemical component of biodiesel. Either catalysis or non-catalysis could be used to complete the process (Hosseini 2022).

Due to comparatively elevated oil content and quick evolution of biomass, algae have emerged as a currently acknowledged biofuel that is generating increasing interest. However, algal oil has not yet been commercialized for use in biodiesel. The qualitative aspects of the FAME fuel was predicted using the fatty acid makeup as well as some other characteristics, including the saponification number, iodine value, and cetane number. As it complies with the main requirements of the biodiesel standard, it is the most suitable for use as biodiesel (Athar 2020).

2. Catalyst

Alkalis, acids, and enzymes are the important categories of catalysts generally used in the creation of biodiesel. Alkali and mineral acid catalysts are comparatively much more in practice in the creation of biodiesel. However, enzyme catalysts have lately gained popularity because they can prevent soap and froth formation and moreover, purification procedure is simple one (Lam 2010). Due to their more expensive price tag and slower reaction periods, enzymes are not used in industry. In recent years, some researchers have created novel biocatalysts to cut costs. A benefit of using these biocatalysts is that purification is not required. The method for producing biodiesel with the assistance of nanocatalysts was also discussed (Leung 2010). Both magnetic and nonmagnetic nanocatalysts were examined as potential catalysts. Reaction promoter derived from agricultural biodegradable waste is also in the limelight for biodiesel production. A brief layout of the various catalyst is given in figure 1.

2.1 Homogeneous base-catalyzed transesterification

Since the transesterification process derived by utilizing acid complement has a slower rate as compared to homogeneous alkaline catalysts and are frequently used. Hydroxide, and methoxide of potassium and sodium and sodium ethoxide are the most popular fundamental catalysts. These catalysts are frequently exercised due to their plentiful profits, including their capability to accelerate reactions under moderate conditions of temperatures and atmospheric pressure. There is a faster conversion and affordability (Talha 2016). When analyzing biodiesel quantitatively and qualitatively, catalytic activity of methoxide of sodium and potassium are superior to hydroxide sodium and potassium. This is because they can dissociate into their respective ions and

does not produce water as an additional product. Commercially, an alkaline homogeneous catalyst i.e. NaOH and KOH is more often used in the biodiesel procurement (Yan 2010)

2.2 A homogeneous acid-catalyzed transesterification

Waste lipids consist of monoacylglycerols an alkaline catalyst that cannot transform into biodiesel. as their combination form soap which prevents the ester, glycerin, and washes water. Thus, liquid acid-catalyzed transesterification is suggested as a solution to many problems brought on by basic catalysts in liquid form. The most characteristic acids catalyst used in transesterification are H_2SO_4 , SO_3H , HCl , RSO_3H , and ferrous sulfate (Borges 2012). Sulfuric acid and hydrochloric acid are preferred catalysts in the manufacturing of biodiesel. Although these can catalyze both categories of esterification as well as transesterification with significant frequency and is unaffected by FFA in the feedstock. Therefore, the primary factor affecting the reaction is the molar proportion of alcohol to oil and the rate can be enhanced by the addition of surplus alcohol. The mechanism involves initial protonation of the acid which produces an oxonium ion, which is followed by a swap overstep between the oxonium ion and the alcohol to generate an intermediate, which is then transformed into an ester (Hussain 2021; Vyas 2010; Nguyen 2014)

2.3 A heterogeneous base-catalyzed transesterification

To address the problems with homogeneous reaction promoters in the production of biodiesel, numerous research on heterogeneous catalysts have been conducted. The major bulk of heterogeneous catalysts extended for biodiesel procurement is generally made up of oxide of alkali or alkaline earth metal sustained over the huge surface of the support (Leung 2010).

Similar to their homogeneous cousins, the activity of heterogeneous basic catalysts is superior than that of heterogeneous acid catalysts. Moreover, stable alkaline catalysts such as calcium oxide, offer numerous benefits like greater activity, prolonged catalyst lifetimes, and the ability to operate in reasonable reaction conditions. However, using CaO as a catalyst can also reduce the pace at which biodiesel is produced. However, the CaO reacts with glycerol during transesterification can give off out calcium diglyceride, necessitating an additional purification process, such as the use of ion exchange resin, to abolish the soluble content from the biodiesel. Comparatively speaking to acid-catalyzed transesterification, which necessitates more exacting reaction conditions, including elevated temperature throughout transesterification, it has been demonstrated that base-catalyzed transesterification has a higher reaction rate (José da Silva 2013; Zhang 2020).

2.4 Heterogeneous acid-promoted transesterification

In spite of the homogeneous acid catalyst's efficacy, it can cause total contamination issues that call for effective separation and product purification processes. The cost of production will go up as a consequence. It is thought that heterogeneous acid catalysts could replace homogeneous acid catalysts in certain applications. Heterogeneous acid catalyst has several benefits, including the ability to perform well in both types of responses esterification as well as transesterification, the elimination of the biodiesel washing step, a simpler catalyst separation process, the ability to regenerate and reuse the catalyst, and the ability to trim down corrosion issues (Talha 2016; Athar 2020). Additionally, solid acid reaction promoters are preferred to liquid-phase acid catalysts because they have abundant active sites with varying degrees of Lewis or Bronsted acidity. Because they can be used with a less expensive feedstock that has high proportions of free fatty acids and benefits from both transesterification and esterification simultaneously are bronsted acid catalysts. Lewis acid active spots are more fruitful than Bronsted sites, but they are also more sensitive to water and/or free fatty acid toxicity (Said 2015). Overall, a distinct reaction mechanism is to blame for the little activity of acid reaction rate enhancers in comparison to their basic counterparts. However, there have been few attempts to use a heterogeneous acid catalyst for the transesterification of triglycerides due to the intimidating perspective of its sluggish reaction tempo and potential side effects. Solid acid catalysts of the tungsten oxide, sulfated zirconia, sulfonated saccharides, nafionl resins, and organosulphur functionalized mesoporous silica variety were frequently used in esterification and transesterification reaction route (Baskar Thangaraj 2019).

2.5 Nanocatalysts for biodiesel production

In recent times, nanotechnology has been exercised to create nanocatalysts for the manufacture of biofuel. Nanoparticles with multiple varieties of structures and cross sections of very minute sizes less than 100 nm are usually exploited to create nanocatalysts. They exhibit the benefits of both earlier mentioned catalysts categories in terms of various reaction parameters like selectivity, competence, and reusability, and thus lie at the interface between hetero and homogeneous catalysis. The limitations of uniform and heterogeneous catalysts do not apply to nanocatalysts. Here, magnetic and nonmagnetic nanocatalysts for biodiesel are separated into different categories (Hosseini 2022). For an oil to be imbibed by the nanocatalyst, it offers a positively charged acid site. Triglyceride adsorption takes place by the acidic spots of the nanocatalyst and thus in turn triggers the interaction between methanol and triglycerides.

2.5.1 Nonmagnetic nanocatalysts

It is feasible to produce biodiesel at a lower cost and to use fixed-bed reactors because solid catalysts can be recycled and used again. In heterogeneous catalysts, mass transfer resistance is a frequent issue that makes it

difficult to move forward with the reaction at an adequate efficiency. The use of bulk solid catalysts for industrial uses is constrained by these drawbacks. The goal of creating catalysts with tiny particle sizes and high active surfaces is to decrease mass relocation resistance and increase biodiesel production yield. The active area of the catalyst and particle size were indirectly related. A solution to address the issue of mass transfer resistance in catalysts is to minimize the particle size probably in the nanoscale and then the development of nanocatalysts. Due to their numerous catalytic sites and high activity, nanocatalysts are frequently exploited in the manufacture of biofuel because of their bulky surface area. Metal oxides, sulfated oxides, hydrotalcite, zeolites, zirconia, and other common nanocatalysts utilized in the creation of biodiesel (Al-Ani 2018; Lam 2010) are shown in Table no 1. Alkaline earth metal complexes, particularly Ca-incorporated nanomaterials, are impending catalysts for the transesterification of oils and are among the first-generation catalysts utilized to make biodiesel from waste oil. Another type of nanocatalyst used in the creation of biodiesel is nano zeolites. With their acid sites, shape selectivity, and high surface area, nanocrystalline zeolites are also employed on a large scale in the creation of biodiesel.

Table 1 showing the impact of magnetic nanocatalysts on the reaction of biodiesel generation

S. No.	Source	Catalyst	Reaction time	Temp.	Yield	Reference
1	Canola oil	Cao/NaY-Fe ₃ O ₄	5 hrs.	65°C	95.37%	(Firouzjaee 2017)
2	Soyabean oil	Mixed iron/cadmium	1 hrs.	200°C	84%	(Mohamed 2020)
3	Chicken oil	Cao/CuFe ₂ O ₄	4 hrs.	70°C	94.52%	(Seffati 2019)
4	Waste cooking oil	Citrus sinensis peel	3 hrs.	65°C	98 %	(Changmai 2021)
5	Vegetable oil	MgO/MgFe ₂ O ₄	4 hrs.	110°C	91.2%	(Alaei 2018)
6	Stillinga oil	KF/CaO-Fe ₃ O ₄	180 min.	65°C	90%	(Ali 2017)
7	Date palm seed oil	CaO/ Fe ₃ O ₄	300 min.	65°C	69.7%	(Alves 2014)
8	Sunflower oil	CaO/ Fe ₃ O ₄	5 hrs.	65°C	97%	(Feyzi 2016)
9	Microalgal Oil	Fe ₃ O ₄	180 min.	65°C	94%	(Chen 2018)
10	Waste cooking oil	Lipase	48 hrs.	40°C	-	(Kanimozhi 2013)

2.5.2 Magnetic nanocatalyst

Nowadays, nanomagnetic reaction promoters are also employed to produce biodiesel, and they are thought to be appropriate for producing biodiesel from inexpensive feedstock. Without using spinning methods or ultrafiltration, the magnetism of the catalyst can be separated from the reaction media. For several rounds, they sustained the catalytic activity. Recently, a variety of magnetic nanoparticles have been created and used to produce biodiesel from inexpensive feedstocks. Magnetic nanocatalysts generally consist of Fe₃O₄ or other magnetic materials as the core material along with some non-magnetic shell (Hosseini 2022; Al-Ani 2019). Processing of soybean oil to develop biodiesel has been successfully carried out using the oxide of cadmium and Tin as nanocatalysts assisted by magnetic material. After one hour of reaction time at 200°C, 84% yield was obtained in the esterification process supported by magnetic SnO. Four times the catalyst's re-use was performed without any activity reduction. CaO/ Fe₃O₄, KF/CaO- Fe₃O₄, and Cs/Al/Fe₃O₄ are a few instances of nanocatalysts used in the creation of biodiesel. The examples quoted state that the esterification processes are more beneficial by large surface area nanocatalysts as compared to transesterification or hydrolysis reactions

(Alaei 2018; Ma 1999). For instance, Fe_3O_4 with guanidine functionalization and Fe_3O_4 supported on SiO_2 nanoparticles were used as recyclable catalysts in the making of biodiesel.

2.6 Enzyme (Biocatalyst) catalyzed transesterification

Researchers have become interested in enzyme-based transesterification because chemical transesterification presents a challenge for the production process. Large amounts of wastewater output and challenges with glycerol recovery are a couple of the issues that ultimately drive up the expenditure of making biodiesel and make it not environmentally welcoming. In contrast, enzyme catalysis results in no by-products, simple product recovery, moderate reactions, insensitivity to high FFA oil, and reusable catalysts (Atadashi 2013; Leung 2016). Consequently, the production of biodiesel through enzyme catalysis has demonstrated a high potential for being an environmentally gracious process and a hopefully good substitute for the chemical method. On the other hand, the production of biodiesel through enzyme catalysis has some drawbacks, particularly when done on an industrial scale, the soaring price of the enzyme, the slow reaction rate, and the enzyme deactivation which reduce recyclability, is the hurdle-creating factors. Moreover, this type of enzymatic method yields a low amount of biodiesel, making it less profitable. The primary enzymes used for this are lipase enzymes. The enzymes are used to change the high FFA basic materials into FAME. The enzymes used to make biofuel have both benefits and drawbacks. Enzymes have the benefit of catalyzing the process under benign circumstances. Additionally, they can be used with feedstocks that contain a lot of FFA and don't saponify during the purifying and neutralization processes (Helwani 2009; Kulkarni 2006; Bajaj 2010).

2.7 Agriculture waste-derived heterogeneous catalyst

Wastes are substances that are produced without the purpose of being used again and have been thrown out, disposed of, or discarded. Agricultural ravages are leftovers or unusable byproducts of agricultural operations or activities. They may also be the remains from household agricultural product consumption or the byproducts of commercial agricultural product processing. A material is considered to be waste if the expense of collecting, transporting, and processing it exceeds its economic value. Wastes are produced throughout a variety of agricultural operations and at every point along the agricultural step chain, from the readiness of land, weeding, and harvesting to the consumption or use of agricultural products at the household and industrial scale. The wastes can come from crops, food, fruits, wood, and veggies and can be solid or liquid (Awogbemi 2021). Wastes from the agricultural sector make up a sizeable percentage of the world's wastes, and they are becoming a threat not only to environmentalists and urban designers, but also to sewage and air parameters, have caused many environmental issues, and pose health risks to both people in addition to animals. Untreated agricultural refuse should not be disposed of or managed improperly because doing so increases greenhouse gas emissions, releases unpleasant odors, and disturbs beautiful landscapes. Particularly in those nations where significant farming and agricultural activities are there, the global generation of agricultural waste is nearly multiple times bigger than that of municipal solid refuse and comes in second only to industrial waste. Govt. also promotes the systems of the 3 R's factor: reduction, reusability, and recycling to handle waste efficiently. Oxide, methoxide, diglyceride, zirconate pyrophosphate, alkali and alkaline earth, and also various others chemicals can be found in commercial sources (Borges 2012; Hussain 2021). Despite some of these catalysts having high conversion efficiencies, their labor-intensive preparation processes make them unsuitable for use as biodiesel production catalysts. Agricultural waste-derived catalysts are inexpensive, non-poisonous, non-caustic, and widely accessible. They have a quite high conversion rate, are biodegradable, and offer producers of biodiesel a practical way to get rid of agricultural refuse.

3 Advantages and Disadvantages of Homogenous and Heterogeneous Catalyst

In the described review section, mainly three different types of catalysts are employed to carry out transesterification Homogeneous, heterogeneous, and enzymatic. In recent years, enzyme catalysts have achieved popularity due to their ability to prevent saponification and simplify the purification process. However, the disadvantages include high costs and the need for a longer response time. On the other hand, due to their easy availability, alkali and acid catalysts are more frequently used in transesterification. Catalysts for alkalis and acids come in uniform and heterogeneous varieties. Due to their cost effectiveness and easy availability, sodium hydroxide and potassium hydroxide are two of the most commonly used homogeneous base catalysts exploited in transesterification (Talha 2016). Because alkali-catalyzed transesterification can be carried out in a low-temperature, low-pressure setting with a high yield, it is regarded as being economically advantageous. However, for a quicker separation procedure, heterogeneous alkali catalysts are preferred. However, acid catalysts are employed because they can prevent saponification. Although homogeneous acid catalysts for transesterification are efficient, they also cause significant contamination issues that necessitate a thorough process for product separation and purification. The mixed acid catalyst is employed to get around the restriction (Arzamendi 2019; Lam 2010). In the transesterification system, the proper heterogeneous catalysts can be used to streamline product separation and purification, thereby lowering waste generation. Mineral acids are two prevalent homogeneous acid catalysts.

4. Conclusion

Non-renewable energy sources should be substituted with secure and clean energy sources because they are currently running out. Biofuels are a novel type of fuel that can be created using biomass, leftover food, plants, and other materials. The right choice of raw materials and catalysts has become increasingly important in recent years as companies attempt to reduce the cost of producing biodiesel. The homogeneous and mass heterogeneous catalysts (acid and base) each have benefits and drawbacks that vary depending on the circumstance. Alkali catalyst-driven esterification processes move along more quickly than acid-driven ones. Due to their delayed deactivation and lack of mass transfer resistance, nanocatalysts are now frequently used on a lab scale in place of bulk catalysts. Due to high-efficiency nanocatalysts are frequently used in mild operating conditions, which lowers energy usage. In particular, magnetic nanocatalysts are more hopeful for the esterification and transesterification of waste oils into biodiesel because they reduce nanoparticle loss and increase their recovery rate during the separation process. However, the use of nanocatalysts in the production of biodiesel has been halted due to safety concerns. More research is required to create highly effective and selective nanocatalysts and determine whether it is practical and affordable to use them in the commercial production of biodiesel.

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Comparative Study of Radiative Properties of Some Rare Earth Doped Glasses for Lasing Applications

Pardeep Kaur, Tejbir Singh and Preet Kaur *

Department of Physics, Sri Guru Granth Sahib World University, Fatehgarh Sahib-140407, Punjab, India
preetkaur_020@yahoo.com, pardeepkaurandhu666@gmail.com**Abstract**

Understanding the effect of rare-earth ions on the luminescent properties of glasses is important for advanced applications in the field of solid-state lasers, planar waveguides, compact microchip lasers, planar waveguides, sensors and optical fiber amplifiers. The present work emphasizes on finding the best laser materials through a comparative study of spectroscopic properties for Er^{3+} , Dy^{3+} , Sm^{3+} and Pr^{3+} doped oxide glasses. The Judd-Ofelt intensity parameters (Ω_2 , Ω_4 , Ω_6) showed high value of Ω_2 for most of the selected glass samples. Further, radiative parameters including radiative transition probability (A_R), branching ratio (β_R), radiative lifetime, stimulation emission cross-section (σ_p), effective band width ($\Delta\lambda_p$) and quantum efficiency (η) have been compared for the selected glasses. High branching ratios are observed for the $^4\text{I}_{13/2} \rightarrow ^4\text{I}_{15/2}$, $^4\text{F}_{9/2} \rightarrow ^6\text{H}_{13/2}$, $^4\text{G}_{5/2} \rightarrow ^6\text{H}_{7/2}$ and $^1\text{D}_2 \rightarrow ^3\text{H}_4$ transitions corresponding to Er^{3+} , Dy^{3+} , Sm^{3+} and Pr^{3+} doped glasses respectively. Glasses doped with Er^{3+} ions are reported to have superior radiative properties than glasses doped with other rare-earth ions. The β_R value is maximum (1.0) for glasses doped with Er^{3+} ions making them promising laser candidate.

Keywords: Judd-Ofelt theory; Rare-earth ions; Radiative properties; Lasers**1. Introduction**

Over the past decade, the field of luminescence from the rare-earth ions has been steadily evolving, mainly due to the ever-increasing demand of amplifiers and optical sources operating on optical wavelengths adapted by fiber communication technology. The rare-earth doped materials play an important role in different applications, such as, solid state lasers, planar waveguides, compact microchip, sensors and optical fiber amplifiers owing to its 4f-4f transitions [1-4]. The enhancement of quantum efficiency of such materials mainly depends on host materials. Host environment affects the fluorescence properties of rare-earth ions. Glasses are found to be suitable host for accommodating rare earth ions since long time. Rare-earth doped glasses are categorized on the basis of f-f and f-d transitions owing to narrow and broad spectral lines. Er^{3+} , Tb^{3+} , Gd^{3+} , Nd^{3+} , Eu^{3+} and Gd^{3+} are the most frequently used rare-earth ions for developing luminescent glasses. Among different oxide glasses, such as, silicate, borate, phosphate, borate and phosphate glasses have achieved much attention due to their unique characteristics such as high thermal stability, high transparency, low melting point, low dispersion, high solubility of rare earth ions and low refractive index [5-7]. Telluride glasses are also being the interest of researchers these days due to its low phonon energy. In the present study, oxide glasses doped with different rare earth ions viz. Dy^{3+} , Sm^{3+} , Er^{3+} and Pr^{3+} are compared by studying their absorption and luminescence properties.

2. Selection of Samples

Glass samples doped with 0.5 mol % of rare-earth ions (Dy^{3+} , Sm^{3+} , Er^{3+} and Pr^{3+}) were selected for the study. The compositions of the selected glass samples are listed in **Table 1**.

3. Judd-Ofelt Theory and Radiative Properties

Spectroscopic properties of rare-earth ion doped glasses are best studied using Judd-Ofelt (JO) theory. Judd and Ofelt separately theorized the intensity of the 4f-4f transition for a better understanding of lanthanide ions [26,27]. Judd-Ofelt theory determines theoretical oscillator strengths of transitions and then compared with experimental oscillator strength to find three intensity parameters Ω_2 , Ω_4 and Ω_6 . JO intensity parameters play a fundamental role in understanding the interactions between rare earth ions and metal ligands. Ω_2 parameter represents the covalency of rare-earth ion with the ligand, while Ω_4 and Ω_6 parameters give information about rigid and viscous nature of host matrix.

Judd-Ofelt parameters are then further employed to determine various radiative properties, such as, Radiative transition probability (A_R), stimulated emission cross-section (σ_{max}^{em}), gain band width, branching ratio (β_r), radiative lifetime (τ_R), optical gain ($\sigma_{max}^{em} \times \tau_R$) and efficiency (η) etc. of rare-earth doped materials. The spectroscopic quality factor (Ω_4/Ω_6) is significant parameter for achieving laser action with simulated emission cross-section value lying in the laser medium. For better lasing action the spectroscopic quality factor should be

greater than 1. Detailed method of evaluation of Judd-Ofelt parameters and radiative properties is discussed somewhere else [28].

Table 1: Compositions of glasses doped with different rare earth ions

Dopant	Name	Composition
Dy³⁺	TDyAgTi [8]	69.1TiO ₂ –20ZnO–10MgO–0.5Dy–0.2 Ag–0.2Ti
	PNaLiDy [9]	69.5NH ₄ H ₂ PO ₄ –15Na ₂ CO ₃ –15Li ₂ CO ₃ –0.5Dy ₂ O ₃
	BaPbAlFB [10]	20BaF ₂ –10PbF ₂ –5Al ₂ O ₃ –64.5B ₂ O ₃ –0.5Dy ₂ O ₃
	ZnBiBaBFTe [11]	5ZnO–5Bi ₂ O ₃ –15BaF ₂ –10TeO ₂ –64.5B ₂ O ₃ –0.5Dy ₂ O ₃
	OFLZBSD [12]	10Li ₂ O ₃ –9.5ZnF ₂ –50B ₂ O ₃ –30 SiO ₂ –0.5Dy ₂ O ₃
	GeOBO[13]	55GeO ₂ –5B ₂ O ₃ –3BaO–9.5Ga ₂ O ₃ –0.5Dy ₂ O ₃
Sm³⁺	PNZSm [14]	42.25P ₂ O ₅ –42.25Na ₂ O ₃ –15ZnO–0.5Sm ₂ O ₃
	TeZnNbSm	64.5TeO ₂ –20ZnF ₂ –12PbO–3Nb ₂ O ₅ –0.5Sm ₂ O ₃
	SrBaBOSm [16]	Sr _{1.0} Ba _{2.0} B ₆ O ₁₂ :Sm ³⁺
	Sm MCZBP [17]	10P ₂ O ₅ –59.5H ₃ BO ₃ 10MgO–5CdP ₂ –15ZnO–0.5Sm ₂ O ₃
Pr³⁺	LiPbAlBPr [18]	10Li ₂ O–10PbO–9.5Al ₂ O ₃ –70B ₂ O ₃ –0.5Pr ₆ O ₁₁
	PrZTFB [19]	29.5B ₂ O ₃ –30TeO ₂ –16ZnO–10ZnF ₂ –7CaF ₂ –7BaF ₂ –0.5Pr ₂ O ₃
	PBAlKBaPr [20]	60P ₂ O ₅ – 4B ₂ O ₃ –Al ₂ O ₃ –10K ₂ O–17.5BaO–0.5Pr ₂ O ₃
	TSWP [21]	74.5TeO ₂ –15Sb ₂ O ₃ –10WO ₃ –0.5Pr ₆ O ₁₁
Er³⁺	BTNME [22]	29.5B ₂ O ₃ –45TeO ₂ –15MgO–10Na ₂ O–0.5Er ₂ O ₃
	BLKEr [23]	48.5B ₂ O ₃ –10Bi ₂ O ₃ –20Li ₂ O–20K ₂ O–0.5Er ₂ O ₃
	BLFBEr [24]	69.5 H ₃ BO ₃ –10 Li ₂ CO ₃ –10BaCO ₃ –5CaF ₂ –5ZnO–0.5 Er ₂ O ₃
	LiBEr [25]	64.5B ₂ O ₃ –15Na ₂ O–10PbO–5ZnO–5Li ₂ O–0.5Er ₂ O ₃

4. Results and Discussion

The comparative analysis on the basis of radiative properties were discussed on the basis of rare earth doping in the following sub-sections:

4.1 Dysprosium (III) doped glasses

Dysprosium ion doped materials are well-known for developing white light emitting diodes. The photoluminescent spectra of Dy³⁺ ions show emission from ⁶F_{9/2}→⁶H_{15/2} (blue region), ⁶F_{9/2}→⁶H_{13/2} (yellow region) and ⁶F_{9/2}→⁶H_{15/2} (red region). Five glass compositions with similar doping concentration have been chosen and compared based on their spectroscopic study. These glasses include Ag and Ti co-embedded glasses doped with Dy³⁺ (TDyAgTi), Dy³⁺ doped alkali and alkaline doped phosphate glasses (PNaLiDy), Dy³⁺ doped Barium lead alumino fluoro borate (BaPbAlFB) glasses, Dy³⁺ doped telluride glasses (ZnBiBaBFTe), Oxyfluoride Lithium Zinc Borosilicate glasses (OFLZBSD) and Borogermanate glasses (GeOBO). The Judd-Ofelt parameters for these glasses are compared and listed in **Table 2**.

Among all selected glasses, the Ω_2 values are maximum for PNaLiDy indicating its highly covalent nature. The lower values of Ω_4 and Ω_6 parameters for all glass samples signify less rigid nature of these glasses. High values

of χ for TDyAgTi, BaPbAlFB and GeOBO makes them better lasing glasses compared to other selected glass samples. The radiative parameters for the selected samples are also listed in **Table 2**. for better understanding of lasing properties of these materials. It is observed that GeOBO glass possesses highest values of branching ratio (> 0.5) and stimulated emission cross-section for ${}^4F_{9/2} \rightarrow {}^6H_{13/2}$ (yellow) transition compared to rest of the glasses, making them potential material for laser applications.

Table 2: JO parameters and radiative properties for Dy³⁺ doped glasses

Glasses	Ω_2	Ω_4	Ω_6	χ (Ω_4/Ω_6)	A_R (s ⁻¹)	σ_{max}^{em} ($\times 10^{-20}$ cm ²)	βr	τ_R (μ s)	$\sigma_{max}^{em} \times \tau_R$ ($\times 10^{-25}$ cm ² s)	η (%)
TDyAgTi	3.21	1.64	0.44	3.7	1520	4.47	-	19.3	8.627	134
PNaLiDy	11.09	1.34	3.44	0.39	1179	0.05	0.3	1480	7.4	74.81
BaPbAlFB	2.48	1.55	0.98	1.58	381.65	0.02	0.552	144	0.288	81
ZnBiBaBFTe	8.49	1.83	3.66	0.5	332	0.07	0.593	879	6.153	62.7
OFLZBSD	2.39	0.55	2.63	0.21	2190.12	0.33	0.54	246	8.118	69
GeOBO	8.42	1.6	1.03	1.55	125	0.26	0.745	352	9.152	47

4.2 Samarium (III) doped glasses

Samarium ions are known for near-infrared (NIR) emission applications as well as orange-red emission. Based on their emission in the visible region, some glass compositions reported over the last few years have been compared to obtain an optimal laser material for visible laser emission. These compositions are mainly composed of phosphate, borate and telluride glasses with 0.5 mol% doping concentration of Sm³⁺. The J-O parameters obtained from the absorption spectra of Sm³⁺ for the selected glasses and their radiative properties are listed in **Table 3**.

Table 3: JO parameters and radiative properties for Sm³⁺ doped glasses

Glasses	Ω_2	Ω_4	Ω_6	χ (Ω_4/Ω_6)	A_R (s ⁻¹)	σ_{max}^{em} ($\times 10^{-20}$ cm ²)	βr	τ_R (μ s)	$\sigma_{max}^{em} \times \tau_R$ ($\times 10^{-25}$ cm ² s)	η (%)
PNZSm	4.46	6.79	10.91	0.62	198.65	0.041	0.59	2.98	0.012	81.2
TeZnPbNbSm	2.12	5.15	2.83	1.82	259	0.11	0.48	1840	20.24	61
SrBaBOSm	32.4	0.58	0.28	2.12	732.37	0.018	0.56	949	1.68	66.38
Sm MCZBP	2.49	4.38	3.15	1.39	259.47	0.155	0.24	1060	16.43	63.7

It is observed that Sm³⁺ doped glasses are more rigid and viscous than those of Dy³⁺ doped glasses with less symmetric environment around the ligand. Also, the χ ratio for these glasses is greater than 1 (except for PNZSm glass sample) which indicates its potentiality for lasing applications. High value of branching ratio (> 0.50) for PNZSm and SrBaBOSm make them promising laser candidate.

4.3 Praseodymium (III) doped glasses

Praseodymium ion (Pr³⁺) is highly preferred rare-earth ion for luminescent applications due to its metastable level, such as ${}^3P_0$, ${}^1D_2$ and ${}^1G_4$, leading to emission in ultraviolet and infrared region. Pr³⁺ ions have lasing action for the ${}^1D_2 \rightarrow {}^3H_4$ transition, making them useful for up-conversion laser development. In this study, we have compared four glasses doped with 0.5 mol% of Pr³⁺ ions. The JO parameters and radiative properties for the glasses are provided in **Table 4**. High values of the Ω_4 and Ω_6 parameter for all glass samples indicate their rigid nature. Further comparison of radiative properties shows branching ratio values lower than 0.5 except for PrZTFB making them less efficient for lasing action.

Table 4: J-O parameters and radiative properties for Pr³⁺ doped glasses

Glasses	Ω_2	Ω_4	Ω_6	χ (Ω_4/Ω_6)	A_R (s ⁻¹)	σ_{max}^{em} ($\times 10^{-20}$ cm ²)	βr	τ_R (μ s)	$\sigma_{max}^{em} \times \tau_R$ ($\times 10^{-25}$ cm ² s)	η (%)
LiPbAlBPr	1.07	2.69	2.15	1.24	1902.14	0.34	0.33	167	5.68	81
PrZTFB	6.54	4.09	8.88	0.46	638.2	2.19	0.62	972	212.87	-
PBAIKBaPr	1.18	2.73	1.13	2.41	228.99	3.17	0.28	69	21.87	-
TSWP	15.58	21.14	6.08	3.48	259.47	0.155	0.24	1060	16.43	63.7

4.5 Erbium (III) doped glasses

Trivalent erbium ions have excellent luminescent characteristics with red, green and blue emission. These ions possess high chemical and thermal stability along with extraordinary mechanical strength. Different glass compositions doped with Er³⁺ are compared on the basis of their spectroscopic properties. The J-O parameters and radiative properties are displayed in **Table 5**. The glasses are covalent in nature with exceptional χ value for LiEr glass. On comparing the radiative properties, it is found that Er³⁺ doped glasses have high value of branching ratio (maximum for BTNME sample). Optical gain values are greater for BLKEr sample making it a better laser material.

Table 5: J-O parameters and radiative properties for Er³⁺ doped glasses

Glasses	Ω_2	Ω_4	Ω_6	χ (Ω_4/Ω_6)	A_R (s ⁻¹)	σ_{max}^{em} ($\times 10^{-20}$ cm ²)	βr	τ_R (μ s)	$\sigma_{max}^{em} \times \tau_R$ ($\times 10^{-25}$ cm ² s)	η (%)
BTNME	8.13	1.71	2.45	0.7	3157	0.416	89.25	0.19	0.079	-
BLKEr	2.36	0.8	1.78	0.45	132.67	0.742	1	7537	559.245	78
BLFBEr	3.74	0.96	1.7	0.56	261	0.338	-	387	13.08	-
LiEr	8.72	7.69	0.01	769	115.28	0.357	1	8874	316.018	-

Conclusion:

Glass samples doped with various rare-earth ions (Dy³⁺, Sm³⁺, Er³⁺ and Pr³⁺) were studied for radiative properties to explore their feasibility as lasing medium. It is observed that dopant plays a major role in lasing action. Among the selected glass compositions, those doped with Er³⁺ ions possess maximum values of branching ratio and high optical gain, making it better lasing material compared to other rare earth dopants. However, the GeOBO, PNZSm and PrZTFB samples hold good lasing properties for yellow, red and green laser applications but the best lasing properties are observed for the BLKEr sample.

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Production of Bio-diesel from Various Adaptable techniques

***Suchi Sharma, Nadeem Sharma, Poonam Rani, Sonia**

*PhD Scholar, Department of Chemistry, MMEC, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana, (India)-133207.

sharmasuchi119@rediffmail.com

Abstract

The population is growing exponentially and the need for energy is increasing in tandem. In order to satisfy the ever-expanding global energy needs, fossil fuels, which were once the primary source of fuel for transportation, are quickly becoming depleted. Climate change caused by carbon emissions from fossil fuels and future energy security is a major factors that are driving us to search for alternative energy sources. However, a number of feedstocks have been shown to be impractical or impossible because of their higher cost due to their primary use as a source of food. The synthesis of alternate fuel from the waste of agriculture, cooking oil waste, and heteropoly acids salts has been identified as feasible and valuable sources in accordance with waste management norms and environmental regulations. Fuel produced by these techniques has similar properties to diesel, and biodiesel, with its low carbon content, biodegradability, and nontoxicity, is an ideal substitute. This review summarizes the data to produce biodiesel from different methods. Along with discussing the advantages and disadvantages of each method, alcohol, and catalyst used to produce biodiesel from leftover cooking oil and agricultural feedstock, this paper will also cover the numerous methods, alcohols, and catalysts utilized in the process.

Keywords: Biodegradable, biodiesel formation Methods, Agricultural waste, cooking oil, Fuel, Heteropolyacid salts.

Introduction:

Amongst the various non-conventional fuels currently explored, biodiesel is made from renewable resources, which have desired chemical qualities like non-toxic, biodegradable, and carbon neutral. Also, unlike non-renewable fuel, biodiesel can be utilized in any standard diesel engine (petrol or diesel). Also, conventional fuel has a short lifespan and releases harmful pollutants like lead, nitrogen, hydrocarbons, sulfur, and carbon oxides (Ma. et al 1999; Mujtaba et al 2021; Soudagar et al 2021). The majority of researchers prefer renewable fuels made from oilseeds and edible waste oil because of their capacity to decrease pollution, greenhouse gas emissions, and reliance on fuel imports, which lowers the cost of energy overall as the best substitute fuel for diesel biodiesel (Mujtaba et al 2021). The sources of cooking oil vary around the world. Oils extracted from plants like maize, margarine, coconut, olive, soybean, grape seed, and canola, or animal-based fats, including butter, ghee, Kermanshah oil, and fish oil, serve as their basic materials (Dizge et al 2009; Campanelli et al 2010; Zhang et al 2023). However, because of the subsequent rise in requirement for edible oil and the unneeded destruction of jungles for plantations, some non-governmental organizations (NGOs) worldwide have harshly criticized the utilization of edible oil to create biodiesel by neglecting the need of the millions of people who are hungry and starving across the world (Tan et al 2011). By using WCO or plant husk as a feedstock for biodiesel, problems like water pollution and drainage system obstructions that require additional work to remove could be mitigated.

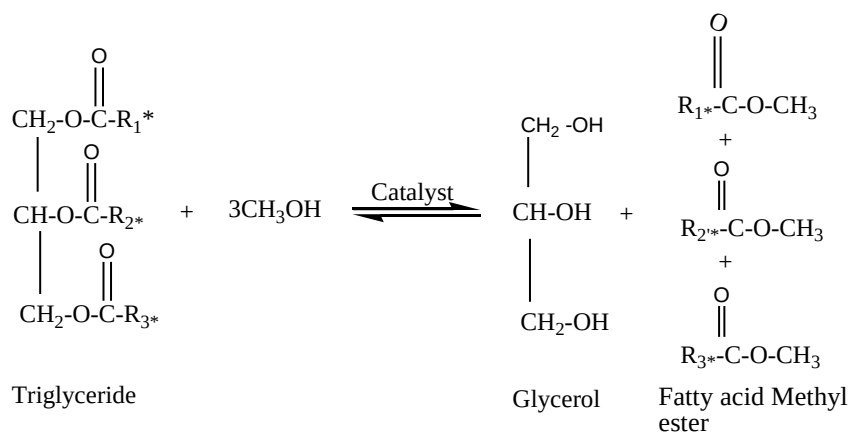
METHODS OF FORMULATION OF BIODIESEL:

From Microemulsion: This is the simplest process to produce biodiesel. It has been established that micro emulsification is an alternative, energy-intensive, and commercially viable method of producing liquid biofuel. Fuels based on microemulsion were synthesized by simply adding waste cooking oil in butane-2-oil and ethanol. But The confirmation of a reverse micellar microemulsion system was established by the presence of nano-sized droplets in the formulations. This technique can have some serious downsides, including high viscosity, poor stability, a propensity for sticking, insufficient combustion, and carbon deposition. Because of these problems, it is not the best option for many applications, since it might result in decreased efficiency and an increase in emissions (Bora et al 2016).

Micro-assisted pyrolysis: When an organic material is thermally degraded by breaking its chemical bonds in an inert environment, this process is known as pyrolysis (Su et al 2022). In conventional (electrical) pyrolysis, heat is transported from the surface of the feedstock particle to the interior core as a result of the formation of a temperature gradient from the outside furnace to the inner feedstock particle. A zone of higher temperature is traversed by the released volatiles as they diffuse from the feedstock particles inside the core to its exterior surface, microwave-assisted pyrolysis (MAP), a novel pyrolysis method, has just been advanced. The characteristics of the feedstocks employed significantly impact the generation of bio-oil, bio-gas, and bio-char using microwave-assisted pyrolysis (Zahan et al 2018). In comparison to conventional electrical pyrolysis, this

novel technique has many advantages, including lower thermal inertia, quicker response times, faster heating rates, and higher heating efficiency. Overall, this method is advantageous and requires high temperatures for the separation system since it is efficient, does not require washing or filtering, and produces no waste. Furthermore, this process is cost-effective and efficient, allowing for a streamlined separation process with minimal effort.

Trans Esterification: Vegetable or animal oils were reacted with alcohols like methanol or ethanol in this process, yielding useful products. A basic catalyst is used to accelerate the speed of the reaction, increase product weight and boost the yield of the final result. To lessen triglycerides' high viscosity, this technique has frequently been used. To increase the reaction rate and yield, a catalyst—typically KOH—is employed. When two reactants are joined, a reversible chemical reaction called transesterification takes place. This process can be used to create a variety of products, ranging from biodiesel to pharmaceuticals. By manipulating the reactants, the reaction can be tailored to produce the desired outcome. Three moles of fatty acids methyl ester and one mole of glycerol are produced when one mole of triglyceride combines with three moles of methyl alcohol in this procedure (Guzatto et al 2011). The general equation representing the reaction between triglyceride and methanol is as follows in **Scheme 1**. The process begins with a series of three sequential reversible reactions in which triglycerides are transformed into diglycerides, diglycerides are changed to monoglycerides, and monoglycerides are then converted to glycerol. Presence of a catalyst speeds up this process. (Bautistal et al 2009; Wang et al 2007). Figure 1; shows the several sorts of reactants that, when combined with the right catalyst, can go through transesterification and produce a desired product with a high conversion rate (Bala et al 2017; Pasha et al 2019; Pedersen et al 2017; Zhange et al 2017; Zhange D et al 2018; Gohain et al 2020).



Scheme 1: Transesterification reaction

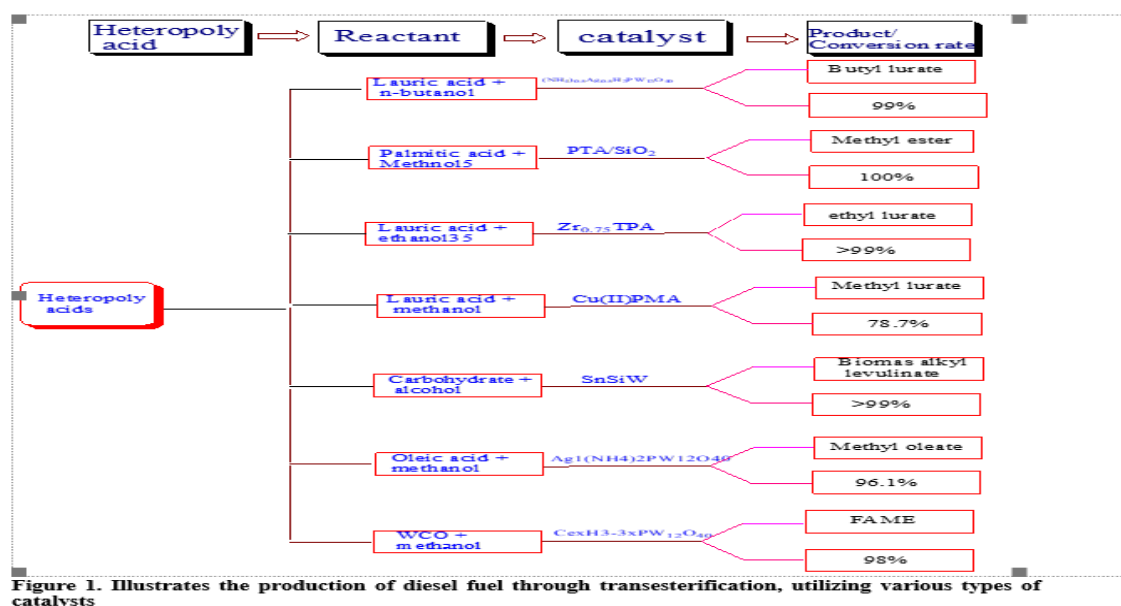


Figure 1. Illustrates the production of diesel fuel through transesterification, utilizing various types of catalysts

Blending: Due to its obvious inherent shortcomings, using vegetable oils as a direct fuel source in diesel engines or as a blend with petro-diesel has been deemed undesirable and impracticable. But, after going through

a chemical modification process, biodiesel fuel can be utilized as an alternative. (Atabani et al 2014; JereKias et al 2014; Rajalingam et al 2016; Shimada et al 2002).

Catalyst employed in Biodiesel procurement:

Homogeneous catalyst: Homogeneous catalysts may be acidic or basic catalysts. A base catalyst is preferred to an acid catalyst (Boa et al 2016). Since they are more affordable, more efficient at catalyzing reactions, and have lower reaction temperatures and pressures than acids (Wen et al 2010) during transesterification, Base catalysts have the potential to react with free fatty acids (FFA) present in the feedstock, leading to the formation of soap through a process called saponification. This reaction can have a detrimental effect on the catalyst, ultimately reducing its efficiency and lifespan. Therefore, it is crucial to monitor the FFA content in the feedstock and choose an appropriate catalyst to avoid any unwanted reactions. Many investigations have been conducted to determine the optimum homogeneous catalyst for the generation of biodiesel from used cooking oil (Meng et al 2008).

Heterogeneous catalyst: In recent times, researchers have shown a keen interest in heterogeneous catalysts owing to their numerous advantages over homogenous catalysts. These catalysts are highly sought after due to their ability to facilitate chemical reactions without being consumed. Unlike homogenous catalysts, which are soluble in the reaction medium, heterogeneous catalysts are insoluble and can be easily separated from the reaction mixture. This property makes them more efficient, cost-effective, and environmentally friendly. Furthermore, heterogeneous catalysts are preferable over homogeneous catalysts in the generation of biodiesel from WCO due to saponification and hydrolysis. These are also of two types like homogeneous catalysts. Oxide (ZnO) of zinc, calcium (CaO) and strontium (SrO) (Yusuf et al 2012), and sodium/silicon dioxide (Na/SiO₂) are examples of hetero-generous base catalysts. Hetero-poly acids, acidic ion-exchange resin, sulfurated metal oxide, and sulfurated amorphous catalysts are a few examples of heterogeneous acid catalysts (Al-Zuhair et al 2009; Hama et al 2011). Fly-ash-supported CaO catalyst from eggshell waste has also been generated, with a performance of 96.5%.

Biocatalysts (enzymes) have been extensively studied as an alternative to chemical catalysts to reduce the obstacles posed by traditional catalysts. The most popular enzyme used to make biodiesel, lipase, works as an efficient catalyst to turn all of the FFA content present in the WCO into fatty acid methyl ester. (Ranganathan et al 2008; Talukder et al 2011; Szczesna et al 2009) The most widely utilized enzyme in biodiesel production, lipase, functions as a powerful catalyst to convert all of the FFA content in the WCO into fatty acid methyl ester. Various organisms, including fungi, bacteria, mammals, and plants, can produce lipase, an enzyme that breaks down lipids. Nonetheless, due to its low production cost and simplicity of modification, microbial lipase is the most often utilized type. Lipase must be immobilized to maximize its efficiency and enable reuse in numerous batches. Many studies have looked into various ways to immobilize lipases, including chemical binding to chitin, adsorption onto macroporous supports, trapping in hydrophobic sol-gel supports, and encapsulation in silica aerogel (Szczesna 2009; Zhou et al 2016).

Biodiesel from agriculture Waste

The production of agricultural goods has greatly expanded. Furthermore, this has increased the probability of generating agricultural waste. The current situation has led to a higher chance of producing excess agricultural waste. Agricultural waste is seen as a feasible source for the synthesis of affordable and environmentally friendly catalysts, and appropriate methods for its disposal are explored (Singh et al 2020). The creation of catalysts from agricultural waste has been accomplished using a variety of techniques in published research. The methodology for synthesizing catalysts from agricultural waste (Martins et al 2012; Awogbemi et al 2021) involves a multi-step process. First, agricultural waste is collected and sorted from various sources. Next, the waste is transported to scientific laboratories for additional processing. The waste is gathered, sorted, and purified to eliminate any contaminants before being dried either in the sun or an oven. Oven drying uses a lot of energy but is quicker and has a controlled drying pace. Sun drying, on the other hand, is less expensive but takes a longer period and exposes the solid waste to outside pollutants. Once the drying process is finished, the material undergoes milling to achieve the desired size through the use of meshes, as described by (Gohain et al 2020) and (Betiku et al 2016). Different types of catalyst and oil used in producing biodiesel from Agriculture waste is shown in Table 1.

Table 1: Various types of Agriculture waste derived catalysts to produce biodiesel.

Agriculture	Catalyst	Oil	Time	Temp	Yield	Reference
Waste orange Peel	SO ₃ H Functionalisation orange peels	Corn acid oil	274	65	91.68	(Lathiya et al 2018)
Waste Mango	K ₂ O, SiO ₂ , CaO	Soyabean oil	340	28	98	(Gohain et al 2020)
Carica papaya stem	K ₂ O ₃ and K ₂ CO ₃	WCO	180	60	95.23	(Gohain et al 2020)
Banana peel	Effective with potassium content	Napoleon's Plume	69.02	65	98.5	(Betiku et al 2016)
Heteropanax Fragrance	Potassium carbonate and oxides	Jatropha curcas oil	65	65	97.75	(Basumatary et al 2021)
Birch Bark ash	Cao	Refined Palm oil	180	60	89.43	
Fry-ash from Wood pellet	Cao	Refined Palm oil	180	60	87.76	(Upriety et al 2016)
Lemna perpusilla Torrey ash	Residue boasts a potassium content of 11.3%, which can be attributed to its exceptional catalytic activity.	Oil of jatropha	300	60	89.43	(Chouhan et al 2013)
Waste ginger straw	Oleic acid.	Oleic acid	214	64	93.2	(Yu et al 2021)
Cocoa pod husk	Due to potassium content	Azadirachta indica oil	57	65	99	(Betiku et al 2017)

Biodiesel From Waste Cooking Oil: Biodiesel derived from renewable resources is a highly promising alternative fuel that is currently being developed due to its numerous benefits. This fuel is characterized by low levels of harmful pollutants and boasts desirable chemical properties such as non-toxicity, biodegradability (Danushka et al, 2021; Marwaha et al, 2018), and carbon neutrality. It emits minimal amounts of pollutants that can harm the environment and human health. In the world, there is a wide range of cooking oil sources. Certain oils, such as maize oil, margarine, coconut oil, palm oil, olive oil, soybean oil, grape seed oil, and canola oil, are generated from plant-based lipids. As an alternative, lipids derived from animals, like butter, ghee, Kermanshah oil, and fish oil, are also utilized in cooking (Noman hay et al., 2017; Khedri et al., 2018). These lipids are trans esterified to synthesize biodiesel. Past research has demonstrated that a variety of vegetable oils, including sunflower oil, palm oil, and soybean oil, may be used to make biodiesel (Zulqarnain et al 2021). However, due to the increased demand for vegetable or edible oil and the unneeded destruction of forests for plantations, many non-governmental organizations (NGOs) around the world have harshly criticized the use of a food source (edible oil) to generate biodiesel at the expense of the millions of people who are hungry or starving in the world. Deforestation is rapidly transforming our planet's landscape, decimating vital ecosystems, and endangering countless species of flora and fauna. Waste cooking oil (WCO) can be used as a feedstock for the manufacturing of biodiesel, (Figure 3) which has the potential to reduce environmental problems like water pollution and drainage system clogs. Often, these issues require more work to fix. However, there is also a growing concern regarding the environmental impact of an increase in the production of WCO in homes and restaurants. WCO can be freely collected from restaurant sand houses using a special “recycle bin” placed in each restaurant or house, which may require public awareness campaigns preceding the collection process. For

biodiesel produced under ideal conditions, the parameters of the fuel, including density, kinematic viscosity, flash point, acid value, calorific value, cetane number, cloud point, etc. were determined (Arachchige et al 2021). Figure 2. Diagrammatic representation of Physical properties of biodiesel produced from WCO (Singh et al 2010; Lugo-Mendez et al 2021; Saydut et al 2016; Venkateswara Rao et al 2016; Patil et al 2009; Sarve et al 2015; Nagaraja et al 2016; Lam et al 2011; Chakraborty et al 2010; Jain et al 2010; Yaakob et al 2013)

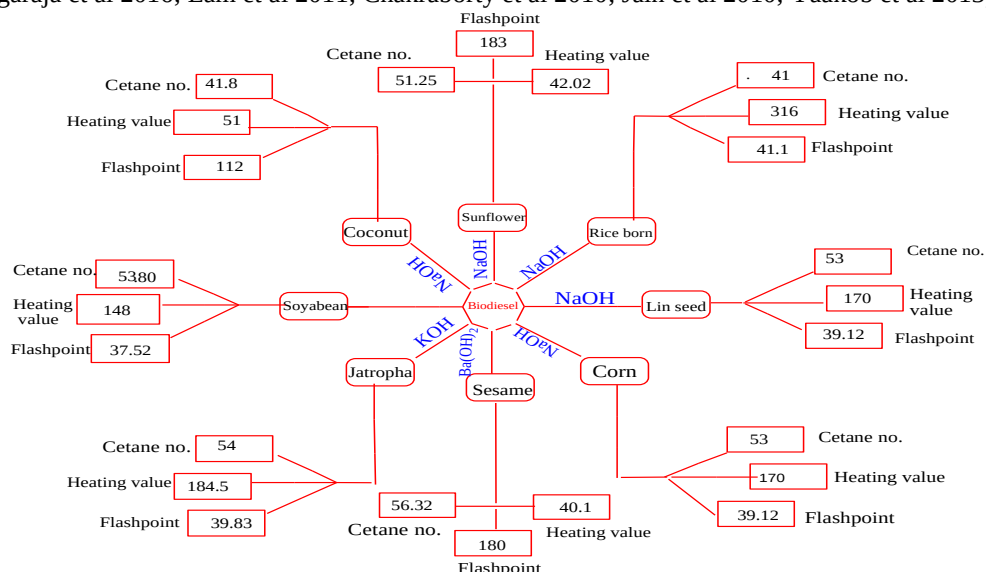


Figure 2: Physical properties of biodiesel generated by employing various types of vegetable oil feedstock.

Conclusion

There are numerous benefits to using used cooking oil to make biodiesel, from cost effectiveness to the reduction of environmental pollutants. Street vendors frequently use second-used cooking oil, or WCO, from nearby restaurants to fry their food. This waste oil can also be utilized by making biodiesel from it. Reusing fried waste frying oil more than once puts it at risk of mutating into a cancer-causing enzyme.

In today's world, these days, either vegetable oil or animal fat is used to make this fuel. However, small producers generally opt for vegetable oil. Biodiesel is also used by adding fuel to it and it can be produced in both small and large quantities. Biodiesel is recognized as a renewable and alternative fuel for diesel engines. First, we must measure the Free Fatty Acid (FFA) content of the WCO used in this production. Transesterification is commonly used to reduce the viscosity during biodiesel production, and acids and bases are widely used as catalysts.

Agricultural waste is often viewed as mere garbage, but it actually holds great potential for being converted into valuable materials, such as catalysts. These catalysts can play a crucial role in facilitating the biodiesel production process in a sustainable and effective manner.

There are several methods for manufacturing catalysts from agricultural waste, including calcination, physical mixing, wet impregnation, and the sol-gel method. By utilizing these techniques, we can unlock the full potential of agricultural waste and create a more sustainable future. In this study, we have conducted a review of the different types of catalysts that can be produced from various agricultural waste materials, vegetable oil, and heteropoly acid salts. Our focus was on their effectiveness in transforming oil into biodiesel.

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Effect of Temperature on The Isotopic Chain of Neutron-Rich Light Mass Compound Nuclei**Sarbjeet Kaur^{1,2,*}, BirBikram Singh^{2,§} and S. K. Patra³**¹ Department of Physics, Sri Guru Granth Sahib World University, Fatehgarh Sahib-140406² Department of Physics, Akal University, Talwandi Sabo, Punjab-151302³ Homi Bhabha National Institute, Anushakti Nagar, Mumbai – 400094^{*}sarbjeetsangha13@gmail.com, [§]drbirbikramsingh@gmail.com**Abstract**

The effect of temperature (T) on the dynamics of the isotopic chain of low-energy neutron-rich light mass compound nuclei is studied within the dynamical cluster decay model (DCM) based on Quantum mechanical fragmentation theory (QMFT). The compound nuclei under study are $^{24,25,26,27}\text{Mg}^*$ formed in $^{12,13,14,15}\text{C} + ^{12}\text{C}$ fusion reactions, respectively. From the preformation profile and fusion cross-sections, it is clear that a fusion enhancement is observed as we go from compound nuclei (CN) $^{24}\text{Mg}^*$ to $^{27}\text{Mg}^*$. This fusion enhancement is greater as we move from a paired-neutron nucleus $^{24}\text{Mg}^*$ and $^{26}\text{Mg}^*$ to an unpaired-neutron nucleus $^{25}\text{Mg}^*$ and $^{27}\text{Mg}^*$, as compared to the transition from an unpaired $^{25}\text{Mg}^*$ neutron nucleus - to a paired neutron nucleus $^{26}\text{Mg}^*$. Further, moving to higher T-values, similar fusion enhancement is present with higher values of fusion cross-sections for particular fragments. The enhancement in fusion cross sections with T is smaller for $^{27}\text{Mg}^*$. This indicates the influence of T on fusion cross-sections. All calculations are made for spherical consideration of nuclei and angular momenta taken up to the *l*-critical value for the respective reactions. The DCM-calculated fusion cross-sections have also been compared with available experimental data and are in good agreement.

Keywords: Compound-nucleus decay, Fusion, Quantum Mechanical Fragmentation Theory, Dynamical cluster-decay model.

1. Introduction

One of the most exciting topics of contemporary nuclear physics is the fusion of neutron-rich nuclei due to the advancements in radioactive beam facilities [1]. The stellar helium burning results in the ^{12}C and ^{16}O isotopes. For massive stars, the subsequent phases of stellar evolution are dictated by $^{12}\text{C} + ^{12}\text{C}$ and $^{12}\text{C} + ^{16}\text{O}$ fusion reactions. The low-energy $^{12}\text{C} + ^{12}\text{C}$ fusion reaction is one of the most studied heavy ion fusion reactions [2,3]. Also, the ^{12}C fusion plays a very important role in a large number of astrophysical scenarios, such as the production of massive stars, core-collapse supernovas, and x-ray superbursts. Superbursts are extraordinarily intense x-ray bursts, about 1000 times more energetic and longer in duration than normal x-ray bursts.

To understand the character of neutron-rich matter, the study of the fusion of an isotopic chain of neutron-rich nuclei is one of the best methods, as the charge distribution of the neutron-rich projectile is unaffected by the additional neutrons due to the unchanged Coulomb potential. Consequently, the comparison of the fusion excitation functions for the different projectiles provides access to the evolution of neutron density distribution with an increasing number of neutrons.

In view of these experimental observations, we have recently investigated the fusion enhancement in neutron-rich light mass CN $^{24,25,26,27}\text{Mg}^*$ formed in $^{12,13,14,15}\text{C} + ^{12}\text{C}$ fusion reactions, respectively, at different $E_{\text{c.m.}}$ values within dynamical cluster decay model (DCM) [4]. The DCM calculated results were compared with the available experimental data [5]. In the present work, we will further study the effect of the temperature (T) on the dynamics of an isotopic chain of $^{12,13,14,15}\text{C} + ^{12}\text{C}$ fusion reactions resulting in low-energy neutron-rich light mass compound nuclei $^{24,25,26,27}\text{Mg}^*$.

The QMFT-based fragmentation potential comprises binding energy (B.E) (which is the sum of liquid drop energy (V_{LDM}) and shell corrections (δU), Coulomb potential (V_{C}), and nuclear proximity potential (V_{P}). The structure information of the CN enters the model via the P_0 (also known as the spectroscopic factors) of the fragments. This approach enabled us to calculate the fusion cross-sections via fragmentation potential, preformation probability, and scattering potential of chosen nuclei. Theoretically calculated fusion cross-sections are compared with available experimental data.

The brief methodology is given in Section 2, and results and discussion of the presented calculations (graphically) are described in section 3. The work is summarized in section 4.

2. Methodology: Dynamical Cluster Decay Model (DCM)

The Quantum Mechanical Fragmentation Theory (QMFT) [6] based dynamical cluster decay model (DCM) [4, 7] worked out in terms of the following collective coordinates: The mass asymmetry $\eta_A = (A_1 - A_2)/(A_1 + A_2)$, Relative separations coordinate R between two interacting nuclei or two fragments, The deformation coordinates $\beta_{\lambda i}$ of incoming and outgoing nuclei, The orientation degrees of freedom θ_i of deformed nuclei, Azimuthal angle ϕ between the principal planes of two interacting nuclei.

In terms of these collective coordinates, using the partial wave analysis, the CN decay cross-section in DCM is

$$\sigma = \frac{\pi}{k^2} \sum_{l=0}^{l_{cortmax}} (2l+1) P_0 P; \text{ where } k = \sqrt{\frac{2\mu E_{C.M}}{\hbar^2}} \quad (1)$$

here, where P_0 is preformation probability referring to η -motion, is the solution of stationary Schrodinger equation in η coordinate at fixed $R = R_a$,

$$P_0 = \sqrt{B_{\eta\eta}} |\psi[\eta(A_i)]|^2 (2/A) \quad (2)$$

The fragmentation potential within DCM is given as

$$V(\eta, R, l, T) = -\sum_{i=1}^2 B_i(A_i, Z_i, T) + V_c(R, Z_i, \beta_{\lambda i}, \theta_i, \phi, T) + V_p(R, A_i, \beta_{\lambda i}, \theta_i, \phi, T) \\ + V_l(R, A_i, \beta_{\lambda i}, \theta_i, \phi, T) \quad (3)$$

i.e., it is the sum of Coulomb (V_c), proximity (V_p), and centrifugal potential (V_l), all being temperature (T) dependent, and B_i is the T -dependent binding energies of two nuclei and defined within Strutinsky renormalization procedure [8] as

$$B_i(A_i, Z_i, \beta_{\lambda i}, T) = \sum_{i=1}^2 V_{LDM}(A_i, Z_i, T) + \sum_{i=1}^2 \delta U \exp\left\{-\frac{T^2}{T_0^2}\right\} \quad (4)$$

where V_{LDM} is the liquid drop energy, and δU is the empirical shell corrections. Based upon the semi-empirical mass formula of Seeger [9], the T -dependent V_{LDM} part is taken from Davidson et al. [10], as

$$V_{LDM}(A, Z, T) = \alpha(T)A + \beta(T)A^{2/3} + \left\{ \gamma(T) - \frac{\eta(T)}{A^{2/3}} \right\} \left(\frac{I^2 + 2I}{A} \right) \\ + \frac{Z^2}{R(T)A^{2/3}} \left\{ 1 - \frac{0.7636}{Z^2} - \frac{2.29}{R(T)A^{2/3}} \right\} + \delta(T) \frac{f(Z, A)}{A^{2/3}} \quad (5)$$

here above terms represent volume, surface, asymmetry, coulomb, and pairing energies, respectively, and $I = a_a(Z-N)$, $a_a=1.0$. Respectively, for even-even, even-odd, and odd-odd nuclei $f(Z, A) = (-1, 0, 1)$.

The shell corrections in accordance with Myers and Swiatecki formula [11]

$$\delta U = C \left[\frac{F(N) + F(Z)}{(A/2)^{2/3}} - cA^{1/3} \right]$$

$$\text{here, } F(X) = \frac{3}{5} \left(\frac{M_i^5 - M_{i-1}^5}{M_i - M_{i-1}} \right) (X - M_{i-1}) - \frac{3}{5} \left\{ X^5 - M_{i-1}^5 \right\} \quad (6)$$

Where $X=N$ or Z , $M_{i-1} < X < M_i$ and M_i as the magic numbers 2, 8, 20, 28, 50, 82, 126 and 184 for both neutrons and protons. The constants are $C = 5.8$ MeV and $c = 0.26$.

The temperature-dependent shell corrections in equation (4) vanish exponentially for higher excitation energies. Therefore, only the liquid drop part is present at higher energies because shell corrections vanish completely.

The penetrability, P , calculated as the WKB tunneling probability, both dependent on T and l

$$P = \exp\left[-\frac{2}{\hbar} \int_{R_a}^{R_b} \{2\mu[V(R) - Q_{eff}]\}^{1/2} dR\right] \quad (7)$$

3. Result and Discussion

The Fig. 1(a-d) presents preformation profile (P_0) of favored fragments of the CN (a) $^{24}\text{Mg}^*$, (b) $^{25}\text{Mg}^*$, (c) $^{26}\text{Mg}^*$, and (d) $^{27}\text{Mg}^*$ at two extreme values of Temperature (T_1 and T_2) and $l = l_c$. The value of T_1 is 3.01 MeV, 3.09 MeV, 3.17 MeV, 3.37 MeV, and T_2 is 3.208 MeV, 3.261 MeV, 3.348 MeV, 3.521 MeV, differentiated by the red sphere and green triangle, for $^{24}\text{Mg}^*$, $^{25}\text{Mg}^*$, $^{26}\text{Mg}^*$, and $^{27}\text{Mg}^*$, respectively. It is observed in Fig. 1 that when we move from Fig. 1(a) to 1(d), i.e., from $^{24}\text{Mg}^*$ to $^{27}\text{Mg}^*$, respectively, the light particles (LPs) ($A \leq 4$) start becoming more favored or probable. Note that some LPs change on going from $^{24}\text{Mg}^*$ to $^{27}\text{Mg}^*$. The ^1H channel of $^{24}\text{Mg}^*$ is more dominant and is replaced by $1n$ in the case of $^{25,26,27}\text{Mg}^*$; the more performed ^2H is present in $^{24,25}\text{Mg}^*$ and is replaced by $2n$ as we go to $^{26,27}\text{Mg}^*$. In the case of $^{27}\text{Mg}^*$, $3n$ has more value of P_0 in place of ^3H . The overall increase in the P_0 of LPs is almost the same. Another observation is that, firstly, LPs compete with symmetric mass fragments (SMFs), mostly with C fragments. The competition between LPs and SMFs decreases going from Fig. 1(a) to 1(d), or LPs start being a more probable exit channel.

On comparing Fig. 1(a) and Fig. 1(b), it is observed that moving from paired $^{24}\text{Mg}^*$ to unpaired $^{25}\text{Mg}^*$, LPs start playing a dominant role. Continuing to Fig. 1(c) from Fig. 1(b), the LPs $1n$ and ^4He have more P_0 in $^{25}\text{Mg}^*$, and $2n$ and ^3H have more P_0 in $^{26}\text{Mg}^*$, which results in almost the same P_0 . Further moving from Fig. 1(c) to Fig. 1(d), i.e., from paired $^{26}\text{Mg}^*$ to unpaired $^{27}\text{Mg}^*$, we observe that LPs $1n$, $2n$, and ^4He start having more preformation probabilities. On moving to a higher T value, i.e., $T = T_2$, the preformed fragments are similar; the only difference is the increase in the magnitude of the P_0 . These effects are more visible from fusion cross sections (σ_{fus}), i.e., from Fig. 2.

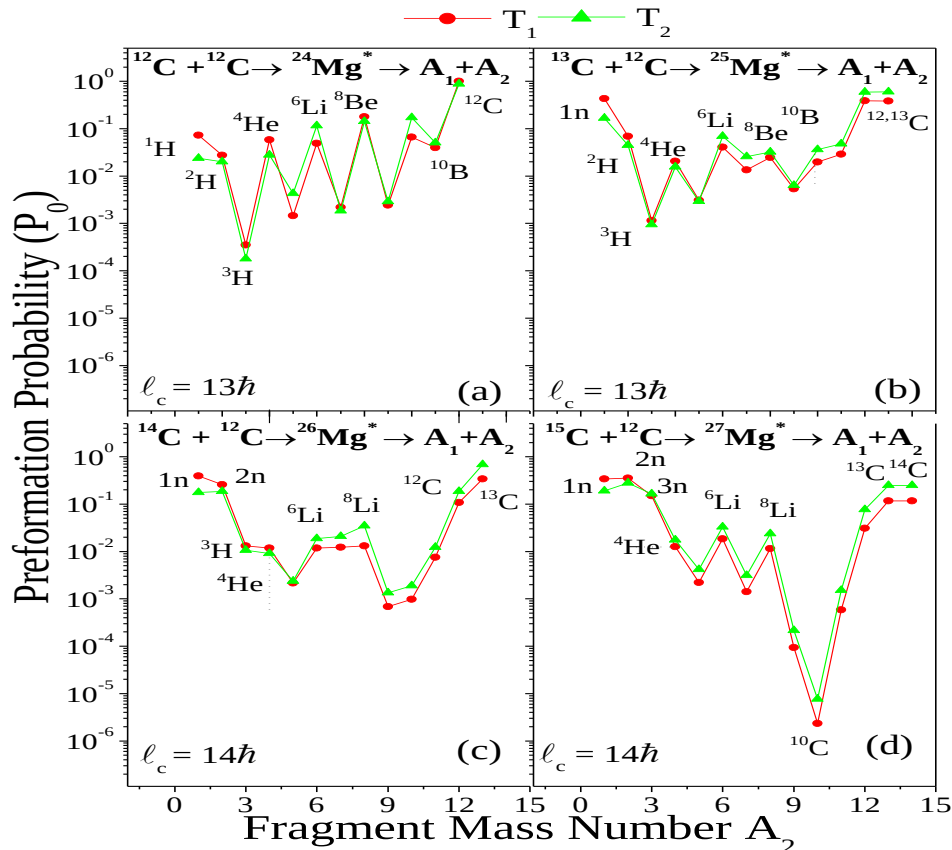


Fig.1: The Preformation profile (P_0) as a function of Fragment Mass Number A_2 of the CN (a) $^{24}\text{Mg}^*$, (b) $^{25}\text{Mg}^*$, (c) $^{26}\text{Mg}^*$, (d) $^{27}\text{Mg}^*$ at two extreme values of Temperature (T) and $l = l_c$.

Fig. 2 presents DCM calculated fusion cross sections (σ_{Fus}) for the compound nuclei $^{24-27}\text{Mg}^*$ at two different energies or T values and their comparison with the available experimental data [5]. The filled red circle represents the present experimentally available σ_{Fus} . And hollow black square represents DCM calculated σ_{Fus} . It is observed that a fusion enhancement is observed for both T values as we go from CN $^{24}\text{Mg}^*$ to $^{27}\text{Mg}^*$. Moving from paired CN $^{24,26}\text{Mg}^*$ to an unpaired CN $^{25,27}\text{Mg}^*$, this fusion enhancement is greater than the transition from an unpaired $^{25}\text{Mg}^*$ to a paired neutron nucleus $^{26}\text{Mg}^*$. Further, moving to higher T -values, similar observations of fusion enhancement from paired to unpaired CN and small change in σ_{Fus} from unpaired to paired CN are present. There is the only difference is in increased values of σ_{Fus} for $^{24-26}\text{Mg}^*$. This change in magnitude is small for $^{27}\text{Mg}^*$ maybe due to the presence of more unpaired neutrons in case of it. This indicates the influence of T on fusion cross sections of $^{12,13,14,15}\text{C} + ^{12}\text{C}$ induced reactions.

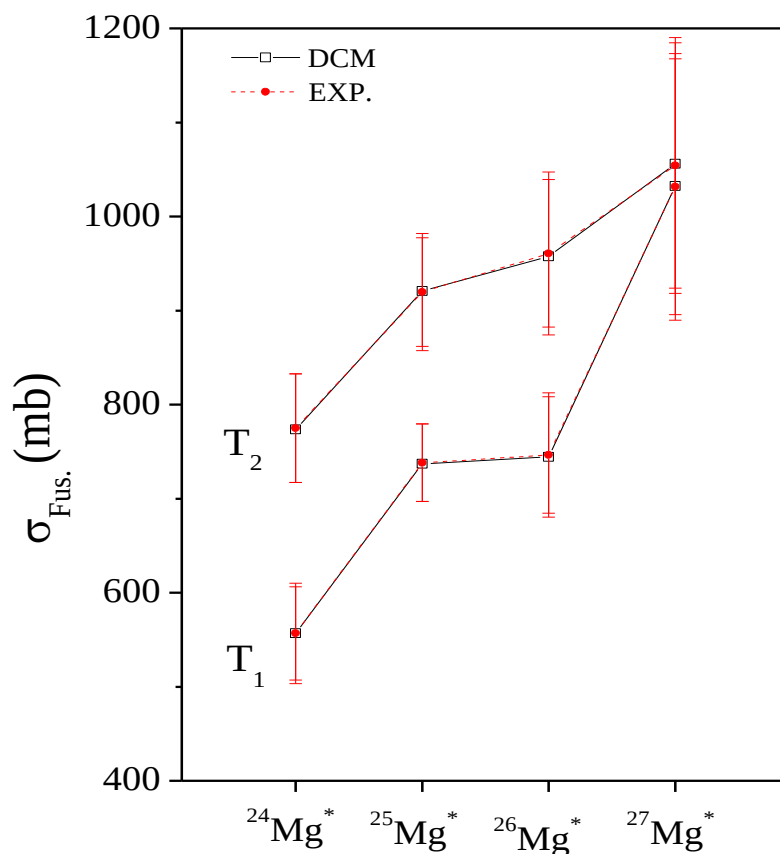


Fig.2: The fusion cross section (σ_{Fus}) for the compound nuclei $^{24-27}\text{Mg}^*$ at two different energies or T values T_1 and T_2 , and their comparison with the available experimental data [5].

The σ_{Fus} are in good agreement with experimental data [5] and almost in the error bars.

4. Summary

From the preformation profile (P_0) and fusion cross sections (σ_{Fus}), it is clear that a fusion enhancement is observed as we go from compound nuclei (CN) $^{24}\text{Mg}^*$ to $^{27}\text{Mg}^*$. On moving to higher Temperature (T) values, similar results are present. The fusion enhancement is observed and has more magnitude on going to unpaired CN $^{25}\text{Mg}^*$ and $^{27}\text{Mg}^*$ as compared to paired CN $^{24}\text{Mg}^*$ and $^{67}\text{Mg}^*$. The change in T values significantly enhances the P_0 and σ_{Fus} of the low-energy neutron-rich light mass compound nuclei $^{24,25,26,27}\text{Mg}^*$ induced by $^{12,13,14,15}\text{C} + ^{12}\text{C}$ fusion reactions, respectively. We can further explore the effect of temperature on different constituents of the fusion cross-sections.

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A review on Multifunctional Gemini Surfactants with several uses: Structure, Synthesis, Properties and their applications

Meenu, Manoj Kumar, Kevinkumar Jesadiya

University Institute of Sciences, Department of Chemistry, Chandigarh University, Gharuan, Mohali, Punjab, India.

gulsatyameenu420@gmail.com

Abstract

Gemini surfactants, commonly referred to as dimeric surfactants or Gemini amphiphiles, belong to the type of surfactants that are made up of two hydrophilic head groups and two hydrophobic tail groups connected by a spacer group. They were originally produced in the 1990s, and since then, they have gained a lot of attention because of their particular properties and possible usage in a range of sectors, including materials science, cosmetics, and therapeutics. The critical micelle concentrations (CMCs) of Gemini surfactants are known to be lower and their surface activity to be larger than those of conventional surfactants. They also exhibit increased solubilization and emulsification characteristics, making them suited for utilization in personal care products, detergents, and drug delivery systems. The length and composition of the spacer group, as well as the size and makeup of the head and tail groups, may all be adjusted to modify the structure of Gemini surfactants. Due of this, surfactants may be developed with particular features and capabilities. Despite their potential benefits, Gemini surfactants have several downsides and challenges, such as a relatively high production cost and possible toxicity. Nonetheless, further investigations are being done to solve these difficulties and learn more about how these specific surfactants may be employed in other scenarios.

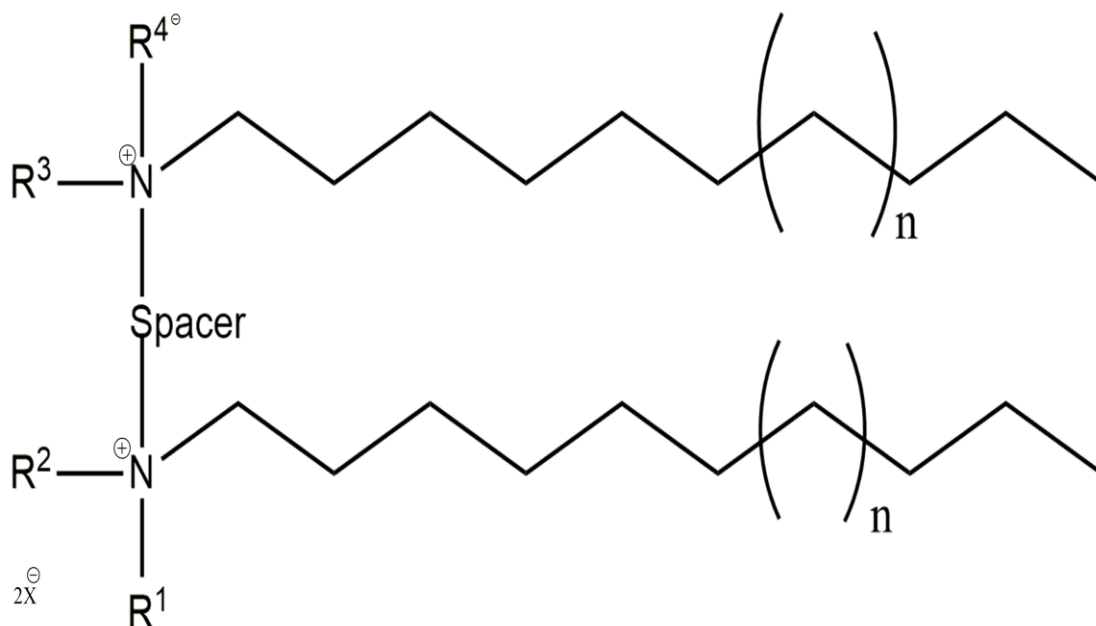
Keywords: Gemini surfactant, aquatic toxicity, nanoparticles, CMC, biocorrosion,

Introduction

Everything on the planet is comprised of synthetics and science. Surfactants are one of the most significant and seemingly irreplaceable chemical compounds [1]. Two hydrophobic chains are connected by a shorter, longer, stretchy spacer at or near the head groups to form gemini surfactants. The distinctive physicochemical qualities and characteristics of gemini surfactants, such as reduced cmc value, and biodegradability, make them preferable to their similar counterpart single surfactants. Surfactants are commonly used as emulsifiers, dispersants, wetting agents, sanitizers, erosion inhibitors in a variety of goods and also in various industrial processes [2-4]. Surfactant particles include both hydrophobic and hydrophilic moieties. A polar or ionic hydrocarbon is a hydrophobic moiety, whereas a straight or stretched hydrocarbon is a hydrophilic moiety [5]. Gemini surfactants self-aggregate at higher concentrations, resulting in the formation of structures which is called as micelles. The cmc is a concentration of surfactants required for micelle synthesis.

In addition to fabric softeners and corrosion inhibitors, gemini surfactants are used as detergents, anti-foaming agents, and bactericidal agents. So far, gemini cationic surfactants featuring pyridinium, imidazolium, pyrrolidinium, piperidinium, and amino acid moieties have been synthesised and investigated.

The fundamental property of amphiphiles is the base for their broad scope of functional applications. Surfactants are utilized in every part of our day to day routines [6]. They are used in detergents, materials science, textiles and leather [2], personal care goods [7], paint and coatings additives [8], improved and tertiary oil recovery in the petroleum sector [9-11]. Surfactants may also play a part in the improvement of nanotechnology [12]. Gemini surfactants are therefore utilised as stabilisers for nanofluid systems and to increases the surface property of nanoparticles.

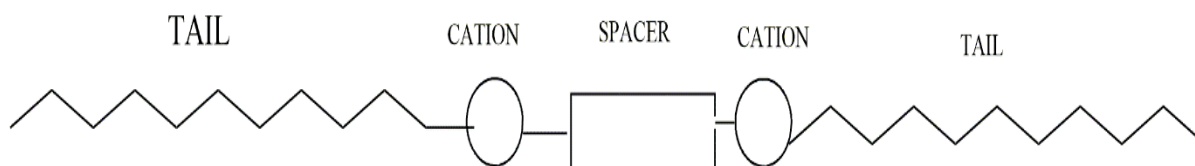


1. Structure

Gemini surfactants are composed of two hydrophilic head groups and two hydrophobic tail groups, which are joined at the head groups by a spacer. Gemini surfactant creates symmetric structure when both hydrophobic portions and hydrophilic groups are identical [13]. The substituents in gemini surfactants are largely responsible for their behaviour in solution and its applications.

Quaternary nitrogen atoms are often found in acyclic forms; nevertheless, there are several geminis with nitrogen included in saturated and unsaturated rings. Compounds containing nitrogen in the annulene unsaturated ring have a unique character because the ring acts as a spacer to some extent [14].

The spacer might be stiff or flexible, having a hydrophobic or hydrophilic propensity. It's a crucial component of gemini surfactant, since it controls adsorption on surfaces and interfaces, as well as the production of self-assembly aggregates. The presence of counterions, which might be organic or inorganic, keeps the molecule's neutral charge. To achieve the expected characteristics of gemini surfactants, the structure must be adjusted using HLB modification [15].

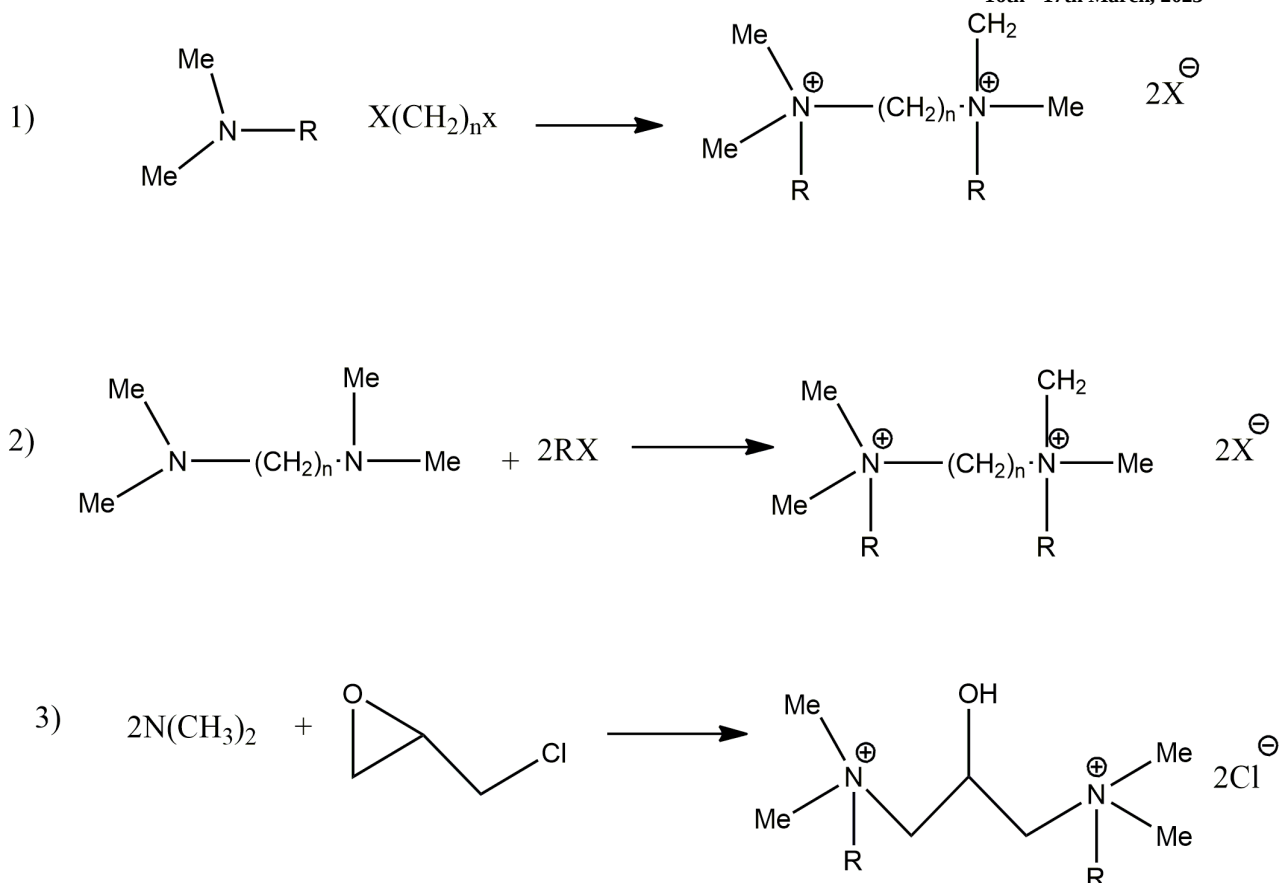


2. Synthesis

There are three basic requirements for obtaining symmetric gemini surfactants:

- (1) The reaction of long-chain tertiary amines with dihalogenated substrates such as organic dichlorides,
- (2) Alkyl halide reaction of N,N,N',N'-tetramethylpolymethylene diamines
- (3) The interaction of long-chain tertiary amines with haloalkylene oxide substrates such as epichlorohydrin.

The product of gemini surfactant is entirely dependent on the reactivity of dihalogenoalkanes [16].



3. Gemini surfactant structural variation and physicochemical characteristics

In gemini surfactants, a spacer group connects two similar or different monomeric amphiphilic moieties, leading to a wide range of structural variations. As a result, gemini surfactants is divided into subclasses according to the hydrophobic chain length, its chemical composition, and flexibility or structure of the spacer. The headgroup is an anionic surfactant, nonionic surfactant, or cationic surfactant in terms of chemical structure.

3.1 Gemini surfactant classification based on headgroup variation

Gemini surfactant features two of the headgroups, and it is anticipated that headgroup variance would significantly affect aggregation activity. Gemini surfactants are further classified into three types of headgroups: cationic gemini surfactant, anionic gemini surfactant, and nonionic gemini surfactant [Fig] [17-19].

3.1.1 Gemini Cationic Surfactants

Cationic surfactants are utilised to solve a variety of stabilising issues and have a wide range of technical uses. Conditioners, beauty care products, electro-dicoatings, and the adjustment of tacky polymer latexes, just as mining and production of paper, all are utilized in cationic surfactants [20-21]. In addition to these QACs, various studies are present which helps in focusing on gemini surfactants with cationic heterocyclic headgroups such as imidazolium, pyridinium, pyrrolidinium, and piperdinium. Such compounds were added to gemini surfactants to increase their physicochemical qualities [22-24].

Due to their antimicrobial characteristics, cationic surfactants are utilized as sanitizers, antibacterial, and antifungal agents in the treatment of human illnesses [25-27].

The cmc value decreases as the hydrophobic chain and spacer lengths increases [28-29].

3.1.2 Gemini Anionic Surfactants

These surfactants were recognized through infrared as well as electrospray ionization-mass spectrometry [30].

When compared to regular surfactants, the cmc of these gemini surfactants was considered exceptionally small, and cmc decreased as the spacer length increased [31]. The physicochemical characteristics of anionic heterogemini surfactants with phosphate headgroups have been created and analyzed from various approaches. The reduction in basic total focus is because of an increment in hydrophobicity and level of dissymmetry [32].

3.1.3 Gemini Nonionic Surfactants

Generally manufactured from sugars, nonionic gemini surfactants exhibit more interesting qualities of sustainability and environmental safety [33].

The total conduct of these nonionic gemini surfactants shifts relying upon the size of the hydrophilic gathering [34].

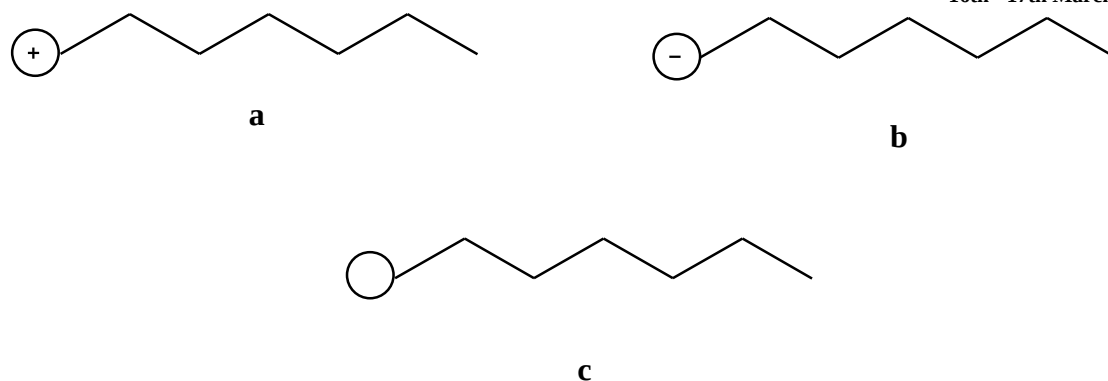
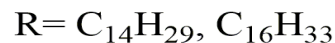
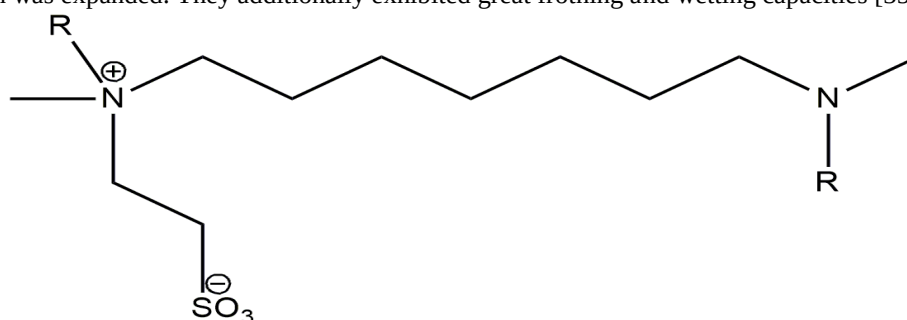


Fig Gemini Surfactant on the basis of charge on their head group: a) Cationic b) anionic c) non-ionic

3.1.4 Surfactants with Gemini dissymmetry

Owing to its unique physiochemical properties, the CMC was displayed to increment as the length of the alkyl bunch was expanded. They additionally exhibited great frothing and wetting capacities [35].



4. Surface Properties

Surfactant's capacity to adsorb at points of interaction or interfaces is one of their most essential properties. As a result of their dual chemical nature, it results in reduction of surface tension [36].

Temperature is also another aspect that influences aggregation behaviour. As the temperature rises, CMC drops to a minimum of roughly 25°C, and as the temperature rises more, CMC rises [37].

5. Biological Processes

Microorganisms play a vital role in many biotechnological along with metabolic processes. They cause deaths and diseases, and the bio-deterioration of specific resources including wood, metal, stones, and steel. Numerous phenols and their derivatives, natural as well as synthetic halogen compounds, oxidising synthetic material and organic and inorganic acids are examples of microbiocides [38].

Gemini surfactant's natural movement depends upon the kind of microscopic organisms. Gram-positive microorganisms are more delicate to ammonium microbiocide than Gram-negative microscopic organisms. Gram-positive microscopic organisms' membrane is comprised of peptidoglycan layers that are effectively infiltrated by surfactant, and Gram-negative microorganisms' cell membrane layer is generally comprised of lipopolysaccharides and proteins, which confine microbiocides from entering [39, 40].

6. Anticorrosion Activity

Corrosion is the disintegration of a material's properties caused by associations between a surface and its current state, leading to changes in the material's properties due to disruption of the material's structure. Corrosion damages the surfaces of metals such as copper, iron, and aluminium, as well as nonmetallic materials such as concrete, glass, paper, and wood [41]. Acids, which are often employed in industry, cause corrosion. Corrosion is a costly and harmful process that has a significant economic and safety impact [42].

The petrochemical business consumes the most corrosion inhibitors in view of cationic gemini surfactants. The use of particular formulas results in a lower rate of corrosion and long-term protection against deterioration [43].

7. Biodegradability

Many tests have been directed to decide the awareness of gemini surfactants to biodegradation. Essential biodegradation is described as an adjustment of a substance's compound construction that influences its characteristics, though last biodegradation is characterized as mineralization to CO₂, mineral salts, and biomass.

The expanded natural action of cationic gemini surfactants could make biodegradation more tough. The biodegradability of geminis is unaffected by changing the spacer to expand the hydrophilicity of the surfactant particle [44].

Surfactants using sugar substitutes have a biodegradation vulnerability of 20 percent to 32 percent. The lesser will be the biodegradability, the longer will be the hydrocarbon substituent or spacer [45]. The work of an immobilized consortia of microorganisms in Ca-alginate globules is one more method for working on the biodegradability of cationic surfactants [46]. This approach was utilized using monomeric cationic surfactants, however it's likely that it may likewise be utilized with gemini surfactants [47].

8. Applications of Gemini Surfactants with Multiple Functions

In terms of their characteristics and ability to interact with a variety of different substances, gemini surfactants are preferred over monomeric surfactants. Gemini surfactant's structural variety can be fine-tuned to get the desired physical and chemical characteristics for specific applications.

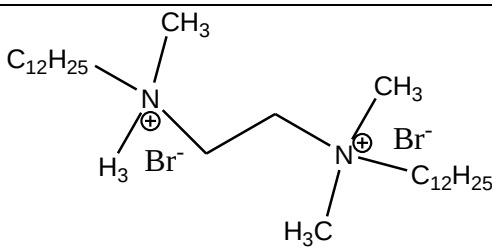
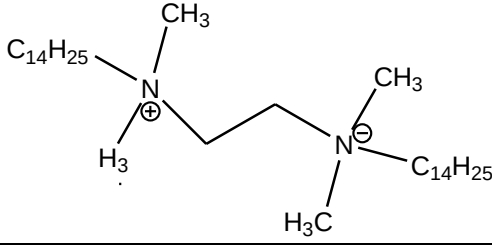
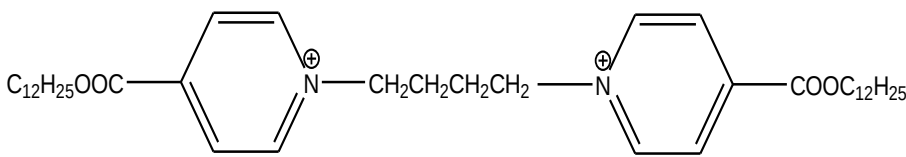
8.1 Drug Nanocarriers

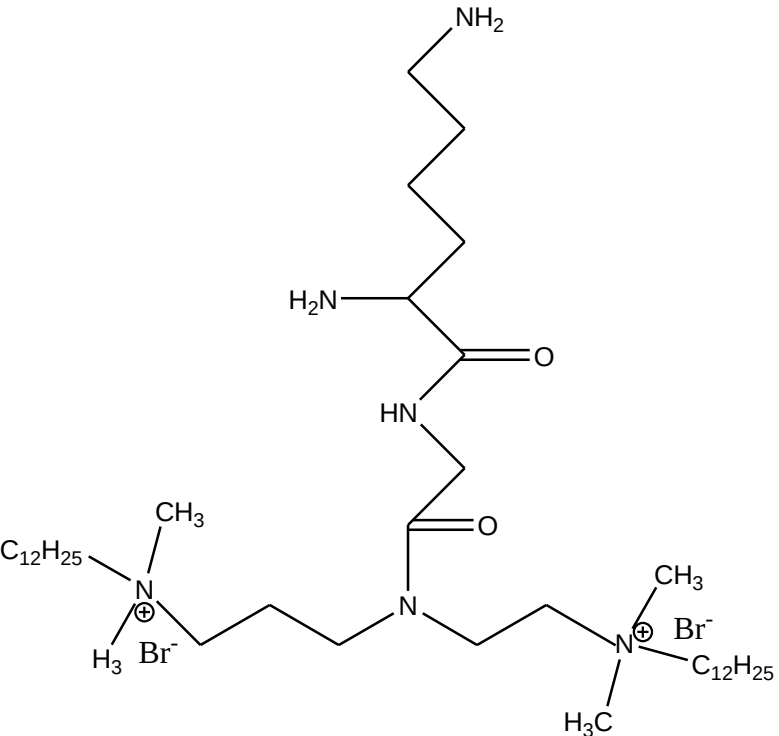
Surfactants in the gemini family can quickly modify their morphological structures in light of pH, high temperature, and salt [48].

The reversible conversion of micelles to other forms, can be done for drug conveyance by changing pH. One study demonstrated that amino corrosive of gemini surfactant, whose potential of hydrogen is the primary determinant of accumulation behaviour, may be used to create colloidal frameworks for transporting hydrophobic drug [49].

8.2 Inhibitor of Corrosion

In contrast to $C_{2n}H_{4n+2}O_{n+1}$, which functions as an aqueous lubricant, gemini surfactants were shown to be effective anticorrosive specialists, friction reducers, and corrosion inhibitors. These surfactants were created by reacting dibasic acids like propanedioic acid, pentanedioic acid and hexanedioic corrosive with $C_6H_{15}NO$. The weight loss, corrosion rate, and thickness reduction of test specimens made of carbon steel were used to evaluate their corrosion behaviour. The incorporation of gemini surfactants altogether decreased the consumption rate, as per the information acquired from these boundaries [50].

Chemical structure	Application	Ref.
	Drug delivery	51
	Drug delivery	52
	Surface modification	53

	Gene carrier	54

8.3 Gene Therapy

Because of their ability to associate with DNA, Gemini alkyl ammonium surfactants are utilized to bring qualities into cells [55].

The gemini surfactant has been exhibited to proficiently tie and gather DNA, shaping a "lipoplex." Many cell types' external layers can be entered by the lipoplex, which then, at that point, shows up in the cytoplasm encased inside endosomes. Changes in the lipoplex's aggregation behaviour as the pH drops may control escape from the endosome. DNA from the lipoplex might be delivered prior to entering the core, permitting the new quality to be communicated proficiently. As gene transfection vectors, sugar-substituted gemini surfactants with peptide moiety were tried [56].

8.4 Bioimaging

When a stable fluorescent marker is required for cancer diagnosis, bioimaging is a very useful approach. Geminis are great stabilizers for model hereditary material produced using DNA and polysaccharide [57].

8.5 Environmental protectors

Gemini surfactants are extremely useful in environmental cleanup because of their unique underlying variations and distinctive qualities, for example, a remarkably low basic micellar fixation, low Kraft temperature, exceptional rheological capabilities, and remarkable wetting capacity. These are utilized to eliminate hydrophobic natural impurities, heavy metals from the dirt during recovery of soil [58].

It has been observed that bromoanalogues of such gemini surfactants are superior toward chloroanalogues in their ability to remove dye due to the increased hydrophobicity of the counterions [59].

8.6 Interaction with proteins

The interactions of gemini amino acid-based surfactants with proteins likewise been considered. This kind is supported for understanding the movement of surfactants as protein denaturants and solubilizers, which is huge in the clinical and restorative fields. Gemini surfactants got from glutamic corrosive connect with hemoglobin uniquely in contrast to their single-chain partner. Because of their bigger size, gemini surfactants had a lower capacity to denaturize hemoglobin, and the level of denaturation diminished as the spacer length rose. The auxiliary design of hemoglobin can likewise be balanced out when the degree of gemini surfactants is low [60].

8.7 Applications of gemini surfactants electrochemically

In electroanalytical chemistry, gemini surfactants are used to modify the surfaces of electrodes in order to increase transfer of electrons and also increase electroanalysis's sensitivity [61].

8.8 Nanoparticles

Nanoparticles are utilized in an assortment of fields including medication, material science, optics, and hardware. Nanoparticle qualities and utilizations are vigorously affected by their size and shape [62].

UV-vis strategies was utilized to describe the nanoparticles. Contorted intramolecular charge move was utilized to distinguish the direction of gemini surfactant particles on metal nanoparticles. As gold(III) is converted to

gold(I), the electrostatic charge between gemini surfactants head groups significantly decreases, enabling the formation of vesicles. This process can be used to create gold nanostructures that could be useful in a variety of applications [63, 64].

Future Aspects

- Despite the fact that several articles on the production of gemini surfactants likewise been published in the literature over the very past 10 years, it is still necessary to investigate new synthesis techniques.
- Significant study will be carried on the production and several uses of unique gemini surfactants with enhanced physiochemical characteristics.

Conclusion

When compared to single chain surfactants, gemini surfactants are amphiphilic molecules with more developed physiochemical properties. These surfactants are three times more effective than normal surfactants at lowering surface pressure and two times more effective at delivering micelles. Despite the fact that there have been various publications on the manufacture of gemini surfactants likewise been published in the literature in the very last ten years. In the context of environmental issues, the production of gemini surfactants with higher biodegradability along with lower cytotoxicity from inexhaustible resources is particularly intriguing for developing sustainable and realistic science. Much more research will be conducted into the synthesis. Due to their structural versatility, gemini surfactants are intriguing drug delivery agents.

The purpose of this review is to understand the combination, characterization, and utilizations of gemini surfactants. A few qualities of cationic gemini surfactants were talked about in this review. The low cmc and incredible effectiveness of these surfactants in diminishing water surface strain are of interest. Aside from that, cationic geminis have intriguing antibacterial characteristics that could be useful in the future.

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Adsorptive removal of Cadmium ions using chitosan-based adsorbents from the aqueous streams***Navneet Kaur Bhullar, **Devyanshu Sachdev****Department of Chemical Engineering, University Institute of Engineering, Chandigarh University, Mohali, Punjab, India, 140413****Dr Shanti Swarup Bhatnagar University Institute of Chemical Engineering and Technology, Panjab University, Chandigarh, India, 160014
devyanshusachdev@gmail.com***Abstract**

The chitosan was modified using solvothermal synthesis for the preparation of the adsorbent and in which the reaction parameters as a function of percentage grafting were optimized such as the amount of solvent, concentration of initiator, cross-linker, monomer and reaction time. The optimum conditions for grafting parameters were observed at 10 mL acetic acid, time of 60 minutes, initiator concentration of 0.45×10^{-2} mol/L, monomer concentration of 0.2 mol/L and crosslinker concentration of 1.75×10^{-4} mol/L. The maximum eradication of 99.99% and 99.99% using CAI and CAIC at pH 6, time 120 minutes, dose 100 mg/L and metal concentration of 10 mg/L after attaining adsorption optimizing parameters.

Keywords: chitosan, percentage grafting, adsorption optimizing parameters

1. Introduction

Heavy metals (HMs) are common non-biodegradable pollutants that are frequently used in a variety of sectors and released into the atmosphere through runoff. HMs are substances with densities greater than 5 g/cm^3 pollutants that are acquired from both anthropogenic and non-anthropogenic sources [1]. The first category consists of Mn, Fe, Cd, Hg, Pb and As. Cadmium ranks seventh among the most toxic HMs and permanently damages the environment. The chemical element cadmium is represented by Cd and had atomic number of 48 [1]. The electroplating, smelting, alloy production, pigment production, plastic production, battery production, mining and refining operations are the main sources of Cadmium release into the atmosphere by waste streams [2] which is further linked to numerous adverse health impacts in humans, including kidney problems, lung dysfunction, bone lesions, cancer and hypertension [2]. Precipitation, ion exchange and adsorption, three popular approaches for eliminating cadmium from wastewater, do not have a high enough affinity or selectivity to lower residual cadmium to the amounts required by increasingly strict governmental regulations [3]. Due to this circumstance, there has been an increase in interest in using biomaterials to eradicate trace quantities of toxic metals and industrial dyes from aqueous streams [4–7].

The present paper focuses on the adsorptive removal of Cadmium using chitosan-based semi-interpenetrating polymer networks which were synthesized by optimizing parameters for percentage grafting which was used as an adsorbent by optimization of adsorption parameters such as pH, temperature, dose, initial dye concentration and time.

2.1. Materials

The chitosan (analytical grade) was purchased from Himedia Chemicals, Mumbai whereas SD Fine Chemicals, Mumbai supplied acetic acid and acrylic acid. Cadmium Nitrate (Merck, Germany) was used to prepare the Cadmium stock solution using millipore water. The pH of the solution was adjusted using 0.1 M NaOH and 0.1 M HCl (Fluka, USA) solutions. In the preparation of buffers, and solutions and during polymerization millipore water was used.

2.2. Solvothermal-assisted synthesis of biopolymer chitosan-based materials

The SIPN hydrogel based on chitosan was obtained by the in-situ polymerization reaction of acrylic acid (AA) monomer in the presence of chitosan by using thiourea as a cross-linker. The initiator used was potassium persulphate (KPS). The reaction mixture was poured into the reaction flask and was subjected to high pressure at 7 psi pressure for 60 minutes. The synthesized gel obtained was washed properly with warm Millipore water to

remove unreacted monomer followed by drying in the oven at 60°C till a constant weight was obtained. The product yield was recorded in terms of percentage grafting (P_g).

2.3. Optimization of reaction parameters influencing the synthesis of SIPN as a function of percentage grafting (P_g)

The different reaction parameters like the amount of solvent, reaction time initiator, monomer and crosslinker concentrations were optimized w.r.t. percentage grafting to obtain the maximum yield.

2.4. Adsorption Experiments

The adsorption experiments for the chitosan-based adsorbents (CAI and CAIC) were used for the eradication of Cadmium from aqueous streams. An electric magnetic stirrer was used to conduct the tests. A measured volume of dye solution was combined with a measured amount of adsorbent. These experiments were carried out in a controlled environment. Then, a spectrophotometric method was used to measure the concentration of Cadmium (UV-3100PC spectrophotometer). The quantity of adsorption at equilibrium (q_e) was calculated using Equation 1 as the amount of sorbate per gram of adsorbent (mg/g).

$$\text{Amount of adsorption } (q_e) = \frac{(C_i - C_f)}{W} * V \dots \dots \dots (1)$$

The percentage removal of Cadmium was carried out using Equation (2) [8]:

$$\text{Percentage Removal of Metal} = \frac{C_i - C_f}{C_i} * 100 \dots \dots \dots (2)$$

3. RESULTS AND DISCUSSIONS

3.1. Optimization of reaction parameters affecting the synthesis of the material as a function of percentage grafting (P_g)

- 3.1.1. Effect of amount of solvent on percentage grafting: The solvent's amount plays an important role in the grafting of polymers. **Fig 1** shows maximum P_g was observed with 10 mL of solvent and a further increase in solvent results in a decrease in P_g . The dependence of solvent can be explained based on OH and SO_4^{2-} concentration, which is sufficient to propagate the polymerization reaction till optimum concentration is reached and a further increase in the amount of solvent results in the termination of polymerization. The influence of solvent (acetic acid) on P_g was studied by varying the solvent volume from 10 to 30 ml of 3% acetic acid solvent keeping other reaction conditions constant such as 10 mL of 5 mol/L acrylic acids, 10 ml of 0.025 mol/L of KPS, 5 mL of 0.0025 mol/L of thiourea at 30 min of reaction time in autoclave maintained at a 7 psi pressure for 0.5 g of chitosan. The maximum percent grafting (666%) was observed in 10 mL of solvent. Further reduction in percentage grafting was obtained due to diffusion of the controlled nature of these reactions.

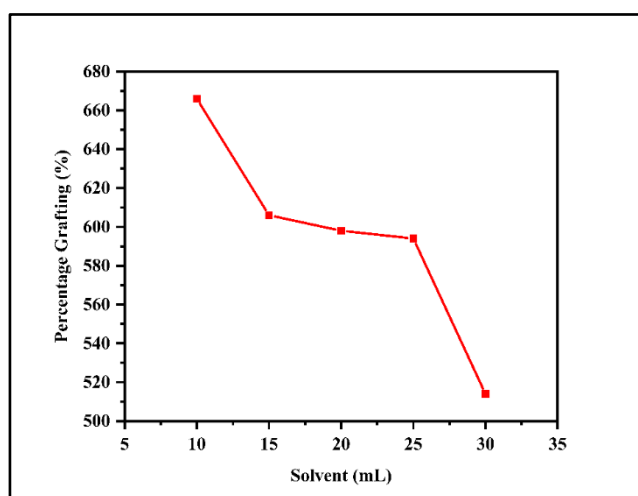


Figure 1: Effect of solvent on P_g

- 3.1.2. **Effect of concentration of initiator ($K_2S_2O_8$) on percentage grafting:** The effect of the concentration of initiator ((0.25 to 0.5) mol/L $\times 10^{-2}$) on grafting acrylic acid (0.05 mol/L) onto chitosan (0.5 gin 10 mL) by keeping other parameters constant is depicted in **Fig 2**. It was observed that there is an increment in the P_g upto 0.45×10^{-2} mol/L of KPS and maximum grafting was found to be 1224% which was due to the predominance of homopolymerization over graft polymerization and a further increase in volume led to decrease in P_g which was due to the generation of many more growing chains of acrylic acid at the same time increases the formation of homopolymer by mutual termination of growing polymeric chains.

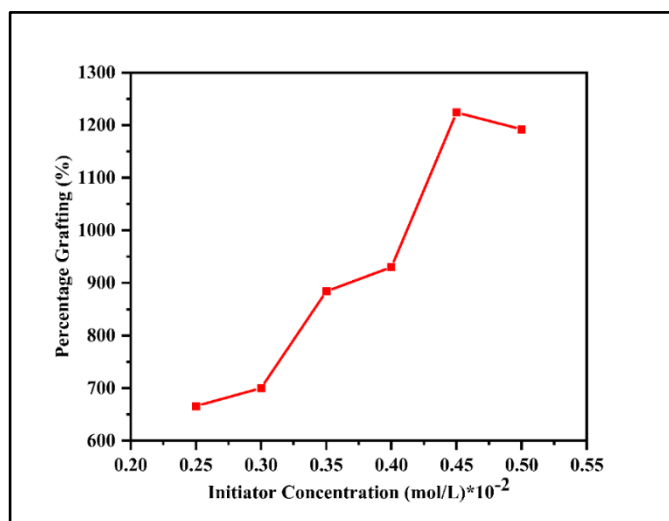


Figure 2: Effect of Initiator Concentration on P_g

- 3.1.3. **Effect of crosslinker (thiourea) on percentage grafting (P_g):** Thiourea was used as a cross-linker agent of the grafted product of chitosan acrylic acid and the effect of crosslinker on P_g is depicted in **Fig 3**. It was observed that P_g increased 1850% up to 1.75×10^{-4} (mol/L) of crosslinker but on increasing crosslinker volume further P_g decreased to 1124%. Therefore, the 1.75 (mol/L) $\times 10^{-4}$ of crosslinker was considered as the minimum necessary amount to crosslink the SIPN.

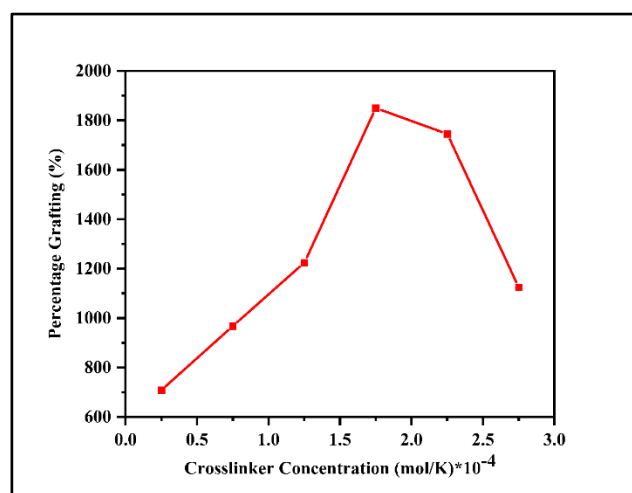


Figure 3: Effect of crosslinker concentration on P_g

- 3.1.4. **Effect of monomer (acrylic acid) on percentage grafting (P_g):** The influence of monomer concentration on the grafting of acrylic acid onto the chitosan is depicted in **Fig 4**. The concentration of monomer was varied from 0.05 to 0.275 mol/L keeping other parameters constant (10 ml of 3% acetic acid, reaction time (30 min), initiator concentration (0.45 mol/L $\times 10^{-2}$), crosslinker (1.75 mol/L $\times 10^{-4}$). The optimum P_g of 2870% was recorded at 0.2 mol/L of monomer concentration. The further increase in monomer concentration (0.225-0.275 mol/L), resulted in decreased P_g (2840-2637%) which was due to the termination of growing polymer chains of

acrylic acid to form homopolymers.

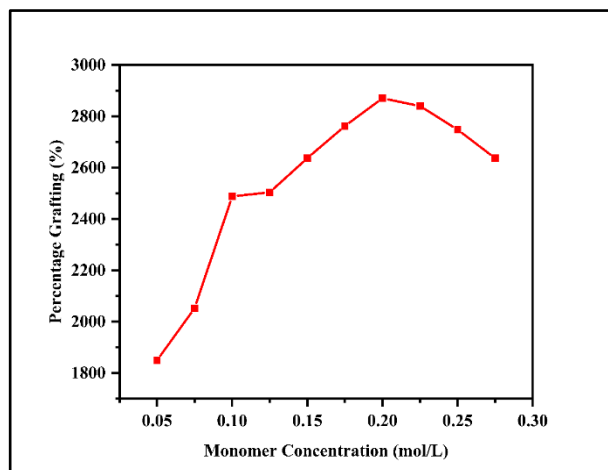


Figure 4: Effect of monomer on P_g

- 3.1.5. Effect of reaction time on percentage grafting (P_g): The influence of reaction time was observed for P_g from 30 to 120 min at 7 psi autoclave pressure and maximum P_g was observed to be 2992% at 60 minutes. On further increase in time, there was a decrease in P_g which is also depicted in **Fig 5**. The active sites on the backbone and monomer increase within reaction time resulting in enhanced grafting of a monomer onto chitosan. Beyond the optimum reaction time, the concentration of the free radicals limits the length of the polymeric chain by initiating numerous chains simultaneously, which results in decreased P_g .

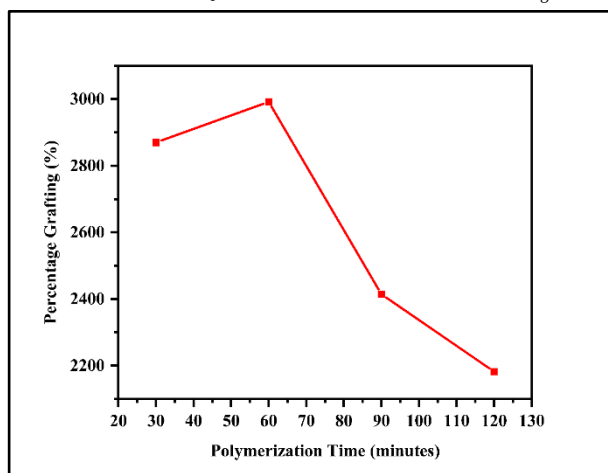


Figure 5: Effect of polymerization time on P_g

3.2. Adsorption Optimizing Parameters

- 3.1.1. Effect of pH: The influence plays an important role in the adsorption process which was investigated for a range of pH 2-6 at 100 RPM, time 120 minutes, dose 50 mg/L and concentration 25 mg/L and temperature 298 K which is depicted in **Fig 6 (a)**. It was observed that for CAI and CAIC, the removal percentage increased from 12.88% and 10.56% at pH 2 to 97.36% and 81.44% at pH 6 respectively. The experiments after pH 6 were not conducted due to the hydrolysis of Cadmium ions. Therefore, the pH was fixed at pH 6 for further optimization of adsorption parameters.
- 3.1.2. Effect of adsorbent dose: The influence of dosage was investigated at a pH 6, initial concentration 25 mg/L, temperature 298 K and time 120 minutes. for a range of dose of 25-500 mg/L which is depicted in **Fig 6 (b)**. It was observed that from 25-100, the removal percentage for Cadmium using CAI and CAIC increased from 51.2% and 64.44% at 25 mg/L to 98.66 at 100mg/L and 99.96% respectively. On increasing further, there was no significant range observed for the removal percentage. Therefore, the adsorbent dosage of 100 mg/L was fixed for the further optimization process.
- 3.1.3. Effect of initial dye concentration: The effect of initial concentration was investigated at dose 100 mg/L, temperature 298 K, 100 RPM, dose 100 mg/L for a range of 10-1000 mg/L which is depicted in **Fig 6 (c)**. It was observed that percent removal for CAI and CAIC decreased from 99.99 % and 99.99% at 10 PPM to 65.944%

and 54.4% at 1000 PPM respectively which also shows that the increase in metal concentration, the adsorption capacity increases but the percent removal decreases due to unavailability of active sites for the adsorption. Therefore, the maximum adsorption was attained at 10 mg/L.

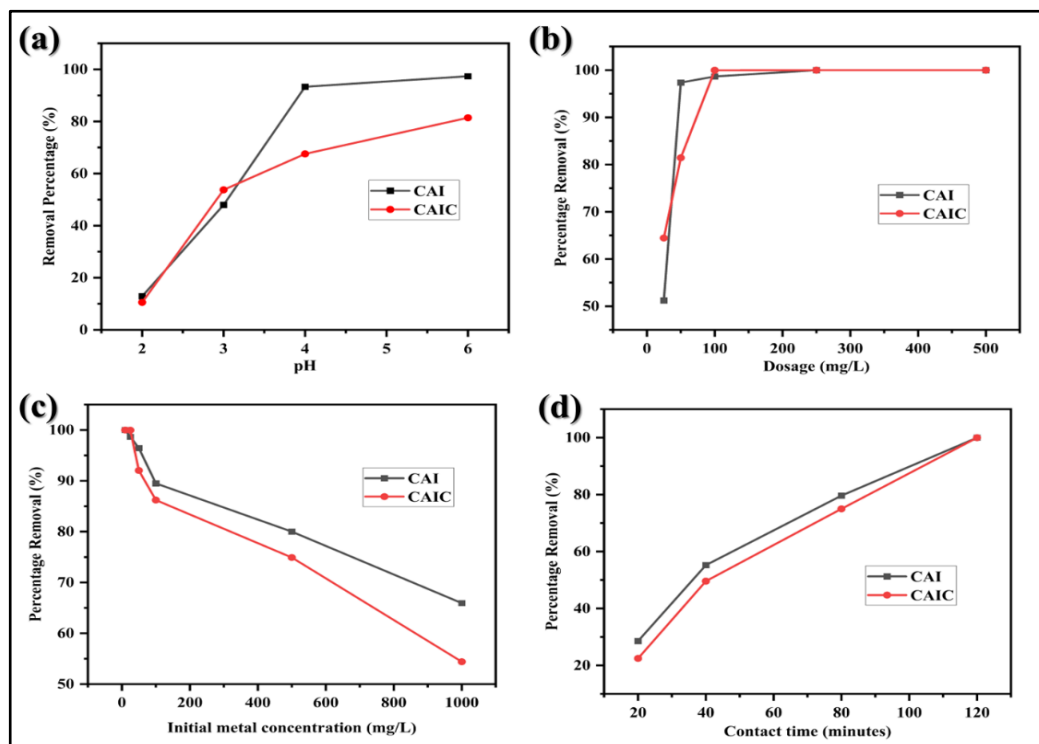


Figure 6: Effect of (a): pH; (b): dosage; (c): metal concentration; (d): contact time

- 3.1.4. **Effect of contact time:** The influence of contact time plays an important role in the adsorption process which was investigated at a time range of 20-120 minutes which is depicted in **Fig 6 (d)** and it was observed that for CAI and CAIC, the removal percentage was increased from 28.56% and 22.44% to 99.99% and 99.99% at 20 and 120 minutes respectively.

3.1.5.

4. CONCLUSION

The chitosan-based adsorbents CAI and CAIC were used to grafted using acetic acid (10 mL), reaction time (60 minutes), monomer concentration (0.2mol/L), initiator concentration (0.45×10^{-2} mol/L and cross-linker concentration 1.75×10^{-4} mol/L a maximum eradication of 99.9% was observed at pH 6, conc 10 PPM, dose 100 mg/L and time 120 minutes.

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CONFLICT OF INTEREST

The authors state that they have no known competing financial interests or personal connections that may seem to have influenced the work described in the publication.

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Machinability of Nimonic Alloys: A Review

***Jasanpreet Singh **Partap Singh Samra ***Amresh Kumar**

* Research Scholar ** Assistant Professor, Mechanical Engineering, Sri Guru Granth Sahib World University, Fatehgarh Sahib-India*** Department of Mechanical Engineering, CEC, Mohali-India
jsnsingh88@gmail.com

Abstract

Surface morphology (high precision, dimensional variation, and surface finishing) of machining products, since last few decades, has become increasingly important in a developed industrial sector, with the production rate influenced by the choice of input parameter. To achieve this goal, parametric prediction for improvement must be used. This paper discusses research on EDM (Electric Discharge Machining) of nimonic alloys, which are recognized for their high specific strength and corrosion resistance at high temperatures. This work could help future researchers by providing ready-to-use information and adding to the limited database on nimonic alloy EDM.

Nimonic Alloy: Importance and Properties

Figure 1 shows the variation of weight percent contribution of materials used in aero gas turbines with time. Nimonic alloys are highly engineered alloys which possess impact strength, high hardness, yield strength [2], resistant to creep [8], fracture toughness, and high strength to weight ratio and added advantage of properties like corrosion resistant [5] oxidation resistant, and resistant to scaling at higher temperatures [5-6]. Nimonic alloys are available with different trade names like Nimonic 75, Nimonic PE11, Nimonic PE16, Nimonic PK 33, Nimonic MP35N [4], Nimonic 80A, Nimonic 81, Nimonic 86 (ref 10), Nimonic 90, Nimonic 105, Nimonic 115, Nimonic 263, Nimonic C263 [2], Nimonic 901, Nimonic 942. Nimonic alloys are in demand in automotive sector [4], industrial sectors, aviation [6], aerospace sector [11], biomedical sector [12].

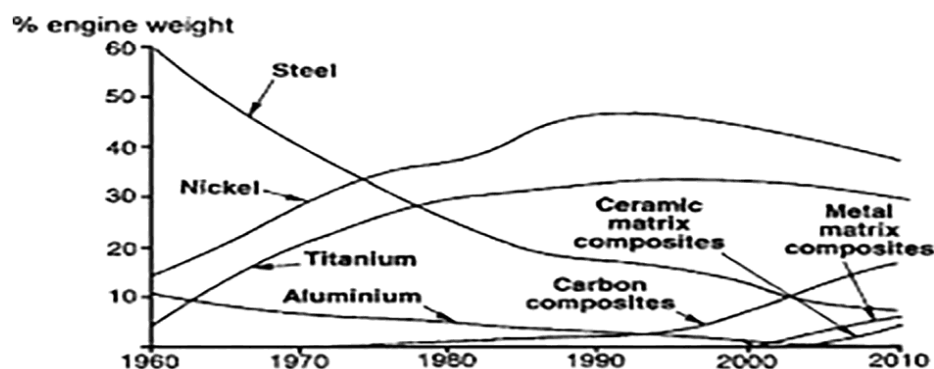


Fig 1: Variation of weight percent contribution of materials used in aero gas turbines with time [2]

Machining difficulties

The conventional machining methods are not quite successful for processing of Ni alloys. The tool wear is found to be high because of high temperatures strength offered by Nimonic alloys. At higher temperatures, the Nimonic alloys maintains higher strength (work harden) [16] which does not support the plastic deformation required for formation of chip and the thermal stress also rise because of low thermal diffusivity resulting to generation of high temperature at the tool tip, the hottest spot. This leads to tool wear at a faster rate [5,11]. Burr formation occurs due to notch wear at tool nose and the entire inset edge fractures. Chips having abrasive saw-toothed edges (due to the shear being localized) can weld with the tool material [6] resulting in formation of built-up edges due to adhesion, which is also accelerated by the hard carbide particles present in the work piece [14] and thus resulting in loss of material from tool and pronounced spelling [8], notching [2] on the face of the tool. This downgrades the machinability and also leads to failure of the cutting tool. Moreover, cutting under the same machining conditions, for work piece made of steel, it is seen that normal stresses acting on tool are half as that obtained while machining Nimonic alloys [8].

Due to the above-mentioned reasons, Nimonic alloys are referred as difficult to machine material and EDM is one of the most suitable techniques for machining of Nimonic alloys. Electrical discharge machining offers unique advantage of machining electrically conductive materials irrespective of their hardness and strength. EDM is an electro – thermal unconventional machining technique in which the material gets removed without any physical contact between the tool and work piece by the formation of sparks.

Applications

Nimonic alloys find applications in automotive sector which include manufacturing of components of gas turbine such as discs, rings and blades, power production sector [4-7], aerospace sector [11], biomedical sector [12] components of steam turbine on a large scale [13], manufacturing reciprocating internal combustion engine components [1], manufacturing exhaust valves used in automobiles, manufacturing inserts used in die casting, manufacturing fasteners used in aerospace industry, manufacturing heat treatment modules [14], heat exchangers, high temperature springs [12]. They are also preferred when the aesthetics is of prime concern [2]. The reason for their immense usage for the manufacturing of equipments used in aero engine sector [8].

Issue countered unconventional machining of Nimonic alloys

The thermal stress, which arises due to low thermal diffusivity, resulting in generation of high temperature at the tool tip, the hottest spot, as the Nimonic alloys maintain higher strength (work harden) [16] at higher temperatures, which does not support the plastic deformation required for chip formation. Tool wear is accelerated as a result of this [5, 11]. Burr formation is caused by notch wear at the tool's nose, as well as fractures throughout the entire inset edge. Chips with abrasive saw-toothed edges can weld with the tool material [6], resulting in the creation of built-up edges due to adhesion, which is exacerbated by the hard carbide particles present in the work piece [14], and therefore resulting in material loss from the chip. For the reasons stated above, nimonic alloys are considered difficult to mill materials, and EDM is one of the best techniques for machining nimonic alloys.

EDM of Nimonic

3.1 Die-sinking EDM

In Die-sinking EDM, the machined surface produced on the object is the mirror image of the shape of the tool. The tool axial movements and current, voltage and other conditions of the gap are monitored numerically by the control system [36].

3.2 Wire-cut EDM

In Wire-Cut EDM (WEDM), the electrode is a metal wire which runs at a particular speed (ref 37) and its dimension is generally in the range 0.005–0.03 cm [38]. WEDM theoretically came into limelight in 1968 and in 1975 it was used practically [38].

3.3 Micro-EDM

Micro-EDM (m-EDM) deals with the manufacturing of micro feature [40] and is one of the most preferred techniques for the same [41]. The electrode size is less than 1 mm. This work is attempt to make a review of the work carried out related to machining of Nimonic alloys using EDM process and is described under the following heads.

4. Detailed literature survey related to EDM of Nimonic alloys

4.1. Effect of process parameters on performance variables

The EDM process employs a variety of process parameters, which can be electrical or non-electrical in nature. Process parameters and their levels are typically chosen based on a literature review, pilot experiments, or availability as determined by the EDM machine manufacturer. Variables used to monitor the performance of the EDM process are referred to as performance variables. The magnitude of performance variables can be calculated using an experimental procedure, analytical equations, or directly using measuring instruments. This section describes the work done to investigate the effect of process parameter variation on response variables. This is required to gain an understanding of the EDM process and improve process performance.

In the EDM process, many process parameters are used, which might be electrical or non-electrical in nature. Process settings and levels are typically chosen based on a literature review, pilot experiments, or availability as determined by the EDM machine manufacturer. Variables used to monitor the performance of EDM processes are referred to as performance variables. The magnitude of the performance variables can be determined using an experimental approach, analytical calculations, or measuring instruments directly. This section summarizes the work done to investigate the impact of process parameter variation on response variables. This is required in order to have a better knowledge of the EDM process and to increase its efficiency.

Choudhary et al. [14] found that during EDM of Nimonic 75, tool polarity had the greatest influence on SR, followed by current and pulse-on time (T_{ON}) with voltage, current(I), pulse-off time T_{OFF} and tool polarity as process parameters and surface roughness (SR) as a performance measure. During WEDM of nimonic-75, Sonawane et al. [6] found that SR, material removal rate (MRR), and overcut increase with increasing peak current and T_{ON} and decrease with decreasing servo voltage (SV), pulse-off time (T_{OFF}), and wire feed rate (WFR), while the influence of wire tension (WT) can be ignored. T_{ON} has the greatest impact on performance characteristics, accounting for 52.89 percent of the total.

In the case of MRR, Goswami et al. [2] discovered that T_{ON} has the greatest influence on MRR and SR, followed by T_{OFF} and all two-factor interactions, whereas in the case of SR, only the T_{ON} X peak current interaction is significant.

Goswami et al. [16] used a trim cut WEDM technique on Nimonic 80A and discovered that T_{ON} has the greatest impact on MRR (52.31 percent) and SR (74.69 %). Wire off-set has the greatest influence (45.34 percent) on wire wear ratio (WWR), and interactions Ton and Toff (14.90 percent) and Ton wire off-set (14.71 percent) are substantial. Goswami et al. [8] conducted a WEDM on the Nimonic 80A and found that all of the control parameters (voltage, wire feed, peak current, T_{ON} , T_{OFF} , and WT) as well as the interactions Ton IP, Ton T_{off} are significant for WWR. Ton (46 percent) and T_{off} (46 percent) have the greatest influence on MRR (33 percent). Unune et al. [42] found that as the wheel rotation per minute (RPM) increases from 700 to 1300 RPM, the SR decreases by 5.96 percent and increases by 83.89 percent.

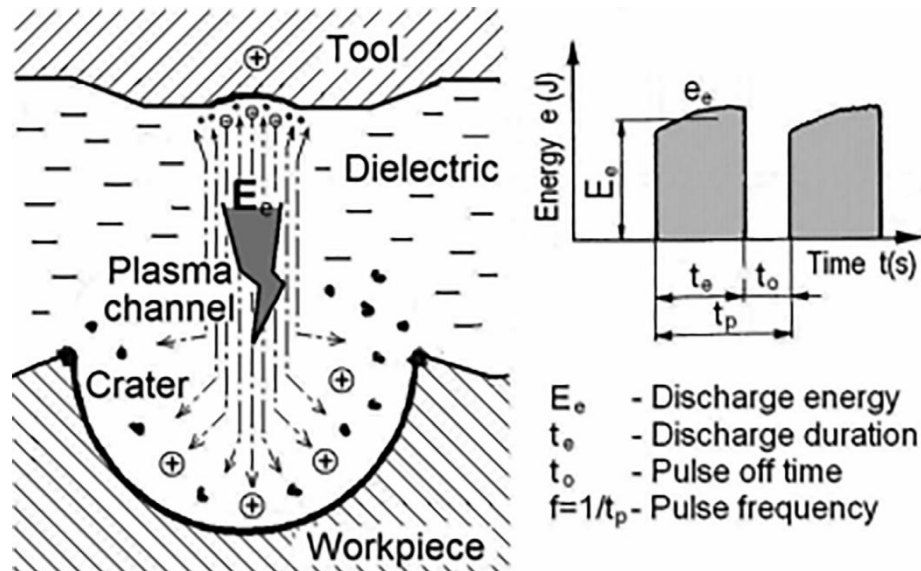


Fig 2: Thermo-Electric model of Electrical Discharge Machining process [35]

Effect of Parameters on EDM of Ni-Alloy

Surface Roughness

Goswami et al. used Taguchi's method based multi response optimization technique during WEDM of Nimonic-80A alloy. The Investigation revealed that MRR and SR increase with increase in pulse-on time and decreases with increase in pulse-off time.

Choudhary et al. adopted Taguchi's experimental design technique to study the effect of control parameters viz. tool current, pulse on-time, polarity, and voltage has been investigated on SR Nimonic 75 alloy using. The S/N ratio plots were referred to observe most influential parameters which were noticed to be tool polarity, pulse on-time affecting surface roughness in EDM of given material. The machined surface was found to be better in case of negative tool polarity over positive tool polarity. The deposition rate of the negative polarity tool electrode was comparatively more than the positive polarity tool electrode. The maximum deposition of carbon was observed on the surface machined with positive polarity tool electrode.

Effect of Electrode materials on EDM of Ni-Alloy

Surface characterization

The product's surface integrity has an impact on its performance over its intended life. Due to melting of the machined area, the surface state changes after the EDM process is completed. And the vaporization of the substance from both electrodes (copper and brass) after then, re-solidification takes place. This can be seen in many forms, such as the presence of craters, fissures, debris, and so on thickness of the recast layer (RLT). The surface's integrity is compromised. The substance is transferred from one electrode to the next. This section describes the work on surface integrity analysis. Various techniques, such as scanning, were used to examine the machined surface. X-ray powder diffraction, electron microscope (SEM) (XRD), X-ray energy dispersive spectroscopy (EDS).

When tool polarity is positive, Choudhary et al. [14] did SEM and EDS investigation in EDM of Nimonic 75 and found that thicker recast layer with globules (Figure 3), uneven surface with higher percentage of carbon, and lower tool material deposition occur. Sonawane et al. [6] found big craters, a matt surface appearance, a lump of debris, and micro-cracks in the Nimonic-75 WEDM at higher discharge energies (Figure 4).

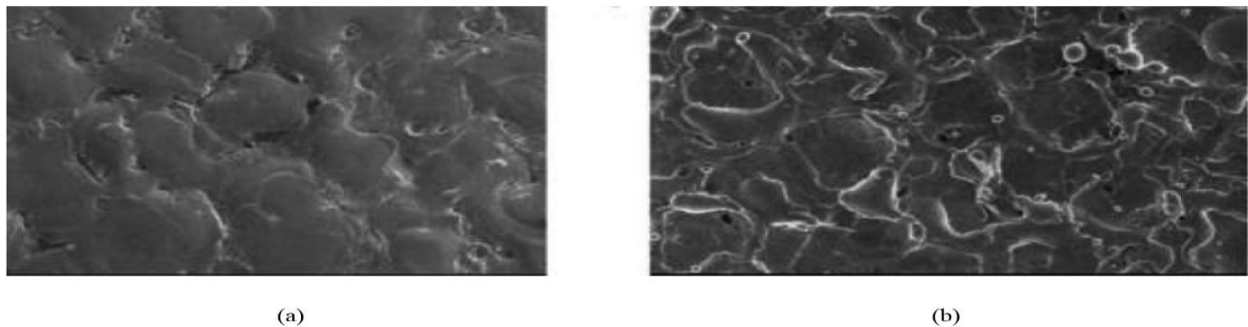


Fig 3: At magnification 100 obtained SEM Images (a) using negative tool polarity (b) at using positive tool polarity [14]

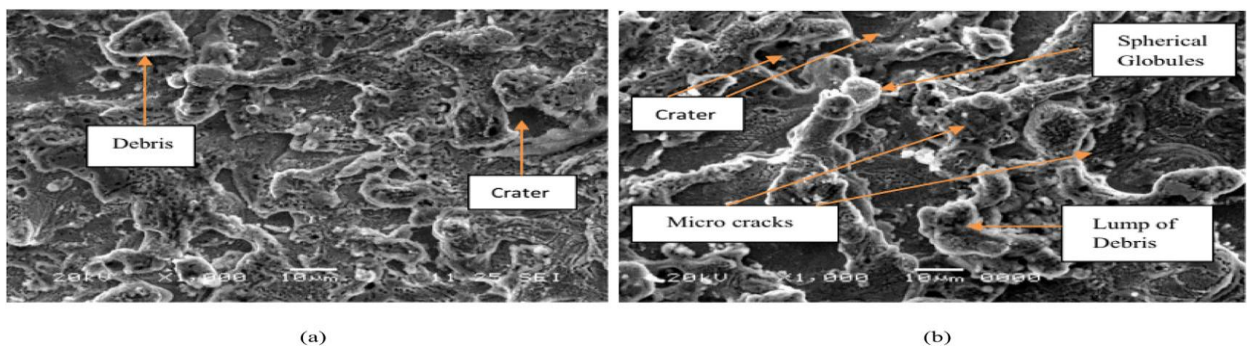


Fig 4: Microstructure in (a) lower discharge energy (b) higher discharge energy [6]

Fig. 3 shows the obtained SEM Images (a) using negative tool polarity (b) at using positive tool polarity. In the WEDM process on Nimonic-80A, Goswami et al. [2] performed SEM investigation and found that surface quality is higher at low energy input settings than at high energy input values, where several built-up edge layers are present together with rough surface (broader RL).

In a micro structural investigation of Nimonic 80A, Goswami et al. [16] found that in low energy input settings, the surface quality is better than in high energy input values, where the surface is rougher in the trim-cut WEDM process. EDS investigation of Nimonic 80A in WEDM process by Goswami et al. [8] revealed deposition of zinc and copper in workpiece due to tool movement, with substantially less deposition at lower discharge energy (Figure 5). When comparing the microstructures of Nimonic 80A in the abrasive mixed electrical discharge diamond surface grinding (AMEDDSG) method, Unune et al. [42] found that surfaces machined with pure dielectric have large surface voids. Using SEM research, Goyal et al. [9] discovered that the surface machined using cryogenically treated wire in the WEDM process on Nimonic 80A has shallow craters. Jangra et al. [43] found that the machined surface of Nimonic-90 has big sized deep holes and that the trim cut operation was performed after the rough-cut operation creates less defects and micro cracks of machined surface.

Fig 4 shows Microstructure in (a) lower discharge energy (b) higher discharge energy [6]. XRD investigation of Nimonic 75 in the EDM process was performed by Singh and Pandey [7], who discovered that the carbon content of the affected layers rises (Figure 6). In the SEM investigation, reduced AR is associated with decreased RLT and micro crack concentration. From the optical microscope images, Pandey et al. [15] concluded that holes obtained at the optimal setting of parameters in Nimonic-90 EDM are better. Mandal et al. [12] discovered micro cracks and micro voids on the surface of Nimonic C 263 after a rough cut WEDM process. The RLT is reduced by multi-cut operation; however, it is unable to eliminate micro-voids, tensile residual stress or tool wire deposition. After grinding, etching is used to strengthen the surface integrity and eliminate the recast layer (Figure 7) and reduce the surface roughness.

Bisaria et al. [5] discovered that at high input energy rates, there is comparatively more atom transfer and a thicker recast layer, whereas at low input energy rates, the craters formed are shallow and the surface is smooth, as seen in SEM analysis (Figure. 8). XRD analysis reveals the presence of tensile residual stresses and various compounds. Mandal et al. [11] concluded that by using the multi-cut strategy in Nimonic C-263 WEDM, the thickness of the recast layer is reduced and the surface finish is improved, as well as a noticeable improvement in irregular deposition. Unune et al. [47] concluded that SEM images of Nimonic 80A in abrasive-mixed media

show fewer grinding marks but larger sized cavities at higher wheel speeds are seen in the pictures of SEM of Nimonic 80A in Abrasive mixed electrical discharge diamond grinding (AEDDGM) process.

4.3 Optimization of process parameters

The experimentation carried out in the EDM process for different settings of the process parameters yields different values for the performance measures. The performance indicators must be maximized or minimized. When optimizing multiple performance measures at the same time, single response optimization is used. Multi objective optimization is used when optimizing multiple performance measures at the same time. This result in the optimal setting of the control factors, and the results can be validated experimentally. This segment describes the work done on optimizing process parameters in Nimonic alloy EDM.

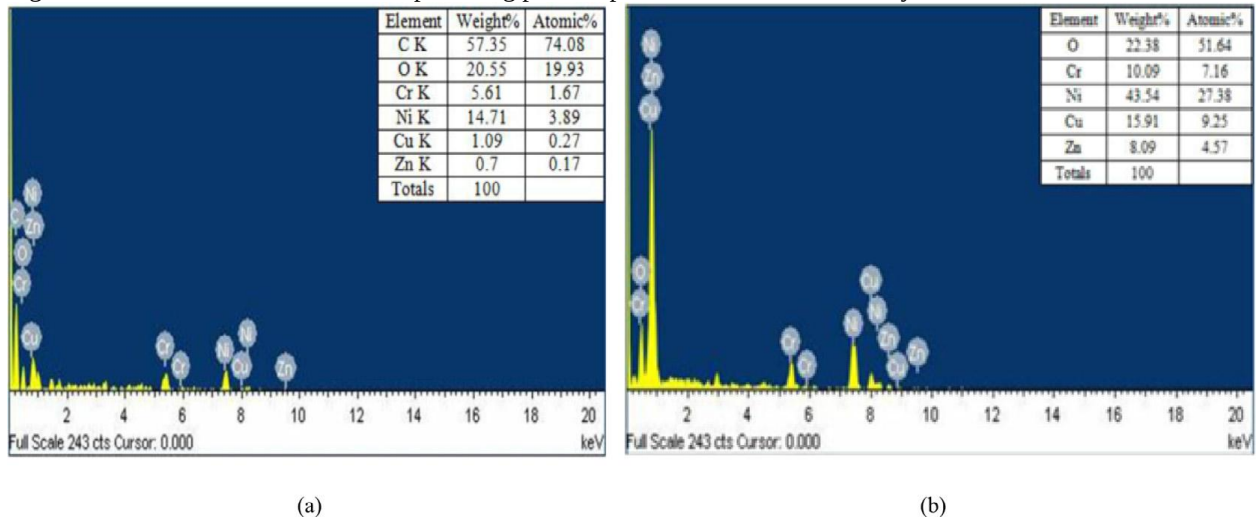


Figure 5: (a) EDS image at lower discharge energy condition, (b) EDS image at higher discharge energy condition [8]

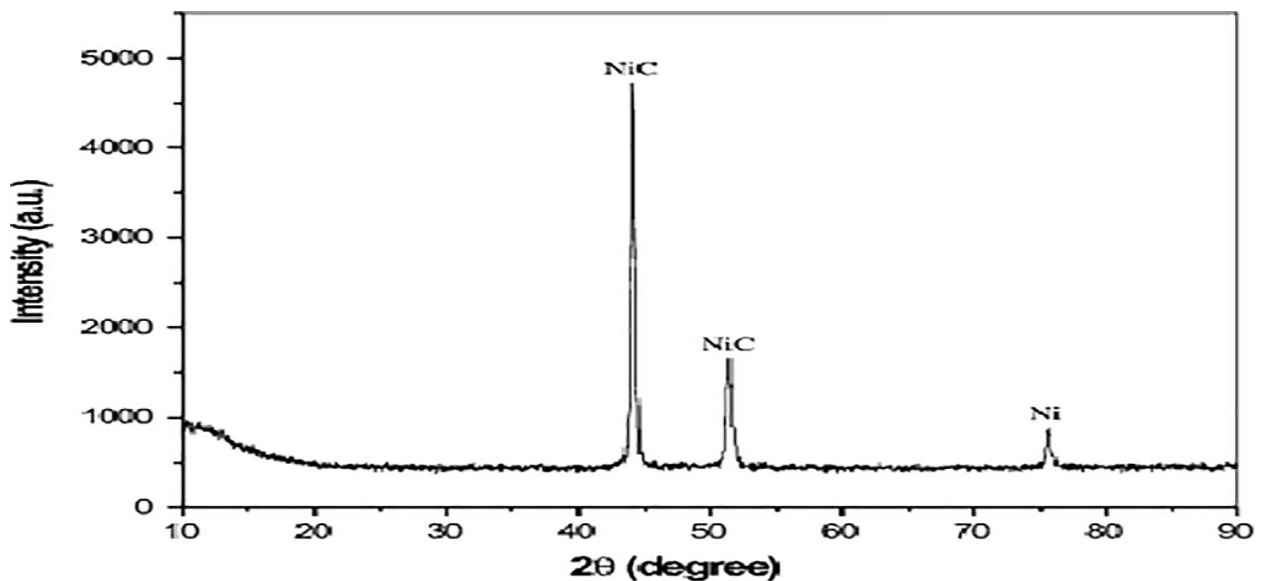


Figure 6: XRD analysis of the machined surface [7]

During the EDM process of Nimonic 75, Choudhary et al. [14] discovered that the lowest SR is obtained at 60ms TON, 8A current, and 40 V gap voltage (VG) with negative tool polarity. Sonawane et al. [6] used principal component analysis to optimize process parameters (TON, SV, TOFF, peak current, WFR, cable tension) for performance variables (SR, overcut, MRR) in WEDM of nimonic-75 (PCA). The best settings were 40 V SV, 51 ms TOFF, 110 ms TON, 230 A peak current, 8 g cable tension, and 5 m/min WFR, with the magnitude of the composite principal component increasing from 1.2013 to 1.2443. T_{OFF} 30 ms, T_{ON} 118 ms, WT 1500 g, input current 80A, spark gap set voltage 50 V, wire feed 10 were obtained by Goswami et al. [2] using utility concept (UC) for multi objective optimization in WEDM of nimonic-80. The results of single response optimization show that at 30 ms T_{OFF} , 118 ms TON, 1500 g WT, 160A input current, 30 V spark gap

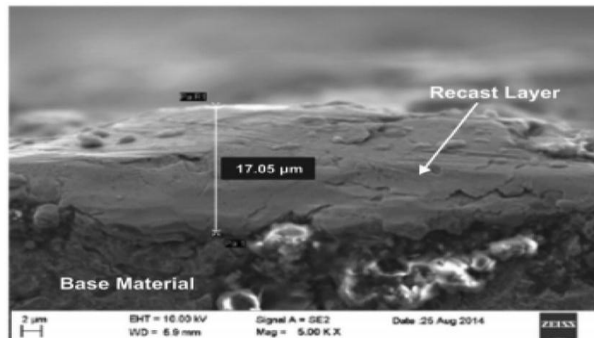
set voltage, 6 wire feed, the maximum MRR is 0.1102 g/min, whereas at 106 ms T_{ON} , 54 ms T_{OFF} , 1260 g WT, 80A input current, 70 V spark gap set voltage, 10 wire feed, the minimum SR is 0.16mm.

Goswami et al. [16] used grey rational analysis (GRA) to perform multi-objective optimization, and the optimum values of input parameters were 14 ms T_{OFF} , 60A peak current, 0.08 mm wire off-set, and 0.6 ms T_{ON} . Single objective optimization results show that the highest MRR and SR are found for 14 ms T_{OFF} , 90A peak current, 0.1 mm wire off-set, 0.6 ms T_{ON} , and 14 ms T_{OFF} , 120A peak current, 0.12 mm wire off-set, 0.45 ms T_{ON} , respectively. After validating their findings with confirmation experiments, Goswami et al. [8] concluded that T_{OFF} : 30 ms, T_{ON} : 118 ms, WF: 8, peak current: 80A, SV: 30 V, and WT: 1020 g are the optimal settings obtained using GRA.

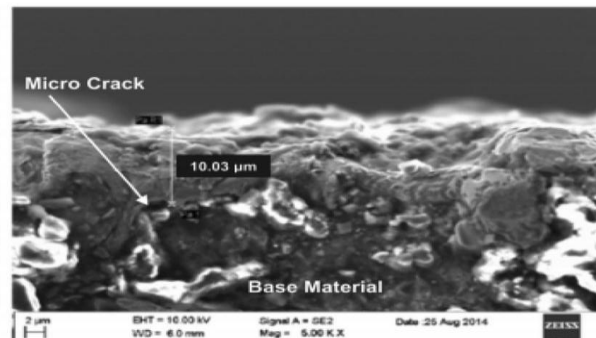
Goyal et al. [9] carried out single objective optimization on Nimonic 80A and observed that the highest MRR is obtained at 115 ms T_{ON} , 45 ms T_{OFF} , 2 m/min feed rate and 160A peak current while the lowest SR is obtained at 110 ms T_{ON} , 50 ms T_{OFF} , 2 m/min feed rate and 80A peak current. Rao et al. [4] used particle swarm optimization (PSO) for multi-objective optimization, and when the PSO results were compared to the RSM results, it was discovered that PSO performed better. Using PSO, the maximum MRR is 3.6713 mm³/min at 50 ms T_{OFF} , 125 ms T_{ON} , 40 V SV, and 12A peak current, while the minimum SR is 0.2618 at 50 ms T_{OFF} , 116 ms T_{ON} , 60 V SV, and 10A peak current. Sonawane et al. [48] used PCA-based utility theory to perform multi-objective optimization, and the optimal input parameter settings obtained were discharge current 200A, discharge voltage 20 V, T_{OFF} 51 ms, T_{ON} 114 ms, WT 2 g, and WFR 5 m/min.

Singh et al. [7] derived their conclusions from single response optimization. The results show that the lowest disc EWR is obtained at 100 ms T_{OFF} , T_{ON} of 100 ms, AR of 0.005, rotational speed of 125 rpm, VG of 50 V, peak current of 16A. At 10 ms T_{OFF} , 100 ms T_{ON} , and 0.036, the current and lowest SR are obtained. AR has a rotational speed of 100 rpm, a voltage of 50 volts, and a peak current of 16 amps, whereas the greatest MRR is obtained at 10 ms T_{OFF} , 400 ms T_{ON} , and 0.036 AR. Rotational speed of 150 rpm, voltage rating of 50 volts, and peak current of 16 amps.

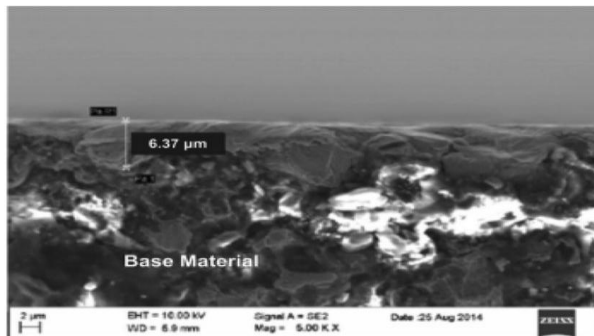
Optimization was achieved by proposing and implementing a new hybrid approach, GRA-based genetic algorithm (GA), and the optimum values obtained are T_{OFF} : 5.92 ms, T_{ON} : 8 ms, discharge current: 10A, and dielectric pressure: 80bar. For optimization, Sathish et al. [45] used a hybrid Bee Colony Cuckoo Search (BCCS) algorithm, and the BCCS predicted values were found to be in agreement with the corresponding confirmatory experiment values. For minimum SR, optimal settings are 50 ms T_{OFF} , 116 ms T_{ON} , 60 V SV, and 10A peak current; for maximum MRR, optimal settings are 50 ms T_{OFF} , 125 ms T_{ON} , 40 V SV, and 12A peak current. Mandal et al. [11] used the desirability function approach to perform multi objective optimization. The obtained optimum input parameter values result in a maximum cutting rate of 2.224 mm per minute and a minimum SR value of 1.38 mm, respectively.



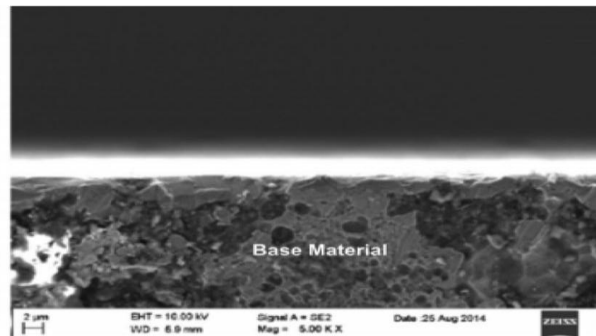
(a)



(b)



(c)



(d)

Figure. 7: Image of Recast layer attained after (a) rough cut operation (b) finish cut operation (c) grinding operation (d) etching, grinding [12]

Process modelling

This entails constructing a model based on the process parameters in order to forecast the response variable. This can be done with mathematical models, analytical models, or simulation-based models, but in general, process modelling using soft computing techniques produces precise and accurate results, owing to their ability to deal with complex engineering scenarios that are multi-dimensional and non-linear in nature. The results of process modelling in the EDM process utilizing Nimonic alloys are presented.

Unune et al. [42] used a fuzzy logic soft computing approach to describe process parameters and forecast MRR and SR. The obtained results were validated by comparing them to the results of confirmatory experimentation, and a 93 percent agreement was found.

Electrical discharge machining developments and conventional machining techniques

Hybrid machining procedures combine two or more operations to produce a finished product. By boosting the existing efficiency of the EDM process, these are employed to gain extended advantages or applications, such as decreased tool wear or improved machinability. The setup includes an EDM machine and a few tweaks. This paper describes the work done on machining nimonic alloys with hybrid machining procedures and a few traditional machining techniques.

AMEDDSG was used by Unune et al. [42] to machine Nimonic 80A using a brass-bonded diamond grinding wheel. Material removal occurs due to sparking as well as abrasion induced by abrasives in the AMEDDSG process, hence the MRR obtained in EDM is one-tenth of that obtained in AMEDDSG. Pulse current, abrasive concentration, wheel RPM, and TON were chosen as control parameters. Singh and Pandey [7] used a copper disc electrode and applied rotating motion to it to perform EDM on Nimonic75. Peak current, AR, T_{OFF} , rotating speed, T_{ON} , VG are the process parameters evaluated, and the set-applications up's include slitting and grooving. Unune et al. [47] used an AMEDDG setup consisting of dielectric material combined with powdered abrasive to mill Nimonic 80A. The impact of powder concentration, wheel speed, TON and current on MRR is examined.

Chetan et al. [49] used the proposed mathematical model to predict specific cutting energy during machining of Nimonic 90 alloy under minimal quantity lubrication (MQL) conditions. The generated findings were found to match the experimental values, and the particular cutting energy was reduced. Chetan et al. [50] used Nimonic 90 alloy in the turning process to correlate the nano MQL condition and sustainable cryogenic procedures. Due to the use of a cryogenic environment, the surface roughness and deformities were reduced.

Chetan et al. [51] investigated the wear-related nature of TiN-coated carbide inserts in the turning process for dry and MQL modes utilizing physical vapor deposition for Ti6Al4V and Nimonic 90 alloy. When compared to Ti6Al4V alloy, the cutting forces for Nimonic 90 alloy were higher. Venkatesan et al. [52] employed coated inserts in the dry turning of Nimonic 263 alloy with feed, speed and depth of cut as input factors and surface roughness and cutting force as response variables.

Conclusions

This paper presents a current state-of-the-art review of research trends in EDM of nimonic alloys, which leads to the following conclusions, including research gaps and future research directions:

- Die-sinking EDM and wire-cut EDM have been used for the majority of the work, and the different nimonic alloys on which work has been documented include Nimonic 75, 80A, 90, 263 and C263. Micro-EDM of nimonic alloys has received very little attention.
- The distinct process parameters studied by various researchers in die-sinking EDM include tool polarity, peak current, T_{ON} , T_{OFF} , SV, and tool feed rate whereas the different reaction variables considered by various researchers include SR, MRR, and surface integrity features. Tool polarity, peak current, T_{ON} , T_{OFF} , SV, WFR, cable tension, spark energy, and spark frequency are considered process parameters on WEDM, whereas response variables are SR, MRR, WWR, WR machining speed, spark gap, hole dilation at entry and exit, hole circularity at entry and exit, hole taper, and surface integrity aspects are considered response variables. De-ionized water, EDM 50 oil, and zinc coated brass wire, brass wire, cryogenically treated brass wire, and molybdenum wire were used as dielectric materials, while the wire electrode was made of zinc coated brass wire, brass wire, cryogenically treated brass wire, and molybdenum wire.
- The many strategies for experiment design are as follows: RSM and Taguchi's methodology SEM, XRD, and EDS are examples of surface integrity analysis techniques. GRA, PSO, PCA, UC, PCA based UC, GRA based GA, BCCS and desirability approach are some of the optimization approaches employed. Fuzzy logic and regression analysis are two methodologies used in process modeling.
- In terms of EDM advancements, rotary disc EDM and a novel hybrid machining method known as AMEDDG were used. Surface integrity has been improved using post-processing techniques like as grinding and grinding-etching in WEDM.

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Information Retrieval and Machine Learning Algorithms for Model Development: A Review*** Harpreet Kaur** Maninder Singh**

*Assistant Professor, Computer Sciences, Apeejay College of Fine Arts, Jalandhar

**Assistant Professor, Punjabi University, Patiala

apharpreetbhatia@gmail.com, singhmaninder25@yahoo.com

Abstract

Machine learning plays an indispensable role in the development of Artificial Intelligence as with the spread of artificial intelligence, machine learning is also escalating. Machine learning focuses on the use of data and algorithms to emulate the way that humans learn, moderately improving its accuracy. In this paper, Machine learning describes the capacity of a system to learn from problem specific training data to automate the process of analytical model building and solve associated tasks, then we elucidate the information retrieval strategies and machine learning algorithms. The methodology is to retrieve data from different sources to create a training set for the machine to behave like humans, by using the vector space model: it treat every piece of information as a vector by calculating cosine similarity and Euclidean distance between them and probabilistic strategy: it comprises information about the occurrence of index terms in relevant and non-relevant documents by using joins and conditional probability and etc. Once the data is prepared one has to choose a machine learning algorithm to solve a problem, thereby by applying machine learning algorithms like linear regression, K-nearest neighbor, and random forest. With the time, number of machine learning algorithms is extensive and growing and, their implementation through framework and libraries is also extending. Following this research step, testing models can help detect possible adversarial attacks, data integrity, and bias and spot failure models.

Keywords: Machine Learning(ML), Vector space model, Probabilistic retrieval strategy, Linear regression, K-nearest neighbor, Random Forest.

1. Introduction

In 1936, Alan Turing gave a theory that how a machine can determine and execute a set of instructions. ML is a burgeoning automation which enables computers to learn automatically from past data. ML uses various algorithms for gathering data, building mathematically models and making predictions using historical data. Information retrieval methods such as the vector space model and probabilistic model have significant applications in Machine Learning development. Here are a few examples of how these methods are used.

Text Classification: One of the primary applications of information retrieval methods is text classification. The vector space model and probabilistic is used in text classification tasks to represent documents and classify them based on their content. Linear regression, KNN and Random forest used classification based technique.

Recommender Systems: Another significant application of information retrieval method is recommender system. Recommender system are used to suggest products and services to the users based on their past behavior and preferences. In these system, vector space model and probabilistic models are used to represent user behavior and item features. KNN algorithm makes a prediction about a movie, it will calculate the distance between the target movie and every other movie in database. It then ranks its distances and returns the top K nearest neighbor movies as the most similar movie recommendations and many more.

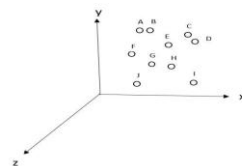
Information retrieval strategies and Machine Learning algorithms are explained as follows:

2. Retrieval Strategies

Information retrieval is a robotic approach that responds to a user query by evaluating a documents corpus and producing a sorted and relevant document list. Following are listed the various retrieval strategies.

2.1 Vector space model

Vector space model is an information retrieval model. It is used to retrieve information in digital form. The mechanism behind this model is that it treats each and every piece of information as vectors. For instance, in a document, words are considered as vectors. Therefore, words have some magnitude and some direction. They are represented as dots in a multidimensional vector space. It helps in comparing similarity between two documents or one document and one query with the help of some similarity coefficient models [1]. Consider the following vector space

**Figure 1: Vector Space**

Suppose A, B, C, ---, I are words of either a document or query represented as vectors. So, each word is a vector with a particular direction. Two measure are Cosine angle and Euclidean distance.

Cosine angle: The angle between two vectors in the vector space model.

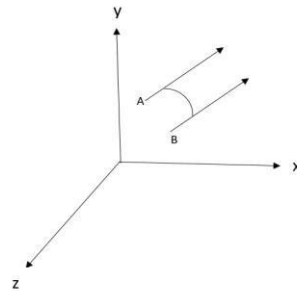


Figure 2: Cosine Angle

Suppose two vectors A and B have direction as in figure, then the angle between them is known as cosine angle. This angle decides the similarity measure of the two words.

Greater the angle → lesser the similarity

Smaller the angle → greater the similarity

Cosine similarity: $(d \cdot d1) / (|d| * |d1|)$

Where ‘d’ is a document, and ‘d1’ is a query and ‘d×d1’ is a vector product.

Euclidean distance: The distance between two vectors in the vector space is known as Euclidean distance.

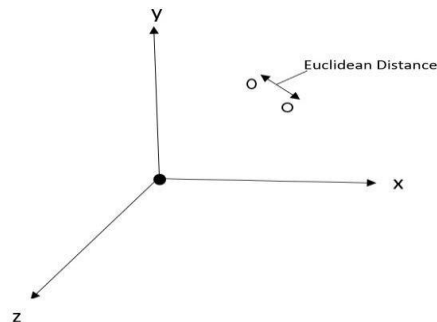


Figure 3: Euclidean distance

The closer the two documents, the smaller the Euclidean distance and hence greater the similarity. The farther the two documents, the greater the Euclidean distance and hence smaller the similarity. As the search engine responds to a given query with a ranked list of relevant documents.

Drawbacks: a) Vector normalization does not consider the length of a document, therefore there is a subtle problem with it that short documents can be favored in expense of long topics with more topics. B) Synonyms are not taken into consideration by any technique used in VSM.

Improvements: To solve first issue, which is ‘standard normalization’, new type of normalization that is ‘pivoted normalization’ is used.

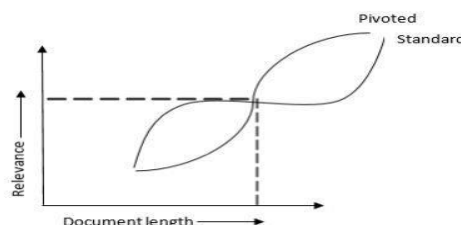


Figure 4: Pivoted Normalization

‘Pivoted normalization’ holds the idea to make shorter documents lesser relevant than longer ones. Second issue is solved by the introduction of ‘GVSM’ (Generalized Vector Space Model).

In [2], suggests that how natural language processing can be applied for building rich models for cybersecurity analytics. For this it applied text mining to the natural-language content of Common Attack Pattern Enumeration and Classification for standardized corpus of cyberattack pattern and used vector-space model in which CAPEC attack patterns are treated as documents with term vectors. [3] Uses the vector-space models in which similar words are clustered together which means the vector of Italy is close to the vector of France.

2.2 Probabilistic Retrieval

Probabilistic Retrieval follows the Law of large numbers that is Fundamental theorem of Probability.

“The average of results obtained from a large number of trials should be close to the expected value, and will tend to become closer as more trials are performed”. For example: when a dice is rolled, assuming the may see 1 to 6 with equal probability, then expected value = $\frac{1+2+3+4+5+6}{6} = 3.5$

“According to the law of large numbers, if a large number of six-sided dice are rolled, the average of their values (sometimes called the sample mean) is likely to be close to 3.5, with the precision increasing as more dice are rolled.”

Conditional Probability: It is defined as the likelihood of an event or outcome occurring, based on the occurrence of previous event or outcome. It is given by,

$$P\left(\frac{B}{A}\right) = \frac{P(A \text{ and } B)}{P(A)} = \frac{P(A \cap B)}{P(A)}$$

Which is read as probability of event B, given that event A has occurred.

Example: $P(A/B2) = ?$

Given $P(A) = 0.52$, therefore $P\left(\frac{A}{B2}\right) = \frac{P(A \cap B2)}{P(B2)} = \frac{0.12}{0.12+0.04} = 0.75$

Bayes Theorem: It is defined as the likelihood of an event or outcome occurring, based on the occurrence of a previous event or outcome, (1) application of Bayes theorem in the form of

$$P\left(\frac{A}{B}\right) = P\left(\frac{B}{A}\right) * \frac{P(A)}{P(B)}$$

(2) usage of odds instead of probabilities, where $o(y) = \frac{P(y)}{p(y1)} = \frac{P(y)}{|1-P(y)|}$

This is why, we can compute the odds of a document represented by a binary vector x being

relevant to query qk as $O(R|qk, x) = \frac{P(R|qk, x)}{P(R|qk, x)} * \frac{P(x|R, qk)}{P(x|R, qk)}$

Currently, additional independent assumptions are needed in order to arrive at formula that is applicable for retrieval of document presented by cooper [5].

$$\frac{P(x|R, qk)}{P(x|R, qk)} = \prod \frac{P(x_i|R, qk)}{P(x_i|R, qk)}$$

Uses probabilistic information retrieval framework in which the probabilistic retrieval problem is formally treated as a statistical decision problem and this framework is used for the development of new retrieval models [4].

3. Machine Learning Algorithms

In Machine Learning different algorithms are used for different tasks, such as Linear Regression can be used for prediction problems, the KNN is used classification problem and Random Forest is used for both prediction and classification problems. ML can be broadly classified into three types:

1 Supervised learning

In this mechanism of ML, Supervised Learning belongs to a relatively basic learning method. In this, sample labeled data is provided to the machine learning system in order to train it and on that basis, it predicts the output. Spam filtering is an example of supervised learning. SL is further divided into two categories:

- Classification
- Regression

2 Unsupervised Learning

Unsupervised Learning does not mark the content in a certain direction during the entire learning and make the machine learn itself from information. With the set of data, training is provided to the machine but the data is not labeled, classified neither categorized and the algorithm need to act on that data without any supervision. Further divided into two categories:

- Clustering
- Association

3 Reinforcement Learning

It is the systematic learning of a certain content and uses the data collected in the previous period. Basically, it is a feedback-based learning method. For example robotic cat, which automatically learns the movement of his arms.

List of ML algorithms are explained as follows:

3.1 Linear regression

The notion of linear regression was first proposed by Sir Francis Galton in 1894. It is one of the most popular algorithm that is used for predictive analysis. It shows the linear relationship between dependent and independent variables and depicts that dependent variable changes according to independent variables. It tries to best fit line between dependent and independent variables, and this best fit line is known as the regression line. Equation for the same is:

$$Y = a + bX + e$$

Y is the response or output or dependable variable, a is the intercept, b is the slope of linear regression line, X is the independent variable and e is the error. If there are more than two variables then it is referred as multiple linear regression.

$$Y = a + bX_1 + cX_2 + dX_3 + \dots + e$$

Linear regression is a statistical test applied to a data set to describe and calculate the relation between the considered variables. Fisher's test, t-test, Chi-square test and analysis of variance (ANOVA) are the Univariate statistical test which does not allow taking the account the effect of other covariates during analyses [6].

Recently, several non-scale invariant and scale-invariant test have been proposed for general linear hypothesis testing problem for high-dimensional data, which include one-way and two way MANOVA tests as special cases [7].

Linear regression is used in medical field to assess the relationship in a rat model between tissue propofol concentrations and exhaled propofol concentration by quantifying the relationship between ≥ 1 independent (predictor) variables and a continuous dependent (outcome) variable [8].

3.2 K-Nearest Neighbor

The K-Nearest-Neighbours (KNN) is a non-parametric classification algorithm. It uses feature similarity to predict the values of new data points will be assigned a value based on how closely it matches the points in the training set. There are two steps in classification: 1) Learning step: Using the training data a classifier is constructed. 2) Assessment of the classifier.

Given the training dataset $\{(x^{(1)}, y^{(1)}), (x^{(2)}, y^{(2)}), \dots, (x^{(n)}, y^{(n)})\}$

Step 1: Store the Training set

Step 2. For each new unlabeled data,

- A. Calculate Euclidean distance with all training data points using the formula: $\sqrt{\sum_{i=1}^n (x_i - y_i)^2}$
- B. Find the k-nearest neighbors.
- C. Assign class containing the maximum number of nearest neighbors [9].

Supervised ML models can learn nonlinear patterns from complex agrometeorological data. In fact, environment-based predictive analysis of oil palm yield with ML methods is not widely explored. Therefore, this work presents the application of a non-parametric regression algorithm K-nearest neighbor for oil palm yield prediction using weather and soil data and suggested that ML is great tool for oil palm yield prediction [10].

The main objective of the research is to help doctors and patients to predict diabetes as soon as possible through ML technique. The prediction of diagnosis of diabetes is based on these algorithms of ML K Nearest neighbours, Naïve Bayes, Support vector Machine and etc [11].

Karsthikeya and Shetty describes the prediction for the crops in agriculture as big problem for farmers because of uncertainty that is climate change so, these problems can be easily solved with ML algorithms [12].

Soofi, Awan explains that data science uses data mining technique to predict the group members, which come under a classification method. Many such classification technique of machine learning are used for classification purposes. These include decision tree classification algorithm, K-NN, and support vector machines [13].

3.3 Random Forest

Random Forest is commonly-used ML algorithm trademarked by Leo Breiman and Adele Cutler, which combines the output of multiple decision trees to reach a single result and it handles both classification and regression problems. Steps for random forest algorithm work:

Step 1: Select random K points from training set.

Step 2: Build the decision tree associated with the selected data points.

Step 3: Choose the number N for decision trees that you want to build.

Step 4: Repeat step 1 and 2.

Step 5: For new data points, find the prediction of each decision tree, and assign the new data points to category that wins the majority votes [16].

Random forest uses ensemble learning, which is technique that combines many classifiers to provide solutions to complex problems. The forest generated by random forest algorithm is trained through bagging or bootstrap aggregating [14]. Bagging is ensemble meta-algorithm that improves the accuracy of ML algorithms.

Random Forest was the last major work of Leo Breiman [15]. In the original paper, Breiman[15] suggested that Random Forest work by reducing correlation, while keeping the variance relatively small. Applications of random forest are numerous and only a few can be mentioned like Statnikov compares random forest and support vector machine for microarray-based cancer classification [17].

4. Building Machine Learning Model and performing Predictions

Data preprocessing, often called preparation is an important step in the analysis process. First data is collected by using different information retrieval strategies like probabilistic model, by retrieval data which may include discrepancies and can lead to discrepancies and result will be incorrect predictions therefore it is important to standardize these inputs and make them ready for analysis [18].

Case study 1: The aim of the project was to understand what factors are most important in deciding the purchase of a house loan. They want to run the model on test data and predict house prices therefore, successful house prices predictions were made using Random forest regression model and it was observed random forest regressor performed better than the other machine learning algorithms which was tried on data set. In terms of importance of features, it was seen that Overall Quality of the house was the most important factor. Following that came the Living Area and the High Quality Surface Built of the house [18].

Case study 2: Machine learning case study on Dell, Dell partnered with Persado, the world's leading technology in AI and ML generated marketing creative and garner data-driven analytics for each of their key audiences. As a result, Dell noticed a 50% average increase in CTR and a 46% average increase in responses from customers. It also generated a 22% average increase in page visits and 77% average increase in add-to-carts [19].

Case study 3: Machine learning case study on Harley Davidson, Albert (an artificial intelligence powered robot) has a lot of appeal. Powered by Machine Learning model and artificial intelligence, robots are writing news stories, working in hotels, managing traffic, and even running McDonalds. Harley Davidson is the only brand to make use of Albert. Results show that Harley Davidson increased its sales by 40% with the use of Albert. The brand also had a 2,930% increase in leads, with 50% of those from high converting 'looklikes' identified by machine learning models and artificial intelligence [19].

Case study 4: Modelling cars uses Vector Space model in Machine Learning. Cars should have dimensions : max_speed, acceleration_time and price. They used the 3 cars like Porsche cayenne, Tesla Model and BMW i3, and their vectors look like Porsche = (304,4.4,99200); tesla = (250,3.8, 79990) and bmw = (160, 7, 60000). They calculated the similarity between two cars by using cosine similarity [21].

Conclusion and Future work

In gist, vital notion of model development have been described by using information retrieval strategies and machine learning algorithms. Following this goal, we have only mentioned to experimental results; of course experiments are necessary in order to evaluate and compare different models. For future research it seems to be important to use test collections that are more representative for the intended applications e.g. collection with large databases by using deep learning algorithms.

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Image Forgery Detection: A Survey of Recent Approaches

***Amneet Kaur, Basav Bamrah, Jaspreet Kaur**

Department Computer Science and Engineering, Baba Banda Singh Bahadur Engineering College, Fatehgarh Sahib Punjab-140407, India
amneetkaur90800@gmail .com, jaspreet.kaur@bbsbec.ac.in, basavbamrah@gmail.com

Abstract

Throughout the last few decades, there has been a sharp rise in the use of digital images. Virtually every facet of life now makes use of digital photos. Many documents that must be filed online require images in the form of soft copies, and a lot of images are shared on social media every day. Editing or altering a digital image has become more simpler thanks to the rapid advancement of digital image processing technology and the prevalence of digital cameras, even for a novice forger. It is conceivable for any user to alter digital images in such a way that it would be difficult to tell one from the other visually. The methods are commonly referred to as Image forgery detection for the purpose of identifying these modifications in images. The detection of fake images is a difficult field of study. It is clear that in the past decade, high-quality work has been done in the area of detecting image forgeries. Yet, given the sophistication of image editing technologies, there is still a need to pay close attention in this subject. The main purpose of this paper is to conduct a survey of some of the most recent techniques for detecting image forgery concentrating on copy-move and splicing assaults that are widely used.

Keywords: Copy-move , Image Forgery detection , Image processing , Splicing , Survey.

1. Introduction

The widespread use of desktop computers, the proliferation of smart devices with ever-improving cameras and image processing apps, and the fact that all of these devices are virtually always connected to the Internet and to distant data servers have made it possible for regular people to gather, store, and process vast amounts of digital visual data on a scale that was previously unimaginable, but because there are sophisticated tools for picture editing, anyone with even a basic understanding of computers may easily alter the image.

Digital image forgery is described as "falsely and fraudulently manipulating a digital image" in the Merriam-Webster dictionary. The idea of image falsification is not new; it first appeared around 1840. The earliest altered photograph was made by French photographer Hippolyte Bayard and was named "Self Portrait as a Drowned Man" in which Bayard claims to have committed himself. Recently, in July 2017, a false photo of Russian President Vladimir Putin meeting with American President Donald Trump at the G20 summit was shared on social media. This bogus image earned several thousand likes and retweets[16].

Sports, legal services, medical imaging, insurance claims, and journalism are just a few of the fields where images play an impressive role. Other fields include forensic investigation, criminal investigation, surveillance systems, intelligence systems, and journalism. In the past ten years, significant study has been done in the area of image forgery detection.

There are two different types of detection methods: active forgery detection and passive forgery detection. The digital image undergoes some sort of pre-processing in an active method, such as a watermark [17] or signatures [14] produced at the moment the image was created. A significantly difficult in image processing approaches is the passive approach , because the image is the only accessible information in this case. Passive forgery further can be categorised as dependent forgery and independent forgery. Copying and pasting (cloning) [2] can be used to alter a picture in dependent forging. Independent forgery, on the other hand, is a type of fraud in which certain aspects of the same image are changed. Resampling, retouching, picture rotation, scaling, resizing, noise addition, blurring, image compression, etc. are examples of independent forgeries.

2. Existing Surveys

The detection of image forgery has been the subject of numerous surveys over the decade. Lanh et al. [7] discussed numerous methods to detect image counterfeiting based on a camera. Author made a clear statement that, in terms of dependability, camera-based systems outperform other forgery detection methods. Pixel-based approaches, format-based techniques, camera-based techniques, physically based techniques, and geometric-based techniques are the five groups that Farid [4] divided under image counterfeiting tools . The author has thoroughly explained each technique. Arif et al. [18], reviewed copy-move forgery detection techniques and categorised it mainly into two classes: block-based and key point-based approach. Meena K.B, Tyagi V [9]

reviewed four types of tampering techniques namely image splicing, copy-move forgery, image resampling and image retouching detection. This paper conducts survey for deep learning techniques for copy-move and splicing forgery.

3. Traditional Techniques

The term "classic" or "traditional" approaches is frequently used to describe conventional passive methods. These methods actually date back to the pre-DL era, which is the one we are now in, and as a result, their eventual training phase requires little to no data. Traditional machine learning methods, such as clustering, support vector machines (SVM), linear/logistic regression, random forests, and so on, are often used in those that still need training data. While they rely on models with a manageable number of parameters and don't necessitate a large amount of training data and classify here as classic approaches. In order to speed up the training process or obtain better performance, deep learning models can also be employed in conjunction with some of the fundamental concepts and principles on which these approaches are based. The statistical attributes derived from the image, such as JPEG recompression properties [11], lighting inconsistencies [5], chromatic aberration [6], device specific parameters [12], resampling[13] etc, were also used in previous systems to conduct image forgery detection.

In an image, the lighting direction in various parts of the image is consistent whereas if it is an image composite, the lighting directions in different parts of image will not match therefore this inconsistency in lighting direction is a trace for detecting forgery in an image [5].

Color channel contraction and expansion with respect to one another can be used to model aberration. This aberration frequently persists throughout the entire image. This aberration can be discovered to be inconsistent in certain areas of a picture when it has been altered, indicating that the image has been faked[6].

4. Deep Learning Based Techniques

Deep learning techniques have become incredibly popular and have been used to solve a wide range of scientific issues. This is because it has been demonstrated that they excel in classification difficulties as well as regression and segmentation problems. Some techniques can even execute more accurately and precisely than humans for some tasks.

CNN has already proven to have exceptional potential in a number of computer vision applications, such as object detection and image segmentation. Due to the diverse origins of the images, a range of distortions appear when a piece of an image is transferred from one to another. CNNs can spot these distortions in falsified images even though they may be invisible to the unaided eye.

In [1], the authors have recompressed images and subtracted it from the original image. Due to the compression difference, the resulting image highlights the forged or sliced part as shown in fig 1. They trained the model by extracting the underlying features on the resulting image. By using the different compression quality, the authors have also shown that different quality leads to different accuracies of the model. In this paper two forgery techniques namely copy-move and splicing have been detected with an accuracy upto 92.3%.

In [18], as a copy-move forgery detection method, deep neural network is able to detect pixel-level localization in copy-move forgery and is also able to separate the source and target region.



Figure 1. [1] Various sample images and their processed forms: (a) the original images (RGB colour format); (b) the images with forgery (RGB colour format); (c) the recompressed forged images (RGB colour format); (d) ground truth of forgery (Binary format); (e) difference of the tampered image with its recompressed image (RGB colour format).

Table 1: Comparison of Traditional and Deep Learning techniques

Sr. No.	Author	Method Used	Forgery Type	Model	Accuracy
1.	Shi, Y.Q., Chen, C., Chen, W [15]	Moments of characteristic functions of wavelet subbands and Markov transition probabilities of difference 2-D arrays	Image splicing	SVM with RBF kernel	91.87%
2.	Fu et al. [8]	HHT and Wavelet Decomposition	Image splicing	SVM	80.15%
3.	Ng, T., Chang, S., Sun, Q [10]	Bicoherence features	Image splicing	SVM	62-70%
4.	Wu Y, Abd-Almageed W, Natarajan P	Y.Wu et al. [19] BusterNet	Copy-move	VGG16	76% - 80.49%
5.	Ali S.S.[1]	[1] Recompression and CNN Quality = 85% Quality = 90% Quality = 95% Quality = 98%	Copy move and Image splicing	CNN	87.71 91.31 91.83 92.23
6.	Abdalla Y Iqbal. M.T and Shehata M [3]	Jpeg Compression	Copy-move	CNN	88.26% - 90.1%

5. Conclusion

In this paper an overview of most accurate copy-move and splicing detection techniques that have been developed recently using Deep learning is presented. Various existing approaches such as BusterNet, Recompression, HHT and Wavelet Decomposition etc, have been examined, and it has been found that they all have one or more shortcomings such as inaccurate forgery detection, Complex computation, open to many attacks, including rotation, scaling, JPEG compression, blurring, and brightness manipulation, among others. Survey on techniques using deep learning as these are more accurate in generalizing the data and has better performance as compared to traditional techniques are focussed in this paper. Summarised overview of deep learning techniques will be useful and helpful to students and researchers in this field. From this it is inferred that Convolutional Neural Networks perform well as compared to other methods providing an accuracy of upto 92.23% while keeping various dataset in consideration.

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Role of IoT and Machine Learning for forecasting Lumpy Skin Disease in Cattle

Devinder Kaur Amandeep Kaur Virk

Department of Computer Science, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab, India

devinder.mgc@gmail.com, amandeep_virk@sggswu.edu.in**Abstract**

Lumpy skin disease (LSD) created havoc in Indian subcontinent during last year resulting in huge financial losses to the cattle farmers. The virus that causes it is called the Lumpy Skin Disease Virus (LSDV) which is a member of the capripoxvirus genus. Cattle are susceptible to this enzootic disease, which is contagious, eruptive, and seldom lethal. The only impacted animal species are cattle which have significant morbidity but low fatality rates, with mortality rates among calves being greater. LSD impairs male sterility, induces female abortions, and reduces the production of milk and beef. From Zambia in 1929, LSD's origins can be traced. In Africa, LSD is thought to be an endemic disease. In 1984, the illness was spread outside Africa. The disease has recently been detected in LSD-free nations (Jordan, Syria, Lebanon, Turkey, Iran, and Iraq), with possible financial losses to the livestock sector. Considering recent events that raise concerns about the spread of this disease, this paper assesses the ability of machine learning algorithms and IoT to forecast the occurrence of LSDV infection.

Keywords: Livestock Farming, Machine Learning, IoT.

Introduction

Lumpy Skin Disease is a deadly, extremely contagious condition that is frequently seen in cattle. Fever, infertility, decreased milk production, and other symptoms are some of the typical symptoms of this disease. Also, since cattle affected with Lumpy Skin Disease rarely die, forecasting the disease's course earlier can considerably reduce economic loss.

A capripox virus is the source of LSD. Via flies, mosquitoes, and ticks, it spreads quickly among cows and buffaloes. The body develops soft, blister-like nodules all throughout, along with fever, runny nose, watery eyes, salivation, decreased milk production, and difficulty swallowing. High fever, decreased milk supply, skin nodules, appetite loss, increased nasal discharge, watery eyes, excessive salivation, discharge of water from the eyes and nose, and the development of body nodules are among the symptoms.

For disease early diagnosis or prediction, machine learning models are frequently utilised. The impact of climatic and geospatial factors on Lumpy Skin Disease could be detected using machine learning algorithms, as demonstrated by Ehsanallah Afshari [6]. In his research, it has been shown that when tested with unlabeled testing Data, the Artificial Neural Network has demonstrated outstanding performance in terms of AUC and F1 scores.

Using bio-climatic characteristics, machine learning algorithms were utilised to predict swine disease outbreaks throughout the world.[7] In various studies, machine learning techniques have been tested for forecasting the onset of infectious diseases in humans or animals.

Machine learning techniques were utilised by Liang et al. [7] to predict African swine fever outbreaks globally utilising bio-climatic data. The support vector machine approach demonstrated the best accuracy in the subset dataset having only significant climatic features (76.02%), whereas the random forest algorithm outperformed other methods with 80.4% accuracy in the dataset encompassing all predictive factors.

In the work by Niu et al.[8], which employed various machine learning algorithms to forecast Peste des Petits Ruminants (PPR) outbreaks based on specific bio-climatic variables and altitude data, the accuracy score of prediction ranged between 47.8 and 99.6%. The test dataset, which contained information from three nations not used in the training procedure, showed the best performance for the random forest algorithm.

1. Importance of Machine Learning in Livestock Farming

Machine learning is a potential approach in dairy research that might be used in the creation and improvement of decision support for farmers. Because cattle, like cows, are a multifactorial system, machine learning algorithms can assess coherent data sources that define and, ultimately, allow controlling cows according to all significant influencing features [10]. The typical behavior of an animal can be predicted using machine learning algorithms, and if the expected behavior deviates from a specified threshold, an alert can be sent.

Machine learning has been applied to the field of cattle husbandry to forecast calving onset, high somatic cell counts, and reproductive outcomes.

The ability to interpret "big data" into "smart data" is improving with the expansion of its use in farm animal medicine, enabling full exploitation of already gathered data. In addition, experts must spend a lot of time interpreting and analyzing data in order to make a clinical diagnosis. A machine learning system may diagnose a disease like mastitis in a matter of seconds, whereas it might take a human 30 to 60 minutes to review all of the data and do so. A more consistent diagnostic report would result from performing such a quick, straightforward diagnostic test frequently [11].

Massive data sets that are difficult to examine using conventional statistical approaches can be analysed and stored using machine learning algorithms. Because machine learning algorithms learn from the data supplied, statisticians contend that they produce better results than traditional analysis approaches, which are biased by the researcher's viewpoint [10].

So, machine learning has the potential to be a highly useful tool for livestock farming and for helping farmers to ensure the welfare of the animals.

2. Machine learning algorithms used for disease detection

- I. *Logistic regression*: One of the machine learning classification approaches called logistic regression uses a set of dependent factors to predict a categorical dependent variable and returns probability values between 0 and 1. [1].
- II. *Support vector machine*: Support vector machines (SVMs) are a class of supervised learning methods that perform well in large-scale environments. Using the extreme situations known as support vectors, it provides the optimum decision boundary to divide multidimensional space into subclasses [2].
- III. *Decision tree*: A decision tree classifier is a tree-like structure that develops a training model to anticipate the target class using basic choice rules inferred from previous data (training data). Each leaf node represents the result, whereas internal nodes indicate features (or qualities), branches, and decision rules [3].
- IV. *Random forest*: An ensemble decision tree-based classification technique called random forest builds a number of trees, each of which is dependent on values from a randomly selected vector with the same distribution for all the trees in the forest [4].
- V. *Artificial neural network (multilayer perceptron)*: The multilayer perceptron is a basic artificial neural network (ANN) type (MLP). It typically has three layers: an input layer, an output layer, and a hidden layer. The data that needs to be processed enters the system at the input layer. The classification process is handled by the output layer. Between the input and output layers, the MLP's true computational engine consists of any number of hidden layers.

3. Evaluating the performance of predictive models

Performance metrics were employed to assess the effectiveness of several classifiers in foretelling unknown data (test set), including accuracy score, precision, recall, F1 score, and area under curve (AUC) [9]. One of the primary performance indicators is accuracy score, which is determined by dividing the total number of forecasts by the number of correct predictions. Precision, or the accuracy of the positive forecasts, is another helpful metric:

$$\text{Precision} = \text{True positive} / (\text{True positive} + \text{False positive})$$

Recall is the proportion of positive cases that the classifier correctly identified:

$$\text{Recall} = \text{True positive} / (\text{True positive} + \text{False negative})$$

The F1 score is the harmonic mean of recall and precision, which gives low scores a lot more weight:

$$F1 = 2 / (1/\text{precision} + 1/\text{recall})$$

The true positive rate (recall) is plotted against the false positive rate using the receiver operating characteristic (ROC) curve. The summary of ROC curves is the area under the curve (AUC), which evaluates the discrimination power of a classifier.

4. IOT BASED LUMPY DISEASE DETECTION

Smart devices and IoT technologies are significantly transforming industries like agriculture and livestock. The livestock sector has evolved as a result of the internet of things. Using battery-powered sensors and smart gadgets has made it easier for farmers to keep tabs on their livestock without having to lug them around everywhere they go. Ranchers can track their cattle in real-time by employing IoT-based livestock monitoring. It aids in addressing a number of issues that the cattle business faces.

Due to the size of the livestock business, it is crucial to monitor livestock and other farm animals. A breakthrough system for monitoring livestock can be designed and built using sensors, GPS, and other technologies, and it is able to integrate all of them with a network protocol for communication. The farmers may remotely check on their farm animals thanks to this monitoring device. The tracker gadget can be fastened to collars in order to monitor the wellbeing of the animals as well as their chewing habits, geographic information, and pasture management. This livestock monitoring system can aid in the management of both farm animals and other farm machinery.

IoT devices can monitor temperature rise and rumination because fever and loss of appetite are the first signs of Lumpy Disease. This can aid in isolating the cattle from other animals before spreading the disease. Figure 1 depicts how the IoT based cattle health monitoring system can detect the onset of Lumpy Skin Disease and help to control its outbreak.

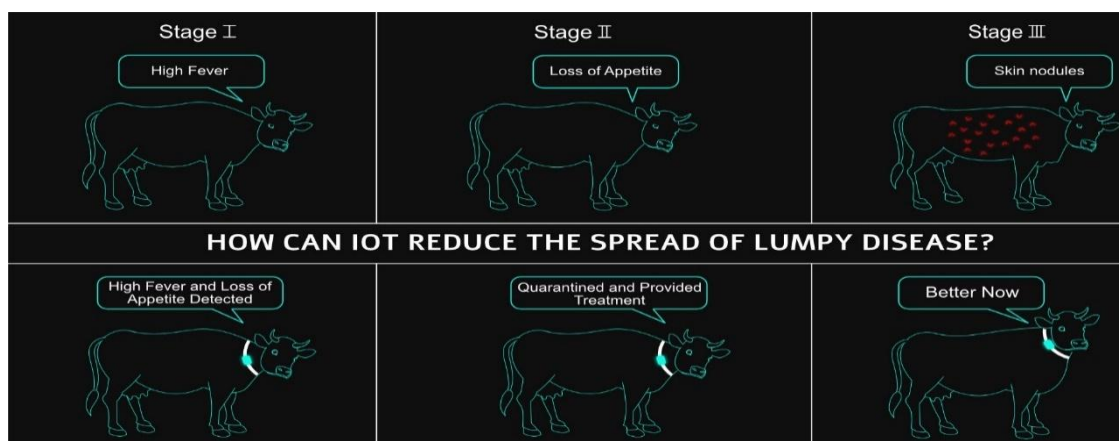


Fig 1. Monitoring the symptoms of Lumpy Skin Disease Using IoT based Cattle Health Monitoring System

The platform for IoT-enabled livestock monitoring may prove to be quite beneficial for livestock production. Data on many facets of cattle health are provided through IoT-enabled livestock management technologies. It is possible to track an animal's position, temperature, blood pressure, and heart rate using a wearable collar or tag that has sensors built in. The data of each cow on the farm is wirelessly transmitted to an IoT Gateway via these wearable IoT devices.

Because it is lightweight and compact, the tracker will not bother animals when they wear it on their bodies. The device includes sensors and a GPS tracker so that the whereabouts and health of the animals can be tracked round-the-clock.

The system's behavioural tracking feature can assist farmers in understanding what their livestock are eating. With the hardware, there are IoT Dashboards, web apps, and mobile applications. Farmers may secure the areas where the cattle can travel freely by setting up geofencing with the aid of the app that comes with the device. In the event that the cattle depart from predetermined bounds, the tracker notifies the mobile application. Also, it gives notifications if the cattle consume harmful or improper food or water. Farmers are able to prevent health problems in their cattle in this way.

Conclusion

Cattle may be afflicted with several different diseases. Farmers are unaware when their cattle are affected by illness since they are not notified when there is an irregular variance in the health of the animals. Because of this, the farmers are unable to offer them with prompt treatment, which can worsen their illnesses. Machine learning systems can anticipate data in several dairy farming sectors. Farmers may gain from improved decision support systems built on the analysis of massive integrated datasets, which will aid them in increasing the efficiency and welfare of their livestock.

Dairy cow physiology and health markers can be tracked using commercially available sensors. While many researchers have recognized the promise of machine learning, it is necessary to start putting these effective instruments and methods into practice in coordination with dairy farmers and data scientists in order to fully appreciate their advantages.

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Artificial Intelligence and Its Applications in E-Commerce - A Review

***Amanpreet Kaur**

Assistant Professor, Institute of Distance and Online Learning, Chandigarh University, Punjab.
amanpreetmaan1095@gmail.com

Abstract

The dramatic shift in norms and behaviour is caused by the exponential advancement of digital technology. One of the computing technologies with the highest rate of growth, artificial intelligence (AI) has significantly changed how businesses operate and how customers are served. The technology is still in its infancy, thus it is only beginning to be applied in a variety of industries. Although there is an increase in research on artificial intelligence and its applications worldwide, the body of literature is still rather fragmented. A thorough review is necessary to come to a decision or comprehend AI applications. This study assembles studies on artificial intelligence in online trade. A thorough review of the literature is done alongside the systematic analysis approach. The current study starts with an introduction that discusses the necessity for the study, literature gap, artificial intelligence and its future, and the goals of performing a systematic literature review. This is followed by the methodology used in the current study. The study's next section focuses on e-commerce, AI applications in various e-commerce processes, and AI and its subsets. Final thoughts, recommendations for further investigation, and study limitations are discussed. The study's findings will open up new avenues for the use of AI in e-commerce.

Keywords: Literature review, Artificial intelligence, AI- subsets, E-commerce, Systematic review

1.Introduction

The modern information age presents new opportunities, technological advancements, and software that can be used for marketing and shopping. Companies must become more inventive as a result of new technologies[1]. Technology aid in boosting the effectiveness, cost-effectiveness, and efficiency of the services offered by enterprises [2]. The development of what are known as information and communication technologies, which have a significant influence on the growth of the corporate environment, provides the foundation for contemporary creativity. Information and communication technologies' efficacy depends on a number of variables, including investments in human capital and the right mix of e-commerce solutions [3]. Retail is one industry where the shift to digital and the significance of e-commerce are particularly apparent, since digital tools like Web sites replace or supplement physical trade to some level [4].

1.1 Meaning of E-commerce

E-commerce has grown significantly since it was initially discussed in the 1980s and is currently among the most popular online activities [5]. Consumer behaviour has changed as a result of the emergence of the Internet and the advancement of digital technology. E-commerce is now being used by more people to make purchases [6].

E-commerce, often known as electronic commerce, is the term for business conducted over the Internet, which is viewed as a single platform that links the seller and the buyer [7]. E-commerce, in Ullman's definition [8], is any commercial activity done online. Any website that can be viewed on PCs, tablets, or mobile phones and is designed to make money falls under this category.

The benefits of e-commerce for online shops (see Fig. 1) mostly relate to improved informational delivery, a greater number of clients served, and a greater number of orders. Internet businesses can operate their online stores more affordably than brick-and-mortar retailers, which results in better sales [10].

According to Ganapathi [11], consumers can profit from a number of things when they shop online (see Fig. 2). Time is saved by the customer not having to travel to the physical store. The consumer has a variety of options to pick from, as well as the ability to compare products or costs. Also, online retailers provide clients with discounts that are unavailable in physical stores. The main benefit is constant accessibility, allowing internet shoppers to buy anything they want, whenever they want.

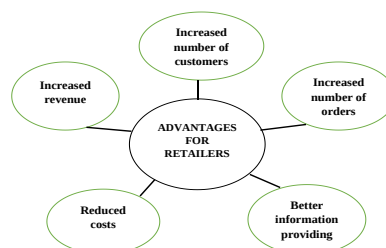


Fig.1: Advantages of e-commerce for online retailers

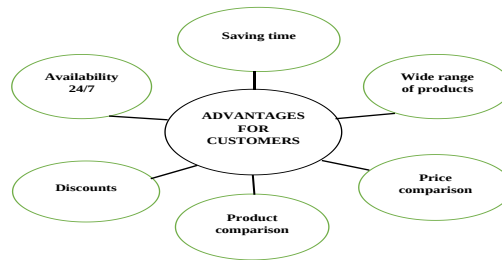


Fig.2: Advantages of e-commerce for customers

E-commerce is the outcome of advancements in economics, science, technology, and culture. The growth of e-commerce is altering consumer behaviour as well as how firms conduct their operations, which is significantly advancing the state of the world economy [12]. New demands from customers are being made, and businesses are continuously faced with the dilemma of how to meet them. It is necessary to implement and employ sophisticated digital technologies as well as make major modifications to the company's current business models and commercial activities in order to implement e-commerce [14].

1.2 Meaning of Artificial Intelligence

Achieving the planned aim, technological systems are now able to discern the environment they are operating in, identify problems, and solve them. Data prepared or gathered by the computer system's sensors, such as cameras, are sent to the computer system. Then it responds after processing the data. Artificial intelligence systems are able to function independently and, to a certain extent, change how they behave based on the study of earlier actions [15].

Applications for artificial intelligence have advanced quickly during the past few decades. In its early stages, expert and knowledge systems used artificial intelligence to provide recommendations. Artificial intelligence has recently evolved to become more human-like and more adept in problem-solving, learning, manipulating objects, and navigating physical space [16]. Artificial intelligence advancements have considerably benefited humankind's economy, enhanced practically every area of daily life, greatly accelerated societal progress, and ushered in a new era [18].

Several definitions of artificial intelligence systems were condensed by Russell and Norvig [22] into two groups (see Fig. 3).

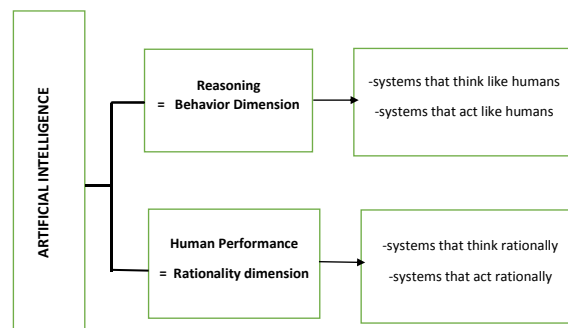


Fig. 3: Dimensions of Artificial Intelligence

By imitating and enhancing human intelligence, artificial intelligence is able to do the automatic activity of mental work. The foundation of artificial intelligence is intelligent technology, from which intelligent instruments, such as robots, voices, or image recognition, are created that are akin to human intellectual labour. These gadgets can respond instantly to control commands [12]. Machine learning, expert systems, and decision support systems are other forms of artificial intelligence [24].

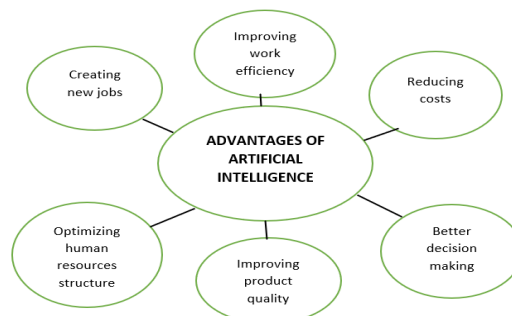


Fig. 4: Advantages of Artificial Intelligence

2. Role of Artificial Intelligence in E-commerce

E-commerce is one of the sectors nowadays that makes the most of AI by amassing a sizable customer base, attempting to comprehend customer wants, conducting real-time research, developing the best possible solutions, and many other tasks [34].

Some research that examine the function of artificial intelligence in e-commerce are listed in Table 1. It includes the study's authors, objective of the study, study theme, and main findings.

2.1 Artificial Intelligence Use in E-commerce

There are various types of artificial intelligence. Artificial intelligence in software includes speech and facial recognition systems, picture analysis tools, search engines, and so-called virtual assistants. Robots, self-driving automobiles, and drones are examples of material technologies that incorporate artificial intelligence [15].

Artificial Intelligence Assistants—Chatbots

Online shopping Customers can access the website 24/7, and virtual assistants and chatbots offer customer service around-the-clock. Using a natural language processing system, the chatbot's main job is to automatically react to consumer inquiries, carry out straightforward voice instructions, and make product recommendations. A different definition of a chatbot is a category of software programme that uses artificial intelligence to have a text-based or voice-based online discussion with users of a particular website or service.

Table 1 : Selected studies about artificial intelligence in e-commerce

Reference	Objective	Study Theme	Findings
Song et al. [12]	To analyze the present situation of the application of artificial intelligence technology in the field of e-commerce	Artificial intelligence in e-commerce	Artificial intelligence will become an important driving force for the transformation of e-commerce
Zhang et al. [27]	To explain how artificial intelligence technology, people, and processes should be managed to successfully create value	Artificial intelligence in e-commerce	The key artificial intelligence capabilities generated include forecasting, planning, and learning. They are not independent—they interact and coevolve with human capabilities to create business value
Soni [34]	To analyze the use of artificial intelligence in e-commerce business	Artificial intelligence in e-commerce	Artificial intelligence can help people excel in their high sales and customer relationships in the e-commerce business
Kar and Halder [36]	To analyze specific integration of chatbots in the IoT systems	Applying chatbots to the Internet of Things	Chatbots can help consumers find products, check order status, compare products, and connect them to the customer support service staff
Kumar and Trakru [37]	To present impact of artificial intelligence in e-commerce	Artificial intelligence in e-commerce	Integration of artificial intelligence in e-commerce companies can help create sophisticated solutions and will impact transactions, customer retention, satisfaction, and efficiency
Pallathadka et al. [38]	To discuss machine learning and artificial intelligence applications in e-commerce, corporate management, and finance	Artificial intelligence in business management, e-commerce, and finance	The most common applications include sales growth, profit maximization, sales forecasting, inventory management, security, fraud detection, and portfolio management
Shankar [42]	To present a framework for understanding artificial intelligence, outline applications of it in different facets of retailing, and discuss the future of artificial intelligence in retailing	Artificial intelligence in retailing	Artificial intelligence will enable retailers better understand consumer psychology by getting them closer to what the human brain is thinking at any given moment
Makridakis [48]	To present changes caused by artificial intelligence, contrasts with the industrial revolution, the impact on developed and developing countries, and the dominant firms in artificial intelligence	The potential effects of artificial intelligence on businesses, manufacturing, and commerce	Relationship between artificial intelligence and humans will strengthen; companies will focus on creating values through collaboration between the human workforce and artificial intelligence tools
Luo et al. [49]	To study the impact of artificial intelligence chatbot disclosure on customer purchases	Impact of artificial intelligence on customer purchases	Prior experience with AI induces more customer purchases and is helpful in reducing the negative disclosure effect
Loureiro et al. [52]	To provide an overview of state-of-the-art research on artificial intelligence in the business context and propose an agenda for future research	Artificial intelligence in business	Future trends in artificial intelligence are the development of advanced automated systems, integration of neurostimulators, and nanochips into the brain, smart devices connected to artificial intelligence systems

The analysis of several authors indicates that artificial intelligence will significantly change e-commerce.

Artificial intelligence can help staff members in the e-commerce sector achieve large sales and solid client relationships. Portfolio management, fraud detection, inventory management, sales forecasting, profit maximisation, and sales growth are the most often used applications. As the connection between humans and artificial intelligence (AI) technology evolves, businesses will place a greater emphasis on creating value through collaboration between human workers and AI technology. The invention of complex automated systems, the integration of neurostimulators and nanochips into the human brain, and smart devices connected to such systems are some of the upcoming breakthroughs in artificial intelligence.

In addition to helping customers identify acceptable products, check the progress of their orders, compare various products, and assist with payments, chatbots can also answer client inquiries and requests. Customers will be sent to the customer support service staff, who will take over, in the event of complaints or inquiries [12, 35, 36].

Recommendations Tool

With the aid of an artificial intelligence algorithm, statistical programming, forecasting, study of consumer behaviour, and the identification of products with high sales potential are all conceivable. The programme can record important details about the searched product based on recent searches made by potential consumers. After that, the recommendation tool provides the necessary browser suggestions and shows information that will ultimately make it easier for clients to find the product quickly [12, 37, 38].

Visual and Voice Search

Visual and audio searches on websites can be implemented using artificial intelligence. Image and sound processing algorithms are the foundation of visual and aural searches. Consumers can search for a product using an image or their voice rather than entering keywords [37, 38]. A potential customer conducts a visual search by entering an image or photo rather than text. The customer uploads an image, types in a specific item, or both, and the search engine recognises it and displays it in the search results [39]. Users can enter spoken language into voice search. After the machine has translated a voice request, the results are shown. Intelligent natural speech detection and processing technologies are the foundation of voice search. Hence, the user is provided with either a verbal response or pertinent information in the form of text or graphics [40].

Customer Relationship Management

Consumers play a crucial role in e-commerce businesses. In the past, businesses managed consumer interactions by using personnel. Artificial intelligence systems are gaining popularity in modern society. Artificial intelligence can forecast consumer behaviour, the items that certain customers will select, and how to develop and maintain the greatest possible connections with them. A business can use artificial intelligence to gather data on customer satisfaction and carefully plan how to address client demands and expectations, independent of the moment or circumstance. In order to maximise profits and sales, people can create a harmonious environment with the aid of artificial intelligence [34, 38].

2.2 Perspective of Artificial Intelligence in E-commerce

In e-commerce, human intellect frequently appears to be constrained in particular jobs. This is especially relevant to supply chain and demand forecasts. Artificial intelligence seems to be a helpful tool in these situations, which provide a problem for organisations [41]. Additionally, it enhances inventory optimization, logistics management, and customer relationship management. Big data analysis is used to create individualised consumer profiles and forecast client shopping habits in marketing and retail, two industries that have included artificial intelligence technologies. It is more crucial than ever to comprehend and predict customer demand through linked supply chains, and artificial intelligence technology is expected to be a key component [29].

The business can gather a variety of data, evaluate clients, and then appropriately respond to their needs and behaviour by offering top-notch services. The company entity can anticipate increased consumer comfort, increased contentment, and a balance of supply and demand mechanisms once the right answer has been decided [2, 41].

According to scientists, humankind and artificial intelligence will work together more in the future, contradicting the widely held belief that people would be replaced by AI. Future market entrants are likely to concentrate on generating value through integrated workforce collaboration with artificial intelligence tools. Making partnerships between artificial intelligence that will function and forecast, and humans that will explain and choose the best course of action is a crucial first step towards success. People will therefore concentrate on value-added tasks that demand design, analysis, and interpretation based on artificial intelligence's processing and outputs [46–48].

According to Kumar and Trakru [37], there are a number of potential e-commerce risks and difficulties that could hinder artificial intelligence's ability to achieve commercial objectives. Due to the shifting demands of consumers in e-commerce, it is imperative to continually investigate the prospects and possibilities. The usefulness of artificial intelligence in a multidisciplinary setting must be investigated in order to enable

advancement in research on its use in the business sector. Experts and researchers will be able to more effectively manage investments in key areas of artificial intelligence, particularly for e-business, by setting priorities and tasks based on comprehensive knowledge [52].

3. Future Research and Limitations

The study can serve as a solid foundation for further investigation into artificial intelligence and its subfields. It combines information from various disciplines and provides a thorough overview of the various technologies used in e-commerce. Since artificial intelligence is still a young technology in the world of e-commerce, there are still a lot of uncharted territories and opportunities for future study. With the development of machine learning algorithms, the technological disruptions brought on by AI can be utilised even further as a way to gain a deeper understanding of the client. More study can be done to address one of e-commerce's shortcomings, namely the absence of touch and feel. The recommendation engines and chatbots with AI-enabled shopping support [106] employed today may one day serve as the final decision-maker. The study's primary flaw, though, is the scant amount of material it examined. The restricted literature does not provide a complete picture of the further fascinating applications of the technology in the field.

The goal of this study is to provide a comprehensive understanding of AI technology in e-commerce. As has been repeatedly emphasised, e-commerce's use of AI is still in its very early stages, and research undertaken so far lack empirical testing. Further studies may confirm the results of this investigation and examine and explore AI applications with unique retail setups, consumer preferences, and simplicity of use, among other factors.

4. Conclusion

The paper's purpose was to explain the fundamentals of artificial intelligence and online commerce as well as their advantages. On the basis of the studies that are now accessible, the article also offers insight into the assessment of the significance of artificial intelligence and its potential applications in the context of e-commerce.

E-commerce is significant in today's world of business and technology. People use the Internet often today; they are open to experimenting with new brands and products but are also critical and demanding.. Past studies have emphasised the need for additional study that will help create knowledge and tactics for using artificial intelligence in e-commerce. It is reasonable to anticipate that artificial intelligence will be employed more and more frequently in the context of internet commerce and will eventually form a crucial component of all businesses of this nature.

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Identity and Freedom in Githa Hariharan's *Fugitive Histories*

***Dinesh Kumar, Ankdeep Kaur Attwal, Baljeet Kaur Anand**

**Research Scholar, Assistant Professor, Department of English, SGGSWU, FGS.*

dineshbassi3@gmail.com

Abstract

Eric Erikson, one of the earliest psychologists, was more interested in the concept of Identity. His works in the psychodynamic tradition aimed to investigate the process of identity formation. An individual's identity is largely formed by his commitment and choice. Freedom is another term that is connected to one's choice and identity. Without freedom no individual can progress. The purpose of this research paper is to study *Fugitive Histories* (2008) of Githa Hariharan, from existential perspective. The text deals with the themes of feminism, communalism, fundamentalism, hatred, intolerance, identity crisis and marginalisation of certain section of society. The text will be critically analysed in this research paper to study the dilemmas of identity and freedom in the characters involved.

Keywords: Identity, Freedom, Choice, Existence, Religious Conflict

Eric Erikson, one of the earlier psychologists was interested in the concept of identity. His work in the psychodynamic tradition aimed to investigate the process of identity formation. An individual's identity is largely formed by his commitment and choice. Freedom is another key term that is connected to one's choice. Without freedom no individual can progress. In the era of globalisation the meaning and identity of things, persons and places is changing rapidly. Thus there cannot be one definite identity in today's fast paced era. Identity formation has been one of the basic struggles of life. Every individual is engrossed in an ongoing race to outshine, outsmart and outdo the other. Heinz Lichtenstein in *The Dilemma of Human Identity* says, "Loss of Identity is a specifically human danger, and maintenance of identity a specifically human necessity" (78). He implies that identity formation is a must for one to live an authentic life. The crisis of identity may not be faced by all but those who are bestowed with a higher purpose of life. Such people might feel alienated and estranged from themselves and society.

According to Encarta World English Dictionary the term "Identity" has been derived from the Latin root "idem"(934) implying sameness and continuity. The process of identity formation is very cumbersome. It takes place in social contexts through interactions with others. In order to achieve security an individual has to adopt the characteristics of a group to which s/he belongs. There happens an identification between the individual and the group. An individual has to pass through the process of describing, naming, labelling and classifying. Once he starts getting recognised he starts behaving as the respectable member of that group. K. Woodward in *Identity and Difference* (1997) says, "Identities in the contemporary world derive multiplicity of sources-from nationality, ethnicity, social class, community, gender... it gives us a location in the world and presents the link between us and the society in which we live" (2). It is implied that identity formation is a literary and complex process.

Freedom is another term that relates to one's choice. Jean Paul Sartre is an active advocate of the concept of freedom. His concept of freedom and moral responsibility establishes through his idea of subjectivity. His idea of subjectivity provides absolute freedom to individual to make a personal choice. But with choice comes the responsibility. The meaning of Sartre's freedom is often misunderstood because of the common meaning of the word. Freedom in normal sense means to possess something of one's own choice. To be free doesn't mean to get what we wish to get. It means whatever we get we have a choice to say anything about it. Sartre's freedom is the power to do things and at the same time power to deny things too. Sartre in *Being and Nothingness* (1977) says, "To be free is-to-be-free-to-change. Freedom implies therefore the existence of an environment to be changed; obstacles to be cleared, tools to be used. Of course it is freedom which reveals them as obstacles, but by free choice it can only interpret the meaning of their being" (506). It is implied that freedom allows the individual to change when he likes to change. It allows him to understand that he is a being not a thing. Man is thus, Freedom. Freedom is identical with consciousness.

Karl Marx's notion of freedom is a little different than Sartre's. His notion of freedom is dialectical theory of human progress of man's efforts to master the forces of nature. Marx and Engels in *The German Ideology* (1976) say, "Freedom is not possible under capitalistic mode of production because its basic objective is exploitation. Freedom is possible only in a classless society where there would be equality and co-operation among all" (75). It is implied that

capitalism is an unjust social system that doesn't allow freedom to human beings. Marx characterises his notion of freedom in terms of human emancipation or human freedom. Thus Marx's concept of freedom is social, collective and positive.

Greek commends freedom as the right to participate in public affairs. One is normally said to be free to the degree where, no human being intrudes in other's affairs. Isaiah Berlin in *Liberty and Loyalty-Modern Political Thought* (1960) quotes Hobbes, “A free man is he that... is not hindered to do what he hath the will to do” (177). It is implied that freedom is a free choice of an individual. He further says, “Freedom positively can be derived from the wish of an individual to be his own master. The wish that his life and decisions depend on himself and not on any external force. He doesn't want to be a machine that works on other's will. He wants to be a subject, and not an object. His actions and decisions should be completely moved by reasons of his own conscience, not affected by the external causes alone” (182). It is clear that freedom means the choice of one's own will that is not influenced by any other factor. Freedom, thus, means zero interference of others in the personal life of an individual. An individual has the right to choose his religion and breathe in a democratic and cosmopolitan environment. Besides he or she must be tolerant enough to respect other religions.

Githa Hariharan, a socially committed writer who won the Commonwealth Writers' Prize in 1993 for her first novel, *The Thousand Faces of Night* (1992). *The Ghosts of Vasu Master* (1994), *When Dream Travel* (1999), *In Times of Siege* (2003) and *Fugitive Histories* (2009) are her other novels. Hariharan, an activist has tried to present the tussel between the various notions of nationalism and sectarianism. She deals with the issues of fanaticism, gender, religion, riots and religious bigotry. In considering the Indian Society, the author presents the life of a common man or woman in political and nationalistic scenario. Githa Hariharan's *Fugitive Histories* (2009) is all about communal violence. The novel becomes her vehicle of protest against the fanatics. It also tells the sufferings of women and children during riots. Their identity and freedom were trampled by the rioters. Hariharan says in an interview to S. Begeshree, “*Fugitive Histories* looks at the familiar ideas in a more personal, private way. It presents the mosaic of lives that collide in unhappy ways, but also in ways that produce love, passion and tenderness. A lot of people with liberal ideas would not hesitate to formally condemn, prejudice against a community”. (Web www.thenindee.com) It is inferred that Hariharan wants to recognise even the smallest unit of country. Her humanitarian and secular approach is visible through her statement. She condemns the fascist, communal forces that belittle, denounce and trample innocent women and children. She advocates that each religion is a force to uplift mankind and seeks respect for all religions.

Fugitive Histories deals with religious bias and hatred. It is about religious identities in India. It presents the plight of the minorities. The novel is divided in three parts 1. Missing Persons 2. Crossing Borders 3. Funeral Rites. Githa Hariharan has tried to expose various problems which have occurred after Babri Masjid incident. Hariharan has brought home the idea that fanaticism has caused riots. She discusses that no freedom is given to establish their identities. She advocates cosmopolitan attitude and encourages humanism in the novel. Sara, a daughter is in search of her identity but she helps those who have suffered the riots. Yasmin gets help from Sara. She is a victim of the Gujrat riots. The novel is based on the struggle of Mala and her husband Asad too who is an artist. As the novel opens, she is to open the trunk of her dead husband. She is trying to find her identity in old memories with Asad:

Mala open the tin trunk, one Asad used to call his all-purpose box. She's never opened it before though it has stood by their bed for years, cloth covering it to make a bedside table. On his side of the bed. When she pulled aside its cover the trunk looked strange at first. It was both recognizable and unfamiliar as if she had come to face to face with someone she knew well but hadn't met for years. (3)

It is implied that she is trying to find her identity after the death of her husband through his paintings. She is determined to prove her worth and ready to live alone and sends her children away:

Not long after the children left, Mala decided to prove to herself what she had told them. ‘Go back of your work. I can manage. Get on with your lives’ They aren't children though she can't get out of the habit of thinking of them as her boy and her girl, as if they are extensions of herself that she has somehow lost control over. As if some organs of vital to her existence, her lungs and her liver, for example, have declared independence and left their home. (3-4)

It is inferred as Mala has chosen independence and decided to search her purpose of life. She has freed her children as not to bother about her.

Another character Yasmin too has declared her independence. She is bold to live her life in her own way. She decides to go to school in spite of all the odds she has to face. Yasmin discusses everything with Sara. She wants to get admission in a college, so that she can get a job and help her parents. Yasmin has lost herself after the riots. She is not able to sleep at night:

Every night Yasmin waits for sleep to find her. She lies as still as possible, eyes shut tight. It should be easy then, the easiest thing in the world for sleep to come to her, settle on her like a warm old blanket. But, like Yasmin sleep too is afraid of the dark. Often it's almost morning before she can fall asleep and once sleep finally comes to her, it has trouble leaving. Sleep sits on her head all day like a thick fat cloud. (115)

She is upset and scared of the harrowing time she has witnessed during the riots. She faces her crisis on daily basis. Fighting for her freedom and identity, she stands alone waiting for God's help. She feels shattered when she listens to the loud speaker, “Go to Pakistan! Go to Pakistan! Go back to Pakistan!” (157) It is implied that all Muslims minorities, felt suffocated because of the discriminating treatment.

Asad is another character who feels alienated and lonely because of his cosmopolitan nature. Mala gets attracted towards him in her first meeting. Soon they start dating each other. They break the rules of society and decide to live a life of their own. Mala's parents cannot like Asad because he is a Muslim. Hindu Brahmins are so fanatic in their customs, they cannot accept Asad as their sacred member. They feel Asad a foreigner, Muslim, can not fit in their framework of a Son-in-law. Mala then as a strong-willed person elopes with Asad and gets married to him against the wishes of her parents. But the couple loses its identity and Asad particularly longs for death. In spite of love for mankind and respect for all religion he is rejected by the society. His religious equality is visible:

Once, on the way back from a May Day rally of Madras, Asad and Mala lingered at a roadside stall selling soapstone objects. Asad picked out the best piece easily. It was a standing Ganesh, one foot a step forward... He gave it to Mala's mother.

Mala's mother said nothing though she winced at the sight of Ganesh only Ganesh comfortably cradled in Asad's hands. (58)

Later Asad gives place to this Ganesh in his studio. Still the Hindu relatives of Mala cannot like Asad. He is torn inside but show his cool image. Asad tries hard to maintain his personal identity above social identity.

Bala, the mother of Mala, also suffers male domination and identity crisis. She was married in her childhood. She felt suffocated. In her early years she thought, “What she wanted was to find a place to be in or a thing to do what would set her free from her family her home, and school in the city, her annual summer home in the village. What she wanted was to be set free from herself. What she wanted was to be someone else” (15). Bala is seen as an object in the house. She longs for her own identity and freedom which she never gets. She is a traditional house wife who is not allowed to come out of her home. Most of the time she is locked in the store-room. Her grandfather thinks that store-room is a better and safe place for women. She suffers as a slave and like a commodity she is placed in a home.

The alienation and identity crisis, Bala witnesses after marriage makes her life purposeless. How could she think of identity when she was not allowed to move out of home and see the light of freedom. Asad had painted her a person who lost her mental balance. She used to cut her hair after a short span of time. It was because of her husband wanted her not to look beautiful. She had stopped to live the life of her wishes. She had no choices. After cutting her hair, she used to make a nest of her hair for birds. She felt some baby bird would learn flying on her nest of hair. It would fly away in the sky. It shows her suppressed desire of freedom. Even her loose hair signifies the idea of freedom. The freedom which she could not secure for herself, she wants to give it to her daughter Mala. When Mala shares her secret love for Asad with Bala. She wants Mala to rebel against social norms:

Bala listens gravely as if it all makes sense to her—a young woman travelling from this village to Bombay, finding herself a strange man there. Then her eyes fill with fear. ‘That one time I want away, he found me’ Bala says, ‘He brought me back, didn't he?’ She pushes Mala away. ‘Run’, she says. ‘Run before he catches you. (67)

It is inferred that Bala wants her daughter not to follow foolish patriarchal rules of society.

When Mala comes to see her mother Bala after marrying Asad, Bala feels so happy and satisfied. She is happy for her daughter's union with the man of her liking. She is happy as Mala has defeated the society she says, “You and I beat them, she gloats. ‘you married him. I couldn't escape this place but I've lived longer,

than that old bastard boss. We’ve won” (76). Thus at last both mother and daughter have made a mark and achieved their identity and freedom.

Another major character who suffers this identity crisis is Sara, Mala’s daughter. She is in love with Rajat Shaw who is a half-Hindu and half-Christian. She is a fun-loving girl who wants to live her life on her own terms. In her school she always felt herself different from other children. She always followed her father’s ideals of loving all, irrespective of caste, colour and creed. She becomes a social worker. She was so much attached to Asad, her father and his death shattered her completely. But she balances herself and shifts from Mumbai to Ahmadabad to help some Muslim victims of riots. To find her own identity she discovers a novel way of helping others. She finds Yasmin suffering after the riots. She supports Yasmin and her mother who have suffered the attacks of fanatics. She makes Yasmin speak of the ill fate she had witnessed during riots. She helps Yasmin to take admission in college and pays her fees too. While she was returning to Delhi in train, she found herself in a lurch as a couple ignored her when they come to know about her religion. She felt hurt how could people think in such an absurd way. Then she remembers her father. In this dilemma of identity:

When Sara came home with questions about what she was, or what she was supposed to do with forms that asked her to fill in the blank next to Religion, Asad told her, ‘Don’t be ashamed of who you are. Don’t be ashamed who you’re not. (180)

It is inferred that she has sought strength from her father to make a choice in life. She is proud to be hybrid now. She overcomes her anxiety. She shares everything with her mother.

Mala smiles; they look deep into each other’s eyes. ‘How lucky I am’ Sara says. She’s already moved back from their past to her presents, thinks Mala. But she gamely prompts Sara. ‘Lucky?’ ‘Yes, I am beginning to realize how lucky, I am. How glad I am that I’m a hybrid’ Sara drops her gaze, adds almost shyly ‘I wish I could tell’ Asad that. (184)

From this conversation between Mala and Sara, it is implied that Sara has achieved her identity and freedom. She feels herself fortunate enough to be daughter of a hybrid couple.

Samar is another character who passes through the process of identity crisis but he too is able to find himself in the novel. He is elder son of Asad and Mala. His grandmother wanted to name him as Ramkrishna but Asad and Mala chose a different name, they wanted him to be free from any identity clash. But Samar himself wants to have some religious identity. He wants to live as a Muslim and he makes a choice to live as a Muslim in Dubai. He doesn’t want to remain as a half-Hindu and half-Muslim. He wants to achieve complete identity. He learns everything about Muslim religion and strictly adheres to its laws. He makes certain rules for himself and happy to be a Muslim.

Thus, Hariharan has shown how sectarian destructiveness has brought alienation and identity crisis in many sections of society. She has brought out a clear picture how the existence and survival of people is endangered during riots. The important point Hariharan has raised in *Fugitive Histories*, is that why do people need name and religion from their identity? Why can’t they exist normally as human beings? So the freedom and identity in a country like India seem impossible without religion. Actually fanaticism, sectarianism hinder the growth of our country.

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Role of Government in Development of Agriculture in Jammu District

Iram Javeed

PhD Scholar, RIMT University, Punjab, India.

iramjaveed5@gmail.com

Abstract

Jammu and Kashmir UT are dependent on agriculture as people derive their livelihood from agriculture only. About 60 percent of the population is dependent on agriculture only. The climate of this region does not favour agriculture, so they are dependent on rainfall. The challenges and obstacles which come in the way of productivity and production are mountainous region, lack of transport and infrastructure, poor conditions of roads etc. The objective of this paper is to highlight the agricultural situation in Jammu District as well as the policies framed by the Central Government to uplift the production of agricultural products in Jammu District and the efforts made by the Government at UT to implement the same. The study is theoretical in nature and is based on secondary data analysis. The results and findings reveal that agricultural schemes have benefitted only a small section of people.

Keywords: Agricultural Schemes, Economic Development, Jammu District, Technology.

Introduction

Agricultural insurance schemes are designed by the Central Authority to provide financial protection to farmers against unforeseen losses due to natural calamities, weather-related risks, pests and diseases, or other unforeseeable events that can negatively impact their crops or livestock. In Jammu district, several agricultural insurance schemes are launched to benefit the farmers.

One such scheme is the Pradhan Mantri Fasal Bima Yojana (PMFBY), which is a centrally sponsored crop insurance scheme. Under this scheme, farmers can avail of insurance coverage for their crops against yield losses, including losses due to localized weather events, such as drought, floods, or storms. The scheme covers all farmers, including sharecroppers and tenant farmers, and provides them with a premium subsidy to make insurance coverage affordable. Another scheme available in Jammu district is the Weather-Based Crop Insurance Scheme (WBCIS), which is designed to protect farmers from losses due to adverse weather conditions. The scheme uses weather data to assess crop losses, and farmers can avail of insurance coverage for their crops against yield losses due to weather events such as excess or deficient rainfall, temperature fluctuations, and other weather-related risks. Additionally, the Livestock Insurance Scheme is available in Jammu district to provide insurance coverage to livestock owners. Under this scheme, farmers can avail of insurance coverage for their animals, including cattle, buffaloes, goats, and sheep, against accidental death or death due to diseases. In conclusion, these agricultural insurance schemes are available to farmers in Jammu district to help protect them against unforeseen losses due to weather, pests, diseases, or other risks that can impact their crops or livestock. These schemes provide farmers with financial protection and help them mitigate risks, thereby supporting the growth and development of the agricultural sector in the region.

Jammu and Kashmir lies at extreme north of India between 32 degree and 36-degree north latitude and 73 degree and 83-degree east longitude. The UT is divided into four zones geographically – Kandi belt which is mountainous and semi- mountainous plains, Siwalik ranges that is hills, Pir Pangal range and Tibetan tract of Ladakh and Kargil. Due to the location and topography, there are extreme variations in the climate of the UT as well as the temperature which is a risk for crops productivity.

The UT derives its economy from agriculture. The main crops are wheat, maize, and paddy while bajra, jowar and barley are cultivated in some parts of Jammu and Kashmir. For the upliftment of agriculture, the Government has started several initiatives like Paramparagat Krishi Vikas Yojana (PKVY), Pradhan Mantri Fasal Bima yojana (PMFBY), Soil health card etc. As per Statista 2023, the land under cultivation in Jammu and Kashmir as per 2022 financial year was 402.47 thousand hectares, out of which 335 thousand hectares was under production of fruit and 60 thousand hectares for production of vegetables.

As per the Budget for Department of Agriculture and Farmers Welfare (DAandFW) is being increased from rupees 21933.50 crore for 2013-14 to rupees 124000 crore in 2022-23 which is for the implementation of especially agriculture and welfare schemes which aims to increase agricultural production and welfare of farmers. Also, rupees 8513.62 crores are granted to Department of Agricultural Research and Education in 2022-23. For Jammu and Kashmir area covered under Micro irrigation is 1104 hectares and Central assistance released is 58.07 crores released under PDMC (Per Drop More Crop) since the launch of the scheme till today.

Map of Jammu District



Source- CEO, JK.

Review of Literature

Sharma et al., (2014) in their study mention that the markets for agricultural production change day by day agricultural development is a process that heavily depends on innovation. By innovation it does not mean only technology and production but also organizations their management, marketing, attitude, new methods of performance etc. All of this require knowledge which is new in its type.

Akhter and Acharya (2015) in their study suggest the use of new cropping patterns and new technologies while the farmers having low income cannot do so. Government intervention is required. Better technologies, how to use water, crop diversification, good wages are all required. Shift from subsistence to commercial farming is the need of the hour. Promotion of cash crops as well as traditional crops.

Peshin et al., (2018) in their work state that the size of farm as well as the annual facilities for irrigation are the two main factors which affect the adoption of new technology thereby impacting productivity of rice. For Jammu and Kashmir they state the reason for low productivity is the total area to be cultivated under irrigation for about decades has not grown.

Panigarhi et al., (2019) conducted a study on 120 farmers engaged in growing rice in Jammu district of Jammu and Kashmir to evaluate the awareness of farmers with regards to protection of plants. The respondents having a lot of experience in farming had average level of awareness regarding plant protection.

Padder (2021) state that the use of new technology depends on farmer to farmer, his exposure, access to products like fertilizers, seeds, and availability of credit. The technology used in green revolution was very expensive and could be purchased by rich farmers only as that technology was highly capital intensive. The rich farmers only could afford to purchase those technologies and could get benefitted from it.

Sharma and Bhatt (2022) in their study highlight the role of innovation and entrepreneurship in agriculture sector of the economy. It is very important with respect to management and marketing in agriculture. Innovations in agriculture increase household incomes. To become an agri-entrepreneur certain qualities are required like innovation, ability to bear risk, confidence, honesty etc.

Objectives of the Study

- I) To find out the role of Government in implementing agricultural insurance schemes for the development of Jammu District.
- II) To find out the impact of agricultural insurance schemes on productivity in agriculture sector of Jammu District.
- III) To provide policy implications on how agricultural insurance schemes in agriculture sector can bring increase in productivity.

Research Methodology

The methodology used to carry out research is through secondary data analysis. Data is collected through various magazines, articles, journals, internet, websites, published data, articles, books, Government records like Directorate of Economics and Statistics Jammu and Kashmir, Directorate of Agriculture Jammu and Kashmir etc. and is further analysed to draw necessary conclusions.

Research Findings

Table 1 National Agricultural Insurance Scheme (NAIS).

No. of Farmers covered	Area Insured (in ha.)	Rs. (in Lakh)			No. of Farmers benefitted
		Sum Insured	Premium	Claims	
49065	68994.99	10902.23	213.80	123.20	4292

* NAIS Business Statistics from Rabi 199-2000 to Rabi 2013-14 i.e. for 29 Seasons.

Source: Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India (Annual Report 2014-15)

The National Agricultural Insurance Scheme was launched in 1999-2000 in the country. The purpose of National Agricultural Insurance Scheme was to relieve the farmers loss financially arising from crop failure, natural disaster, and calamities. It also urged farmers to use innovative technology. It also aimed at balancing farmers income. But despite launching the National Agricultural Insurance Scheme in modified form it benefitted very a smaller number of farmers in terms of coverage as seen in table 1 above. Because of these shortcomings this scheme was replaced by Pradhan Mantri Fasal Bima Yojna, launched in the year 2016.

Table. 2: State-Wise progress under Pradhan Mantri Fasal Bima Yojna (PMFBY)- 2018-19.

											(₹ in Lakh)
S.No.	State / UTs	Number of Farmers covered	Area Insured (In Ha)	Sum Insured	Farmers' Premium	Gol Premium (Share)	State Govt. Premium (Share)	Gross Premium	Claims Reported	Claims Paid	Number of Farmers Benefitted
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	Andhra Pradesh	3740663	2927202.86	1988482.74	46423.49	69162.69	69162.69	184748.87	132811.07	103282.41	397609
2	A & N Islands	1408	1057.52	363.37	6.06	11.18	11.65	28.90	14.56	14.56	295
3	Assam	138094	94324.95	59509.25	1182.54	721.10	721.10	2624.74	154.12	148.59	2235
4	Bihar	5017309	4610148.66	2175564.36	38245.60	103055.81	103055.81	244357.21	74999.63	74788.56	434925
5	Chhattisgarh	4560366	6885389.25	2180257.50	42077.91	54482.18	54482.18	151042.26	258615.20	258589.35	1429495
6	Goa	1633	1216.27	1350.98	14.88	0.46	0.46	15.80	12.39	12.39	158
7	Gujarat	5913092	8289552.30	3812612.24	104419.64	374856.16	388475.61	867751.41	494181.17	494087.81	2473347
8	Haryana	4134305	6072977.60	3778187.63	65854.64	42459.81	57501.44	165815.90	212169.99	212160.02	962173
9	Himachal Pradesh	648455	225536.84	82188.94	1134.62	1279.84	1279.84	3694.30	2557.37	2556.90	122800
10	Jammu & Kashmir	312737	262646.48	148082.84	2588.28	4588.64	4588.64	11765.55	3438.90	1671.90	29067
11	Jharkhand	3365274	1292800.04	698461.11	11729.37	37225.68	39049.86	88004.91	50410.01	9114.56	251170
12	Karnataka	6443360	6397842.67	2558076.79	57789.46	190106.79	190106.79	438003.03	492711.98	481737.38	3295837
13	Kerala	50021	45124.12	41387.27	825.68	483.10	483.10	1791.89	1691.87	1691.54	11060
14	Madhya Pradesh	20389304	36752640.40	12784141.54	220350.41	573184.44	572251.03	1365785.88	815702.86	740344.61	3037936
15	Maharashtra	36233454	21327617.20	6556661.26	159876.54	532446.86	532446.86	1224770.27	893800.87	892984.50	15508240
16	Manipur	18927	28554.13	9193.63	158.99	207.61	207.61	574.22	263.02	263.02	11960
17	Meghalaya	3727	4136.87	3074.72	111.90	22.45	22.45	156.79	13.56	4.34	58
18	Odisha	5790047	4134359.54	2312140.57	45649.67	99039.63	99039.63	243728.93	325636.26	325480.61	1555474
19	Puducherry	19276	17292.72	9112.91	112.57	230.85	256.01	599.44	802.47	802.44	4767
20	Rajasthan	24765936	27542569.79	6784223.27	142184.69	354477.27	354477.27	851139.23	690322.05	650891.65	7252586
21	Sikkim	2220	515.58	437.26	9.47	0.20	0.20	9.86	14.35	14.35	332
22	Tamil Nadu	5011568	3505493.72	2065502.19	35557.12	177951.90	177951.90	391460.91	741200.05	726585.57	3176043
23	Telangana	2436453	2227201.03	1533140.97	29173.00	29013.14	29013.14	87199.28	51971.36	36884.09	384163
24	Tripura	24063	5946.11	3947.11	90.65	12.79	12.79	116.23	170.46	170.46	6404
25	Uttar Pradesh	18822341	16346456.77	7129981.03	131944.72	137969.30	137969.30	407883.33	139737.50	139258.84	2391343
26	Uttarakhand	518656	286789.30	193368.72	2403.73	738.92	738.92	3881.57	1585.84	1584.30	71510
27	West Bengal	13367975	5475785.38	3744023.54	69949.99	64758.86	72736.07	207444.93	123646.58	86143.73	1387717
Total		161730664	154761178	60653474	1209866	2848488	2886042	6944396	5508635	5241268	44198704

Source : Department of Agriculture, Cooperation & Farmers Welfare

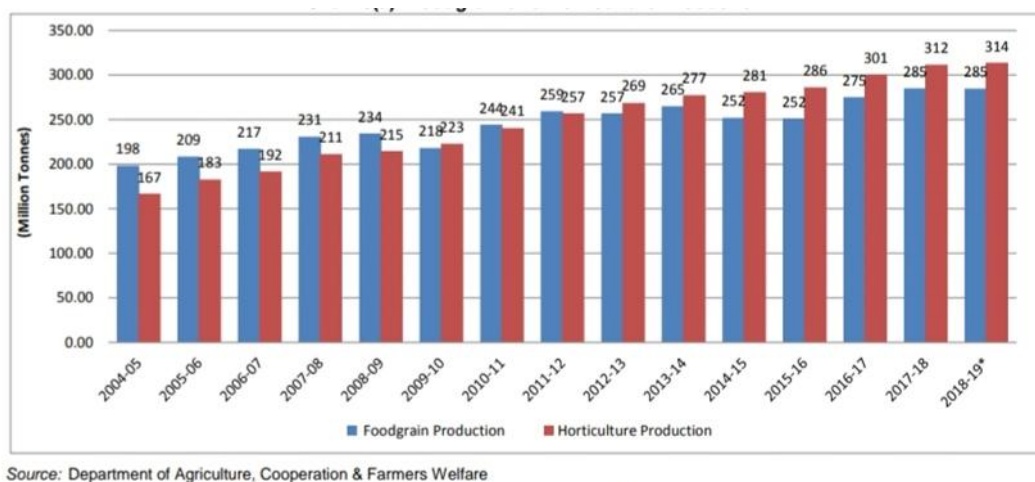
The Pradhan Mantri Fasal Bima Yojna (PMFBY) was revised with several characteristics like use of latest technology and innovation, one premium, claims to be paid into accounts of farmers directly, one season, farmers to participate voluntary, subsidies to be paid on time, linked to Aadhaar, Risk coverage etc. Despite all these efforts the success rate of this scheme was very less from 2016-17 to 2017-18. Farmers insured were less in number, areas, claims, farmers benefitted all low especially in case of Jammu and Kashmir. Only 29067 lakh farmers got benefitted against 312737 lakh farmers covered.

Fig.1



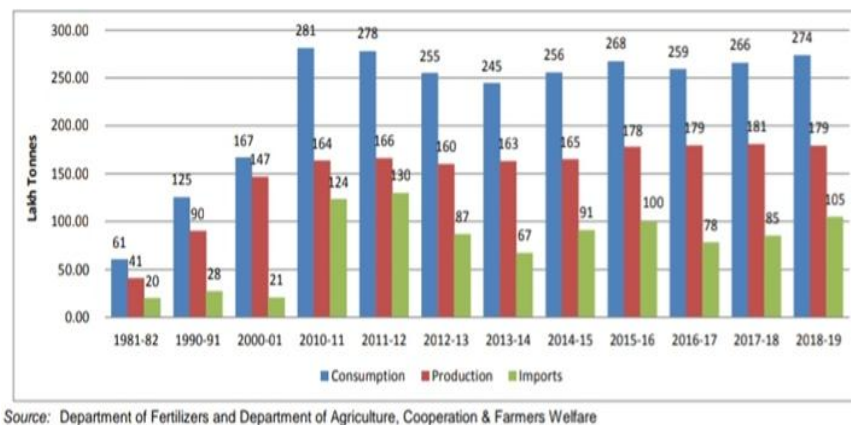
Main export places of agriculture of India are USA, UAE, Indonesia, China, Pakistan, UK etc. The figure above shows that the total percentage of merchandise exports of India were 12 percent, but they declined from 12.9 percent in the year 2017-18 to 11.9 percent in 2018-19.

Fig.2: Foodgrain and Horticulture Production.



In figure above as per the data, we cannot see much increase in the production of foodgrains. But, as promised by the Pradhan Mantri Fasal Bima Yojna (PMFBY) the increase in production of foodgrains. Nothing seems like that. The data from 2016 till 2019 is 27.5 to 28.5 million tonnes.

Fig.3: Consumption, Production, and Imports of Fertilizers in India.



The figure above gives clear picture of that the consumption of fertilizers in India is far more than the level of its production. Also, the data from 2016 till 2019 show increase in consumption of fertilizers from 268 to 274 lakh tonnes.

Table.3: State-wise area Insured under all Insurance Schemes.

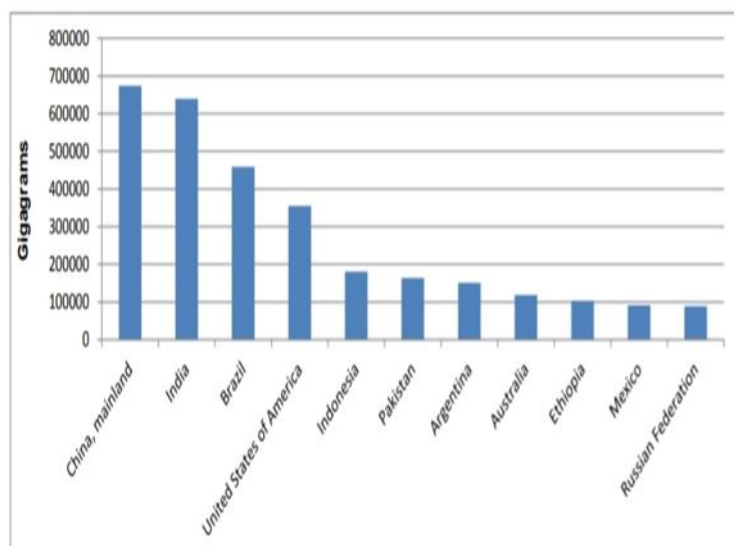
States/UTs	2015-16			2016-17			2017-18			2018-19		
	Gross Area Sown	Area Insured	% of Area Insured	Gross Area Sown*	Area Insured	% of Area Insured	Gross Area Sown*	Area Insured	% of Area Insured	Gross Area Sown*	Area Insured	% of Area Insured
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Andhra Pradesh	75.32	23.49	31.19	75.32	15.60	20.71	75.32	21.52	28.58	75.32	22.34	29.66
A & N Islands	0.48	0.01	2.87	0.48	0.00	0.53	0.48	0.00	0.52	0.48	0.01	1.16
Arunachal Pradesh	3.01	0.00	0.00	3.01	0.00	0.00	3.01	0.00	0.00	3.01	0.00	0.00
Assam	40.60	0.29	0.70	40.60	0.41	1.01	40.60	0.42	1.03	40.60	0.48	1.19
Bihar	75.72	28.06	37.06	75.72	24.84	32.81	75.72	21.26	28.07	75.72	0.00	0.00
Chandigarh	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
Chhattisgarh	56.40	23.52	41.53	56.40	24.14	42.80	56.40	22.16	39.30	56.40	22.75	40.33
Daad & Nagar Haveli	0.23	0.00	0.00	0.23	0.00	0.00	0.23	0.00	0.00	0.23	0.00	0.00
Daman & Diu	0.03	0.00	0.00	0.03	0.00	0.00	0.03	0.00	0.00	0.03	0.00	0.00
Delhi	0.58	0.00	0.00	0.58	0.00	0.00	0.58	0.00	0.00	0.58	0.00	0.00
Goa	1.57	0.00	0.00	1.57	0.01	0.35	1.57	0.00	0.25	1.57	0.00	0.17
Gujarat	115.22	10.31	8.95	115.22	30.21	26.22	115.22	26.58	23.07	115.22	26.11	22.66
Haryana	65.10	0.00	0.00	65.10	20.85	32.02	65.10	19.34	29.70	65.10	20.55	31.56
Himachal Pradesh	9.33	0.54	5.80	9.33	1.29	13.88	9.33	1.11	11.87	9.33	0.89	9.59
Jammu & Kashmir	11.59	0.00	0.00	11.59	0.00	0.00	11.59	1.53	13.16	11.59	1.10	9.50
Jharkhand	18.12	4.17	23.01	18.12	3.72	20.53	18.12	2.90	16.02	18.12	6.31	34.82
Karnataka	120.09	17.18	14.31	120.09	26.12	21.75	120.09	18.08	15.06	120.09	22.19	18.48
Kerala	26.28	2.46	9.36	26.28	0.53	2.02	26.28	0.48	1.82	26.28	0.43	1.65
Lakshadweep	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00
Madhya Pradesh	237.14	121.15	51.09	237.14	126.09	53.17	237.14	121.22	51.12	237.14	129.53	54.62
Maharashtra	234.67	83.01	35.37	234.67	72.98	31.10	234.67	58.96	25.12	234.67	88.19	37.58
Manipur	4.37	0.17	3.84	4.37	0.09	2.09	4.37	0.19	4.27	4.37	0.01	0.18
Meghalaya	3.03	0.01	0.33	3.03	0.00	0.01	3.03	0.03	1.12	3.03	0.01	0.23
Mizoram	1.88	0.00	0.00	1.88	0.00	0.00	1.88	0.00	0.00	1.88	0.00	0.00
Nagaland	5.04	0.00	0.00	5.04	0.00	0.00	5.04	0.00	0.00	5.04	0.00	0.00
Odisha	48.03	20.47	42.63	48.03	13.19	27.46	48.03	13.54	28.19	48.03	14.62	30.44
Puducherry	0.26	0.02	7.66	0.26	0.07	28.64	0.26	0.00	0.00	0.26	0.10	38.67
Punjab	78.72	0.00	0.00	78.72	0.00	0.00	78.72	0.00	0.00	78.72	0.00	0.00
Rajasthan	250.14	114.55	45.79	250.14	103.77	41.49	250.14	98.48	39.37	250.14	74.31	29.71
Sikkim	1.37	0.00	0.00	1.37	0.00	0.00	1.37	0.00	0.00	1.37	0.00	0.00
Tamil Nadu	60.74	12.45	20.50	60.74	12.30	20.24	60.74	11.66	19.20	60.74	11.10	18.27
Telangana	48.93	16.07	32.84	48.93	8.22	16.80	48.93	10.46	21.39	48.93	7.77	15.89
Tripura	4.86	0.01	0.21	4.86	0.03	0.58	4.86	0.03	0.63	4.86	0.00	0.02
Uttar Pradesh	262.03	37.98	14.49	262.03	65.11	24.85	262.03	47.08	17.97	262.03	51.34	19.59
Uttarakhand	10.83	1.11	10.26	10.83	1.32	12.22	10.83	1.16	10.75	10.83	1.09	10.07
West Bengal	98.81	8.84	8.95	98.81	19.96	20.19	98.81	16.75	17.05	98.81	18.02	18.23
All India Total	1970.54	523.86	26.58	1970.54	570.84	28.97	1970.54	514.99	26.13	1970.54	519.25	26.35

Source: Department of Agriculture, Cooperation & Farmers Welfare

Source- Department of Agriculture, Cooperation and Farmers Welfare

The data as per above table for Jammu and Kashmir from 2015 till 2019 shows the area insured against the area cropped is very less. The results don't show much improvement with respect to insurance of area under crops.

Figure 4- Total Agricultural Emissions in major countries in 2017.



Source: FAOSTAT (as on 31-01-2020)

The above figure shows the data on agricultural emission which is equivalent to carbon dioxide in the year 2017, where India stands second in rank.

Conclusion

It is seen from the above data that Government sponsored schemes failed to produce results and did not improve the productivity of the crops. Despite of continuous efforts of the Government agriculture sector faced several challenges which blocked the growth in the region. Those factors were ignorance of the farmers, illiteracy, old equipment's, traditional methods of farming etc. If the Government wants maximum benefits from the schemes than proper awareness regarding the benefits of the schemes should be launched. Also, it should be noted that

the schemes are properly implemented or not. It is further suggested that the funds released for Research and Development of Agriculture be increased, so that maximum benefit is drawn.

Challenges Faced by the Scheme

- I) At present the PMFBY scheme cannot make a distinction between large and marginal farmers and gives rise identification issue. Small farmers being the most effected class. The Central government introduced the Pradhan Mantri Fasal Bima Yojana (PMFBY) in April 2016, claiming that the scheme will bring benefit for the farmers suffering from random monsoons, frequent rains, drought, floods, forest fires etc.
- II) Government sponsored crop insurance schemes resulted in a failure around the world, and India is one of those countries. Pradhan Mantri Fasal Bima Yojana (PMFBY) could not show many benefits. The government's focus will be to bring in more farmers without loans (which comprise merely 5 per cent of total farmers at present) under the scheme. Insurance for is a risk as the farmers depend on rain amidst climate change.
- III) Different limitations include the attitude of farmers and state Government, funds, equipment, skills, accessibility, clarity, and efforts of insurers.
- IV) One challenge is to differentiate between insurance and relief for disaster. Insurance is commercial based while relief for disaster for small farmers is a social inference. Marginal farmers should be given a Social Protection in the form of insurance than a commercial policy.
- V) lack of awareness regarding agricultural insurance schemes. Backward regions with very less development because of limited information.

Policy Implications

- I) All-essential crops must be included in crop insurance. Divergence of crops and mixed farming must be adopted.
- II) ‘Potential yield’ must be applied for crops for which no data is accessible.
- III) Loss caused by wild animals, and frost to crops must be borne at the individual level.
- IV) Farmers should be notified prior to taking crop insurance payment.
- v) Panchayati Raj Institutions must be participating in implementation process.

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Focus Group Discussions-Mixed Method Approach

Nancy Devinder Kaur

Assistant Professor, Department of Journalism and Mass Communication, Punjabi University, Patiala

head_jmc@pbi.ac.in

Abstract

This chapter deals with exploring focus group discussions-a qualitative research method as a unique part of Mixed Method Research Approach. The researcher has explained the versatile and malleable aspect of this method and has Pen down the techniques of using focus group discussions for yielding both qualitative and quantitative data. The paper also illustrates the importance of this method in media and communication studies. Focus group discussions can successfully be used as a main research method when dealing with sensitive issues related to human psychology. This research method can also be used as a supporting tool for enhancing the richness of quantitative data.

Key words: Focus group discussions. Qualitative Research, Quantitative Research and Mixed Method Approach

Media research has evolved over past two decades with primary focus on mixed approach research design. With digitalization of media technology, the media's content, role and influence on the society has significantly increased. Also, the audience across the globe has become more perceptive, active and better-informed. Now to develop link between media and audience researchers cannot solely rely on empirical media research. They need to develop on agreement between quantitative and qualitative research methods for more detailed and intensive research in media.

Mass media is interdisciplinary in nature sharing features with sociology, psychology, business management, law and also languages. Thus, media research also needs to be multi-facet. With this understanding, media researchers are cross fertilizing the quantitative and qualitative methods. The trend is shifting to design or evolve research methods or tools that yield both qualitative and quantitative data and at the same time are cost effective and manageable to execute. One such method is Focus Group Discussions. Focus Group Discussions are primarily used as qualitative research method. Qualitative research embraces methodologies that are theoretically framed by critical or interpretative social science paradigms that emphasize interpretation over measurement. (Barrie Counter, pp33). These kind of research methods comprise of in-depth interviews or ethnographic approaches based on observation. The qualitative research methods give importance to study the variables under investigation in their natural settings. A detailed data is collected and the research has both descriptive and analytical reasoning about the actions of selected variables. Therefore, such methods are also called interpretative researches.

This design in mass media field emerged in 1970's. A few sociologist favoured qualitative tools derived from literary or semiotic theories to investigate media issues and content. They were in line with the Frankfurt school of thought and challenged direct influence of media model and methodologies of the positivist empirical behaviours in perspective (Barrie Counter, pp18).

These research designs soon gained importance from the researchers as these tools brought personal values to the study and also validated the accuracy of the data collected (John W. Cresswell, pp17). They help in understanding complex human issues.

Focus Groups Discussions: The origin of focus groups was in sociology. This method helps in understanding human perceptive in detail. This technique is very effective and proper when the researcher is dealing with sensitive issues. Focus groups is a group interviewed based, in other words it is a type of in-depth interview accomplished in a group where meetings present characteristics defined with respect to the proposal, size composition and interviews based. (Lobanath Mishra, 2016).

The versatile nature of focus group discussions is making it very popular in communication and media studies.

Process of conducting focus group discussions:

The first step for conducting focus group is to identify the aim or key objectives of the study. The researcher should have a clarity regarding the kind of data researcher wants.

Based upon the objectives Research design is formulated

Research design:

- Objectives of the study
- List of questions
- Ethical clearance
- Identify the participants

- Select the location
- Guidelines for the moderator
- Number of focus groups sessions
- Material required for sessions (recording equipment's, stationary items ... etc)

After drafting the research design and also preparing for the sessions the next step is data collection:

Data collection:

- Send the invites to the respondents
- Ensure proper sitting arrangement
- Install the required equipment
- Get the consent forms filled
- Conduct the sessions
- Track the questionnaire for completion
- Conclude

The last step is data analysis, interpretation and report writing

Analysis of data:

- Analyse the sessions
- Content analysis
- Interpretation of data
- Report writing

Focus group discussions are cost effective and economical method for research. The only limitations to this method is training of the moderator. The success of this research method is based on the experience and wisdom of the moderator or researcher.

This method shares a lot of proximity with interview method but they are quite distinctive methods. Interviews involve a one-to-one interaction between an interviewer and an interviewee. It is kind of questions-answers session. On the contrary in focus group there is a moderator who initiates the conversation and keeps the interaction on the selected topic.

In interviews the researcher plays a centre stage role and in focus group discussions, the researchers remain on the periphery.

Both the methods are qualitative in nature but in focus group discussions a lot of arguments and perspectives generate within a limited duration, thus yielding whole some data giving deeper understanding of a problem or issue. This method has an advantage of creating synergy effect on participants. Here, the participants influence each other and also lead to discussion between the respondents. This helps the researcher in proper understanding of human psychology and behaviour.

Focus group discussions are a 'cost-effective' and impactful method in participatory research. By 1990's, its popularity and usage has increased in various disciplines like education, communication and media studies and marketing research. (Lunt and Livingstone, 1996)

One important aspect that led to its popularity was its versatile and flexible nature. Focus group discussions can be very conveniently used with any other research method (Both qualitative and quantitative)

Another very important consideration is the number of respondents for each session. It is generally accepted that 8 to 10 participants are enough for one session of discussion.

A focus group session can also work successfully with as far as three participants. Small groups can limit the data, while in large group, with more than 12 to 18 participants the discussion can become chaotic. The large groups are difficult for the moderator to handle and also irritating for the participants who don't get to actively participate in the discussions

Apart from the size for the group, selection of participants is also very important. The composition of the group largely depends on the main aim of the research. Homogenous group yield more results as similar characteristics (Age, gender, ethnic and social status) interact readily with each other, but in few instances, likeness is challenged by some researchers, since participants with varied characteristics give honest and spontaneous view and give better insight regarding the topic under investigation. It is even believed that mixed gender sessions improve the quality of interaction.

For recruiting the participants, the researchers follow purposive or convenient random participants selected on volunteer bases.

With the emergence of internet and personal computers, major changes have come in media and entertainment sector. Mobile phones have revolutionized the communication and entertainment patterns of the audience. Now with social media, YouTube and google the audience has become information rich and more active. Also, massive media content is now produced and consumed. These smart new technologies are blurring the lines between the media content makers and audience eg. TikTok, internet reels etc. All these technologies are providing a forum to audience to become content producers. Media producers and distributors are

concentrating on knowing the audience like never before. In order to have a large market share, they want to develop loyal fan base. The content producers and advertisers are doing research to know the amount of attention different media or types of media content are able to attract, and to explain what turns on the audience on to a particular media outputs and for enriching the academic literature.

Therefore, the market analysts and the researchers are shifting to mixed method strategies.

Mixed media research is being focused on as an innovative and effective methods. This concept of mixing different methods originated in 1959, When Campbell and Fisk used this technique to study validity of psychological traits (pp14 John W. Cresswell). The researchers acknowledged that every research method had certain limitations and if mixed method approach is followed limitations or biases of a single research method can be neutralized. Thus triangulation design evolved. This means convergence or mixture of qualitative and quantitative methods (Jick, 1979)

By,1990's this trend gained a lot of popularity in the research field. Research writers across the globe developed procedures for mixed method strategies. John W. Cresswell in his book research design: Qualitative, Quantitative and Mix Methods Approaches has given three general strategies.

> Sequential Mixed Methods: With this procedure the researches focus on expanding the data of one method with another method. -The researchers have both the options: executing qualitative method just followed by quantitative or vice versa

> Concurrent Mixed Methods: In these types of design the researchers converges qualitative and quantitative in order to provide both forms of data.

> Transformation mixed method: In this research design both qualitative and quantitative perspectives feature in a single research method.

Selecting the research design depends on the nature of the research problem and also on the experience of the researcher. Focus group discussion is one confident qualitative research method which is very flexible and easy to mould as per the requirement of the research proposal. Thus, best suited for mixed approach researchers.

Now-a-days the researchers are using focus groups discussions as a part of mixed method approach research design. Focus group discussions are being used to enrich the development of survey. Focus group discussion are used for developing questionnaire. The success of a survey depends on the clarity and effectiveness of the questionnaire. The researcher conducts focus group discussion for having an understanding of the sample. The sessions give an insight of the intellectual level of the respondents. Thus, the researcher can plan the questionnaire as per the target audience. This increases the effectiveness of the questionnaire.

Focus group discussions are also used with content analysis, especially in the advertising print media and films studies. This kind of combination of research methods, makes the researcher know the research topic completely and also add richness and enhance the interpretation of data.

Researchers now-a-days do content analysis of the selected subject matter and then after that they support there analysed data by conducting 2 or 3 sessions of the focus groups. The researchers are now favouring Quantitative data for full filling the objectives of the research and for testing the hypothesis. In the next step qualitative methods are employed for the interpretations of the data collected. This is called as sequential research.

Focus group discussions are easy to use in combination with experiment research designs. Experiment researchers give quantitative data and focus group discussions help the researcher to understand the behaviour and psychology of the respondents. The combination of data adds more richness, authenticity and reliability to the research.

Focus group discussions are quite popular as a supplementary source of data. Researchers are very frequently using this method for empowering the quantitative data. This method can easily be incorporated with in-depth interviews, copy testing and also with field studies.

If incorporating questionnaire before the sessions or after the sessions, increases the time duration of the sessions and it is called extended focus groups.

In an extended focus group discussion, respondents are asked to complete a questionnaire before beginning the session. This has two advantages: one it gives opinion of all the respondents and secondly the research has both the qualitative and quantitative data.

The researcher also has an option of getting questionnaire filled at the end of the session and then can compare both the set of questionnaires. This also gives enriched data.

Also, during focus group discussions the researcher has the flexibility of using flash cards or in some case the sessions are being conducted in a pre-arranged setting. The researcher has an option using audio clips and other innovative techniques to supplement the focus group discussions. The method is quite effective even on online mode.

Overall, focus group discussion method is very versatile and flexible method of research.

Conclusion

Focus group discussion can be utilized as a multi-method research design. It may be used as a principle research method or as a form of participatory method to any other main research method.

As media is getting advanced and the audience is also changing in orientation, they are becoming more active, informed and skilled. This is asking for transformation in research methodologies also. Now-a-days, researchers prefer to select mixed method approach researches. This has led to a rapid growth in the application of focus group discussion techniques in communication and media studies.

This method is versatile and quick approach to data collection. But proper planning, execution of the research and analysis are very important. Done with proper planning this method provides authentic primary data and also complete understanding of human behaviour and psychology.

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ਕਿਸਾਨ ਅੰਦੋਲਨ ਦੌਰਾਨ ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦੀ ਭੂਮਿਕਾ

ਗੁਰਪ੍ਰੀਤ ਸਿੰਘ

ਖੇਜਾਰਥੀ, ਮੋਲਾਨਾ ਆਜ਼ਾਦ ਨੈਸ਼ਨਲ ਫੈਲੋਸ਼ਿਪ ਫ਼ਾਰ ਮਾਈਨਾਰਟੀ (ਜੇ.ਆਰ.ਐੱਫ਼) ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।

gurpreetsara01@gmail.com

ਇਸ ਖੋਜ ਪੱਤਰ ਦੌਰਾਨ ਖੇਜਾਰਥੀ ਕਿਸਾਨ ਸੰਘਰਸ਼ ਦੌਰਾਨ ਸ਼ੁਰੂ ਹੋਏ ਅਖ਼ਬਾਰ ‘ਟਰਾਲੀ ਟਾਈਮਜ਼’ ਦੇ ਪਹਿਲੇ ਪੰਨੇ ਦਾ ਅਧਿਐਨ ਕਰੇਗਾ। ਟਰਾਲੀ ਟਾਈਮਜ਼ ਅਖ਼ਬਾਰ ਕਿਸਾਨ ਧਰਨੇ ਦੌਰਾਨ ਧਰਨਾ ਸਥਾਨ ਤੋਂ ਹੀ ਸ਼ੁਰੂ ਕੀਤਾ ਗਿਆ ਅਖ਼ਬਾਰ ਸੀ। ਜੇ ਇਕ ਤਰ੍ਹਾਂ ਇਸ ਸੰਘਰਸ਼ ਦੀਆਂ ਘਟਨਾਵਾਂ ਅਤੇ ਸੂਚਨਾਵਾਂ ਨੂੰ ਲੋਕਾਂ ਤੱਕ ਪਹੁੰਚਾਉਣ ਦਾ ਉਪਰਾਲਾ ਸੀ। ਇਸ ਖੋਜ ਕਾਰਜ ਦੌਰਾਨ ਪਹਿਲੇ ਪੰਨੇ ਦੀ ਵਿਸ਼ਾ ਸਮਗਰੀ, ਫੋਟੋਆਂ ਅਤੇ ਨਾਮਵਰ ਹਸਤੀਆਂ ਦੀਆਂ ਰਚਨਾਵਾਂ ਨੂੰ ਵਾਚਿਆ ਜਾਵੇਗਾ ਅਤੇ ਕਿਸਾਨ ਸੰਘਰਸ਼ ਦੌਰਾਨ ਇਸ ਦੀ ਭੂਮਿਕਾ ਅਤੇ ਪ੍ਰਭਾਵ ਦਾ ਪਤਾ ਕੀਤਾ ਜਾਵੇਗਾ। ਇਸ ਖੋਜ ਕਾਰਜ ਲਈ ਖੇਜਾਰਥੀ ਸਮਗਰੀ ਵਿਸ਼ਲੇਸ਼ਣ ਵਿਧੀ ਦੀ ਵਰਤੋਂ ਕਰਦੇ ਹੋਏ ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦੇ ਪਹਿਲੇ ਪੰਨੇ ਦਾ ਅਧਿਐਨ ਕਰੇਗਾ।

ਪ੍ਰਮੁੱਖ ਸ਼ਬਦ: ਟਰਾਲੀ ਟਾਈਮਜ਼, ਤਿੰਨ ਖੇਤੀ ਕਾਨੂੰਨ-2020, ਕਿਸਾਨ ਸੰਘਰਸ਼, ਸਮੱਗਰੀ ਵਿਸ਼ਲੇਸ਼ਣ

ਭਾਰਤ ਦੀ ਅਰਥਵਿਵਸਥਾ ਵਿਚ ਖੇਤੀਬਾੜੀ ਸੈਕਟਰ ਦਾ ਅੱਜ ਵੀ ਮਹੱਤਵਪੂਰਨ ਯੋਗਦਾਨ ਹੈ। ਪਰੰਤੂ ਇਸ ਦੇ ਉਲਟ ਕਿਸਾਨਾਂ ਦੀ ਹਾਲਤ ਦਿਨ ਪਰ ਦਿਨ ਨਿੱਘਰਦੀ ਜਾ ਰਹੀ ਹੈ। ਅਜ਼ਾਦੀ ਤੋਂ ਬਾਅਦ ਵਿੱਚ ਭਾਰਤ ਵਿਚ ਖੇਤੀ ਸੁਧਾਰਾਂ ਲਈ ਕਾਫ਼ੀ ਕਦਮ ਚੁੱਕੇ ਗਏ, ਹਰੀ ਕ੍ਰਾਂਤੀ ਜਿਸ ਦੀ ਇਕ ਪ੍ਰਮੁੱਖ ਉਦਾਹਰਨ ਹੈ। ਸਾਲ 2020 ਵਿੱਚ ਵੀ ਭਾਰਤ ਸਰਕਾਰ ਨੇ ਖੇਤੀਬਾੜੀ ਸੈਕਟਰ ਵਿੱਚ ਸੁਧਾਰ ਕਰਨ ਅਤੇ ਕਿਸਾਨਾਂ ਦੀ ਹਾਲਤ ਸੁਧਾਰਨ ਦੇ ਨਾਮ ਤੇ ਸੰਸਦ ਵਿੱਚ ਤਿੰਨ ਆਰਡੀਨੈਂਸ ਪੇਸ਼ ਕੀਤੇ।

ਇਨ੍ਹਾਂ ਵਿੱਚੋਂ ਪਹਿਲਾ ਆਰਡੀਨੈਂਸ ‘ਕਿਸਾਨੀ ਜਿਵੇਸ ਵਪਾਰ ਅਤੇ ਵਣਜ (ਪ੍ਰੋਤਸਾਹਨ ਅਤੇ ਸਹੂਲਤ) ਕਾਨੂੰਨ-2020’। ਇਹ ਕਾਨੂੰਨ ਕਿਸਾਨਾਂ ਨੂੰ ਆਪਣੀ ਫ਼ਸਲ ਬਾਹਰਲੇ ਰਾਜਾਂ ਦੀਆਂ ਮੰਡੀਆਂ ਵਿੱਚ ਵੇਚਣ ਦੀ ਸਹੂਲਤ ਦਿੰਦਾ ਸੀ ਅਤੇ ਪ੍ਰਾਈਵੇਟ ਮੰਡੀਆਂ ਨੂੰ ਆਗਿਆ ਦਿੰਦਾ ਸੀ। ਇਸ ਤੋਂ ਬਾਅਦ ਦੂਸਰਾ ਕਾਨੂੰਨ ‘ਕਿਸਾਨ (ਸਸ਼ਕਤੀਕਰਨ ਤੇ ਸੁਰੱਖਿਆ) ਮੁੱਲ ਇਕਰਾਰ ਅਤੇ ਖੇਤੀ ਸੇਵਾਵਾਂ ਕਾਨੂੰਨ-2020’ ਸੀ ਜਿਸ ਅਨੁਸਾਰ ਕਿਸਾਨ ਅਤੇ ਕਾਰਪੋਰੇਟ ਵਿਚ ਕੰਟਰੈਕਟ ਖੇਤੀ ਦਾ ਖਾਕਾ ਤਿਆਰ ਕਰਦਾ ਸੀ। ਜਿਸ ਅਨੁਸਾਰ ਕਿਸਾਨ ਖੇਤੀ ਉਪਜ ਦੀ ਪੈਦਾਵਾਰ ਤੇ ਪਹਿਲਾਂ ਕਾਰਪੋਰੇਟ ਨਾਲ ਕੰਟਰੈਕਟ ਕਰਦਾ। ਤੀਸਰਾ ਅਤੇ ਆਖ਼ਰੀ ਕਾਨੂੰਨ ‘ਜ਼ਰੂਰੀ ਵਸਤਾਂ ਕਾਨੂੰਨ-2020 ਸੀ। ਜਿਸ ਅਨੁਸਾਰ ਕਾਰਪੋਰੇਟ ਅਦਾਰਿਆਂ ਨੂੰ ਬਿਨਾਂ ਕਿਸੇ ਹੱਦ ਤੋਂ, ਵੱਧ ਤੋਂ ਵੱਧ ਅਨਾਜ, ਦਾਲਾਂ, ਆਲੂ, ਪਿਆਜ਼ ਹੋਰ ਖਾਣ ਦੀ ਜ਼ਰੂਰੀ ਵਸਤਾਂ ਸਟੋਰ ਕਰਨ ਦੀ ਆਗਿਆ ਦਿੰਦੀ ਸੀ ਜੋ 17 ਸਤੰਬਰ 2020 ਨੂੰ ਲੋਕ ਸਭਾ ਵਿਚ ਅਤੇ 20 ਸਤੰਬਰ 2020 ਨੂੰ ਰਾਜ ਸਭਾ ਵਿਚ ਪਾਸ ਕੀਤੇ ਗਏ।

ਜਿਸ ਦੇ ਵਿਰੋਧ ਵਜੋਂ ਪੰਜਾਬ ਦੀਆਂ ਵੱਖ ਵੱਖ ਕਿਸਾਨ ਜਥੇਬੰਦੀਆਂ ਨੇ 24 ਸਤੰਬਰ ਨੂੰ ਪੰਜਾਬ ਵਿਚ ਤਿੰਨ ਦਿਨਾਂ ਰੇਲ ਰੋਕੇ ਅੰਦੋਲਨ ਕੀਤਾ। 27 ਸਤੰਬਰ 2020 ਨੂੰ ਰਾਸ਼ਟਰਪਤੀ ਦੀ ਮੋਹਰ ਲੱਗਣ ਨਾਲ ਇਹ ਆਰਡੀਨੈਂਸ ਕਾਨੂੰਨ ਬਣ ਗਏ। ਰਾਸ਼ਟਰਪਤੀ ਵੱਲੋਂ ਮੋਹਰ ਲੱਗਣ ਤੇ ਬਾਅਦ ਕਿਸਾਨਾਂ ਦਾ ਵਿਰੋਧ ਹੋਰ ਤਿੱਖਾ ਹੋ ਗਿਆ। ਪਹਿਲਾਂ ਪਹਿਲ ਇਸ ਵਿਰੋਧ ਦਾ ਕੇਂਦਰ ਪੰਜਾਬ ਹੀ ਰਿਹਾ। ਪਰ ਆਰਡੀਨੈਂਸ ਕਾਨੂੰਨ ਬਣਨ ਤੇ ਬਾਅਦ ਦੇਸ਼ ਭਰ ਵਿਚ ਇਨ੍ਹਾਂ ਦਾ ਵਿਰੋਧ ਹੋਣ ਲੱਗਿਆ। ਜਿਸ ਦੇ ਸਿੱਟੇ ਵਜੋਂ 3 ਨਵੰਬਰ ਨੂੰ ਪੰਜਾਬ ਅਤੇ ਹਰਿਆਣਾ ਤੇ ਇਲਾਵਾ ਦੇਸ਼ ਦੇ ਵੱਖ ਵੱਖ ਹਿੱਸਿਆਂ ਵਿੱਚ ਨੈਸ਼ਨਲ ਹਾਈਵੇ ਜਾਮ ਕੀਤੇ ਗਏ ਅਤੇ 25 ਨਵੰਬਰ 2020 ਨੂੰ ਪੰਜਾਬ ਦੀਆਂ ਕਿਸਾਨਾਂ ਯੂਨੀਅਨਾਂ ਨੇ ਦਿੱਲੀ ਚੱਲੇ ਦਾ ਨਾਅਰਾ ਦਿੱਤਾ। ਜਿਸ ਨੂੰ ਹਰਿਆਣਾ ਦੀਆਂ ਜਥੇਬੰਦੀਆਂ ਦਾ ਭਰਪੂਰ ਸਹਿਯੋਗ ਮਿਲਿਆ।

26 ਨਵੰਬਰ ਨੂੰ ਵੱਡੀ ਗਿਣਤੀ ਵਿਚ ਕਿਸਾਨ ਪੁਲਿਸ ਦੀ ਰੋਕਾਂ ਤੋੜਦੇ ਹੋਏ ਟਰੈਕਟਰ-ਟਰਾਲੀਆਂ ਲੈ ਕੇ ਦਿੱਲੀ ਦੇ ਬਾਰਡਰਾਂ ਤੇ ਜਾ ਪਹੁੰਚੇ। ਜਿੱਥੇ ਦਿੱਲੀ ਪੁਲਿਸ ਨੇ ਪਹਿਲਾਂ ਹੀ ਬੈਰੀਕੇਟਿੰਗ ਕੀਤੀ ਹੋਈ ਸੀ। ਤਾਂ ਕਿਸਾਨਾਂ ਨੇ ਸਿੰਘੂ ਅਤੇ ਟਿੱਕਰੀ ਬਾਰਡਰਾਂ ਉੱਤੇ ਹੀ ਆਪਣਾ ਡੇਰਾ ਲਾ ਲਿਆ। ਨੈਸ਼ਨਲ ਮੀਡੀਆ ਦੀ ਕਵਰੇਜ ਇਸ ਵਿਰੋਧ ਪ੍ਰਦਰਸ਼ਨ ਨੂੰ ਲੈ ਕੇ ਜ਼ਿਆਦਾ ਸੁਖਾਵੀਂ ਨਹੀਂ ਸੀ। ਜਿਸ ਕਰਕੇ ਕਿਸਾਨ ਯੂਨੀਅਨਾਂ ਨੇ ਆਪਣੇ ਪੱਧਰ ਤੇ ਹੀਲੇ ਵਸੀਲੇ ਕਰਕੇ ਆਪਣੀ ਗੱਲ ਲੋਕਾਂ ਤੱਕ ਪਹੁੰਚਾਉਣੀ ਸ਼ੁਰੂ ਕੀਤੀ। ਇਸੇ ਕੜੀ ਤਹਿਤ ਅੰਦੋਲਨ ਵਿੱਚ ਸ਼ਾਮਲ ਕੁਝ ਨੌਜਵਾਨਾਂ ਵੱਲੋਂ ਚੱਲ ਰਹੇ ਮੋਰਚਾ ਵਿਚ ਸ਼ਾਮਲ ਲੋਕਾਂ ਦੀ ਕਹਾਣੀਆਂ ਇਕ ਦੂਜੇ ਤੱਕ ਪਹੁੰਚਾਉਣ ਲਈ ਇਕ ਅਖ਼ਬਾਰ ‘ਟਰਾਲੀ ਟਾਈਮਜ਼’ ਦੀ ਸ਼ੁਰੂਆਤ ਕੀਤੀ।

ਇਸ ਅਖ਼ਬਾਰ ਦਾ ਪਹਿਲਾ ਅੰਕ 18 ਦਸੰਬਰ 2020 ਨੂੰ ਪ੍ਰਕਾਸ਼ਿਤ ਕੀਤਾ ਗਿਆ। ਇਸ ਦੀ ਸਭ ਤੋਂ ਵੱਡੀ ਗੱਲ ਇਹ ਸੀ ਕਿ ਇਹ ਧਰਨੇ ਵਾਲੀ ਜਗ੍ਹਾ ਤੇ ਹੀ ਪ੍ਰਕਾਸ਼ਿਤ ਕੀਤਾ ਜਾਂਦਾ ਸੀ। ਭਾਵੇਂ ਇਹ ਕਿਸਾਨ ਯੂਨੀਅਨਾਂ ਦੁਆਰਾ ਸਥਾਪਿਤ ‘ਸੰਯੁਕਤ ਕਿਸਾਨ ਮੋਰਚਾ’ ਦਾ ਅਧਿਕਾਰਕ ਅਖ਼ਬਾਰ ਨਹੀਂ ਸੀ। ਪਰ ਫਿਰ ਵੀ ਕਿਸਾਨ ਸੰਘਰਸ਼ ਦੌਰਾਨ ਇਸ ਦਾ ਯੋਗਦਾਨ ਸ਼ਲਾਘਾਯੋਗ ਰਿਹਾ ਹੈ।

‘ਟਰਾਲੀ ਟਾਈਮਜ਼’ ਦੇ ਦੂਸਰੇ ਅੰਕ ਵਿੱਚ ਦਿੱਤੀ ਜਾਣਕਾਰੀ ਅਨੁਸਾਰ ਇਸ ਅਖ਼ਬਾਰ ਦਾ ਮੁੱਖ ਮਕਸਦ “ਇਸ ਵਿਚ ਮੋਰਚੇ ਵਿਚਲੇ ਲੋਕਾਂ ਦੀਆਂ ਕਹਾਣੀਆਂ ਲੋਕਾਂ ਤੱਕ ਪਹੁੰਚਾਉਣ ਦਾ ਉਜ਼ਰ ਕੀਤਾ ਗਿਆ ਹੈ। ਸਾਡਾ ਮਨਸਾ ਸੁਹਿਰਦਤਾ ਨਾਲ ਲੋਕ ਮਨ ਦੀ ਤਰਜਮਾਨੀ ਕਰਨ ਦਾ ਹੈ। ਇਸ ਵਿਚ ਹਰ ਵਾਰ ਵੱਖੋ ਵੱਖ ਲਿਖਾਰੀਆਂ ਦੇ ਲੇਖ ਪਹੁੰਚ ਕਰਕੇ ਲਿਖਾਏ ਜਾਂਦੇ ਹਨ। ਖ਼ਿਆਲ ਸਿਰਫ਼ ਇਹੋ ਰੱਖਿਆ ਜਾਂਦਾ ਹੈ ਕਿ ਲਿਖਤ ਆਪਸੀ ਵਖਰੇਵਿਆਂ ਤੇ ਉੱਪਰ ਉੱਠ ਕੇ ਸਾਂਝੇ ਕਿਸਾਨ ਮਜ਼ਦੂਰ ਮੋਰਚੇ ਦੀ ਚੜ੍ਹਦੀਕਲਾ ਲਈ ਵਚਨਬੱਧ ਹੋਵੇ। ਪਹਿਲੇ ਪੰਨੇ ਤੇ ਮੋਰਚੇ ਦੀ ਦਸ਼ਾ ਤੇ ਦਿਸ਼ਾ ਬਾਰੇ ਪੰਛੀ ਝਾਤ ਹੋਵੇਗੀ। ਬਾਕੀ ਪੰਨਿਆਂ ਤੇ ਲਿਖਾਰੀਆਂ ਵੱਲੋਂ ਭੇਜੀਆਂ ਗਈਆਂ ਲਿਖਤਾਂ, ਤਸਵੀਰਾਂ ਅਤੇ ਕਲਾਕ੍ਰਿਤਾਂ ਹੋਣਗੀਆਂ” ਸੀ।

ਭਾਰਤ ਵਿੱਚ ਅਜ਼ਾਦੀ ਲਈ ਹੋਏ ਸੰਘਰਸ਼ ਤੇ ਬਾਅਦ ਇਹ ਸ਼ਾਇਦ ਪਹਿਲਾਂ ਮੌਕਾ ਸੀ ਜਦੋਂ ਕਿਸੇ ਚਲਦੇ ਸੰਘਰਸ਼ ਦੌਰਾਨ ਅਖ਼ਬਾਰ ਦਾ ਪ੍ਰਕਾਸ਼ਨ ਸ਼ੁਰੂ ਹੋਇਆ ਸੀ। ਅਜ਼ਾਦੀ ਤੇ ਪਹਿਲਾਂ ਕਾਫ਼ੀ ਅਜ਼ਾਦੀ ਘੁਲਾਟੀਆਂ ਨੇ ਆਪਣੇ ਸੰਘਰਸ਼ ਨੂੰ ਮਜ਼ਬੂਤ ਕਰਨ ਲਈ ਅਤੇ ਲੋਕਾਂ ਤੱਕ ਆਪਣਾ ਸੁਨੇਹਾ ਪਹੁੰਚਾਉਣ ਲਈ ਅਖ਼ਬਾਰ ਛਾਪੇ ਸਨ। ਜਿਨ੍ਹਾਂ ਵਿਚ ਸਭ ਤੋਂ ਪਹਿਲਾਂ ਰਾਜਾ ਰਾਮ ਮੋਹਨ ਰਾਏ ਜੀ ਦੁਆਰਾ ਸ਼ੁਰੂ ਕੀਤਾ ਗਿਆ ‘ਮਿਰਤੁਲ ਅਖ਼ਬਾਰ’, ਗ਼ਦਰ ਪਾਰਟੀ ਦੁਆਰਾ ਸ਼ੁਰੂ ਕੀਤਾ ਗਿਆ ‘ਗ਼ਦਰ’ ਅਖ਼ਬਾਰ ਅਤੇ ਮਹਾਤਮਾ ਗਾਂਧੀ ਜੀ ਦੁਆਰਾ ਗਾਂਧੀ ਜੀ ਦੁਆਰਾ ਚਲਾਏ ਗਏ ਯੰਗ ਇੰਡੀਆ, ਨਵਜੀਵਨ ਅਤੇ ਹਰੀਜਨ ਅਜ਼ਾਦੀ ਸੰਗਰਾਮ ਦੌਰਾਨ ਹੀ ਸ਼ੁਰੂ ਕੀਤੇ ਗਏ। ਜਿਨ੍ਹਾਂ ਸਭ ਦਾ ਉਦੇਸ਼ ਅਜ਼ਾਦੀ ਦੇ ਸੰਘਰਸ਼ ਵਿੱਚ ਲੋਕਾਂ ਨੂੰ ਇੱਕਮੁੱਠ ਕਰਨਾ।

ਸਾਲ ਭਰ ਤੇ ਲੰਮੇ ਇਸ ਸੰਘਰਸ਼ ਦੌਰਾਨ ‘ਟਰਾਲੀ ਟਾਈਮਜ਼’ ਨੇ ਵੀ ਮਹੱਤਵਪੂਰਨ ਭੂਮਿਕਾ ਅਦਾ ਕੀਤੀ ਹੈ। ਇਸ ਅਖ਼ਬਾਰ ਦੀ ਸ਼ੁਰੂਆਤ ਕਰਨ ਵਾਲੀ ਟੀਮ ਦੀ ਜੇਕਰ ਗੱਲ ਕੀਤੀ ਜਾਵੇ ਤਾਂ ਇਸ ਵਿੱਚ ਕਈ ਮਹੱਤਵਪੂਰਨ ਨਾਮ ਸ਼ਾਮਲ ਸਨ, ਜਿੰਨਾ ਵਿੱਚੋਂ ਸੁਰਮੀਤ ਮਾਵੀ ਦਾ ਨਾਮ ਪ੍ਰਮੁੱਖ ਹੈ। ਸੁਰਮੀਤ ਮਾਵੀ ਵੈਸੇ ਕਿਸੇ ਜਾਣ ਪਹਿਚਾਣ ਦਾ ਮੁਹਤਾਜ ਨਹੀਂ ਹੈ। ਜਿੰਨਾ ਨੇ ਆਪਣੇ ਕੈਰੀਅਰ ਦੀ ਸ਼ੁਰੂਆਤ ਬਤੌਰ ਸਹਾਇਕ ਨਿਰਦੇਸ਼ਕ ਕੀਤੀ ਅਤੇ ਬਾਅਦ ਵਿੱਚ ਪੰਜਾਬੀ ਫ਼ਿਲਮ ‘ਹੀਰ ਐਂਡ ਹੀਰੋ’ ਵਿਚ ਬਤੌਰ ਐਕਟਰ ਕੰਮ ਕੀਤਾ। ਮਸ਼ਹੂਰ ਪੰਜਾਬੀ ਫ਼ਿਲਮ ‘ਪੰਜਾਬ 1984’ ਦਾ ਲੇਖਕ ਵੀ ਸੁਰਮੀਤ ਮਾਵੀ ਹੀ ਸੀ। ਇਸ ਤੋਂ ਇਲਾਵਾ ਕਾਫ਼ੀ ਫ਼ਿਲਮਾਂ ਦੇ ਡਾਇਲਾਗ ਲਿਖੇ ਹਨ। ਉਸ ਤੋਂ ਅਗਲਾ ਪ੍ਰਮੁੱਖ ਨਾਮ ਗੁਰਦੀਪ ਧਾਲੀਵਾਲ ਹੈ, ਜੋ ਪੇਸ਼ੇ ਵਜੋਂ ਇੱਕ ਫ਼ੋਟੋਗਰਾਫ਼ਰ ਹਨ। ਜਿਨ੍ਹਾਂ ਨੇ ਕਿੰਗਸਟਨ ਯੂਨੀਵਰਸਿਟੀ ਲੰਡਨ ਤੇ ‘ਇੰਗਲਿਸ਼ ਲਿਟਰੇਚਰ’ ਵਿਚ ਆਪਣੀ ਗਰੈਜੂਏਸ਼ਨ ਦੀ ਪੜ੍ਹਾਈ ਕੀਤੀ ਅਤੇ ਪੰਜਾਬ ਵਾਪਸ ਆਕੇ ਬਤੌਰ ਫ਼ੋਟੋਗਰਾਫ਼ਰ ਆਪਣੀ ਪਹਿਚਾਣ ਬਣਾਈ। ਨਵਕਿਰਨ ਨੱਤ ‘ਟਰਾਲੀ ਟਾਈਮਜ਼’ ਟੀਮ ਦੀ ਮਹੱਤਵਪੂਰਨ ਮੈਂਬਰ ਹੈ। ਨਵਕਿਰਨ ਨੇ ਕਈ ਸਾਲ ਦੰਦਾ ਦੀ ਡਾਕਟਰ ਦੇ ਤੌਰ ਤੇ ਕੀਤਾ ਤੇ ਬਾਅਦ ਵਿੱਚ ਫ਼ਿਲਮ ਸਟੱਡੀਜ਼ ਦੀ ਪੜ੍ਹਾਈ ਕੀਤੀ ਅਤੇ ਕਿਸਾਨ ਧਰਨੇ ਦੌਰਾਨ ਆਪਣਾ ਮਹੱਤਵਪੂਰਨ ਯੋਗਦਾਨ ਪਾਇਆ। ਅੱਜ ਕੱਲ੍ਹ ਔਰਤਾਂ ਦੇ ਹੱਕਾਂ ਲਈ ਖ਼ਾਸ ਤੌਰ ਤੇ ਸੰਘਰਸ਼ ਕਰਨ ਰਹੇ ਹਨ।

ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦੀ ਮਹੱਤਤਾ ਦਾ ਪਤਾ ਇਸ ਗੱਲ ਤੇ ਲਗਦਾ ਹੈ ਕਿ ਇਸ ਦੀ ਸ਼ੁਰੂਆਤ ਸਮੇਂ ਇਸ ਦੀ ਚਰਚਾ ਦੁਨੀਆ ਭਰ ਦੇ ਮੀਡੀਆ ਵਿਚ ਹੋਈ। ਸੰਘਰਸ਼ ‘ਚੋਂ ਨਿਕਲੇ ਇਸ ਅਖ਼ਬਾਰ ਦੀ ਭਾਸ਼ਾ ਅਤੇ ਜਜ਼ਬਾ ਵੀ ਸੰਘਰਸ਼ ਭਰਪੂਰ ਹੀ ਸੀ। ਇਸ ਦੇ ਪਹਿਲੇ ਅੰਕ ਦੇ ਪਹਿਲੇ ਪੰਨੇ ਦੀਆਂ ਮੁੱਖ ਸੁਰਖੀਆਂ “ਇੱਕੋ ਨਾਹਰਾ- ਲੜਾਂਗੇ, ਜਿੱਤਾਂਗੇ!” ਅਤੇ “ਜੁੜਾਂਗੇ, ਲੜਾਂਗੇ, ਜਿੱਤਾਂਗੇ!” ਸੀ। ਜਿਸ ਵਿੱਚ ਪ੍ਰਮੁੱਖ ਤੌਰ ਤੇ ਲੋਕਾਂ ਨੂੰ ਇੱਕਜੁੱਟ ਹੋਕੇ ਸੰਘਰਸ਼ ਕਰਨ ਦੀ ਅਪੀਲ ਕੀਤੀ ਗਈ ਸੀ। ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦੀ ਸ਼ੁਰੂਆਤ ਉਸ ਸਮੇਂ ਹੁੰਦੀ ਹੈ, ਜਦੋਂ ਮੁੱਖ ਧਾਰਾ ਦਾ ਮੀਡੀਆ ਧਰਨਾ ਦੇ ਰਹੇ ਸੰਘਰਸ਼ੀ ਲੋਕਾਂ ਨੂੰ ਭਾੜੇ ਤੇ ਆਏ, ਖ਼ਾਲਿਸਤਾਨੀ, ਪਾਕਿਸਤਾਨ ਸਮਰਥਕ ਆਦਿ ਗ਼ਰਦਾਨ ਰਿਹਾ ਸੀ ਅਤੇ ਲੋਕਾਂ ਦੀਆਂ ਅਸਲੀ ਮੁਸ਼ਕਲਾਂ ਸਰਕਾਰ ਸਾਹਮਣੇ ਰੱਖਣ ਦੀ ਵਜਾਏ ਤਿੰਨ ਖੇਤੀ ਕਾਨੂੰਨਾਂ ਨੂੰ ਸਹੀ ਠਹਿਰਾਉਣ ਤੇ ਉਤਾਰੂ ਸੀ।

ਭਾਵੇਂ ਟਰਾਲੀ ਟਾਈਮਜ਼ ਸੰਯੁਕਤ ਕਿਸਾਨ ਮੋਰਚੇ ਦਾ ਅਧਿਕਾਰਤ ਅਖ਼ਬਾਰ ਨਹੀਂ ਸੀ। ਪਰ ਇਸ ਦੀ ਲੋਕਪ੍ਰਿਯਤਾ ਦਾ ਅੰਦਾਜ਼ਾ ਅਸੀਂ ਇਸ ਗੱਲ ਤੇ ਲਗਾ ਸਕਦੇ ਹਾਂ। ਕਿ ਇਸ ਦੀ ਸ਼ੁਰੂਆਤ ਵਾਲੇ ਦਿਨ ਹੀ ਪ੍ਰਸਿੱਧ ਪੱਤਰਕਾਰ ਰਵੀਸ਼ ਕੁਮਾਰ ਨੇ ਆਪਣੇ ਸ਼ੋਅ ਪ੍ਰਾਈਮ ਟਾਈਮ ਵਿਚ ਰਵੀਸ਼ ਕੁਮਾਰ ਵਿੱਚ ਇਸ ਦਾ ਜ਼ਿਕਰ ਕੀਤਾ ਅਤੇ ਕਿਹਾ “ਗੋਦੀ ਮੀਡੀਆ ਕੇ ਦੁਸ਼ਪ੍ਰਚਾਰ ਕਾ ਜਵਾਬ ਹੈ ਟਰਾਲੀ ਟਾਈਮਜ਼”। ਪੰਜਾਬੀ ਦੇ ਸੀਨੀਅਰ ਪੱਤਰਕਾਰ ਜਤਿੰਦਰ ਪੰਨੂ ਨੇ ਦੇ ਟਰਾਲੀ ਟਾਈਮਜ਼ ਬਾਰੇ ਵਿਚਾਰ ਕੁੱਝ ਇਸ ਤਰ੍ਹਾਂ ਦੇ ਸਨ “ਭਾਰਤ ਦੀ ‘ਲਘੂ ਭੂਮੀ’ (ਨਾਜ਼ੀ

ਜਰਮਨਾਂ ਨਾਲ ਲੜਦਿਆਂ ਰੂਸੀ ਇਨਕਲਾਬੀਆਂ ਵੱਲੋਂ ਦੂਜੀ ਸੰਸਾਰ ਜੰਗ ਵੇਲੇ ਕੱਢਿਆ ਪਰਚਾ) ਹੈ”। ਭਾਰਤ ਦੇ ਪ੍ਰਸਿੱਧ ਗਰਾਫਿਕਸ ਕਲਾਕਾਰ ਉਰੀਜਤ ਸੇਨ ਨੇ ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦੀ ਤੁਲਨਾ ‘ਗ਼ਦਰ ਅਖ਼ਬਾਰ’ ਨਾਲ ਕੀਤੀ।

ਇਸ ਖੋਜ ਕਾਰਜ ਦੌਰਾਨ ਖੋਜਾਰਥੀ ‘ਟਰਾਲੀ ਟਾਈਮਜ਼’ ਅਖ਼ਬਾਰ ਦੇ ਪਹਿਲੇ ਪੰਨੇ ਦਾ ਅਧਿਐਨ ਕਰੇਗਾ ਅਤੇ ਦੇਖੇਗਾ ਕਿ ਪਹਿਲੇ ਦਿਨ ਤੋਂ ਲੈ ਕੇ ਆਖ਼ਰੀ ਅੰਕ ਤੱਕ ਇਸ ਦੇ ਪਹਿਲੇ ਪੰਨੇ ਦੀ ਵਿਸ਼ਾ ਸਮੱਗਰੀ ਕਿਸ ਤਰ੍ਹਾਂ ਦੀ ਰਹੀ। ਸ਼ੁਰੂਆਤੀ ਅੰਕ ਵਿਚ ਪਹਿਲੇ ਪੰਨੇ ਉਪਰ ਇਕ ਲੇਖ ਅਤੇ ਸੰਪਾਦਕੀ ਨੂੰ ਜਗ੍ਹਾ ਦਿੱਤੀ ਗਈ। ਲੇਖ ਅਤੇ ਸੰਪਾਦਕੀ ਦਾ ਵਿਸ਼ਾ ਵਸਤੂ ਬਿਲਕੁਲ ਇੱਕੋ ਜਿਹਾ ਸੀ, ਜੋ ਲੋਕਾਂ ਨੂੰ ਇਕੱਠੇ ਹੋਕੇ ਸੰਘਰਸ਼ ਕਰਨ ਦਾ ਸੁਨੇਹਾ ਦੇ ਰਹੀਆਂ ਸਨ। ਆਮ ਤੌਰ ਤੇ ਅਖ਼ਬਾਰਾਂ ਵਿੱਚ ਸੰਪਾਦਕੀ ਤੀਜੇ ਜਾਂ ਚੌਥੇ ਪੇਜ ਤੇ ਲਿਖੀ ਜਾਂਦੀ ਹੈ, ਪਰ ‘ਟਰਾਲੀ ਟਾਈਮਜ਼’ ਵਿਚ ਇਸ ਦੀ ਮਹੱਤਤਾ ਨੂੰ ਸਮਝਦੇ ਹੋਏ ਪਹਿਲੇ ਪੰਨੇ ਤੇ ਹੀ ਥਾਂ ਦਿੱਤੀ ਗਈ। ਇਸ ਤੋਂ ਇਲਾਵਾ ਸ਼ਹੀਦ ਭਗਤ ਸਿੰਘ ਦਾ ਪ੍ਰਸਿੱਧ ਕਥਨ “ਇਨਕਲਾਬ ਦੀ ਤਲਵਾਰ ਵਿਚਾਰਾਂ ਦੀ ਸਾਥ ‘ਤੇ ਤੇਜ਼ ਹੁੰਦੀ ਹੈ’ ਵੀ ਪਹਿਲੇ ਪੰਨੇ ਉੱਤੇ ਹੀ ਛਾਪਿਆ ਗਿਆ। ਪਹਿਲੇ ਪੰਨੇ ਤੇ ਵਰਤੀਆਂ ਗਈਆਂ, ਫੋਟੋਆਂ ਸ਼ਾਂਤੀਪੂਰਨ ਸੰਘਰਸ਼ ਅਤੇ ਇੱਕਜੁੱਟਤਾ ਦਾ ਸੁਨੇਹਾ ਦਿੰਦੀਆਂ ਹਨ। ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦੀ ਟੀਮ ਨੇ ਡਿਜੀਟਲ ਮੀਡੀਆ ਦੀ ਭੂਮਿਕਾ ਨੂੰ ਸਮਝਦੇ ਹੋਏ। ਇਸ ਦੇ ਡਿਜੀਟਲ ਲਿੰਕ ਵਜੋਂ ਇਕ ਕਿਊ.ਆਰ ਕੋਡ ਵਿਚ ਦਿੱਤਾ ਗਿਆ। ਜਿਸ ਦੀ ਮਦਦ ਨਾ ਤੁਸੀਂ ਕਿਤੇ ਵੀ ਬੈਠੇ ਇਸ ਦੀ ਡਿਜੀਟਲ ਕਾਪੀ ਭੇਜ ਸਕਦੇ ਹੋ।

ਜੇਕਰ ਦੂਸਰੇ ਅੰਕ ਦੀ ਗੱਲ ਕੀਤੀ ਜਾਵੇ ਤਾਂ ਇਸ ਨੂੰ ਚਾਰ ਕਾਲਮਾਂ ਵਿਚ ਵੰਡਿਆ ਗਿਆ। ਇਕ ਪਹਿਲੇ ਦੇ ਕਾਲਮਾਂ ਵਿੱਚ ਮੋਰਚੇ ਦੀ ਮੌਜੂਦਾ ਸਥਿਤੀ ਬਾਰੇ ਜਾਣਕਾਰੀ ਦਿੱਤੀ ਗਈ ਅਤੇ ਭਵਿੱਖ ਵਿਚ ਆਉਣ ਵਾਲੀਆਂ ਮੁਸ਼ਕਲਾਂ ਬਾਰੇ ਜਾਣੂ ਕਰਵਾਇਆ ਗਿਆ ਸੀ। ਸੰਪਾਦਕੀ ਦਾ ਵਿਸ਼ਾ ਸਿੱਖਾਂ ਦੇ ਨੇਵੇਂ ਗੁਰੂ ਸ੍ਰੀ ਗੁਰੂ ਤੇਗ਼ ਬਹਾਦਰ ਜੀ ਦੇ ਸ਼ਹੀਦੀ ਦਿਵਸ ਨਾਲ ਸਬੰਧਿਤ ਸੀ, ਸ਼ਹੀਦੀ ਦਿਵਸ ਹੋਣ ਕਰਕੇ ਸੰਪਾਦਕੀ ਵਿਚ ਸੰਘਰਸ਼ ਦੌਰਾਨ ਜਾਨ ਗੁਆਉਣ ਵਾਲੇ ਲੋਕਾਂ ਨੂੰ ਵੀ ਸ਼ਰਧਾਂਜਲੀ ਭੇਟ ਕੀਤੀ ਗਈ ਅਤੇ ਸੰਘਰਸ਼ ਦੌਰਾਨ ਹੁਣ ਤੱਕ ਗੁਆਉਣ ਵਾਲੇ ਲੋਕਾਂ ਦੀ ਸੂਚੀ ਵੀ ਜਾਰੀ ਕੀਤੀ। ਇਸ ਅੰਕ ਦਾ ਪਹਿਲਾਂ ਪੰਨਾ ਅੱਧੇ ਤੋਂ ਜ਼ਿਆਦਾ ਸ਼ਹਾਦਤ ਨਾਲ ਸਬੰਧਿਤ ਸਮਗਰੀ ਨਾਲ ਭਰਿਆ ਸੀ। ਇਸ ਪੰਨੇ ਦੀ ਮੁੱਖ ਸੁਰਖੀ ਵੀ ‘ਸ਼ਹੀਦੇ ਤੁਹਾਡੇ ਕਾਜ ਅਧੂਰੇ, ਲਾ ਕੇ ਜਿੰਦਗੀਆਂ ਕਰਾਂਗੇ ਪੂਰੇ’ ਸੀ। ਜੇਕਰ ਇਸ ਅੰਕ ਦੇ ਪਹਿਲੇ ਪੰਨੇ ਤੇ ਵਰਤੀ ਗਈ ਫੋਟੋ ਦੀ ਗੱਲ ਕੀਤੀ ਜਾਵੇ ਤਾਂ ਇਸ ਦੀ ਸਭ ਤੋਂ ਜ਼ਿਆਦਾ ਜੋ ਗੱਲ ਪ੍ਰਭਾਵਿਤ ਕਰਦੀ ਹੈ ਉਹ ਹੈ ਕਿ ਇਸ ਵਿਚ ਮਰਦਾਂ ਅਤੇ ਔਰਤਾਂ ਨੂੰ ਬਰਾਬਰ ਸੰਘਰਸ਼ ਕਰਦੇ ਦਿਖਾਇਆ ਗਿਆ ਹੈ। ਆਮ ਤੌਰ ਤੇ ਇਹ ਪ੍ਰਭਾਵ ਹੈ ਕਿ ਔਰਤਾਂ ਖੇਤੀਬਾੜੀ ਦੇ ਕੰਮਾਂ ਧੰਦਿਆਂ ਅਤੇ ਸੰਘਰਸ਼ਾਂ ਵਿਚ ਸ਼ਾਮਲ ਨਹੀਂ ਹੁੰਦੀਆਂ ਪਰ ਹੇਠ ਵਾਲੀ ਫੋਟੋ ਇਹ ਭੁਲੇਖਾ ਦੂਰ ਕਰਦੀ ਹੈ।



ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦਾ ਤੀਸਰੇ ਅੰਕ ਦਾ ਪਹਿਲਾ ਪੰਨਾ ਔਰਤਾਂ ਨੂੰ ਸਮਰਪਿਤ ਕੀਤਾ ਗਿਆ। ਇਸ ਵਿਚ ਅੱਧੇ ਤੋਂ ਜ਼ਿਆਦਾ ਪੰਨੇ ਉਪਰ ਭਾਰਤੀ ਕਿਸਾਨ ਯੂਨੀਅਨ ਦੀ ਇਸਤਰੀ ਵਿੰਗ ਦੀ ਪ੍ਰਧਾਨ ਹਰਿੰਦਰ ਬਿੰਦੂ ਨਾਲ ਗੱਲਬਾਤ ਦੇ ਅੰਸ਼ ਪ੍ਰਕਾਸ਼ਿਤ ਸਨ। ਜਿਸ ਵਿਚ ਉਹ ਦੱਸਦੇ ਹਨ ਕਿ ਕਿਸ ਤਰ੍ਹਾਂ ਉਗਰਾਹਾਂ ਜਥੇਬੰਦੀ ਨੇ ਪਿੰਡ, ਬਲਾਕ ਅਤੇ ਜ਼ਿਲ੍ਹੇ ਪੱਧਰ ਤੇ ਕਮੇਟੀਆਂ ਬਣਾਈਆਂ ਅਤੇ ਔਰਤਾਂ ਦੇ ਖ਼ਾਸ ਇਜਲਾਸ ਕਰਵਾਉਣੇ ਸ਼ੁਰੂ ਕੀਤੇ। ਪਰਿਵਾਰਾਂ ਦੀ ਸਮਾਜਿਕ ਸਿਖਲਾਈ ਕਰਵਾਈ ਗਈ ਤਾਂ ਕਿ ਜਦੋਂ ਔਰਤਾਂ ਇਜਲਾਸ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਤਾਂ ਮਰਦ ਘਰ ਦੀ ਜ਼ਿੰਮੇਵਾਰੀ ਸਾਂਭ ਸਕਣ ਇਸੇ ਕੋਸ਼ਿਸ਼ਾਂ ਕਰਕੇ ਮੋਰਚੇ ਵਿਚ ਔਰਤਾਂ ਦੀ ਸ਼ਮੂਲੀਅਤ ਅਤੇ ਯੋਗਦਾਨ ਸਪਸ਼ਟ ਨਜ਼ਰ ਆਉਂਦਾ ਹੈ। ਇਸ ਗੱਲਬਾਤ ਸਭ ਤੋਂ ਦਾ ਪ੍ਰਕਾਸ਼ਿਤ ਹੋਣਾ ਇਹ ਦੱਸਦਾ ਹੈ ਕਿ ਪਹਿਲੇ ਪੰਨੇ ਨੂੰ ਔਰਤਾਂ ਦੇ ਨਾਮ ਕਰਕੇ ਅਖ਼ਬਾਰ ਨਾਰੀ ਸਸ਼ਕਤੀਕਰਨ ਦੀ ਗੱਲ ਕਰਦਾ ਹੈ। ਭਾਵੇਂ ਕਿ ਸੰਘਰਸ਼ ਦੇ ਸਾਰੇ ਪ੍ਰਮੁੱਖ ਆਗੂ ਮਰਦ ਸਨ। ਦਸੰਬਰ ਮਹੀਨੇ ਦੀ ਆਖ਼ਰੀ ਤਰੀਕ ਨੂੰ ਛਪਣ ਕਰਕੇ ਸੰਪਾਦਕੀ ਦਾ ਵਿਸ਼ਾ

ਛੋਟੇ ਸਾਹਿਬਜ਼ਾਦੇ ਅਤੇ ਮਾਤਾ ਗੁਜਰੀ ਜੀ ਦੀ ਸ਼ਹਾਦਤ ਨਾਲ ਸਬੰਧਿਤ ਰੱਖਿਆ ਗਿਆ। ਤਾਂ ਧਾਰਮਿਕ ਅਤੇ ਇਤਿਹਾਸਿਕ ਹਵਾਲਿਆਂ ਨਾਲ ਲੋਕਾਂ ਨੂੰ ਇੱਕਜੁੱਟ ਕਰਕੇ ਲੜਨ ਲਈ ਪ੍ਰੇਰਿਆ ਜਾ ਸਕੇ।

ਚੌਥਾ ਅੰਕ ਕਾਫ਼ੀ ਮਹੱਤਵਪੂਰਨ ਸੀ ਕਿਉਂਕਿ ਇਸ ਦਾ ਵਿਸ਼ਾ ਕਿਸਾਨ ਸੰਘਰਸ਼ ਵਿਚ ਮਜ਼ਦੂਰਾਂ ਦੀ ਹਿੰਮਦਾਰੀ ਨਾਲ ਸਬੰਧਿਤ ਸੀ। ਕਿਉਂਕਿ ਕਿਸਾਨ ਅਤੇ ਮਜ਼ਦੂਰ ਦਾ ਇਕ ਅਟੁੱਟ ਰਿਸ਼ਤਾ ਹੈ, ਦੇਵੇਂ ਇਕ ਦੂਸਰੇ ਉਪਰ ਨਿਰਭਰ ਕਰਦੇ ਹਨ। ਇਸ ਗੱਲ ਦੀ ਮਹੱਤਤਾ ਸਮਝਦੇ ਹੋਏ ਅਖ਼ਬਾਰ ਨੇ ਇਸ ਵਿਸ਼ੇ ਨੂੰ ਪ੍ਰਮੁੱਖਤਾ ਨਾਲ ਥਾਂ ਦਿੱਤੀ। ਜਿਸ ਵਿਚ ਜਿੱਥੇ ਸੰਘਰਸ਼ ਦੌਰਾਨ ਮਜ਼ਦੂਰਾਂ ਦੇ ਯੋਗਦਾਨ ਜ਼ਿਕਰ ਕਰਦੇ ਹਨ, ਉੱਥੇ ਉਨ੍ਹਾਂ ਨੂੰ ਪੇਸ਼ ਆਉਂਦੀਆਂ ਮੁਸ਼ਕਲਾਂ ਅਤੇ ਕਿਸਾਨ-ਮਜ਼ਦੂਰ ਦੇ ਰਿਸ਼ਤੇ ਵਿਚ ਆਈਆਂ ਤਰੇੜਾਂ ਦਾ ਵੀ ਜ਼ਿਕਰ ਬੇਬਾਕੀ ਨਾਲ ਕੀਤਾ ਗਿਆ ਹੈ। ਜਿਸ ਤੋਂ ਇਸ ਗੱਲ ਦਾ ਅੰਦਾਜ਼ਾ ਲਾਇਆ ਜਾ ਸਕਦਾ ਹੈ ਕਿ ਅਖ਼ਬਾਰ ਬਿਨਾਂ ਕਿਸੇ ਪੱਖਪਾਤ ਤੋਂ ਛਾਪਿਆ ਜਾਂਦਾ ਸੀ।

ਭਾਵੇਂ ਕਿਸਾਨ ਸੰਘਰਸ਼ ਦਾ ਮੁੱਖ ਧੁਰਾ ਪੰਜਾਬ ਰਿਹਾ। ਪਰ ਇਸ ਵਿਚ ਹਰਿਆਣਾ ਦਾ ਯੋਗਦਾਨ ਵੀ ਘੱਟ ਨਹੀਂ ਸੀ। ਜਿਸ ਕਰਕੇ ਅਖ਼ਬਾਰ ਦੇ ਪੰਜਵੇਂ ਅੰਕ ਦੇ ਪਹਿਲਾ ਪੰਨੇ ਉਪਰ ਹਰਿਆਣਾ ਕਿਸਾਨ ਜਥੇਬੰਦੀਆਂ ਦੇ ਯੋਗਦਾਨ ਨੂੰ ਪ੍ਰਮੁੱਖ ਥਾਂ ਦਿੱਤੀ ਗਈ ਅਤੇ ਹਰਿਆਣਾ ਦੀਆਂ ਕਿਸਾਨ ਜਥੇਬੰਦੀਆਂ ਬਾਰੇ ਵਿਸਥਾਰ ਨਾਲ ਦੱਸਿਆ ਗਿਆ। ਹਰਿਆਣਾ ਦੀਆਂ ਜਥੇਬੰਦੀਆਂ ਦੀ ਸਥਾਪਨਾ ਅਤੇ ਉਨ੍ਹਾਂ ਦੇ ਸੰਘਰਸ਼ ਦਾ ਜ਼ਿਕਰ ਕਰਦੇ ਹੋਏ ਕਿਸਾਨ ਮੋਰਚੇ ਦੌਰਾਨ ਪੰਜਾਬ ਦੀਆਂ ਜਥੇਬੰਦੀਆਂ ਨਾਲ ਮੇਢੇ ਨਾਲ ਮੇਢੇ ਲਾਕੇ ਖੜਨ ਬਾਰੇ ਗੱਲ ਕੀਤੀ ਗਈ। ਪੰਜਾਬ ਅਤੇ ਹਰਿਆਣਾ ਵਿਚਕਾਰ ਇਸ ਤੋਂ ਪਹਿਲਾਂ ਕਾਫ਼ੀ ਮਨ-ਮੁਟਾਅ ਚਲਦੇ ਰਹੇ ਹਨ। ਪਰ ਇਸ ਸੰਘਰਸ਼ ਦੇਵਾਂ ਰਾਜਾ ਦੇ ਲੋਕਾਂ ਨੇ ਇਕ ਦੂਜੇ ਦੇ ਭਾਈ ਬਣ ਕੇ ਕੰਮ ਕੀਤਾ। ਸੰਪਾਦਕੀ ਵਿਚ ਕੇਂਦਰ ਸਰਕਾਰ ਨਾਲ ਕੀਤੀਆਂ ਮੀਟਿੰਗਾਂ ਅਤੇ ਸਰਕਾਰ ਦੀ ਕੋਈ ਠੋਸ ਹੱਲ ਨਾ ਕੱਢਣ ਦੀ ਨੀਤੀ ਬਾਰੇ ਚਰਚਾ ਕੀਤੀ ਹੈ। ਇਸ ਤੋਂ ਸੰਯੁਕਤ ਕਿਸਾਨ ਮੋਰਚੇ ਦੁਆਰਾ ਲਏ ਗਏ ਮਹੱਤਵਪੂਰਨ ਫ਼ੈਸਲੇ ਵੀ ਇਕ ਕਾਲਮ ਵਿਚ ਛਾਪੇ ਗਏ। ਜਿਸ ਨਾਲ ਸੰਯੁਕਤ ਕਿਸਾਨ ਮੋਰਚੇ ਦਾ ਸੁਨੇਹਾ ਦੂਰ ਤੱਕ ਪਹੁੰਚ ਸਕੇ ਅਤੇ ਪਿੰਡਾਂ ਵਿਚ ਬੈਠੇ ਲੋਕਾਂ ਨੂੰ ਵੀ ਇਨ੍ਹਾਂ ਅਹਿਮ ਫ਼ੈਸਲਿਆਂ ਬਾਰੇ ਜਾਣਕਾਰੀ ਹੋਵੇ।

ਕਿਸਾਨ ਸੰਘਰਸ਼ ਤੋਂ ਪਹਿਲਾਂ ਪੰਜਾਬ ਦੇ ਨੌਜਵਾਨਾਂ ਬਾਰੇ ਇਕ ਭਰਮ ਕਾਫ਼ੀ ਪ੍ਰਚਲਿਤ ਸੀ ਕਿ ਇੱਥੋਂ ਦਾ ਨੌਜਵਾਨਾ ਨਸਲੇ ਦੀ ਭੇਟ ਚੜ੍ਹ ਗਿਆ ਹੈ ਅਤੇ ਹੁਣ ਉਨ੍ਹਾਂ ਵਿਚ ਪਹਿਲਾਂ ਵਰਗੀ ਹਿੰਮਤ ਤੇ ਤਾਕਤ ਨਹੀਂ ਰਹੀ। ਪਰ ਕਿਸਾਨ ਸੰਘਰਸ਼ ਦੁਆਰਾ ਨੌਜਵਾਨਾਂ ਦੇ ਨਿਭਾਏ ਰੋਲ ਨੇ ਸਾਰੇ ਲੋਕਾਂ ਦੇ ਭੁਲੇਖੇ ਦੂਰ ਕਰ ਦਿੱਤੇ। ਜਿਸ ਕਰਕੇ ਇਸ ਵਿਸ਼ੇ ਨੂੰ ਛੇਵੇਂ ਅੰਕ ਵਿਚ ਪ੍ਰਮੁੱਖਤਾ ਨਾਲ ਪਹਿਲੇ ਪੰਨੇ ਉੱਤੇ ਥਾਂ ਦਿੱਤੀ ਗਈ। ਇਸ ਦੀ ਮੁੱਖ ਸੁਰਖੀ ‘ਜਵਾਨੀ ਜੜ੍ਹਾਂ ਪੱਟਣ ਨੂੰ ਕਾਹਲੀ ਐ, ਜ਼ਾਲਮ ਸਰਕਾਰ ਦੀਆਂ’ ਸੀ। ਲੇਖ ਵਿਚ ਨੌਜਵਾਨਾਂ ਦੇ ਸੰਘਰਸ਼ ਵਿਚ ਯੋਗਦਾਨ ਨੂੰ ਵਿਸਥਾਰ ਨਾਲ ਦੱਸਿਆ ਗਿਆ। ਸੰਪਾਦਕੀ ਵਿਚ ਸੰਯੁਕਤ ਕਿਸਾਨ ਮੋਰਚਾ ਅਤੇ ਸਰਕਾਰ ਦੀਆਂ ਮੀਟਿੰਗਾਂ ਦਾ ਜ਼ਿਕਰ ਕੀਤਾ ਗਿਆ ਅਤੇ ਪ੍ਰਧਾਨ ਮੰਤਰੀ ਨਰਿੰਦਰ ਮੋਦੀ ਦੁਆਰਾ ਅਮਰੀਕਾ ਦੀ ਅਸੈਂਬਲੀ ਵਿਚ ਹੋਈ ਭੰਨਤੋੜ ਬਾਰੇ ਟਵੀਟ ਕਰਨ ਅਤੇ ਆਪਣੇ ਦੇਸ਼ ਦੀ ਰਾਜਧਾਨੀ ਦੇ ਬਾਹਰ ਬੈਠੇ ਸ਼ਾਂਤਮਈ ਪ੍ਰਦਰਸ਼ਨ ਕਰ ਰਹੇ ਲੋਕਾਂ ਦੀ ਗੱਲ ਨਾ ਸੁਣਨ ਬਾਰੇ ਤੱਥ ਕੱਢਿਆ ਗਿਆ। ਜੇ ਕੰਮ ਮੁੱਖ ਧਾਰਾ ਦੇ ਮੀਡੀਆ ਨੂੰ ਕਰਨਾ ਚਾਹੀਦਾ ਸੀ ਉਹ ਇਸ ਚਾਰ ਪੰਨਿਆਂ ਦੇ ਅਖ਼ਬਾਰ ਦੁਆਰਾ ਕੀਤਾ ਜਾ ਰਿਹਾ ਸੀ।

ਸ਼ਾਇਦ ਇਹ ਪਹਿਲਾ ਸੰਘਰਸ਼ ਹੋਵੇਗਾ, ਜਿਸ ਵਿਚ ਔਰਤਾਂ ਦੇ ਯੋਗਦਾਨ ਨੂੰ ਬਰਾਬਰ ਦੀ ਤਵੱਜੋ ਦਿੱਤੀ ਗਈ। ਭਾਵੇਂ ਇਸ ਤੋਂ ਪਹਿਲਾਂ ਵੀ ਔਰਤਾਂ ਸੰਘਰਸ਼ਾਂ ਵਿਚ ਸ਼ਾਮਲ ਹੁੰਦੀਆਂ ਰਹੀਆਂ ਹਨ। ਪਰ ਇਸ ਤਰ੍ਹਾਂ ਰੋਲ ਪਹਿਲਾ ਕਿਸੇ ਅੰਦੋਲਨ ਵਿਚ ਨਹੀਂ ਦੇਖਿਆ ਗਿਆ। ਸੱਤਵੇਂ ਅੰਕ ਵਿਚ ਵੀ ਇਸ ਨਾਲ ਸਬੰਧਿਤ ਲੇਖ ਪਹਿਲੇ ਪੰਨੇ ਪ੍ਰਕਾਸ਼ਿਤ ਕੀਤਾ ਗਿਆ। ਜਿਸ ਵਿਚ ਸੰਘਰਸ਼ ਵਿਚ ਸ਼ਾਮਲ ਜੁਝਾਰੂ ਔਰਤਾਂ ਦੀਆਂ ਕਹਾਣੀਆਂ ਸਾਂਝੀਆਂ ਕੀਤੀਆਂ ਗਈਆਂ। ਹੇਠਲੀ ਤਸਵੀਰ ਇਸ ਕਹਾਣੀ ਨੂੰ ਹੋਰ ਸਪਸ਼ਟ ਕਰਦੀ ਹੈ।



ਲੀਡਰਾਂ ਅਨੁਸਾਰ ਟਰੈਕਟਰ ਪਰੇਡ ਦੇ ਆਖਰੀ ਸਮੇਂ ਤੱਕ ਰੂਟ ਬਦਲਣ ਕਰਕੇ ਲਾਲ ਕਿਲ੍ਹੇ ਦਾ ਘਟਨਾਕ੍ਰਮ ਵਾਪਰਿਆ। ਪਰ ਕੌਮੀ ਮੀਡੀਆ ਨੇ ਇਸ ਘਟਨਾ ਨੂੰ ਪੂਰੀ ਤਰ੍ਹਾਂ ਨਾਲ ਵੱਖਰੇ ਨਜ਼ਰੀਏ ਤੋਂ ਪੇਸ਼ ਕੀਤਾ। ਜਿਸ ਕਰਕੇ ਦੇਸ਼ ਇਕ ਹਿੱਸੇ ਵਿਚ ਅੰਦੋਲਨ ਲਈ ਸੰਦੇਹ ਪੈਦਾ ਹੋ ਗਿਆ ਸੀ। ਇਸ ਅੰਕ ਵਿਚ ਦਿੱਲੀ ਪੁਲਿਸ ਦੇ ਡਰਾਵੇ ਦੇ ਨਾਮ ਹੇਠ ਛਪੀ ਸਟੋਰੀ ਵਿਚ ਦਿੱਲੀ ਪੁਲਿਸ ਦੁਆਰਾ ਪਰੇਸ਼ਾਨ ਕਰਨ ਦਾ ਜ਼ਿਕਰ ਕੀਤਾ ਗਿਆ। ਸੰਪਾਦਕੀ ਟੀਮ ਦੀ ਮੈਂਬਰ ਨਵਕਿਰਨ ਨੱਤ ਨੂੰ ਬਿਨਾਂ ਕਿਸੇ ਵਰੰਟ ਦੇ ਪੁੱਛਗਿੱਛ ਕਰਨ ਬਾਰੇ ਦੱਸਿਆ ਗਿਆ। ਜਿਸ ਤੋਂ ਇਸ ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦਾ ਸੰਪਰਸ਼ ਦੌਰਾਨ ਅਸਰ ਸਪਸ਼ਟ ਨਜ਼ਰ ਆਉਂਦਾ ਹੈ।

ਬਾਰੂਵੇਂ ਅੰਕ ਦੇ ਪਹਿਲੇ ਪੰਨੇ ਉਪਰ ਸੰਪਾਦਕੀ ਨੂੰ ਥਾਂ ਨਹੀਂ ਮਿਲੀ। ਕਲਾਂ ਅਤੇ ਸਾਂਝੀਵਾਲਤਾ ਦੀ ਗੱਲ ਕਰਦਾ ਲੇਖ ਦੇ ਕੇਂਦਰ ਵਿਚ ਛਾਪਿਆ ਗਿਆ। ਜਿਸ ਵਿਚ ਸੰਪਰਸ਼ ਦੌਰਾਨ ਵੱਖ ਵੱਖ ਕਲਾਤਮਕ ਸਿਰਜਣਾ ਨਾਲ ਵਿਰੋਧ ਕਰਨ ਬਾਰੇ ਦੱਸਿਆ ਗਿਆ। ਜਿਸ ਵਿਚ ਸਿੰਘੂ ਹੱਦ ਤੇ ਬਣੀਆਂ ਲੈਂਡਸਕੇਪ ਪੇਂਟਿੰਗਾਂ ਮੱਕੀ ਦੀਆਂ ਖੇਤਾਂ ਅਤੇ ਹੱਸਦੀਆਂ ਔਰਤਾਂ ਦੀਆਂ ਤਸਵੀਰਾਂ, ਟਿੱਕਰੀ ਵਿਖੇ ਅਨੇਕਾਂ ਪਿੰਡਾਂ ਦੇ ਮੀਲ-ਪੱਥਰ ਅਤੇ ਕੰਧਾਂ, ਪਿੱਲਰ, ਬੈਨਰਾਂ, ਗੱਤਿਆਂ ਅਤੇ ਝੰਡਿਆਂ ਤੇ ਬਣਾਏ ਗਏ ਸਕੈਚ, ਤਸਵੀਰਾਂ, ਡੂਡਲ ਆਦਿ ਸਭ ਦਾ ਵਿਸ਼ੇਸ਼ ਜ਼ਿਕਰ ਕੀਤਾ ਗਿਆ। ਇਸ ਤੋਂ ਮੋਰਚੇ ਦਾ ਹਾਲ ਬਿਆਨ ਕਰਦਾ ਇਕ ਛੋਟਾ ਲੇਖ ਵੀ ਪ੍ਰਕਾਸ਼ਿਤ ਗਿਆ ਜਿਸ ਮੋਰਚੇ ਦੀ ਮੌਜੂਦਾ ਸਥਿਤੀ ਅਤੇ ਭਵਿੱਖ ਦੇ ਪ੍ਰੋਗਰਾਮਾਂ ਬਾਰੇ ਜਾਣਕਾਰੀ ਸੀ। ਇਸ ਤੋਂ ਪ੍ਰਸਿੱਧ ਕਵੀ ਬ੍ਰਜੇਲਤ ਬ੍ਰੈਖਤ ਦੀ ਕਵਿਤਾ ‘ਐ ਜਰਨੈਲ, ਤੇਰਾ ਟੈਂਕ’ ਪ੍ਰਚਿਤ ਕਰਨ ਲਈ ਛਾਪੀ ਗਈ।

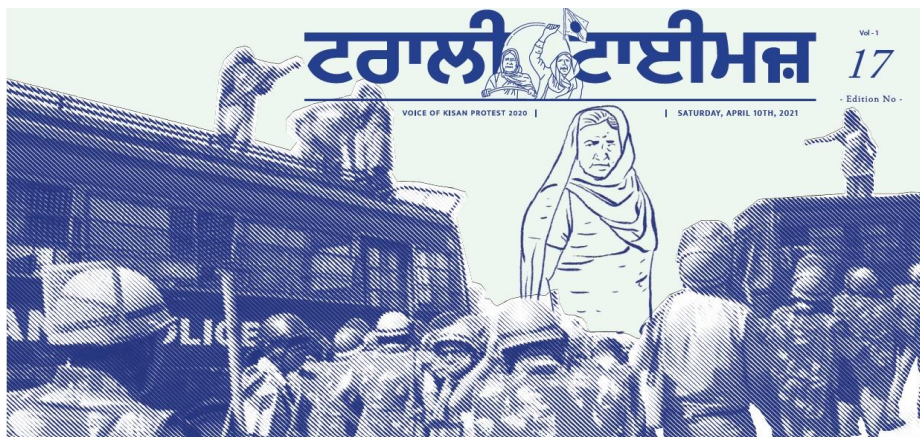
ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦਾ ਤੇਰਵਾਂ ਅੰਕ 13 ਮਾਰਚ ਨੂੰ ਛਾਪਿਆ ਗਿਆ। 8 ਮਾਰਚ ਨੂੰ ਅੰਤਰਰਾਸ਼ਟਰੀ ਔਰਤ ਦਿਵਸ ਹੋਣ ਕਰਕੇ ਇਸ ਦੇ ਪਹਿਲੇ ਪੰਨੇ ਤੇ ਜ਼ਿਆਦਾ ਥਾਂ ਇਕ ਵਾਰ ਫੇਰ ਤੋਂ ਔਰਤਾਂ ਦੇ ਹਿੱਸੇ ਹਾਈ। ਲੇਖ ਵਿਚ ਔਰਤਾਂ ਦੇ ਸੰਪਰਸ਼ ਵਿਚ ਯੋਗਦਾਨ ਅਤੇ ਇਤਿਹਾਸ ਵਿਚ ਮਹਾਨ ਔਰਤਾਂ ਬਾਰੇ ਜ਼ਿਕਰ ਕੀਤਾ ਗਿਆ। ਇਸ ਤੋਂ ਇਲਾਵਾ ਔਰਤਾਂ ਨੂੰ ਭਵਿੱਖ ਵਿਚ ਆਉਣ ਵਾਲੀਆਂ ਸਮੱਸਿਆ ਦਾ ਵੀ ਜ਼ਿਕਰ ਕੀਤਾ ਗਿਆ ਸੀ। ਇਸ ਤੋਂ ਇਲਾਵਾ ਸਵਿਤੀਬਾਈ ਫੂਲੇ ਦਾ ਕਥਨ ‘ਜਾਗੋ, ਉਠੋ, ਪੜ੍ਹੋ ਤੇੜ ਦਿਓ ਪਰੰਪਰਾਵਾਂ-ਹੋਵੇ ਆਜ਼ਾਦ-ਨੀਂਦ ਤਿਆਗੋ, ਰਣ ਭੇਰੀ ਬਜਾਉ, ਛੇਤੀ ਉਠੋ।’ ਕਿਸਾਨ ਆਗੂ ਦਰਸ਼ਨਪਾਲ ਦੇ ਭਾਸ਼ਣ ਵਿਚੋਂ ਵੀ ਪੰਜਾਬੀਅਤ ਅਤੇ ਸਿੱਖੀ ਸਰੂਪ ਦੇ ਮਾਣ ਨਾਲ ਸਬੰਧਿਤ ਕੁਝ ਅੰਸ਼ ਛਾਪੇ ਸਨ। ਜਿਸ ਵਿਚ ਉਹ ਦੱਸਦੇ ਸਨ ਕਿ ਜਦੋਂ ਕਿਸੇ ਮਹਾਂ ਪੰਚਾਇਤ ਲਈ ਆਗੂ ਭੇਜਣ ਬਾਰੇ ਫੈਨ ਆਉਂਦਾ ਤਾਂ ਲੋਕ ਮੰਗ ਕਰਦੇ ਹਨ ਕਿ ਜੇਕਰ ਸਿੱਖੀ ਸਰੂਪ ਵਾਲੇ ਲੀਡਰ ਹੋਣ ਤਾਂ ਸਾਨੂੰ ਹੋਰ ਵੀ ਚੰਗਾ ਲੱਗੇਗਾ। ਜਿਸ ਕਰਕੇ ਮੈਨੂੰ ਸਿੱਖੀ ਸਰੂਪ ਤੇ ਮਾਣ ਹੈ।

ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦਾ ਚੌਦਵਾਂ ਅੰਕ ਕਾਫ਼ੀ ਮਹੱਤਵਪੂਰਨ ਹੈ ਕਿਉਂਕਿ ਇਸ ਦੇ ਪਹਿਲੇ ਪੰਨੇ ਤੇ ਤਿੰਨ ਲੇਖ ਛਾਪੇ ਗਏ ਸਨ। ਜੋ ਕਿ ਆਪਣੇ ਆਪਣੇ ਖੇਤਰ ਦੀ ਪ੍ਰਸਿੱਧ ਹਸਤੀਆਂ ਦੇ ਸਨ। ਸਭ ਤੋਂ ਪਹਿਲਾਂ ਲੇਖ ਪ੍ਰੋਫੈਸਰ ਅਤੇ ਲੇਖਕ ਆਨੰਦ ਤੇਲਤੁੰਬੜੇ ਦਾ ਹੈ ਜੋ ਜਗਸੀਰ ਸਿੰਘੂ ਨੇ ਪੰਜਾਬੀ ਵਿਚ ਅਨੁਵਾਦ ਕਰਕੇ ਛਾਪਿਆ ਹੈ। ਜਿਸ ਪ੍ਰੋਫੈਸਰ ਆਨੰਦ ਤੇਲਤੁੰਬੜੇ ਭਾਰਤ ਵਿਚ ਵਿਕਾਸ ਦੇ ਨਾਮ ਤੇ ਦਿਨੋਂ ਦਿਨ ਹੋ ਰਹੇ ਨਿੱਜੀਕਰਨ ਦੇ ਬਾਰੇ ਦੱਸਦੇ ਹਨ ਹਨ ਕਿ ਕੋਈ ਵੀ ਇਸ ਤਰ੍ਹਾਂ ਦੇ ਸਪਸ਼ਟ ਅੰਕੜੇ ਨਹੀਂ ਹਨ ਕਿ ਪ੍ਰਾਈਵੇਟ ਖੇਤਰ ਜਨਤਕ ਖੇਤਰ ਨਾਲੋਂ ਜ਼ਿਆਦਾ ਤੇਜ਼ੀ ਨਾਲ ਵਿਕਾਸ ਕਰਦਾ ਹੈ। ਇਸ ਲਈ ਉਹ ਕਈ ਇਤਿਹਾਸਿਕ ਹਵਾਲੇ ਦੇ ਕੇ ਆਪਣੀ ਦਲੀਲ ਨੂੰ ਸਹੀ ਸਿੱਧ ਕਰਦੇ ਹਨ। ਦੂਸਰਾ ਲੇਖ ਕਿਸਾਨਾਂ ਅਤੇ ਮਜ਼ਦੂਰਾਂ ਦੀ ਸਾਂਝੀਵਾਲਤਾ ਦੀ ਗੱਲ ਕਰਦਾ ਹੈ ਜਿਸ ਵਿਚ ਦੱਸਿਆ ਗਿਆ ਹੈ ਕਿ ਕਿਸੇ ਤਰ੍ਹਾਂ ਮਜ਼ਦੂਰ ਅਤੇ ਕਿਸਾਨ ਇਕ ਦੂਜੇ ਨਾਲ ਜੁੜੇ ਹੋਏ ਹਨ ਅਤੇ ਇਸ ਸੰਪਰਸ਼ ਦੇ ਨਾਲ ਉਨ੍ਹਾਂ ਦੇ ਰਿਸ਼ਤੇ ਹੋਰ ਕਿੰਨੇ ਮਜ਼ਬੂਤ ਹੋਏ ਹਨ। ਇਸ ਤੋਂ ਪ੍ਰਸਿੱਧ ਪੰਜਾਬੀ ਲੇਖਕ ਜਸਵੰਤ ਸਿੰਘ ਜਫ਼ਰ ਲੇਖ ‘ਪੰਜਾਬ ਨੂੰ ਕਿਹੜਾ ਰੋਗ ਹੈ?’ ਸਿਰਲੇਖ ਹੇਠ ਛਾਪਿਆ ਗਿਆ। ਜਿਸ ਵਿਚ ਉਹ ਪੰਜਾਬ ਦੀਆਂ ਸਮੱਸਿਆ ਬਾਰੇ ਵਿਸਥਾਰ ਨਾਲ ਜ਼ਿਕਰ ਕਰਦੇ ਹੋਏ ਸਰਕਾਰ ਦੀਆਂ ਮਾੜੀਆਂ ਨੀਤੀਆਂ ਨੂੰ ਜ਼ਿੰਮੇਵਾਰ ਦੱਸਦੇ ਹਨ। ਆਪਣੇ ਸ਼ੁਰੂਆਤ ਦੇ ਹੀ ਥੋੜ੍ਹੇ ਸਮੇਂ ਅੰਦਰ ਹੀ ਟਰਾਲੀ ਟਾਈਮਜ਼ ਅੰਦਰ ਇਨ੍ਹਾਂ ਹਸਤੀਆਂ ਦੇ ਛਪੇ ਲੇਖ ਇਸ ਦੀ ਪ੍ਰਸਿੱਧੀ ਨੂੰ ਦਰਸਾਉਂਦੇ ਹਨ।

ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦਾ ਪੰਦਰਵਾਂ ਅੰਕ 27 ਮਾਰਚ 2021 ਨੂੰ ਛਾਪਿਆ ਗਿਆ। ਜਿਸ ਪਹਿਲਾ ਪੂਰੀ ਤਰ੍ਹਾਂ ਨਾਲ ਕਿਸਾਨੀ ਸੰਪਰਸ਼ ਕਹਾਣੀਆਂ ਨਾਲ ਸਬੰਧਿਤ ਸੀ। ਜਿਸ ਵਿਚ ਸਭ ਤੋਂ ਪਹਿਲਾਂ ਲੇਖ ਕਿਸਾਨ ਸੰਪਰਸ਼ ਦੌਰਾਨ ਜਾਨ ਗਵਾਉਣ ਵਾਲੇ ਲੋਕਾਂ ਨਾਲ ਸਬੰਧਿਤ ਛਾਪਿਆ ਗਿਆ। ਜਿਸ ਵਿਚ ਕਿਸਾਨ ਦੀ ਐਥੀ ਜੀਵਨ ਜਾਂਚ ਅਤੇ ਸੰਪਰਸ਼ ਭਰੀ ਜ਼ਿੰਦਗੀ ਦਾ ਜ਼ਿਕਰ ਕੀਤਾ ਗਿਆ ਅਤੇ ਇਸ ਅੰਦੋਲਨ ਵਿਚ ਸ਼ਹਾਦਤ ਦਾ ਜਾਮ ਪੀਣ ਵਾਲਿਆਂ ਦੇ ਹਮੇਸ਼ਾ ਅਮਰ ਰਹਿਣ ਦੀ ਗੱਲ ਕੀਤੀ ਗਈ। ਪੰਜਾਬੀ ਦੇ ਪ੍ਰਸਿੱਧ ਕਵੀ ਪ੍ਰੇਮ ਪੂਰਨ ਸਿੰਘ ਦੀ ਹਲ ‘ਵਾਹੁਣ ਵਾਲੇ’ ਵੀ ਛਾਪੀ ਗਈ। ਕੈਨੇਡਾ ਵਿਚ ਵੱਸਦੇ ਪੰਜਾਬੀਆਂ ਦੁਆਰਾ ਕਿਸਾਨ ਸੰਪਰਸ਼ ਦੇ ਸਮਰਥਨ ਵਿਚ ਕੈਨੇਡਾ ਦੀ ਧਰਤੀ ਤੇ ਕੀਤੇ ਜਾਂ ਰਹੇ ਰੋਸ ਮੁਜ਼ਾਹਰਿਆਂ ਬਾਰੇ ਜ਼ਿਕਰ ਕੀਤਾ ਗਿਆ।

ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦੇ ਸੋਲ੍ਹਵੇਂ ਅੰਕ ਦੇ ਪਹਿਲੇ ਪੰਨੇ ਪਰ ਪ੍ਰਸਿੱਧ ਪ੍ਰੋਫੈਸਰ ਡਾ. ਰਜਿੰਦਰ ਪਾਲ ਸਿੰਘ ਬਰਾੜ ਦਾ ਕਾਰਪੋਰੇਟ ਦੀ ਵਿਆਖਿਆ ਕਰਦਾ ਲੇਖ ਛਾਪਿਆ ਗਿਆ। ਜਿਸ ਵਿਚ ਉਨ੍ਹਾਂ ਨੇ ਕਾਰਪੋਰੇਟ ਘਰਾਣਿਆਂ ਬਾਰੇ ਵਿਸਥਾਰ ਨਾਲ ਚਾਨਣਾ ਪਾਇਆ। ਪੂੰਜੀਵਾਦ ਵਿਚ ਪੂੰਜੀਪਤੀ ਦਾ ਇੱਕੋ ਇਕ ਨਿਸ਼ਾਨਾ ਮੁਨਾਫ਼ਾ ਕਮਾਉਣ ਵੱਲ ਸੇਧਤ ਹੁੰਦਾ ਹੈ। ਪਿਛਲੇ ਕੁਝ ਸਮੇਂ ਤੋਂ ਇਨ੍ਹਾਂ ਦੀ ਅੱਖ ਜ਼ਮੀਨਾਂ ਉਪਰ ਹੈ। ਉਸ ਦੇ ਵੀ ਨੇਸ ਕਾਰਨ ਹਨ। ਕਿਉਂਕਿ ਬਾਕੀ ਸਾਰੀਆਂ ਚੀਜ਼ਾਂ ਦੀ ਮੰਗ ਘਟ ਜਾਂਦੀ ਹੈ। ਪਰ ਭੋਜਨ ਅਜਿਹੀ ਚੀਜ਼ ਹੈ ਜਿਸ ਦੀ ਜ਼ਰੂਰਤ ਹਮੇਸ਼ਾ ਮਨੁੱਖ ਨੂੰ ਰਹਿੰਦੀ ਹੈ। ਜਿਸ ਕਰਕੇ ਸਰਕਾਰ ਵੀ ਇਸ ਤਰ੍ਹਾਂ ਦੇ ਕਾਨੂੰਨ ਲੈ ਕੇ ਆ ਰਹੀ ਹੈ ਤਾਂ ਜੋ ਕਾਰਪੋਰੇਟ ਘਰਾਣਿਆਂ ਦਾ ਰਾਹ ਸੋਖਾ ਕੀਤਾ ਜਾਵੇ। ਇਸ ਤੋਂ ਇਲਾਵਾ ਮੋਰਚਾਨਾਮਾ ਦੇ ਨਾਮ ਹੇਠ ਇਕ ਕਾਲਮ ਛਾਪਿਆ ਗਿਆ। ਜਿਸ ਵਿਚ ਮੋਰਚੇ ਦੌਰਾਨ ਧਰਨਾ ਸਥਾਨ ਤੇ ਮਨਾਏ ਗਏ ਵੱਖ ਵੱਖ ਤਿਉਹਾਰਾਂ ਦਾ ਜ਼ਿਕਰ ਕਰਦੇ ਹੋਏ ਭਵਿੱਖ ਦੇ ਪ੍ਰੋਗਰਾਮ ਉਲੀਕਣ ਦੀ ਗੱਲ ਕੀਤੀ ਗਈ।

ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦੇ ਸਤਾਰ੍ਹਵੇਂ ਅੰਕ ਵਿਚ ਬਹੁਤ ਹੀ ਕਮਾਲ ਦੀ ਫੋਟੋ ਪਹਿਲੇ ਪੰਨੇ ਤੇ ਪ੍ਰਕਾਸ਼ਿਤ ਕੀਤੀ ਗਈ। ਜਿਸ ਪੁਲਿਸ ਦੇ ਸਾਹਮਣੇ ਔਰਤਾਂ ਨੂੰ ਆਵਾਜ਼ ਬੁਲੰਦ ਕਰਦੇ ਦਿਖਾਇਆ ਗਿਆ ਹੈ। ਜੋ ਪੁਲਿਸ ਦੀਆਂ ਬੱਸਾਂ ਦੀਆਂ ਛੱਤਾਂ ਤੇ ਚੜ੍ਹ ਕੇ ਉਨ੍ਹਾਂ ਖ਼ਿਲਾਫ਼ ਨਾਅਰੇਬਾਜ਼ੀ ਕਰ ਰਹੀਆਂ ਹਨ। ਜੋ ਹੇਠਲੀ ਤਸਵੀਰ ਵਿਚ ਸਾਫ਼ ਨਜ਼ਰ ਆ ਰਿਹਾ ਹੈ।



ਇਸ ਸੰਘਰਸ਼ ਨੇ ਔਰਤਾਂ ਨੂੰ ਵੱਖਰੀ ਕਿਸਮ ਦੀ ਮਜ਼ਬੂਤੀ ਪ੍ਰਦਾਨ ਕੀਤੀ ਹੈ। ਜਿਸ ਦਾ ਨਮੂਨਾ ਇਸ ਤਸਵੀਰ ਵਿਚ ਦੇਖਣ ਨੂੰ ਮਿਲਿਆ ਹੈ। ਜਿਸ ਨੂੰ ਦੇਖ ਕੇ ਕਿੰਨੀਆਂ ਹੋਰ ਔਰਤਾਂ ਦੇ ਅੰਦਰ ਆਪਣੇ ਹੱਕਾਂ ਲਈ ਲੜਨ ਦੀ ਚਿਣਗ ਉੱਠੀ ਹੋਈ।

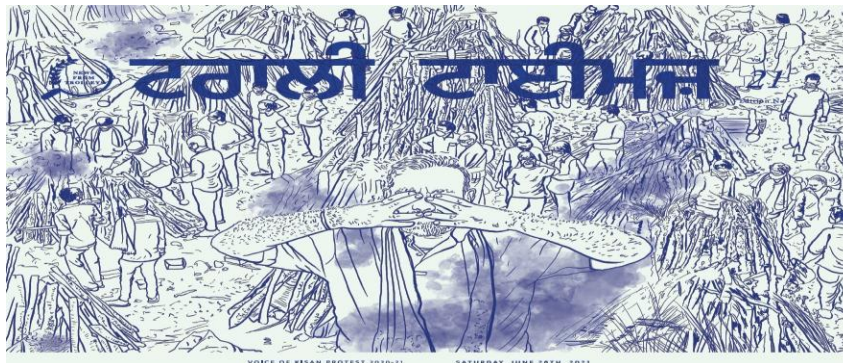
ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦੇ ਅਠਾਰਵੇਂ ਅੰਕ ਦੇ ਪਹਿਲੇ ਪੰਨੇ ਉਪਰ ਪਿਛਲੇ ਦਾ ਅੰਕ ਦਾ ਬਾਕੀ ਲੇਖ ਜੋ ਕਿ ਸਿੱਧੇ ਭੁਗਤਾਨ ਬਾਰੇ ਅਤੇ ਆੜ੍ਹਤੀਏ ਦੇ ਰੋਲ ਬਾਰੇ ਸੀ ਨੂੰ ਹੀ ਪੂਰਾ ਕੀਤਾ ਗਿਆ। ਜਿਸ ਵਿਚ ਸਿੱਧੇ ਭੁਗਤਾਨ ਦੇ ਫ਼ਾਇਦੇ ਅਤੇ ਨੁਕਸਾਨ ਸਮਝਾਏ ਗਏ ਅਤੇ ਕਿਸਾਨ ਦੀ ਜ਼ਿੰਦਗੀ ਵਿਚ ਆੜ੍ਹਤੀਏ ਦੀ ਭੂਮਿਕਾ ਬਾਰੇ ਵੀ ਵਿਸਥਾਰ ਨਾਲ ਦੱਸਿਆ ਗਿਆ। ਇਸ ਤੋਂ ਇਲਾਵਾ ਖ਼ਾਲਸਾ ਏਡ ਵੱਲੋਂ ਕਰਵਾਈ ਗਈ ਦੌੜ ਵਿਚ ਜਿੱਤ ਹਾਸਲ ਕਰਨ ਵਾਲੇ ਬਜ਼ੁਰਗ ਦਰਸ਼ਨ ਸਿੰਘ ਦੀ ਕਹਾਣੀ ਵੀ ਛਾਪੀ ਹੈ। ਜੋ ਨੌਜਵਾਨਾਂ ਨੂੰ ਪ੍ਰੇਰਨਾ ਦਿੰਦੀ ਹੈ।

ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦੇ ਉੱਨ੍ਹਵੇਂ ਅੰਕ ਵਿਚ ਦੋ ਮਹੱਤਵਪੂਰਨ ਲੇਖ ਛਾਪੇ ਗਏ ਸਨ। ਪਹਿਲੇ ਵਿਚ 26 ਜਨਵਰੀ ਤੋਂ ਬਾਅਦ ਦੇ ਦੌਰ ਦੀ ਚਰਚਾ ਕੀਤੀ ਗਈ ਕਿ ਉਕਤ ਘਟਨਾ ਤੋਂ ਬਾਅਦ ਸੰਘਰਸ਼ ਦੀ ਸਥਿਤੀ ਕਿਸ ਤਰ੍ਹਾਂ ਦੀ ਹੋ ਗਈ ਸੀ। ਭਾਵੇਂ ਕਿ ਕੁਝ ਮਤਭੇਦ ਵੀ ਉੱਭਰੇ ਪਰ ਸਮਾਂ ਕੇ ਸਥਿਤੀ ਪਹਿਲਾਂ ਵਰਗੀ ਹੁੰਦੀ ਗਈ। ਇਕ ਵਾਰ ਮੋਰਚਾ ਬਿਲਕੁਲ ਨਾਜ਼ੁਕ ਸਥਿਤੀ ਵਿਚ ਪਹੁੰਚ ਗਿਆ ਸੀ। ਪਰ ਗਾਜੀਪੁਰ ਹੱਦ ਤੇ ਕਿਸਾਨ ਆਗੂ ਰਾਕੇਸ਼ ਟਿਕੈਤ ਅੱਥਰੂਆਂ ਦੇ ਵਹਿਣ ਦੀਆਂ ਲਾਈਵ ਤਸਵੀਰਾਂ ਨੇ ਯੂਪੀ ਅਤੇ ਹਰਿਆਣੇ ਦੇ ਕਿਸਾਨਾਂ ਵਿਚ ਗੁੱਸੇ ਦੀ ਲਹਿਰ ਜਗਾ ਦਿੱਤੀ ਤੇ ਰਾਤੋ ਰਾਤ ਕਿਸਾਨ ਵੱਡੀ ਗਿਣਤੀ ਵਿਚ ਗਾਜੀਪੁਰ ਬਾਰਡਰ ਤੇ ਇਕੱਠੇ ਹੋ ਗਏ। ਬਾਅਦ ਵਿਚ ਅੰਤਰਰਾਸ਼ਟਰੀ ਹਸਤੀਆਂ ਦੇ ਸਮਰਥਨ ਅਤੇ ਕਿਸਾਨ ਯੂਨੀਅਨਾਂ ਦੀ ਸੂਝ ਬੂਝ ਨਾਲ ਮੋਰਚਾ ਫਿਰ ਤੋਂ ਆਪਣੇ ਪਹਿਲਾਂ ਵਾਲੀ ਮਜ਼ਬੂਤ ਸਥਿਤੀ ਵਿਚ ਆ ਗਿਆ। ਦੂਸਰਾ ਲੇਖ ਅਨੁਰੂਪ ਕੌਰ ਸੰਧੂ ਦਾ ਸੀ ਜਿਸ ਨੇ ਕਿਸਾਨ ਮੋਰਚੇ ਦੌਰਾਨ ਜਾਨ ਗੁਆਉਣ ਵਾਲੇ ਲੋਕਾਂ ਦੀ ਸੂਚੀ ਤਿਆਰ ਕੀਤੀ ਸੀ। ਇਸ ਕਾਰਜ ਦੌਰਾਨ ਆਈਆਂ ਚੁਨੌਤੀਆਂ ਅਤੇ ਆਪਣੀ ਜ਼ਿੰਦਗੀ ਉਪਰ ਪਏ ਪ੍ਰਭਾਵ ਦਾ ਉਸ ਨੇ ਬਾਖ਼ੂਬੀ ਜ਼ਿਕਰ ਕੀਤਾ ਹੈ।

ਵੀਹਵੇਂ ਅੰਕ ਵਿਚ ਭਾਰਤ ਦੀ ਪ੍ਰਸਿੱਧ ਲੇਖਿਕਾ ਅਰੁੰਧਤੀ ਰਾਏ ਦਾ ਲੇਖ ਇਸ ਨੂੰ ਖ਼ਾਸ ਬਣਾਉਂਦਾ ਹੈ। ਜਿਸ ਵਿਚ ਲੇਖਿਕਾ ਕਰੋਨਾ ਕਾਲ ਦੌਰਾਨ ਸਰਕਾਰ ਦੀਆਂ ਨਲਾਇਕੀਆਂ ਨੂੰ ਉਪਰ ਤਿੱਖੇ ਹਮਲੇ ਕਰਦੇ ਹੈ ਅਤੇ ਪ੍ਰਧਾਨ ਮੰਤਰੀ ਨੂੰ ਸੰਬੋਧਿਤ ਕਰਦੇ ਹੋਏ ਕਹਿੰਦੀ ਹੈ ਕਿ

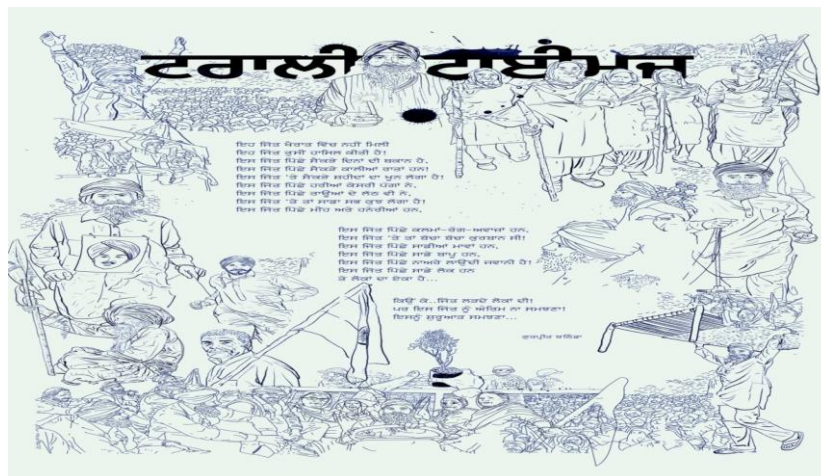
ਤੁਸੀਂ ਹੁਣ ਗੱਦੀ ਛੱਡ ਦੇਵੇ ਇਹ ਸਮੱਸਿਆ ਤੁਹਾਡੇ ਵੱਸ ਤੋਂ ਬਾਹਰ ਹੋ ਚੁੱਕੀ ਹੈ। ਇਸ ਤੋਂ ਇਲਾਵਾ ਕਿਸਾਨ ਰਜਿੰਦਰ ਸਿੰਘ ਦੀਪ ਸਿੰਘ ਵਾਲਾ ਦਾ ਖੇਤੀ ਕਾਨੂੰਨਾਂ ਦੀ ਵਿਆਖਿਆ ਕਰਦਾ ਲੇਖ ਛਾਪਿਆ ਗਿਆ। ਜਿਸ ਵਿਚ ਨਵੇਂ ਕਾਨੂੰਨ ਲਾਗੂ ਹੋਣ ਨਾਲ ਪੈਦਾ ਹੋਣ ਵਾਲੇ ਸੰਕਟ ਬਾਰੇ ਅਹਿਮ ਜਾਣਕਾਰੀ ਸਾਂਝੀ ਕੀਤੀ ਹੈ। ਅਗਲਾ ਲੇਖ ਕਰੋਨਾ ਲਹਿਰ ਹੋਣ ਕਾਰਨ ਦੇਸ਼ ਵਿਚ ਕਾਫ਼ੀ ਗਿਣਤੀ ਵਿਚ ਹੋ ਰਹੀਆਂ ਮੌਤਾਂ ਬਾਰੇ ਅੰਤਰਰਾਸ਼ਟਰੀ ਮੀਡੀਆ ਦੀਆਂ ਖ਼ਬਰਾਂ ਨਾਲ ਸਬੰਧਿਤ ਸੀ। ਜਿਸ ਵਿਚ ਸਰਕਾਰ ਦੀਆਂ ਗ਼ਲਤ ਨੀਤੀਆਂ ਅਤੇ ਵਿਦੇਸ਼ਾਂ ਵਿਚ ਹੁੰਦੀ ਬਦਨਾਮੀ ਦਾ ਖੁੱਲ੍ਹ ਕੇ ਜ਼ਿਕਰ ਕੀਤਾ ਗਿਆ ਹੈ। ਕਿ ਕਿਸ ਤਰ੍ਹਾਂ ਭਾਰਤ ਦੀ ਸਰਕਾਰ ਸਥਿਤੀ ਨੂੰ ਕਾਬੂ ਕਰਨ ਵਿਚ ਨਾਕਾਮਯਾਬ ਰਹੀ ਹੈ।

ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦਾ ਇੱਕੀਵਾਂ ਅੰਕ ਅੰਦੋਲਨ ਦੇ ਸੱਤ ਮਹੀਨੇ ਪੂਰੇ ਹੋਣ ਤੇ ਛਾਪਿਆ ਗਿਆ। ਉਸ ਵਕਤ ਦੇਸ਼ ਕਰੋਨਾ ਦੀ ਮਾਰ ਝੱਲ ਰਿਹਾ ਸੀ। ਜਿਸ ਕਰਕੇ ਇਸ ਵਿਚ ਛਾਪੀ ਤਸਵੀਰ ਉਸ ਸਮੇਂ ਦੀ ਸਥਿਤੀ ਨੂੰ ਕਾਫ਼ੀ ਸਹੀ ਤਰੀਕੇ ਨਾਲ ਬਿਆਨ ਕਰਦੀ ਹੈ ਜਿਸ ਵਿਚ ਸਾਰੇ ਪਾਸੇ ਹਾਹਾਕਾਰ ਮੱਛੀ ਹੋਈ ਹੈ ਤੇ ਦੇਸ਼ ਦਾ ਸ਼ਾਸਕ ਅੱਖਾਂ ਬੰਦ ਕਰਕੇ ਸਭ ਦੇਖ ਰਿਹਾ ਹੈ।



ਇਸ ਤਸਵੀਰ ਤੋਂ ਇਲਾਵਾ ਇਸ ਅੰਕ ਵਿਚ ਕਰੋਨਾ ਨਾਲ ਸਬੰਧਿਤ ਗੁਜਰਾਤੀ ਕਵਿਤਾ ਦਾ ਪੰਜਾਬੀ ਅਨੁਵਾਦ ‘ਲਾਸ਼ਾਂ ਢੋਂਦੀ ਗੰਗਾ’ ਸਿਰਲੇਖ ਹੇਠ ਛਾਪਿਆ ਗਿਆ। ਇਸ ਤੋਂ ਮੋਰਚੇ ਨਾਲ ਸਬੰਧਿਤ ਚਲਦੇ ਕਾਲਮ ਮੋਰਚਾਨਾਮਾ ਵਿਚ ਸਰਕਾਰ ਦੀਆਂ ਮੋਰਚੇ ਨੂੰ ਲੀਹ ਤੋਂ ਲਾਹੁਣ ਦੀਆਂ ਚਾਲਾਂ ਬਾਰੇ ਅਤੇ ਮੋਰਚੇ ਬਾਰੇ ਪ੍ਰਚਲਿਤ ਕੂੜ ਪ੍ਰਚਾਰ ਸਬੰਧੀ ਜਾਣਕਾਰੀ ਸਾਂਝੀ ਕੀਤੀ ਗਈ ਸੀ। ਜਿਸ ਵਿਚ ਮੀਡੀਆ ਦੁਆਰਾ ਕੀਤਾ ਜਾ ਰਿਹਾ ਝੂਠਾ ਪ੍ਰਚਾਰ ਅਤੇ ਗੱਲਾਂ ਵਧਾ ਚੜ੍ਹਾ ਕੇ ਦੱਸਣ ਦੀ ਗੱਲ ਆਖੀ ਗਈ ਸੀ।

ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦਾ ਅਖੀਰਲਾ ਅੰਕ 9 ਦਸੰਬਰ 2021 ਨੂੰ ਸਰਕਾਰ ਦੁਆਰਾ ਤਿੰਨੇ ਖੇਤੀ ਕਾਨੂੰਨ ਸੰਸਦ ਵਿਚ ਰੱਦ ਕਰਨ ਉਪਰੰਤ ਕਿਸਾਨ ਯੂਨੀਅਨਾਂ ਦੁਆਰਾ ਵਾਪਸ ਘਰਾਂ ਨੂੰ ਪਰਤਣ ਦੇ ਕੀਤੇ ਐਲਾਨ ਤੋਂ ਬਾਅਦ ਛਾਪਿਆ ਗਿਆ। ਜਿਸ ਵਿਚ ਪਹਿਲੇ ਪ੍ਰਸਿੱਧ ਆਰਟਿਸਟ ਗੁਰਪ੍ਰੀਤ ਬਠਿੰਡਾ ਦੀ ਕਵਿਤਾ ਧਰਨੇ ਦੀਆਂ ਤਸਵੀਰਾਂ ਸਮੇਤ ਛਾਪੀ ਗਈ। ਜਿਸ ਵਿਚ ਕਿਸਾਨ ਮੋਰਚੇ ਦੇ ਸਫ਼ਰ ਨੂੰ ਬਾਖ਼ੂਬੀ ਚਿਤਰਿਆ ਗਿਆ ਹੈ।



ਟਰਾਲੀ ਟਾਈਮਜ਼ ਦੇ ਅਧਿਐਨ ਤੋਂ ਇਸ ਗੱਲ ਦਾ ਪਤਾ ਲਗਦਾ ਹੈ ਕਿ ਕਿਸਾਨੀ ਸੰਘਰਸ਼ ਜਦੋਂ ਮੁੱਖ ਧਾਰਾ ਦਾ ਮੀਡੀਆ ਇਸ ਮੋਰਚੇ ਬਾਰੇ ਕੂੜ ਪ੍ਰਚਾਰ ਕਰ ਰਿਹਾ ਸੀ ਤਾਂ ਇਸ ਅਖ਼ਬਾਰ ਨੇ ਹਨੇਰੇ ਵਿਚ ਚਾਨਣ ਫੈਲਾਉਣ ਦਾ ਕੰਮ ਕੀਤਾ। ਕਿਸਾਨਾਂ ਦੀ ਅਵਾਜ਼ ਬਣ ਕੇ ਇਸ ਨੇ ਅੰਦੋਲਨ ਵਿਰੁੱਧ ਪ੍ਰਚਾਰ ਕਰਨ ਵਾਲੀ ਹਰ ਤਾਕਤ ਦਾ ਜਵਾਬ ਦਿੱਤਾ ਅਤੇ ਮੋਰਚੇ ਵਿਚ ਸ਼ਾਮਲ ਹਰ ਵਰਗ ਨੂੰ ਬਰਾਬਰ ਥਾਂ ਕੇ ਉਸ ਦੀ

ਅਹਿਮੀਅਤ ਦਰਸਾਈ ਚਾਹੇ ਉਹ ਔਰਤਾਂ ਹੋਣ, ਨੌਜਵਾਨ ਹੋਣ, ਬਜ਼ੁਰਗ ਹੋਣ ਜਾਂ ਕਿਸਾਨ ਆਗੂ। ਇਸ ਨੇ ਸਾਰਿਆਂ ਇੱਕਜੁੱਟ ਹੋਕੇ ਲੜਨ ਲਈ ਪ੍ਰੇਰਿਤ ਕੀਤਾ। ਜਿਸ ਤਰ੍ਹਾਂ ਇਸ ਦੇ ਪਹਿਲੇ ਅੰਕ ਦੀਆਂ ਸੁਰਖੀਆਂ ਹੀ ਏਕੇ ਦੀ ਭਾਵਨਾ ਪੈਦਾ ਕਰਕੇ ਸੰਘਰਸ਼ ਕਰਨ ਲਈ ਪ੍ਰੇਰਿਤ ਕਰਦੀਆਂ ਸਨ। ਦੂਜੇ ਅੰਕ ਵਿਚ ਮੋਰਚੇ ਦੀ ਮੌਜੂਦਾ ਸਥਿਤੀ ਦੀ ਵਿਸਥਾਰ ਨਾਲ ਜਾਣਕਾਰੀ ਦੇ ਕੇ ਮੋਰਚੇ ਦੇ ਸ਼ਹੀਦਾਂ ਨੂੰ ਸ਼ਰਧਾਂਜਲੀ ਭੇਟ ਕੀਤੀ। ਇਸ ਅੰਕ ਦੀ ਛਪੀ ਤਸਵੀਰ ਮਰਦਾਂ ਅਤੇ ਔਰਤਾਂ ਦੀ ਏਕਤਾ ਦੀ ਮਿਸਾਲ ਹੈ। ਜੇਕਰ ਪੂਰੇ ਅਖ਼ਬਾਰ ਦੇ ਸਮੇਂ ਨੂੰ ਦੇਖਿਆ ਜਾਵੇ ਤਾਂ ਇਸ ਵਿਚ ਔਰਤਾਂ ਨੂੰ ਵਿਸ਼ੇਸ਼ ਸਥਾਨ ਹਾਸਲ ਹੈ। ਇਸ ਦੇ ਕਈ ਅੰਕਾਂ ਦੇ ਪਹਿਲੇ ਪੰਨੇ ਉਪਰ ਔਰਤਾਂ ਨਾਲ ਸਬੰਧਿਤ ਲਿਖਤਾਂ ਦਾ ਪ੍ਰਭਾਵ ਰਿਹਾ। ਇਸ ਤੋਂ ਇਲਾਵਾ ਹਰ ਮਹੱਤਵਪੂਰਨ ਦਿਹਾੜੇ ਨੂੰ ਜਗ੍ਹਾ ਦਿੱਤੀ ਗਈ। ਇਸ ਦੀ ਸੰਪਾਦਕੀ ਸਿੱਧੀ ਅਤੇ ਸਪਸ਼ਟ ਹਕੂਮਤ ਨੂੰ ਸਵਾਲ ਕਰਨ ਵਾਲੀ ਜੇ ਕੰਮ ਮੁੱਖ ਧਾਰਾ ਦੇ ਮੀਡੀਆ ਨੂੰ ਕਰਨਾ ਚਾਹੀਦਾ ਸੀ। ਉਹ ਭੂਮਿਕਾ ਇਹ ਚਾਰ ਪੰਨਿਆਂ ਦਾ ਅਖ਼ਬਾਰ ਕਰ ਰਿਹਾ ਸੀ। ਇਸ ਦੀ ਸਭ ਖ਼ਾਸ ਗੱਲ ਇਹ ਸੀ ਕਿ ਇਹ ਲੋੜ ਪੈਣ ਤੇ ਕਿਸਾਨ ਆਗੂਆਂ ਨੂੰ ਸਵਾਲ ਕਰਦਾ ਸੀ। ਜੇ ਕਿ ਪੱਤਰਕਾਰੀ ਦੇ ਮੁੱਢਲੇ ਅਸੂਲਾਂ ਵਿਚੋਂ ਹੈ। ਮਜ਼ਦੂਰਾਂ ਦੇ ਹੱਕਾਂ ਦੀ ਆਵਾਜ਼ ਵੀ ਜ਼ੋਰ ਸ਼ੋਰ ਨਾਲ ਉਠਾਈ ਗਈ। ਇਸ ਦੇ ਚੌਥੇ ਅੰਕ ਦਾ ਪਹਿਲਾ ਪੰਨਾ ਪੂਰੀ ਤਰ੍ਹਾਂ ਕਿਰਤੀ ਲੋਕਾਂ ਨੂੰ ਸਮਰਪਿਤ ਸੀ। ਜਿਸ ਵਿਚ ਕਿਸਾਨ ਸੰਘਰਸ਼ ਦੌਰਾਨ ਮਜ਼ਦੂਰਾਂ ਦਾ ਯੋਗਦਾਨ ਅਤੇ ਕਿਸਾਨ ਮਜ਼ਦੂਰਾਂ ਦੇ ਰਿਸ਼ਤੇ ਬਾਰੇ ਬਾਰੀਕੀ ਨਾਲ ਗੱਲਬਾਤ ਕੀਤੀ ਗਈ ਹੈ।

ਮੋਰਚੇ ਵਿਚ ਏਕਤਾ ਬਣਾਈ ਰੱਖਣ ਲਈ ਇਸ ਨੇ ਵਿਸ਼ੇਸ਼ ਭੂਮਿਕਾ ਨਿਭਾਈ ਮੋਰਚੇ ਵਿਚ ਸ਼ਾਮਲ ਹਰਿਆਣਾ ਦੀ ਕਿਸਾਨ ਜਥੇਬੰਦੀਆਂ ਦੇ ਸਹਿਯੋਗ ਅਤੇ ਭੂਮਿਕਾ ਭਰਪੂਰ ਸਲਾਘਾ ਕੀਤੀ ਗਈ। ਜੇ ਪੰਜਵੇਂ ਅੰਕ ਦੇ ਪਹਿਲੇ ਪੰਨੇ ਉਪਰ ਦੇਖਿਆ ਜਾ ਸਕਦਾ ਹੈ। ਨੌਜਵਾਨਾਂ ਦੀ ਭੂਮਿਕਾ ਕਿਸਾਨ ਸੰਘਰਸ਼ ਦੌਰਾਨ ਕਿਸੇ ਤੋਂ ਲੁਕੀ ਨਹੀਂ ਰਹੀ। ਜਿਨ੍ਹਾਂ ਨੌਜਵਾਨਾਂ ਨੂੰ ਪਹਿਲਾਂ ਨਿਕੰਮੇ ਅਤੇ ਨਕਾਰਾ ਸਮਝਿਆ ਜਾਂਦਾ ਸੀ ਉਨ੍ਹਾਂ ਨੇ ਸਮਾਂ ਆਉਣ ਤੇ ਸਾਰੀਆਂ ਧਾਰਨਾਵਾਂ ਨੂੰ ਬਦਲ ਕੇ ਰੱਖ ਦਿੱਤਾ। ਜਿਸ ਕਰਕੇ ਛੇਵੇਂ ਅੰਕ ਵਿਚ ਨੌਜਵਾਨਾਂ ਨੂੰ ਸਲਾਹਿਆ ਗਿਆ। ਸੱਤਵੇਂ ਅੰਕ ਵਿਚ ਛਾਪੀ ਗਈ ਤਸਵੀਰ ਬਹੁਤ ਹੀ ਦਿਲਚਸਪ ਹੈ ਜਿਸ ਵਿਚ ਇਕ ਔਰਤ ਵੱਡੇ ਇਕੱਠ ਨੂੰ ਸੰਬੋਧਿਤ ਕਰਦੀ ਦਿਖਾਈ ਗਈ ਹੈ। ਜਿਸ ਦਾ ਸਾਫ਼ ਸੁਨੇਹਾ ਹੈ ਕਿ ਔਰਤਾਂ ਹੁਣ ਕਿਸੇ ਤੋਂ ਵੀ ਪਿੱਛੇ ਨਹੀਂ ਹਨ। ਉਹ ਸੰਘਰਸ਼ਾਂ ਦੀ ਅਗਵਾਈ ਕਰਨ ਦੀ ਹਿੰਮਤ ਰੱਖਦੀਆਂ ਹਨ। ਅਗਲੇ ਅੰਕ ਵਿਚ ਭਾਰਤੀ ਸੰਵਿਧਾਨ ਦੀ ਪ੍ਰਸਤਾਵਨਾ ਪਹਿਲੇ ਪੰਨੇ ਤੇ ਛਾਪੀ ਗਈ ਅਤੇ ਆਲੇ ਦੁਆਲੇ ਕਿਸਾਨ ਸੰਘਰਸ਼ ਨਾਲ ਸਬੰਧਿਤ ਤਸਵੀਰਾਂ ਛਾਪੀਆਂ ਗਈਆਂ। ਜੇ ਸੁਆਲ ਕਰ ਰਹੀਆਂ ਹੋਣ ਕਿ ਪ੍ਰਸਤਾਵਨਾ ਦੇ ਸ਼ਬਦਾਂ ਵਾਲੇ ‘ਅਸੀਂ, ਭਾਰਤ ਦੇ ਲੋਕ’ ਵਿਚ ਅਸੀਂ ਸ਼ਾਮਲ ਨਹੀਂ ਹਾਂ?

ਇਸ ਅਖ਼ਬਾਰ ਨੇ ਹਰ ਉਸ ਧਿਰ ਦੀ ਗੱਲ ਕੀਤੀ ਹੈ ਜੋ ਮੋਰਚੇ ਵਿਚ ਸ਼ਾਮਲ ਸੀ ਅਤੇ ਸੀਮਤ ਸਾਧਨਾਂ ਦੇ ਬਾਵਜੂਦ ਆਪਣੀ ਪਹੁੰਚ ਪੂਰੇ ਸੰਸਾਰ ਤੱਕ ਸੰਭਵ ਕੀਤੀ। ਡਿਜੀਟਲ ਤਕਨਾਲੋਜੀ ਦਾ ਇਸਤੇਮਾਲ ਕਰਕੇ ਹਰ ਇਕ ਨਾਲ ਜੁੜਨ ਵਿਚ ਸਫਲ ਰਿਹਾ। ਜਿਸ ਕਰਕੇ ਇਸ ਵਿਚਲੀਆਂ ਇਕੱਲੀਆਂ ਪੰਜਾਬ ਜਾਂ ਭਾਰਤ ਤੱਕ ਨਾਂ ਵਿਦੇਸ਼ਾਂ ਵਿਚ ਬੈਠੇ ਲੋਕਾਂ ਨਾਲ ਵੀ ਜੁੜਦੀਆਂ ਸਨ। ਪੰਜਾਬ ਦੇ ਲੋਕ ਵੱਡੀ ਗਿਣਤੀ ਵਿਚ ਵਿਦੇਸ਼ਾਂ ਵਿਚ ਰਹਿੰਦੇ ਹਨ। ਜਿਨ੍ਹਾਂ ਨੂੰ ਕਿਸਾਨ ਸੰਘਰਸ਼ ਦੀ ਹਰ ਇਕ ਪੁਖਤਾ ਜਾਣਕਾਰੀ ਦੇਣ ਅਤੇ ਸੰਘਰਸ਼ ਵਿਚ ਸ਼ਾਮਲ ਕਰਨ ਲਈ ਇਸ ਅਖ਼ਬਾਰ ਨੇ ਮਹੱਤਵਪੂਰਨ ਭੂਮਿਕਾ ਨਿਭਾਈ। ‘ਟਰਾਲੀ ਟਾਈਮਜ਼’ ਦੀ ਟੀਮ ਦਾ ਬਿਨਾ ਕਿਸੇ ਖ਼ਾਸ ਸਾਧਨਾਂ ਤੋਂ ਕੀਤਾ ਇਹ ਤਜਰਬਾ ਮੋਰਚੇ ਵਿਚ ਆਪਣੀ ਭੂਮਿਕਾ ਨਿਭਾਉਣ ਵਿਚ ਪੂਰੀ ਤਰ੍ਹਾਂ ਸਫਲ ਰਿਹਾ।

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An Insight into India's First Heritage Village, Pragpur of Himachal Pradesh

***Deeksha Rana and **Dr. Seema Choudhary**

*Research Scholar, **Assistant Professor, Dept. of Geography, Himachal Pradesh University, Shimla
deeksharana13@gmail.com

Abstract

Heritage simply means culture, values, beliefs, traditions that have been existed for a long time and have great importance. It can be tangible or intangible. They are of immense significance as they exhibit our ancestral ways of living and what techniques, traditions were followed during those times. Pragpur village, in the Kangra district of Himachal Pradesh is widely known as the first heritage village of India. Local people were deeply connected to the profound roots and heritage of this village which inspired the state government to certify it in 1997 as the first heritage village of the nation. The village is popularly known for its culture, ancient architecture and heritage. Winding cobbled lane, mud plastered walls and slate roofed houses justifies the glory of this heritage village. The present paper tries to explore the village through field visit and discusses about its attractive architecture, culture and heritage on one hand and the conservation challenges it is facing on the other. The study is empirical as well as descriptive in nature. It briefly explains the ancient ways of living and provides a walkthrough to past times. To protect and develop this heritage village, sustainable ways of development is the key and their adoption and implementation is significant. So that, heritage and development go hand in hand and prosperous for all.

Keywords: Pragpur, Heritage village, culture, sustainable development, Himachal Pradesh, India.

Introduction

UNESCO defines, “Heritage is our legacy from the past, what we live with today, and what we pass on to future generation.” The term heritage is a wider concepts which possess both tangible and intangible heritage along with natural ecosystem of settlement. It includes built environment, historic places and monuments, settlement patterns, heritage collection, past and present cultural practices including living experiences of the residents of these villages. It can act as catalyst for overall sustainable growth and change in these rural settlements (Zolfani, 2013). It is very important to preserve our heritage as it is the wealth of experience and skills passed down from generation to generation. It helps a nation to maintain its identity. Its importance can be understood with the fact that various international and national organizations (ASI, MoC, UNESCO World Heritage Centre) are working for the maintenance and preservation of heritage sites around the world. That's why in the 2030 Agenda adopted by UN General Assembly integrated for the first time the role of culture or heritage in general as enabler of Sustainable Development across the Sustainable Development Goals.

The first heritage village of India is in Pragpur, Himachal Pradesh. Himachal Pradesh is the northernmost hilly state in India. It has rugged topography and it constitutes small to very high hills. Its height ranges between 350 metres to 7000 metres from mean sea level. About ninety percent of the population of the state lives in rural areas. The state has twelve districts and Kangra district is one among them. The village, Pragpur lies in the Pragpur block of Kangra district, in the foothills of Dhauladhar mountains and is considered to receive astral benefits and prayers that are offered to three nearby ancient shaktipeeths (Primordial energy) that is Temples of Brajeshwari, Jawalamukhi and Chintpurni for thousands of years. Pragpur is supposed to be composed of two different syllables, ‘Prag’ (Pollen) and ‘Pur’ (full of) stating full of pollens which one can witness during the spring season. Pragpur was established by the Sood clan. It was this community that owns the legacy to build elegant houses, lanes in this village.

Pragpur has unique architecture, unchanged shops, old water tanks, mud-plastered walls and slate-roofed houses because of which it was declared heritage village on 9th December 1997 by a state's notification. The village has both tangible and intangible heritage. Intangible includes the traditions, rituals while the intangible includes houses, cobbled lanes, the taal etc. The present study tries to explore the heritage of the village on the one hand and brings forth the important issues that needs to be addressed to preserve the heritage village.

Objective of the Study

To explore and describe the rich heritage of Pragpur village in Himachal Pradesh.

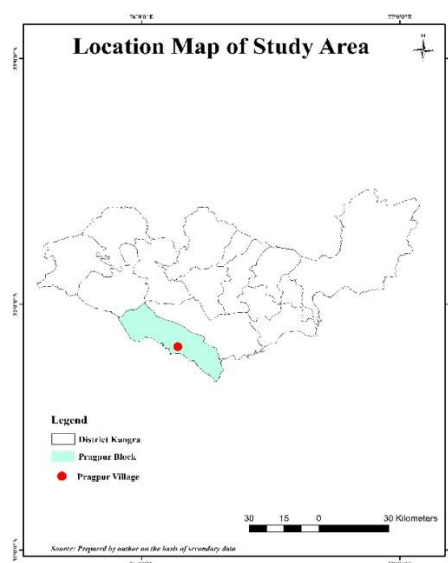
Database and Methodology

The study is purely based on primary sources of data. A field visit was made on 23rd to 24th January, 2023 to explore the village, architecture of the houses, lanes, taal etc. Interactions were also made with the villagers to know about the history of the village. The study is empirical and descriptive in nature. Various observations were noticed and pictures has also been captured using GPS map camera.

Study Area

Pragpur is a village situated in Kangra district of Himachal Pradesh. The location of study area is shown in Figure 1.1. It was developed around 3 hundred years ago and lies in Dhauladhar range. It was notified as a “Heritage Village” by a State Government notification which dates back to 9 December 1997. Pragpur is an attractive village with unchanged shops, cobblestone streets, old water tanks, mud-plastered walls and slate-roofed houses. (Heritage Places, District Kangra, Govt. of Himachal Pradesh”).

Figure 1.1



Discussion and Results

The first heritage village of India that is Pragpur was built three centuries ago. Even today, the narrow streets, mud plastered walls, the central taal, slated roofs gives a touch of history. The present study tries to describe the aesthetic beauty of the village along with its beautiful culture and unique architecture.

The Judges Court

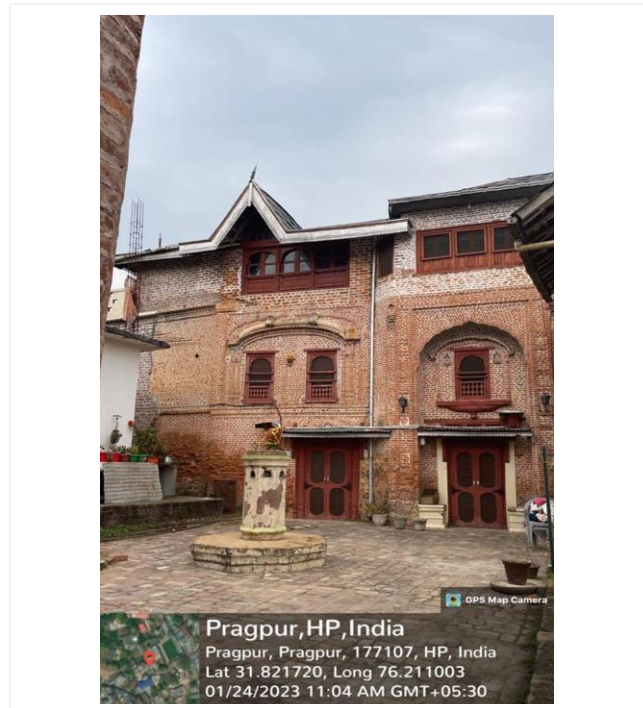
Judges Court is the biggest structure of the village Pragpur. The Judges Court was the ancestral home of Vilai and Rani Lal. It is around 300 years old and at present it stays as a heritage hotel.



It was designed by Justice Sir Jai Lal and it was built in Indo- European tradition. It is run by the owner of the family as a heritage hotel. The building also has touches of Mughal art blend-carved windows, onion domes and gothic arches.

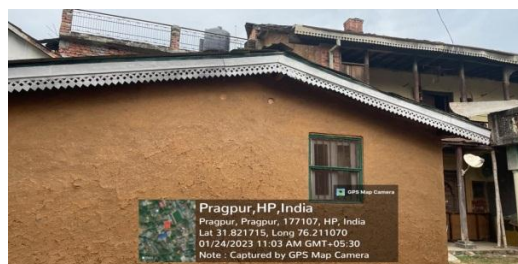
Building Material and Construction of Houses

Houses are double storeyed with walls of local stone and sun dried mud brick in mud mortar. Ceiling are low and ground floor rooms are small with beautifully maintained mud floors. In the centre of the aangan tulusi is planted and worshipped. The beauty of the houses can be seen in the pictures captured below. The houses looks afresh and gives a fine touch of medieval times.



Mud Plastered Walls

In ancient times, people use the naturally available material to build their houses and mud plastered walls are the perfect example of this. The walls of the houses are built of pressed clay. The picture below shows the mud plastered wall with slate roof and sides are decorated using iron jali in traditional style.



Doors and Windows

Wood has been primarily used for doors and windows. Commonly, wood of tuni, ber and sambal are used for constructing doors and windows. The door frames have beautifully carved flowering and geometrical patterns.



Cobbled Lane

The houses of the villages are well connected with cobbled lanes which are very comfortable to walk. They are spacious and have been built using traditional stones and are in various pattern.



The Ancient Water System

The ancient water system of Pragpur is known as Taal. The taal is built before 1868 and it is at the centre of the village. It was built to deal with water shortage problems prevalent at that time. This tank is even fulfilling the needs of the villagers at present also. Bio filters are also present in the tank to maintain continuous flow and to avoid stagnancy. It is maintained by Nehar Vikas Samiti and the pipes have not been changed since their installation. Pipes are standing strong with very less maintenance.



1.5.7 Dilapidated Houses

At present, it has been seen that many houses have crumbled and are in a very deteriorated stage. These are the houses which were abandoned. As people settled for better economic prospects in different areas, they left the village and their magnificent buildings which are decaying and crumbling with time have largely remained unspoiled. They give Pragpur medieval ambience.



Customs, Traditions

Pragpur has its own customs and rituals which have been passed from ancestors to present generation. These rituals, traditions or customs are followed throughout the year with great enthusiasm. Here, the worship of Kul Devta and Kul Devi is very prominent and worship is performed whole heartedly. Every Year during Bisowa eve, People from all around the village gather at Kaleshwar Mahadev and take a holy dip in the pond.

The most important festivals celebrated here are Chet, Navratras, Haryali, Rakhri, Sair, Dusherra, Diwali, Shivratri, Bisowa, Gugga and Lohri.

Dress and Ornaments

The people of Pragpur have their own dress and ornaments that represents their culture. Men wear Kurta, trouser and safa (turban) whereas women wear kurti with salwar and Chadru. In winters people wear wollen coat, sadri and sweaters. At the time of marriage, bride wears ghagri made of silken cloth. They wear gold or silver jewellery like Balu, Baluk, Koka for the nose, Maang Tika for the hair, Pher for the ear, Panjeb for anklet etc.

The architectural heritage of the village like Sood mansion, temples and Sarais are under decaying gradually. At present, INTACH is responsible for maintaining and preserving the buildings. These decaying buildings needs urgent attention. Pragpur is rightly known as heritage village. It gives the glance and touch of

ancient times. Hence, to preserve it is the priority. If the potential of this village is harnessed it can attract large tourists in terms of rural tourism, agriculture tourism as well. It will generate more employment opportunities for youth and even minimise their migration to far flung areas. Main occupation of the village people is agriculture and hence, other employment opportunities is the need of the time. Pragpur's own potential can solve many economic problems and further strengthen the growth and development of the village.

Conclusions

- The village truly deserves its title to be known as India's first heritage village. The lanes, art and architecture of the house, art around the window's, cobbled lanes are treat to eyes.
- The village is well preserved and maintained by the community collectively. However, it requires attention of the administration authorities to harness its full potential.

Policy Imperatives

- It was noticed that the rich heritage of the village is dying. Buildings are crumbling and decaying. Hence, to maintain and preserve this heritage urgent attention is required from the respective authorities.
- The village has the potential to contribute in rural tourism. Its unique and rich cultural history, houses, lanes have the prospects to contribute in strengthening rural tourism.
- Proper advertisement of the village like other tourists' places can stimulate the tourism in the respected area.

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Trends of Female Labour Force Participation: A Comparative Analysis of India and Punjab

Simranjit Kaur

Research Scholar, Punjab Agricultural University, Ludhiana

Kaursimran199524@gmail.com

Abstract

Female labor force participation is a major factor contributing to the expansion of any nation's economy. India, a country with a large working-age population, faces challenges in utilising the demographic dividend because of its poor Female Labour Force Participation. India's GDP can grow by 27 per cent if women's participation in the economy is raised to the same level as those of men (Lagarde and Solberg 2018). In this article, based on the Labour Bureau data of Statistical Profile on Women Labour, we have developed trends of female labour force participation in India and also compared India's Female labour participation rates with Punjab state. Relationship between female work participation rate and literacy rates in India has been established which has shown positive trend. There is a U-shaped relationship between economic development and women's participation in the labour force, which is the notion that has received the most attention in the literature and has been the subject of numerous research (Verick 2014). Low literacy levels, social attitude, domestic duties, gender wage pay gap, lack of women safety are responsible factors for poor female work participation rate. The need of the hour is not only to create awareness among females to contribute in GDP of nation but also to increase job opportunities for women that are matching with their profiles. Societal mindset also needs to be change that the work area of females should not be limited to unpaid duties.

Keywords: Female labor force, India, trends, development, literacy, domestic duties.

Introduction

Labor force participation rate is defined as the section of working population in the age group of 16-64 in the economy currently employed or seeking employment. Poor female labor force participation is a big hurdle in the development process of any country. India is one of the youngest countries in the World. However, poor utilization of this demographic dividend means closing the WINDOW OF OPPORTUNITY. Policy measures, no doubt, are stressing on skill development programs and on many areas to tap the benefits of demographic dividend. But one of the primary reasons of underutilized demographic dividend is poor female labor force participation, which must be focused.

U Shaped Hypothesis: According to a number of researches, the FLFP rate displays a U shape as the economy develops (Uberti and Douarin 2023, Verick 2014). As a result, FLFP rates are typically higher when a country is in an underdeveloped stage since women must work to provide for their families. FLFP rates start to drop as development progresses, like in the case of India. Again, FLFP will be high in developed economies.

Methodology: Based on the Labour Bureau data of Statistical Profile on Women Labour, Work participation rate by sex in India from 1971 to 2011 has been shown. The positive relationship has been shown between female work participation rate and literacy rates of females in India. We have compared female workers as percentage of total workers in India and Punjab. Also, percentage of female main workers in rural and urban areas has been computed separately in both India and Punjab based on census 2011. Moreover, female worker participation rate of Punjab state has been compared at nation level.

Work participation rate in India:

Table 1: Work participation rate by sex in India (1971-2011)

Year	Males (%)	Females (%)
1971	52.61	12.11
1981	52.62	19.67
1991	51.61	22.27
2001	51.68	25.63
2011	53.3	25.5

Source: Office of the Registrar General, India (Statistical Profile on Women Labour, Labour Bureau)

It can be clearly seen that female work participation rate has increased from 12.11 in 1971 to 25.5 in 2011. However, it is far less than male work participation rate.

Female workers as percentage to total workers in India and Punjab:

Table 2: Distribution of female workers as percentage of Cultivators, Agricultural labourers, Workers in Household Industry and Otherworkers in Punjab and India: 2011 census

	Cultivators	Agricultural labourers	Household Industry	Other workers
India	24.01	55.21	5.71	29.18
Punjab	9.94	19.14	7.5	63.43

Source: Office of the Registrar General, India (Statistical Profile on Women Labour 2012-13)

In India, Percentage of female workers in total workers is more in agricultural labourers' category which is 55% and it is very less in household industry which is 5% only. If we compare Punjab figures with national level, it has been found that less percentage of female workers are working as cultivators and agricultural labourers as compared with India. However more proportion of females in Punjab are working in household industry and Other workers category as compared with India.

Distribution of female main workers in Rural and Urban areas of India and Punjab:

Table 3: Percentage Distribution of female main workers in Rural and Urban based on Census 2011

	Rural/urban	Percentage of female main workers
Punjab	Rural	64.90
	Urban	35.09
India	Rural	81.28
	Urban	18.71

Source: Computed from Statistical Profile on Women Labour 2012-13, Labour bureau.

It has been analysed that female main workers are more in rural areas in both India and Punjab. However, in India, percentage of female main workers in rural areas is 81.28 which is more than same at Punjab level (64.90).

Comparison of Female work participation rate in India and Punjab :

Table 4: Trends of Female work participation rate in India and Punjab (1991-2011)

Female work participation rate (%)			
	1991	2001	2011
Punjab	4.4	19.1	13.9
India	22.27	25.63	25.5

Source: Office of the Registrar General, India (Statistical Profile on Women Labour)

Female worker participation rate has increased from 4.4 in 1991 to 19.1 in 2001 in Punjab but it again declines from 19.1 in 2001 to 13.9 in 2011. Also, it can be clearly seen that Female worker participation rate is far more at nation level than Punjab state.

Contributing factors

Social Attitude: Poor FLFP is largely a result of social attitudes regarding women. Without a doubt, Indian mentality and thought processes contribute to the history of the nation's development. Despite the changing environment and the modernization of attitudes towards females, many families in India still believe that girls are not required to pursue occupations or actively engage in society. In actuality, a woman's talent and skill are solely evaluated by how well she can handle household duties. Policy attempts will be ineffective if people's mindsets do not shift.

Invisible Labor: A housewife provides a variety of helpful services, including meal preparation, laundry, housecleaning, and child care. These activities aren't counted in the country's income. According to a UN survey, men in India spent 51.8 minutes a day on unpaid labour while women in India put in 352 minutes daily. Those who perform household chores have been classified as non-workers in accordance with the Census of 2011, as they did not engage in an economically productive activity. The dependents, pensioners, beggars, etc. fall into this category. According to the poll, 159.9 million women identified "domestic work" as their primary occupation.

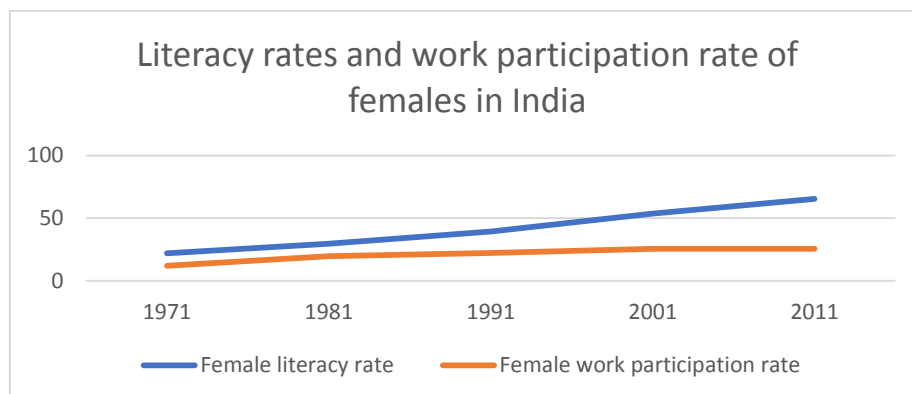
Education: Education raises consciousness. Women with greater education pay more attention to their careers and objectives. An uneducated woman does not give her career any thought, and she cannot help her daughter give her career any thought. This is how the vicious cycle starts. Fertility rates are inversely correlated with female education, but FLFP rates are positively correlated.

Table 5: Trends of female literacy rates and female work participation rate in India (1971-2011)

Years	Female literacy rate	Female work participation rate
1971	21.97	12.11
1981	29.76	19.67
1991	39.29	22.27
2001	53.67	25.63
2011	65.46	25.5

Source: Office of the Registrar General, India (Statistical Profile on Women Labour)

Relationship between literacy rates and work participation rate of females in India.



It can be clearly seen that in India, in almost every decade, with increase in literacy rate, female work participation rate goes on increasing. Thus, there is direct and positive impact of literacy on work participation rates.

Other Causes: Poor FLFP is also influenced by the gender wage pay gap, women's lack of social awareness, and women's lack of safety. All businesses in Iceland are now required by law to demonstrate that their salary policies do not discriminate against women. The nation has a female prime minister, and it tops the World Economic Forum's index of gender inequality. In order to address the issue of the gender wage pay gap, researchers expressed their hope that Iceland's legislation would inspire others to take a similar action.

Conclusion: It is rightly remarked, "Educating a boy is educating a person, educating a girl is educating a nation." Unfortunately, numerous social obstacles prevent girls from pursuing education. Higher education is not readily accessible or offered in rural places. Also, there is a lack of motivation and opportunity to relocate in order to find employment. Consider the following sentence: "Our family's income doubled when my wife started working." Or this one: "When our daughter acquired a job, our household's purchasing power increased by 33%." Why can't we use it to increase the gross domestic product for the entire country? Why aren't there more women working in paid employment instead of doing menial tasks around the house? The urgent need is to raise knowledge of people's rights, especially among girls. Female labor force participation rate is important determinant of economic growth. The need of the hour is not only to create awareness among females to contribute in GDP of nation but also to increase job opportunities for women that are matching with their profiles. Societal mindset also needs to be change that the work area of females should not be limited to unpaid duties.

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Empirical Study on Evolving Trends and Challenges in Multidisciplinary Research

***Paramjit Singh**Harneet Billing**

*Research Scholar, **Assistant Professor, Sri Guru Granth Sahib World University, Fatehgarh Sahib
paramujiara@gmail.com

Abstract

The evolving trends in Multidisciplinary research revolve around the latest terminologies and learning methodologies that have proved a boon for the researchers to flourish in their careers. The main objective of studying the trends and challenges in response to Interdisciplinary approach is to deal with the problems of communication among the varied domains. The trends and challenges may also be linked to technological development and advancement. This is the empirical study of 100 Senior Secondary teachers of Ambala. The paper focusses on the multidisciplinary working in technology to enhance learning and innovation. A major challenge for multidisciplinary research is to collaborate for the synthesis of knowledge while maintaining flexibility during the research. The paper focusses to establish a positive linkage between the evolving trends and the challenges to create opportunities to work in collaboration to harness success and satisfaction. The purpose of the paper is to create a community of well-balanced and learned members open to multidisciplinary research and communication. It identifies the key areas that should be adopted to prepare, aspire, and inspire researchers to overcome all hurdles and focus on facilitated teaching learning that can support the multidisciplinary research methodology. The challenges in innovation based upon the multidisciplinary research compels the researcher to perform and inform about all the competencies aligned with the advancements in education and technology with a positive mindset. The role of the researcher is to draw attention towards constructing synergized close-knit units of knowledge and to effectively address towards the evolving trends and challenges in multidisciplinary research. This will certainly help to empower the academic domains and transform the learning culture.

Key Words –Trends, challenges, multidisciplinary research, technology, innovation

Introduction

The Hudson maxim speaks aptly of the significance of multidisciplinary research that “All progress is born of enquiry. Doubt is often better than overconfidence, for it leads to enquiry, and enquiry leads to invention”. This is the essence of the process of multidisciplinary research. This research technique is the amalgamation of tools from varied disciplines which are used extensively in all research queries. Multidisciplinary research is the upcoming most sought after techniques to address to all challenges related to research. The coordinated and unified efforts of all researchers and research scholars will surely help to make use of authentic knowledge and share the expertise for a better research platform for all. This will also provide a base to search for specialized learning areas to achieve specialized learning outcomes for the learners of other disciplines as well. It is the process to work upon multifarious academic approaches and hypothesis with the set and defined objectives to contribute to the systematic methodology involving various disciplines. India is categorized as one of the fastest growing economies due to its talented brain power. The requirement of trends in multidisciplinary research is also identified in the NEP 2020. This will help to attain the latest standards and quality of education across India. The research combining different disciplines will be able to present creativity, promote critical thinking and will help in the formation of a vibrant society.

Review of Related Literature

A special study was conducted by the management of MBA programs in 2013-14 by the faculty of Economics of Lomonosov Moscow State University to check the main requirements of the clients and evaluate the results of the programme. The study consisted of three surveys and 150 respondents that compared priorities and preferences of the results of different students. These results were based on approaches involving professional education, analytical skills, decision based focused thinking and readiness for work. It also took technology, face to face contacts with peers and professionals into cognizance to create a supporting environment.

Miller, Zealand and Michigan (2009) conducted a study entitled The Future of Learning : 12 Views on Emerging Trends in Higher Education to identify trends that would affect higher education in the year 2015. Representatives from research universities, state colleges, community colleges, private institutions, and architectural and design firms participated in the discussion and from a series of exercises, determined a list of 12 future trends. Among those trends, the round table concluded that globalization will influence and shape all aspects of teaching and learning. Advancements in technology will drive ongoing changes throughout college and university life and offer new opportunities to enhance and broaden learning experiences. The participants also concluded that the competition for students and resources will force colleges and universities to sharpen

their brands and identities to distinguish themselves in new ways. Hence, it is imperative for colleges and universities to be aware of future trends in higher education so that they can provide students and faculty with a strong, resilient, and vibrant academy for generations to come.

Valverde - Berrocoso, Garrido - Arroyo, Carmen Burgos, Videla and Morales-Cevallos (2020) conducted a study entitled Trends in Educational Research about e-Learning: A Systematic Literature Review (2009–2018). The aim of this systematic literature review (SLR) was to identify the research topics, the most relevant theories, the most researched modalities and the research methodologies used. The PRISMA protocol was followed, and different tools were used for the bibliographic management and text-mining. The selection of literature was carried out in three first-quartile journals indexed in JCR-SSCI specialized in Educational Technology. A total of 248 articles composed the final sample. The analysis of the texts identified three main nodes: online students, online teachers and curriculum-interactive learning environments. It was revealed that MOOC was the most researched e-learning modality. The Community of Inquiry and the Technological Acceptance Model, were the most used theories in the analyzed studies. Wang Chong, Jun Lin and Yulu Chen (2022) conducted a study entitled “A methodological review of systematic literature reviews in higher education : Heterogeneity and homogeneity” in a rapidly expanding and interdisciplinary field of research. Higher education scholars have demonstrated exigency for aggregating research findings to map the research landscape, identify future research directions, and bridge the research-practice divide. With a proliferation of systematic literature reviews in higher education, the aim of this review is to provide a state of the art systematic literature review methodologies in the field of higher education. Adhering to the exploratory nature of this study, the review analyses systematic literature reviews published in 16 top-tiered international journals in higher education. Through qualitative research synthesis using thematic analysis and informed by grounded theory, a methodological framework comprising of six stages and 20 steps was developed. A handy checklist for conducting and evaluating systematic literature reviews in higher education was created.

Trends In Multidisciplinary Research

Multidisciplinary research should integrate the social, psychological and biological branches to interpret current trends in differential capacities. These can prove advantageous in understanding the overall opportunities to raise the level of education and ascend to the next available level. These trends also favour the connect between the patterns of hypotheses and results including its investigation based on scientific advancements. The growing need for a problem solving approach is to apply knowledge from different disciplines to find an answer to an existing problem. All multidisciplinary researches will require team work, tolerance for ambiguity and leadership skills for a multi-dimensional approach. All educational fields cater to the involvement of one or more disciplines for educational progress, this being the major reason to arrive at a solution that requires immediate attention. The multi-faceted disciplines like mechatronics, biochemistry, bioinformatics, biophysical chemistry, biomedical engineering etc are a valid proof of the progression of education towards multidisciplinary approach. The skilled team members are responsible for the projection, discussion and applicability of the research problem that will provide a comprehensive and deeper insight of the view point under review. Multidisciplinary research increases creativity, removes monotony of work and favours expertise from different areas to create a diverse and dynamic team. The blending of these educational varieties lead to high experimentation value and skill development. The researchers can hone their own skills and can also collaborate for the extension and development of their creativity. The trends in multidisciplinary research favours innovation and invention. Space exploration is a wonderful example of multidisciplinary research involving disciplines like engineering, astronomy, geography etc. Many drills and research projects are a part of space exploration.

Challenges In Multidisciplinary Research

Multidisciplinary research is not every one's cup of tea. It involves a suitably directed thought process, vision to identify the problem area, approach to solve that problem, directives to form a valid hypotheses and knowledge to apply and reach to the conclusion. The researches involving different disciplines may lack coherence and understanding. The team may be stuck at a certain challenge in the absence of an expert who could address to the same. It may prove hazardous to deliberate the ideas without any knowledge. This may also lead to absence of meaningful review and may support criticism. Critical reviews in multidisciplinary research restrict progression of the concept. To reduce the failures, all willing to pursue this field should be willing and should nurture their talent accordingly. The greatest challenge that haunts every higher educational institution is the creation of avenues, skills, experts and apparatus to guide the young research scholars who would feel rejuvenated and thrilled on their research journey. The creation of a corporate landscape needs attention and greater efficiency to incorporate interdisciplinary and multidisciplinary expertise. It is really necessary to educate professionals for multidiscipline and multi skill approach and at the same time it is extremely difficult to engage professionals and trainers for inculcating these skills in the youth. Possessing multidisciplinary skills is a blessing for the revolutionary approach that is overtaking all sectors today. All educational institutions, business

houses and even the corporate world require the eradication of traditional culture and traditional trends that lack efficiency and expert cohesiveness. Multidisciplinary approach demands multiple skills in the same individual. As the work culture is not according to the country or place of origin so it may not be possible for everyone to adopt a multidimensional and multidisciplinary approach.

Innovation And Technology

Technology is an enabler and facilitates to provide tools for data analysis including complex data sets. It helps in the imaging and visualization for studying biological or multi-trend processes for the development of new material with unique properties. It supports printing technology and revolutionizes the study of genetics too. The brain machine interfaces used in the multidisciplinary research procedures enable the study of complex ecosystems with suitable simulation tools. Technology and innovation go hand in hand to support sensors and control systems. It enhances the communication skills with the use of communication and computing technologies. Deep learning algorithms and the study of social and cultural phenomena is also a result of innovation through technology.

Empirical Study

This paper is the empirical study of 100 teachers of Senior Secondary school in Ambala. The study was conducted through review of their view points, discussion, meetings and finally the circulation of google form that contained questions about the evolving trends and challenges of multidisciplinary research. It also contained questions about the necessary conditions that would encourage the research at multiple forums. All the teachers participated actively in the study conducted. The study identifies the use of authentic knowledge and share the expertise for a better research platform for all. This study examines the motivations and processes used by the researchers to establish a clear view about the progression and processes involved in the study of multiple disciplines. Information about multidisciplinary research is used as a framework to facilitate analysis of the data, which was collected through qualitative methods including observations and interviews.

Methodology

The research was conducted on 100 teachers from Senior Secondary School of Ambala. The data was collected by means of documentation, interview and survey in the form of Google forms. The data analysis was carried out quantitatively based on the data related to study document and qualitatively based on the interview. The survey is related to the impact of multidisciplinary research to enhance creativity in higher educational institutions. Trends in Multidisciplinary research acts as a tool for the empowerment of the researcher which can work wonders to support the researchers in a programmed research environment. The trends and challenges involving multidisciplinary research have specific, reliable and measurable learning outcomes. It helps the researchers and research scholars to exert and implement their pedagogical and professional competencies with their valuable experience. The filling of google form by the teachers is also successful in motivating them to engage themselves in continuous learning efforts. This will further help in building strong research network and work in collaboration.

Findings And Result

The paper establishes a link between the rubrics of research and multiple disciplines as well as successfully addresses towards the need of research interventions in research processes. It also identifies the values that can be demonstrated to the researchers to prepare them to become skilled researchers. The practical implications presented can be used to present skills of multidisciplinary research for guiding the aspiring researchers. The results suggest that 88.3% teachers believe that multidisciplinary research is essential as is the need of the hour. Lack of diverse perspectives, limited funding and difficulty in communicating across disciplines are the major challenges that 97.2% teachers feel about. 98.3% teachers support the view that multidisciplinary research encourages creativity and collaboration. More emphasis on team science is the ongoing evolving trend in multidisciplinary research these days and is given a green signal by 91.7% teachers. 97.2% teachers are of the view that team science in research involving multiple disciplines increase efficiency. 86.1% teachers are of the view that inadequate training is the major hurdle and 88.3% teachers feel that communication barriers are also an obstacle in the multidisciplinary research practices. The study conducted by the team of anthropologists and biologists is a perfect example of the said research. Collaboration between academia and industry is one of the evolving trends in the research and 86.1% clientele believes the same. The greater use of technology and data analysis is the new pattern that has resulted in forming the belief system of 92.2% teachers. Multidisciplinary research is important as it allows the researchers to solve complex problems that need expert advice. Integrating findings in multidisciplinary research becomes a challenge when researchers have difference in their research objectives, evidences and researchers may use a different terminology for the same concept due to language

barriers and 98.3% teachers support this view 98.3% teachers believe that the role of leadership is to establish a clear vision and direction, to facilitate communication and collaboration between the researchers and to identify the potential challenges that need immediate redressal.

Suggestions

All Educational Institutions should emphasize upon the creation of a curriculum that involves creativity, critical thinking and innovation. There is a scope to realize the need of revaluation and redesigning the curriculum including primary schools that could divert the impressionable young minds towards inquiry based and discovery based learning. A broad understanding of the concepts studied by the students can be taken up at the college and university level. This will help in generating positive attitudes, positive behaviour, and positive skills and enhance growth. The College and Universities must honour the educators with suitable incentives to actively support the multidisciplinary programmes involving monitoring, mentoring and training. Specialized skill courses and skill development cells be formed to encourage skill development and facilitate technical expertise. This will surely encourage cross faculty collaboration. Creative teaching methodologies, activity and research based experimentation should be made available within the campus of colleges and Universities for graduate and post graduate learners. All learning must result in effective communication, innovation and presentation of better skills involving multidisciplinary research. All students must attend offline or online conferences to get an overview of the latest educational trends that would trigger the knowledge cells to produce best results.

Conclusion

The role of educational institutions in multidisciplinary research to maneuver off from traditional and conventional methods needs a halt. All multidisciplinary research must foster innovation and creativity. All educational institutions should facilitate the researchers to develop multi-faceted innovative skills to find solutions to the existing research problems. The Government is also taking several measures to promote multidisciplinary integrated education and research.

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Paradigm Shift in Television News

Amarpreet Singh

Research Scholar, Department of Journalism and Mass Communication, Punjabi University, Patiala
amarpreetchawla@gmail.com

In the fast-growing world, various forms of news media have become a part of modern life. Media has become huge, diverse, global, fast, commercial and very powerful. The media industry has witnessed a lot of changes in the last three decades. Now, people are a part of the global village where the media plays a crucial role in making them aware of the happenings around the world. The element of timeliness has become very crucial. A man who is a part of today's competitive world can't imagine his life without news. In the storm of 24-hour news content across the country, media houses are working on attractive, eye-catching and hard-hitting presentations and layout of the screen space. The most successful news channel is the one which is prepared to go LIVE with breaking news at the snap of a finger. With the introduction of new media technologies, such as smart phones and increasing penetration of the internet, the consumption of news on digital platforms continues to rise. These days, the content on TV channels can be watched over the smart phone and it can be used to cover the events also, replacing the professional video cameras. The concept of mobile journalism has been emerging as a new form of storytelling where journalists use portable devices to share their experiences and news.

Indian Television and News: The Background

Doordarshan paved the way for the golden age in Indian television with its introduction in 1959. Television was introduced in India as an experimental educational service. In India, the first experimental television service was started in 1959, in Delhi with an aim to produce and transmit social education programs under a project aided by UNESCO. “A UNESCO grant of \$20000 for the purchase of community receivers and a United States offer of some equipment proved much too tempting to resist, and on September 15, 1959, the Delhi Television Centre went on air”. (Kumar, 2010) Under this project, 20 sets were installed at various community centers in and around Delhi and 150-200 people viewed the programs at the each center. Bulky and expensive TV receivers were provided by the government for community viewing with programs relating to socio-economic development. Subsequently, 250 schools in Delhi joined the viewers. Special programs with having developmental and educational content were telecast on experimental basis on selected days of the week to cater to the needs of the large audiences.

Indian Television in 1960's

For generations Indians relied on radio for news, views and entertainment. The scene changed with the introduction of Television. The experiment became a service in 1965, when Doordarshan began beaming signals to reach television sets in living rooms in and around the country's capital. In the initial years, the development of the television broadcasting proceeded at a very slow pace. In 1965, the news in Hindi started with Pratima Puri reading out the first five-minute-long news bulletin. She also went on to interview Yuri Gagarin, the first man to travel into outer space. In early years Doordarshan, news was like radio news, with hardly any visuals. Until then, all the regular daily transmissions were operated by the All India Radio. For the years, AIR provided the content for TV that was illustrated with available visuals for daily telecasts. Doordarshan news readers with head bent down, did reading out the news, without a pause. The news telecasts used to be deadly dull with hardly any field reporting, quotes or interviews, or live action. A little later Perspective, a magazine program was started.

In an interview to Richa Anirudh in a program, "Zindgi Live", on IBN7 (posted on YouTube on June 1, 2013), Salma Sultan said that the journey with Doordarshan was quite interesting as at that time an aged and mature newsreader was essential. It was contended that maturity was a must for newsreader as it required credibility, which comes with age.

Television News in 1970's

TV was confined to Delhi and its adjacent areas for several years, but the decade of 1970 saw a major expansion of television. In 1972, the television service was extended to Amritsar and Bombay followed by Srinagar, Lucknow, Madras and Calcutta. SITE was most ambitious program in history of Indian Television. This prepared a major ground for expansion of TV network across India. There was a sharp rise of number of TV sets. Till 1975, only seven Indian cities had the television service. But even then Doordarshan remained the sole provider of the programs and it continued to dominate the Indian television scene till early 1990s.

The SITE was a one-year pilot project in 1975-76, primarily undertaken to experiment with television through satellite communication to broadcast special programs in six states which included 2400 villages. (Aggarwal.V.B, Gupta V.S, 2002)

Milestone in 1980's

On August 15, 1982, Doordarshan achieved a milestone by switching from black and white to color transmission just before the 9th Asian Games in Delhi. Doordarshan made full use of the electronic news gathering (ENG) and outdoor broadcasting vans. (Shrivastava, 1989). The audiences witnessed the LIVE color telecast of the Prime Minister Smt. Indira Gandhi's speech on Independence Day. With switching to color transmission, it also shifted its emphasis from social-educational to commercial-entertainment programming. Same day, Doordarshan introduced a national telecast service from its own TV studio in National Capital, named DD1.

Revolutionary change in 1990's

With Doordarshan's monopoly over the airwaves, every ribbon cut by the IB minister made headline news. The content was presented in a very straight forward way without exaggerations. Field-based coverage got more professional over time, and the birth of satellite television in the early 1990s transformed the television experience.

In subsequent years, Doordarshan news coverage broke many barriers. Reporters were sent out to cover national and international developments. Viewers got familiarized with newsreaders and presenters, accepted them happily as members of the family and established long lasting bonds with them. Many faces seen on TV like Salma Sultan, Shammi Narang, Manjari Joshi, Avinash Kaur Sareen, Sarala Maheshwari, Shobna Jagdish and Ved Prakash acquired celebrity status with the passage of time. The news readers were like Bollywood stars. Sarla Maheshwari's sarees, sweetness in Meenu Joshi's voice and Shami Narang's base in the voice became very popular. Attraction for watching the news rather than reading or listening as well as, the popularity newsreaders made people watch news. Doordarshan gave Salma Sultan an identity, but with the passage of time, she became the identity of Doordarshan.

The Economic Policy of 1991, which stressed on privatisation, globalisation, liberalisation and commercialization, gave a boost to television industry. The Indian television suddenly became much more entertainment- driven. A new television atmosphere was created by the satellite and cable technology as some other private television networks like STAR-TV, ZEE-TV, SONY, and MTV started broadcasting in India. The competition with channels forced Doordarshan to change its programming strategies in order to retain its dominant market share. (Singhal and Rogers, 2008)

To grant autonomy to Doordarshan and All India Radio, to promote national integration and to provide comprehensive broadcast coverage, the Prasar Bharti Bill was passed by the Parliament. But it was implemented in 1997. One year later, the first news channel started working in India.

Post 2000

24x7 news cycle came in with the advent of cable and satellite television and brought with it a much faster pace of news production and reporting, with instant updates. Television opened new horizons for viewers; sitting in living room, anyone could access information about what was happening. As a result, India's Public Service Broadcaster's News Doordarshan was forced to launch DD-News on November 03, 2003 by converting DD-Metro into a 24-hours news channel.

In view of the competition in the field and the TRP race, many channels chose the path of sting operation. A sting operation is a search done by the media house to expose the evils prevailing in society, although it involves questionable ethical issue. In 2007, a private TV channel alleged that a sting operation had revealed that a government school teacher pushed students to prostitution. A lady maths teacher was accused of having created a pornographic film at the last school that she worked in. After news was aired, worried parents began to gather in front of school where lady teacher worked and within minutes, a demonstration by angry parents turned into a riot. A few days later, the Delhi police arrested the concerned reporter of the TV channel in connection with a fake sting operation.

In a recent case in 2023, in which The Board of Control for Cricket in India's Chief Selector Chetan Sharma had to resign from BCCI after a sting operation by ZEE Media. The Chief Selector's explosive remarks on various Indian senior players created a ruckus in Indian Cricket. Sharma alleged several players of taking injections to comeback to international cricket.

Media Trial was another issue which several TV channels were accused of. In the year 2020, the bollywood actor Sushant Rajput's suicide case, 24x7 Indian news channels grabbed that issue, with minute to minute update, digging into candid details of his personal life and tried to visualize the whole incident. Reporters were being covered from his flat in Mumbai where he died, from his native town and media channels tried to get reactions from government officials as well. Too much exaggeration and hype was given to that

issue by putting other issues in the bin. Each channel tried to unleash new facts regarding that issue. Media Trial is a very serious issue which these channels have been involved in for past few years.

With 'Reportage on the Sushant Singh Rajput case, Indian TV news has hit a new low. Here is what should have happened — a prominent actor dies by suicide; the media covers his life and legacy; there is a conversation on mental health; there is due investigation; and there is closure. Instead, here is what has happened — a prominent actor dies by suicide; the media decides that it is not suicide but a product of either a deep-rooted conspiracy by an amorphous Bollywood power elite or an outright murder; conspiracy theories are peddled, reputations tarnished, and every norm of reportage is thrown into the bin; public opinion is manufactured; State agencies either willingly or due to this media-generated pressure enter the field; and citizens remain distracted.

This is not to suggest that a fair probe is not needed. But by acting as investigator, prosecutor, and judge, on flimsy grounds, TV news has been irresponsible. Today, they have found one target; tomorrow, it could be someone else.' (HT Sep03,2020)

Cut throat competition was another factor in which every channel wanted to be the first to break the news. Having same visuals, but with watermark of exclusive was another practice by news channels to make fool of viewers. Shaky mobile visuals could become a first headline of the bulletin and even a half an hour bulletin can be prepared on it by exaggerating it. Due to competition, almost all private news channels schedule their bulletin on air timing 3-4 minutes prior to others i.e. 10.56 am, 11.26 am to catch maximum eyeballs. Most of the channels seem to be in a hurry to break the news, that they commence the bulletins with the headlines, instead of an anchor giving his/her introduction.

'Television news died the day it stopped telling the stories of people. When it fell into the trap of a cheaper, studio-driven model, It became a twisted version of radio. Pictures became rarer and rarer, though this was meant to be a platform for visual storytelling. And once debates became the staple, they had to be jazzed up with the drama and dialectics of confrontation to make them more entertaining.' (Dutt.B,2020)

'The Delhi High Court's humorous comment in Tharoor vs Goswami that "TV viewers who want to watch action films should (instead) watch TV debates on current affairs..." is more a cry of anguish. The nation wants to know when we they will have news without the noise and content and sans fiction.

The toxic triangle of viewership, ratings and revenue is the catalyst driving most debates and that paradigm must be continuously stigmatized along with use of a relentless societal scissor to cut this Gordian knot. The clear line between editorial and commercial decisions, and between news and entertainment, must be restored. (Sanghvi.V, Shergill.J,2020)

In case of elections results of five states including West Bengal on May 02, 2021, news channels started giving trends just after a few seconds of commencement of counting. How was it possible? Another surprising thing was that with a same source of getting trends, how there could be different trends on different news channels. Content was being presented in more than a dozen of windows, which viewers could hardly retain. Actually, the phenomenon had much to do with the business model of television in India. Every channel wanted their viewers to glue their eye balls with colorful catchy graphics. Similarly, in coverage of covid-19, news channels were trying to arrange various experts sitting far away in different countries so as to make an impact that their organization has global approach.

'Uneven debates, deliberate interruptions, verbal blood sport, conscious invitation of biased and malicious participants, strategic muting of mikes, the formulation of one-sided themes and unevenly numbered viewpoints are standard tactics for driving TRP ratings and advertisement revenue. Serious news items are presented as popular crime thrillers and extremist anchors pose a potent threat to democracy. A set of reforms are now essential.' (Sanghvi.V, Shergill.J,2020)

To conclude, the researcher would summarize the change in television news in following words:

Everything has to change with time, and change is inevitable in the presentation of news. From "Rukavat ke Liye Khed Hai" to Big Breaking colourful, attractive and vibrant graphics with loud sound effects, upper band, lower band, ticker, aston band and news flash, everything has changed with the passage of time. The channels do try to adopt all the tactics to catch their pray. Morality is confined to books only. In an attempt to be the first to break the news, the privacy and sensitivity of the content are also side lined. For the news channel, news became only a substance. Each channel is engaged in polishing a product and selling it in its own way. Every channel is concerned about TRP only. The purpose of journalism is to make citizens better informed so that they may take decisions about current topics that affect them, about their role in society and politics, and about how their chosen government as well as politicians are faring. Traditional media companies who have strong moral standards need to upgrade themselves as per the latest technological advancements. The new media houses need to reorient themselves with meaningful news coverage and responsible journalism. Latest technology is also highly demanding and journalists will have to keep abreast with the changing societal, as well

as, technological norms. Right to privacy should be as important as right to freedom of information and both must be safeguarded by the news channels and media houses. Social media has restructured the way news is consumed by the viewers. But it can never replace responsible and sensible journalism. The role and relevance of good journalism will never die. It is rather the need of the hour to revive high standards of journalism in India. Even in the age of social media, television is still a very big medium which is watched by millions of people every day. Therefore, it is the duty of the people who are owning and running this medium to be more responsible towards the society and its needs.

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Politics and Resistance in the Select Stories from Shahnaz Bashirs' *Scattered Souls* and Feroz Rather's *The Night of Broken Glass: A Comparative Study*

Mohd Nageen Rather

PhD. Scholar, Madhyanchal Professional University, Bhopal. M.P
rathernageen7@gmail.com

Abstract

Kashmir, once eulogised by emperors and poets as the 'paradise on earth', later mutated into a deeply troubled space. The post-partition territorial disputes between India and Pakistan, and the armed insurgency of 1989 and after, have exposed the Valley to one of the bloodiest, most repressive military occupations in the world. The conflict and violence of contemporary Kashmir has evoked response from indigenous Kashmiri writers with an aim to challenge the mainstream writings. After choosing English medium, they imperatively attempted to give voice to the plight of the common masses who are trapped in the politics and also depict the trajectory of transition of life under duress of violent times. These literary works remind us that the acts of telling and re-telling, of recalling and not forgetting these are the most potent forms of protest. Shahnaz Bashir's *Scattered Souls* and Feroz Rather *The Night of Broken Glass* are the latest addition to such literature. The present paper aims to do a comparative analysis the two short stories from these books through the perspectives of the theory of Resistance Literature by Barbara Harlow and the theory of Minor Literature by Gilles Deleuze and Felix Guattari. For a thorough analysis of the selected stories the qualitative research paradigm, guided by thematic textual analysis, has been used. The results show that the select stories defy the mainstream narrative, explore historical incidents, critique the violence and finally emerge as the specimen of resistance and minor literature.

Key words: Kashmir, Dispute, Resistance Literature, Kashmiri Anglophone Writings

In this research paper, analysis of the select short stories will be carried out through the theoretical construct of Resistance literature by Barbara Harlow and also through the perspectives of Minor Literature by Gilles Deleuze and Felix Guattari. The resistance literature is derived and shaped from the key text titled *Resistance Literature* (1987) by Barbara Harlow. Harlow pointed out some features of such literature which include: (a) politicization of the narratives, (b) location of narratives in a certain historical backdrop, (c) reclaiming history, proclaiming a distinct cultural identity, (d) narratives shaped by the conditions, either material or ideological, in which they are produced, (e) blending fiction and fact, (f) demonstrating and representing a shared identity of the community.

Minority literature was first time used by Gilles Deleuze and Felix Guattari in their work titled *Kafka: Toward a Minor Literature* (1986). They defined minority literature not as literature created by a minority in their own language but using the majority language. The primary three characteristics: de-territorialisation, political integration and collective expression of minority are perfect for analysis of the select stories. This research will investigate how these two theories are applicable on the selected short stories.

Shahnaz Bashir's book *Scattered Souls* (2016) is a collection of short stories. It explores and highlights the depiction of 1990s situation of Kashmir and also describes how both the men and the women have suffered endlessly from the massive and devastating conflict of Kashmir.

The story titled "The Ex-militant" is set in 1990s in Kashmir. It portrays how the people who have left the path of violence continuously suffer, how the past of the people keep influencing their present. The story revolves around the character Ghulam Mohiudeen. During 1990s armed uprising was on its peak in Kashmir. There erupted massive violence and human rights violation. This was very tough time for Kashmiris. Young boys from left their homes and joined militancy. The narrator says that "elderly women would kiss the brows of boys leaving their homes to cross the mountains in Pakistan. While explaining the situation in Kashmir during that period, Mohiudeen says to Izhar Sahab:

There were vowing green headbands on almost every forehead. The flags people waved, the placards they flailed-all had the same message: Freedom. Elderly women would kiss the brows of boys leaving their homes to cross the mountains into Pakistan. Toffee and petals were showered on them, something that happens to bridegrooms leaving to meet their brides" (35).

Resistance literature is essentially and *predominantly political*. This story is very apt in this context. It portrays the overall political scenario of Kashmir during 1990s and even after that. Ghulam Mohiudeen along with his two friends Fayaz Shah and Irshad Beigh also left for Pakistan to get training and bring guns and ammunition. After returning from Pakistan Mohiudeen along with his friends started working in Kashmir for their mission. One day while they were on their mission to stencil slogans of freedom struggle on the walls in Raj Bagh, they were caught by army. For many days they were tortured and interrogated at Papa 2, the main interrogation centre in Srinagar to get information from them about their mission. Later, they were sent to Kot

Bhalwal, the famous jail in Jammu. After three years Mohiudeen was released from Kot Bhalwal. This story depicts how people were happily ready to leave their homes and their loved ones for the cause of freedom. It also shows how ex-militants like Mohiudeen were tortured by security forces. It evokes readers' sympathies for the ill-fated populace of Kashmir. The conversation of Mohiudeen with journalist Izhar Sahab depicts the sufferings of ex-militants. They were not able to easily get some government service, even neighbors despised them, and even their families suffered.

Resistance narratives are different from other narratives as they depict *factual fiction*. They portray the real incidents. This is also true with this story. "The Ex-militant" is not totally fictitious, it tells the story of every person who was once a militant and now struggling to live a normal life. The author has also indirectly tried to say it not totally fictitious in this story. During conversation between Mohiudeen and Izhar Sahab, Mohiudeen say him, "You can trim the narrative according to your own judgment, I won't mind. But do change the names, places" (45).

The *combination of fact and fiction* is displayed and permeated throughout the story. The setting of narrative, real places from Kashmir add to the realism of story. The characters in the narrative are derived from the real life of pos-1990 Kashmir. Setting of the story is Srinagar; it seems to the very conscious choice of author as Srinagar is the centre of Kashmir. The author tried to show that the militancy in Kashmir was not fixed to particular part. Author has also mentioned PAPA 2 and Kot Bhalwal, these are two real places.

The story discusses the militancy in the Kashmir, like how is started and how people cherished it. It highlights the state of mind of Kashmiri people especially young generation and how armed forces of India reacted against them. After releasing from jail, Mohiudeen wanted to start normal life. But he was never allowed by security forces as well as by society to live a normal life. It was not easy for ex-militant to get married, finally Mohiudeen got married with his lady love Sakeena in court. Life for ex-militant is never easy, same was the case with Mohiudeen. After the death of his parents when their joint family split into nuclear families, his elder brothers did not gave him equal share from property. They cut off "a considerable amount from the share of cash I was to receive. Father spent bundles of currency on the journey he took to visit you in Kot Bhalwal," they said" (42). Mohiudeen was only able to build one roomed house and buy second-hand, old modelled auto rickshaw. The story highlights how ex-militants suffer. While talking to Izhar sahib, the journalist, Mohiudeen told him how he suffered in society. His neighbours despise him. Government officials still kept inquiring about him in neighbourhood. He is not able to get a permanent electricity connection, ration card, gas, water connection, cable connection etc. Every month he has to show up in police station. Not only Mohiudeen but also his family suffered along with him. His daughter Insha was forced to leave her school because her father was unable to pay her fees on time. Truis Peer, the local chemist was not ready to give her medicines as she was suffering from fever just because she was not the daughter of any reputed person but the daughter of ex-militant. His family was forced to live in one roomed shanty in the place which was not worth living. Threat of the police was every time; one night police came and arrested him without any reason.

This story can also be positioned as minor literature. This story is written *in a major language by minority writer*. The choice of language by author for writing this resistance story is very important. The author's choice of English language seems to be very conscious. As English is the global language, Bashir has chosen it to show the pain and sufferings of Kashmiri people to the whole world. This story is based on the political background; it portrays the political situation of Kashmir in 1990s. Through this story author had tried to show the political situation of the Kashmir. Fayaz Shah and Irshad Beigh were the companions of Mohiudeen but they entered the politics and were living a respectable and luxurious life while a common man like Mohiudeen was suffering in society as well by the hands of security.

One more characteristic features of minor literature is that in it everything takes a *collective value*. As Deleuze and Guattari explain in minor literature "there are no possibilities for an individuated enunciation that would belong to this or that 'master' and that could be separated from a collective enunciation" (17). This story is not only the story of Mohiudeen and his family but it is the story of every ex-militant and his family. After their release from jail every ex-militant in Kashmir is supposed to face these problems which Bashir has highlighted in this story. Thus this story fits in the framework of both resistance literature as well as minority literature.

The next story for the analysis in this paper is by another Kashmiri writer Feroz Rather is "The Night of Broken Glass". It is the eponymous and the concluding story of the book. It portrays the mass killing of Kashmiris. This story portrays a massacre in Kashmir. Kashmir has seen many massacres. Here the story is about the massacre in Bijbehara in which all the important characters of book like Jamshid, Syed Anzar Shah, his son Syed Aslam Shah along with 40 civilians are killed as they were protesting against the rape of Rosy, daughter of Syed Anzar Shah.

Though the story tells us the mass killing of fictitious characters of book, but it has been written on the background of a real massacre known as Bijbehara Massacre. In October 1993 as per the official reports Indian

soldiers sieged the holy Hazratbal Shrine of Muslims in Srinagar due to information about the presence of militants there. Sieging of holy shrine sparked the anger in Muslims towards Indian rule. People across the whole valley started protesting. It was October, 22 and eighth day of siege when actual incident took place. Approximately, 15000 people, after praying Friday prayers at Jamia Masjid Bijbehara, started march towards Jammu-Srinagar highway. When they reached Highway, a large contingent of the BSF 74th battalion allegedly blocked the road and fired indiscriminately, killing more than 40 people and injuring over 200.

The narrator of this story is a nameless character, Showkat's and Nuzhat's younger brother who was six years at the time of that bloody massacre which shattered his family as well as whole Bijbehara town. This story pictures the life in a conflict zone. Taking about Resistance literature and Minor literature, this story is a best example of both. Barbara Harlow argues that resistance literature is basically and *predominantly political* in nature. Political nature is also the characteristic of minor literature. This story portrays the political condition of Kashmir during 1990s. It is the story of year 1993 set in Bijbehara. Narrator is curious to know what happened in 1993, so he went Ghulam, a cobbler. Ghulam narrates him the whole story. In the story titled “Robin Polish” readers get to know that Syed Anzar Shah, a reputed person of the town and also Imam of Jama Masjid Bijbehara suddenly fainted while leading Friday prayer in Mosque, and after that Jamshid led prayer. When Jamshid recited a chapter ‘Joseph’, Anzar Shah started weeping. ‘Something’ has happened to Shah which has shattered him, but what was this ‘something’ is revealed in this story. Night before this Friday, Major S came to Syed Manzil and interrogated Anzar Shah about Jamshid, but when refused to give any information, Major thrashed Shah and went in kitchen where he harassed his wife and raped his daughter Rosy as she was the beloved of Jamshid. After this Rosy jumped into Jhelum and committed suicide.

Major S went into kitchen and latched the door from inside. Rosy and Hasin rose in alarm, backing away from him. He seized Hasin by her hair and hurled her against the wall. She fell down, unconscious. Major S grabbed Rosy, who was trying to wriggle out through window. He cupped her cheeks with one rough hand. ‘Jamshid's bride!’ he jeered. ‘He fucks you every night. You must know where he is’ (217-18).

This shows the victimization of women in Kashmir. Not only militants, their family, relatives, neighbors and loved ones are subjected to torture and humiliation. After completing prayer, Syed Anzar Shah, Jamshid, Aslam Shah and other people started a march towards a bridge, and were protesting against this inhuman activity of Major S. They were indiscriminately fired by army, killing Jamshid, Nadim, Anzar Shah, Aslam Shah and many other civilians. Many other were also injured. Almost all dead bodies were found except the body of Jamshid. This story also depicts the psychological condition of the family members of the victims of these kind of massacres. After this incident Ghulam and Misrah, mother of Nadim left Bijbehara. Ghulam had still kept the shoes of his son Jamshid, Anzar Shah, Nadim and was polishing them religiously.

‘Look around,’ he said. This was all that remained of that fateful night. That pair he pointed over there, those soft brown loafers, they were his son's shoes, yes, they belonged to Jamshid. That one black loafer, that was Syed Anzar Shah's. Those yellow shoes with hard sole and square heels, they shod Nadim's humongous feet (211).

This story *blends fact and fiction* which is the important characteristic of resistance literature. Bijbehara Massacre is real incident in the history of Kashmir. However Rather had wrote it in a fictitious context. He has changed the date from October 22 to April 28 where the year is same. Cause of protest has also been changed. Characters killed in this massacre are also fictitious.

Historical referring is another characteristic of resistance literature and this not exception to this story. Not only Bijbehara Massacre, Kashmir has seen many other massacres like Sopore Massacre in 1993, Gawkadale Massacre in 1990, Handwara Massacre in 1990 etc. in which civilians were killed mercilessly by armed forces. This story highlights the victimization of women and mass killings in Kashmir which are abundantly found in the history of Kashmir. Women are the worst sufferers of any war. In Kashmir they easily became the victims of cruelty of Indian forces. Mass killing was very common in 1990s in Kashmir, armed forces used to any group of civilians heading towards them and killing innocents ruthlessly.

Through the analysis of these selected short stories, it can be concluded that Feroz Rather's stories can be labelled as the specimen of the resistance literature, and minor literature. As far as the thematic patterns are concerned, the analysis revealed that Rather has mainly explored the issues of the bloodshed, tortures, love, pain, sufferings, loss, physical violence, trauma, victimization of women, corruption, and casteism. By the depiction of this horror he wants to highlight how Kashmir is synonymous to a lost paradise.

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Human Avarice and Ecological Destruction in Siddhartha Sarma's *The Grasshopper's Run*

Amandeep Kaur

Research Scholar, Department of English, SGGSWU, Fatehgarh Sahib
amn2890@gmail.com

Abstract

Natural resources are a significant part of the ecosystem. Human actions have had a crucial role to play in the exploitation of the land, air, forests, wildlife, oil and other mineral reserves. In relation to this, Children's literature in India has been exploring the causes and impacts of the misuse of flora and fauna. Siddhartha Sarma's novel *The Grasshopper's Run* is one such effort to recognise the ideal and sustainable way of living with nature while looking at the geo-political aspect of resource wars.

Environment cannot be studied in isolation. The entire ecosystem of a place including all the human and non-human life forms make up the environment of a place. Any change or disruption in a seemingly tiny part of it can disrupt the entire ecological balance of the place. Although environmental literacy as a concept has been around for some decades now, yet it has not shown the required impact at the grassroots level. Human beings are still not making the essential changes in their ways of living and dealing with the environment so as to protect the planet from total collapse. It is now being understood that any serious efforts in creating awareness towards ecological conservation and environmental justice ought to include the young population in its fold.

Due to the importance of children's literature in making up the impressionable minds of the future generations and instilling a way of life in them, it is appropriate to examine the genre from the perspective of sustaining life and natural environment.

The current paper aims to study the selected young adult novel under the lens of eco-critical theory with particular emphasis on geopolitics and ecological justice. The constructs of eco-criticism shall be applied in the Indian context to understand what the young readers of today are being taught about the world we live in and the issues we have been facing.

Key words: Ecocriticism, Resource Wars, Geopolitics, Ecological Justice

The present paper is an ecocritical analysis of the children's novel *The Grasshopper's Run* (2009) written by Siddhartha Sarma. It studies how the novel addresses the issue of ecological exploitation at the hands of people in power and how the misuse displaces the humans' ideal way of living alongside nature.

The Grasshopper's Run (2009) is Siddhartha Sarma's first novel. This 2011 Sahitya Academy Award winner novel is set in the North East of India and showcases the scenario of the states of Nagaland and Assam during the Second World War. It recounts a semi-fictional tale of events when British Indian Army is fighting against the Japanese Army's invasion into India through Nagaland. Uti and Gojen are the two child characters who witness the struggle and are affected by it grievously. At the start of the novel, Uti and his tribe is slaughtered by the Japanese forces. The story then follows Gojen's, the urban friend of Uti, revenge journey against the Japanese Colonel who ordered the raid.

The novel takes its name from the Naga myth about the story of the Grasshopper and the End of the World, which is an important part of pre-Christian Ao Naga eschatology. J.P. Mills in his exhaustive book *The Ao Nagas* (1926) details the belief of the Ao Naga tribes of North-East India about the origins of fire and how the world would come to end. The tale is about the fight of fire and water in which water emerged victorious and fire ran and hid in the bamboos. The legend goes that one day fire will come back again and will fight with water. The old Aos call it the Great Fire or Molomi that will rise up from the banks of river Brahmaputra and will burn the earth. However, "in the end water will be the conqueror, for a great flood will follow the great fire and swamp the world for ever" (TGR 100-101). Meanwhile, the Grasshopper with his big eyes saw the fire when it hid in bamboos and told it to the monkey. However, man saw the monkey making fire and stole it from him. Talking about the title of the novel, Sarma, in one of the email interviews with the researcher, states that

While researching the Battle of Kohima and the great changes which came to the Naga Hills during the Second World War, I thought the legend of the Grasshopper could be re-told as an allegory for the events of 1944. 'Run' in the title refers to two meanings of the word: first, to the fact that Gojen is a middle distance runner by aptitude, and second, to a journey (n.p.).

In this context, it may be said that the Molomi is symbolic of war as well as the Japanese Colonel who unleashes devastation over the tribal ecosystem. At the time of his death, Uti recalls the tale of Molomi that his mother used to narrate to him and Gojen. He understands that the Colonel is the fire that has come to end their world but he was certain that the Grasshopper would find the fire and avenge the annihilation of his friend, the tribe and the village. Therefore, Gojen could be considered to be the mythical Grasshopper that ultimately traces down the fire or the Japanese Colonel. Sarma also states that "Gojen himself seems to remember the tale and

understand its significance towards the end of the story, while the group is returning from Kohima” (Sarma n.p.). Hence, Gojen’s journey to Kohima in search of Mori is identical to the Grasshopper’s hunt about the whereabouts of the fire.

Based on this mythical tale, the novel recounts the story of how the human struggle for dominance can destroy habitats and human lives. The nature and animal imagery in the novel showcases that forces of nature create and destroy at the same time. However, man wants to overpower nature by using only the destructive forces. In the novel, the Japanese Army is symbolic of the unethical destruction with which they want to gain power over man and land.

The first few pages of the novel recount how the Japanese Colonel destroys the Ao Naga village and its people. The hills around the village had been a sort of walls that made it difficult for invaders to get to know of this inhabitation. Mori, the Colonel, was not ready to consider the fact that the settlement could not have been a British Indian Army’s post but a Naga village. Hence, he ordered a strike. For his presumptuousness, he declared the villagers as informers of his enemy and got Uti killed cruelly who fought bravely against the intruder. Mori wanted the British Indian Army and civilians to visualise him as a brutal enemy and thus torched the entire village into a wasteland. Leaving the hamlet scorched was his technique to present himself as above nature and people.

The novel informs its young readers about the reasons behind the conflict between the Japanese and the British. The narrator explains that the Japanese wanted to claim the terrain of Assam and Burma for two reasons. The first objective was to capture the airfields of Assam that “were being used by the British and American aircraft to supply food, guns and medical aid to the Chinese partisans under Chiang Kai-Shek. Those airfields needed to be captured to choke off the Chinese resistance, which had stubbornly refused to surrender” (TGR 64). Hence, the Japanese were trying to capture the Indian terrain from the British to counter the Chinese opposition.

Secondly, Japan wanted to stop the British from occupying Burma because the Japanese wanted the oilfields and mineral reserves of Burma for themselves. The narrator keenly summarises the causes by saying that “If oil was becoming more and more important in peace, it was doubly so in war” (65). The same is noted by Gar Smith in *The War and Environment Reader* (2017) that “[A]ccording to a 2013 UN Environment Programme report, at least 40 percent of all intrastate conflicts involved the exploitation of natural resources—land, water, diamonds, timber, minerals, and, of course, oil” (21). Gojen knows that the armies are fighting because of the oil only but for him it is sheer madness that he is unable to understand.

Gojen and Uti are the child characters who are presented as living in the times of war but have seemingly been oblivious to its horrors. Gojen studies in a school run by Christian missionaries and belong to the family of plantations and timber mill owners. He is thirteen years old and Uti was of the same age when he dies in the struggle between Japanese and British Indian conflict. Uti was the grandson of the Ao Naga chief and after his death the tribe’s legacy also ends. So, the war destroyed an entire tribe including the next generation of the people who could have been the continuators of a nature oriented lifestyle.

Gojen spends a year with Uti in his tribe learning the Ao’s way of life in the *morung*, a dormitory where young Nagas are taught the traditional and cultural aspects of their tribes. Through these lessons, they understand the intrinsicality of nature in every Naga’s life and learn how to live well. Gojen’s grandfather had been friends with Uti’s grandfather, so the boys become aware of each other’s way of life at a very young age. It may be said that despite being an urban boy Gojen assimilates into the tribal life and becomes one with nature. Besides this, he also imbibes the rebellious spirit which is emblematic of the warring Naga tribes.

Apart from the lessons at the *morung*, the boys go for hunting trips in the swamps nearby Gojen’s grandfather’s estate. The narrator tells that these hunting expeditions are made for fun by the plantation owners of the area. Uti and Gojen go through these hunting lessons as a part of the tradition. Birds are usually hunted down to serve good food to the guests. During one such trips, Uti’s grandfather Shilukaba asks Gojen if he knew the difference between these hunting trips and the hunting done by the tribesmen. Gojen learns from Shilukaba that “In the hills, they hunt for food . . . the only reason to hunt something was to eat it, or to take an animal for those who deserved such good food” (TGR 43-44). Shilukaba also teaches Gojen that a human can deserve a kill only “by becoming a part of the swamps and taking as much discomfort as the birds you hunt live with. By making yourself and the birds as equals” (44). As the mythical Grasshopper hunted down the fire, Gojen as the symbolical grasshopper hunts down Colonel Mori towards the end of the novel. So, in this way Gojen’s hunting carries much broader significance than the hunting undertaken by his family and other estate owners. The novel talks about hunting as means of subsistence for the tribals living close to Naga Hills. Shilukaba stresses the fact that “In the hills, they hunt for food. Sometimes they go out for a long while, not knowing for certain if they will get anything to feed their families. . . . People here get good food anyway; it does not cost much for you. People like you, like the Ingraz, hunt because it is fun” (43). Gojen ingrains in his mind the meaning of hunting from the tribe’s chief and never kills an animal for fun again. Nagaland and other North-Eastern states have been

biodiversity hotspots. Nagaland presented in the novel is different from the present day scenario. Ecologists and conservationists consider hunting as one of the threats to species extinction as well as habitat loss in these areas. Correspondingly, in order to conserve the wildlife of Nagaland and other Indian states, the Government of India banned hunting through The Wildlife Protection Act of India (1972). However, despite such laws poaching is still prevalent in North- Eastern states of India. The naturalists and conservationists put the onus of associated faunal loss on the hunting traditions of the tribal communities of the regions. Through Shilukaba's views on hunting, Sarma highlights the fact that the hunting done by indigenous communities is starkly different from the commercial poaching of modern days. Subsistence hunting has had been a part of the North-East India's tribal life for centuries. Anirban Dutta-Roy in his article “Rethinking Hunting in Northeast India” (2021) discusses about the regulated hunting by the Nagas through the institution of *kebang* that has maintained order in villages for centuries. The wise elders of the *kebang* enforced strict regulations on various aspects of hunting, trapping, and other forms of natural resource extraction. They also acted on cues from their natural surroundings, modifying their hunting and fishing activities if it appeared to be impacting their resource availability. These dynamic ‘place-based’ knowledge systems have allowed various indigenous groups across the world to respond to the feedback they receive. Such an elaborate system of natural resource management and human-nature relationship contradicts the image of the reckless hunter that appears in popular perception (n.p.).

Additionally, these communities consider the forest and the animals as guiding spirits. Hence, the flora and fauna have been a spiritual significance in their lives. Such complex and inclusive relationship of these communities with nature needs much acknowledgement in terms of putting non-monetary value over nature's benefits. Bhavendu Joshi et al in their article “Culture Shapes Community Conservation in Nagaland” (2022) transcribes about the nature imbued Naga lifestyle and refers to the fact that “the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) has broadened its framework to now also include [Naga's] culture and indigenous knowledge in understanding *Nature's Contributions to People*” (n.p.). This move by IPBES asserts that the wisdom of the indigenous communities is synonymous to sustainable living.

Having grown up in Assam, Sarma himself has been a witness to the culture of the Nagas. He makes it clear to the readers that hunting should not be considered glamorous. It is rather a force that comes with so many possibilities. By relating hunting to swimming he emphasises that “those who confess to be fascinated with either water or guns are frequently those who should not be permitted anything to do with either” (TGR 42). The analogy with the mythical water and fire is stated here again. The two elements are related time and again to the characters of the novel. The allusions might mean that although every human is made up of these elements but the decision to become destructive or constructive is one's own.

Gojen's taking up arms against the Colonel could be taken as an act of defensive warfare. In order to take his revenge, he sets to hone his skills in shooting. For this, he uses his lessons learnt during the hunting trips. At this point, the novel talks in detail about guns and rifles. Considering the fact that the novel is set during Second World War, the use of guns by the child characters seems plausible. Sarma, in the email interview clarifies that

Being historically accurate fiction, the novel's characterization of a 15-year-old rifle user is based on the necessity of the plot and adherence to the inner organic integrity of the setting and background. It is therefore not a glorification or justification of war or violence. The experiences of the characters, including Gojen, also reinforce the idea that violence is never good, neither for the perpetrators nor the victims and survivors, regardless of the size, scope or implications of a conflict (n.p.).

In relation to this, Uti's fight against the Colonel and the Japanese Army expounds the warring spirit of the Aos. Uti fights for his land and his people's independence. His fight ends with his village being burnt down by the enemy. Many tribes are displaced because of the Japanese Army's invasion into the Naga Hills. The tribesmen enlists themselves with the British Army and are called Naga Scouts because “The British were quick to realise that the tribesmen were best in tracking Japanese in the hills. These were their hills, after all” (TGR 74). Sarma repeatedly calls the hills as the hills belonging to the Nagas. The British Army was also aware of the fact that the tribesmen know the hills more than anyone else does. Hence, the British army recruits the Nagas against their common enemy i.e. the Japanese army.

The Japanese Government, on the other hand, waged a war to loot and plunder. Under the guidance of the Prime Minister Tojo, the army enlarges the plan from taking over Assam and Burma to infiltrate into India and overthrow the British Raj. For this motive, the Lt General of the Imperial Japanese Army, Mutaguchi gives the reins in the hands of Mori whom everyone in the army considers a maniac. Mori's senior, Lt General Sato disliked Mori for his “complete inability to understand the realities of war. . . . Sato knew the man was a psychopath and must not be left unsupervised. Ironically, such a man held the keys to the campaign” (67). Colonel Mori was just concerned about conquering the land by any means.

In other words, the war on both sides is fought for taking the control of land primarily. Studied from the ecocritical point of view, land in this case does not have any autonomy of its own. Deep ecologists consider this scenario as the example of anthropocentrism, the belief that land and nature exist for the benefits of humans. The narrative declares Naga Hills as the hills belonging to Nagas. All the Naga tribes had their differences because of land disputes only. The British is ruling over the land and people of India. Japan wants to have the Indian land under its own dominion.

Plantations is another issue that the ecologists consider as ecosystem unfriendly. Gojen belongs to the family of planters and estate owners. He is shown to have been living a very comfortable life in a large house with furnishings of wood. His uncles are timber mill owners and are profiting because “the mill was doing well during the war” (38). The narrator states that the estates and farms are made by clearing forests because of which elephants and other wild animals would usually crash into the fields. Against such intrusion, farmers and estate owners are always ready with their machetes and guns. These farms and estates are connected with the Kaziranga National Reserve that the narrator mentions as

a British experiment at conservation – after several decades of rather indiscriminate hunts up and down both banks of the Brahmaputra—animals were now protected, within the Reserve. The problem was this, the animals didn’t know their special status was limited to Kaziranga, so they tried to roam as they had done before. (88)

It may be deciphered that colonialism and clashes between Britain and Japan was the reason behind the disturbances of the natural habitats of the animals as well as the tribals. Meanwhile, the plantation owners were benefitting by gaining land locally and supplying tea overseas. The narrative gives subtle allusions to the large-scale tea business of Assam and the ecological impact it was having. When asked about the negative impact of the plantations over the ecosystem, Sarma agrees that plantations negatively affect the ecology of a place, depending on the scale of the plantations and the ecological complexities of the host geography. In the case of East or Upper Assam, where most of the oldest and largest (in terms of size and number) tea plantations exist, the ecological effect has been extensive but localized at the same time. Extensive because of the scale of the tea industry. Localized because the topography, climate and surrounding vegetation have been robust enough to thrive despite the introduction of tea cultivation. Therefore, while the planting of tea did replace large tracts of farmland and forest, the impact has not been as negative for Assam as it would have been for less healthy tropical geographies (Sarma n.p.).

According to Sarma, the health of any ecosystem depends upon the topography of a certain place. However, the tea business of Assam has been experiencing losses because of climate change. Assam is India’s largest tea producing state and the world’s second country after China. The story of plantations of Assam started with Britain’s interest in the possible market in Assam. From 1839 to 1854, Assam tea business expanded to immerse “into the networks of colonial capitalist economy and trade. Within histories of plant colonialism and imperial botanising, this represented the triumph of British science and mastery over Assam’s allegedly ‘enchanted’ and ‘savage’ landscape” (Dey 538). With this began the socio-environmental impact of the market on the ecosystem of Assam. Today, many depend upon the tea industry for their livelihood. However, climate change is real in this comparatively healthy geography. In 2020 at the Chevening Conversation on ‘Climate Change and its Impact on Tea’ in Guwahati, Assam, the speakers discussed about water shortage, deforestation as the major reasons behind the climate change experienced in the state. One of the speakers was the chairman of Tea Board and Tea Research Association, Prabhat Kamal Bezboruah. He highlighted the water scarcity issue which is the result of unregulated cutting of trees in Arunachal, Meghalaya, Nagaland, and Assam “making the Brahmaputra river catchment areas more vulnerable. Critiquing the clearing of forests in Arunachal Pradesh and Nagaland for creating additional tea gardens, Bezboruah said, “Tea gardens might be a green cover, but it is no replacement for a forest” (Bajaj n.p.). Assam, Nagaland and other nearby areas are famous for tea plantations. However, as the market for tea is expanding, more and more areas under forest cover are being cleared to make space for tea plantations. This deforestation is becoming a serious issue as it is adversely affecting the health of the land.

Thus, the novel has finely recorded the story of the plantations as the representation of the economic, political, social, and environmental scenario of the land. It attempts to incite the reader to go about the narrative from all these aspects and relate with the present situation of the land. War and colonialism annexed the ecosystem of North-Eastern India and led to the ongoing degeneration of the land and its people. The narrative repeatedly mentions the tribals moving out from their villages because of Japanese attacks: “Some of the young men had joined up as scouts for the British; some other had simply vanished with a quiet word or two” (TGR 90). These people eventually join Gojen and other rebels against the Japanese Army. This is how Sarma

fictionalises the spirit of the times and the behaviour of the people who have been wronged with. Alongside this, the novel also serves as a study about the impacts of war upon the ecosystem of the area, the repercussions of which can be felt in the form of ongoing climate change witnessed in the geography of Assam and Nagaland.

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Contextualising Friendship in Terror-ridden Afghanistan in Khaled Hosseini's, *The Kite Runner*

Maninder Kaur

*PhD Scholar, Desh Bhagat University Mandi Gobindgarh, Punjab
 minubains12@gmail.com

Kite flying, the traditional sport of Afghanistan was banned under the fundamentalist Taliban regime. Hosseini was so heart-broken that he dedicated his celebrated novel, *The Kite Runner* (2003) to it: “I was so taken with the story and so swept up in that world that I had to write it.” *The Kite Runner* is the story of Amir, a Sunni Muslim, who struggles seeking his identity in the world because of a series of traumatic childhood events. Hosseini weaves the brutality and sufferings of the people of Afghanistan during the Taliban regime in this novel.

The Kite Runner is the story of friendship between Amir, the main protagonist of the novel who is a well-to-do Pashtun boy, and Hassan, a Hazara boy who is the son of Ali, the servant of Amir's father. They both spend their days kite fighting in the peaceful city of Kabul. Later, flying kites becomes a way to seek solace from the horrific reality the two boys were living in. Hassan proves to be a successful “kite runner” for Amir; he knows where the kite will land without watching it. And how in future Amir turns to be a “kite runner” for dead Hassan's son, Sohrab and adopts him as his own son. This research paper will study Hosseini's depiction of friendship, guilt and redemption in Afghanistan which is tense with the friction of nation's different ethnic groups and is suffering under the tyranny of the Taliban.

In the story *The Kite Runner* by Khaled Hosseini, there are many things that will cross our mind. While the story takes one through a lifetime, there is one thing that is clear. Friendship is the key. From when the boys, Amir and Hassan, were young all the way to adulthood, there was a bond not forgotten. When Hassan says at the beginning of the story “for you a thousand times over,” it is truer than anything else. He had sacrificed his whole life for Amir and never expected anything in return. But the friendship was not just one sided, even though it seemed like that Hassan did huge things for Amir while Amir did little or nothing for Hassan, in the end, Amir shows his true loyalty to his friendship with Hassan. In the small town of Kabul, Afghanistan, there is a sport called kite running. The first big act of friendship is when indeed, Hassan tells Amir “for you a thousand times over,” when he goes to run the kite for him after their big win. Even though Hassan is the son of Amir's family servant, they grew up to be best of friends.

The narrator Amir looks back on his childhood in Afghanistan and recalls the bond he had with another boy, Hassan. Even though at this point in the story Amir believes he and Hassan are not brothers by blood, both grew up under the same roof and they fed from the same breasts, which justifies the bond he feels with Hassan. This quote: “Hassan and I fed from the same breasts. We took our first steps on the same yard. And, under the same roof, we spoke our first words,” reveals one of the main themes of the book, the bonds of friendship.

Amir dreams that someday he will return to Kabul and revisit the land of his and Hassan's childhood and he will find there his old faithful friend, Hassan waiting for him. Hassan sends these words in a letter to Amir, which Amir receives after Hassan has died. Hassan has suffered extreme violence and immeasurable trauma while living in Kabul in the years when Amir had gone. Hassan's message underscores his devoted loyalty to Amir. Even though Amir betrayed him, Hassan still remains his friend. His dream that Amir returns “to the land of our childhood” hints at Hassan's yearning for both himself and Kabul to return to innocence.

At a pivotal moment in the text, the central theme of betrayal and redemption emerges. Amir knows that Hassan is being brutally assaulted by Assef- a cruel and racist neighborhood boy, but chooses not to intervene. This crucial decision reveals Amir's inability to do what is right and drives the plot forward. Amir's decision not to act also underscores the ethnic tensions between the Pashtuns and Hazaras, as Assef remarks coldly, “it's only a Hazara.” At this point in the novel, Amir is beginning to become consumed by guilt over what he did to Hassan. He recalls Hassan's dream about a lake and reimagines himself as the monster in the dream, dragging Hassan down to his death. Amir once believed that winning the kite tournament would relieve him from his guilt of his mother's death and make him worthy in his father's eyes, but his betrayal of Hassan has made that impossible. He remains miserable now by constantly carrying the weight of this betrayal.

Amir has just learned that Baba had betrayed Ali, Baba's servant and friend, by fathering Hassan. This fact means that he and Hassan are actually brothers, and Hassan's son Sohrab is actually his nephew. At this moment, Amir realises that he is not just atoning for his sins, but his father's too. Rahim Khan's summoning of Amir to Kabul was a test of his manhood and honour, and in this moment, Amir is convinced that he must act. This is his chance to now become a man with a little boy, an orphan, Hassan's son in Kabul. These words, first spoken by Rahim Khan to Amir over the phone, echo in Amir's mind. Amir never wanted to return to Kabul, since he has a safe and quiet life in America with a wife, secure job, and a home. By traveling to Kabul, he is putting his life in danger. Amir ultimately realizes that he *must* return to Kabul. Returning to Kabul to rescue

Hassan's son Sohrab, who is now an orphan, is the only way to end the cycle of betrayal both he and his father put into motion.

The character of Hassan seems to be too good to be real. No matter what Amir does, he stays loyal to him. Khaled Hosseini very cleverly shows the definition of friendship for two people who belong to two different sections of society. For Hassan, a Hazara, friendship was loyalty, something that stayed to be the utmost gift, a priority till the last breath. Whereas, for Amir, a rich Pashtun, friendship was an authority, something he could claim with power, and reject when convenient. Religion and culture played an integral part in carving out their friendship. Amir, a Pashtun boy, had all the powers that he could easily exert over Hassan. Frankly, a lot of times, it felt like their friendship was a one-sided affair. Hassan is adorably fond of Amir; whereas, Amir repels Hassan with indifference and ignorance.

The first reason why friendship is the main theme is because Amir and Hassan are like brothers. Hassan would always listen to Amir: “I talked Hassan into firing walnuts with his slingshot at the neighbor's one-eyed German shepherd. Hassan never wanted to, but if I asked, really asked, he wouldn't deny me. Hassan never denied me anything” (3, 4). This explains that Hassan would do anything for Amir. Their relationship is so strong that Hassan can't say ‘no’ to him and he would help Amir with anything. Hassan is a solid friend, willing to do anything for Amir. Even when Hassan's father gets angry at them for this behaviour, he never tells Amir. Hassan is the pinnacle of what loyalty, and a feeling of allegiance look like.

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‘ਨਾਦ ਬਿੰਦ’ ਨਾਵਲ ਦਾ ਦਾਰਸ਼ਨਿਕ ਸੰਦਰਭ

ਸੰਦੀਪ ਕੌਰ

ਰਿਸਰਚ ਸਕਾਲਰ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ

Sandeep1615kaur@gmail.com

ਰੂਪ-ਰੇਖਾ

ਡਾ. ਕੈਰੋਂ ਲੋਕਧਾਰਾ ਵਿਗਿਆਨੀ ਦੇ ਨਾਲ-ਨਾਲ ਨਾਵਲ ਲੇਖਣੀ ਵਿਚ ਵੀ ਕਮਾਲ ਦੀ ਸਿਰਜਣਾ ਕਰਦੇ ਹਨ। ਉਨ੍ਹਾਂ ਦਾ ਗਿਆਨ ਤੇ ਦਰਸ਼ਨ ਨਾਵਲ ‘ਨਾਦ ਬਿੰਦ’ ਵਿਚ ਪ੍ਰਤੱਖ ਰੂਪ ਵਿਚ ਪ੍ਰਤਿਬਿੰਬਤ ਹੁੰਦਾ ਹੈ। ‘ਨਾਦ ਬਿੰਦ’ ਉਨ੍ਹਾਂ ਦਾ ਪਹਿਲਾ ਨਾਵਲ ਹੈ। ਇਸ ਨਾਵਲ ਦੀ ਮਹੱਤਤਾ ਤੇ ਵਿਲੱਖਣਤਾ ਵਿਸ਼ੇ ਦੀ ਦਾਰਸ਼ਨਿਕ ਚੋਣ ਕਰਕੇ ਬਣਦੀ ਹੈ। ਇਸ ਪੇਪਰ ਵਿਚ ਨਾਵਲ ‘ਨਾਦ ਬਿੰਦ’ ਦੇ ਦਾਰਸ਼ਨਿਕ ਸੰਦਰਭ ਨੂੰ ਵਾਚਿਆ ਜਾਵੇਗਾ। ਨਾਵਲਕਾਰ ਦੀ ਦ੍ਰਿਸ਼ਟੀ ਤੇ ਨਾਵਲ ਦੇ ਸਰੋਕਾਰਾਂ ਦਾ ਵਿਸ਼ਲੇਸ਼ਣ ਕਰਨ ਵਿਚ ਇਹ ਸੰਦਰਭ ਮਹੱਤਵਪੂਰਨ ਰਹੇਗਾ। ਸੰਦਰਭ ਦੀ ਮਹੱਤਤਾ ਨੂੰ ਸਮਝਣ ਵਿਚ ਵੀ ਇਹ ਪੇਪਰ ਕਾਫੀ ਮਦਦਗਾਰ ਸਾਬਿਤ ਹੋਵੇਗਾ।

‘ਨਾਦ ਬਿੰਦ’ ਜੋਗਿੰਦਰ ਕੈਰੋਂ ਦਾ ਪਹਿਲਾਂ ਨਾਵਲ ਹੈ ਇਸ ਪਲੇਠੇ ਨਾਵਲ ਵਿਚ ਦਾਰਸ਼ਨਿਕ ਵਿਸ਼ੇ ਨੂੰ ਆਧਾਰ ਬਣਾਉਣਾ ਤੇ ਸਾਹਿਤਕ ਹਲਕਿਆਂ ਵਿਚ ਇਸ ਨਾਵਲ ਦੀ ਨਿਵੇਕਲੀ ਵੱਖਰਤਾ ਸਥਾਪਿਤ ਹੋਣੀ ਇਸ ਨਾਵਲ ਦੀ ਮੂਲ ਪ੍ਰਾਪਤੀ ਕਹੀ ਜਾ ਸਕਦੀ ਹੈ। ‘ਨਾਦ ਬਿੰਦ’ ਨਾਵਲ ਵਿਚ ਦੋ ਦਾਰਸ਼ਨਿਕ ਵਿਚਾਰਧਾਰਾਵਾਂ ਸਮਾਨੰਤਰ ਕਾਰਜਸ਼ੀਲ ਰਹਿੰਦੀਆਂ ਹਨ। ਪਹਿਲੀ ਪਦਾਰਥਵਾਦੀ ਜਾਂ ਮਾਰਕਸਵਾਦੀ ਦਰਸ਼ਨ ਪ੍ਰਣਾਲੀ ਤੇ ਦੂਸਰੀ ਯੋਗ ਧਾਰਮਿਕ/ਅਧਿਆਤਮਿਕ ਦਰਸ਼ਨ ਪ੍ਰਣਾਲੀ ਹੈ। ‘ਨਾਦ -ਬਿੰਦ’ ਨਾਵਲ ਦੇ ਦਾਰਸ਼ਨਿਕ ਵਿਚਾਰਧਾਰਾਵਾਂ ਦੀ ਟੱਕਰ ਦਾ ਸੰਵਾਦ ਹੈ। ਨਾਵਲਕਾਰ ਨੇ ਇਸ ਟੱਕਰ ਦੀ ਉਸਾਰੀ ਕਿਉਂ ਕੀਤੀ ਹੈ? ਇਹ ਟੱਕਰ ਹੀ ਨਾਵਲ ਦੇ ਦਾਰਸ਼ਨਿਕ ਸੰਦਰਭ ਨੂੰ ਸਮਝਣ ਵਿਚ ਸਹਾਇਕ ਹੋਵੇਗੀ। “ ਸਾਹਿਤ ਦੀ ਸਿਰਜਣਾ ਇਕ ਵਿਸ਼ੇਸ਼ ਮਨੋਰਥ ਨਾਲ ਹੁੰਦੀ ਹੈ। ਇਹ ਸਵੀਕਾਰ ਕਰਨਾ ਕਠਿਨ ਹੈ ਕਿ ਸਾਹਿਤ ਦਾ ਕੋਈ ਮੰਤਵ ਹੀ ਨਾ ਹੋਵੇ ਅਤੇ ਇਸ ਦੀ ਉਤਪਤੀ ਕੇਵਲ ਮਨੁੱਖੀ ਜਜ਼ਬਿਆਂ ਦੇ ਸਹਿਜ ਪ੍ਰਗਟਾਵੇ ਲਈ ਹੀ ਹੁੰਦੀ ਹੋਵੇ। ਅਸਲ ਵਿਚ ਇਕ ਸਜੀਵ ਕਲਾਤਮਕ ਪੂਰਨਤਾ ਦਾ ਸੰਕਲਪ ਤਾਂ ਹੀ ਪੈਦਾ ਹੁੰਦਾ ਹੈ ਜੇਕਰ ਕਲਾਕਾਰ ਆਪਣੀ ਰਚਨਾ ਨੂੰ ਵਿਸ਼ੇਸ਼ ਪ੍ਰਕਾਰ ਦੀਆਂ ਕੀਮਤਾਂ ਦੇ ਰੰਗ ਵਿਚ ਰੰਗੇ ਅਤੇ ਇਹ ਕੀਮਤਾਂ ਦੇ ਰੰਗ ਵਿਚ ਰੰਗਣ ਦੀ ਪ੍ਰਕਿਰਿਆ ਉਸ ਤੋਂ ਮੰਗ ਕਰਦੀ ਹੈ ਕਿ ਉਹ ਆਪਣੇ ਆਪ ਨੂੰ ਉਸ ਵਿਚਾਰਧਾਰਾ ਨਾਲ ਸੰਬੰਧਿਤ ਕਰੇ, ਜਿਸ ਦਾ ਉਹ ਬੌਧਿਕ ਤੌਰ ਤੇ ਅਨੁਸਰਨ ਕਰਦਾ ਹੈ। ਉਹ ਤਾਂ ਹੀ ਆਪਣੀ ਵਿਚਾਰਧਾਰਾ ਨੂੰ ਕਲਾ ਦੀ ਸੂਖਮਤਾ ਵਿਚ ਬਦਲ ਸਕਦਾ ਹੈ ਜੇਕਰ ਉਹ ਆਪਣੀ ਸੋਚਣ ਦੀ ਪ੍ਰਕ੍ਰਿਆ ਨੂੰ ਪੂਰਨ ਤੌਰ ਤੇ ਜ਼ਿੰਦਗੀ ਦੇ ਵਿਕਾਸ ਦੀ ਪ੍ਰਕ੍ਰਿਆ ਨਾਲ ਸਾਂਝਿਆਂ ਕਰ ਸਕੇ। ” ‘ਨਾਦ ਬਿੰਦ’ ਦਾ ਰਚੇਤਾ ਵੀ ਉਪਰੋਕਤ ਨੁਕਤੇ ਤੋਂ ਨਾਵਲੀ ਕਥਾ ਉਸਾਰਦਾ ਹੈ।

ਭਾਰਤੀ ਦਰਸ਼ਨ ਵਿਚ ਛੇ ਦਰਸ਼ਨ ਪ੍ਰਣਾਲੀਆਂ ਹਨ। ਹਰ ਇਕ ਦਰਸ਼ਨ ਪ੍ਰਣਾਲੀ ਇਕ ਦੂਸਰੀ ਨਾਲੋਂ ਵਿਲੱਖਣ ਤੇ ਵਿਸ਼ੇਸ਼ ਹੈ। ਇਹ ਇਕ ਦੂਸਰੀ ਦੇ ਅਨੁਸਰਨ, ਅਨੁਕਰਨ ਤੇ ਵਿਰੋਧ ਜਾਂ ਪ੍ਰਤੀਕਰਮ ਵਜੋਂ ਉਪਜੀਆਂ ਹਨ। ਹਰ ਇਕ ਦਰਸ਼ਨ ਪ੍ਰਣਾਲੀ ਆਪਣੇ ਤੋਂ ਪਹਿਲੀ ਪ੍ਰਣਾਲੀ ਦਾ ਵਿਕਾਸ ਹੀ ਕਰਦੀ ਹੈ। ਵੇਦਾਂਤ ਦਰਸ਼ਨ ਦਾ ਭਾਰਤ ਦੀਆਂ ਸਾਰੀਆਂ ਦਰਸ਼ਨ ਪ੍ਰਣਾਲੀਆਂ ਤੇ ਪ੍ਰਭਾਵ ਰਿਹਾ ਹੈ। ਨਾਵਲਕਾਰ ਨੇ ਇਸ ਪ੍ਰਭਾਵ ਨੂੰ ਨਾਵਲ ਵਿਚ ਯੋਗ ਦਰਸ਼ਨ ਦੇ ਸੰਦਰਭ ਵਿਚ ਉਭਾਰਿਆ ਹੈ। ਮੂਲ ਰੂਪ ਵਿਚ ਤਾਂ ਯੋਗ ਦਰਸ਼ਨ ਬਜਰਯਾਨ ਪਰੰਪਰਾ ਦੇ ਨਸ਼ਾ ਸੇਵਨ ਅਤੇ ਕਾਮ ਆਦਿ ਦੇ ਘੋਰ ਚਰਿਤਰਹੀਣਤਾ ਪ੍ਰਤਿ ਇਕ ਪ੍ਰਤੀਕਰਮ ਵਜੋਂ ਹੋਂਦ ਵਿਚ ਆਇਆ। ਉਹ ਵੱਜਰਯਾਨੀਆਂ ਦੇ ਅਸ਼ਲੀਲ ਵਿਹਾਰ ਤੋਂ ਛਿੱਥੇ ਪੈ ਗਏ ਸਨ। ਇਸ ਕਰਕੇ ਜੋਗੀਆਂ ਨੇ ਆਪਣੇ ਮੱਤ ਵਿਚ ਬਿੰਦ ਰੱਖਿਆ ਅਤੇ ਸਰੀਰ ਸਾਧਨਾ ਤੇ ਬਲ ਦਿੱਤਾ। ਇਸ ਦਾ ਅੰਤਿਮ ਪੱਖ ਹਨ ਤੇ ਨਾਰੀ ਨਿੰਦਿਆ ਸੀ। ਨਾਵਲ ਵਿਚ ਜੋਗੀਆਂ ਦੇ ਦਰਸ਼ਨ ਨੂੰ ਮੁੜ ਵੱਜਰਯਾਨੀਆਂ ਦੇ ਦਰਸ਼ਨ ਤੇ ਮਾਰਗ ਦੇ ਪ੍ਰਵਕਤਾ ਬਣਨ ਦੇ ਸੰਦਰਭ ਵਿਚ ਪੇਸ਼ ਕੀਤਾ ਹੈ। “ਯੋਗ ਦਰਸ਼ਨ ਦਾ ਮਹੱਤਵ ਨਿਰੋਲ ਸ਼ਾਸਤਰਾਂ ਵਿਚ ਨਹੀਂ ਹੈ, ਮਨੁੱਖੀ ਜੀਵਨ ਨਾਲ ਇਸ ਦਾ ਗਹਿਰਾ ਸੰਬੰਧ ਹੈ। ਧਰਮ ਦੀ ਕਿਰਿਆ ਲਈ ਸਰੀਰ ਮਾਧਿਅਮ ਬਣਦਾ ਹੈ। ਇਸ ਲਈ ਯੋਗ ਵਿਚ ਸਰੀਰ ਨੂੰ ਸਾਧਣ ਦੀ ਸਿੱਖਿਆ ਦਿੱਤੀ ਗਈ ਹੈ।”² ਦਰਸ਼ਨ ਦਾ ਮਨੋਰਥ ਮਨੁੱਖ ਨੂੰ ਦੁੱਖਾਂ ਤੋਂ ਮੁਕਤ ਕਰਨ ਵਿਚ ਨਿਹਿਤ ਹੈ। ਵਿਚਾਰਵਾਦੀ ਦਰਸ਼ਨ ਤੇ ਇਸ ਤੋਂ ਪ੍ਰਭਾਵਿਤ ਦਰਸ਼ਨ ਪ੍ਰਣਾਲੀਆਂ ਆਤਮਾ ਨੂੰ ਅਨੰਤ ਸ਼ਕਤੀ ਵਿਚ ਅਭੇਦਤਾ ਨੂੰ ਸੁੱਖ ਪ੍ਰਾਪਤੀ ਦੱਸਦੀਆਂ ਹਨ। ਜੋਗੀ ਵੀ ਆਤਮਾ ਦੀ ਸ਼ਕਤੀ ਨੂੰ ਜਗਾਉਣ ਦੇ ਸਵੈ ਅਨੁਭਵ ਨੂੰ ਸਾਧਨਾ ਦਾ ਮਨੋਰਥ ਦੱਸਦੇ ਹਨ। ਨਾਵਲਕਾਰ ਇਸੇ ਸੰਦਰਭ ਵਿਚ ਕਥਾ ਨੂੰ ਉਸਾਰਦਾ ਹੈ। ਯੋਗ ਦਰਸ਼ਨ ਦਾ ਪੰਜਾਬ ਵਿਚ ਬਹੁਤ ਪੁਰਾਣਾ ਇਤਿਹਾਸ ਹੈ। ਪੰਜਾਬੀ ਮਾਨਸਿਕਤਾ ਵਿਚ ਵੀ ਇਨ੍ਹਾਂ ਦਾ ਬਹੁਤ ਆਦਰ ਤੇ ਸਤਿਕਾਰ ਕੀਤਾ ਜਾਂਦਾ ਹੈ। ਪਰ ਨਾਵਲ ਇਸ ਪੱਖੋਂ ਇਕ ਨਵੀਂ ਪਹਿਲ ਕਰਦਾ ਹੈ ਕਿ ਉਹ ਇਨ੍ਹਾਂ ਦੇ ਜੀਵਨ ਤੇ ਡੇਰੇ ਦੇ ਸਭਿਆਚਾਰ ਨੂੰ ਵਿਹਾਰਕ ਰੂਪ, ਯੋਗੀਆਂ ਦੀ ਮਾਨਸਿਕਤਾ, ਪੂਜਾ ਵਿਧੀਆਂ ਦੇ ਚਿੰਨ੍ਹਾਂ ਆਦਿ ਰਾਹੀਂ ਅਧਿਐਨ ਕਰਦਾ ਹੋਇਆ ਆਲੋਚਨਾਤਮਿਕ ਕਿਰਤ ਦੀ ਸਿਰਜਣਾ ਕਰਦਾ ਹੈ।

‘ਨਾਦ ਬਿੰਦ’ ਨਾਵਲ ਦਾ ਸਿਰਲੇਖ ਹੀ ਯੋਗ ਦਰਸ਼ਨ ਨਾਲ ਸਿੱਧਾ ਵਾਸਤਾ ਰੱਖਦਾ ਹੈ। ਇਸ ਸੰਕਲਪ ਦੀ ਸਾਰਥਿਕਤਾ ਦੀ ਪੜਚੋਲ ਹੀ ਨਾਵਲ ਦਾ ਦਾਰਸ਼ਨਿਕ ਸੰਦਰਭ ਬਣਦੀ ਹੈ। ਨਾਵਲਕਾਰ ਨੇ ਕੇਵਲ ਇਕ ਅੱਧੀ ਘਟਨਾ ਨੂੰ ਹੀ ਨਾਵਲ ਵਿਚ ਵਿਸਥਾਰ ਨਹੀਂ ਦੇਣਾ ਹੁੰਦਾ ਬਲਕਿ ਨਾਵਲ ਕਈ ਅੰਤਰ-ਪਾਠਾਂ ਦਾ ਸਮਨਵੇਂ ਹੁੰਦਾ ਹੈ। ਨਾਵਲ ਵਿਚ ਪੇਸ਼ ਦਰਸ਼ਨ ਤੇ ਲਹਿਰਾਂ ਦੀ ਵਿਆਖਿਆ ਕਿਸ ਪ੍ਰਸੰਗ ਵਿਚ ਲੇਖਕ ਨੇ ਕੀਤੀ ਹੈ ਨੂੰ ਸਪਸ਼ਟ ਕਰਨ ਲਈ ਪ੍ਰਸੰਗ ਦੀ ਸਮਝ ਹੋਣੀ ਜ਼ਰੂਰੀ ਹੈ। “ਐਲਨ ਡੰਡੀਜ਼ ਨੇ ਤਾਂ ਇੱਥੋਂ ਤਕ ਕਹਿ ਦਿੱਤਾ ਸੀ ਕਿ ਪ੍ਰਸੰਗ ਵਿਹੁਣਾ ਪਾਠ ਅਰਥਹੀਣ ਹੈ।”³ ਨਾਵਲ ਦੀ ਕਥਾ ਦਾ ਮੂਲ ਅਧਾਰ ਕੀ ਹੈ? ਤੇ ਕਿਸ ਪ੍ਰਸੰਗ ਵਿਚ ਨਾਵਲਕਾਰ ਨੇ ਕਥਾ ਨੂੰ ਪੇਸ਼ ਕੀਤਾ ਹੈ, ਰਾਹੀਂ ਹੀ ਪਾਠ ਦੀ ਪੜਤ ਸੰਭਵ ਹੋ ਸਕਦੀ ਹੈ। ਨਾਵਲ ਯੋਗ ਦਰਸ਼ਨ ਦੀ ਪ੍ਰਾਚੀਨਤਾ, ਇਸ ਦੀ ਪੰਜਾਬੀ ਜੀਵਨ ਵਿਚ ਮਹੱਤਤਾ ਤੇ ਲੋਕ ਸੰਸਕ੍ਰਿਤੀ ਦਾ ਹਿੱਸਾ ਬਣਨ ਦੇ ਸੰਦਰਭ ਰਾਹੀਂ ਪਿੰਡ ਦੇ ਧਰਾਤਲ ਤੇ ਇਕ ਡੇਰੇ ਵਿਚ ਕਾਰਜਸ਼ੀਲ ਜੋਗੀਆਂ ਦੇ ਕਾਰ ਵਿਹਾਰ ਨੂੰ ਸੁਨਿਸ਼ਚਿਤ ਕਰਦਾ ਹੈ। ਉਂਝ ਤਾਂ ਸਿਰਲੇਖ ਤੋਂ ਹੀ ਸਪਸ਼ਟ ਹੈ ਕਿ ‘ਨਾਦ-ਬਿੰਦ’ ਯੋਗ ਮਤ ਦਾ ਦਾਰਸ਼ਨਿਕ ਸੰਕਲਪ ਹੈ। ਇਹ ਨਿਰਾ-ਪੁਰਾ ਸਧਾਰਨ ਸੰਕਲਪ ਨਹੀਂ ਹੈ ਬਲਕਿ ਇਸ ਦੇ ਗਹਿਰੇ ਅਰਥ ਟੈਬੂ ਵਿਚ ਨਿਹਿਤ ਹਨ। ਮਨੁੱਖ ਟੈਬੂ ਤੇ ਮਨਾਹੀ ਤੋਂ ਹਮੇਸ਼ਾ ਹੀ ਨਾਬਰ ਰਹਿਣ ਦੀ ਪ੍ਰਵਿਰਤੀ ਦਾ ਲਖਾਇਕ ਰਿਹਾ ਹੈ। ਮਿਥਿਹਾਸਿਕ ਬਾਬੇ ਆਦਮ ਦੀ ਕਥਾ ਵੀ ਇਸੇ ਦਾਰਸ਼ਨਿਕ ਸੱਚ ਨੂੰ ਦ੍ਰਿੜ੍ਹ ਕਰਦੀ ਹੈ। ਨਾਵਲ ਵਿਚ ਯੋਗ ਦਰਸ਼ਨ ਵਿਚ ਪ੍ਰਚਲਿਤ ਮਨਾਹੀਆਂ ਦਾ ਮਨੁੱਖੀ ਵਿਹਾਰ, ਅਸਤਿਤਵ, ਜੀਵਨ, ਸਮਾਜ, ਧਰਮ, ਦਰਸ਼ਨ ਵਿਚ ਕੀ ਮਹੱਤਤਾ ਹੈ ਤੇ ਇਸ ਮਹੱਤਤਾ ਤੇ ਪ੍ਰਸ਼ਨ ਚਿੰਨ੍ਹ ਲਗਾਇਆ ਗਿਆ ਹੈ। ਨਾਵਲੀ ਬਿਰਤਾਂਤ ਨੂੰ ਇਸੇ ਸੰਦਰਭ ਵਿਚ ਪੜ੍ਹਿਆ ਤੇ ਸਮਝਿਆ ਜਾ ਸਕਦਾ ਹੈ।

ਭੋਗ ਦੀ ਲਾਲਸਾ ਹੀ ਮਨੁੱਖ ਦੀ ਭਟਕਣ ਤੇ ਅਸ਼ਾਂਤੀ ਦਾ ਕਾਰਨ ਬਣਦੀ ਹੈ। ਡਾ. ਜਗਬੀਰ ਸਿੰਘ ਇਸ ਦਰਸ਼ਨ ਵਿਚ ਸਮੇਂ ਨਾਲ ਆਈ ਸੀਮਤਾ ਦੇ ਪੱਖ ਬਾਰੇ ਕਹਿੰਦੇ ਹਨ, “ਸਿੱਧ-ਨਾਥ ਪਰੰਪਰਾ ਮੱਧ-ਕਾਲੀਨ ਭਾਰਤ ਵਿਚ ਬ੍ਰਾਹਮਣਵਾਦੀ ਕਰਮ-ਕਾਂਡ ਦੇ ਪ੍ਰਤੀ ਵਿਦਰੋਹ ਦਾ ਸੰਦੇਸ਼ ਲੈ ਕੇ ਉੱਭਰੀ ਸੀ ਪਰ ਨਾਨਕ ਕਾਲ ਤਕ ਪਹੁੰਚ ਕੇ ਇਸ ਦੀ ਵਿਦਰੋਹੀ ਭਾਵਨਾ ਉੱਕਾ ਹੀ ਅਲੇਪ ਹੋ ਚੁੱਕੀ ਸੀ। ਬ੍ਰਾਹਮਣਵਾਦੀ ਕਰਮ-ਕਾਂਡ ਦੀ ਥਾਵੇਂ ਨਾਥ ਜੋਗੀਆਂ ਦਾ ਆਪਣਾ ਕਰਮ-ਕਾਂਡ ਸਥਾਪਤ ਹੋ ਚੁੱਕਿਆ ਸੀ ਜਿਸ ਨਾਲ ਇਸ ਦੇ ਧਾਰਮਿਕ ਸੰਦੇਸ਼ ਦੀ ਅੰਦਰਲੀ ਸਾਰਥਿਕਤਾ ਮੱਧਮ ਪੈ ਚੁੱਕੀ ਸੀ।”⁴ ਇਕ ਧਾਰਮਿਕ ਡਰ ਹੈ ਜਿਸ ਨੂੰ ਮਨੁੱਖ ਚੋਰੀ ਤੇ ਝੂਠ ਨਾਲ ਭੋਗਣ ਦਾ ਇੱਛੁਕ ਰਹਿੰਦਾ ਹੈ ਤੇ ਇਸ ਦਾ ਭੋਗ ਮਨੁੱਖ ਨੂੰ ਪਾਪ ਦਾ ਅਹਿਸਾਸ ਕਰਾਉਂਦਾ ਹੈ।

‘ਨਾਦ-ਬਿੰਦ’ ਨਾਵਲ ਨੂੰ ਦਮਨ ਦੇ ਸੰਕਲਪ ਦੀ ਪ੍ਰਕਿਰਤੀ ਰਾਹੀਂ ਸਮਝਿਆ ਜਾ ਸਕਦਾ ਹੈ। ਇਸੇ ਸੰਦਰਭ ਵਿਚ ਰੱਖ ਕੇ ਨਾਵਲਕਾਰ ਨੇ ਸੰਪੂਰਨ ਬਿਰਤਾਂਤ ਨੂੰ ਉਸਾਰਿਆ ਹੈ। ਨਾਵਲ ਵਿਚ ਦਮਨ ਤਿੰਨ ਧਰਾਤਲਾਂ ਤੇ ਵਾਪਰਦਾ ਹੈ। ਸਭ ਤੋਂ ਪਹਿਲਾਂ ਰੰਗੀ ਨਾਥ ਨਕਸਲਵਾਦੀ ਲਹਿਰ ਨਾਲ ਜੁੜਿਆ ਕਾਰਕੁੰਨ ਹੈ। ਇਹ ਤੱਥ ਭਲੀਭਾਂਤ ਸਪਸ਼ਟ ਹੈ ਕਿ ਮਾਰਕਸਵਾਦੀਆਂ ਤੇ ਨਕਸਲਵਾਦੀਆਂ ਤੇ ਹਰ ਤਰ੍ਹਾਂ ਦਾ ਤਸੱਦਦ ਹੋਇਆ ਹੈ। ਇਹ ਤਸੱਦਦ ਮੂਲ ਸਮੱਸਿਆ ਨੂੰ ਜਨਮ ਦਿੰਦਾ ਹੈ। “ਰਾਜ ਕੋਲ ਦਮਨ ਦੇ ਕਈ ਤਰੀਕੇ ਹੁੰਦੇ ਹਨ, ਜਿਵੇਂ ਫੌਜ, ਪੁਲਿਸ, ਅਦਾਲਤਾਂ ਆਦਿ ਰਾਜ ਦੇ ਦਮਨਕਾਰੀ ਸੰਦ ਹਨ। ਇਸ ਤੋਂ ਇਲਾਵਾ ਰਾਜ ਕੋਲ ਕੁਝ ਵਿਚਾਰਧਾਰਕ ਸੰਦ ਵੀ ਹੁੰਦੇ ਹਨ, ਜਿਵੇਂ ਸਕੂਲ, ਕਾਲਜ, ਫਿਲਮਾਂ, ਮੀਡੀਆ, ਯੂਨੀਵਰਸਿਟੀਆਂ ਤੇ ਅਖਬਾਰ ਆਦਿ।”⁵ ਰੰਗੀ ਵੀ ਤਸੱਦਦ ਨੂੰ ਨਾ ਝੱਲਦਾ ਹੋਇਆ ਕੋਈ ਖੁਫ਼ੀਆ ਟਿਕਾਣਾ ਮਿਲਣ ਉਪਰੰਤ ਲਹਿਰ ਨਾਲੋਂ ਟੁੱਟ ਜਾਂਦਾ ਹੈ। ਇੱਥੇ ਸੱਤਾ ਤੇ ਬੁਰਜ਼ੂਆ ਵਰਗ ਦੁਆਰਾ ਦਮਿਤ ਤੇ ਨਿਤਾਣੇ ਵਰਗ ਤੇ ਕੀਤੇ ਦਮਨ ਰਾਹੀਂ ਨਾਵਲੀ ਸਮੱਸਿਆ ਦੇ ਆਰੰਭ ਹੋਣ ਦੀ ਕਹਾਣੀ ਨੂੰ ਸਮਝਿਆ ਜਾ ਸਕਦਾ ਹੈ। ਦੂਸਰਾ ਯੋਗ ਦਰਸ਼ਨ ਜਿਸ ਤਰ੍ਹਾਂ ਦੇ ਜੀਵਨ-ਵਿਹਾਰ ਦੀ ਸਿੱਖਿਆ ਦਿੰਦਾ ਹੈ ਉਹ ਇਕ ਯੋਗੀ ਲਈ ਨਾਦ ਤੇ ਬਿੰਦ ਦੇ ਨਿਯੰਤਰਨ ਰਾਹੀਂ ਦਮਨ ਦੀ ਪ੍ਰਵਿਰਤੀ ਸਮਾਨ ਹੀ ਜੀਵਨ ਵਿਚ ਕਾਰਜਸ਼ੀਲ ਰਹਿੰਦੀ ਹੈ। ਪ੍ਰਕਿਰਤਿਕ ਇੱਛਾਵਾਂ ਦਾ ਦਮਨ ਕਰਾਉਣ ਵਾਲਾ ਇਹ ਦਰਸ਼ਨ ਨਾਵਲੀ ਪਾਤਰ ਤੇ ਸਮਾਜ ਲਈ ਸਮੱਸਿਆ ਬਣਦਾ ਹੈ। “ਧਨ, ਜੋਬਨ, ਕਾਮਨੀ ਨਿਰੰਤਰ ਪਰਿਵਰਤਨਸ਼ੀਲ ਜੀਵਨ ਦੇ ਸੂਚਕ ਹਨ। ਧਨ, ਜਵਾਨੀ, ਇਸਤਰੀ ਦਾ ਅਜਿਹਾ ਨਿਰੰਕੁਸ਼ ਤਿਆਗ ਅਸਲ ਵਿਚ ਜੀਵਨ ਤੇ ਇਹ ਪ੍ਰੇਰਨਾ ਗੋਰਖ ਨਾਥ ਜੀ ਦੀ ਬਾਣੀ ਦੀ ਪ੍ਰਧਾਨ ਸੁਰ ਹੈ।”⁶ ਦਮਨ ਮਨੁੱਖ ਦੇ ਪ੍ਰਕਿਰਤਿਕ ਵਿਕਾਸ ਵਿਚ ਅੜਚਣ ਤੇ ਕਈ ਮਾਨਸਿਕ ਗੁੰਝਲਾਂ ਦਾ ਉਤਪਾਦਕ ਹੈ। ਯੋਗ ਵਿਚ ਜਿਹੜਾ ਦਮਨ ਦਾ ਪ੍ਰਤੀਬੰਧ ਲਗਾਇਆ ਗਿਆ ਹੈ ਪਾਤਰ ਉਸ ਤੋਂ ਵਿਮੁਖ ਹੁੰਦੇ ਨਜ਼ਰ ਆਉਂਦੇ ਹਨ। ਦਮਨ ਯੋਗ ਦੀ ਕੱਟੜਤਾ ਦਾ ਮੂਲ ਕਾਰਕ ਬਣਦਾ ਹੈ।

ਪੰਜਾਬ ਵਿਚ ਮਾਰਕਸਵਾਦੀ ਜਾਂ ਨਕਸਲਵਾਦੀ ਲਹਿਰ ਦੇ ਕਹਿਰ ਕਾਰਨ ਕਈ ਪਰਿਵਾਰ ਉੱਜੜੇ ਸਨ। ਇਸ ਲਹਿਰ ਨੂੰ ਆਧਾਰ ਬਣਾ ਕੇ ਬਹੁਤ ਸਾਰਾ ਸਾਹਿਤ ਰਚਿਆ ਗਿਆ ਹੈ। ਸਾਹਿਤ ਦੀਆਂ ਸਾਰੀਆਂ ਵਿਧਾਵਾਂ ਵਿਚ ਇਸ ਲਹਿਰ ਦੀਆਂ ਕਾਰਵਾਈਆਂ ਦੇ ਨਾਲ ਇਕ ਸਾਂਝਾ ਤੱਤ ਇਨ੍ਹਾਂ ਦੀ ਹੋਣੀ ਦੀ ਕਥਾ ਨੂੰ ਪੇਸ਼ ਕਰਨਾ ਵੀ ਰਿਹਾ ਹੈ। ਹੱਕਾਂ ਤੇ ਇਨਕਲਾਬ ਦੀ ਪ੍ਰਾਪਤੀ ਲਈ ਉੱਠੀ ਇਹ ਲਹਿਰ ਸਮੇਂ ਦੀ ਸਿਆਸਤ ਤੇ ਬੁਰਜ਼ੂਆ ਵਰਗ ਦੇ ਵਿਰੋਧ ਕਰਕੇ ਦਬਾਅ ਦਿੱਤੀ ਗਈ। ਤਸੱਦਦ ਦਾ ਫਲਸਫ਼ਾ ਪੂਰੀ ਤਰ੍ਹਾਂ ਅਮਲ ਵਿਚ ਲਿਆਉਂਦਾ ਗਿਆ। “ਸਾਹਿਤਕ ਰਚਨਾ ਦੇ ਵਸਤੂ ਅਤੇ ਸਮੂਹਕ ਚੇਤਨਾ ਵਿਚ ਸੰਬੰਧ ਦੀ ਵਿਗਿਆਨਕ ਪੁਣਛਾਣ ਗੋਲਡਮਾਨ ਨੇ ਕੀਤੀ। ਉਸ ਨੇ ਸਾਹਿਤਕ ਰਚਨਾ ਵਿਚ ਪੇਸ਼ ਚੇਤਨਾ ਦਾ ਸਮਾਜਕ ਜੜਾਂ ਦੀ ਤਲਾਸ਼ ਵਲ ਧਿਆਨ ਦੁਆਇਆ। ਸਾਹਿਤਕ ਰਚਨਾ ਵਿਚਲੀ ਚੇਤਨਾ ਦੀ ਹਰ ਸੰਰਚਨਾ ਦੀ ਜੜ ਕਿਸੇ ਸਮਾਜਕ ਵਰਗ ਦੀ ਚੇਤਨਾ ਦੀ ਕੋਈ ਸੰਰਚਨਾ ਹੁੰਦੀ ਹੈ। ਸਾਹਿਤਕ ਰਚਨਾ ਆਪਣੇ ਰਚਨਾਕਾਰ ਦੇ ਵਿਚਾਰਾਂ ਤੇ ਭਾਵਾਂ ਨੂੰ ਤਾਂ ਪੇਸ਼ ਕਰਦੀ ਹੈ ਪਰ ਸਾਨੂੰ ਇਹ ਨਹੀਂ ਭੁੱਲਣਾ ਚਾਹੀਦਾ ਕਿ ਲੇਖਕ ਦੇ ਵਿਚਾਰ ਅਤੇ ਭਾਵ ਉਸ ਦੇ ਆਪਣੇ ਵਰਗ ਦੇ ਦੂਜੇ ਲੋਕਾਂ ਦੇ ਵਿਚਾਰਾਂ, ਚਿੰਤਨ ਤੇ ਵਿਹਾਰ ਅਨੁਸਾਰ ਬਣਦੇ ਵਿਗੜਦੇ ਵੀ ਹਨ।”⁷ ਨਾਵਲ ਵੀ ਇਸੇ ਤਸੱਦਦ ਦੀ ਦਾਸਤਾ ਦੇ ਸੰਦਰਭ ਵਿਚ ਸ਼ੁਰੂ ਹੁੰਦਾ ਹੈ। ਰੰਗੀ ਜੋ ਕਿ ਲੁਕਾਈ ਦੇ ਹੱਕਾਂ ਲਈ ਕਾਰਜਸ਼ੀਲ ਸੀ। ਪਰ ਪੁਲਿਸ ਤੇ ਫਿਰ ਤਸੀਹਾ ਕੇਂਦਰ ਵਿਚ ਅਨੇਕਾਂ ਤਸੀਹੇ ਝੱਲਣ ਉਪਰੰਤ ਆਪਣੀ ਜਾਨ ਬਚਾਉਣ ਲਈ ਉਹ ਭੱਜ ਨਿਕਲਿਆ ਸੀ। ਰੰਗੀ ਭਾਵੇਂ ਰਸਤੇ ਤੋਂ ਭਟਕ ਜਾਂਦਾ ਹੈ ਪਰ ਨਾਵਲਕਾਰ ਇਹ ਦ੍ਰਿੜ੍ਹ ਕਰਦਾ ਹੈ ਕਿ ਸੰਘਰਸ਼ਸ਼ੀਲ ਤੇ ਇਨਕਲਾਬੀ ਫਲਸਫ਼ਾ ਹੀ ਮਨੁੱਖ ਦੇ ਵਿਕਾਸ ਵਿਚ ਕਾਰਜਸ਼ੀਲ ਹੋ ਸਕਦਾ ਹੈ। ਯਥਾਰਥ ਨੂੰ ਵੇਖਣਾ ਤੇ ਸਮਝਣਾ ਮਨੁੱਖ ਦਾ ਪਹਿਲਾਂ ਗਿਆਨਮਈ ਕਾਰਜ ਹੈ। ਮਾਰਕਸਵਾਦੀ ਫਲਸਫ਼ਾ ਮਨੁੱਖ ਨੂੰ ਚਿੰਤਨਸ਼ੀਲ ਤੇ ਸਮਾਜ ਦੇ ਪੈਦਾਵਾਰੀ ਸਾਧਨਾਂ ਤੇ ਪੈਦਾਵਾਰੀ ਤਾਕਤਾਂ ਦੀ ਮਾਲਕੀ ਤੇ ਕਿਰਤ ਦੀ ਦੁਰਵਰਤੋਂ ਤੋਂ ਜਾਣੂ ਕਰਾਉਣ ਵਾਲਾ ਸਮਾਜਕ ਫਲਸਫ਼ਾ ਹੈ। ਇਸ ਲਈ ਨਾਵਲ ਦਾ ਪਾਤਰ ਭਾਵੇਂ ਆਰੰਭ ਵਿਚ ਇਸ ਦਰਸ਼ਨ ਤੋਂ ਕਿਨਾਰਾ ਕਰ ਲੈਂਦਾ ਹੈ ਪਰ ਯੋਗ ਤੇ ਭੋਗ ਉਪਰੰਤ ਉਹ ਫਿਰ ਤੋਂ ਇੱਛਾ ਕਰਦਾ ਕੇ ਉਹ ਵਾਪਸ ਉਸ ਲਹਿਰ ਨਾਲ ਜੁੜੇ ਤਾਂ ਕਿ ਸਾਰਿਆਂ ਨੂੰ ਮੁੱਢਲੀਆਂ ਸਹੂਲਤਾਂ ਤਾਂ ਘੱਟੋ-ਘੱਟ ਪ੍ਰਾਪਤ ਹੋਣ। ਮਾਰਕਸਵਾਦੀ ਦਰਸ਼ਨ ਦੀ ਭਾਰਤ ਵਿਚ ਲੋੜ ਨੂੰ ਇਹ ਨਾਵਲ ਦ੍ਰਿੜ੍ਹ ਕਰਦਾ ਹੈ।

ਨਾਵਲ ਦਾ ਮੁੱਖ ਦਾਰਸ਼ਨਿਕ ਸੰਦਰਭ ਤਾਂ ਬੇਸ਼ੱਕ ਮਾਰਕਸਵਾਦ ਦੀ ਅਹਿਮੀਅਤ ਤੇ ਲੋੜ ਨੂੰ ਦ੍ਰਿੜ੍ਹ ਕਰਾਉਣਾ ਹੈ। ਇਸ ਦ੍ਰਿੜ੍ਹਤਾ ਲਈ ਜੋਗ ਦਰਸ਼ਨ ਦੇ ਸੰਕਲਪਾਂ ਤੇ ਵਿਹਾਰਕਤਾ ਨੂੰ ਅਧਾਰ ਬਣਾ ਕੇ ਦੇਵਾਂ ਦੀ ਸਾਰਥਿਕਤਾ ਨੂੰ ਉਭਾਰਿਆ ਗਿਆ ਹੈ। ਨਾਵਲਕਾਰ ਦ੍ਰਿੜ੍ਹ ਕਰਾਉਂਦਾ ਹੈ ਕਿ ਜਿਹੜੇ ਸੰਕਲਪ ਜੋਗ ਮੱਤ ਦੀ ਦੇਣ ਹਨ ਯੋਗੀ ਉਨ੍ਹਾਂ ਨੂੰ ਅਮਲ ਵਿਚ ਲਿਆਉਣ ਵਿਚ ਅਜੇ ਕਿੰਨੇ ਦੂਰ ਹਨ। ਯੋਗੀ ਹੋਣ ਦੇ ਭਰਮ ਨੂੰ ਪਾਲ ਕੇ ਉਨ੍ਹਾਂ ਧਾਰਮਿਕ ਤੇ ਦਾਰਸ਼ਨਿਕ ਵਾਤਾਵਰਣ ਉਸਾਰਿਆ ਹੋਇਆ ਹੈ। ਡੇਰੇ ਦੇ ਮੁੱਖ ਪੀਰ ਸੁਗੰਧੀ ਨਾਥ ਦਾ ਹਰ ਵੇਲੇ

ਸੁਲਫੇ ਸੂਟੇ ਦੀ ਲੋਰ ਵਿਚ ਰਹਿਣਾ ਤੇ ਇਸੇ ਅਵਸਥਾ ਵਿਚ ਉਸਨੂੰ ਅਨਹਦ ਨਾਦ ਸੁਣਾਈ ਦੇਣ ਦਾ ਭਰਮ ਪਾਲਣਾ ਤੇ ਪਿੰਡ ਦੇ ਲੋਕਾਂ ਵਿਚ ਝੂਠੀ ਆਸਥਾ ਬਣਾਈ ਰੱਖਣੀ ਪਰ ਨੂਰਾਂ ਨੂੰ ਵੇਖ ਕੇ ਉਸ ਉੱਪਰ ਮੋਹਿਤ ਹੋਣਾ ਇਕ ਯੋਗੀ ਦੇ ਸਿਧਾਂਤਕ ਤੇ ਵਿਹਾਰਕ ਅਸਾਵੇਂਪਣ ਨੂੰ ਦ੍ਰਿੜ੍ਹ ਕਰਦੇ ਨੁਕਤੇ ਹਨ। ਗੁਰਮਤਿ ਵਿਚ ਵੀ ਇਸ ਫਲਸਫੇ ਦੇ ਦੰਭੀ ਵਿਹਾਰਕ ਹਨ ਦਾ ਗੁਰੂ ਨਾਨਕ ਸਾਹਿਬ ਵਿਰੋਧ ਕਰਦੇ ਹਨ।

ਸਤਿਗੁਰ ਕੈ ਜਨਮੈ ਗਵਨੁ ਮਿਟਾਇਆ, ਅਨਹਤ ਰਾਤੇ ਇਹੁ ਮਨੁ ਲਾਇ ॥

ਮਨਸਾ ਆਸਾ ਸਬਦਿ ਜਲਾਈ, ਗੁਰਮੁਖਿ ਜੋਤਿ ਨਿਰੰਤਰਿ ਪਾਈ ॥

ਤ੍ਰੈ ਗੁਣ ਮੇਟੇ ਖਾਈਐ ਸਾਰੁ, ਨਾਨਕ ਤਾਰੇ ਤਾਰਣਹਾਰੁ ॥⁸

ਇਸ ਨਾਵਲ ਵਿਚ ਜੋਗਿੰਦਰ ਕੈਰੋ ਨੇ ਆਲੋਚਨਾਤਮਿਕ ਤੇ ਖੋਜ ਰਾਹੀਂ ਡੇਰੇ ਦੇ ਸਭਿਆਚਾਰ ਦਾ ਅਧਿਐਨ ਕੀਤਾ ਤੇ ਦਾਰਸ਼ਨਿਕ ਸੰਕਲਪਾਂ ਤੇ ਫਲਸਫੇ ਦੀ ਸਿਧਾਂਤਕ ਪੇਸ਼ਕਾਰੀ ਉਪਰੰਤ ਯੋਗੀਆਂ ਦੀ ਵਿਹਾਰਕਤਾ ਨੂੰ ਪਰਖਿਆ ਉਹ ਸੱਚਮੁੱਚ ਸਾਹਿਤ ਤੇ ਪੰਜਾਬੀ ਪਾਠਕ ਲਈ ਉਸਾਰੂ ਕਾਰਜ ਹੈ।

ਸੰਸਾਰ ਦਾ ਹਰ ਦਰਸ਼ਨ, ਧਰਮ, ਸਮਾਜ-ਸ਼ਾਸਤਰ, ਨੀਤੀ ਸ਼ਾਸਤਰ ਮਨੁੱਖ ਨੂੰ ਭੋਗਾਂ ਤੋਂ ਅਵੱਸ਼ ਵਰਜਦਾ ਹੈ। ਮਨੁੱਖ ਹਰ ਸ਼ੈਲੀ ਦਾ ਭੋਗ ਕਰਨ ਦੀ ਲਾਲਸਾ ਰੱਖਦਾ ਹੈ। ਨਾਵਲ ਮਨੁੱਖੀ ਮਾਨਸਿਕਤਾ ਦੀ ਭੋਗ ਤੋਂ ਪਹਿਲਾਂ ਤੇ ਉਪਰੰਤ ਦੀ ਸਥਿਤੀ ਦੀ ਦਾਰਸ਼ਨਿਕ ਵਿਆਖਿਆ ਵਿਸ਼ਲੇਸ਼ਣ ਕਰਦਾ ਹੈ। “ਮਨੁੱਖ ਅਸ਼ਰਫ਼ੁਲ ਮਖਲੂਕਾਤ ਹੋਣ ਦੇ ਬਾਵਜੂਦ ਸੀਮਤ ਚੇਤਨਾ ਵਾਲ ਪ੍ਰਾਣੀ ਹੈ। ਚੇਤਨਾ ਦੀਆਂ ਸੀਮਾਵਾਂ ਕਾਰਨ ਉਸਨੂੰ ਸਮੁੱਚਤਾ ਜਾਂ ਇਕਸੁਰਤਾ ਦੀ ਭਾਲ ਸੁਪਨਿਆਂ ਦੀ ਚੜ੍ਹਤਲ ਦੇ ਪਲਾਂ ਵਿੱਚ ਸੰਭਵ ਦੇ ਘੇਰੇ ਦੀ ਵਸਤੂ ਪ੍ਰਤੀਤ ਹੁੰਦੀ ਹੈ। ਪਰ ਇਸ ਤਲਾਸ਼ ਵਿਚ ਜਦੋਂ ਉਸਦਾ ਵਾਹ ਪ੍ਰਸਥਿਤੀਆਂ ਦੀ ਕਠੋਰਤਾ ਤੇ ਜਟਿਲਤਾ ਨਾਲ ਪੈਦਾ ਹੈ ਤੇ ਸੁਪਨੇ ਹੌਲੀ ਹੌਲੀ ਤਿੜਕਣ ਲੱਗ ਪੈਂਦੇ ਹਨ, ਜੋ ਉਸਨੂੰ ਸਮੂਹੀਅਤ ਦੇ ਮੰਡਲ ਵਿਚੋਂ ਚਿੰਤਨ ਦੇ ਮੰਡਲ ਵਿੱਚ ਲੈ ਆਉਂਦੇ ਹਨ।”⁹ ਯੋਗ ਮਨੁੱਖ ਨੂੰ ਭੋਗ ਤੋਂ ਪੂਰਨ ਰੂਪ ਵਿਚ ਰੋਕਦਾ ਹੈ। ਪਰ ਮਨੁੱਖ ਪ੍ਰਕਿਰਤਿਕ ਭੋਗ ਦੀ ਇੱਛਾ ਨੂੰ ਬਹੁਤੀ ਦੇਰ ਤਕ ਰੋਕ ਨਹੀਂ ਸਕਦਾ। ਵਰਜਿਤ ਫਲ ਦੀ ਇੱਛਾ ਹਮੇਸ਼ਾ ਬਣੀ ਰਹਿੰਦੀ ਹੈ। ਇਸ ਮਾਨਸਿਕ ਸੰਸਕਾਰ ਤੋਂ ਮਨੁੱਖ ਮੁਕਤ ਨਹੀਂ ਹੋ ਸਕਦਾ। ਰੰਗੀ ਦਾ ਭੋਗ ਵਿਚ ਖਪਿਤ ਹੋਣਾ ਉਸਨੂੰ ਭੋਗ ਤੋਂ ਵੀ ਨਿਰਲੇਪ ਕਰ ਦਿੰਦਾ ਹੈ। ਉਹ ਨਿਰੰਤਰ ਭੋਗ ਤੋਂ ਅੱਕ ਜਾਂਦਾ ਹੈ। ਨਿਯੰਤਰਤਾ ਦੀ ਸੀਮਾ ਨੂੰ ਉਲੰਘਣਾ ਘਾਤਕ ਹੁੰਦਾ ਹੈ। ਅੰਗਰੇਜ਼ੀ ਕਹਾਵਤ Excess of anything is dangerous. ਇਸ ਪਹਿਲੂ ਦੀ ਪੁਸ਼ਟੀ ਕਰਦੀ ਹੈ। ਭੋਗ ਮਨੁੱਖ ਨੂੰ ਆਪਣੇ ਵਲ ਉਕਸਾਉਂਦਾ ਜ਼ਰੂਰ ਹੈ ਪਰ ਮਨੁੱਖ ਦੀ ਮਾਨਸਿਕਤਾ ਵਰਜਿਤ ਭੋਗ ਤੋਂ ਉਪਰੰਤ ਪਾਪ ਦਾ ਅਹਿਸਾਸ ਕਰਨ ਲੱਗ ਜਾਂਦੀ ਹੈ। ਲਾਲਸਾ ਤੇ ਮੋਹ ਮਨੁੱਖ ਦੇ ਵਿਕਾਰ ਦਾ ਵੱਡਾ ਕਾਰਨ ਬਣਦੇ ਹਨ।

ਦਰਸ਼ਨ ਦਾ ਮੁੱਖ ਪ੍ਰਯੋਜਨ ਮੁਕਤੀ ਹੈ। ਮੁਕਤੀ ਗਿਆਨ ਰਾਹੀਂ ਸੰਭਵ ਹੈ। ਦਾਰਸ਼ਨਿਕ ਗਿਆਨ ਲਈ ਨਿੱਜੀ ਯਤਨ ਲੋੜੀਂਦੇ ਹਨ। ਭਾਰਤੀ ਦਰਸ਼ਨ ਦੇ ਪ੍ਰਸੰਗ ਵਿਚ ਮੁਕਤੀ ਨੂੰ ਧਾਰਮਿਕ ਦਾਰਸ਼ਨਿਕ ਅਰਥਾਂ ਦੇ ਪ੍ਰਸੰਗ ਵਿਚ ਵਿਚਾਰਿਆ ਜਾ ਸਕਦਾ ਹੈ। ਰਹੱਸਮਈ ਅਵਸਥਾ ਦੀ ਪ੍ਰਾਪਤੀ ਦੀ ਗੱਲ ਭਾਰਤੀ ਦਰਸ਼ਨ ਦੇ ਸਾਰੇ ਸਕੂਲ(ਵੇਦਾਂਤ, ਯੋਗ, ਸਾਂਖ, ਗੀਤਾ, ਨਿਆਇ) ਕਰਦੇ ਹਨ। ਨਾਵਲ ਦਾ ਆਧਾਰ ਬਣੇ ਦਰਸ਼ਨ ਵੀ ਮਨੁੱਖੀ ਤੇ ਸਮਾਜਿਕ ਮੁਕਤੀ ਦੀ ਗੱਲ ਕਰਦੇ ਹਨ। ਨਾਵਲ ਦਾ ਦਾਰਸ਼ਨਿਕ ਸੰਦਰਭ ਹੀ ਮੁਕਤੀ ਵਿਚ ਨਿਹਿਤ ਹੈ। ਮਾਰਕਸਵਾਦੀ ਦਰਸ਼ਨ ਬੁਰਜ਼ੂਆ ਵਰਗ ਦੇ ਫਲਸਫੇ ਤੋਂ ਮੁਕਤੀ ਪ੍ਰਾਪਤ ਕਰਨ ਹਿਤ ਇਨਕਲਾਬ ਨੂੰ ਵਿੱਢਦਾ ਹੈ। ਮਾਰਕਸਵਾਦ ਸਮਾਜ ਵਿਚ ਜੋ ਕੁਝ ਵੀ ਅਸਾਂਝਾ ਹੈ ਉਸ ਸਭ ਤੋਂ ਮੁਕਤ ਕਰਾਉਣ ਦਾ ਫਲਸਫਾ ਹੈ। ਯੋਗ ਦਰਸ਼ਨ ਦੁਨਿਆਵੀ ਇੱਛਾਵਾਂ ਤੋਂ ਮੁਕਤ ਹੋਣ ਦਾ ਫਲਸਫਾ ਹੈ। ਦੁਨਿਆਵਾਰੀ ਤੋਂ ਉੱਪਰ ਉੱਠ ਕੇ ਦਸਵੇਂ ਦੁਆਰ ਵਿਚ ਧਿਆਨ ਨੂੰ ਟਿਕਾ ਕੇ ਪਰਮਾਤਮਾ ਨੂੰ ਪ੍ਰਾਪਤ ਕਰਨਾ ਹੀ ਇਸ ਦਰਸ਼ਨ ਦਾ ਮੂਲ ਮਨੋਰਥ ਹੈ। ਇਸ ਮੁਕਤੀ ਲਈ ਮਨੁੱਖ ਦੇ ਨਿੱਜੀ ਯਤਨ ਅਤਿ ਲੋੜੀਂਦੇ ਹਨ। ਤੀਸਰਾ ਭੋਗੀ ਬਿਰਤੀਆਂ ਤੋਂ ਮਨੁੱਖੀ ਮੁਕਤੀ ਦੇ ਸੰਦਰਭ ਵਿਚ ਨਾਵਲ ਦਾ ਆਖਰੀ ਕਾਂਡ ਉਸਾਰਿਆ ਗਿਆ ਹੈ। ਮਨੁੱਖ ਦੀ ਭੋਗੀ ਬਿਰਤੀ ਉਸਦੇ ਵਿਅਕਤੀਗਤ ਵਿਕਾਸ ਦੇ ਨਾਲ ਸਮਾਜ ਤੇ ਜ਼ਿੰਦਗੀ ਦੇ ਅਸਲੀ ਮਨੋਰਥ ਤੋਂ ਵੀ ਉਸਨੂੰ ਭਟਕਾ ਦਿੰਦੀ ਹੈ। ਭੋਗੀ ਬਿਰਤੀਆਂ ਵਿਚ ਖਚਿਤ ਹੋਣਾ ਤੇ ਇਸਦੇ ਬੰਧਨ ਤੋਂ ਮੁਕਤ ਹੋਣ ਦੀ ਗੱਲ ਨਾਵਲ ਦੀ ਸੰਰਚਨਾ ਵਿਚ ਪਈ ਹੈ। ਮੁਕਤੀ ਹੀ ਮਨੁੱਖ ਦੇ ਜੀਵਨ ਦਾ ਮੂਲ ਮਨੋਰਥ ਹੈ ਤੇ ਦਰਸ਼ਨ ਤੇ ਨਾਵਲ ਦਾ ਆਧਾਰ ਬਣੇ ਵਿਭਿੰਨ ਵਰਤਾਰੇ ਮਨੁੱਖੀ ਬੰਧਨਾਂ ਦੀਆਂ ਅਨੇਕ ਗੁੰਝਲਾਂ ਨੂੰ ਮੂਰਤੀਮਾਨ ਕਰਦੇ ਹਨ।

‘ਨਾਦ ਬਿੰਦ’ ਨਾਵਲ ਦਾ ਦਾਰਸ਼ਨਿਕ ਸੰਦਰਭ ਯਥਾਰਥਵਾਦੀ ਫਲਸਫੇ ਦੀ ਲੋੜ ਤੇ ਮਹੱਤਤਾ ਵਿਚ ਨਿਹਿਤ ਹੈ। ਨਾਵਲਕਾਰ ਪਦਾਰਥਵਾਦੀ ਫਲਸਫੇ ਰਾਹੀਂ ਸਮਾਜ ਨੂੰ ਸਮਝਣ ਤੇ ਬਦਲਣ ਦੀ ਗੱਲ ਕਰਦਾ ਹੈ। “ਜਦੋਂ ਕਲਾ ਵਿਚ ਸਚਾਈ ਦੀ ਗੱਲ ਚਲਦੀ ਹੈ ਤਾਂ ਇਹ ਕਹਿਣਾ ਉਚਿਤ ਪ੍ਰਤੀਤ ਹੁੰਦਾ ਹੈ ਕਿ ਕਲਾ ਦਾ ਪ੍ਰਭਾਵ ਉਦੋਂ ਹੀ ਗਹਿਰਾ ਹੁੰਦਾ ਹੈ, ਜਦੋਂ ਇਸ ਦੁਆਰਾ ਸੱਚਾਈ ਦੀ ਸਪਸ਼ਟ ਤਸਵੀਰ ਪ੍ਰਤੱਖ ਹੋ ਜਾਏ। ਲੋਕਾਂ ਦੀਆਂ ਨਜ਼ਰਾਂ ਵਿਚ ਯਥਾਰਥ ਉਦੋਂ ਹੀ ਪ੍ਰਤੱਖ ਹੋਏਗਾ, ਜਦੋਂ ਕਲਾ ਵਿਚ ਅਸਲੀਅਤ ਪ੍ਰਤੀਬਿੰਬਤ ਹੋਏਗੀ।”¹⁰ ਇਸ

ਅਮਲ ਵਿਚ ਨਾਵਲ ਭਾਰਤੀਆਂ ਤੇ ਖਾਸ ਕਰ ਪੰਜਾਬੀ ਸਮਾਜ ਦੀ ਪਿਛਾਹ-ਖਿੱਚੂ ਬਿਰਤੀਆਂ, ਰੀਤੀਆਂ, ਜ਼ਿੰਮੀਂਦਾਰ ਵਰਗ ਦੀਆਂ ਵਧੀਕੀਆਂ, ਪੇਡੂ ਸਮਾਜ ਦੀਆਂ ਅਲਾਮਤਾਂ ਆਦਿ ਪਹਿਲੂਆਂ ਨੂੰ ਅਗਰ ਸਰ ਕਰਦਾ ਹੋਇਆ ਇਸ ਫਲਸਫੇ ਨੂੰ ਅਪਣਾਉਣ ਦਾ ਸੰਕੇਤ ਕਰਦਾ ਹੈ।" ਪੰਜਾਬੀ ਨਾਵਲ ਨੇ ਮਨੁੱਖੀ ਜੀਵਨ ਦਾ ਯਥਾਰਥ ਚਿਤਰਨ ਵਿਭਿੰਨ ਵਿਧੀਆਂ ਰਾਹੀਂ ਕਰਨ ਦਾ ਯਤਨ ਕੀਤਾ ਹੈ। ਨਾਵਲ ਵਰਤਮਾਨ ਸਾਹਿਤ ਦਾ ਇਕ ਹਰਮਨ ਪਿਆਰਾ ਰੂਪ ਹੈ। ਅਜੋਕਾ ਨਾਵਲਕਾਰ, ਇਕ ਸੁਚੱਜੇ ਵਿਗਿਆਨੀ ਵਾਂਗ ਨਵੀਨ ਜੀਵਨ ਪਰਿਸਥਿਤੀਆਂ ਨੂੰ ਯਥਾਰਥਕ ਦ੍ਰਿਸ਼ਟੀ ਰਾਹੀਂ ਚਿਤਰਨ ਦਾ ਯਤਨ ਕਰ ਰਿਹਾ ਹੈ। ਨਾਵਲ ਸਾਹਿਤ ਦਾ ਹੀ ਇਕ ਅਜਿਹਾ ਰੂਪ ਹੈ, ਜਿਸ ਵਿਚ ਜੀਵਨ ਦੀਆਂ ਜਟਿਲ ਸਮੱਸਿਆਵਾਂ ਨੂੰ ਭਰਵੇਂ ਰੂਪ ਵਿਚ ਚਿਤਰਨਾ ਸੰਭਵ ਹੈ। ਨਾਵਲ ਵਿਚ ਯਥਾਰਥ ਚਿਤਰਨ ਆਪਣੇ ਆਪ ਵਿਚ ਗਲਪ ਬੋਧ ਦੀ ਵਿਧੀ ਹੈ ਜੋ ਮਨੁੱਖੀ ਜੀਵਨ ਵਾਂਗ ਅਤਿ ਡੂੰਘੀ ਅਤੇ ਗੰਭੀਰ ਭਾਵ ਵਾਲੀ ਹੁੰਦੀ ਹੈ।" ¹¹ ਯਥਾਰਥ ਤੇ ਪਰਮਾਰਥ ਦੀ ਟੱਕਰ ਨੂੰ ਪੇਸ਼ ਕਰਦਿਆਂ ਯਥਾਰਥ ਦੀ ਜਿੱਤ ਨਾਵਲ ਦਾ ਕੇਂਦਰੀ ਥੀਮ ਬਣਦੀ ਹੈ। ਪਰਮਾਰਥ ਦੀ ਅਵਸਥਾ ਰੰਗੀ ਤੇ ਸੁਗੰਧ ਨਾਥ ਵਰਗੇ ਐਫ਼ੜ ਕਦੇ ਵੀ ਪ੍ਰਾਪਤ ਨਹੀਂ ਕਰ ਸਕਦੇ ਹਨ। ਯੋਗ ਦਰਸ਼ਨ ਪਰਮਾਰਥ ਰਾਹੀਂ ਚਮਤਕਾਰ ਤੇ ਗੈਬੀ ਸ਼ਕਤੀਆਂ ਦੀ ਪ੍ਰਾਪਤੀ ਦਾ ਸਵਪਨ ਯੋਗੀਆਂ ਅੱਗੇ ਉਸਾਰਦਾ ਹੈ। ਯਥਾਰਥ ਨੂੰ ਅੰਤਿਮ ਸੱਚ ਦੱਸਦਿਆਂ ਨਾਵਲੀ ਸਰੋਕਾਰ ਹੱਲ ਵਲ ਵਧਦੇ ਹਨ।

ਨਿੱਜ ਨੂੰ ਕੇਂਦਰ ਵਿਚ ਰੱਖਣ ਵਾਲਾ ਕੋਈ ਵੀ ਵਰਤਾਰਾ ਨਾ ਤਾਂ ਖੁਦ ਵਿਕਾਸ ਕਰ ਸਕਦਾ ਹੈ ਤੇ ਨਾ ਹੀ ਕਿਸੇ ਹੋਰ ਦੇ ਵਿਕਾਸ ਵਿਚ ਸਹਾਈ ਹੋ ਸਕਦਾ ਹੈ। ਇਹ ਨਾਵਲ ਇਸ ਸੰਦਰਭ ਵਿਚ ਕਥਾ ਨੂੰ ਉਸਾਰਦਾ ਹੈ। ਇਸੇ ਕਾਰਨ ਨਾਵਲਕਾਰ ਕੇਵਲ ਮਾਰਕਸ ਦੇ ਫਲਸਫੇ ਦੀ ਪ੍ਰੋਤ੍ਯੁਤਾ ਕਰਦਾ ਵਿਖਾਈ ਦਿੰਦਾ ਹੈ। ਨਾਵਲ ਯੋਗ ਨੂੰ ਨਿੱਜਵਾਦੀ ਦਰਸ਼ਨ ਦੇ ਸੰਦਰਭ ਵਿਚ ਪੇਸ਼ ਕਰਦਾ ਹੈ। ਬੇਸ਼ੱਕ ਹਰ ਦਰਸ਼ਨ ਵਿਚ ਨਿੱਜੀ ਯਤਨ ਲੋੜੀਂਦੇ ਬਣਦੇ ਹਨ। ਪਰ ਨਿੱਜੀ ਅਹੰਕਾਰ ਦੀ ਉਤਪਤੀ ਤੇ ਵਿਕਾਸ ਦਾ ਪਨਪਣਾ ਪਿਛਾਹ-ਖਿੱਚੂ ਵਰਤਾਰਾ ਹੈ। ਮਹਾਪੀਰ ਦੁਆਰਾ ਸੂਟੇ ਲਾਉਣਾ ਉਸ ਨੂੰ ਨਿਰਵਿਵਾਦ ਵਿਅਕਤੀਗਤ ਆਨੰਦ ਦਿੰਦਾ ਹੋਵੇਗਾ। ਹਰ ਵੇਲੇ ਸੁਲਫੇ ਸੂਟੇ ਦੀ ਲੋਰ ਵਿਚ ਰਹਿਣ ਵਾਲੇ ਵਿਅਕਤੀ ਲਈ ਸਮਾਜ, ਮਨੁੱਖਤਾ, ਜੀਵਨ ਆਦਰਸ਼ ਕੀ ਮਾਅਨੇ ਰੱਖਦੇ ਹਨ ਇਸ ਤੋਂ ਹਰ ਕੋਈ ਪਰੀਚਿਤ ਹੈ। ਮਹਾਪੀਰ ਦਾ ਰਹਿਣ ਨਿਵਾਸ ਸਭ ਤੋਂ ਖੂਫੀਆਂ ਹੈ ਜਿੱਥੇ ਕਿਸੇ ਨੂੰ ਜਾਣ ਦੀ ਇਜਾਜ਼ਤ ਨਹੀਂ ਹੈ। ਨਾਵਲ ਵਿਚ ਸੰਨਿਆਸ ਕਿੱਥੇ ਹੈ ? , ਦਾ ਪ੍ਰਸ਼ਨ ਸਹਿਜ ਸੁਭਾਅ ਉਪਜਦਾ ਹੈ। ਯੋਗ ਦਰਸ਼ਨ ਤੇ ਪੰਜਾਬੀ ਸਮਾਜ ਵਿਚ ਯੋਗੀ ਦੇ ਕਿਰਦਾਰ ਨੂੰ ਉੱਚਾ ਤੇ ਸੁੱਚਾ ਵਿਖਾਇਆ ਜਾਂਦਾ ਹੈ। ਯੋਗ ਤੇ ਭੋਗ ਵਿਚ ਪਿਆ ਰੰਗੀ ਨਿੱਜੀ ਸੁੱਖ ਨੂੰ ਪਹਿਲ ਦੇਣ ਦੀ ਪ੍ਰਵਿਰਤੀ ਕਾਰਨ ਦਵੰਦ ਵਿਚ ਹੈ।

ਨਾਵਲ ਵਿਚ ਔਰਤ ਪਾਤਰਾਂ ਨੂੰ ਸ਼ਕਤੀਸ਼ਾਲੀ ਵਿਖਾਉਣ ਪਿੱਛੇ ਨਾਵਲਕਾਰ ਦੀ ਇਹ ਦਾਰਸ਼ਨਿਕ ਸੋਚ ਕੰਮ ਕਰ ਰਹੀ ਹੈ ਕਿ ਔਰਤ ਇਸ਼ਕ ਤੇ ਆਪਣੀ ਹੋਂਦ ਦੀ ਸਥਾਪਤੀ ਲਈ ਵਧੇਰੇ ਤਰਕਮਈ ਵਿਚਾਰ ਰੱਖਦੀ ਹੈ। ਨਾਵਲ ਦੇ ਔਰਤ ਪਾਤਰ ਕਿਸੇ ਵੀ ਦਵੰਦ ਵਿਚ ਨਹੀਂ ਹਨ। ਨਾਵਲ ਵਿਚ ਔਰਤ ਦਾ ਸ਼ਕਤੀਸ਼ਾਲੀ ਤੇ ਸਮਝਦਾਰ ਪਾਤਰ ਵਜੋਂ ਬਿੰਬ ਉਸਾਰਨ ਦੇ ਮਨੋਰਥ ਹਿਤ ਦੋਵੇਂ ਔਰਤ ਪਾਤਰਾਂ (ਨੂਰਾਂ ਤੇ ਮੀਰਾ) ਖਾਸਕਰ ਮੀਰਾ ਨਾਇਕਾ ਵਜੋਂ ਉੱਭਰਦੀ ਹੈ। ਮਨੁੱਖ ਨੂੰ ਘੱਟੋ-ਘੱਟ ਆਪਣੀ ਇੱਛਾਵਾਂ ਤੇ ਸੀਮਾਵਾਂ ਦਾ ਪਤਾ ਹੋਣਾ ਲਾਜ਼ਮੀ ਹੈ। ਇਸ ਨਾਵਲ ਦੀਆਂ ਔਰਤ ਪਾਤਰਾਂ ਆਪਣੇ ਜੀਵਨ ਦੇ ਹਰ ਮਸਲੇ ਦਾ ਫ਼ੈਸਲਾ ਲੈਣ ਪ੍ਰਤੀ ਸਪਸ਼ਟ ਹਨ। ਸਮਾਜ ਵਿਚ ਦੂਜੇਲਾ ਸਥਾਨ ਪ੍ਰਾਪਤ ਕਰਨ ਵਾਲੀ ਔਰਤ ਫ਼ੈਸਲੇ ਪਹਿਲੇ ਦਰਜੇ ਵਾਲੇ ਲੈਂਦੀ ਹੈ। ਨਾਵਲ ਇਸ ਦਾਰਸ਼ਨਿਕ ਸੱਚ ਨੂੰ ਪ੍ਰਗਟ ਕਰਦਾ ਹੈ ਕਿ ਸਮਾਜ ਦੇ ਸੰਤਾਪ ਨੂੰ ਵਿਹਾਰਕ ਪੱਧਰ ਤੇ ਆਪਣੇ ਪਿੰਡੇ ਤੇ ਹੰਢਾਉਣ ਵਾਲੀ ਧਿਰ ਨੂੰ ਹਰ ਸਥਿਤੀ ਦਾ ਗਿਆਨ ਹੁੰਦਾ ਹੈ। ਇਸ ਸੰਦਰਭ ਵਿਚ ਨਾਵਲ ਦੀਆਂ ਔਰਤ ਪਾਤਰਾਂ ਦੀ ਹੋਂਦ ਨੂੰ ਤੇ ਹੋਈ ਨੂੰ ਸਮਝਿਆ ਜਾ ਸਕਦਾ ਹੈ। ਉਨ੍ਹਾਂ ਉੱਪਰ ਕਿਸੇ ਦਰਸ਼ਨ ਜਾਂ ਧਰਮ ਦਾ ਦਬਾਅ ਨਹੀਂ ਹੈ। ਉਹ ਵਰਜਣਾ ਦੇ ਕਿਸੇ ਮਾਨਸਿਕ ਸੰਤਾਪ ਦੀ ਹੋਈ ਦਾ ਸ਼ਿਕਾਰ ਨਹੀਂ ਹਨ। ਰੰਗੀ ਯੋਗ ਦੇ ਦੰਭ ਵਿਚ ਹਰ ਚੀਜ਼ ਚੋਰੀ ਭੁਗਤਣਾ ਲੋਚਦਾ ਹੈ। ਮੀਰਾ ਫੋਕੇ ਆਦਰਸ਼ ਨੂੰ ਧਾਰਨ ਕਰਨ ਦੀ ਹਮਾਇਤੀ ਨਹੀਂ ਸੀ। ਰੰਗੀ ਇਨ੍ਹਾਂ ਸਾਹਿਤ ਪੜ੍ਹ ਕੇ ਵੀ ਆਦਰਸ਼ਵਾਦ ਦੇ ਦੰਭ ਦਾ ਚੋਲ੍ਹਾ ਪਾ ਕੇ ਰੱਖਦਾ ਹੈ। ਮੀਰਾ ਉਲਾਰੂ ਮਾਨਸਿਕਤਾ ਦੀ ਸ਼ਿਕਾਰ ਨਹੀਂ ਹੈ। ਮੀਰਾ ਇਹ ਦਾਅਵਾ ਕਰਦੀ ਕਿ ਜੇਕਰ ਉਹ ਰੰਗੀ ਨਾਥ ਨੂੰ ਪ੍ਰਾਪਤ ਨਾ ਕਰ ਸਕੀ ਤਾਂ ਉਹ ਰੂਹ ਬਣ ਜਾਏਗੀ। ਰੰਗੀ ਪ੍ਰਤੀ ਉਸਦਾ ਕੋਈ ਸੁਨਹਿਰਾ ਸੁਪਨਾ ਨਹੀਂ ਬਲਕਿ ਉਹ ਯਥਾਰਥ ਨੂੰ ਪਛਾਣਦੀ ਹੈ। ਇਸ ਪਹਿਲੂ ਨੂੰ ਉਭਾਰ ਕੇ ਨਾਵਲ ਸਮਾਪਤੀ ਵਲ ਵਧਦਾ ਹੈ।

ਇੱਛਾ ਤੇ ਵਰਜਣਾ ਦੇ ਦਵੰਦ ਜਾਂ ਦੁਚਿੱਤੀ ਨੂੰ ਕੇਂਦਰ ਵਿਚ ਰੱਖ ਕੇ ਨਾਵਲ ਦਾ ਪਲਾਟ ਉਸਾਰਿਆ ਗਿਆ ਹੈ। ਨਾਵਲ ਦਾਰਸ਼ਨਿਕ ਸੰਦਰਭ ਵਿਚ ਇੱਛਾ ਦੀ ਪ੍ਰਕਿਰਤੀ ਤੇ ਦਮਨ ਦੇ ਸਿੱਟਿਆਂ ਦੀ ਕਥਾ ਉਸਾਰਦਾ ਹੈ। ਨਾਵਲ ਵਰਜਣਾ ਨੂੰ ਯੋਗ ਦਰਸ਼ਨ, ਸਮਾਜ ਸੰਸਕ੍ਰਿਤੀ ਤੇ ਧਰਮ ਦੇ ਸੰਕਲਪਾਂ ਤੇ ਸਿਧਾਂਤਾਂ ਅਨੁਸਾਰ ਪੇਸ਼ ਕਰਦਾ ਹੈ। ਮਨੁੱਖ ਦੀਆਂ ਪ੍ਰਕਿਰਤਿਕ ਇੱਛਾਵਾਂ ਨੂੰ ਦਬਾਉਣ ਵਿਚ ਯੋਗ

ਦਰਸ਼ਨ ਦੀ ਵਿਚਾਰਧਾਰਾ ਵਧੇਰੇ ਕੱਟੜ ਹੈ। “ ਕਿਸੇ ਵੀ ਰਿਸ਼ੀ ਦੀ ਅਪੂਰਨਤਾ ਦਾ ਦੂਜਾ ਕਾਰਨ ਉਸ ਦੀਆਂ ਦੱਬੀਆਂ ਕਾਮਨਾਵਾਂ ਹੋ ਸਕਦੀਆਂ ਹਨ। ਤਿਆਗ ਉਪਰੰਤ ਵੀ ਇਹ ਕਾਮਨਾਵਾਂ ਉਸ ਦੇ ਨਾਲ-ਨਾਲ ਰਹਿੰਦੀਆਂ ਹਨ।”¹² ਦਵੰਦ ਦੀ ਪ੍ਰਕਿਰਤੀ ਨੂੰ ਭਗਤ ਕਬੀਰ ਆਪਣੀ ਬਾਣੀ ਵਿਚ ਮਨੁੱਖ ਦੀ ਸਭ ਤੋਂ ਵੱਡੀ ਅੜਚਣ ਦੱਸਦੇ ਹਨ। ਦੁਬਿਧਾ ਦੇ ਕਾਰਨਾਂ ਦੀ ਪਹਿਚਾਣ ਕਰਾਉਣਾ ਹੀ ਨਾਵਲਕਾਰ ਦਾ ਮੰਤਵ ਲੱਗਦਾ ਹੈ।

ਰਹੱਸ ਤੇ ਯਥਾਰਥ ਦੀ ਟੱਕਰ ਨਾਵਲ ਦੀ ਕੇਂਦਰੀ ਧੁਨੀ ਬਣਦੀ ਹੈ। “ਯੋਗ ਸਾਧਨਾ ਕਠਿਨ ਹੈ ਕਿਉਂਕਿ ਇਸ ਵਿਚ ਸਥੂਲ ਸਰੀਰ ਨਾਲੋਂ ਸੂਖਮ ਸਰੀਰ ਦਾ ਪ੍ਰਯੋਗ ਵਧੇਰੇ ਹੁੰਦਾ ਹੈ। ਇੰਦਰੀ ਸੰਜਮ ਇਸ ਦੀ ਪਹਿਲੀ ਪਉੜੀ ਹੈ। ਪੰਜ ਇੰਦਰੀਆਂ ਦਾ ਗਿਆਨ ਪ੍ਰਾਪਤ ਕਰਦੇ ਹੋਏ ਮਨ ਦੀ ਇਕਾਗਰਤਾ ਨੂੰ ਪ੍ਰਾਪਤ ਕਰਨਾ ਹੀ ਯੋਗ ਦੀ ਪ੍ਰਮੁੱਖ ਪ੍ਰਾਪਤੀ ਹੈ। ਇਸ ਵਿਚ ਨਾੜੀ ਚੱਕਰ ਦਾ ਵਿਗਿਆਨ ਵੀ ਸੰਮਲਿਤ ਹੈ।”¹³ ਨਾਵਲਕਾਰ ਦੁਆਰਾ ਚੁਣਿਆ ਸਿਰਲੇਖ ਅਸਲ ਵਿਚ ਕਾਲਪਨਿਕ ਪ੍ਰਾਪਤੀ ਦੀ ਆਸ ਲਗਾਉਣ ਵਾਲੇ ਯੋਗ ਸਭਿਆਚਾਰ ਦੀ ਅਸਲ ਹਕੀਕਤ ਤੋਂ ਪਰੀਚਿਤ ਕਰਾਉਣ ਲਈ ਹੀ ਚੁਣਿਆ ਗਿਆ ਹੈ। ਨਾਦ ਸ਼ਬਦ ਦੇ ਅਰਥ ਸੰਗੀਤ ਦੇ ਹਨ ਅਤੇ ਵਿਸ਼ੇਸ਼ ਤੌਰ ਤੇ ਉਸ ਸੰਗੀਤ ਦੇ ਜਿਸ ਦੀਆਂ ਅਨੰਤ ਧੁਨੀਆਂ ਵਿਚ ਜੋਗੀ ਪਰਮਾਨੰਦ ਦੀ ਅਵਸਥਾ ਵਿਚ ਹੋਣ ਦਾ ਪਰਪੰਚ ਰਚਦਾ ਹੈ। ਬਿੰਦ ਪਰ ਅਨੰਦ ਸੰਸਕ੍ਰਿਤ ਦੇ ਸ਼ਬਦ ‘ ਵਿੰਦਾ ’ ਤੋਂ ਨਿਕਲਿਆ ਹੈ ਜਿਸ ਦੇ ਅਰਥ ਹਨ ਬੂੰਦ, ਕਤਰਾ ਆਦਿ। ਨਾਥ ਸੰਪਰਦਾ ਵਿਚ ਇਹ ਸ਼ਬਦ ਉਸ ਬੂੰਦ ਦਾ ਲਖਾਇਕ ਹੈ ਜਿਸ ਤੋਂ ਮਨੁੱਖ ਦੀ ਉਤਪਤੀ ਹੁੰਦੀ ਹੈ, ਜਿਸ ਦੀ ਲੋੜ ਸਭਿਆਚਾਰਕ ਨਹੀਂ ਮੂਲ ਅਕਾਂਖਿਆਵੀ ਸਰੀਰਕ ਲੋੜ ਹੈ। ਜੋਗੀ ਲਈ ਦਸਮ ਦੁਆਰ ਵਿਚ ਪੈਦਾ ਹੋਣ ਵਾਲੀਆਂ ਨਾਦ-ਤਰੰਗਾਂ ਦੀ ਪ੍ਰਾਪਤੀ ਲਈ ਬਿੰਦ ਦਾ ਦਮਨ ਜ਼ਰੂਰੀ ਹੈ।”¹⁴ ਨਾਦ ਅਤੇ ਬਿੰਦ ਸੁਭਾਵਿਕ ਅਤੇ ਵਾਸਤਵਿਕ ਨਹੀਂ ਹਨ। ਨਾਦ ਇਕ ਮਿਥਕ ਸੰਕਲਪ ਹੈ, ਰਹੱਸ ਵਿਚ ਗਲੇਫਿਆ ਹੋਇਆ ਅਜਿਹਾ ਸੁਪਨਾ –ਬਿੰਬ ਜਿਸ ਦਾ ਕੋਈ ਵਿਵੇਕ ਕੋਈ ਤਰਕ ਨਹੀਂ।

ਨਾਵਲਕਾਰ ਸਮਾਜੀ-ਸਿਆਸੀ ਮਸਲਿਆਂ ਨੂੰ ਦਾਰਸ਼ਨਿਕ ਸੰਦਰਭ ਵਿਚ ਚਿਤਰਦਾ ਹੋਇਆ ਸਿਆਸਤ ਦੀਆਂ ਚਾਲਾਂ ਨੂੰ ਬੇਨਕਾਬ ਕਰਨਾ ਲੇਖਦਾ ਹੈ। ਲੋਕਤੰਤਰ ਦੇ ਦਰਸ਼ਨ ਨੂੰ ਸਮਝਣਾ ਅਤਿ ਲਾਜ਼ਮੀ ਹੈ। ਲੋਕ ਪੱਖੀ ਲਹਿਰਾਂ ਨੂੰ ਸਿਆਸਤ ਦੁਆਰਾ ਕਿਵੇਂ ਤੇ ਕਿਸ ਰੂਪ ਵਿਚ ਦਬਾਇਆ ਗਿਆ ਦੇ ਸੰਦਰਭ ਰਾਹੀਂ ਨਾਵਲ ਸ਼ੁਰੂ ਹੁੰਦਾ ਹੈ। ਸਿਆਸਤ ਤੇ ਬੁਰਜੂਆ ਵਰਗ ਦੀ ਏਕਤਾ ਸਮਾਜ ਤੇ ਕੰਟਰੋਲ ਸਥਾਪਿਤ ਕਰਦੇ ਹਨ। ਨਾਵਲ ਇਸ ਕਰਕੇ ਦਾਰਸ਼ਨਿਕ ਨਾਵਲ ਦੀ ਕੋਟੀ ਵਿਚ ਸ਼ੁਮਾਰ ਹੁੰਦਾ ਹੈ। ਸੱਤਾਧਾਰੀਆਂ ਤੇ ਮਾਰਕਸਵਾਦੀਆਂ ਦੀ ਟੱਕਰ ਨੂੰ ਤੇ ਉਸ ਟੱਕਰ ਦੇ ਨਤੀਜਿਆਂ ਦੀ ਘੋਖ ਕਰਨਾ ਨਾਵਲ ਦਾ ਮੂਲ ਸੰਦਰਭ ਬਣਦਾ ਹੈ। ਬੁਰਜੂਆ ਵਰਗ ਦੀ ਹਮਾਇਤ ਕਰਦੀ ਸੱਤਾ ਨਿਤਾਇਆਂ ਤੇ ਇਨਕਲਾਬੀਆਂ ਦਾ ਨਾਮ ਨਿਸ਼ਾਨ ਮਿਟਾਉਣ ਲਈ ਹਮੇਸ਼ਾ ਹੀ ਕਾਰਜਸ਼ੀਲ ਰਹੀ ਹੈ। ਸਿਆਸਤ ਹੀ ਦੇਸ਼ ਦੀ ਹੋਣੀ ਨੂੰ ਨਿਰਧਾਰਨ ਕਰਨ ਦਾ ਇਕੋ ਇਕ ਸਰੋਤ ਹੁੰਦੀ ਹੈ। ਨਾਵਲ ਸਪੱਸ਼ਟ ਕਰਦਾ ਹੈ ਕਿ ਕਲਪਨਾ, ਧਰਮ, ਕਰਾਮਾਤਾਂ, ਸ਼ਕਤੀਆਂ, ਬਿੰਦ ਸੰਯਮ ਨਾਲ ਆਸਾਵਾਂਪਣ ਦੂਰ ਨਹੀਂ ਹੋ ਸਕਦਾ।

ਮਨੁੱਖੀ ਜ਼ਿੰਦਗੀ ਵਿਚ ਸਮਰਪਣ ਦਾ ਗੁਣ ਹੋਣਾ ਬਹੁਤ ਲਾਜ਼ਮੀ ਹੈ। ਸਮਰਪਣ ਦੀ ਭਾਵਨਾ ਹੀ ਮਨੁੱਖ ਨੂੰ ਕਿਸੇ ਆਦਰਸ਼ ਦੀ ਪ੍ਰਾਪਤੀ ਵਿਚ ਦ੍ਰਿੜ੍ਹ ਕਰਦੀ ਹੈ। ਨਾਵਲ ਦਾ ਦਾਰਸ਼ਨਿਕ ਸੰਦਰਭ ਇਸ ਵਿਚ ਨਿਹਿਤ ਹੈ ਕਿ ਮਨੁੱਖ ਜਿਸ ਵੀ ਦਰਸ਼ਨ ਦੀ ਪਾਲਣਾ ਕਰੇ ਉਸ ਪ੍ਰਤੀ ਪੂਰੀ ਇਕਾਗਰਤਾ ਤੇ ਦ੍ਰਿੜ੍ਹਤਾ ਵਿਖਾਵੇ। ਇਕਾਗਰਤਾ ਤੇ ਦ੍ਰਿੜ੍ਹਤਾ ਦੇ ਸੰਕਲਪ ਤੋਂ ਅਭਿੱਜ ਪਾਤਰ ਸੰਤਾਪ ਨੂੰ ਭੋਗਦੇ ਹਨ। ਇਕਾਗਰਤਾ ਯੋਗ ਦਰਸ਼ਨ ਦੀ ਮੂਲ ਚੁਲ ਹੈ। ਪਰ ਵਿਹਾਰਕ ਰੂਪ ਵਿਚ ਹਰ ਕਾਰਜ ਵਿਚ ਇਕਾਗਰਤਾ ਲਾਜ਼ਮੀ ਮਨੁੱਖੀ ਵਿਹਾਰ ਦਾ ਗੁਣ ਹੋਣੀ ਚਾਹੀਦੀ ਹੈ। ਰੰਗੀ ਦੀ ਨਕਸਲਵਾਦੀ ਲਹਿਰ ਤੇ ਫ਼ਲਸਫ਼ੇ ਨਾਲ ਸਮਰਪਣ ਦੀ ਘਾਟ ਹੀ ਉਸ ਨੂੰ ਭਗੌੜਾ ਬਣਾਉਣ ਦਾ ਕਾਰਨ ਬਣਦੀ ਹੈ। ਸਮਰਪਣ ਮਨੁੱਖ ਨੂੰ ਉਸ ਵਿਚਾਰਧਾਰਾ ਤੇ ਫ਼ਲਸਫ਼ੇ ਲਈ ਕੁਰਬਾਨ ਹੋਣ ਦਾ ਗੁਣ ਸਿਖਾਉਂਦਾ ਹੈ। ਕੁਰਬਾਨੀ ਦਾ ਸੰਕਲਪ ਭਾਰਤੀ ਦਰਸ਼ਨ ਵਿਚ ਖ਼ਾਸ ਮਹੱਤਤਾ ਰੱਖਦਾ ਹੈ। ਯੋਗ ਦਰਸ਼ਨ ਦੀ ਜੀਵਨ-ਜਾਚ ਨਾਲ ਵੀ ਰੰਗੀ ਸਮਰਪਿਤ ਹੋ ਕੇ ਨਹੀਂ ਜੁੜਿਆ ਉਸ ਨੂੰ ਜੇ ਕੁਝ ਵੀ ਅਚੰਭਿਤ ਕਰਦਾ ਉਹ ਹਰ ਵਾਰ ਉਸ ਵਲ ਤੁਰ ਪੈਂਦਾ ਹੈ। ਇਸ ਤੋਂ ਬਾਅਦ ਮੀਰਾ ਨੂੰ ਵੇਖ ਉਹ ਜੋਗ ਪ੍ਰਤੀ ਸਮਰਪਣ ਦੀਆਂ ਹੱਦਾਂ ਨੂੰ ਪਾਰ ਕਰਦਾ ਹੈ। ਮੀਰਾ ਨਾਲ ਇਸ਼ਕ ਪ੍ਰਤੀ ਵੀ ਉਹ ਕੋਈ ਸਮਰਪਣ ਭਾਵਨਾ ਨਹੀਂ ਵਿਖਾਉਂਦਾ ਹੈ। ਮਨੁੱਖ ਦਾ ਸਮਰਪਣ ਹੀ ਉਸ ਨੂੰ ਇਸ ਉੱਚ ਦਾਰਸ਼ਨਿਕ ਪੱਧਰ ਦੀ ਪ੍ਰਾਪਤੀ ਕਰਵਾ ਸਕਦਾ ਹੈ।

ਦਰਸ਼ਨ ਤੇ ਦਾਰਸ਼ਨਿਕ ਕਿਰਤ ਦਾ ਇਕੋ ਇਕ ਸਾਂਝਾ ਮਨੋਰਥ ਚੇਤੰਨਤਾ ਦਾ ਪ੍ਰਸਾਰ ਕਰਨਾ ਹੁੰਦਾ ਹੈ। ਮਨੁੱਖ ਜੋ ਤੇ ਜਿਵੇਂ ਹੈ ਉਵੇਂ ਹੀ ਉਸਦੀ ਚੇਤਨਾ ਤੇ ਮਾਨਸਿਕਤਾ ਬਣੀ ਰਹੇ ਤਾਂ ਫਿਰ ਦਰਸ਼ਨ ਤੇ ਗਿਆਨ ਦਾ ਕੋਈ ਅਰਥ ਨਹੀਂ ਰਹਿ ਜਾਂਦਾ ਹੈ। ਮਾਰਕਸਵਾਦੀ

ਦਰਸ਼ਨ ਸਮਾਜਕ ਯਥਾਰਥ ਨੂੰ ਪੂੰਜੀਵਾਦ ਨਿਜ਼ਾਮ ਦੀਆਂ ਨੀਤੀਆਂ ਤੇ ਇਨ੍ਹਾਂ ਨੀਤੀਆਂ ਦਾ ਸਮਾਜ ਦੇ ਹਰ ਵਰਗ ਤੇ ਅਸਰ ਰਸੂਖ ਨੂੰ ਘੋਖਣ ਦਾ ਦ੍ਰਿਸ਼ਟੀਕੋਣ ਪ੍ਰਦਾਨ ਕਰਦਾ ਹੈ। ਇਹ ਦਰਸ਼ਨ ਚੇਤਨਾ ਦੇ ਪ੍ਰਸਾਰ ਦਾ ਇਕੋ ਇਕ ਦਰਸ਼ਨ ਬਣਦਾ ਹੈ। ਇਸੇ ਦਰਸ਼ਨ ਰਾਹੀਂ ਨਾਵਲਕਾਰ ਵੀ ਚੇਤਨਾ ਦਾ ਪ੍ਰਸਾਰ ਪਾਠਕ ਤਕ ਕਰਾਉਂਦਾ ਹੈ। ਡਾ. ਟੀ. ਆਰ ਵਿਨੇਦ ਦਾ ਕਥਨ ਹੈ, "ਮਾਰਕਸਵਾਦੀ ਸਾਹਿਤਕਾਰ ਦੇ ਇਕੋ ਵੇਲੇ ਦੋ ਪ੍ਰਯੋਜਨ ਹੁੰਦੇ ਹਨ, ਇਕ ਤਾਂ ਉਹ ਆਪਣੇ ਸਮੇਂ ਦੇ ਸਮਾਜ ਦੀਆਂ ਮਨੁੱਖ ਅਤੇ ਕੁਦਰਤ ਦੇ ਵਿਰੁੱਧ ਜਾਂਦੀਆਂ ਹਰਕਤਾਂ ਦੀ ਆਲੋਚਨਾ ਕਰਦਾ ਹੈ, ਦੂਸਰੇ ਸਮਾਜਵਾਦ ਦੀ ਉਸਾਰੀ ਲਈ ਲੋੜੀਂਦੇ ਗੁਣਾਂ ਦਾ ਪਾਠਕ ਦੀ ਸ਼ਖਸੀਅਤ ਵਿਚ ਸੰਚਾਰ ਕਰਦਾ ਹੈ।"¹⁵ ਨਾਵਲਕਾਰ ਜਿਸ ਚੇਤਨਾ ਦਾ ਪ੍ਰਸਾਰ ਕਰਦਾ ਹੈ ਉਹ ਰਹੱਸਵਾਦ ਦੀ ਪ੍ਰਕਿਰਤੀ ਤੇ ਉਸ ਦੇ ਦੰਭ ਨੂੰ ਪੇਸ਼ ਕਰਦੀ ਹੈ। ਅੰਧਵਿਸ਼ਵਾਸ ਤੇ ਨਿਰ-ਆਧਾਰ ਸੰਕਲਪਾਂ ਨੂੰ ਤਰਕ ਰਾਹੀਂ ਰੱਦਿਆ ਜਾਂਦਾ ਹੈ। ਰੰਗੀ ਨੂੰ ਯੋਗ ਧਾਰਨ ਕਰਨ ਉਪਰੰਤ ਲੱਗਦਾ ਹੈ ਕਿ ਉਸ ਨੂੰ ਕਿਸੇ ਅਗੰਮੀ ਸ਼ਕਤੀ ਦੇ ਦਰਸ਼ਨ ਹੋਏ ਹਨ ਤੇ ਉਹ ਹੁਣ ਅਸਧਾਰਨ ਮਨੁੱਖ ਬਣ ਗਿਆ ਹੈ। ਚੇਤਨਤਾ ਦੀ ਘਾਟ ਹੀ ਉਸਨੂੰ ਯਥਾਰਥ ਤੋਂ ਮੁਨਕਰ ਹੋਣ ਤੇ ਦੰਭੀ ਕਿਰਦਾਰ ਬਣਾਉਂਦੀ ਹੈ।

'ਨਾਦ ਬਿੰਦ' ਨਾਵਲ ਦੇ ਦਾਰਸ਼ਨਿਕ ਸੰਦਰਭ ਨੂੰ ਸਮਝ ਕੇ ਹੀ ਨਾਵਲਕਾਰ ਦੀ ਰਚਨਾ ਦ੍ਰਿਸ਼ਟੀ ਨੂੰ ਪਹਿਚਾਣਿਆ ਜਾ ਸਕਦਾ ਹੈ। ਨਾਵਲਕਾਰ ਦੀ ਦ੍ਰਿਸ਼ਟੀ ਹੀ ਸਰੋਕਾਰਾਂ ਨੂੰ ਉਭਾਰਦੀ ਹੋਈ ਵਿਭਿੰਨ ਕਲਾਤਮਕ ਜੁਗਤਾਂ ਰਾਹੀਂ ਨਾਵਲੀ ਸੰਰਚਨਾ ਬਣਦੀ ਹੈ। ਇਸ ਲਈ ਦਾਰਸ਼ਨਿਕ ਸੰਦਰਭ ਦਾ ਮਹੱਤਵ ਦੇਹਰਾ ਬਣਦਾ ਹੈ। ਨਾਵਲਕਾਰ ਨੇ ਕਿਸੇ ਨ ਕਿਸੇ ਵਿਚਾਰਧਾਰਾ ਦਾ ਸੰਚਾਰ ਕਰਨਾ ਹੁੰਦਾ ਹੈ। ਪਰ ਉਸ ਦੇ ਨਾਲ ਹੀ ਉਸਨੇ ਹੋਰ ਵਿਚਾਰਧਾਰਾਵਾਂ ਤੇ ਸਰੋਕਾਰਾਂ ਦੀ ਪ੍ਰਕਿਰਤੀ ਨੂੰ ਵੀ ਸਪਸ਼ਟ ਕਰਨਾ ਹੁੰਦਾ ਹੈ ਜੋ ਉਸ ਮੂਲ ਵਿਚਾਰਧਾਰਾ ਨਾਲ ਅੰਤਰ ਸਬੰਧਿਤ ਹੋਣ। ਇਸ ਤਰ੍ਹਾਂ ਇਸ ਨਾਵਲ ਦਾ ਦਾਰਸ਼ਨਿਕ ਸੰਦਰਭ ਵਿਚਾਰਧਾਰਾਈ ਦਰਸ਼ਨ ਦੀ ਪ੍ਰਕਿਰਤੀ ਦੀ ਵਿਹਾਰਕ ਸਾਰਥਿਕਤਾ ਦੀ ਪੜਚੋਲ ਕਰਨਾ ਹੈ। ਇਸ ਦੇ ਨਾਲ ਇਸੇ ਪ੍ਰਕਿਰਤੀ ਅਧੀਨ ਯੋਗ ਦਰਸ਼ਨ ਦੇ ਸਿਧਾਂਤਕ ਤੇ ਵਿਹਾਰਕ ਅਸਾਵੇਪਣ, ਯੋਗ ਦੀ ਸਾਰਥਿਕਤਾ ਤੇ ਪ੍ਰਸ਼ਨ ਚਿੰਨ੍ਹ ਲਗਾਇਆ ਹੈ। ਇਸਦੇ ਸਮਰੂਪ ਪਦਾਰਥਵਾਦੀ ਦਰਸ਼ਨ ਦੀ ਮਹੱਤਤਾ ਤੇ ਸਮਾਜ ਪ੍ਰਤੀ ਸਾਰਥਿਕਤਾ ਨੂੰ ਨਾਵਲਕਾਰ ਨੇ ਦ੍ਰਿੜ੍ਹਾਇਆ ਹੈ। ਯਥਾਰਥ ਅੰਤਿਮ ਸੱਚ ਹੈ ਦੇ ਸੰਦਰਭ ਵਿਚ ਨਾਵਲ ਦੀ ਟੈਕਸਟ ਨੂੰ ਸਮਝਿਆ ਜਾ ਸਕਦਾ ਹੈ।

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ਗੁਰੂ ਨਾਨਕ ਬਾਣੀ ਅਨੁਸਾਰ ਨੈਤਿਕਤਾ

ਸੁਪ੍ਰੀਤ ਕੌਰ

ਖੇਜਾਰਬੀ, ਪੰਜਾਬੀ, ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਵਰਲਡ ਯੂਨੀਵਰਸਿਟੀ, ਫਤਹਿਗੜ੍ਹ ਸਾਹਿਬ।

supreet92randhawa@gmail.com

ਪਿਛਲੇ ਕੁਝ ਸਾਲਾਂ ਦੌਰਾਨ ਸਾਡੇ ਜੀਵਨ ਵਿਚਲੀਆਂ ਸਮੱਚੀਆਂ ਕਦਰਾਂ ਕੀਮਤਾਂ ਵਧੇਰੇ ਡੂੰਘੇ ਰੂਪ ਵਿਚ ਪ੍ਰਭਾਵਿਤ ਹੋਈਆਂ ਹਨ। ਕੇਵਲ ਮਾਰੂ ਅਤੇ ਮੁਨਾਫ਼ਾ ਪ੍ਰਸਤ ਸੋਚ ਨੇ ਵਿਕਾਸ ਦੇ ਨਾਲ-ਨਾਲ ਤਣਾਅ ਦਾ ਮਾਹੌਲ ਵੀ ਸਿਰਜਿਆ ਹੈ। ਅਜਿਹੇ ਤਣਾਅ ਦੇ ਮਾਹੌਲ ਵਿਚ ਮਨੁੱਖੀ ਸੋਚ ਜਾਂ ਮਨ ਦਾ ਧਿਆਨ ਧਰਮ ਵੱਲ ਜਾਣਾ ਸੁਭਾਵਿਕ ਹੀ ਹੈ ਕਿਉਂਕਿ ਮਨੁੱਖ ਨੂੰ ਮਾਨਸਿਕ ਟਕਾਅ ਅਤੇ ਧਰਵਾਸਾ ਕੇਵਲ ਧਰਮ ਹੀ ਦੇ ਸਕਦਾ ਹੈ ਜੋ ਉਸਨੂੰ ਅਗਾਂਹਵਧੂ ਸੋਚ ਦਾ ਧਾਰਨੀ ਬਣਾਉਂਦਾ ਹੈ। ਮਨੁੱਖੀ ਵਿਕਾਸ ਗਤੀ, ਵਿਗਿਆਨਕ ਖੋਜ ਅਤੇ ਤਕਨੀਕ ਨੇ ਸਮੁੱਚੇ ਵਿਸ਼ਵ ਨੂੰ ਇਕ ਪਿੰਡ ਬਣਾ ਦਿੱਤਾ ਹੈ। ਅਜਿਹੇ ਵੰਨ-ਸੁਵੰਨਤਾ ਭਰੇ ਪਿੰਡ ਵਿਚ ਜੀਵਨ ਦੇ ਸੁਚੱਜੇ ਨਿਰਵਾਹ ਲਈ ਧਰਮ ਦਾ ਹੋਣਾ ਵੀ ਵਧੇਰੇ ਜ਼ਰੂਰੀ ਹੈ।

ਧਰਮ ਦੀ ਹਾਨੀ ਮਨੁੱਖੀ ਜੀਵਨ ਵਿਚੋਂ ਸਦਾਚਾਰ ਦੇ ਮਨਫ਼ੀ ਹੋਣ ਦੀ ਨਿਸ਼ਾਨੀ ਹੈ। ਅਜਿਹਾ ਸਮਾਜ ਸਮਾਜਿਕ ਬੁਰਾਈਆਂ ਨਾਲ ਭਾਰੂ ਹੋ ਜਾਂਦਾ ਹੈ ਅਤੇ ਆਮ ਮਨੁੱਖ ਦੇ ਜੀਵਨ ਵਿਚੋਂ ਅਣਖ ਤੇ ਸਵੈਮਾਨ ਦਾ ਖ਼ਾਤਮਾ ਹੋ ਜਾਂਦਾ ਹੈ, ਜਿਸ ਕਾਰਨ ਉਸ ਦੀ ਸਥਿਤੀ ਉਨ੍ਹਾਂ ਪਸ਼ੂਆਂ ਵਾਂਗ ਹੋ ਜਾਂਦੀ ਹੈ, ਜਿਨ੍ਹਾਂ ਨੂੰ ਜਿਹੜਾ ਮਰਜ਼ੀ ਜਿਧਰ ਨੂੰ ਮਰਜ਼ੀ ਲੈ ਜਾਵੇ, ਉਹ ਵਿਰੋਧ ਕਰਨ ਵਿਚ ਅਸਮਰੱਥ ਹੁੰਦੇ ਹਨ।¹ ਜਦੋਂ ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ ਦਾ ਇਸ ਧਰਤੀ ਤੇ ਆਗਮਨ ਹੋਇਆ ਤਾਂ ਧਰਮ ਦੇ ਸਾਰੇ ਗੁਣ ਅਲੋਪ ਹੋ ਚੁੱਕੇ ਸਨ, ਜਿਸ ਦਾ ਜ਼ਿਕਰ ਗੁਰੂ ਸਾਹਿਬ ਆਪਣੀ ਬਾਣੀ ਵਿਚ ਕਰਦੇ ਹੋਏ ਦੱਸਦੇ ਹਨ : -

ਸਰਮ ਧਰਮ ਕਾ ਡੇਰਾ ਦੂਰਿ ॥

ਨਾਨਕ ਕੁਤੁ ਰਹਿਆ ਭਰਪੂਰਿ ॥²

ਸਰਬ-ਸ਼ਕਤੀਮਾਨ ਰੱਬ ਦੀ ਰਜ਼ਾ ਵਿਚ ਰਹਿਣ ਦਾ ਠੀਕ ਭਾਵ ਕੀ ਹੈ, ਇਹ ਜਾਣਨਾ ਕਠਿਨ ਹੈ। ਰਜ਼ਾ ਦੇ ਇਕ ਅਰਥ ਤਾਂ ਬਹੁਤ ਸਾਧਾਰਨ ਹਨ। ਜਦੋਂ ਕੋਈ ਘਟਨਾ ਸਾਡੀ ਮਰਜ਼ੀ ਜਾਂ ਹਿੱਤ ਜਾਂ ਸੁੱਖ ਦੇ ਵਿਰੁੱਧ ਵਾਪਰੇ, ਉਸ ਵਿਚ ਰੱਬ ਦੀ ਖੁਸ਼ੀ ਸਮਝ ਕੇ ਸਬਰ ਕਰ ਛੱਡਣਾ, ਦੁਖ ਨਾ ਮੰਨਣਾ। ਨਾਮ ਜਪਣ ਦਾ ਸਿੱਟਾ ਵੀ ਸਦਾ ਇਹ ਯਾਦ ਰੱਖਣਾ ਹੀ ਨਿਕਲਦਾ ਹੈ ਕਿ ਜ਼ਿੰਦਗੀ ਦੀ ਹਕੀਕਤ ਹੁਕਮ ਹੈ, ਹਉਮੈ ਨਹੀਂ, ਜਿਸ ਦਾ ਅਰਥ ਇਹ ਹੈ ਕਿ ਮਨੁੱਖ ਆਪਣੀ ਵਿਅਕਤੀਗਤ ਤੇ ਸੀਮਤ ਮਰਜ਼ੀ ਅਨੁਸਾਰ ਆਪਣੇ ਤੇ ਬਾਹਰਲੇ ਜੀਵਨ ਨੂੰ ਢਾਲਣ ਦੇ ਯਤਨ ਵਿਚ ਸਫਲ ਨਹੀਂ ਹੋ ਸਕਦਾ; ਆਪਣੇ ਅਮਲ ਨੂੰ ਜ਼ਿੰਦਗੀ ਦੀਆਂ ਅਸਲੀਅਤਾਂ ਦੇ ਅਨੁਕੂਲ ਬਣਾਉਣ ਵਿਚ ਹੀ ਉਸ ਦੇ ਜੀਵਨ ਦੀ ਸਫਲਤਾ ਹੈ।

ਜਪੁਜੀ ਵਿਚ ਦ੍ਰਿੜ ਕਰਾਏ ਜੀਵਨ ਦ੍ਰਿਸ਼ਟੀਕੋਣ ਅਨੁਸਾਰ ਸੱਚ ਉੱਤੇ ਪੁੱਜੇ ਮਨੁੱਖ ਦਾ ਪ੍ਰਧਾਨ ਗੁਣ ਕੋਈ ਕਰਮਹੀਣ ਤੇ ਬੇਹਰਕਤ ਅਵਸਥਾ ਨਹੀਂ, ਸਗੋਂ ਉਹ ਆਪਣੀ ਚੇਤਨਾ ਦੇ ਸਾਜ਼ ਨੂੰ ਵਿਸ਼ਵਾਸਥੀ ਇੱਛਾ ਤੇ ਸੰਗੀਤ ਨਾਲ ਇਕਾਗਰ ਕਰਕੇ ਹਰ ਪਲ ਗਤੀਸ਼ੀਲ ਰਹਿੰਦਾ ਹੈ। ਉਨ੍ਹਾਂ ਦਾ ਅਸਲ ਮੰਤਵ ਮਨੁੱਖ ਨੂੰ ਇਹ ਸੋਝੀ ਦੇਣੀ ਹੈ ਕਿ ਬਾਕੀ ਪਰਕਿਰਤੀ ਦੀ ਤਰ੍ਹਾਂ ਉਹ ਵੀ ਕਿਸੇ ਨਾ ਕਿਸੇ ਤਰ੍ਹਾਂ ਦੇ ਨਿਯਮਾਂ ਅਧੀਨ ਹੈ। ਮਨੁੱਖ ਦਾ ਸਰੀਰ ਪਦਾਰਥਕ ਨਿਯਮਾਂ ਦੇ ਅਧੀਨ ਹੈ ਪਰ ਉਸਦਾ ਮਨ ਨੈਤਿਕ ਜਾਂ ਸਦਾਚਾਰਕ ਨਿਯਮਾਂ ਅਧੀਨ ਹੈ। ਗੁਰੂ ਨਾਨਕ ਜਪੁਜੀ ਵਿਚ ਵਾਰ-ਵਾਰ ਸਭ ਪਰਕਿਰਤੀ ਨੂੰ ਰੱਬ ਦੇ ਹੁਕਮ ਦੀ ਪਾਲਣਾ ਕਰਦੀ ਦਿਖਾ ਕੇ ਮਨੁੱਖੀ ਭਾਵਾਂ ਨੂੰ ਹੁਕਮ ਦੇ ਅਨੁਸਾਰੀ ਬਣਨ ਲਈ ਤਿਆਰ ਕਰਦੇ ਤੇ ਆਦਰਸ਼ਕ ਸਮਾਜ ਦੀ ਹੋਂਦ ਨੂੰ ਨੇੜੇ ਲਿਆਉਂਦੇ ਹਨ। ਕਿਉਂਕਿ ਰੱਬ ਦਾ ਹੁਕਮ, ਕੁਦਰਤੀ ਨਿਯਮਾਂ ਦੇ ਰੂਪ ਵਿਚ ਵੀ ਵਿਆਪਕ ਹੁੰਦਾ ਹੈ ਇਸ ਲਈ ਜਿਸ ਮਨੁੱਖ ਵਿਚ ਦੈਵੀ ਹੁਕਮ ਦੀ ਚੇਤਨਾ ਵਧਦੀ ਹੈ ਉਹ ਕੁਦਰਤੀ ਨਿਯਮਾਂ ਦੀ ਹੋਂਦ ਨੂੰ ਮੰਨਦਾ, ਉਨ੍ਹਾਂ ਨਾਲ ਅਨੁਕੂਲਤਾ ਦੀ ਜ਼ਰੂਰਤ ਮਹਿਸੂਸ ਕਰਦਾ ਤੇ ਆਪਣੇ ਅੰਦਰ ਜੀਵਨ ਨੂੰ ਕਿਸੇ ਨਿਸ਼ਚਿਤ ਨਿਯੰਤਰਨ ਹੇਠ ਰੱਖਣ ਦੀ ਸਮਰੱਥਾ ਪੈਦਾ ਕਰਦਾ ਹੈ।

ਨੈਤਿਕਤਾ ਇਕ ਅਜਿਹਾ ਵਿਸ਼ਾ ਹੈ, ਜਿਸ ਦੀ ਲੋੜ ਸਾਨੂੰ, ਪਹਿਲੇ ਸਮਿਆਂ ਵਿਚ ਵੀ ਸੀ, ਹੁਣ ਵੀ ਹੈ ਅਤੇ ਆਉਣ ਵਾਲੇ ਸਮਿਆਂ ਵਿਚ ਵੀ ਬਰਕਰਾਰ ਰਹੇਗੀ। ਇਸ ਦੀ ਸਦੀਵੀ ਹੋਂਦ ਤੋਂ ਸਹਿਜੇ ਇਨਕਾਰ ਨਹੀਂ ਕੀਤਾ ਜਾ ਸਕਦਾ। ਨੈਤਿਕ ਕਦਰਾਂ-ਕੀਮਤਾਂ ਦਾ ਸੰਬੰਧ ਸੋਚ-ਸਮਝ ਕੇ ਕੀਤੇ ਗਏ ਕਰਮਾਂ ਨਾਲ ਹੁੰਦਾ ਹੈ। ਕਿਸ ਤਰ੍ਹਾਂ ਦੇ ਕਰਮ ਕਰਨੇ ਠੀਕ ਹਨ ਜੋ ਕੀਤੇ ਜਾਣੇ ਚਾਹੀਦੇ ਹਨ, ਕਿਸ ਤਰ੍ਹਾਂ ਦੇ ਕਰਮ ਗ਼ਲਤ ਹਨ ਜੋ ਨਹੀਂ ਕੀਤੇ ਜਾਣੇ ਚਾਹੀਦੇ। ਇਹ ਹੀ ਨੈਤਿਕ ਕਦਰਾਂ-ਕੀਮਤਾਂ ਦਾ ਵਿਸ਼ਾ ਹੁੰਦਾ ਹੈ। ਨੈਤਿਕ ਕਦਰਾਂ-ਕੀਮਤਾਂ ਨੈਤਿਕਤਾ ਦੇ ਘੇਰੇ ਵਿਚ ਆਉਂਦੀਆਂ ਹਨ। ਨੈਤਿਕਤਾ ਸੰਸਕ੍ਰਿਤ ਦੇ ਸ਼ਬਦ ਨੀਤੀ ਦਾ ਵਿਕਸਿਤ ਰੂਪ ਹੈ, ਜਿਸ ਦੇ ਪ੍ਰਧਾਨ ਅਰਥ

ਹਨ, ਲੈ ਜਾਣਾ ਜਾਂ ਅਗਵਾਈ ਕਰਨੀ। ਭਾਵ ਜੇ ਮਨੁੱਖ ਦੇ ਜੀਵਨ ਵਿਚ ਅਗਵਾਈ ਕਰੇ ਜਾਂ ਉਸ ਨੂੰ ਕਿਸੇ ਆਦਰਸ਼ ਪ੍ਰਾਪਤੀ ਵੱਲ ਲੈ ਜਾਵੇ ਉਹੀ ਨੈਤਿਕਤਾ ਆਖੀ ਜਾ ਸਕਦੀ ਹੈ।³ ਨੈਤਿਕਤਾ ਤੋਂ ਭਾਵ ਉਹ ਆਚਰਣ ਹੈ ਜਿਸ ਵਿਚ ਸੰਤੁਲਿਤ ਮਨੁੱਖਾਂ ਨੂੰ ਆਪਸੀ ਭਾਈਚਾਰੇ ਅਤੇ ਹੋਰ ਜੀਵਾਂ ਨਾਲ ਸੁਸ਼ੀਲ ਵਿਵਹਾਰ ਕਰਨਾ ਚਾਹੀਦਾ ਹੈ।⁴

ਜਦੋਂ ਕਦੇ ਮਨੁੱਖ, ਇਨ੍ਹਾਂ ਨੈਤਿਕਤਾ ਨਿਯਮਾਂ ਦੀ ਉਲੰਘਣਾ ਕਰਦਾ ਹੈ ਤਾਂ ਉਸ ਨੂੰ 'ਅਨੈਤਿਕ' ਮੰਨਿਆ ਜਾਂਦਾ ਹੈ। ਗੁਰਬਾਣੀ ਵਿਚ 'ਗੁਰਮੁਖ' ਤੇ 'ਮਨਮੁਖ' ਅਤੇ 'ਸੁਹਾਗਣ' ਤੇ 'ਦੁਹਾਗਣ' ਦੁਆਰਾ, ਇਸ ਮਸਲੇ ਦੀ ਅਹਿਮੀਅਤ ਨੂੰ ਦਰਸਾਇਆ ਗਿਆ ਹੈ। ਇਸ ਮੁਤਾਬਕ, ਗੁਰਮੁਖ ਉਹ ਹੈ, ਜੋ ਗੁਰੂ ਦੁਆਰਾ ਨਿਸ਼ਚਿਤ ਕੀਤੀ ਨੈਤਿਕ ਸੋਚ ਤੋਂ ਪ੍ਰੇਰਨਾ ਗ੍ਰਹਿਣ ਕਰਦਾ ਹੈ ਅਤੇ ਮਨਮੁਖ, ਮਨ ਦੇ ਆਖੇ ਲੱਗ ਕੇ, ਜਦੋਂ ਮਨਮਰਜ਼ੀ ਕਰਦਾ ਹੈ ਤਾਂ ਅਚੇਤ-ਸੁਚੇਤ ਰੂਪ ਵਿਚ ਸਥਾਪਤ ਕੀਤੇ ਨੈਤਿਕ-ਨਿਯਮਾਂ ਦੀ ਅਕਸਰ ਉਲੰਘਣਾ ਹੁੰਦੀ ਹੈ। ਅਜਿਹੇ ਆਧਾਰਾਂ ਉਪਰ ਹੀ, 'ਸੁਹਾਗਣ' ਤੇ 'ਦੁਹਾਗਣ' ਵਿਚ ਅੰਤਰ ਹੁੰਦਾ ਹੈ। ਇਸੇ ਆਧਾਰ 'ਤੇ 'ਪੁੰਨ ਤੇ ਪਾਪ', 'ਚੰਗੇ ਕਰਮਾਂ' ਤੇ 'ਮੰਦੇ ਕਰਮਾਂ' ਦਾ ਫ਼ੈਸਲਾ ਕੀਤਾ ਜਾਂਦਾ ਹੈ। ਗੁਰੂ ਨਾਨਕ ਦੇ ਵਿਚਾਰ ਅਨੁਸਾਰ ਸਮਾਜ ਇਕ ਲਗਾਮ ਹੈ ਜੋ ਮਨੁੱਖ ਦੇ ਬੇਲਗਾਮੇ ਮਨ ਨੂੰ ਕਾਬੂ ਕਰਨ ਵਿਚ ਸਹਾਇਤਾ ਕਰਦਾ ਹੈ। ਸਮਾਜ ਤੋਂ ਲਜਿਆ ਖਾਣ ਵਾਲਾ ਮਨੁੱਖ ਕਈ ਐਸ਼ਾਂ ਤੋਂ ਆਪਣੇ ਆਪ ਨੂੰ ਬਚਾ ਸਕਦਾ ਹੈ। ਸਮਾਜ ਦੀ ਸ਼ਰਮ ਦਾ ਅਹਿਸਾਸ ਸੰਤੋਖੀ ਮਨੁੱਖ ਨੂੰ, ਵਰਜਤ ਢੰਗਾਂ ਦੁਆਰਾ ਆਪਣੀਆਂ ਚਾਹਾਂ ਪੂਰੀਆਂ ਕਰਨ ਤੋਂ ਰੋਕਦਾ ਹੈ।

ਗੁਰੂ ਸਾਹਿਬ ਮਨੁੱਖ ਦੀ ਸੋਚ ਤੇ ਮਨ ਨੂੰ ਇਹ ਅਨੁਭਵੀ ਅਹਿਸਾਸ ਕਰਾਉਂਦੇ ਹਨ ਕਿ ਜੇ ਉਹ ਆਪਣੀ ਨਿੱਤ ਬਦਲ ਰਹੀ ਨਾਸਵੰਤ ਸਰੀਰੀ ਹੋਂਦ ਨਹੀਂ ਪਛਾਣਦਾ ਅਤੇ ਆਪਣੀਆਂ ਸੀਮਤ ਮਨੁੱਖੀ ਲੋੜਾਂ ਦੀ ਸੁਚੇਤ ਰੂਪ ਵਿਚ ਪਛਾਣ ਨਹੀਂ ਕਰਦਾ ਤਾਂ ਬੇਮੁਹਾਰੇ ਮਨੁੱਖੀ ਮਨ ਦੀ ਭੁੱਖ ਕਦੇ ਵੀ ਤ੍ਰਿਪਤ ਨਹੀਂ ਹੋ ਸਕਦੀ। ਭਾਵੇਂ ਕਹੀਆਂ ਜਾਂਦੀਆਂ ਨੇ ਪੁਰੀਆਂ ਦਾ ਭਾਰ ਵੀ ਉਹ ਆਪਣੇ ਢਿੱਡ ਵਿਚ ਪਾ ਲਵੇ। ਭਾਵ ਤ੍ਰਿਸ਼ਨਾਲੂ ਮਨੁੱਖ ਦੇ ਸਰੀਰੀ ਮਨ ਦੀ ਭੁੱਖ ਕਦੇ ਖਤਮ ਨਹੀਂ ਹੋ ਸਕਦੀ। ਉਹ ਹਉਮੈ ਨਾਲ ਗ੍ਰਸਤ ਆਪਣੇ ਅਚੇਤ ਮਨ ਦੀਆਂ ਬੇਲੋੜੀਆਂ ਇੱਛਾਵਾਂ ਭਾਵ ਤ੍ਰਿਸ਼ਨਾ ਵਿਚ ਭਟਕਦਾ ਹੋਇਆ ਪਸ਼ੂ ਦੀ ਪੱਧਰ ਉੱਤੇ ਹੀ ਆਪਣੀ ਸਾਰੀ ਜ਼ਿੰਦਗੀ ਬਤੀਤ ਕਰ ਲੈਂਦਾ ਹੈ।

ਆਪਣੀਆਂ ਬੇਲੋੜੀਆਂ ਇੱਛਾਵਾਂ ਦੀ ਪੂਰਤੀ ਲਈ ਮਨੁੱਖ ਦਿਨ-ਰਾਤ ਸਰੀਰ ਨੂੰ ਟਿਕਣ ਨਹੀਂ ਦਿੰਦਾ। ਬੇਲੋੜੀ ਖਪਤਕਾਰੀ ਦੀ ਪੈਦਾ ਕੀਤੀ ਭਟਕਣਾ ਨੇ ਮਨੁੱਖ ਕੋਲੋਂ ਕੁਦਰਤੀ ਨਿਆਮਤ ਨੀਂਦ ਵੀ ਖੋਹ ਲਈ ਹੈ। ਉਸ ਨੂੰ ਸੰਤੁਲਿਤ ਭੋਜਨ ਦੀ ਪਛਾਣ ਹੀ ਨਹੀਂ ਰਹੀ। ਰੂਹਾਨੀ ਪੱਖ ਤੋਂ ਬਿਨਾ ਅਸੀਂ ਸਹਿਣਸ਼ੀਲਤਾ, ਪਿਆਰ, ਸ਼ਾਂਤਮਈ ਸਹਿਰੋਂਦ, ਸਰਬਤ ਦੀ ਚਿੰਤਾ ਅਤੇ ਸਰਬਤ ਦੇ ਭਲੇ ਵਰਗੀਆਂ ਕਦਰਾਂ ਕੀਮਤਾਂ ਵਿਕਸਤ ਨਹੀਂ ਕਰ ਸਕਦੇ। ਇਹ ਕਦਰਾਂ ਕੀਮਤਾਂ ਗੁਰੂ ਨਾਨਕ ਦੇ ਪੈਗ਼ਾਮ ਦਾ ਨਿਚੋੜ ਹਨ। ਇਸ ਤੋਂ ਪਹਿਲਾਂ ਕਿ ਸਾਡੇ ਸਾਰਿਆਂ ਲਈ ਹਾਲਤਾਂ ਬਦ ਤੋਂ ਹੋਰ ਬਦਤਰ ਹੋ ਜਾਣ, ਸਾਨੂੰ ਰੂਹਾਨੀਅਤ ਨੂੰ ਇੱਕ ਮੌਕਾ ਦੇਣਾ ਚਾਹੀਦਾ ਹੈ। ਇਹੀ ਕਾਰਣ ਹੈ ਕਿ ਬਾਣੀ ਵਿਚੋਂ ਜਿਹੜਾ ਮਨੁੱਖ ਉੱਭਰਦਾ ਹੈ ਜਾਂ ਜਿਸ ਮਨੁੱਖ ਨੂੰ ਪ੍ਰਵਾਨਗੀ ਮਿਲਦੀ ਹੈ, ਉਹ ਮਨੁੱਖ ਨੈਤਿਕ ਮੁੱਲਾਂ ਵਾਲਾ ਹੈ। ਭਾਵ ਬਾਣੀ ਸੰਸਾਰ ਵਿਚ ਉਹ ਮਨੁੱਖ ਮੁਕਤ ਹੈ, ਸਚਿਆਰਾ ਹੈ, ਗੁਰਮੁਖ ਜਾਂ ਸੰਤ ਹੈ ਜਿਸ ਨੇ ਨੈਤਿਕ ਮੁੱਲਾਂ ਦੇ ਝਰੇਖੇ ਵਿਚੋਂ ਆਪਣੇ ਆਪ ਨੂੰ ਪ੍ਰਵਾਨ ਕਰਵਾਇਆ ਹੈ। ਇਹ ਤੱਥ ਭਲੀ ਭਾਂਤ ਜਾਣ ਲੈਣਾ ਜ਼ਰੂਰੀ ਹੈ ਕਿ ਗੁਰਮਤਿ ਵਿਚਾਰਧਾਰਾ ਦਾ ਇਕ ਬਿੰਦੂ ਜੇਕਰ ਬ੍ਰਹਮ ਨਾਲ ਜੁੜਿਆ ਹੈ ਤਾਂ ਦੂਸਰਾ ਬਿੰਦੂ ਬ੍ਰਹਮ ਵਰੋਸਾਈ ਧਰਤੀ ਨਾਲ ਸੰਬੰਧਤ ਹੈ। ਗੁਰਮਤਿ ਵਿਚਾਰਧਾਰਾ ਦੀ ਵਡਿਆਈ ਦਾ ਰਹੱਸ ਹੀ ਇਹ ਹੈ ਕਿ ਇਸ ਦੇ ਆਰ-ਪਾਰ ਇਕ ਨੈਤਿਕ ਮੁੱਲਾਂ ਵਾਲਾ ਸੰਸਾਰ ਵੱਸਿਆ ਹੋਇਆ ਹੈ।⁵

"ਸਤੁ, ਸੰਤੋਖ, ਗਿਆਨ" ਸਿੱਖ - ਸਦਾਚਾਰ ਦੇ ਪ੍ਰਮੁੱਖ ਨੈਤਿਕ ਗੁਣ ਹਨ। ਇਨ੍ਹਾਂ ਵਿਚੋਂ ਸਤੁ ਉਸ ਅਭਿਆਸ ਵੱਲ ਸੰਕੇਤ ਹੈ, ਜੋ ਸੱਚ ਦੇ ਆਦਰਸ਼ ਨੂੰ ਵਿਹਾਰਕ ਜੀਵਨ ਵਿਚ ਸੱਚ-ਆਚਾਰ ਦੇ ਰੂਪ ਵਿਚ ਗ੍ਰਹਿਣ ਕਰਾਉਂਦਾ ਹੈ। 'ਸਤ' ਨੂੰ ਅਕਸਰ ਜਤੁ ' ਨਾਲ ਜੋੜ ਕੇ 'ਜਤੁ ਸਤੁ' ਦਾ ਰੂਪ ਦਿੱਤਾ ਜਾਂਦਾ ਹੈ, ਜਿਸ ਤੋਂ ਭਾਵ ਹੈ ਇਕ ਪਾਸੇ ਸਵੈ-ਕਾਬੂ ਜਾਂ ਮਨੋਵੇਗਾਂ ਉਪਰ ਵਸੀਕਾਰ ਅਤੇ ਦੂਸਰੇ ਪਾਸੇ ਸੁੱਚਮ ਜਾਂ ਪਵਿਤ੍ਰਤਾ ਦਾ ਜੀਵਨ। ਇਸ ਗੁਣ ਦਾ ਪ੍ਰਗਟਾਵਾ ਵਿਅਕਤੀ ਦੇ ਨਿਆਂ-ਪੂਰਨ ਵਿਵਹਾਰ, ਵਿਆਹੁਤਾ ਜੀਵਨ ਦੀ ਵਫ਼ਾ ਅਤੇ ਹੱਕ-ਹਲਾਲ ਦੀ ਕਮਾਈ ਰਾਹੀਂ ਹੁੰਦਾ ਹੈ। ਸੰਤੋਖ ਦਾ ਗੁਣ ਹੀ ਸਦਾਚਾਰ ਦੀ ਉੱਤਮਤਾ ਲਈ ਆਵੱਸ਼ਕ ਹੈ। ਇਹ ਵਿਅਕਤੀ ਦੀਆਂ ਲਾਲਸਾਵਾਂ, ਕਾਮਨਾਵਾਂ ਤੇ ਲੋਭ-ਲਾਲਚ ਨੂੰ ਬੇਮੋਚ ਤੇ ਬੇਮੁਹਾਰ ਹੋਣ ਤੋਂ ਰੋਕਦਾ ਹੈ ਅਤੇ ਉਸ ਨੂੰ ਸੰਜਮ ਵਿਚ ਰਹਿਣ ਦੀ ਪ੍ਰੇਰਨਾ ਦਿੰਦਾ ਹੈ। 'ਸੰਤੋਖੀ ਜਿਊੜੇ' ਹੀ ਸੇਵਾ ਤੇ ਉਪਕਾਰ ਦੇ ਸਮਰੱਥ ਹਨ। 'ਗਿਆਨ ਜਾਂ ਵਿਚਾਰਸ਼ੀਲਤਾ' ਬੌਧਿਕ ਗੁਣ ਹੈ, ਜੋ ਗੁਰੂ ਸਾਹਿਬਾਨ ਨੇ ਪ੍ਰਮੁੱਖ ਸਦਗੁਣਾਂ ਵਿਚ ਗਿਣਿਆ ਹੈ। ਸਦਗੁਣਾਂ ਦੀ ਕੋਈ ਵੀ ਸੂਚੀ ਸੂਝ-ਸਿਆਣਪ ਜਾਂ ਦਾਨਾਈ ਦੇ ਵਿਵੇਕਸ਼ੀਲ ਗੁਣ ਤੋਂ ਬਿਨਾ ਮੁਕੰਮਲ ਨਹੀਂ, ਕਿਉਂਕਿ ਮਨ ਦੇ ਵਿਕਾਰਾਂ ਤੇ ਵੇਗਾਂ ਉਪਰ ਉੱਚੀ ਮਤ ਦਾ ਸੁਲਝਿਆ ਹੋਇਆ ਸੰਜਮ ਹੀ ਵਿਅਕਤੀ ਨੂੰ ਸਦਾਚਾਰ ਦੇ ਮਾਰਗ ਉੱਤੇ

ਅਡੋਲ ਰੱਖ ਸਕਦਾ ਹੈ।⁶ ਗੁਰਬਾਣੀ ਅਨੁਸਾਰ, ਗੁਣਾਤਮਕ ਸਾਂਝ ਦੀ ਕਮਾਈ ਨਾਲ, ਔਗੁਣ (ਅਨੈਤਿਕਤਾ) ਵੀ, ਨੈਤਿਕਤਾ (ਗੁਣਾਂ) ਵਿਚ, ਸਹਿਜੇ ਹੀ ਰੂਪਾਂਤਰਿਤ ਹੋ ਸਕਦੇ ਹਨ :-

ਸਚਹੁ ਓਰੈ ਸਭੁ ਕੇ ਉਪਰਿ ਸਚੁ ਆਚਾਰੁ॥⁷

ਇਸ ਤਰ੍ਹਾਂ, ਸੱਚ ਦੀ ਅਹਿਮੀਅਤ ਦਰਸਾ ਕੇ, ਆਚਾਰ ਨੂੰ, ਸੱਚ ਤੋਂ ਵਧੇਰੇ ਮਹੱਤਤਾ ਦਿੰਦੀ ਹੈ। ਇਹ ਮਨੁੱਖੀ-ਨੈਤਿਕਤਾ ਦਾ ਪਹਿਲਾ ਪਾਠ ਹੈ। ਗੁਰਬਾਣੀ, ਅਨੈਤਿਕਤਾ ਨੂੰ ਵੰਗਾਰਦੀ ਹੀ ਨਹੀਂ, ਸਗੋਂ ਉਸ ਦਾ ਬਦਲ, ਤਰਕਸੰਗਤ ਢੰਗ ਨਾਲ, ਨੈਤਿਕਤਾ ਰਾਹੀਂ ਪੇਸ਼ ਵੀ ਕਰਦੀ ਹੈ। ਸਗੋਂ ਬਾਣੀਕਾਰ, ਦੂਜਿਆਂ ਦੇ ਹੱਕ ਮਾਰਨ ਵਾਲੇ ਨੂੰ ਵੀ, 'ਅਧਰਮੀ' ਅਨੈਤਿਕ ਮੰਨਦੇ ਹਨ। ਜੀਵ-ਹੱਤਿਆ ਨੂੰ ਵੀ ਗੁਰੂ, ਅਸਮਾਜਕ ਕਾਰਜ ਮੰਨਦੇ ਹਨ। ਅਧਰਮੀ ਅਨੈਤਿਕ ਕਾਰਜਾਂ ਦਾ ਵਿਰੋਧ, ਉਹ ਤਿੱਖੇ ਵਿਅੰਗ ਰਾਹੀਂ ਉਸਾਰਦੇ ਹਨ :-

ਹਰੁ ਪਰਾਇਆ ਨਾਨਕਾ ਉਸੁ ਸੂਅਰ ਉਸੁ ਗਾਇ॥

ਗੁਰੁ ਪੀਰੁ ਹਾਮਾ ਤਾ ਭਰੇ ਜਾ ਮੁਰਦਾਰੁ ਨ ਖਾਇ॥⁸

ਗੁਰਮੁਖ ਜੀਵ ਲਈ ਘਰ ਤੇ ਜੰਗਲ ਆਪਣੇ ਆਪ ਹੀ ਇਕ ਸਮਾਨ ਹੋ ਜਾਂਦੇ ਹਨ। ਉਸ ਦੀ ਦੁਰਮਤ ਚਲੀ ਜਾਂਦੀ ਹੈ ਅਤੇ ਪ੍ਰਭੂ-ਉਸਤਤ ਆ ਵੱਸਦੀ ਹੈ। ਉਸਦੇ ਮੁੱਖ ਵਿਚ ਸਚਾ ਨਾਮ ਹੁੰਦਾ ਹੈ ਕਿਉਂਕਿ ਸਫਲ ਜੀਵਨ ਲਈ ਇਹੋ ਸੱਚਾ ਰਸਤਾ ਹੈ।

ਗਿਰੁ ਬਨੁ ਸਮਸਰਿ ਸਹਜਿ ਸੁਭਾਇ ॥

ਦੁਰਮਤਿ ਗਤੁ ਭਈ ਕੀਰਤਿ ਠਾਇ ॥

ਸਚ ਪਉੜੀ ਸਾਚਉ ਮੁਖ ਨਾਉ॥⁹

ਗੁਰੂ ਨਾਨਕ ਬਾਣੀ ਕਿਤੇ ਵੀ ਕਿਸੇ ਮਨੁੱਖ, ਜਾਤ, ਨਸਲ ਨਾਲ ਨਫ਼ਰਤ ਜਾਂ ਈਰਖਾ ਭਾਵ ਦੀ ਭਾਵਨਾ ਰੱਖਣੀ ਨਹੀਂ ਸਿਖਾਉਂਦੀ ਬਲਕਿ ਸਭ ਨੂੰ ਉਸ ਅਕਾਲਪੁਰਖ ਦੀ ਸਿਰਜਣਾ ਜਾਣ ਕੇ ਜੀਵਨ ਬਤੀਤ ਕਰਨ ਲਈ ਪ੍ਰੇਰਦੀ ਹੈ। ਗੁਰੂ ਨਾਨਕ ਬਾਣੀ ਸਹਿਰੋਂਦ ਦੀ ਭਾਵਨਾ ਅਤੇ ਅਮਨ ਸ਼ਾਂਤੀ ਲਈ ਸਮੁੱਚੀ ਮਾਨਵਤਾ ਨੂੰ ਸੰਦੇਸ਼ ਦਿੰਦੀ ਹੈ:

ਜਬ ਲਗੁ ਦੁਨੀਆ ਰਹੀਐ

ਨਾਨਕੁ ਕਿਛੁ ਸੁਣੀਐ ਕਿਛੁ ਕਹੀਐ॥¹⁰

ਇਹ ਸਰੀਰ ਆਤਮਾ, ਬ੍ਰਹਮ ਜੋਤਿ ਦਾ ਮੰਦਰ ਹੈ, ਇਸ ਲਈ ਇਸ ਨੂੰ ਅਰੇਗ ਤੇ ਸ਼ੁੱਧ ਸਾਫ ਰੱਖਣਾ ਜ਼ਰੂਰੀ ਹੈ। ਸਰੀਰ ਨੂੰ ਮਨ, ਬਚਨ, ਕਰਮ ਕਰਕੇ ਮਲੀਨ ਨਹੀਂ ਹੋਣ ਦੇਣਾ ਚਾਹੀਦਾ ਹੈ। ਇਸ ਦੇ ਪਵਿੱਤਰ ਹੋਣ ਤੇ ਇਸ ਨੂੰ ਪਵਿੱਤਰ ਰੱਖਣ ਦੇ ਖਿਆਲ ਨੇ ਸਾਡੀ ਧਾਰਮਿਕ ਤੇ ਅਖਲਾਕੀ ਉੱਚਤਾ ਤੇ ਸੇਧ ਨੂੰ ਖਾਸਾ ਸੁੱਚਾ ਰੱਖਿਆ ਹੈ।¹¹ ਸਾਨੂੰ ਏਸ ਗੱਲ ਵੱਲੋਂ ਜ਼ਰੂਰ ਖ਼ਬਰਦਾਰ ਰਹਿਣਾ ਚਾਹੀਦਾ ਹੈ ਕਿ ਇਨ੍ਹਾਂ ਲੋੜਾਂ ਦੇ ਮੰਗਣ ਵਿਚ 'ਲਬ' 'ਲੋਭ' ਨਾ ਆ ਜਾਵੇ। ਅਸੀਂ ਸਰੀਰਕ ਸੁਖਾਂ ਵਿਚ ਖੱਚਤ ਨਾ ਹੋ ਜਾਈਏ! 'ਅਹਿ ਜਗ ਮਿੱਠਾ-ਅੱਗਾ ਕਿਨ ਡਿੱਠਾ' ਕਹਿ ਕੇ ਪਸ਼ੂ ਬਿਰਤੀਆਂ ਦੇ ਗੁਲਾਮ ਨਾ ਬਣ ਜਾਈਏ। ਸਰੀਰ ਨੂੰ ਕਾਇਮ ਰੱਖਣਾ ਇਕ ਸਾਧਨ ਹੈ। ਅਸਲ ਜੀਵਨ ਤਾਂ ਆਤਮਿਕ ਜੀਵਨ ਹੈ। ਸਰੀਰ ਦੇ ਗੁਲਾਮ ਹੋ ਗਏ ਤਾਂ ਪਸ਼ੂ ਹੋ ਗਏ।¹²

ਨੈਤਿਕ ਗੁਣ ਦੇ ਵਿਕਾਸ ਦਾ ਦੂਸਰਾ ਪੱਖ ਔਗੁਣ ਜਾਂ ਬੁਰਾਈ ਉੱਤੇ ਬੰਧੇਜ਼ ਹੈ। ਸਿੱਖ ਧਰਮ ਦੀ ਨੈਤਿਕਤਾ 'ਹਉਮੈ' ਨੂੰ ਬੁਰਾਈਆਂ ਦਾ ਮੂਲ ਮੰਨਦੀ ਹੈ। ਗੁਰਬਾਣੀ ਵਿਚ ਕਾਮ, ਕ੍ਰੋਧ, ਲੋਭ, ਮੋਹ, ਹੰਕਾਰ ਨੂੰ ਪੰਜ ਵਿਕਾਰ, ਪੰਜ ਚੋਰ ਆਦਿ ਕਿਹਾ ਹੈ ਅਤੇ ਇਨ੍ਹਾਂ ਨੂੰ ਰਾਸ ਕਰਨ ਉੱਤੇ ਅਤਿਅੰਤ ਬਲ ਦਿੱਤਾ ਗਿਆ ਹੈ। ਇਹ ਪੰਜੇ ਵਿਕਾਰ ਹਉਮੈ - ਭਾਵ ਦੀ ਉਪਜ ਹਨ। ਮਨੁੱਖ ਨੂੰ ਹਉਮੈ ਦੇ ਦੀਰਘ ਰੋਗ ਦੀ ਜਾਂਚ-ਪੜਤਾਲ ਕਰ ਕੇ ਇਸ ਦਾ ਇਲਾਜ ਲੱਭਣ ਦੀ ਪ੍ਰੇਰਨਾ ਕੀਤੀ ਗਈ ਹੈ। ਨਾਨਕ ਬਾਣੀ ਨੇ ਜੋ ਇਲਾਜ ਸੁਝਾਇਆ ਹੈ, ਉਹ 'ਹੁਕਮ' ਦੀ ਪਛਾਣ ਹੈ : ਨਾਨਕ ਹੁਕਮੈ ਜੋ ਬੁਝੈ ਤ ਹਉਮੈ ਕਰੈ ਨ ਕੇਇ।¹³ ਪਖੰਡ ਇਕ ਹੋਰ ਬੁਰਾਈ ਹੈ, ਜਿਸ ਸੰਬੰਧੀ ਗੁਰੂ ਨਾਨਕ ਦੀ ਦੇ-ਤਰਫ਼ੀ ਤਾੜਨਾ ਹੈ : "ਛੇਡੀਲੇ ਪਾਖੰਡਾ!"¹⁴ ਇਸੇ ਤਰ੍ਹਾਂ ਨਿੰਦਾ, ਕਠੋਰਤਾ, ਪਰਾਇਆ ਹੱਕ ਤੇ ਵਹਿਮਾਂ-ਭਰਮਾਂ ਨੂੰ ਤਿਆਗਣ ਦੇ ਆਦੇਸ਼ ਪ੍ਰਾਪਤ ਹਨ।¹⁵ ਆਸਾ ਦੀ ਵਾਰ ਵਿਚ ਸ੍ਰੀ ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ ਨੇ ਮਨੁੱਖੀ ਜੀਵਨ ਦੇ ਵੱਖ-ਵੱਖ ਪਹਿਲੂਆਂ ਸੱਚ-ਝੂਠ, ਨੇਕੀ-ਬਦੀ, ਪਿਆਰ-ਨਫ਼ਰਤ, ਖਰਾ-ਖੇਟਾ ਆਦਿ ਜੋ ਨਿਵੇਕਲਾ ਅਤੇ ਦਾਰਸ਼ਨਿਕ ਚਿਤਰਨ ਚਿਤਰਿਆ ਹੈ। ਖੇਟੇ ਵਪਾਰ ਵਿਚ ਲਗਿਆ, ਮਨ ਤੇ ਤਨ ਖੇਟੇ ਰਹਿੰਦੇ ਹਨ। ਖੇਟੇ ਵਪਾਰ ਵਿਚ ਲਗਿਆ ਅਗੇ ਬੜਾ ਦੁਖ ਸਹਿਣਾ ਪੈਂਦਾ ਹੈ। ਉਹ ਉਵੇਂ ਹੀ ਦੁਖੀ ਹੋਕੇ ਰੋਂਦੇ ਹਨ ਜਿਵੇਂ ਫ਼ਾਹੀ ਫਾਥੇ ਹਿਰਨ ਨੂੰ ਦੁਖ ਹੁੰਦਾ ਹੈ ਤੇ ਉਹ ਦੁਖ ਵਿਚ ਰੋਂਦਾ ਹੈ।

ਖੇਟੇ ਵਣਜਿ ਵਣਜਿਐ ਮਨੁ ਤਨੁ ਖੇਟਾ ਹੋਇ।

ਫਾਹੀ ਫਾਥੇ ਮਿਰਗ ਜਿਉ ਦੁਖੁ ਘਣੇ ਨਿਤ ਹੋਇ॥¹⁶

ਸ਼ਖਸੀ ਉੱਨਤੀ ਲਈ ਸਭ ਤੋਂ ਪਹਿਲਾ ਕਦਮ ਇਹ ਹੈ ਕਿ ਮਨੁੱਖ ਨੂੰ ਆਪਣੇ ਆਲੇ-ਦੁਆਲੇ ਦਾ ਪੂਰਾ ਗਿਆਨ ਹੋਵੇ। ਪ੍ਰਕਿਰਤੀ ਦੀ ਪੂਰੀ ਸੂਝ ਹੋਵੇ। ਉਹ ਜਦ ਧਰਤੀ ਤੇ ਧਰਤੀ ਦੇ ਪਦਾਰਥਾਂ ਨੂੰ ਤੱਕਦਾ ਹੈ ਤਾਂ ‘ਗੁਰੂ ਏਕੁ ਧਿਆਨੁ, ਦੀ ਰਹਿਨੁਮਾਈ ਵਿਚ ਉਸ ਨੂੰ ਇਸ ਗੱਲ ਦਾ ਚਾਨਣਾ ਹੁੰਦਾ ਹੈ ਕਿ ਸਾਰਾ ਬ੍ਰਹਮੰਡ ਨਿਯਮਾਂ ਅਨੁਸਾਰ ਚੱਲ ਰਿਹਾ ਹੈ। ਗੁਰੂ ਨਾਨਕ ਸਾਹਿਬ ਨੇ ਗ੍ਰਹਿਸਤ ਵਿਚ ਵਿਚਰਦਿਆਂ ਹੀ ਜੀਵਨ ਜਿਉਣ ਦੀ ਸੁਚੱਜੀ ਜਾਂਚ ਸਿਖਾਈ ਹੈ। ਸਿਧ ਗੋਸਟਿ ਵਿਚ ਵੀ ਆਪ ਜੀ ਨੇ ਕੰਵਲ ਦੇ ਫੁੱਲ ਦੀ ਉਦਾਹਰਣ ਦੁਆਰਾ ਸੰਸਾਰ ਵਿਚ ਰਹਿਣ ਦੀ ਅਸਲ ਜੁਗਤ ਸਮਝਾਈ ਹੈ ਕਿ ਕਿਸ ਤਰ੍ਹਾਂ ਚਿੱਕੜ ਵਿਚ ਵੀ ਹੁੰਦਿਆਂ ਹੋਇਆ ਕੰਵਲ ਇਸ ਤੋਂ ਅਭਿੱਜ ਰਹਿੰਦਾ ਹੈ।

ਗੁਰੂ ਨਾਨਕ ਬਾਣੀ ਵਿਚਲੀ ਸੁਤੰਤਰ ਇੱਛਾ ਅਤੇ ਕਰਮ ਸਿਧਾਂਤ ਇਹ ਸੁਝਾਉਂਦੇ ਹਨ ਕਿ ਜੀਵ ਚੰਗੇ ਜਾਂ ਮਾੜੇ ਵਿਚ ਚੋਣ ਦਾ ਆਧਾਰ ਨੈਤਿਕਤਾ ਹੀ ਹੈ।¹⁷ ਕਿਸੇ ਦਾ ਧਰਮ ਉਹ ਨਹੀਂ ਜਿਸ ਦਾ ਉਹ ਜੁਬਾਨੀ ਦਾਅਵਾ ਕਰਦਾ ਹੈ ਸਗੋਂ ਉਹ ਹੈ ਜੋ ਉਸ ਦੇ ਅੰਦਰ ਹੈ ਤੇ ਜਿਸ ਨੇ ਉਹ ਦੀ ਸ਼ਖਸੀਅਤ ਬਣਾਈ ਹੈ। ਇਸ ਧਰਮ ਨੂੰ ਪ੍ਰਾਪਤ ਕਰਨ ਲਈ ਮਿਹਨਤ ਕਰਨੀ ਪੈਂਦੀ ਹੈ। ਬਾਹਰਲੀਆਂ ਰਹੁ-ਰੀਤਾਂ ਨਾਲ ਕੁਝ ਨਹੀਂ ਸੰਵਾਰਦਾ। ਸੁਨਿਆਰੇ ਦੇ ਪਹਾਰੇ, ਭਠੀ ਚੜ੍ਹ ਕੇ ਸੋਨੇ ਦੇ ਸੁੱਧ ਹੋਣ ਵਾਂਗ ਤਾਊ ਕਸੌਟੀ ਲਗਦੀ ਹੈ। ਸੇਵਾ, ਤਿਆਗ, ਕੁਰਬਾਨੀ ਤੇ ਸੱਚ ਦੇ ਰਾਹ ਤੇ ਤੁਰਨਾ ਪੈਂਦਾ ਹੈ।¹⁸ ਸਚਿਆਰ ਸ਼ਖਸੀਅਤ ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ ਦਾ ਆਦਰਸ਼ ਹੈ। ਗੁਰੂ ਜੀ ਦੇ ਮੰਤਵ ਤੇ ਫਲਸਫੇ ਦਾ ਆਧਾਰ ਹੈ। ਗੁਰੂ ਦੁਆਰਾ ਸਮ-ਦਰਸ਼ੀ ਹੋ ਕੇ ਦੇਖੋ, ਹਰ ਹਿਰਦੇ ਵਿਚ ਇਕੋ ਜੇਤ ਵਿਆਪਕ ਹੈ।

ਗੁਰਮੁਖਿ ਏਕ ਦ੍ਰਿਸਟਿ ਕਰਿ ਦੇਖਹੁ ਘਟਿ ਘਟਿ ਜੋਤਿ ਸਮੇਈ ਜੀਉ।¹⁹

ਸਮੁੱਚੇ ਤੌਰ ਤੇ ਕਿਹਾ ਜਾ ਸਕਦਾ ਹੈ ਕਿ ਗੁਰੂ ਨਾਨਕ ਬਾਣੀ ਦੇ ਮੂਲ ਸਰੋਕਾਰ ਮਨੁੱਖ ਨੂੰ ਨੈਤਿਕ ਪੱਖੋਂ ਬਲਵਾਨ ਬਣਾਉਂਦੇ ਹੈ। ਇਹੀ ਕਾਰਣ ਹੈ ਕਿ ਬਾਣੀ ਵਿਚੋਂ ਇਕ ਆਦਰਸ਼ਕ ਮਨੁੱਖ ਦਾ ਬਿੰਬ ਉਭਰਦਾ ਹੈ ਜੋ ਸਰਬੱਤ ਦੇ ਭਲੇ ਨੂੰ ਆਪਣਾ ਪ੍ਰਯੋਜਨ ਬਣਾਉਂਦਾ ਹੈ। ਬਾਣੀ ਦਾ ਨੈਤਿਕ ਪੱਖ ਏਨਾ ਮੁੱਲਵਾਨ ਹੈ ਕਿ ਇਸ ਦੇ ਝਰੋਖੇ ਵਿਚੋਂ ਉਸ ਜ਼ਿੰਦਗੀ ਦੇ ਦੀਦਾਰ ਹੁੰਦੇ ਹਨ ਜਿਸ ਦੇ ਆਰ-ਪਾਰ ਸੱਚੇ ਸੱਚ ਪਸਰਿਆ ਹੋਇਆ ਹੈ। ਅੱਜ ਵਿਸ਼ਵ ਨੇ ਵਿਗਿਆਨਿਕ ਉੱਨਤੀ ਕਰਕੇ ਮਨੁੱਖ ਲਈ ਹਰ ਤਰ੍ਹਾਂ ਦੇ ਸੁਖ-ਸਾਧਨ ਇਕੱਤਰ ਕਰ ਲਏ ਹਨ। ਪਰ ਇਨ੍ਹਾਂ ਸਾਧਨਾਂ ਦੀ ਦੁਰਵਰਤੋਂ ਅਸ਼ਾਂਤੀ, ਤਣਾਅ, ਦੁੱਖ ਅਤੇ ਹਉਮੈ ਵਿਚ ਵਾਧਾ ਹੀ ਕਰਦੀ ਹੈ। ਅਜਿਹੇ ਸਮੇਂ ਵਿਚ ਸ਼ਬਦ ਗੁਰੂ ਦੁਆਰਾ ਦਰਸਾਈਆਂ ਨੈਤਿਕ ਕਦਰਾਂ-ਕੀਮਤਾਂ ਸਮੁੱਚੀ ਮਾਨਵਤਾ ਦੀ ਅਗਵਾਈ ਕਰਨ ਦੇ ਸਮਰੱਥ ਹਨ।

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ਭਾਉ ਖਲਾ ਅਗਨਿ ਤਪ ਤਾਉ ।

ਭਾਂਡਾ ਭਾਉ ਅੰਮ੍ਰਿਤੁ ਤਿਤੁ ਢਾਲਿ ॥

ਘੜੀਐ ਸਬਦੁ ਸਚੀ ਟਕਸਾਲ

ਜਿਨ ਕਉ ਨਦਰਿ ਕਰਮੁ ਤਿਨ ਕਾਰ ॥

ਨਾਨਕ ਨਦਰੀ ਨਦਰਿ ਨਿਹਾਲ॥

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ਭਾਸ਼ਾ ਅਤੇ ਸਾਹਿਤਕ ਭਾਸ਼ਾ

*ਮਨਪ੍ਰੀਤ ਕੌਰ

*ਖੇਜਾਰਬੀ, ਪੰਜਾਬੀ ਵਿਭਾਗ, ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਵਰਲਡ ਯੂਨੀਵਰਸਿਟੀ, ਫਤਹਿਗੜ੍ਹ ਸਾਹਿਬ।

manpreetpawar95@gmail.com

Abstract

ਭਾਸ਼ਾ ਮਨੁੱਖ ਦੇ ਅਨੁਭਵਾਂ, ਤਜਰਬਿਆਂ ਨੂੰ ਸੂਤਰਬੱਧ ਕਰਕੇ ਗਿਆਨ ਪ੍ਰਬੰਧ ਸਿਰਜਣ ਦਾ ਵਸੀਲਾ ਹੈ। ਭਾਸ਼ਾ ਸੰਬੰਧਤ ਖਿੱਤੇ ਦੇ ਸਿਰਜੇ ਹੋਏ ਸੱਭਿਆਚਾਰਕ, ਸਮਾਜਕ, ਆਰਥਕ, ਰਾਜਸੀ ਗਿਆਨ ਪ੍ਰਬੰਧ ਨੂੰ ਅਗਾਂਹ ਤੋਰਨ ਅਤੇ ਨਵੀਆਂ ਕਾਢਾਂ ਲਈ ਕਲਪਨਾ ਸ਼ਕਤੀ ਦਾ ਆਧਾਰ ਬਣਦੀ ਹੈ। ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਦਾ ਸੰਬੰਧ ਕਲਾਤਮਕ ਸੰਸਾਰ ਦੀ ਸਿਰਜਣਾ ਨਾਲ ਹੈ। ਇਸ ਵਿਚ ਬੰਦੇ ਦੇ ਅਨੁਭਵਾਂ, ਤਜਰਬਿਆਂ ਅਤੇ ਵਸਤੂ ਸੰਸਾਰ ਦੀਆਂ ਉਘੜ-ਦੁਘੜੀਆਂ ਸੰਰਚਨਾਵਾਂ ਨੂੰ ਵਿਸ਼ੇਸ਼ ਕਲਾਤਮਕ ਭਾਸ਼ਾਈ ਜੁਗਤਾਂ ਰਾਹੀਂ, ਨਿਸ਼ਚਤ ਪ੍ਰਸੰਗ ਅਧੀਨ, ਇਕ ਖਾਸ ਉਦੇਸ਼ ਨਾਲ ਸਿਰਜਿਆ ਜਾਂਦਾ ਹੈ। ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਇਤਿਹਾਸਕ ਵਿਖਿਆਨ ਵਾਂਗ ਬੀਤੇ ਦਾ ਤੱਥਾਤਮਕ ਵੇਰਵਾ ਦੇਣ ਤਕ ਸੀਮਤ ਨਹੀਂ ਰਹਿੰਦੀ ਬਲਕਿ ਇਸ ਸਾਹਿਤਕ ਸੰਸਾਰ ਵਿਚ ਬੀਤ ਚੁੱਕੇ ਅਤੇ ਵਾਪਰ ਰਹੇ ਵਿਚ ਸੰਵਾਦ ਰਚਾ ਕੇ ਸੀਮਾਵਾਂ ਅਤੇ ਸੰਭਾਵਨਾਵਾਂ ਵਾਲਾ ਪ੍ਰਵਚਨ ਸਿਰਜਦੀ ਹੈ। ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਆਪਣੀ ਇਸੇ ਸੰਵਾਦੀ ਸੁਰ ਰਾਹੀਂ ਵਿਭਿੰਨ ਪ੍ਰਵਚਨ ਵਿਚਲੇ ਸਾਂਵੇ-ਅਸਾਂਵੇ ਸੰਬੰਧਾਂ ਨੂੰ ਸਿਰਜਦੀ ਹੈ।

ਭਾਸ਼ਾ ਮਨੁੱਖ ਦੇ ਅਨੁਭਵਾਂ, ਤਜਰਬਿਆਂ ਨੂੰ ਸੂਤਰਬੱਧ ਕਰਕੇ ਗਿਆਨ ਪ੍ਰਬੰਧ ਸਿਰਜਣ ਦਾ ਵਸੀਲਾ ਹੈ। ਭਾਸ਼ਾ ਸੰਬੰਧਤ ਖਿੱਤੇ ਦੇ ਸਿਰਜੇ ਹੋਏ ਸੱਭਿਆਚਾਰਕ, ਸਮਾਜਕ, ਆਰਥਕ, ਰਾਜਸੀ ਗਿਆਨ ਪ੍ਰਬੰਧ ਨੂੰ ਅਗਾਂਹ ਤੋਰਨ ਅਤੇ ਨਵੀਆਂ ਕਾਢਾਂ ਲਈ ਕਲਪਨਾ ਸ਼ਕਤੀ ਦਾ ਆਧਾਰ ਬਣਦੀ ਹੈ। ਮਨੁੱਖੀ ਭਾਸ਼ਾ ਸੰਬੰਧੀ ਡਾ. ਯੂਵਲ ਨੋਆ ਹਰਾਰੀ (Yuval Noah Harari) ਦੇ ਵਿਚਾਰ ਵੇਖੇ ਜਾ ਸਕਦੇ ਹਨ। ਉਹ ਮਨੁੱਖ ਦੀ ਹੋਰਨਾਂ ਜੀਵਾਂ ਉੱਪਰ ਸਿਕਦਾਰੀ ਦਾ ਕਾਰਨ ਇਸ ਦੀ ਵਿੱਲਖਣ ਭਾਸ਼ਾ ਨੂੰ ਮੰਨਦੇ ਹਨ “ਸਾਡੀ ਭਾਸ਼ਾ ਅਸਚਰਜ ਰੂਪ ਵਿਚ ਲਚਕੀਲੀ ਹੈ। ਅਸੀਂ ਧੁਨੀਆਂ ਅਤੇ ਸੰਕੇਤਾਂ ਦੀ ਸੀਮਤ ਸੰਖਿਆ ਨੂੰ ਜੋੜ ਕੇ ਅੰਤਹੀਣ ਵਾਕ ਬਣਾ ਸਕਦੇ ਹਾਂ। ਇਸ ਤਰ੍ਹਾਂ ਅਸੀਂ ਆਪਣੇ ਆਲੇ-ਦੁਆਲੇ ਦੀ ਦੁਨੀਆਂ ਬਾਰੇ ਅਸਾਧਾਰਨ ਮਾਤਰਾ ਵਿਚ ਜਾਣਕਾਰੀ ਗ੍ਰਹਿਣ ਕਰ ਸਕਦੇ ਹਾਂ, ਉਸ ਨੂੰ ਇਕੱਤਰ ਕਰ ਸਕਦੇ ਹਾਂ ਅਤੇ ਸੰਚਾਰਤ ਕਰ ਸਕਦੇ ਹਾਂ”¹। ਇਹ ਜਾਣਕਾਰੀ ਭਾਸ਼ਾ ਰਾਹੀਂ ਸੰਚਾਰਤ ਹੋ ਕੇ ਭਾਸ਼ਾ ਦਾ ਪ੍ਰਕਾਰਜ ਖੇਤਰ ਮੋਕਲਾ ਕਰਦੀ ਹੈ।

ਭਾਸ਼ਾ ਕੇਵਲ ਤੱਥਾਤਮਕ ਜਾਣਕਾਰੀ ਦੇਣ ਜਾਂ ਹੋਏ ਬੀਤੇ ਦਾ ਵੇਰਵਾ ਦੇਣ ਤਕ ਸੀਮਤ ਨਹੀਂ ਰਹਿੰਦੀ ਬਲਕਿ ਗਲਪਨਿਕ ਸਮਰੱਥਾ ਦੀ ਧਾਰਨੀ ਹੁੰਦੀ ਹੈ। ਇਹ ਗਲਪਨਿਕਤਾ ਮਨੁੱਖ ਦੀ ਕਲਪਨਾ ਨਾਲ ਸੰਬੰਧਤ ਹੈ “ਕਲਪਿਤ ਚੀਜ਼ਾਂ ਬਾਰੇ ਗੱਲ ਕਰਨ ਦੀ ਸਮਰੱਥਾ ਸੋਪੀਅਨਜ਼ ਦੀ ਭਾਸ਼ਾ ਦੀ ਸਭ ਤੋਂ ਵਿਲੱਖਣ ਵਿਸ਼ੇਸ਼ਤਾ ਹੈ”²। ਇਸ ਪ੍ਰਕਾਰ ਗ੍ਰਹਿਣ ਕੀਤਾ ਗਿਆਨ ਮਨੁੱਖ ਦੀ ਕਲਪਨਾ ਘੜਨ, ਵਿਕਸਤ ਕਰਨ ਅਤੇ ਮੁੜ ਉਸ ਕਲਪਨਾ ਦਾ ਭਾਸ਼ਾ ਰਾਹੀਂ ਸੰਚਾਰਤ ਹੋਣਾ ਭਾਸ਼ਾ ਦੇ ਪ੍ਰਕਾਰਜੀ ਮਹੱਤਵ ਦੀ ਗਵਾਹੀ ਭਰਦਾ ਹੈ। ਕੇਵਲ ਕਲਪਨਾ ਹੀ ਨਹੀਂ ਸਗੋਂ ਸੁਚੇਤ-ਅਚੇਤ ਪੱਧਰ ‘ਤੇ ਭਾਸ਼ਾ ਰਾਹੀਂ ਗ੍ਰਹਿਣ ਕੀਤਾ ਸਮਾਜਕ, ਸੱਭਿਆਚਾਰਕ, ਵਿਗਿਆਨਕ, ਆਦਿ ਗਿਆਨ ਵਿਅਕਤੀ ਦੇ ਅਵੇਰਤਨ ਨੂੰ ਘੜਦਾ ਹੈ। ਜਿਸ ਤੋਂ ਉਸ ਦਾ ਜਿੰਦਗੀ, ਕੁਦਰਤ ਆਦਿ ਪ੍ਰਤੀ ਨਜ਼ਰੀਆ, ਕੀਮਤਾਂ ਪ੍ਰਤੀ ਸਮਝ, ਦ੍ਰਿਸ਼ਟੀਕੋਣ ਅਤੇ ਨਿਸ਼ਚਤ ਵਿਚਾਰਧਾਰਾ ਬਣਦੀ ਹੈ।

ਭਾਸ਼ਾ ਕੇਵਲ ਅੱਖਰਾਂ ਦਾ ਜੋੜ-ਮੇਲ ਨਹੀਂ ਬਲਕਿ ਸੰਬੰਧਤ ਖਿੱਤੇ ਦੇ ਸੱਭਿਆਚਾਰ ਦਾ ਮੁਜੱਸਮਾ ਹੁੰਦੀ ਹੈ। “ਭਾਸ਼ਾ ਸਵੈ-ਚਲਿਤ ਵਰਤਾਰਾ ਨਹੀਂ ਬਲਕਿ ਗ੍ਰਹਿਣ ਕੀਤਾ ਜਾਣ ਵਾਲਾ ਸੱਭਿਆਚਾਰਕ ਪ੍ਰਕਾਰਜ ਹੈ”³। ਸੰਬੰਧਤ ਖਿੱਤੇ ਦੀ ਵਿਰਾਸਤ, ਗਿਆਨ ਪ੍ਰਬੰਧ ਅਤੇ ਇਤਿਹਾਸਕਤਾ ਭਾਸ਼ਾ ਰਾਹੀਂ ਸੰਚਾਰਿਤ ਹੋਣ ਕਰਕੇ ਹੀ ਜਿਊਂਦੀ ਹੈ। ਭਾਸ਼ਾ ਵੀ ਇਸ ਸੰਚਾਰ ਤੋਂ ਵਿਰਵੀ ਨਹੀਂ ਰਹਿ ਸਕਦੀ। “ਭਾਸ਼ਾ ਸੱਭਿਆਚਾਰ ਤੋਂ ਬਿਨਾਂ ਤੁਰ ਨਹੀਂ ਸਕਦੀ ਜੋ ਰੀਤਾਂ ਅਤੇ ਵਿਸ਼ਵਾਸਾਂ ਦੇ ਰੂਪ ਵਿਚ ਸੰਗਠਿਤ ਹੁੰਦੀ ਹੈ ਅਤੇ ਬੰਦੇ ਦੀ ਜੀਵਨ ਬੁਣਤਰ ਨੂੰ ਨਿਰਧਾਰਤ ਕਰਦੀ ਹੈ”⁴। ਹਰੇਕ ਸ਼ਬਦ ਦਾ ਆਪਣਾ ਖਾਸ ਸੱਭਿਆਚਾਰਕ, ਲੋਕਧਾਰਾਈ ਸੰਕਲਪ ਹੁੰਦਾ ਹੈ ਅਤੇ ਵਰਤੋਂ ਲਈ ਵੀ ਵੱਖਰਾ ਪ੍ਰਸੰਗ ਹੁੰਦਾ ਹੈ ਭਾਵ ਹਰੇਕ ਸ਼ਬਦ ਖਾਸ ਪ੍ਰਸੰਗ ਅਧੀਨ ਆਪਣੇ ਅਰਥਾਂ ਦਾ ਸੰਚਾਰ ਕਰਦਾ ਹੈ। ਇਸ ਨੂੰ ਮਿਖਾਇਲ ਬਾਖਤੀਨ (Mikhail Bakhtin) ਦੇ ਹਵਾਲੇ ਨਾਲ ਸਮਝ ਸਕਦੇ ਹਾਂ “ਹਰੇਕ ਸ਼ਬਦ ਦਾ ਖਾਸ ਕਿੱਤੇ, ਰੂਪਾਕਾਰ, ਰੁਝਾਨ, ਵਿਸ਼ੇਸ਼ ਸਮੂਹ, ਹਰੇਕ ਦਿਨ, ਘੰਟੇ ਅਨੁਸਾਰ ਆਪਣੀ ਤਾਸੀਰ ਜਾਂ ਸੁਭਾਅ ਹੁੰਦਾ ਹੈ। ਹਰੇਕ ਸ਼ਬਦ ਦਾ ਸਮਾਜਕ ਵਰਤਾਰੇ ਦੇ ਨਿਸ਼ਚਿਤ ਪ੍ਰਸੰਗ ਅਨੁਸਾਰ ਆਪਣਾ ਅਰਥ, ਅਨੁਭਵ ਹੁੰਦਾ ਹੈ। ਸਾਰੇ ਸ਼ਬਦ ਅਤੇ ਰੂਪ ਖਾਸ ਉਦੇਸ਼ ਨਾਲ ਪ੍ਰਸਾਰੇ ਜਾਂਦੇ ਹਨ”⁵। ਹਰੇਕ ਸ਼ਬਦ ਦੀ ਉਤਪਤੀ, ਵਿਕਾਸ, ਰੂਪਾਂਤਰਨ ਸੰਬੰਧਤ ਸੱਭਿਆਚਾਰਕ

ਪ੍ਰਬੰਧ ਅਨੁਸਾਰ ਹੁੰਦਾ ਹੈ। ਸਿੱਟੇ ਵਜੋਂ ਸਾਰੇ ਸ਼ਬਦ ਸੰਕਲਪ ਦੀ ਪੱਧਰ ‘ਤੇ ਆਪਸ ਵਿਚ ਜੁੜ ਕੇ ਲੜੀਦਾਰ ਰੂਪ ਵਿਚ ਭਾਸ਼ਾ ਦਾ ਪ੍ਰਸਾਰ ਕਰਦੇ ਹਨ।

ਵਿਚਾਰਾਂ, ਵਿਭਿੰਨ ਗਿਆਨ ਪ੍ਰਬੰਧਾਂ ਦਾ ਸੰਚਾਰ ਸਾਮਾਨ ਦੀ ਢੇਆ-ਢੁਆਈ ਵਾਂਗ ਨਹੀਂ ਬਲਕਿ ਵਿਸ਼ੇਸ਼ ਉਦੇਸ਼ ਅਧੀਨ, ਖਾਸ ਲਹਿਜੇ ਦਾ ਧਾਰਨੀ ਹੁੰਦਾ ਹੈ। ਸ਼ਬਦ ਮਨੁੱਖ ਦੀ ਸਭ ਤੋਂ ਵੱਡੀ ਕਾਢ ਕਹਿ ਲਈਏ ਤਾਂ ਇਸ ਵਿਚ ਕੋਈ ਅਤਿਕਥਨੀ ਨਹੀਂ ਹੋਵੇਗੀ। ਮਨੁੱਖ ਨੇ ਆਪਣੇ ਤਜਰਬਿਆਂ, ਅਨੁਭਵਾਂ ਨੂੰ ਸ਼ਾਬਦਿਕ ਰੂਪ ਦਿੱਤਾ ਅਤੇ ਹੌਲੀ-ਹੌਲੀ ਇਹਨਾਂ ਤਜਰਬਿਆਂ, ਅਨੁਭਵਾਂ ਦੀਆਂ ਕੜੀਆਂ ਦਾ ਲੜੀਦਾਰ ਰੂਪ ਬਣਦਾ ਗਿਆ ਜੋ ਵਿਸ਼ਾਲ ਭਾਸ਼ਾਈ ਪ੍ਰਬੰਧ ਨੂੰ ਸਿਰਜਦਾ ਹੈ। ਜਦੋਂ ਤਜਰਬਿਆਂ ਤੋਂ ਇਕੱਠਾ ਹੋਇਆ ਗਿਆਨ ਭਾਸ਼ਾ ਨੇ ਸੰਭਾਲ ਲਿਆ ਤਾਂ ਅਜਿਹੇ ਵਿਚ ਵਿਭਿੰਨ ਅਨੁਭਵ ਸੰਵਾਦੀ ਰੂਪ ਵਿਚ ਜੁੜੇ ਅਤੇ ਅਨੇਕਾਂ ਪ੍ਰਵਚਨ ਬਣ ਗਏ। ਹਰੇਕ ਪ੍ਰਵਚਨ ਦੀ ਸਿਰਜਣਾ ਵਿਚ ਭਾਸ਼ਾ ਦਾ ਪ੍ਰਕਾਰਜ ਅਤੇ ਸਰੂਪ ਅਲੱਗ ਹੁੰਦਾ ਹੈ ਅਰਥਾਤ ਮੌਕੇ, ਪ੍ਰਸੰਗ, ਵਿਸ਼ੇ ਅਤੇ ਉਦੇਸ਼ ਆਦਿ ਅਨੁਸਾਰ ਭਾਸ਼ਾ ਦਾ ਪ੍ਰਕਾਰਜ ਬਦਲ ਜਾਂਦਾ ਹੈ ਜਿਵੇਂ ਕਿ ਕਿਸੇ ਵਿਗਿਆਨਕ ਪ੍ਰਵਚਨ ਦੀ ਭਾਸ਼ਾ ਇਤਿਹਾਸਕ ਪ੍ਰਵਚਨ ਤੋਂ ਵੱਖਰੀ ਹੁੰਦੀ ਹੈ ਅਤੇ ਇਕ ਸਾਹਿਤਕ ਕਿਰਤ ਦੀ ਭਾਸ਼ਾ ਵਿਗਿਆਨਕ ਅਤੇ ਇਤਿਹਾਸਕ ਦੋਨਾਂ ਤੋਂ ਭਿੰਨ ਹੋਵੇਗੀ। ਇਸ ਨੂੰ ਮਿਖਾਇਲ ਬਾਖਤੀਨ (Mikhail Bakhtin) ਨੇ Speech Genre ਦਾ ਨਾਮ ਦਿੱਤਾ ਹੈ ਕਿ “ਵਿਸ਼ਾ ਸਮੱਗਰੀ, ਸ਼ੈਲੀ, ਰਚਨਾਤਮਕ ਬਣਤਰ ਇਹ ਤਿੰਨੋਂ ਪੱਖ ਬਹੁਤ ਗੂੜ੍ਹੇ ਢੰਗ ਨਾਲ ਜੁੜੇ ਹੁੰਦੇ ਹਨ ਅਤੇ ਸਮਾਨ ਰੂਪ ਵਿਚ ਸੰਚਾਰ ਦੇ ਖਾਸ ਮਾਹੌਲ ਤੋਂ ਨਿਰਧਾਰਤ ਹੁੰਦੇ ਹਨ। ਬੇਸ਼ੱਕ ਹਰੇਕ ਉਚਾਰ ਵਿਅਕਤੀਗਤ ਹੁੰਦਾ ਹੈ ਪਰ ਹਰੇਕ ਮਾਹੌਲ ਜਿਸ ਵਿਚ ਭਾਸ਼ਾ ਵਰਤੀ ਜਾਂਦੀ ਹੈ, ਉਹ ਆਪਣੇ ਲਹਿਜੇ ਅਨੁਸਾਰ ਖਾਸ ਤਰਾਂ ਦੇ ਉਚਾਰ ਵਿਕਸਿਤ ਕਰਦੀ ਹੈ। ਇਸ ਨੂੰ ‘Speech Genre’ ਕਹਿੰਦੇ ਹਨ”⁶। ਇੰਝ ਵੱਖਰੇ ਉਚਾਰ ਰੂਪਾਕਾਰਾਂ (speech genre) ਨੂੰ ਉਸ ਦੇ ਹਾਲਾਤ, ਚੁਫੇਰਾ ਨਿਰਧਾਰਤ ਕਰਦਾ ਹੈ। ਇਹ ਹਾਲਾਤ, ਉਦੇਸ਼ ਪ੍ਰਵਚਨ ਦੀ ਬੁਣਤਰ ਅਤੇ ਬਣਤਰ ਨੂੰ ਘੜਦੇ ਹਨ ਅਤੇ ਵੱਖਰੇ ਉਚਾਰ ਸਾਹਮਣੇ ਆਉਂਦੇ ਹਨ। ਇਸ ਨੂੰ ਪਾਲ ਸਿੰਪਸਨ (Paul Simpson) ਰਜਿਸਟਰ (Register) ਦਾ ਨਾਮ ਦਿੰਦਾ ਹੈ “ਰਜਿਸਟਰ ਹੀ ਸਾਹਿਤਕ ਰਚਨਾ ਨੂੰ ਭਾਸ਼ਾ ਦੀਆਂ ਹੋਰਨਾਂ ਵੰਨਗੀਆਂ ਤੋਂ ਨਿਖੇੜਦਾ ਹੈ ... ਲੇਖਕ ਜਾਂ ਵਕਤਾ ਖਾਸ ਸਮੇਂ ਵਿਚ ਭਾਸ਼ਾ ਨੂੰ ਕਿਵੇਂ ਵਰਤਦਾ ਹੈ ਇਹ ਰਜਿਸਟਰ ਤੋਂ ਪਤਾ ਲਗਦਾ ਹੈ”⁷। ਭਾਵ ਇਕ ਖਾਸ ਸਮੇਂ, ਹਾਲਾਤਾਂ ਵਿਚ ਭਾਸ਼ਾ ਨੂੰ ਵਰਤਣ ਦੇ ਮਾਧਿਅਮ, ਉਦੇਸ਼ ਅਤੇ ਸੰਚਾਰ ਵਿਚ ਸ਼ਾਮਲ ਲੋਕਾਂ ਦੇ ਆਪਸੀ ਸੰਬੰਧ ਖਾਸ ਰਜਿਸਟਰ ਘੜਦੇ ਹਨ ਜਿਵੇਂ ਭੌਤਿਕ ਵਿਗਿਆਨ ਸਾਹਿਤ ਨਾਲੋਂ ਅਲੱਗ ਰਜਿਸਟਰ ਹੈ ਕਿਉਂਕਿ ਦੋਨੋਂ ਇਕ ਦੂਜੇ ਨਾਲੋਂ ਉਦੇਸ਼, ਮਾਧਿਅਮ, ਪ੍ਰਕਾਰਜ ਆਦਿ ਦੀ ਪੱਧਰ ‘ਤੇ ਭਿੰਨ ਹਨ।

ਸਾਹਿਤਕ ਭਾਸ਼ਾ :

ਕੋਈ ਵੀ ਕਲਾਕ੍ਰਿਤ ਸਿਰਜਣਾਤਮਕ ਕਲਪਨਾ ਦੀ ਉਪਜ ਅਤੇ ਮਨੁੱਖ ਦੀਆਂ ਸੁਹਾਜਤਮਕ ਬਿਰਤੀਆਂ ਦਾ ਪ੍ਰਗਟਾਵਾ ਹੁੰਦੀ ਹੈ। ਆਕਾਰਮੁਕਤ ਸੰਰਚਨਾਵਾਂ ਨੂੰ ਵਿਸ਼ੇਸ਼ ਕਲਾਤਮਕ ਰੀਤੀਆਂ ਦੁਆਰਾ ਸੁਹਜਮਈ ਆਕਾਰ ਵਿਚ ਢਾਲ ਲਿਆ ਜਾਂਦਾ ਹੈ ਜਿਵੇਂ ਕਿ ਮਿੱਟੀ ਆਕਾਰਮੁਕਤ ਹੈ ਪਰ ਜਦੋਂ ਮਿੱਟੀ ਤੋਂ ਸੁਰਾਹੀ ਬਣ ਜਾਂਦੀ ਹੈ ਤਾਂ ਉਹ ਰਚਨਾਤਮਕ ਢੰਗ ਨਾਲ ਵਿਸ਼ੇਸ਼ ਆਕਾਰ ਗ੍ਰਹਿਣ ਕਰ ਲੈਂਦੀ ਹੈ ਪਰ ਮਿੱਟੀ ਤੋਂ ਅਲਗ ਨਹੀਂ ਹੁੰਦੀ। ਇੰਝ ਹੀ ਸਾਹਿਤ ਇਕ ਸ਼ਾਬਦਿਕ ਕਲਾ ਹੈ ਭਾਵ ਸ਼ਬਦਾਂ ਨੂੰ ਵਿਸ਼ੇਸ਼ ਕਲਾਤਮਕ ਜੁਗਤਾਂ ਰਾਹੀਂ ਖਾਸ ਉਦੇਸ਼ ਅਤੇ ਪ੍ਰਕਾਰਜ ਅਧੀਨ ਵਰਤਿਆ ਜਾਂਦਾ ਹੈ ਜਿੱਥੇ ਵਜੋਂ ਪੈਦਾ ਹੋਈ ਰਚਨਾ ਭਾਸ਼ਾ ਦਾ ਸੁਹਾਜਤਮਕ ਅਤੇ ਰਚਨਾਤਮਕ ਪ੍ਰਕਾਰਜ ਮੰਨਿਆ ਜਾ ਸਕਦਾ ਹੈ। ਸੁਹਾਜਤਮਕਤਾ ਤੋਂ ਭਾਵ ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਦੀ ਕੇਵਲ ਬਣਤਰ ਤੋਂ ਨਹੀਂ ਬਲਕਿ ਬੁਣਤਰ ਤੋਂ ਹੈ ਸਮੁੱਚੇ ਪਾਠ ਦੀ ਰਚਨਾ ਤੋਂ ਹੈ ਜੋ ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਦੁਆਰਾ ਰਚਿਆ ਜਾਂਦਾ ਹੈ। ਇਸ ਸਾਹਿਤਕ ਸੰਸਾਰ ਦੀ ਰਚਨਾ ਵਿਚ ਕਲਾਤਮਕ ਭਾਸ਼ਾਈ ਜੁਗਤਾਂ ਵਰਤੀਆਂ ਜਾਂਦੀਆਂ ਹਨ। ਜੋਨਾਥਨ ਕੁਲਰ (Jonathan Culler) ਦੇ ਹਵਾਲੇ ਨਾਲ ਵੇਖ ਸਕਦੇ ਹਾਂ “ਸਾਹਿਤ ਭਾਸ਼ਾ ਹੈ, ਜਿਸ ਵਿਚ ਕਿਸੇ ਪਾਠ ਦੇ ਵਿਭਿੰਨ ਤੱਤ, ਹਿੱਸੇ ਜਟਿਲ ਰਿਸ਼ਤੇ ਵਿਚ ਬੱਝੇ ਹੁੰਦੇ ਹਨ”⁸। ਇੱਥੇ ਸਾਹਿਤ ਨੂੰ ਭਾਸ਼ਾ ਕਿਹਾ ਜਾਣਾ ਭਾਸ਼ਾ ਦੇ ਕਲਾਤਮਕ ਪ੍ਰਕਾਰਜ ਅਤੇ ਸੁਹਾਜਤਮਕ ਰੂਪ ਵਿਚ ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਨੂੰ ਕੇਂਦਰ ਵਿਚ ਲੈ ਆਉਂਦਾ ਹੈ। ਸਾਹਿਤ ਦੀ ਸਿਰਜਣਾ ਕਰਦੀ ਭਾਸ਼ਾ ਨੂੰ ਆਪਣੀਆਂ ਨਿਵੇਕਲੀਆਂ ਕਲਾਤਮਕ ਜੁਗਤਾਂ ਕਰਕੇ ਹੀ ਸਾਹਿਤ ਕਿਹਾ ਗਿਆ ਹੈ। ਹਰੇਕ ਸਾਹਿਤਕ ਪਾਠ ਦੀਆਂ ਆਪਣੀਆਂ ਨਿੱਖੜਵੀਆਂ ਸੰਰਚਨਾਵਾਂ ਹੁੰਦੀਆਂ ਹਨ ਜਿੱਥੇ ਵਜੋਂ ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਕਲਾਤਮਕ ਢੰਗ ਨਾਲ ਸੰਚਾਰ ਕਰਦੀ ਹੈ। ਸਾਹਿਤ ਦੇ ਅੱਗੋਂ ਵਿਭਿੰਨ ਰੂਪਾਕਾਰ ਹਨ। ਹਰੇਕ ਰੂਪਾਕਾਰ ਦਾ ਆਪਣੀਆਂ ਰੂਪਾਕਾਰਕ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ ਸਦਕਾ ਵਿੱਲਖਣ ਭਾਸ਼ਾਈ ਸਿਸਟਮ ਹੈ। ਜਿਵੇਂ ਗਦ ਰੂਪਾਕਾਰਾਂ ਦਾ ਭਾਸ਼ਾਈ ਪ੍ਰਕਾਰਜ ਪਦ ਰੂਪਾਕਾਰਾਂ ਤੋਂ ਭਿੰਨ ਹੁੰਦਾ ਹੈ। ਅੱਗੋਂ ਗਦ ਦੇ ਗਲਪੀ ਰੂਪਾਕਾਰਾਂ ਦੀ ਭਾਸ਼ਾ ਗੈਰ - ਗਲਪੀ ਰੂਪਾਕਾਰਾਂ ਤੋਂ ਵੱਖਰੀ ਹੁੰਦੀ ਹੈ। ਸਗੋਂ ਗਲਪਨਿਕ ਰੂਪਾਕਾਰਾਂ ਜਿਵੇਂ ਕਹਾਣੀ ਤੇ ਨਾਵਲ ਦੀ ਭਾਸ਼ਾ ਵਿਚ ਵੀ ਅੰਤਰ ਨਿਖੇੜ ਹੁੰਦਾ ਹੈ। ਇੰਝ ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਵਿਚ ਰੂਪਾਕਾਰਾਂ ਦਾ ਆਧਾਰ ‘ਤੇ ਵੱਖਰੀਆਂ ਵੰਨਗੀਆਂ ਹਨ।

ਭਾਰਤੀ ਆਚਾਰਯ, ਕਾਵਿ-ਸ਼ਾਸਤਰੀਆਂ ਨੇ ਸਾਹਿਤ ਦੇ ਤਿੰਨ ਮੁਖ ਗੁਣ ਮੰਨੇ ਹਨ : ‘ਸੱਤਿਅਮ, ਸ਼ਿਵਮ, ਸੁੰਦਰਮ’⁹। ਸਾਹਿਤ ਦਾ ਸੁੰਦਰਮ ਵਾਲਾ ਪੱਖ ਸਾਹਿਤ ਦੇ ਸ਼ਾਬਦਿਕ ਕਲਾ ਹੋਣ ਨੂੰ ਹੀ ਸਾਕਾਰ ਕਰਦਾ ਹੈ। ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਦੀ ਬੁਣਤਰ ਵਿਚੋਂ ਹੀ ਸੱਤਿਅਮ, ਸ਼ਿਵਮ ਪੱਖ

ਪ੍ਰਕਾਸ਼ਮਾਨ ਹੁੰਦੇ ਹਨ। ਸਾਹਿਤ ਦੀ ਕਸੈਟੀ ਸੱਚ ਤਲਾਸ਼ਣ ਵਿਚ ਨਹੀਂ ਬਲਕਿ ਰਚਨਾਤਮਕ ਜੁਗਤਾਂ ਦੁਆਰਾ ਵਿਭਿੰਨ ਪਸਾਰਾਂ ਸਹਿਤ ਸੱਚ ਸਿਰਜਣ ਵਿਚ ਨਿਹਿਤ ਮੰਨੀ ਜਾ ਸਕਦੀ ਹੈ।

ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਦਾ ਸੰਬੰਧ ਕਲਾਤਮਕ ਸੰਸਾਰ ਦੀ ਸਿਰਜਣਾ ਨਾਲ ਹੈ। ਇਸ ਵਿਚ ਬੰਦੇ ਦੇ ਅਨੁਭਵਾਂ, ਤਜਰਬਿਆਂ ਅਤੇ ਵਸਤੂ ਸੰਸਾਰ ਦੀਆਂ ਉਘੜ-ਦੁਘੜੀਆਂ ਸੰਰਚਨਾਵਾਂ ਨੂੰ ਵਿਸ਼ੇਸ਼ ਕਲਾਤਮਕ ਭਾਸ਼ਾਈ ਜੁਗਤਾਂ ਰਾਹੀਂ, ਨਿਸ਼ਚਤ ਪ੍ਰਸੰਗ ਅਧੀਨ, ਇਕ ਖਾਸ ਉਦੇਸ਼ ਨਾਲ ਸਿਰਜਿਆ ਜਾਂਦਾ ਹੈ। ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਇਤਿਹਾਸਕ ਵਿਖਿਆਨ ਵਾਂਗ ਬੀਤੇ ਦਾ ਤੱਥਾਤਮਕ ਵੇਰਵਾ ਦੇਣ ਤਕ ਸੀਮਤ ਨਹੀਂ ਰਹਿੰਦੀ ਬਲਕਿ ਇਸ ਸਾਹਿਤਕ ਸੰਸਾਰ ਵਿਚ ਬੀਤ ਚੁੱਕੇ ਅਤੇ ਵਾਪਰ ਰਹੇ ਵਿਚ ਸੰਵਾਦ ਰਚਾ ਕੇ ਸੀਮਾਵਾਂ ਅਤੇ ਸੰਭਾਵਨਾਵਾਂ ਵਾਲਾ ਪ੍ਰਵਚਨ ਸਿਰਜਦੀ ਹੈ। ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਆਪਣੀ ਇਸੇ ਸੰਵਾਦੀ ਸੂਰ ਰਾਹੀਂ ਵਿਭਿੰਨ ਪ੍ਰਵਚਨਾ ਵਿਚਲੇ ਸਾਂਵੇ-ਅਸਾਵੇਂ ਸੰਬੰਧਾਂ ਨੂੰ ਸਿਰਜਦੀ ਹੈ। ਇਸ ਨੂੰ ਮਿਖਾਇਲ ਬਾਖਤਿਨ (Mikhail Bakhtin) ਦੇ ਹਵਾਲੇ ਨਾਲ ਸਮਝ ਸਕਦੇ ਹਾਂ “ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਇਕੱਲੇ ਅਤੇ ਬੰਦ ਭਾਸ਼ਾਈ ਸਿਸਟਮ ਦਾ ਇਕੱਠ ਨਹੀਂ ਬਲਕਿ ਖਾਸ ਤੌਰ ਤੇ ਬਹੁਤ ਸਾਰੀਆਂ ਭਾਸ਼ਾਵਾਂ ਦਾ ਇਕੱਠ ਹੈ ਜੋ ਆਪਸ ਵਿਚ ਪ੍ਰਸੰਗ ਅਤੇ ਆਪਸੀ ਪਛਾਣ ਸਥਾਪਤ ਕਰਦੀਆਂ ਹਨ”¹⁰। ਇਹਨਾਂ ਆਪਸੀ ਪਛਾਣਾਂ ਦੇ ਸੰਵਾਦੀ ਸੂਰ ਵਿਚੋਂ ਹੀ ਪ੍ਰਵਚਨ ਸਿਰਜਿਆ ਜਾਂਦਾ ਹੈ। ਇਸੇ ਦੇ ਆਧਾਰ ਤੇ ਬਾਖਤਿਨ ਵਿਭਿੰਨ ਭਾਸ਼ਾਈ ਸ਼ੈਲੀਆਂ ਨਾਲ ਜੋੜ ਕੇ ਵਿਚਾਰ ਪੇਸ਼ ਕਰਦਾ ਹੈ “ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਵਿਭਿੰਨ ਭਾਸ਼ਾਗਤ ਸ਼ੈਲੀਆਂ ਦਾ ਜਟਿਲ ਅਤੇ ਪਰਿਵਰਤਨਸ਼ੀਲ ਸਿਸਟਮ ਹੈ”¹¹। ਇਹ ਭਾਸ਼ਾਗਤ ਪਛਾਣਾਂ, ਸ਼ੈਲੀਆਂ ਭਾਸ਼ਾ ਦੇ ਸਿਰਜਣਾਤਮਕ ਰੂਪ ਦਾ ਪ੍ਰਗਟਾਵਾ ਹਨ। ਹਰੇਕ ਪ੍ਰਵਚਨ ਦਾ ਆਪਣਾ ਪੂਰਾ ਪ੍ਰਬੰਧ ਹੈ, ਉਸ ਦੀ ਭਾਸ਼ਾ ਦਾ ਖਾਸ ਲਹਿਜਾ, ਪ੍ਰਸੰਗ ਹੁੰਦਾ ਹੈ। ਇੰਝ ਅਨੇਕਾਂ ਪ੍ਰਵਚਨਾਂ ਦੀ ਆਪਸੀ ਮੁੱਠ-ਭੇੜ ਵਿਚੋਂ ਨਿਕਲਿਆ ਪ੍ਰਵਚਨ ਭਾਸ਼ਾਈ ਜਟਿਲਤਾ ਦਾ ਧਾਰਨੀ ਹੁੰਦਾ ਹੈ। ਸਾਹਿਤਕ ਕਿਰਤ ਵਿਚ ਵਿਭਿੰਨ ਪ੍ਰਵਚਨ ਸੰਵਾਦੀ ਰੂਪ ਵਿਚ ਆਪਸ ਜੁੜੇ ਹੁੰਦੇ ਹਨ ਅਜਿਹੇ ਵਿਚ ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਜਟਿਲ ਅਤੇ ਬਹੁਅਰਥੀ ਹੋ ਨਿੱਬੜਦੀ ਹੈ। ਇਸ ਨੂੰ ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਦੀ ਮੂਲ - ਚੂਲ ਵੀ ਮੰਨਿਆ ਜਾ ਸਕਦਾ ਹੈ। ਜਿਵੇਂ ਕੁਲਵੰਤ ਸਿੰਘ ਵਿਰਕ ਦੀ ਕਹਾਣੀ ‘ਖੱਬਲ’ ਦੀ ਉਦਾਹਰਨ ਵੇਖੀ ਜਾ ਸਕਦੀ ਹੈ “ਪਾਕਿਸਤਾਨ ਬਣੇ ਨੂੰ ਅਜੇ ਤਿੰਨ ਚਾਰ ਮਹੀਨੇ ਹੀ ਹੋਏ ਸਨ। ਇੱਥੇ ਹਰ ਸ਼ੈਅ ਉੱਖੜੀ-ਉੱਖੜੀ ਲੱਗਦੀ ਸੀ। ਥਾਣਿਆਂ, ਚੌਕੀਆਂ ਵਿਚ ਸਮਾਨ ਦੇ ਢੇਰ ਲੱਗੇ ਸਨ। ਟਰੱਕ, ਪਲੰਘ, ਪੰਝੂੜੇ, ਮੋਜ਼, ਸੋਫਾ ਸੈੱਟ, ਤਸਵੀਰਾਂ ਸਭ ਆਪਣੀਆਂ ਥਾਂਵਾਂ ਤੋਂ ਉੱਖੜ ਕੇ ਥਾਣੇ ਆ ਗਈਆਂ ਸਨ। ਭਲਾ ਪੰਝੂੜਿਆਂ ਦਾ ਥਾਣਿਆਂ ‘ਚ ਕੀ ਕੰਮ? ਕਦੀ ਇਹਨਾਂ ਦੀ ਘਰਾਂ ਵਿਚ ਖਾਸ ਥਾਂ ਹੋਣੀ ਏ। ਉਸ ਵੇਲੇ ਘਰ ਵਾਲਿਆਂ ਦਾ ਖਿਆਲ ਹੋਣਾ ਏ ਕਿ ਜੇ ਏ ਉਸ ਥਾਂ ਤੋਂ ਬਿਨਾਂ ਕਿਸੇ ਹੋਰ ਥਾਂ ‘ਤੇ ਰੱਖੇ ਜਾਣ ਤਾਂ ਬੜੇ ਕੋਝੇ ਲਗਣ ... ਇਹਨਾਂ ਨੂੰ ਹੁਣ ਕਦੇ ਕਿਸੇ ਨੇ ਮਾਂਜਿਆ ਨਹੀਂ ਲਿਸ਼ਕਾਇਆ ਨਹੀਂ ਸੀ, ਗਿਣਿਆ ਨਹੀਂ ਸੀ”¹²। ਇਥੋਂ ਵੰਡ ਦੇ ਦੁਖਾਂਤ ਨੂੰ ਬਹੁਅਰਥਾਂ ਵਿਚ ਸਮਝ ਸਕਦੇ ਹਾਂ।

ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਇਕ ਅਜਿਹੇ ਸੰਸਾਰ ਦੀ ਸਿਰਜਣਾ ਕਰਦੀ ਹੈ ਜੋ ਵਸਤੂ ਸੰਸਾਰ ਵਰਗਾ ਹੋ ਕੇ ਵੀ ਉਸ ਤੋਂ ਭਿੰਨ ਹੁੰਦਾ ਹੈ। ਇਸ ਸੰਸਾਰ ਦੀ ਸਿਰਜਣਾ ਲੇਖਕ ਦੇ ਮਨ ਦੇ ਚਿਤਰਪਟ ਉਪਰ ਹੁੰਦੀ ਹੈ। ਬੰਦੇ ਦੇ ਅਨੁਭਵਾਂ, ਤਜਰਬਿਆਂ, ਹੋਏ ਬੀਤੇ ਦੀਆਂ ਯਾਦਾਂ ਜਾਂ ਤੱਥਾਤਮਕ ਵੇਰਵਾ ਦੇਣ ਤਕ ਸੀਮਤ ਨਹੀਂ ਬਲਕਿ ਉਹਨਾਂ ਅਨੁਭਵਾਂ, ਯਾਦਾਂ ਦੀਆਂ ਵਿਭਿੰਨ ਕੜੀਆਂ ਜੋੜ ਕੇ ਕਲਪਨਿਕ ਰੂਪ ਵਿਚ ਪੇਸ਼ ਕੀਤਾ ਜਾਂਦਾ ਹੈ। ਇਹ ਪੇਸ਼ਕਾਰੀ ਪਾਠਕ ਅਤੇ ਸਰੋਤੇ ਦੀ ਕਲਪਨਾ ਨੂੰ ਉਡਾਰੀ ਦਿੰਦੀ ਹੈ ਅਤੇ ਉਹ ਉਹਨਾਂ ਅਨੁਭਵਾਂ ਨੂੰ ਮਹਿਸੂਸ ਕਰਦਾ ਹੈ। ਇਸ ਪ੍ਰਕਾਰ ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਨੂੰ ਲੇਖਕ ਦੀ ਕਲਪਨਾ ਤੋਂ ਪਾਠਕ ਦੀ ਕਲਪਨਾ ਤਕ ਦਾ ਸਫਰ ਮੰਨਿਆ ਜਾ ਸਕਦਾ ਹੈ।

ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਕੇਵਲ ਵਿਖਿਆਨ ਦੇ ਢੰਗ ਰਾਹੀਂ ਸੰਚਾਰ ਨਹੀਂ ਕਰਦੀ ਬਲਕਿ ਇਹ ਸੰਚਾਰ ਕਲਾਮਈ ਹੁੰਦਾ ਹੈ। ਪੂਰੇ ਵਿਸ਼ੇ ਦਾ ਸਰਲ ਭਾਸ਼ਾ ਵਿਚ ਵੇਰਵਾ ਨਹੀਂ ਦਿੱਤਾ ਜਾਂਦਾ ਬਲਕਿ ਕਹੇ ਦੁਆਰਾ ਅਣਕਿਹਾ ਸਿਰਜਿਆ ਜਾਂਦਾ ਹੈ। ਇਹ ਅਣਕਿਹਾ ਸਮੇਂ, ਸਥਾਨ ਦੇ ਅਹਿਸਾਸਾਂ ਦੇ ਰੂਪ ਵਿਚ ਪਾਠਕ ਦੇ ਅਵਚੇਤਨ ਵਿਚ ਹੀ ਪਿਆ ਹੁੰਦਾ ਹੈ। ਸਰੋਤੇ, ਪਾਠਕ ਨੂੰ ਅਨੁਭਵਾਂ ਵਿਚੋਂ ਲੰਘਾ ਕੇ ਉਸ ਦੇ ਅਵਚੇਤਨ ਦੀਆਂ ਵਿਭਿੰਨ ਪਰਤਾਂ ਨੂੰ ਟੁੰਬਿਆ ਜਾਂਦਾ ਹੈ। ਇਹ ਭਾਸ਼ਾ ਦਾ ਸੰਕੇਤਕ ਢੰਗ ਨਾਲ ਪ੍ਰਕਾਰਜ ਮੰਨ ਸਕਦੇ ਹਾਂ। ਸਿਰਜੇ ਸੰਸਾਰ ਦੀਆਂ ਜੜਾਂ ਅਤੇ ਟਾਹਣੀਆਂ ਦਾ ਫੈਲਾਅ ਅਣਕਹੇ ਵਿਚ ਹੁੰਦਾ ਹੈ। ਇਹ ਸਿਰਜਣਾ ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਦੀਆਂ ਕਲਾਤਮਕ ਜੁਗਤਾਂ, ਹਾਲਾਤਾਂ, ਸਮੇਂ ਸਥਾਨ ਅਨੁਸਾਰ ਢੁੱਕਵੀਂ ਸ਼ਬਦਾਵਲੀ, ਅਲੰਕਾਰ, ਬਿੰਬ, ਪ੍ਰਤੀਕਾਂ ਆਦਿ ਰਾਹੀਂ ਹੁੰਦੀ ਹੈ।

ਪਲੈਟੋ ਨੇ ਸਾਹਿਤ ਨੂੰ ‘ਦਿਸਦੇ ਦੀ ਨਕਲ’¹³ ਕਿਹਾ ਹੈ ਪਰ ‘ਅਰਸਤੂ ਨੇ ਇਸ ਨੂੰ ਵਸਤੂ ਸੰਸਾਰ ਦੀ ਹੂ-ਬ-ਹੂ ਨਕਲ ਨਹੀਂ ਬਲਕਿ ਸਿਰਜਣਾਤਮਕ ਨਕਲ ਮੰਨਿਆ ਹੈ’¹⁴। ਸਾਹਿਤਕ ਸੰਸਾਰ ਦੀ ਸਿਰਜਣਾ ਵਿਚ ਸੱਭਿਆਚਾਰਕ, ਲੋਕਧਾਰਾਈ ਪ੍ਰਬੰਧ ਅਤੇ ਮਨੁੱਖੀ ਅਵਚੇਤਨ ਦੀਆਂ ਵਿਭਿੰਨ ਪਰਤਾਂ ਅਤੇ ਵਿਹਾਰ ਨੂੰ ਰੂਪਮਾਨ ਕੀਤਾ ਜਾਂਦਾ ਹੈ। ਪ੍ਰਚਲਿਤ ਅਰਥਾਂ ਤੋਂ ਨਵੇਂ ਅਰਥਾਂ ਵਿਚ ਵੇਖਣਾ ਇਸ ਸਿਰਜਣਾਤਮਕ ਨਕਲ ਦੀ ਮੂਲ-ਚੂਲ ਮੰਨਿਆ ਜਾ ਸਕਦਾ ਹੈ। ਇਸ ਨੂੰ ਸ਼ਕਲੇਵਸਕੀ (Victor Shklovsky) ਦੇ ‘ਅਜਨਬੀਕਰਨ’ ਦੇ ਸਿਧਾਂਤ ਨਾਲ ਸਮਝਿਆ ਜਾ ਸਕਦਾ ਹੈ “ਵਸਤੂ ਨੂੰ ਅਜਨਬੀਕ੍ਰਿਤ ਢੰਗ ਨਾਲ ਪੇਸ਼ ਕਰਨਾ ਕਲਾ ਦੀ ਤਕਨੀਕ ਹੈ... ਕਲਾ ਵਸਤੂ ਦੀ ਕਲਾਤਮਕਤਾ ਨੂੰ ਅਨੁਭਵ ਕਰਨ ਦਾ ਢੰਗ ਹੈ। ਵਸਤੂ ਦੀ ਕਲਾਤਮਕਤਾ ਵਸਤੂ ਨਾਲੋਂ ਮਹੱਤਵਪੂਰਨ ਹੈ”¹⁵। ਸ਼ਕਲੇਵਸਕੀ ਸਾਹਿਤਕ ਕਿਰਤ ਦੀ ਕਸੈਟੀ ਨਵੇਂ ਬਿੰਬਾਂ ਦੀ ਸਿਰਜਣਾ

ਵਿਚ ਨਿਹਿਤ ਮੰਨਦਾ ਹੈ ਕਿ “ਲੇਖਕ ਰੂੜ੍ਹ ਹੋ ਚੁੱਕੇ ਬਿੰਬਾਂ ਨੂੰ ਇਕੱਤਰ ਕਰਨ ਵਲ ਵਧੇਰੇ ਰੁਚਿਤ ਹੁੰਦੇ ਹਨ ਬਜਾਇ ਕਿ ਨਵੇਂ ਬਿੰਬ ਘੜਨ ਵਲ”¹⁶। ਕਿਉਂਕਿ ਬਿੰਬ ਦਾ ਉਦੇਸ਼ ਵਸਤੂ ਪ੍ਰਤੀ ਨਿਵੇਕਲਾ ਦ੍ਰਿਸ਼ਟੀਕੋਣ ਘੜਨਾ ਹੁੰਦਾ ਹੈ। ਜੀਵਨ ਦੀਆਂ ਜਟਿਲਤਾਵਾਂ ਦੀਆਂ ਸਮੀਕਰਨਾਂ ਤਾਂ ਨਿੱਤ ਬਦਲ ਰਹੀਆਂ ਹਨ ਤਾਂ ਅਜਿਹੇ ਵਿਚ ਇਹਨਾਂ ਗੁੰਝਲਦਾਰ ਪ੍ਰਵਿਰਤੀਆਂ ਨੂੰ ਰੂੜ੍ਹ ਹੋ ਚੁੱਕੇ ਬਿੰਬਾਂ ਰਾਹੀਂ ਨਹੀਂ ਪ੍ਰਗਟਾਇਆ ਜਾ ਸਕਦਾ। ਇਸ ਤਰਾਂ ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਦੀ ਕਲਾਤਮਕਤਾ ਦੇ ਜ਼ਰੀਏ ਜੀਵਨ ਦੀਆਂ ਗੁੰਝਲਾਂ ਨੂੰ ਪੇਸ਼ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।

ਲੇਖਕ ਕਿਸੇ ਅਨੁਭਵ, ਯਾਦ, ਵਿਸ਼ੇ ਆਦਿ ਨੂੰ ਢੁੱਕਵੇਂ ਸ਼ਬਦਾਂ ਵਿਚ ਕਲਾਤਮਕ ਜੁਗਤਾਂ ਦੀ ਜੁਗਲਬੰਦੀ ਰਾਹੀਂ ਚਿਤਰਦਾ ਹੈ, ਜਿਸ ਨਾਲ ਪਾਠਕ ਦੀਆਂ ਅੱਖਾਂ ਸਾਹਵੇਂ ਦ੍ਰਿਸ਼ ਸਾਕਾਰ ਹੋ ਜਾਂਦਾ ਹੈ। ਅਨੁਭਵ ਵਿਚੋਂ ਲੰਘਦਿਆਂ ਪਾਠਕ ਸਾਹਿਤਕ ਰਸ ਮਾਣਦਾ ਹੈ।

ਸਾਹਿਤਕ ਪਾਠ ਕਿਉਂਕਿ ਇਕ ਬੰਦੇ ਦੇ ਨਿੱਜੀ ਖਿਆਲਾਂ, ਵਿਚਾਰਾਂ ਦਾ ਸਿੱਟਾ ਹੁੰਦਾ ਹੈ। ਲੇਖਕ ਕਿਸੇ ਖਾਸ ਉਦੇਸ਼ ਅਧੀਨ ਰਚਨਾ ਕਰਦਾ ਹੈ। ਇਹ ਵਿਚਾਰ ਸਿੱਧੇ ਰੂਪ ‘ਚ ਲਿਖਤ ਵਿਚ ਸਾਹਮਣੇ ਨਹੀਂ ਪਏ ਹੁੰਦੇ ਸਗੋਂ ਕਲਾਤਮਕ ਜੁਗਤਾਂ ਵਿਚ ਬੁਣੇ ਹੁੰਦੇ ਹਨ। ਇਸ ਨੂੰ ਮਿਖਾਇਲ ਬਾਖਤਿਨ (Mikhail Bakhtin) ਦੇ ਹਵਾਲੇ ਨਾਲ ਸਮਝ ਸਕਦੇ ਹਾਂ “ਸਾਹਿਤਕ ਪਾਠ ਚ ਭਾਸ਼ਾ ਇਕ ਆਗਿਆਕਾਰੀ ਅੰਗ ਵਜੋਂ ਪੂਰੇ ਤਸੱਲੀਬਖਸ਼ ਢੰਗ ਨਾਲ ਲੇਖਕ ਦੀ ਇੱਛਾ ਅਨੁਸਾਰ ਕੰਮ ਕਰਦੀ ਹੈ”¹⁷। ਪਰੰਤੂ ਇਸ ਵਿਚਾਰਧਾਰਕ ਪਹਿਲੂ ਨੂੰ ਸਾਹਿਤਕ ਕਲਾਤਮਕਤਾ ਤੋਂ ਵਿਰਵੇ ਰੱਖ ਕੇ ਪੇਸ਼ ਕਰਨਾ ਸਾਹਿਤਕਤਾ ਦੀ ਕਸੌਟੀ ‘ਤੇ ਪੂਰਾ ਨਹੀਂ ਉੱਤਰਦਾ।

ਸੋ, ਭਾਸ਼ਾ ਮਨੁੱਖ ਦੇ ਤਜਰਬਿਆਂ, ਅਨੁਭਵਾਂ ਤੋਂ ਪੈਦਾ ਹੋਏ ਗਿਆਨ ਪ੍ਰਬੰਧ ਨੂੰ ਸੰਭਾਲਣ, ਸੰਚਾਰਤ ਕਰਨ ਦਾ ਵਸੀਲਾ ਹੈ। ਜਿਸ ਤੋਂ ਬੰਦੇ ਦੀ ਕਲਪਨਾ, ਅਵਰੋਹਣ ਨੂੰ ਘੜਿਆ ਜਾਂਦਾ ਹੈ, ਜਿਸ ਦੇ ਸੰਚਾਰਤ ਹੋਣ ਦਾ ਮਾਧਿਅਮ ਵੀ ਭਾਸ਼ਾ ਹੈ। ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਇਹਨਾਂ ਭਾਵਾਂ, ਅਨੁਭਵਾਂ ਨੂੰ, ਗਿਆਨ ਪ੍ਰਬੰਧ ਨੂੰ ਕਲਪਨਾ ਦੀ ਪੁੱਠ ਰਾਹੀਂ ਪੇਸ਼ ਕਰਦੀ ਹੈ। ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਬੰਦੇ ਦੇ ਭਾਵਾਂ, ਬੀਤੇ ਦੀਆਂ ਯਾਦਾਂ ਨੂੰ ਸਦਮਾ ਜਾਂ ਹਉਕਾ ਨਹੀਂ ਬਣਨ ਦਿੰਦੀ ਸਗੋਂ ਸਾਹਿਤਕ ਰਚਨਾ ਰਾਹੀਂ ਗਿਆਨ ਵਿਚ ਬਦਲ ਦਿੰਦੀ ਹੈ। ਭਾਸ਼ਾ ਦੇ ਵਿਭਿੰਨ ਪ੍ਰਕਾਰਜ ਖੇਤਰ ਹਨ। ਹਰੇਕ ਖੇਤਰ ਦਾ ਉਦੇਸ਼, ਰੂਪ, ਮਾਧਿਅਮ ਦੂਜੇ ਤੋਂ ਵੱਖਰਾ ਹੈ। ਸਾਹਿਤ ਨੂੰ ਭਾਸ਼ਾ ਦਾ ਸਿਰਜਣਾਤਮਕ ਰੂਪ ਮੰਨਿਆ ਜਾ ਸਕਦਾ ਹੈ ਜੋ ਕਲਾਤਮਕ ਢੰਗ ਨਾਲ ਸੰਚਾਰ ਕਰਦਾ ਹੈ। ਭਾਸ਼ਾ ਜੋ ਕਿ ਵਸਤੂ ਸੰਸਾਰ ਵਿਚ ਸੰਚਾਰ ਦਾ ਮਾਧਿਅਮ ਹੈ ਭਾਵ ਹੋਏ ਬੀਤੇ ਦਾ ਵੇਰਵਾ ਦਿੰਦੀ ਹੈ ਪਰ ਸਾਹਿਤਕ ਭਾਸ਼ਾ ਵਸਤੂ ਸੰਸਾਰ ਦੇ ਅੰਦਰ ਵਿਭਿੰਨ ਪ੍ਰਵਚਨਾਂ ਦੇ ਆਪਸੀ ਸੰਬੰਧਾਂ ਨੂੰ ਪੇਸ਼ ਕਰਦੀ, ਦਿਸਦੇ ਤੋਂ ਪਾਰ ਜਾਣ ਦੀ ਸਮਰੱਥਾ ਰੱਖਦੀ ਹੈ।

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ਭਾਰਤੀ ਕਬੀਲਿਆਂ ਦੀ ਸਥਾਨਕਤਾ ਸਥਿਤੀ ਦੀ ਪੜਚੋਲ

*ਬਲਜਿੰਦਰ ਸਿੰਘ

*ਰਿਸਰਚ ਸਕਾਲਰ, ਪੰਜਾਬੀ ਵਿਭਾਗ, ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਵਰਲਡ ਯੂਨੀਵਰਸਿਟੀ, ਫਤਿਹਗੜ੍ਹ ਸਾਹਿਬ।

baljinder25bal@gmail.com

ਤੱਤ ਸਾਰ (Abstract)

ਕਬੀਲਾ ਸਮੂਹ ਨੂੰ ਲੰਮੇ ਇਤਿਹਾਸਕ ਕਾਲ ਵਿਚ ਸਮਾਜ-ਸਭਿਆਚਾਰ ਦੀ ਮੁੱਖਧਾਰਾ ਤੋਂ ਮਨਫੀ ਕਰ ਕੇ ਪ੍ਰਭੂਤਾਵਾਦੀ (ਕੇਂਦਰੀ ਰਾਜਸੀ ਸੱਤਾ, ਕੇਂਦਰ ਰਾਸ਼ਟਰਵਾਦੀਆਂ ਅਤੇ ਦੇਸੀ-ਵਿਦੇਸੀ ਪੂੰਜੀਪਤੀਆਂ/ਵਿਸ਼ਵੀਕਰਨ) ਸੱਤਾ ਦੇ ਦਾਬੇ ਹੇਠ ਹਾਸੀਆਗਤ ਜੀਵਨ ਬਤੀਤ ਕਰਨ ਲਈ ਮਜ਼ਬੂਰ ਕੀਤਾ ਜਾਂਦਾ ਰਿਹਾ ਹੈ। ਭਾਰਤੀ ਉਪ-ਮਹਾਂਦੀਪ ਦੇ ਵੱਖੋ-ਵੱਖ ਭੂਗੋਲਿਕ ਖੇਤਰਾਂ 'ਤੇ ਵਿਚਰ ਰਹੇ ਆਦਿਵਾਸੀ, ਘੁਮੰਤਰੂ, ਅਰਧ-ਘੁਮੰਤਰੂ ਅਤੇ ਸਥਾਈ ਕਬੀਲਾ ਸਮੂਹਾਂ ਦਾ ਜੀਵਨ ਥੋੜੇ-ਬਹੁਤ ਫਰਿਮਪ;ਰਕ ਨਾਲ ਹਾਸੀਆਗਤ ਸਥਿਤੀ ਨੂੰ ਹੰਢਾਉਂਦਾ ਵੇਖਿਆ ਜਾ ਸਕਦਾ ਹੈ। ਇਨ੍ਹਾਂ ਵੱਖੋ-ਵੱਖ ਸਮਾਜਿਕ ਸਥਿਤੀਆਂ ਵਿਚ ਵਿਚਰ ਰਹੇ ਕਬੀਲਾ ਨਿਵਾਸੀਆਂ ਨੂੰ ਇਨ੍ਹਾਂ ਦੀ ਮੂਲ ਭਾਸ਼ਾ, ਜਲ, ਜੰਗਲ, ਜ਼ਮੀਨ, ਧਰਮ, ਇਤਿਹਾਸ, ਮਿਥਿਹਾਸ ਅਤੇ ਮੂਲ ਸਭਿਆਚਾਰਕ ਹੋਂਦ-ਹਸਤੀ ਤੋਂ ਵਿਰਵਿਆਂ ਕਰ ਕੇ ਪ੍ਰਭਾਵੀ ਸਭਿਆਚਾਰ ਦੇ ਗਲਬੇ ਹੇਠ ਨਿਮਨ ਦਰਜੇ ਦਾ ਸਥਾਨ ਦੇ ਕੇ ਸ਼ਾਮਲ (Assimilation) ਕਰਨ ਦੇ ਛਤਕਰੇ ਦੇ ਪਾਜ਼ ਨੂੰ ਇਤਿਹਾਸਕ ਅਤੇ ਮੌਜੂਦਾ ਸਥਿਤੀ ਦੇ ਪ੍ਰਸੰਗ ਵਿਚ ਰੱਖ ਤਲਾਸ਼ਣ/ਸਮਝਣ ਦਾ ਜਤਨ ਕੀਤਾ ਗਿਆ ਹੈ। ਇਹੀ ਇਸ ਖੋਜ-ਪਰਚੇ ਦਾ ਹਾਸਲ ਹੈ।

ਬਾਕੀ ਸਥਾਨਕਤਾ ਸ਼੍ਰੇਣੀਆਂ ਵਾਂਗ ਕਬੀਲਾ ਸਮੂਹ ਨੂੰ ਵੀ ਲੰਮੇ ਇਤਿਹਾਸਕ ਕਾਲ ਦੌਰਾਨ ਸਮਾਜ-ਸਭਿਆਚਾਰ ਦੀ ਮੁੱਖਧਾਰਾ ਤੋਂ ਮਨਫੀ ਕਰ ਕੇ ਪ੍ਰਭੂਤਾਵਾਦੀ (ਕੇਂਦਰੀ ਰਾਜਸੀ ਸੱਤਾ, ਕੇਂਦਰ ਰਾਸ਼ਟਰਵਾਦੀਆਂ ਅਤੇ ਦੇਸੀ-ਵਿਦੇਸੀ ਪੂੰਜੀਪਤੀਆਂ/ਵਿਸ਼ਵੀਕਰਨ) ਸੱਤਾ ਦੇ ਦਾਬੇ ਹੇਠ ਹਾਸੀਆਗਤ ਜੀਵਨ ਬਤੀਤ ਕਰਨ ਲਈ ਮਜ਼ਬੂਰ ਕੀਤਾ ਜਾਂਦਾ ਰਿਹਾ ਹੈ। ਭਾਰਤੀ ਉਪ-ਮਹਾਂਦੀਪ ਦੇ ਵੱਖੋ-ਵੱਖ ਭੂਗੋਲਿਕ ਖੇਤਰਾਂ 'ਤੇ ਵਿਚਰ ਰਹੇ ਆਦਿਵਾਸੀ, ਘੁਮੰਤਰੂ, ਅਰਧ-ਘੁਮੰਤਰੂ ਅਤੇ ਸਥਾਈ ਕਬੀਲਾ ਸਮੂਹਾਂ ਦਾ ਜੀਵਨ ਥੋੜੇ-ਬਹੁਤ ਫਰਕ ਨਾਲ ਹਾਸੀਆਗਤ ਸਥਿਤੀ ਨੂੰ ਹੰਢਾਉਂਦਾ ਵੇਖਿਆ ਜਾ ਸਕਦਾ ਹੈ। ਇਨ੍ਹਾਂ ਵੱਖੋ-ਵੱਖ ਸਮਾਜਿਕ ਸਥਿਤੀਆਂ ਵਿਚ ਵਿਚਰ ਰਹੇ ਕਬੀਲਾ ਨਿਵਾਸੀਆਂ ਨੂੰ ਇਨ੍ਹਾਂ ਦੀ ਮੂਲ ਭਾਸ਼ਾ, ਜਲ, ਜੰਗਲ, ਜ਼ਮੀਨ, ਧਰਮ, ਇਤਿਹਾਸ, ਮਿਥਿਹਾਸ ਅਤੇ ਮੂਲ ਸਭਿਆਚਾਰਕ ਹੋਂਦ-ਹਸਤੀ ਤੋਂ ਵਿਰਵਿਆਂ ਕਰ ਕੇ ਪ੍ਰਭਾਵੀ ਸਭਿਆਚਾਰ ਦੇ ਗਲਬੇ ਹੇਠ ਨਿਮਨ ਦਰਜੇ ਦਾ ਸਥਾਨ ਦੇ ਕੇ ਸ਼ਾਮਲ (Assimilation) ਕਰਨ ਦਾ ਛਤਕਰੇ ਲੰਮੇ ਸਮੇਂ ਤੋਂ ਰਚਿਆ ਜਾ ਰਿਹਾ ਹੈ। ਅੱਜ ਵੀ ਬਹੁ-ਗਿਣਤੀ ਘੁਮੰਤਰੂ ਅਤੇ ਅਰਧ-ਘੁਮੰਤਰੂ ਕਬੀਲਾ ਸਮੂਹ ਸੜਕਾਂ, ਰੇਲ-ਪਟੜੀਆਂ, ਪੁਲਾਂ ਹੇਠ, ਰੁੱਖਾਂ ਹੇਠ ਜਾਂ ਖਾਲੀ ਪਈਆਂ ਉਜਾੜ ਜ਼ਮੀਨਾਂ 'ਤੇ ਕੱਖਾਂ-ਕਾਨਿਆਂ ਦੀਆਂ ਸਥਾਈ ਜਾਂ ਅਸਥਾਈ ਰੂਪ ਵਿਚ ਝੁਗੀਆਂ-ਝੋਂਪੜੀਆਂ ਬਣਾ ਕੇ ਗੁੰਮਨਾਮੀ, ਇਕਲਾਪਾ ਅਤੇ ਮੁਫਲਿਸ ਭਰਿਆ ਜੀਵਨ ਬਤੀਤ ਕਰਨ ਲਈ ਮਜ਼ਬੂਰ ਹਨ। ਅਜਿਹੀ ਸਥਿਤੀ ਹੀ ਕਬੀਲਿਆਂ ਨੂੰ ਗ਼ਰੀਬੀ, ਲਾਚਾਰੀ, ਭੁੱਖਮਰੀ, ਅਨਪੜ੍ਹਤਾ, ਬੇਰੁਜ਼ਗਾਰੀ ਅਤੇ ਨਾਗਰਿਕਤਾ ਦੇ ਮੁੱਢਲੇ ਹੱਕ-ਹਕੂਕਾਂ ਤੋਂ ਵਿਰਵਿਆਂ ਕਰ ਕੇ ਹਾਸੀਏ 'ਤੇ ਧੱਕਣ ਵਿਚ ਅਹਿਮ ਭੂਮਿਕਾ ਨਿਭਾਉਂਦੀ ਆ ਰਹੀ ਹੈ।

" 'ਕਬੀਲਾ' ਅੰਗਰੇਜ਼ੀ ਸ਼ਬਦ ਟਰਾਇਬ (Tribe) ਦਾ ਪੰਜਾਬੀ ਅਨੁਵਾਦ ਹੈ। Tribe ਲਾਤੀਨੀ ਸ਼ਬਦ Tribus ਤੋਂ ਨਿਕਲਿਆ, ਜਿਸ ਦੇ ਅਰਥ ਹਨ ਇਕ ਤਿਹਾਈ, ਜੋ ਕਿ ਉਨ੍ਹਾਂ ਤਿੰਨਾਂ ਵਿਅਕਤੀਆਂ ਵਿੱਚੋਂ ਇਕ ਲਈ ਵਰਤਿਆ ਜਾਂਦਾ ਹੈ, ਜਿਨ੍ਹਾਂ ਨੇ ਕਬੀਲੇ ਵਾਲੀਆਂ ਰਵਾਇਤਾਂ ਅਤੇ ਔਕੜਾਂ ਝੱਲ ਕੇ ਰੋਮ ਲੱਭਿਆ। ਰੋਮਨਾਂ ਨੇ ਟ੍ਰਾਇਬ ਸ਼ਬਦ ਉਨ੍ਹਾਂ 35 ਬੰਦਿਆਂ ਸੰਬੰਧੀ ਵੀ ਵਰਤਿਆ ਜੋ ਈਸਾ ਤੋਂ 241 ਵਰ੍ਹੇ ਪੂਰਵ ਆਪਣੇ ਰੀਤੀ ਰਿਵਾਜਾਂ ਅਨੁਸਾਰ ਰੋਮ ਦਾ ਹਿੱਸਾ ਬਣੇ।¹ ਜੇਕਰ ਭਾਰਤੀ ਕਬੀਲਿਆਂ ਦੇ ਸੰਬੰਧ ਵਿਚ ਗੱਲ ਕਰੀਏ ਤਾਂ, 'ਭਾਰਤ ਦੇ ਆਦਿਵਾਸੀ ਕਬੀਲੇ ਜਿੱਥੇ ਜੰਗਲਾਂ ਅਤੇ ਟਾਪੂਆਂ ਵਿਚ ਗੁੰਮਨਾਮੀ ਦਾ ਜੀਵਨ ਬਤੀਤ ਕਰਦੇ ਹੋਏ ਬਾਹਰੀ ਸੰਪਰਕ ਤੋਂ ਟੁੱਟੇ ਰਹੇ ਹਨ ਉਥੇ ਖਾਨਾਬਦੋਸ਼ ਕਬੀਲੇ ਵੱਖ-ਵੱਖ ਸਭਿਆਚਾਰਾਂ ਵਿੱਚੋਂ ਖਹਿ ਕੇ ਲੰਘਦੇ ਰਹੇ ਹਨ ਜਿਸਦੇ ਸਿੱਟੇ ਵਜੋਂ ਕਬੀਲਿਆਈ ਸਭਿਆਚਾਰ ਜ਼ਿਆਦਾ ਖੁਲ੍ਹੇ ਡੁੱਲ੍ਹੇ ਅਤੇ ਬਹੁਰੰਗੀ ਹਨ।² ਇਸੇ ਪਰਸ-ਪਰ ਸੰਬੰਧਾਂ ਕਾਰਨ ਹੀ ਕਬੀਲੇ ਸਬੰਧੀ ਪ੍ਰਾਪਤ ਹੁੰਦੀਆਂ ਵੱਖੋ-ਵੱਖ ਪਰਿਭਾਸ਼ਾਵਾਂ ਥੋੜੇ-ਬਹੁਤ ਫਰਕ ਨਾਲ ਅਲੱਗ-ਅਲੱਗ ਵੇਖਣ ਨੂੰ ਮਿਲਦੀਆਂ ਹਨ।

ਇਨਸਾਈਕਲੋਪੀਡੀਆ ਅਮੇਰੀਕਾਨਾ ਅਨੁਸਾਰ: ਕਬੀਲਾ ਉਨ੍ਹਾਂ ਲੋਕਾਂ ਨੂੰ ਕਿਹਾ ਜਾਂਦਾ ਹੈ ਜੋ ਕਿਸੇ ਸਾਂਝੇ ਇਲਾਕੇ ਵਿਚ ਵੱਸਦੇ ਹੋਣ, ਆਪਣੀਆਂ ਵੱਖਰੀਆਂ ਰਸਮਾਂ-ਰੀਤਾਂ ਹੋਣ ਅਤੇ ਪ੍ਰਮੁੱਖ ਸਭਿਆਚਾਰ ਦਾ ਹਿੱਸਾ ਨਾ ਹੋਣ।³

ਇਨਸਾਈਕਲੋਪੀਡੀਆ ਬਰਿਟੈਨਿਕਾ ਅਨੁਸਾਰ: ਕਬੀਲਾ ਇਕ ਅਜਿਹਾ ਸਮੂਹ ਹੁੰਦਾ ਹੈ ਜਿਸ ਦੇ ਮੈਂਬਰ ਇਕ ਸਾਂਝੀ ਉਪਭਾਸ਼ਾ ਬੋਲਦੇ ਹੋਣ ਅਤੇ ਜਿਨ੍ਹਾਂ ਦੀ ਆਪਣੀ ਸਰਕਾਰ ਅਤੇ ਕਾਨੂੰਨ ਹੁੰਦੇ ਹਨ। ਸਾਂਝਾ ਨਾਂ, ਸਾਂਝਾ ਇਲਾਕਾ, ਇਕੋ ਜਿਹਾ ਪਹਿਰਾਵਾ, ਸਭਿਆਚਾਰ, ਜਿਊਣ ਦਾ ਢੰਗ ਅਤੇ ਇਕ ਸਾਂਝਾ ਵਿਰਸਾ ਕੁਝ ਪ੍ਰਮੁੱਖ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ ਹੁੰਦੀਆਂ ਹਨ।⁴

ਡੀ. ਐਨ. ਮਜੂਮਦਾਰ ਅਨੁਸਾਰ: ਕਬੀਲਾ ਪਰਿਵਾਰਾਂ ਦਾ ਜਾਂ ਪਰਿਵਾਰਾਂ ਦੇ ਸਮੂਹਾਂ ਦਾ ਇਕ ਇਕੱਠ ਹੈ, ਜਿਸ ਦਾ ਇਕ ਸਾਂਝਾ ਨਾ ਹੁੰਦਾ ਹੈ, ਜਿਸ ਦੇ ਮੈਂਬਰ ਇਕ ਸਾਂਝੇ ਇਲਾਕੇ ਵਿਚ ਵੱਸਦੇ ਹਨ ਤੇ ਇਕ ਸਾਂਝੀ ਬੋਲੀ ਬੋਲਦੇ ਹਨ ਅਤੇ ਵਿਆਹ ਤੇ ਵਿਵਸਾਇ ਸਬੰਧੀ ਕੁਝ ਕੁ ਮਨਾਹੀਆਂ ਦਾ ਪਾਲਣ ਵੀ ਕਰਦੇ ਹਨ। ਇਨ੍ਹਾਂ ਨੇ ਆਪਸਦਾਰੀ ਅਤੇ ਜੰਮੇਵਾਰੀਆਂ ਦੀ ਪਰਸਪਰਤਾ ਦੀ ਇਕ ਯੋਗ ਨਿਰਧਾਰਤ ਪ੍ਰਣਾਲੀ ਵਿਕਸਤ ਕੀਤੀ ਹੁੰਦੀ ਹੈ। ਕਬੀਲਾ ਸੁਜਾਤੀ ਵਿਵਾਹਕ ਇਕਾਈ ਹੁੰਦਾ ਹੈ, ਜਿਸ ਦੇ ਮੈਂਬਰ ਕਬੀਲੇ ਦੇ ਅੰਦਰ ਹੀ ਵਿਆਹ ਕਰਦੇ ਹਨ। ਇਕ ਕਬੀਲੇ ਦੇ ਕਈ ਗੋਤ ਹੁੰਦੇ ਹਨ ਜਿਨ੍ਹਾਂ ਵਿਚ ਆਪਸੀ ਸੰਬੰਧ ਹੁੰਦੇ ਹਨ।⁵

ਡਾ. ਦਰਿਆ ਅਨੁਸਾਰ: ਕਬੀਲਾ ਉਹ ਸਮਾਜਿਕ ਸਮੂਹ ਹੈ ਜਿਸ ਦਾ ਆਪਣਾ ਸਮਾਜਿਕ, ਰਾਜਨੀਤਕ ਅਤੇ ਧਾਰਮਿਕ ਪ੍ਰਬੰਧ ਹੁੰਦਾ ਹੈ, ਜੋ ਕਿਸੇ ਸਾਂਝੇ ਇਲਾਕੇ ਵਿਚ ਵੱਸਦਾ ਹੋਣ ਕਰ ਕੇ ਇਕ ਵੱਖਰੀ ਭਾਸ਼ਾ/ਗੁਪਤ ਭਾਸ਼ਾ ਦੀ ਵਰਤੋਂ ਕਰਦਾ ਹੋਇਆ ਪਰੰਪਰਕ ਅਤੇ ਪ੍ਰਚਲਿਤ ਰਵਾਇਤਾਂ ਅਤੇ ਕਦਰਾਂ-ਕਮੀਤਾਂ ਨੂੰ ਬੜੀ ਕੱਟੜਤਾ ਨਾਲ ਨਿਭਾਉਂਦਾ ਹੈ।⁶

ਉਪਰੋਕਤ ਵੱਖੋ-ਵੱਖ ਪਰਿਭਾਸ਼ਾਵਾਂ ਦੇ ਅਧਿਐਨ ਤੋਂ ਬਾਅਦ ਇਹ ਸਪਸ਼ਟ ਹੋ ਜਾਂਦਾ ਹੈ ਕਿ 'ਕਬੀਲਾ' ਉਨ੍ਹਾਂ ਲੋਕਾਂ ਦਾ ਸਮੂਹ ਹੁੰਦਾ ਹੈ ਜਿਨ੍ਹਾਂ ਦਾ ਸਾਂਝਾ ਨਾਂ, ਸਾਂਝਾ ਥਾਂ, ਸਾਂਝੀ ਉਪਭਾਸ਼ਾ, ਸਾਂਝਾ ਧਰਮ (ਟੋਟਮ), ਸਾਂਝੀਆਂ ਮਨਾਹੀਆਂ (ਟੈਬੂ), ਇਕ ਤਰ੍ਹਾਂ ਦਾ ਪਹਿਰਾਵਾ, ਸੁਤੰਤਰ ਨਿਆਂ ਪ੍ਰਬੰਧ ਅਤੇ ਇਕ ਸਾਂਝੀ ਸਭਿਆਚਾਰਕ ਹੋਂਦ ਹੁੰਦੀ ਹੈ। ਇਸ ਪਰਿਭਾਸ਼ਾ ਦੀ ਰੇਸ਼ਨੀ ਵਿਚ ਭਾਰਤ ਦੇ ਕਿਸੇ ਇਕ ਕਬੀਲੇ ਦੀ ਪਛਾਣ ਕਰ ਸਕਣਾ ਕਠਨ ਕਾਰਜ ਹੈ ਕਿਉਂਕਿ ਮੌਜੂਦਾ ਦੇਰ ਅੰਦਰ ਇਹ ਸਾਰੇ ਪਛਾਣ ਲੱਛਣ ਕਿਸੇ ਇਕ ਕਬੀਲਾ ਸਮੂਹ ਵਿਚੋਂ ਪ੍ਰਾਪਤ ਹੋਣਾ ਅਸੰਭਵ ਹੈ ਕਿਉਂਕਿ ਵਿਸ਼ਵੀਕਰਨ, ਮੰਡੀਕਰਨ, ਪੂੰਜੀਵਾਦ ਅਤੇ ਹਿੰਦੂ-ਰਾਸ਼ਟਰਵਾਦ ਦੇ ਸ਼ਿਕਾਰ ਭਾਰਤੀ ਕਬੀਲੇ ਆਪਣੇ ਕਈ ਪਛਾਣ ਲੱਛਣ ਗੁਵਾ ਚੁੱਕੇ ਹਨ।

ਕਬੀਲਿਆਂ ਦੀ ਸੰਖੇਪਕ ਇਤਿਹਾਸਕ ਸਥਿਤੀ:

ਭਾਰਤੀ ਉਪ-ਮਹਾਂਦੀਪ ਦੇ ਵੱਖੋ-ਵੱਖ ਇਲਾਕਿਆਂ ਅਤੇ ਸਭਿਆਤਾਵਾਂ ਵਿਚ ਵਿਚਰਦੇ ਆਦਿਵਾਸੀ, ਘੁਮੰਤਰੂ, ਅਰਧ-ਘੁਮੰਤਰੂ, ਅਪਰਾਧੀ ਅਤੇ ਸਥਾਈ (ਜਨ ਜਾਤੀ) ਕਬੀਲਿਆਂ ਦਾ ਆਪੋ-ਆਪਣਾ ਵਿਲੱਖਣ ਇਤਿਹਾਸ ਹੈ, ਜਿਸ ਨੂੰ ਸਮੁੱਚੇ ਰੂਪ ਵਿਚ ਇਕ ਥਾਂ 'ਤੇ ਪੇਸ਼ ਕਰ ਸਕਣਾ ਕਠਨ ਕਾਰਜ ਹੈ। ਦੂਸਰਾ ਕਾਰਨ, ਕੁਲੀਨਵਾਦੀ ਇਤਿਹਾਸਕਾਰਾਂ (ਰਾਸ਼ਟਰਵਾਦੀ ਅਤੇ ਬਸਤੀਵਾਦੀ) ਵਲੋਂ ਕਬੀਲਿਆਂ ਦੇ ਸਮਾਜ-ਸਭਿਆਚਾਰ, ਰਾਸ਼ਟਰੀ ਅੰਦੋਲਨ ਅਤੇ ਰਾਸ਼ਟਰ ਨਿਰਮਾਣ ਦੇ ਵਿਕਾਸ ਵਿਚ ਪਾਏ ਗਏ ਯੋਗਦਾਨ ਨੂੰ ਅਹਿਮੀਅਤ ਨਾ ਦਿੰਦਿਆਂ ਮੁੱਖ-ਇਤਿਹਾਸਕਾਰੀ ਦੇ ਪਿੜ ਵਿਚੋਂ ਲਾਂਭੇ ਕਰਨ ਦੀ ਕਵਾਇਦ ਕਾਰਨ ਪ੍ਰਮਾਣਿਕ ਤੱਥਾਂ ਦੀ ਘਾਟ ਸਾਹਮਣੇ ਆਉਂਦੀ ਹੈ। ਅਸੀਂ ਇੱਥੇ ਕਬੀਲਿਆਂ ਦੀ ਉਸ ਸਾਂਝੀ ਇਤਿਹਾਸਕ ਸਥਿਤੀ ਨੂੰ ਸੰਖੇਪ ਵਿਚ ਦਰਸਾ ਰਹੇ ਹਾਂ ਜਿਸ ਤੋਂ ਉਨ੍ਹਾਂ ਦੇ ਸਮਾਜ-ਸਭਿਆਚਾਰ, ਰਾਸ਼ਟਰੀ ਅੰਦੋਲਨ ਅਤੇ ਰਾਸ਼ਟਰ ਨਿਰਮਾਣ ਵਿਚ ਪਾਏ ਯੋਗਦਾਨ ਅਤੇ ਉਨ੍ਹਾਂ ਦੀ ਹਾਸ਼ੀਆਗਤ ਜੀਵਨ ਸਥਿਤੀ ਪੇਸ਼ ਹੁੰਦੀ ਹੈ।

ਆਦਿਵਾਸੀ ਕਬੀਲਾ ਨਿਵਾਸੀਆਂ ਨੂੰ ਰਾਸ਼ੀਏ 'ਤੇ ਧੱਕਣ ਦਾ ਛਤ੍ਰਯੰਤਰ ਆਰਿਆਈ ਕਾਲ ਤੋਂ ਹੀ ਆਰੰਭ ਹੋ ਗਿਆ ਸੀ। ਭਾਰਤੀ ਸ਼ਾਸਤਰਾਂ ਨੇ ਇਨ੍ਹਾਂ ਨੂੰ ਵੱਡੇ-ਵੱਡੇ ਦੰਦਾਂ, ਸਿੰਙਾਂ ਅਤੇ ਪੂਛ ਵਾਲੇ ਜੰਤੂਨੁਮਾ ਜੀਵ ਸਿੱਧ ਕਰਨ ਵਿਚ ਕਦੇ ਕੋਈ ਕਸਰ ਨਹੀਂ ਛੱਡੀ। ਇਨ੍ਹਾਂ ਨੂੰ ਦਾਨਵ, ਰਾਖਸ਼ ਜਾਂ ਅਸੁਰ ਕਹਿ ਕੇ ਅਪਮਾਨਿਤ ਕੀਤਾ ਗਿਆ।⁷ ਇਸ ਦਾ ਪ੍ਰਮਾਣ ਬ੍ਰਾਹਮਣਵਾਦੀ ਗ੍ਰੰਥ 'ਰਮਾਇਣ' ਅਤੇ 'ਮਹਾਭਾਰਤ' ਵਿਚ ਵੇਖਿਆ ਜਾ ਸਕਦਾ ਹੈ। ਰਮਾਇਣ ਵਿਚ ਜੰਗਲੀ ਪਾਤਰਾਂ ਵਜੋਂ ਜਿਥੇ 'ਸਬਰੀ', 'ਹਨੂੰਮਾਨ' ਅਤੇ 'ਵਾਨਰ ਸੈਨਾ' ਨੂੰ ਪੇਸ਼ ਕੀਤਾ ਗਿਆ ਹੈ ਉਥੇ ਹੀ ਮਹਾਭਾਰਤ ਵਿਚ 'ਇਕਵੱਲਿਆ' ਅਤੇ ਅਰੁਜਨ ਨੂੰ ਮੱਲ ਯੁੱਧ ਵਿਚ ਬੰਦੀ ਬਣਾਉਣ ਵਾਲਾ ਆਦਿਵਾਸੀ ਪੁੱਤਰ 'ਬੱਬਰੂਵਾਹਨ' ਦੇ ਰੂਪ ਵਿਚ ਪੇਸ਼ ਕੀਤਾ ਗਿਆ ਹੈ। ਇਹ ਉਹ ਪਾਤਰ ਹਨ ਜੋ ਬਲਸ਼ਾਲੀ ਯੋਧੇ ਹੋਣ ਦੇ ਬਾਵਜੂਦ ਵੀ ਕੋਈ ਖਾਸ ਮਹੱਤਵ ਨਹੀਂ ਰੱਖਦੇ। 'ਇਹ ਸੱਚ ਹੈ ਕਿ ਭਾਰਤ ਦੀ ਆਰਿਆ ਸਭਿਅਤਾ ਦੀ ਅਸ਼ਵਯੋਧ ਪ੍ਰਵਿਰਤੀ ਨੇ ਉਨ੍ਹਾਂ (ਆਦਿਵਾਸੀਆਂ) ਨੂੰ ਹਮੇਸ਼ਾਂ ਛਲਿਆ, ਲੁੱਟਿਆ, ਲਤਾੜਿਆ ਅਤੇ ਉਨ੍ਹਾਂ ਨੂੰ ਜੰਗਲਾਂ ਵਿਚ ਖਦੇੜ ਦਿੱਤਾ। ...ਨੁਮਾਇਸ਼ ਦੀ ਚੀਜ਼ ਬਣਾ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਸਦੀਆਂ ਤੋਂ ਮੈਨੇ ਰਹਿਣ ਲਈ ਮਜ਼ਬੂਰ ਕੀਤਾ ਗਿਆ। ਬੋਲਣ ਵੀ ਦਿੱਤਾ ਗਿਆ ਤਾਂ ਹਨੂੰਮਾਨ ਦੀ ਭਾਸ਼ਾ ਵਿਚ, ਭਾਵ ਰਾਮ ਦੇ ਪੱਖ ਵਿਚ।'⁸ ਇਸ ਤਰ੍ਹਾਂ ਆਰਿਆਈ ਸਭਿਅਤਾ ਨੇ ਭਾਰਤੀ ਉਪ-ਮਹਾਂਦੀਪ ਦੇ ਮੂਲ ਆਦਿਵਾਸੀ ਨਿਵਾਸੀਆਂ ਨੂੰ ਜੰਗਲੀ, ਪਸ਼ੂ,

ਰਾਖਸ਼, ਪੱਛੜੇ ਅਤੇ ਅਸਭਿਅਕ ਕਹਿ ਕੇ ਮਾਨਵੀ ਹੋਂਦ ਤੋਂ ਵਿਰਵਿਆਂ ਕਰਨ ਦਾ ਪ੍ਰਵਚਨ ਹੀ ਨਹੀਂ ਘੜਿਆ ਸਗੋਂ ਉਨ੍ਹਾਂ ਨੂੰ ਸਦਾ ਲਈ ਜੰਗਲਾਂ 'ਚ ਖਦੇੜ ਕੇ ਹਾਸ਼ੀਏ ਦੇ ਪਾਤਰ ਬਣਾਉਣ ਵਿਚ ਵੀ ਅਹਿਮ ਭੂਮਿਕਾ ਨਿਭਾਈ ਹੈ।

ਮੁਗ਼ਲ ਕਾਲ ਸਮੇਂ ਭਾਰਤੀ ਉਪ-ਮਹਾਂਦੀਪ ਦੇ ਬਾਕੀ ਲੋਕਾਂ ਵਾਂਗ ਕਬੀਲਿਆਂ ਦੀ ਸਥਿਤੀ ਵੀ ਦਮਿਤ ਸੀ। ਮੁਗ਼ਲ ਸ਼ਾਸਕਾਂ ਦੇ ਵਾਰ-ਵਾਰ ਹਮਲੇ ਕਰਨ ਨਾਲ ਭਾਰਤੀ ਰਿਆਸਤਾਂ ਤਬਾਹ ਹੋ ਗਈਆਂ ਅਤੇ ਮੁਗ਼ਲ ਸ਼ਾਸਨ ਕਾਇਮ ਹੋ ਗਿਆ। ਮੁਗ਼ਲ ਸ਼ਾਸਕਾਂ ਵਲੋਂ ਜਬਰੀ ਇਸਲਾਮ ਧਰਮ ਵਿਚ ਸ਼ਾਮਲ ਕਰਨ ਦੀ ਕਵਾਇਦ ਨੇ ਕਬੀਲਾ ਵਾਸੀਆਂ ਨੂੰ ਮੂਲ ਇਲਾਕਿਆਂ ਨੂੰ ਛੱਡ ਦੂਸਰੇ ਇਲਾਕਿਆਂ ਵਿਚ ਹਿਜ਼ਰਤ ਕਰਨ ਲਈ ਮਜ਼ਬੂਰ ਕਰ ਦਿੱਤਾ ਸੀ।⁹ ਇਹ ਹਿਜ਼ਰਤ ਅੱਜ ਵੀ ਜਾਰੀ ਹੈ। ਮੁਗ਼ਲ ਕਾਲ ਸਮੇਂ ਹੀ ਪੰਜਾਬ ਦੇ ਕਬੀਲਿਆਂ ਨੇ ਸਿੱਖ ਇਤਿਹਾਸ ਵਿਚ ਅਹਿਮ ਯੋਗਦਾਨ ਪਾਇਆ ਹੈ। ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਦੀਆਂ ਸੰਸਾਰ ਯਾਤਰਾਵਾਂ ਸਮੇਂ ਉਨ੍ਹਾਂ ਦਾ ਸੰਗੀ ਬਣ ਕੇ ਵਿਚਰਨ ਵਾਲਾ ਭਾਈ ਮਰਦਾਨਾ ਮਰਾਸੀ ਕਬੀਲੇ ਦਾ ਸੀ। "ਸਦੀਆਂ ਤੋਂ ਆਰਥਿਕ ਸਾਧਨਾਂ ਅਤੇ ਸੰਪਤੀ ਤੋਂ ਵਿਰਵੇ ਇਹ ਲੋਕ ਜਿੱਥੇ ਇਕਲਾਪਾ ਹੰਢਾਉਣ ਲਈ ਮਜ਼ਬੂਰ ਹੋ ਗਏ ਹਨ, ਉੱਥੇ ਰੋਜ਼ੀ ਰੋਟੀ ਲਈ ਨਿੱਕੇ-ਨਿੱਕੇ ਧੰਦੇ ਅਤੇ ਮਜ਼ਦੂਰੀ ਕਰ ਕੇ ਪੇਟ ਪਾਲਣ ਲਈ ਮਜ਼ਬੂਰ ਹੋ ਗਏ ਹਨ। ਸਥਿਤੀ ਦਾ ਵਿਰੋਧਾਭਾਸ ਇਹ ਹੈ ਕਿ ਰਾਜੇ ਮਹਾਰਾਜਿਆਂ ਦੀ ਸਰਪ੍ਰਸਤੀ ਮਾਨਣ ਵਾਲਾ ਇਹ ਕਬੀਲਾ ਅੱਜ ਆਪਣੀ ਪਛਾਣ ਦੱਸਣ ਤੋਂ ਵੀ ਸ਼ਰਮਾਉਂਦਾ ਹੈ।"¹⁰ ਇਸੇ ਪ੍ਰਕਾਰ ਸਿਕਲੀਗਰ ਕਬੀਲੇ ਦਾ ਵੀ ਸਿੱਖ ਇਤਿਹਾਸ ਵਿਚ ਅਹਿਮ ਯੋਗਦਾਨ ਰਿਹਾ ਹੈ। "...ਇਨ੍ਹਾਂ ਦੇ ਪੂਰਵਜ ਛੇਵੀਂ ਪਾਤਸ਼ਾਹੀ ਤੋਂ ਲੈ ਕੇ ਦਸਵੀਂ ਪਾਤਸ਼ਾਹੀ ਤੱਕ ਗੁਰੂ ਸਾਹਿਬਾਨ ਦੀ ਸੇਵਾ ਵਿਚ ਵਿਚਰਦੇ ਰਹੇ ਹਨ। ਉਦੋਂ ਇਨ੍ਹਾਂ ਦਾ ਕਿੱਤਾ ਗੁਰੂ ਸਾਹਿਬਾਨ ਅਤੇ ਉਨ੍ਹਾਂ ਦੀਆਂ ਫੌਜਾਂ ਲਈ ਲੋਹੇ ਤੋਂ ਹਥਿਆਰਾਂ ਦਾ ਨਿਰਮਾਣ ਕਰਨਾ ਸੀ ਕਿਉਂਕਿ ਇਹ ਲੋਕ ਅਸਤਰ-ਸਸਤਰ ਕਲਾ ਦੇ ਮਾਹਿਰ ਮੰਨੇ ਜਾਂਦੇ ਹਨ।"¹¹ ਇਨ੍ਹਾਂ ਨੇ ਸਿਰਫ਼ ਅਸਤਰ-ਸਸਤਰ ਬਣਾਉਣ ਦੀ ਸੇਵਾ ਹੀ ਨਹੀਂ ਕੀਤੀ ਸਗੋਂ ਛੇਵੇਂ ਪਾਤਸ਼ਾਹ ਅਤੇ ਦਸਮ ਪਿਤਾ ਦਾ ਸਾਥ ਦੇ ਕੇ ਮੁਗ਼ਲਾਂ ਖ਼ਿਲਾਫ਼ ਕਈ ਜੰਗਾਂ ਵੀ ਲੜੀਆਂ। ਇਸੇ ਪ੍ਰਕਾਰ ਵਣਜਾਰਾ ਕਬੀਲੇ ਦੇ ਲੱਖੀ ਸ਼ਾਹ ਵਣਜਾਰੇ ਨੇ ਦਿੱਲੀ ਵਿਖੇ ਗੁਰੂ ਤੇਗ਼ ਬਹਾਦੁਰ ਜੀ ਦੀ ਸ਼ਹੀਦੀ ਸਮੇਂ ਮੁਗ਼ਲਾਂ ਤੋਂ ਚੋਰੀ ਗੁਰੂ ਸਾਹਿਬ ਦੇ ਧੜ ਦਾ ਸੰਸਕਾਰ ਆਪਣੇ ਪੂਰੇ ਘਰ ਨੂੰ ਅੱਗ ਲਾ ਕੇ ਕੀਤਾ ਸੀ, ਜਿਸ ਦੇ ਬਦਲੇ ਵਿਚ ਲੱਖੀ ਸ਼ਾਹ ਵਣਜਾਰੇ ਦੇ ਪੂਰੇ ਪਰਿਵਾਰ ਨੂੰ ਮੁਗ਼ਲ ਹਕੂਮਤ ਹੱਥੋਂ ਅਕਹਿ ਕਸ਼ਟ ਸਹਿੰਦਿਆਂ ਸ਼ਹੀਦ ਹੋਣਾ ਪਿਆ ਸੀ। ਇਸੇ ਲੱਖੀ ਸ਼ਾਹ ਵਣਜਾਰਾ ਦੇ ਘਰ ਦੀ ਜ਼ਮੀਨ ਉਤੇ ਅੱਜ ਗੁਰਦੁਆਰਾ ਰਕਾਬ ਗੰਜ ਅਤੇ ਰਾਸ਼ਟਰਪਤੀ ਭਵਨ ਬਣਿਆ ਹੋਇਆ ਹੈ। ਅਜਿਹੇ ਲਾਸਾਨੀ ਇਤਿਹਾਸਕ ਯੋਗਦਾਨ ਦੇ ਬਾਵਜੂਦ ਸਮੇਂ ਦਾ ਵਿਡਾਣ ਇਹ ਹੈ ਕਿ ਨਾ ਤਾਂ ਸਿੱਖ ਸਮਾਜ ਵਲੋਂ ਅਤੇ ਨਾ ਹੀ ਭਾਰਤੀ ਸਰਕਾਰ ਵਲੋਂ ਅੱਜ ਇਨ੍ਹਾਂ ਕਬੀਲਿਆਂ ਦੀ ਹਾਸ਼ੀਆਗਤ ਸਥਿਤੀ ਸਬੰਧੀ ਕੋਈ ਸਾਰ ਲਈ ਜਾਂਦੀ ਹੈ।

ਅੰਗਰੇਜ਼ ਕਾਲ ਕਬੀਲਿਆਂ ਲਈ ਵਧੇਰੇ ਕਸ਼ਟਦਾਇਕ ਰਿਹਾ ਹੈ ਕਿਉਂਕਿ ਆਰਿਆਈ ਲੋਕਾਂ ਨੇ ਜਿਥੇ ਇਨ੍ਹਾਂ ਕਬੀਲਿਆਂ ਨੂੰ ਜੰਗਲਾਂ ਵਿਚ ਧੱਕਣ ਦਾ ਕਾਰਜ ਕੀਤਾ ਸੀ ਉਥੇ ਹੀ ਅੰਗਰੇਜ਼ ਬਸਤੀਕਾਰਾਂ ਨੇ ਇਨ੍ਹਾਂ ਨੂੰ ਉਨ੍ਹਾਂ ਦੇ ਜੰਗਲਾਂ ਤੋਂ ਵਿਰਵਿਆਂ ਕਰਨ ਦਾ ਕਾਰਜ ਕੀਤਾ ਜੋ ਅੱਜ ਵੀ ਭਿਆਨਕ ਰੂਪ ਵਿਚ ਜਾਰੀ ਹੈ। 'ਅੰਗਰੇਜ਼ ਹਕੂਮਤ ਦੁਆਰਾ ਕਬੀਲਿਆਂ ਵਿਰੁੱਧ ਕੀਤੀਆਂ ਗਈਆਂ ਵਧੀਕੀਆਂ ਕਾਰਨ ਹੀ ਆਦਿਵਾਸੀ ਕਬੀਲੇ ਅੰਗਰੇਜ਼ ਹਕੂਮਤ ਵਿਰੁੱਧ ਲੜਨ ਲਈ ਤਿਆਰ ਹੋ ਗਏ ਸਨ। 1857 ਤੋਂ ਪਹਿਲਾਂ ਭਾਰਤ ਦੇ ਵੱਖ-ਵੱਖ ਇਲਾਕਿਆਂ ਵਿਚ ਅੰਗਰੇਜ਼ ਹਕੂਮਤ ਵਿਰੁੱਧ ਕਈ ਛੋਟੇ-ਮੋਟੇ ਯੁੱਧ ਲੜੇ ਗਏ ਸਨ। ਉਂਜ ਤਾਂ ਪੂਰਵਉੱਤਰ, ਰਾਜਸਥਾਨ, ਮੱਧਪ੍ਰਦੇਸ਼, ਛਤੀਸਗੜ੍ਹ, ਆਂਧਰਾਪ੍ਰਦੇਸ਼, ਕੇਰਲਾ, ਅੰਡਮਾਨ ਆਦਿ ਸਾਰੇ ਖੇਤਰਾਂ ਦੇ ਆਦਿਵਾਸੀਆਂ ਨੇ ਅੰਗਰੇਜ਼ਾਂ ਅਤੇ ਉਨ੍ਹਾਂ ਦੇ ਸਹਿਯੋਗੀ ਦੇਸੀ ਸ਼ੋਸ਼ਕ ਜ਼ਿੰਮੀਂਦਾਰਾਂ-ਮਹਾਜਨਾਂ ਦੇ ਖ਼ਿਲਾਫ਼ ਲੜਾਈਆਂ ਲੜੀਆਂ ਹਨ ਪਰ ਸਭ ਤੋਂ ਮਹੱਤਵਪੂਰਨ ਯੋਗਦਾਨ ਰਿਹਾ ਹੈ- ਝਾੜਖੰਡ ਦਾ।'¹² 1857 ਅਤੇ ਇਸ ਤੋਂ ਪਹਿਲਾਂ ਹੋਈਆਂ ਛੋਟੀਆਂ-ਮੋਟੀਆਂ ਬਗ਼ਾਵਤਾਂ ਕਾਰਨ ਹੀ ਅੰਗਰੇਜ਼ ਸਰਕਾਰ ਨੇ 1871 ਈ: ਵਿਚ ਕਬੀਲਿਆਂ ਦੀਆਂ ਬਗ਼ਾਵਤੀ ਗਤੀਵਿਧੀਆਂ ਨੂੰ ਰੋਕਣ ਲਈ ਜ਼ਰਾਇਮ-ਪੇਸ਼ਾ ਐਕਟ (Criminal Tribes Act) ਲਾਗੂ ਕੀਤਾ ਸੀ। ਭਾਵੇਂ ਕਿ ਇਸ ਦੇ ਕਈ ਹੋਰ ਕਾਰਨ ਵੀ ਸਨ। ਇਸ ਐਕਟ ਕਾਰਨ ਕਬੀਲੇ ਦਾ ਹਰ ਨਵਜਾਤ ਬੱਚਾ ਵੀ ਅਪਰਾਧੀ ਬਣ ਜਾਂਦਾ ਸੀ। ਇਸ ਐਕਟ ਤਹਿਤ ਕਬੀਲਾ ਵਾਸੀਆਂ ਨੂੰ ਤਿੰਨ ਕਿਸਮ ਵਾਲੀਆਂ ਤਾਰਾਂ ਵਾਲੇ ਘੇਰੇ ਵਿਚ ਰੱਖਿਆ ਜਾਂਦਾ ਸੀ। ਇਕ ਤਾਰ ਵਾਲੇ ਘੇਰੇ ਅੰਦਰ ਸਧਾਰਨ ਕਿਸਮ ਦੇ ਚੋਰਾਂ ਨੂੰ ਰੱਖਿਆ ਜਾਂਦਾ ਸੀ, ਜੋ ਥਾਣੇ ਵਿਚ ਇਕ ਵਾਰ ਹਾਜ਼ਰੀ ਦਿੰਦੇ ਸਨ। ਦੋ ਤਾਰਾਂ ਵਾਲੇ ਘੇਰੇ ਵਿਚ ਵੱਡੇ ਚੋਰਾਂ ਨੂੰ ਰੱਖਿਆ ਜਾਂਦਾ ਜੋ ਦਿਹਾੜੀ ਵਿਚ ਦੋ ਵਾਰ ਹਾਜ਼ਰੀ ਦਿੰਦੇ ਸਨ। ਤਿੰਨ ਤਾਰਾਂ ਵਾਲਾ ਘੇਰਾ ਉਨ੍ਹਾਂ ਵਿਅਕਤੀਆਂ ਲਈ ਬਣਾਇਆ ਜਾਂਦਾ ਸੀ ਜੋ ਡਾਕੂ ਜਾਂ ਲੁਟੇਰੇ ਹੋਇਆ ਕਰਦੇ ਸਨ। ਇਹ ਥਾਣੇ ਵਿਚ ਤਿੰਨ ਵਾਰ ਹਾਜ਼ਰੀ ਦਿੰਦੇ ਸਨ। ਇਹ ਹੀ ਨਹੀਂ ਬਾਰ੍ਹਾਂ ਸਾਲ ਤੱਕ ਦੇ ਹਰ ਕਬੀਲਾ ਵਾਸੀ ਦੇ ਬੱਚੇ ਨੂੰ ਦਿਨ 'ਚ ਇਕ ਵਾਰੀ ਥਾਣੇ ਵਿਚ ਹਾਜ਼ਰੀ ਦੇਣੀ ਪੈਂਦੀ ਸੀ। ਇਹ ਥਾਣੇ ਨੂੰ ਇਤਲਾਹ ਕੀਤੇ ਬਿਨਾਂ ਬਾਹਰ ਨਹੀਂ ਜਾ ਸਕਦੇ ਸਨ। ਬਸਤੀਵਾਦੀ ਹਕੂਮਤ ਦੀ ਅਜਿਹੀ ਗ਼ੁਲਾਮੀ ਭੋਗਣ ਅਤੇ ਉਸ ਦਾ ਮੁੱਢਲੇ ਤੌਰ 'ਤੇ ਡਟਵਾਂ

ਵਿਰੋਧ ਕਰਨ ਵਾਲੇ ਇਨ੍ਹਾਂ ਕਬੀਲਾਈ ਅੰਦੋਲਨਕਾਰੀਆਂ ਨੂੰ ਨਾ ਤਾਂ ਰਾਸ਼ਟਰਵਾਦੀ ਇਤਿਹਾਸਕਾਰਾਂ ਨੇ ਕੋਈ ਅਹਿਮੀਅਤ ਦਿੱਤੀ ਅਤੇ ਨਾ ਹੀ ਇਨ੍ਹਾਂ ਨੂੰ ਬਾਕੀ ਸਬਾਲਟਰਨ ਸ਼੍ਰੇਣੀਆਂ ਵਾਂਗ 1947 ਵਿਚ ਆਜ਼ਾਦੀ ਹਾਸਲ ਹੋ ਸਕੀ। ਭਾਰਤੀ ਉਪ-ਮਹਾਂਦੀਪ ਦੇ ਕਬੀਲਾ ਨਿਵਾਸੀਆਂ ਨਾਲ ਇਹ ਇਕ ਵੱਡੀ ਤ੍ਰਾਸਦੀ ਵਾਪਰੀ ਕਿ ਉਨ੍ਹਾਂ ਨੂੰ ਅਖੌਤੀ ਆਜ਼ਾਦੀ ਦੇ ਪੰਜ ਸਾਲ ਬੀਤ ਜਾਣ ਤੋਂ ਬਾਅਦ ਇਸ ਜਰਾਇਮ-ਪੇਸ਼ਾ ਐਕਟ ਤੋਂ ਨਿਜ਼ਾਤ ਹਾਸਲ ਹੋਈ। ਆਜ਼ਾਦ ਭਾਰਤ ਦੇ ਪਹਿਲੇ ਪ੍ਰਧਾਨ ਮੰਤਰੀ ਪੰਡਿਤ ਜਵਾਹਰ ਲਾਲ ਨਹਿਰੂ ਨੇ ਇਨ੍ਹਾਂ ਕਬੀਲਿਆਂ ਪ੍ਰਤਿ ਰਹਿਮ ਦਿਲੀ ਵਿਖਾਉਂਦਿਆਂ 1952 ਈ: ਵਿਚ ਇਨ੍ਹਾਂ ਨੂੰ ਜਰਾਇਮ-ਪੇਸ਼ਾ ਐਕਟ ਤੋਂ ਮੁਕਤ ਕੀਤਾ ਸੀ ਪਰ ਇਹ ਅੱਜ ਵੀ ਗੁਲਾਮੀ ਦੇ ਝੰਡੇ ਹੇਠਾਂ ਹੀ ਜੀਵਨ ਬਤੀਤ ਕਰ ਰਹੇ ਹਨ ਕਿਉਂਕਿ ਅੱਜ ਵੀ ਪੁਲਿਸ ਪ੍ਰਸ਼ਾਸਨ, ਰਾਜਨੀਤਕ ਸੱਤਾ ਅਤੇ ਮੁੱਖ-ਸਮਾਜ ਦੀਆਂ ਅੱਖਾਂ ਵਿਚ ਇਹ ਮੁਜ਼ਰਮ ਹੀ ਹਨ। ਅੱਜ ਵੀ, ‘ਸਿਵਲ ਸਰਵਿਸ ਵਿਚ ਜਿੰਨੇ ਆਈ. ਪੀ. ਐਸ. (I.P.S.) ਅਫਸਰਾਂ ਦੀ ਚੋਣ ਹੁੰਦੀ ਹੈ, ਉਨ੍ਹਾਂ ਨੂੰ ਕ੍ਰਿਮੀਨਲ ਟ੍ਰਾਇਬ ਐਕਟ ਦਾ ਵਿਸ਼ਾ ਪੜ੍ਹਾਇਆ ਜਾਂਦਾ ਹੈ ਕਿ ਇਸ-ਇਸ ਜਾਤੀ ਦੇ ਲੋਕਾਂ ਨਾਲ ਤੁਸੀਂ ਕਿਸ ਤਰ੍ਹਾਂ ਦਾ ਵਿਹਾਰ ਕਰਨਾ ਹੈ ਅਤੇ ਜੇਕਰ ਮਡਰ (ਹੱਤਿਆ), ਚੋਰੀ ਜਾਂ ਡਕੈਤੀ ਹੋ ਜਾਵੇ, ਤਾਂ ਕਿਹੜੇ ਲੋਕਾਂ ਨੂੰ ਬੰਦ ਕਰਨਾ ਹੈ।’¹³ ਪੁਲਿਸ ਪ੍ਰਸ਼ਾਸਨ ਇਸ ਵਰਤਾਰੇ ਨੂੰ ਵਿਹਾਰਕ ਰੂਪ ਦਿੰਦਿਆਂ ਕਿਸੇ ਵੀ ਥਾਂ ਚੋਰੀ ਜਾਂ ਜੁਰਮ ਹੋਣ ‘ਤੇ ਇਨ੍ਹਾਂ ਕਬੀਲਾਈ ਲੋਕਾਂ ਨੂੰ ਬੰਦੀ ਬਣਾ ਲੈਂਦੀ ਹੈ ਅਤੇ ਬਿਨਾਂ ਕਿਸੇ ਦੇਸ਼ ਦੇ ਉਨ੍ਹਾਂ ਦੀ ਬੜੀ ਬੇਰਹਿਮੀ ਨਾਲ ਕੁੱਟ-ਮਾਰ, ਗਾਲੀ-ਗਲੇਚ ਅਤੇ ਬਲਾਤਕਾਰ ਵਰਗੀਆਂ ਭਿਆਨਕ ਘਟਨਾਵਾਂ ਨੂੰ ਅੰਜਾਮ ਦਿੰਦੀ ਹੈ। ਦਿੱਲੀ ਵਿਚ ਤਾਂ ਸ਼ਾਂਤੀ ਭੰਗ ਹੋਣ ਦੇ ਖਤਰੇ ਦੇ ਦੇਸ਼ ਵਿਚ ਸਾਂਸੀਆਂ ਨੂੰ 15 ਅਗਸਤ ਤੋਂ ਪੰਦਰਾਂ ਦਿਨ ਪਹਿਲਾਂ ਹੀ ਫੜ ਕੇ ਧਾਰਾ 107 ਅਤੇ 157 ਤਹਿਤ ਬੰਦ ਕੀਤਾ ਜਾਂਦਾ ਹੈ, ਫਿਰ ਤਿੰਨ ਅਕਤੂਬਰ ਜਾਂ ਉਸ ਦੇ ਬਾਅਦ ਹੀ ਇਨ੍ਹਾਂ ਨੂੰ ਛੱਡਣ ਦਾ ਉਪਰਾਲਾ ਕੀਤਾ ਜਾਂਦਾ ਹੈ।¹⁴ ਦੇਸ਼ ਦੀ ਰਾਜਧਾਨੀ ਵਿਚ ਆਜ਼ਾਦੀ ਦਿਹਾੜੇ ‘ਤੇ ਸਾਂਸੀ ਕਬੀਲਿਆਂ ਨਾਲ ਹੁੰਦੇ ਇਸ ਕਿਸਮ ਦੇ ਦੁਰਵਿਹਾਰ ਤੋਂ ਇਹ ਗੱਲ ਸਪਸ਼ਟ ਹੋ ਜਾਂਦੀ ਹੈ ਕਿ ਪੁਲਿਸ ਪ੍ਰਸ਼ਾਸਨ ਦੀ ਚੌਧਰ ਹੇਠ ਇਹ ਹਾਸੀਆਗਤ ਜੀਵਨ ਜਿਊਣ ਲਈ ਮਜ਼ਬੂਰ ਹਨ। ਇਸ ਕਬੀਲੇ ਪ੍ਰਤਿ ਪੁਲਿਸ ਪ੍ਰਸ਼ਾਸਨ ਦੀ ਦਰਿੰਦਗੀ ਇਸ ਗੱਲ ਤੋਂ ਵੀ ਵੇਖੀ ਜਾ ਸਕਦੀ ਹੈ ਕਿ, ਦਿੱਲੀ ਦੇ ਸਾਂਸੀ ਲੋਕਾਂ ਦੇ 10-12 ਸਾਲ ਤਕ ਦੇ ਬੱਚੇ ਜੋ ਸਕੂਲਾਂ ਵਿਚ ਪੜ੍ਹਦੇ ਹਨ, ਨੂੰ ਪੁਲਿਸ ਸ਼ਰਾਬ ਬਣਾਉਣ ਦੇ ਜੁਲਮ ਵਿਚ ਫੜ ਕੇ ਲੈ ਜਾਂਦੀ ਹੈ ਅਤੇ ਮਾਰ-ਕੁਟਾਈ ਕਰ ਕੇ ਉਨ੍ਹਾਂ ਦਾ ਬੁਰਾ ਹਾਲ ਕਰ ਦਿੰਦੀ ਹੈ। ਬਚਪਨ ਤੋਂ ਹੀ ਉਨ੍ਹਾਂ ਨੂੰ ਅਪਰਾਧੀ ਬਣਾ ਦਿੱਤਾ ਜਾਂਦਾ ਹੈ। ਉਨ੍ਹਾਂ ਦੀ ਪੜ੍ਹਾਈ ਵਿਚੋਂ ਛੁੱਟ ਜਾਂਦੀ ਹੈ। ਪੁਲਿਸ ਇਨ੍ਹਾਂ ਦੀਆਂ ਔਰਤਾਂ ਨੂੰ ਵੀ ਨਹੀਂ ਬਖਸ਼ਦੀ।¹⁵

ਇਸ ਤਰ੍ਹਾਂ ਵੇਖਿਆ ਜਾ ਸਕਦਾ ਹੈ ਕਿ ਕਬੀਲਾ ਨਿਵਾਸੀਆਂ ਨੂੰ ਇਤਿਹਾਸ ਦੇ ਹਰ ਮੋੜ ‘ਤੇ ਧੋਖੇ, ਗੁਮਨਾਮੀ, ਅਪਮਾਨ, ਤ੍ਰਿਸਕਾਰ ਅਤੇ ਸ਼ੋਸ਼ਣ ਦਾ ਸ਼ਿਕਾਰ ਹੁੰਦਿਆਂ ਹਾਸੀਆਗਤ ਜੀਵਨ ਬਤੀਤ ਕਰਨ ਲਈ ਮਜ਼ਬੂਰ ਹੋਣਾ ਪਿਆ ਹੈ ਜੋ ਅੱਜ ਵੀ ਕਿਸੇ-ਨਾ-ਕਿਸੇ ਰੂਪ ਵਿਚ ਜਿਊਂਦਾ ਤਿਊਂਦਾ ਜਾਰੀ ਹੈ।

ਕਬੀਲਿਆਂ ਦੀ ਮੌਜੂਦਾ ਸਬਾਲਟਰਨ ਸਥਿਤੀ:

ਸਦੀਆਂ ਤੋਂ ਗੁੰਮਨਾਮੀ, ਤਸੱਦਦ ਅਤੇ ਲੁੱਟ-ਖਸ਼ੁੱਟ ਨੂੰ ਆਪਣੇ ਪਿੰਡੇ ‘ਤੇ ਹੰਢਾਉਂਦੇ ਆ ਰਹੇ ਕਬੀਲਾ ਸਮੂਹ ਭਾਰਤੀ ਉਪ-ਮਹਾਂਦੀਪ ਦੀ ਅਖੌਤੀ ਆਜ਼ਾਦੀ ਦੇ ਸੱਤ ਦਹਾਕੇ ਬੀਤ ਜਾਣ ਤੋਂ ਬਾਅਦ ਵੀ ਵਿਦਿਆ, ਰੁਜ਼ਗਾਰ, ਸਿਹਤ ਅਤੇ ਕਾਨੂੰਨੀ ਹੱਕ-ਹਕੂਕਾਂ ਤੋਂ ਵਿਰਵਿਆਂ ਰਹਿ ਕੇ ਹਾਸੀਆਗਤ ਜੀਵਨ ਬਤੀਤ ਕਰਨ ਲਈ ਮਜ਼ਬੂਰ ਹਨ। ਭਾਰਤੀ ਉਪ-ਮਹਾਂਦੀਪ ਦੇ ਵੱਖੋ-ਵੱਖ ਇਲਾਕਿਆਂ ਵਿਚ ਵੱਖੋ-ਵੱਖ ਪਰਸਥਿਤੀਆਂ ਨੂੰ ਹੰਢਾ ਰਹੇ ਬਹੁ-ਗਿਣਤੀ ਕਬੀਲਿਆਂ ਨੂੰ ਆਪਣੇ ਹੱਕ-ਹਕੂਕਾਂ ਅਤੇ ਆਪਣੀ ਮੂਲ ਪਰੰਪਰਕ ਸਭਿਅਕ ਹੋਂਦ-ਹਸਤੀ ਨੂੰ ਬਚਾਏ ਰੱਖਣ ਲਈ ਕੇਂਦਰੀ ਰਾਜਨੀਤਕ ਸੱਤਾ, ਰਾਸ਼ਟਰਵਾਦੀਆਂ, ਪੂੰਜੀਪਤੀਆਂ/ਬਹੁ-ਰਾਸ਼ਟਰੀ ਕਾਰਪੋਰੇਟ ਘਰਾਣਿਆਂ, ਵਿਸ਼ਵੀਕਰਨ ਸਮਾਜ ਦੀਆਂ ਮੰਡੀਵਾਦੀ ਤਾਕਤਾਂ ਦੀਆਂ ਚਾਲਾਂ ਨਾਲ ਕਰੜਾ ਸੰਘਰਸ਼ ਕਰਦਿਆਂ ਜੂਝਣਾ ਪੈ ਰਿਹਾ ਹੈ। ਜੰਗਲੀ ਇਲਾਕਿਆਂ ਦੇ ਆਦਿਵਾਸੀ ਕਬੀਲੇ ਇਹ ਸੰਘਰਸ਼ ਹਥਿਆਰਬੰਦ ਹੋ ਕੇ ਲੜਨ ਲਈ ਮਜ਼ਬੂਰ ਹਨ। ਇਸ ਦਾ ਕਾਰਨ ਆਦਿਵਾਸੀ ਅਤੇ ਘੁਮੰਤਰੂ ਆਦਿਵਾਸੀਆਂ ਦੇ ਨਾਮ ‘ਤੇ ਜੋ ਕਾਨੂੰਨ ਬਣੇ ਜਾਂ ਉਨ੍ਹਾਂ ਦੇ ਇਲਾਕਿਆਂ ਵਿਚ ਜਿੰਨੇ ਵੀ ਕਾਨੂੰਨ ਬਣੇ, ਉਹ ਆਦਿਵਾਸੀਆਂ ਨੂੰ ਬੇਘਰ ਕਰਨ ਲਈ, ਜੰਗਲ ‘ਚੋਂ ਉਜਾੜਣ ਲਈ ਬਣੇ ਜਾਂ ਫਿਰ ਉਨ੍ਹਾਂ ਨੂੰ ਕੰਗਾਲ ਕਰਨ ਲਈ। ਕੇਂਦਰੀ ਸੱਤਾ ਇਨ੍ਹਾਂ ਨੂੰ ਅਤਿਵਾਦੀ, ਨਕਸਲਵਾਦੀ ਜਾਂ ਮਾਓਵਾਦੀਆਂ ਦਾ ਨਾਂ ਦੇ ਕੇ ਦੇਸ਼ ਵਿਰੋਧੀ ਤਸਲੀਮ ਕਰਦੀ ਹੈ। ‘ਗਰੀਨ ਹੱਟ ਓਪਰੇਸ਼ਨ’ ਤਹਿਤ ਇਨ੍ਹਾਂ ਦੀ ਅਵਾਜ਼ ਨੂੰ ਪੁਲਿਸ ਅਤੇ ਫ਼ੌਜੀ ਤਾਕਤ ਨਾਲ ਸਦਾ ਲਈ ਮੈਨ ਕਰਵਾਉਣ ਲਈ ਲੰਮੇ ਸਮੇਂ ਤੋਂ ਕਰੜੇ ਤਸੱਦਦ ਕਰਦੀ ਆ ਰਹੀ ਹੈ। ਪੁਲਿਸ, ਫ਼ੌਜ ਅਤੇ ਜੰਗਲੀ ਮਹਿਕਮੇ ਦੇ ਅਧਿਕਾਰੀਆਂ ਵਲੋਂ ਇਨ੍ਹਾਂ ਦੀ ਕੁੱਟ-ਮਾਰ, ਗਾਲੀ-ਗਲੇਚ, ਅੱਗਜਨੀ ਅਤੇ ਔਰਤਾਂ ਨਾਲ ਜਬਰ-ਜਨਾਹ ਵਰਗੇ ਅਮਾਨਵੀ ਵਰਤਾਰੇ ਨਿੱਤ ਦਿਨ ਦਾਬੇ ਹੇਠ ਰੱਖਣ ਲਈ ਕੀਤੇ ਜਾਂਦੇ ਹਨ। ਅਜਿਹੀ ਸਥਿਤੀ ਆਦਿਵਾਸੀ ਅਤੇ ਘੁਮੰਤਰੂ ਕਬੀਲਿਆਂ ਨੂੰ ਭਾਰਤ ਦੇ ਹੋਰ ਕਬੀਲਿਆਂ ਨਾਲੋਂ ਵਧੇਰੇ ਹਾਸੀਆਗਤ ਜੀਵਨ ਹੰਢਾਉਣ ਲਈ ਮਜ਼ਬੂਰ ਕਰਦੀ ਹੈ।

ਆਦਿਵਾਸੀ ਕਬੀਲੇ ਸਦੀਆਂ ਤੋਂ ਜੰਗਲ ਵਿਚ ਰਹਿ ਕੇ ਆਪਣੀ ਵੱਖਰੀ ਅਤੇ ਆਜ਼ਾਦ ਜੀਵਨ ਸ਼ੈਲੀ ਰਾਹੀਂ ਜੀਵਨ ਬਤੀਤ ਕਰਦੇ ਆ ਰਹੇ ਹਨ। ਇਸ ਲਈ ਜਲ-ਜੰਗਲ-ਜ਼ਮੀਨ ਇਨ੍ਹਾਂ ਦੇ ਘਰ ਜਾਂ ਰੁਜ਼ਗਾਰ ਦਾ ਸਾਧਨ ਹੀ ਨਹੀਂ ਸਗੋਂ ਇਨ੍ਹਾਂ ਦੇ ਇਸ਼ਟ ਵੀ ਹਨ, ਜਿਸ ਦੀ ਪੂਜਾ-ਅਰਚਨਾ ਬੜੀ ਸ਼ਰਧਾ-ਭਾਵਨਾਂ ਨਾਲ ਕੀਤੀ ਜਾਂਦੀ ਹੈ। ਸਮੇਂ ਦੀ ਹਕੂਮਤ ਅਤੇ ਕਾਰਪੋਰੇਟ ਘਰਾਣੇ ਇਨ੍ਹਾਂ ਜੰਗਲਾਂ ਅਤੇ ਪਹਾੜਾਂ ਤੋਂ ਖਣਿਜ ਪਦਾਰਥਾਂ ਦੇ ਰੂਪ ਵਿਚ ਕੋਲਾ, ਮੈਗਨੀਜ਼, ਬਾਕਸਾਇਟ, ਯੂਰੇਨਿਅਮ ਆਦਿ ਵਰਗੀਆਂ ਮਹਿੰਗੀਆਂ ਅਤੇ ਅਣਮੋਲ ਧਾਤਾਂ ਦੀ ਬੇਤਹਾਸ਼ਾ ਪ੍ਰਾਪਤੀ ਲਈ ਇਨ੍ਹਾਂ ਦੇ ਜਲ-ਜੰਗਲ-ਜ਼ਮੀਨਾਂ ਨੂੰ ਵਿਕਾਸ ਦੇ ਨਾਂ 'ਤੇ ਤਬਾਹ ਕਰ ਰਹੇ ਹਨ। ਇਹ ਤਬਾਹੀ ਵਾਤਾਵਰਣ ਸੰਕਟ ਹੀ ਖੜ੍ਹਾ ਨਹੀਂ ਕਰ ਰਹੀ ਸਗੋਂ ਇਨ੍ਹਾਂ ਕਬੀਲਿਆਂ ਦੇ ਘਰ, ਜੀਵਨ, ਸਭਿਅਤਾ, ਆਸਥਾ ਅਤੇ ਰੁਜ਼ਗਾਰ ਦੇ ਸਾਧਨਾਂ ਦਾ ਘਾਣ ਕਰ ਕੇ ਹਾਸੀਏ ਦੇ ਪਾਤਰ ਵੀ ਬਣਾ ਰਹੀ ਹੈ। ਹਾਕਮ ਜਮਾਤ ਅਤੇ ਕਾਰਪੋਰੇਟ ਘਰਾਣਿਆਂ ਦਾ ਇਹ ਸਾਂਝਾ ਵਰਤਾਰਾ ਆਦਿਵਾਸੀ ਕਿਸਾਨ ਨੂੰ ਸਸਤਾ ਮਜ਼ਦੂਰ ਜਾਂ ਕੋਲਾ ਚੋਰ ਬਣਨ 'ਤੇ ਮਜ਼ਬੂਰ ਕਰਦਾ ਹੈ।

ਭਾਰਤੀ ਉਪ-ਮਹਾਂਦੀਪ ਦੇ ਕਬੀਲਿਆਂ ਵਿਚ ਜਾਤ-ਪਾਤ, ਉਚ-ਨੀਚ, ਅਮੀਰ-ਗਰੀਬ, ਪਿੱਤਰ-ਸੱਤਾ, ਧਾਰਮਿਕ ਭੇਦ-ਭਾਵ ਆਦਿ ਵਰਗੀਆਂ ਸਮਾਜਿਕ ਅਲਾਮਤਾਂ ਨੂੰ ਕੋਈ ਥਾਂ ਨਹੀਂ ਦਿੱਤੀ ਜਾਂਦੀ ਪਰ ਮੌਜੂਦਾ ਦੌਰ ਅੰਦਰ ਕਬੀਲਿਆਂ ਦਾ ਮੁੱਖਧਾਰਾ ਦੇ ਪ੍ਰਭਾਵ ਹੇਠ ਆਉਣ ਕਾਰਨ ਇਹ ਅਲਾਮਤਾਂ ਉਨ੍ਹਾਂ ਵਿਚ ਵੀ ਪੈਦਾ ਹੋ ਗਈਆਂ ਹਨ। ਅੱਜ ਪੜ੍ਹੇ-ਲਿਖੇ ਆਦਿਵਾਸੀਆਂ ਨੂੰ ਮੁੱਖਧਾਰਾ ਵਿਚ ਲਿਆਉਣ ਦਾ ਜਤਨ ਘਰ ਵਾਪਸੀ ਦੇ ਨਾਮ 'ਤੇ ਹੋ ਰਿਹਾ ਹੈ। ਇਹ ਸਭ ਹਿੰਦੂਵਾਦੀਆਂ ਵਲੋਂ ਆਦਿਵਾਸੀ ਦੀ ਹੋਂਦ ਨੂੰ ਖਤਮ ਕਰ ਕੇ, ਉਨ੍ਹਾਂ ਨੂੰ ਹਿੰਦੂ ਬਣਾਉਣ ਜਾਂ ਬਣਾਈ ਰੱਖਣ ਦੀ ਸਾਜਿਸ਼ ਹੈ।¹⁶ ਕਬੀਲਿਆਂ ਦਾ ਸੋਚੀ-ਸਮਝੀ ਸਾਜਿਸ਼ ਤਹਿਤ ਹਿੰਦੂਵਾਦ ਦੇ ਗ਼ਲਬੇ ਹੇਠ ਲਿਆ ਕੇ ਉਨ੍ਹਾਂ ਦੀ ਸਭਿਅਤਾ ਦਾ ਹਿੰਦੂ ਸਭਿਅਤਾ ਵਿਚ ਵਿਲੀਨੀਕਰਨ (Assimilation) ਕੀਤਾ ਜਾ ਰਿਹਾ ਹੈ। ਕਬੀਲਿਆਂ ਨੂੰ ਹਿੰਦੂ ਸਮਾਜ ਵਿਚ ਸ਼ਾਮਲ ਕਰ ਕੇ ਜਿਥੇ ਦਲਿਤਾਂ ਵਾਲਾ ਸਥਾਨ ਦੇ ਕੇ ਜਾਤੀ ਵਿਵਸਥਾ ਦੇ ਬੰਧਨਾਂ ਵਿਚ ਬੰਨ੍ਹਿਆ ਜਾ ਰਿਹਾ ਹੈ ਉਥੇ ਹੀ ਉਨ੍ਹਾਂ ਦੇ ਹੱਥਾਂ ਵਿਚ ਤ੍ਰਿਸੂਲ ਫੜਾ ਕੇ ਦੰਗੇ-ਫਸਾਦਾਂ ਲਈ ਹੱਥ-ਠੇਕਾ ਵੀ ਬਣਾਇਆ ਜਾ ਰਿਹਾ ਹੈ।

ਦਲਿਤਾਂ ਅਤੇ ਆਦਿਵਾਸੀਆਂ ਦੀ ਜ਼ਿੰਦਗੀ ਓਪਰੀ ਸਤ੍ਹੇ ਤੋਂ ਵੇਖਣ ਨਾਲ ਇਕ ਹੀ ਕਿਸਮ ਦੀ ਹਾਸੀਆਗਤ ਵਿਖਾਈ ਪੈਂਦੀ ਹੈ ਪਰ ਦਲਿਤਾਂ ਅਤੇ ਆਦਿਵਾਸੀਆਂ ਦੀ ਸਥਿਤੀ ਵਿਚ ਇਕ ਵੱਡਾ ਅੰਤਰ ਇਹ ਹੈ ਕਿ ਦਲਿਤਾਂ ਨੂੰ ਪਿੰਡ ਦੇ ਬਾਹਰ, ਭਾਰਤੀ ਸਭਿਅਤਾ ਤੋਂ ਮਨਫੀ ਕਰਨ ਦੇ ਬਾਅਦ ਵੀ, ਉਸੇ ਦੇ ਅਧੀਨ ਰਹਿ ਕੇ ਉਸ ਨੂੰ ਮੰਨਣ 'ਤੇ ਮਜ਼ਬੂਰ ਕੀਤਾ ਗਿਆ। ਉਸ ਨੂੰ ਜੀਣ ਦੀਆਂ ਮਾਨਵੀ ਸ਼ਰਤਾਂ ਤੋਂ ਵਿਰਵਿਆਂ ਰੱਖਿਆ ਗਿਆ। ਉਸ ਦਾ ਆਤਮ ਸਨਮਾਨ ਕੁਚਲ ਦਿੱਤਾ ਗਿਆ। ਇਸ ਦੇ ਉਲਟ ਆਦਿਵਾਸੀਆਂ ਨੂੰ ਸਭਿਅਤਾ ਤੋਂ ਹੀ ਮਨਫੀ ਕਰ ਕੇ ਜੰਗਲਾਂ 'ਚ ਧੱਕ ਦਿੱਤਾ ਗਿਆ।¹⁷ ਪਰ ਅੱਜ ਉਸ ਨੂੰ ਜੰਗਲਾਂ ਤੋਂ ਵੀ ਵਿਰਵਿਆਂ ਕਰ ਕੇ ਦਰ-ਦਰ ਦੀਆਂ ਠੇਕਰਾਂ ਖਾਣ ਲਈ ਮਜ਼ਬੂਰ ਕੀਤਾ ਜਾ ਰਿਹਾ ਹੈ।

ਵਰਣ ਜਾਂ ਜਾਤੀ ਵਿਵਸਥਾ ਬ੍ਰਾਹਮਣਵਾਦ ਦੀ ਦੇਣ ਹੈ ਜਦਕਿ 'ਗੋਤ' ਪਰਿਵਾਰ ਦੇ ਵੱਡੇ ਬਜ਼ੁਰਗ ਦੇ ਸਤਿਕਾਰ ਭਾਵ ਨੂੰ ਕਾਇਮ ਰੱਖਦਿਆਂ ਉਸ ਦੇ ਨਾਮ 'ਤੇ ਰੱਖੀ ਜਾਂਦੀ ਹੈ। ਭਾਰਤੀ ਉਪ-ਮਹਾਂਦੀਪ ਦੇ ਕਬੀਲਿਆਂ ਵਿਚ 'ਜਾਤੀ' ਵਿਵਸਥਾ ਨਾ ਹੋ ਕੇ 'ਗੋਤ' ਵਿਵਸਥਾ ਦਾ ਪ੍ਰਚਲਣ ਹੈ। ਜਿਸ ਤੋਂ ਇਹ ਗੱਲ ਸਪਸ਼ਟ ਹੈ ਕਿ ਕਬੀਲਿਆਂ 'ਚ ਜਾਤ-ਪਾਤ ਨੂੰ ਕੋਈ ਥਾਂ ਨਹੀਂ ਦਿੱਤੀ ਜਾਂਦੀ ਪਰ ਸਾਡੇ ਦੇਸ ਦੇ ਸੰਵਿਧਾਨ ਵਿਚ ਕਬੀਲਿਆਂ ਲਈ 'ਜਨਜਾਤੀ' ਜਾਂ 'ਸ਼ਡਿਊਲਡ ਟ੍ਰਾਇਬ' ਸ਼ਬਦਾਂ ਦੀ ਵਰਤੋਂ ਕਰ ਕੇ ਇਕ ਆਦਮਜਾਤੀ ਸਮੂਹ ਨੂੰ ਬ੍ਰਾਹਮਣਵਾਦੀ ਜਾਤੀ ਵਿਵਸਥਾ ਵਿਚ ਬੰਨ੍ਹਿਆ ਗਿਆ ਹੈ। ਹਿੰਦੂ ਰਾਸ਼ਟਰਵਾਦ ਦੇ ਪ੍ਰਭਾਵ ਹੇਠ ਆਏ ਬਹੁ-ਗਿਣਤੀ ਕਬੀਲਿਆਂ ਨੂੰ ਸਮਾਜ ਵਿਚ ਉਹੀ ਸਥਾਨ ਦਿੱਤਾ ਗਿਆ ਹੈ ਜੋ ਦਲਿਤਾਂ ਨੂੰ ਪ੍ਰਾਪਤ ਹੈ। ਇਸੇ ਕਾਰਨ ਸਮਾਜ ਵਿਚ ਕਬੀਲਾ ਸਮੂਹਾਂ ਨੂੰ ਸਵਰਨ-ਸ਼੍ਰੇਣੀਆਂ ਵਲੋਂ ਉਸੇ ਪ੍ਰਕਾਰ ਦਾ ਜਾਤੀ ਵਿਤਕਰਾ ਕਰਦਿਆਂ ਸਰੀਰਕ ਅਤੇ ਮਾਨਸਿਕ ਸ਼ੋਸ਼ਣ ਦਾ ਸ਼ਿਕਾਰ ਬਣਾਇਆ ਜਾਂਦਾ ਹੈ ਜਿਵੇਂ ਦਲਿਤਾਂ ਨੂੰ ਬਣਾਇਆ ਜਾਂਦਾ ਹੈ। ਮਹਾਂਰਾਸ਼ਟਰ ਵਿਚ ਕਬੀਲਾ ਵਾਸੀਆਂ ਨਾਲ ਹੁੰਦੇ ਜਾਤੀ ਵਿਤਕਰੇ ਦਾ ਉਲੇਖ ਕਰਦਿਆਂ ਮਹਾਂਸ਼ਵੇਤਾ ਦੇਵੀ ਲਿਖਦੀ ਹੈ ਕਿ, 'ਵਣਜਾਰਾ ਅਤੇ ਹੋਰ ਵੀ ਖ਼ਾਨਾਬਦੇਸ਼ੀ ਕਬੀਲੇ, ਜਿਵੇਂ ਗਾਡੀ-ਲੁਹਾਰ ਆਦਿ ਨੂੰ ਕਿਸੇ ਵੀ ਖੂਹ ਤੋਂ ਪਾਣੀ ਨਹੀਂ ਲੈਣ ਦਿੱਤਾ ਜਾਂਦਾ। ਉਨ੍ਹਾਂ ਨੂੰ ਕੋਈ ਵੀ ਪਾਣੀ ਨਹੀਂ ਲੈਣ ਦਿੰਦਾ ਕਿਉਂਕਿ ਹੋਰ ਸਾਰੇ ਬ੍ਰਾਹਮਣ ਹਨ ਜਾਂ ਰਾਜਪੂਤ।¹⁸ ਕਬੀਲਿਆਂ ਨਾਲ ਹੁੰਦੇ ਜਾਤੀ ਵਿਤਕਰੇ ਦੀ ਅਜਿਹੀ ਸਥਿਤੀ ਦੇਸ ਦੇ ਹੋਰ ਇਲਾਕਿਆਂ ਵਿਚ ਵੀ ਵੇਖੀ ਜਾ ਸਕਦੀ ਹੈ। ਬੇਸ਼ੱਕ ਪੰਜਾਬ ਵਿਚ ਜਾਤੀ ਵਿਤਕਰਾ ਦੇਸ ਦੇ ਹੋਰ ਇਲਾਕਿਆਂ ਦੇ ਮੁਕਾਬਲੇ ਘੱਟ ਕਠੋਰ ਹੈ ਪਰ ਇਸ ਦੇ ਬਾਵਜੂਦ ਇਸ ਦੀ ਹੋਂਦ ਤੋਂ ਇਨਕਾਰੀ ਨਹੀਂ ਹੋਇਆ ਜਾ ਸਕਦਾ। ਪੰਜਾਬ ਵਿਚ ਸਾਂਸੀ, ਬਾਜ਼ੀਗਰ, ਮਰਾਸੀ, ਗਾਡੀ-ਲੁਹਾਰ, ਸਪੇਰੇ ਆਦਿ ਕਬੀਲਿਆਂ ਨੂੰ ਤ੍ਰਿਸਕਾਰ ਭਾਵ ਦੀ ਦ੍ਰਿਸ਼ਟੀ ਨਾਲ ਵੇਖਦਿਆਂ ਕੁਝ ਸਵਰਨ-ਜਾਤੀ ਲੋਕਾਂ ਵਲੋਂ ਆਪਣੇ ਘਰ ਦੀਆਂ ਦਹਿਲੀਜ਼ਾਂ ਨੂੰ ਪਾਰ ਵੀ ਨਹੀਂ ਕਰਨ ਦਿੱਤਾ ਜਾਂਦਾ। ਸਮਾਜ ਵਿਚ ਕਬੀਲੇ ਦਾ ਪਰੰਪਰਕ ਨਾਮ ਹੀ ਜਾਤੀ ਸੂਚਕ ਦੇ ਅਰਥ ਬੋਧ ਵਜੋਂ ਲਿਆ ਜਾਂਦਾ ਹੈ ਜਿਸ ਕਾਰਨ ਪੜ੍ਹਿਆ-ਲਿਖਿਆ ਕਬੀਲਾ ਵਰਗ

ਆਪਣੇ ਕਬੀਲੇ ਦਾ ਨਾਮ ਦੱਸਣ ਸਮੇਂ ਹੀਣਭਾਵ (Inferiority Complex) ਮਹਿਸੂਸ ਕਰਦਾ ਹੈ। ਕਬੀਲਾ ਸਮੂਹ ਨੂੰ ਦਲਿਤ ਜਾਤੀ ਨਾਲੋਂ ਦੇਹਰੇ ਜਾਤੀਵਾਦੀ ਵਿਤਕਰੇ ਦਾ ਸ਼ਿਕਾਰ ਹੋਣਾ ਪੈਂਦਾ ਹੈ ਕਿਉਂਕਿ ਕਬੀਲਿਆਂ ਨੂੰ ਸਿਰਫ਼ ਸਵਰਨ-ਜਾਤੀਆਂ ਦਾ ਹੀ ਨਹੀਂ ਸਗੋਂ ਦਲਿਤ ਜਾਤੀ ਦੇ ਵਿਤਕਰੇ ਦਾ ਵੀ ਸ਼ਿਕਾਰ ਹੋਣਾ ਪੈਂਦਾ ਹੈ। ਦਲਿਤ ਜਾਤੀ ਦੇ ਲੋਕ ਖੁਦ ਨੂੰ ਕਬੀਲਾ ਜਨ-ਜਾਤੀ ਦੇ ਲੋਕਾਂ ਨਾਲੋਂ ਉਚ ਦਰਜੇ ਦੇ ਹੋਣ ਦਾ ਭਰਮ ਪਾਲਦੇ ਹਨ ਜਦਕਿ ਹਕੀਕਤ ਦੇਵਾਂ ਦੀ ਹਾਸੀਆਗਤ ਹੀ ਹੈ। ਅਜਿਹੀ ਸਥਿਤੀ ਵਿਚ ਕਬੀਲੇ ਹਾਸੀਆਗਤ ਸਥਿਤੀ ਦੇ ਘੇਰੇ ਵਿਚ ਰਹਿ ਕੇ ਹੀ ਹਾਸੀਆਗਤ ਸ਼੍ਰੇਣੀ ਦੇ ਦਮਨ, ਤ੍ਰਿਸਕਾਰ ਅਤੇ ਸ਼ੋਸ਼ਣ ਦਾ ਸ਼ਿਕਾਰ ਹੋ ਕੇ ਹਾਸੀਏ ਤੋਂ ਵੀ ਅੱਗੇ ਧੱਕੇ ਜਾਂਦੇ ਹਨ।

ਕਬੀਲਿਆਂ ਦਾ ਹਾਸੀਏ 'ਤੇ ਧੱਕੇ ਜਾਣ ਦਾ ਇਕ ਕਾਰਨ ਅਨਪੜ੍ਹਤਾ ਵੀ ਹੈ। ਬੇਸ਼ੱਕ ਕੁਝ ਸਥਾਈ ਕਬੀਲਾ ਨਿਵਾਸੀ ਪੜ੍ਹ-ਲਿਖ ਕੇ ਉਚ-ਅਹੁਦਿਆਂ 'ਤੇ ਬਿਰਾਜਮਾਨ ਹਨ ਪਰ ਉਨ੍ਹਾਂ ਦੀ ਗਿਣਤੀ ਬਹੁਤ ਥੋੜੀ ਹੈ ਜਦਕਿ ਅੱਜ ਵੀ ਘੁਮੰਤਰੂ ਅਤੇ ਅਰਧ-ਘੁਮੰਤਰੂ ਕਬੀਲੇ ਅਨਪੜ੍ਹਤਾ ਦੇ ਹਨੇਰੇ ਵਿਚ ਜੀਵਨ ਬਤੀਤ ਕਰ ਰਹੇ ਹਨ। ਅਨਪੜ੍ਹ ਹੋਣ ਕਾਰਨ ਹੀ ਉਹ ਆਪਣੇ ਹੱਕ-ਹਕੂਕਾਂ ਅਤੇ ਰਾਜਨੀਤਿਕ ਸੱਤਾ ਵਲੋਂ ਹੁੰਦੀ ਲੁੱਟ-ਖਸੁੱਟ ਤੋਂ ਵੀ ਜਾਗਰੂਕ ਨਹੀਂ ਹੋ ਸਕਦੇ। ਕਬੀਲਿਆਂ ਦੇ ਅਨਪੜ੍ਹ ਰਹਿ ਜਾਣ ਪਿੱਛੇ ਕਈ ਕਾਰਨ ਹਨ, ਜਿਨ੍ਹਾਂ ਵਿਚੋਂ ਪ੍ਰਮੁੱਖ ਕਾਰਨ ਉਨ੍ਹਾਂ ਦਾ ਜੰਗਲੀ ਅਤੇ ਘੁਮੰਤਰੂ ਜੀਵਨ ਹੈ। ਦੂਸਰਾ ਕਾਰਨ, ਸਰਕਾਰੀ ਸਕੂਲਾਂ ਅਤੇ ਅਧਿਆਪਕਾਂ ਦੀ ਘਾਟ ਹੋਣ ਕਰ ਕੇ ਵੀ ਕਬੀਲਾਈ ਬੱਚੇ ਸਕੂਲ ਜਾਣ ਦੀ ਬਜਾਏ ਆਪਣੇ ਮਾਪਿਆਂ ਨਾਲ ਮਿਹਨਤ-ਮਜ਼ਦੂਰੀ ਕਰਨ ਨੂੰ ਵਧੇਰੇ ਤਰਜੀਹ ਦਿੰਦੇ ਹਨ। ਆਰੰਭਤਮ ਰਾਏ ਜੰਗਲ ਦੇ ਆਦਿਵਾਸੀ ਕਬੀਲਿਆਂ ਦੀ ਸਕੂਲ ਸਥਿਤੀ ਨੂੰ ਬਿਆਨ ਕਰਦਿਆਂ ਲਿਖਦੀ ਹੈ ਕਿ, "ਬੱਚੇ ਜਿਨ੍ਹਾਂ ਨੂੰ ਸਕੂਲ ਵਿਚ ਹੋਣਾ ਚਾਹੀਦਾ ਹੈ ਵਿਹਲੇ ਘੁੰਮਦੇ ਹਨ। ਖੂਬਸੂਰਤ ਪਿੰਡਾਂ ਵਿਚ ਕੰਕਰੀਟ ਦੀਆਂ ਬਣੀਆਂ ਸਕੂਲੀ ਇਮਾਰਤਾਂ ਜਾਂ ਤਾਂ ਮਲਬੇ ਦੇ ਢੇਰ ਵਿਚ ਤਬਦੀਲ ਹੋ ਚੁੱਕੀਆਂ ਹਨ ਜਾਂ ਫਿਰ ਪੁਲਿਸ ਵਾਲਿਆਂ ਨਾਲ ਭਰੀਆਂ ਪਈਆਂ ਹਨ।"¹⁹ ਅਜਿਹੀ ਸਥਿਤੀ ਵਿਚ ਬੱਚੇ ਤਾਂ ਕੀ ਅਧਿਆਪਕ ਵੀ ਸਕੂਲ ਵਿਚ ਹਾਜ਼ਰ ਨਹੀਂ ਹੁੰਦੇ। ਸਰਕਾਰ ਵਲੋਂ ਇਨ੍ਹਾਂ ਗ਼ਰੀਬ ਬੱਚਿਆਂ ਦੀ ਸਕੂਲਾਂ ਪ੍ਰਤਿ ਖਿੱਚ ਪੈਦਾ ਕਰਨ ਲਈ ਪੌਸ਼ਟਿਕ ਭੋਜਨ ਅਤੇ ਵਜੀਫਾ ਦੇਣਾ ਨੀਅਤ ਕੀਤਾ ਹੈ ਜੋ ਕਦੇ ਵੀ ਸਹੀ ਸਮੇਂ 'ਤੇ ਨਸੀਬ ਨਹੀਂ ਹੁੰਦਾ। ਕਬੀਲਾਈ ਬੱਚਿਆਂ ਨੂੰ ਉਨ੍ਹਾਂ ਦੀ ਮਾਤ-ਭਾਸ਼ਾ ਵਿਚ ਸਿਖਿਆ ਨਾ ਦੇਣਾ ਵੀ ਅਨਪੜ੍ਹਤਾ ਦਾ ਕਾਰਨ ਬਣਦਾ ਹੈ ਕਿਉਂਕਿ ਕੁਝ ਇਲਾਕੇ ਦੇ ਕਬੀਲਾਈ ਬੱਚੇ ਜਬਰੀ ਬੋਪੀ ਹੋਈ ਹਿੰਦੀ ਭਾਸ਼ਾ ਦੀਆਂ ਧੁਨੀਆਂ ਦਾ ਸੁੱਧ ਉਚਾਰਣ ਨਹੀਂ ਕਰ ਸਕਦੇ, ਜਿਸ ਕਾਰਨ ਜਮਾਤ ਵਿਚ ਉਨ੍ਹਾਂ ਦਾ ਅਧਿਆਪਕ ਅਤੇ ਵਿਦਿਆਰਥੀਆਂ ਵਲੋਂ ਮਜ਼ਾਕ ਬਣਾ ਕੇ ਹੀਣਭਾਵ ਦਾ ਸ਼ਿਕਾਰ ਬਣਾਇਆ ਜਾਂਦਾ ਹੈ। ਰਮਿਨਕਾ ਗੁਪਤਾ ਇਸ ਸਥਿਤੀ ਨੂੰ ਬਿਆਨ ਕਰਦੇ ਹੋਇਆਂ ਲਿਖਦੀ ਹੈ ਕਿ, 'ਰਾਜਸਥਾਨ ਦਾ ਭੀਲ 'ਸ' ਨੂੰ 'ਚ' ਬੋਲਦਾ ਹੈ। ਹਜ਼ਾਰੀਬਾਗ ਦਾ ਆਦਿਵਾਸੀ 'ਯ' ਨੂੰ 'ਅ' ਬੋਲਦਾ ਹੈ। ਜਦੋਂ ਭੀਲ ਦਾ ਬੋਲ ਪੜ੍ਹਨ ਜਾਂਦਾ ਹੈ ਅਤੇ 'ਸਮੇਸੇ' ਨੂੰ 'ਚਮੇਚਾ' ਬੋਲਦਾ ਹੈ ਅਤੇ ਹਜ਼ਾਰੀਬਾਗ ਤੇ ਰਾਂਚੀ ਵਿਚ 'ਯਾਦ' ਨੂੰ 'ਆਦ' ਕਹਿੰਦਾ ਹੈ ਤਾਂ ਬਾਕੀ ਹਿੰਦੀ ਭਾਸ਼ਾ ਵਾਲੇ ਬੱਚੇ ਉਸ ਦਾ ਮਜ਼ਾਕ ਬਣਾਉਂਦੇ ਹਨ ਤਾਂ ਉਹ ਸਕੂਲ ਛੱਡ ਦਿੰਦਾ ਹੈ।"²⁰ ਅਜਿਹਾ ਹੀ ਨਹੀਂ, ਕੁਝ ਇਲਾਕਿਆਂ ਵਿਚ ਪੜ੍ਹਾਇਆ ਜਾਣ ਵਾਲਾ ਪਾਠਕ੍ਰਮ ਵੀ ਕਬੀਲਾਈ ਬੱਚਿਆਂ ਅੰਦਰ ਹੀਣਭਾਵ ਭਰਨ ਵਾਲਾ ਹੁੰਦਾ ਹੈ। 'ਰਾਜਸਥਾਨ ਦੇ ਇਕ ਪਰਾਇਮਰੀ ਸਕੂਲ ਦੀ ਪੁਸਤਕ ਵਿਚ ਲਿਖਿਆ ਹੈ, "ਭੀਲ ਇਕ ਚੋਰ ਹੁੰਦਾ ਹੈ।" ਦੇਸ ਦੇ ਹਿੰਦੀ ਖੇਤਰਾਂ ਦੇ ਸਕੂਲਾਂ ਵਿਚ ਜਾਂ ਹੋਰ ਇਲਾਕਿਆਂ ਵਿਚ ਪੜ੍ਹਾਇਆ ਜਾਂਦਾ ਹੈ ਕਿ ਉਹ (ਕਬੀਲਾਈ ਲੋਕ) ਦੌੜ ਜਾਂ ਦਾਨਵ ਹਨ। ਪੂਰੀ ਰਮਾਇਣ ਇਨ੍ਹਾਂ ਦੇ ਤ੍ਰਿਸਕਾਰ ਦੀ ਕਥਾ ਹੈ ਅਤੇ ਮਹਾਭਾਰਤ ਇਨ੍ਹਾਂ ਨੂੰ ਠੱਗਣ ਦਾ ਖ਼ਿਤਾਬ ਦਿੰਦਾ ਹੈ। ਇਸ ਪ੍ਰਕਾਰ ਸਿਖਿਆ ਪਾਠਕ੍ਰਮ ਦੇ ਮਾਧਿਅਮ ਤੋਂ ਇਨ੍ਹਾਂ ਨੂੰ ਅਪਮਾਨਿਤ ਕੀਤਾ ਗਿਆ।"²¹ ਅਜਿਹੀ ਸਥਿਤੀ ਵਿਚ ਕਬੀਲਾਈ ਬੱਚੇ ਸਕੂਲ ਛੱਡਣ ਵਿਚ ਹੀ ਆਪਣੀ ਭਲਾਈ ਸਮਝਦੇ ਹਨ।

ਸਦੀਆਂ ਤੋਂ ਬੇਜ਼ਮੀਨੇ ਅਤੇ ਬੇਘਰੇ ਹੋਣ ਦਾ ਸੰਤਾਪ ਹੰਢ ਰਹੇ ਖ਼ਾਨਾਬਦੇਸ਼ੀ ਕਬੀਲੇ ਦਰ-ਦਰ ਦੀਆਂ ਠੇਕਰਾਂ ਖਾਣ ਲਈ ਮਜ਼ਬੂਰ ਹਨ। ਉਜਾੜ, ਬੰਜਰ ਅਤੇ ਖਾਲੀ ਪਈਆਂ ਜ਼ਮੀਨਾਂ ਨੂੰ ਆਪਣੀ ਰਿਹਾਇਸ਼ਗਾਹ ਬਣਾ ਕੇ ਰਹਿਣ ਲਈ ਮਜ਼ਬੂਰ ਹਨ। ਇਨ੍ਹਾਂ ਦੀਆਂ ਸਥਾਈ ਜਾਂ ਅਸਥਾਈ ਝੁੱਗੀਆਂ-ਝੱਪੜੀਆਂ ਜੀਵਨ ਦੀਆਂ ਮੁੱਢਲੀਆਂ ਲੋੜਾਂ ਤੋਂ ਸੱਖਣੀਆਂ ਗੁਰਬਤ ਦੇ ਹਨੇਰੇ ਵਿਚ ਸਿਸਕੀਆਂ ਲੈ ਰਹੀਆਂ ਸਹਿਜੇ ਹੀ ਵੇਖੀਆਂ ਜਾ ਸਕਦੀਆਂ ਹਨ। ਗੰਦਗੀ ਭਰੇ ਮਹੌਲੇ ਵਿਚ ਰਹਿਣ ਕਾਰਨ ਇਹ ਛੋਟੀ ਉਮਰ ਵਿਚ ਹੀ ਭਿਆਨਕ ਬਿਮਾਰੀਆਂ ਦੇ ਸ਼ਿਕਾਰ ਹੋ ਕੇ ਮੌਤ ਦੇ ਮੂੰਹ ਪੈ ਜਾਂਦੇ ਹਨ। ਬਿਨਾਂ ਜ਼ਮੀਨ, ਜਾਇਦਾਦ ਜਾਂ ਘਰ ਤੋਂ ਇਨ੍ਹਾਂ ਘੁਮੰਤਰੂ ਕਬੀਲਿਆਂ ਦੀ ਆਰਥਿਕ ਹਾਲਤ ਏਨੀ ਜ਼ਿਆਦਾ ਮਾੜੀ ਹੁੰਦੀ ਹੈ ਕਿ ਇਹ ਕਿਸੇ ਬੈਂਕ ਤੋਂ ਕਰਜ਼ੇ ਦੀ ਸਹੂਲਤ ਲੈ ਕੇ ਆਪਣਾ ਘਰ ਵੀ ਨਹੀਂ ਬਣਾ ਸਕਦੇ। ਸਰਕਾਰ ਵਲੋਂ ਇਨ੍ਹਾਂ ਘੁਮੰਤਰੂ ਕਬੀਲਿਆਂ ਨੂੰ ਇਸ ਕਦਰ ਹਾਸੀਏ 'ਤੇ ਧੱਕਿਆ ਗਿਆ ਹੈ ਕਿ ਇਨ੍ਹਾਂ ਨੂੰ ਵੋਟ ਦਾ ਅਧਿਕਾਰ ਵੀ ਨਹੀਂ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਮਰਦਮਸ਼ੁਮਾਰੀ ਸਮੇਂ ਇਨ੍ਹਾਂ ਦੀ ਗਿਣਤੀ ਕੀਤੀ ਜਾਂਦੀ ਹੈ। ਕਿਸੇ ਪਿੰਡ-ਗਰਾਂ ਦੇ ਬਾਹਰ ਖਾਲੀ ਪਈ ਜ਼ਮੀਨ 'ਤੇ ਇਨ੍ਹਾਂ ਘੁਮੰਤਰੂ ਕਬੀਲਿਆਂ ਨੂੰ ਤਿੰਨ ਦਿਨਾਂ ਤੋਂ ਵੱਧ ਸਮਾਂ ਬਿਤਾਉਣ ਨਹੀਂ ਦਿੱਤਾ ਜਾਂਦਾ। ਤਿੰਨ ਦਿਨਾਂ ਤੋਂ ਬਾਅਦ ਪਿੰਡ ਵਾਲਿਆਂ ਵਲੋਂ ਇਨ੍ਹਾਂ ਨੂੰ

ਅਪਰਾਧੀ ਭਾਵ ਤੋਂ ਵੇਖਦਿਆਂ ਉਥੋਂ ਕੂਚ ਕਰਨ ਲਈ ਕਹਿ ਦਿੱਤਾ ਜਾਂਦਾ ਹੈ। ਇਨ੍ਹਾਂ ਘੁਮੰਤਰੂ ਕਬੀਲਿਆਂ ਦੀ ਹਾਲਤ ਇਸ ਕਦਰ ਬੁਰੀ ਹੁੰਦੀ ਹੈ ਕਿ ਇਨ੍ਹਾਂ ਕੋਲ ਘਰ ਬਣਾਉਣ ਲਈ ਤਾਂ ਕੀ ਮੁਰਦਾ ਜਲਾਉਣ ਲਈ ਵੀ ਜ਼ਮੀਨ ਨਸੀਬ ਨਹੀਂ ਹੁੰਦੀ। ਇਸ ਪ੍ਰਕਾਰ ਘੁਮੰਤਰੂ ਕਬੀਲੇ ਜੰਗਲ ਦੇ ਆਦਿਵਾਸੀ ਕਬੀਲਿਆਂ ਵਾਂਗ ਭਾਰਤ ਦੇ ਹੋਰਨਾਂ ਕਬੀਲਿਆਂ ਨਾਲੋਂ ਵਧੇਰੇ ਹਾਸ਼ੀਆਗਤ ਜੀਵਨ ਹੰਢਾਉਣ ਲਈ ਮਜ਼ਬੂਰ ਹੋ ਜਾਂਦੇ ਹਨ।

ਇਸ ਪ੍ਰਕਾਰ ਆਦਿਵਾਸੀ, ਘੁਮੰਤਰੂ, ਅਰਧ-ਘੁਮੰਤਰੂ ਅਤੇ ਅਪਰਾਧਕ ਕਬੀਲੇ ਭਾਰਤੀ ਉਪ-ਮਹਾਂਦੀਪ ਦੇ ਹੋਰ ਕਬੀਲਿਆਂ ਨਾਲੋਂ ਵਧੇਰੇ ਦੱਬੇ, ਕੁਚਲੇ, ਤ੍ਰਿਸਕਾਰਤ ਅਤੇ ਸ਼ੋਸ਼ਣ ਦੇ ਸ਼ਿਕਾਰ ਹਨ ਜਦਕਿ ਪੰਜਾਬ ਦੇ ਕਬੀਲਿਆਂ ਦੀਆਂ ਮੁਸ਼ਕਲਾਂ ਜਾਂ ਸਥਿਤੀ ਆਦਿਵਾਸੀ ਅਤੇ ਘੁਮੰਤਰੂ ਕਬੀਲਿਆਂ ਵਰਗੀ ਗੰਭੀਰ ਨਹੀਂ ਹੈ। ਪੰਜਾਬ ਦੇ ਕਬੀਲੇ ਇੰਨੇ ਮਜ਼ਬੂਰ ਨਹੀਂ ਹੋਏ ਕਿ ਉਨ੍ਹਾਂ ਨੂੰ ਹਥਿਆਰ ਚੁੱਕਣ ਲਈ ਮਜ਼ਬੂਰ ਹੋਣਾ ਪਿਆ ਹੋਵੇ।

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- 4 **Encyclopedia Americana**, Vol. 27, p. 98.
- 5 ਡੀ. ਐਨ. ਮਜੂਮਦਾਰ, ਭਾਰਤੀ ਸੰਸਕ੍ਰਿਤੀਆਂ ਅਤੇ ਜਾਤੀਆਂ, (ਅਨੁ. ਬਲਦੇਵ ਸਿੰਘ), ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ, ਪੰਨਾ 414.
- 6 ਦਰਿਆ, ਪੰਜਾਬ ਦੇ ਕਬੀਲੇ ਅਤੀਤ ਅਤੇ ਵਰਤਮਾਨ, ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ, 2014, ਪੰਨਾ 111.
- 7 ਰਮਣਿਕਾ ਗੁਪਤਾ, ਆਦਿਵਾਸੀ ਅਸਮਿਤਾ ਕਾ ਸੰਕਟ, ਸਾਮਿਯਕ ਪ੍ਰਕਾਸ਼ਨ, ਨਈ ਦਿੱਲੀ, ਪੰਨਾ 52.
- 8 ਵਹੀ, ਪੰਨੇ 50-51.
- 9 ਭਾਰਤ ਦੇ ਬਹੁਤੇ ਕਬੀਲੇ ਆਪਣਾ ਮੂਲ ਰਾਜਸਥਾਨ ਦੇ ਰਾਜਪੂਤ ਰਾਜਿਆਂ ਨਾਲ ਜੋੜ ਕੇ ਵੇਖਦੇ ਹਨ। ...ਮੁਗਲਾਂ ਵੱਲੋਂ ਚਿਤੌੜ ਸਮੇਤ ਹੋਰ ਨਿੱਕੀਆਂ-ਨਿੱਕੀਆਂ ਰਿਆਸਤਾਂ ਨੂੰ ਜਿੱਤ ਲੈਣ ਮਗਰੋਂ ਇਨ੍ਹਾਂ ਲੋਕਾਂ ਦੀ ਭਾਰਤ ਦੇ ਹੋਰ ਹਿੱਸਿਆਂ ਵਿੱਚ ਹਿਜ਼ਰਤ ਸ਼ੁਰੂ ਹੁੰਦੀ ਹੈ। ਇਨ੍ਹਾਂ ਦੇ ਰਾਜਸਥਾਨ ਅਤੇ ਆਸ-ਪਾਸ ਦੇ ਇਲਾਕਿਆਂ ਵਿੱਚੋਂ ਹਿਜ਼ਰਤ ਦੇ ਹੇਠ ਲਿਖੇ ਮੁੱਖ ਕਾਰਨ ਹਨ: 1. ਮੁਗਲਾਂ ਵੱਲੋਂ ਥੋਪੇ ਗਏ ਮੁਸਲਮਾਨ ਧਰਮ ਨੂੰ ਨਾ ਅਪਣਾਉਣਾ। 2. ਮੁਗਲਾਂ ਨਾਲ ਰੋਟੀ-ਬੋਟੀ ਦੀ ਸਾਂਝ ਤੋਂ ਇਨਕਾਰ ਕਰਨਾ। 3. ਮੁਗਲਾਂ ਦੀ ਪਰਾਧੀਨਤਾ ਸਵੀਕਾਰ ਨਾ ਕਰਨਾ।- ਮੋਹਨ ਤਿਆਗੀ, ਪੰਜਾਬ ਦੇ ਖ਼ਾਨਾਬਦੇਸ਼ ਕਬੀਲੇ: ਸਭਿਆਚਾਰ ਅਤੇ ਲੋਕ ਜੀਵਨ, ਨੈਸ਼ਨਲ ਬੁਕ ਟਰੱਸਟ, ਇੰਡੀਆ, 2014, ਪੰਨੇ 49-50.
- 10 ਉਹੀ, ਪੰਨਾ 121.
- 11 ਉਹੀ, ਪੰਨਾ 48.
- 12 ਕੇਦਾਰ ਪ੍ਰਸਾਦ ਮੀਨਾ, "ਆਦਿਵਾਸੀ ਸੰਘਰਸ਼ ਕਾ ਇਤਿਹਾਸ", *ਹਾਸ਼ੀਏ ਕਾ ਵਿਰਤਾਂਤ: ਇਸਤਰੀ, ਦਲਿਤ ਔਰ ਆਦਿਵਾਸੀ ਸਮਾਜ ਕਾ ਵਿਕਲਪਿਕ ਇਤਿਹਾਸ*, (ਸੰਪਾ. ਦੀਪਕ ਕੁਮਾਰ ਔਰ ਦੇਵੇਂਦਰ ਚੌਥੇ) ਆਧਾਰ ਪ੍ਰਕਾਸ਼ਨ, ਪੰਚਕੁਲਾ, 2011, ਪੰਨਾ 363.
- 13 ਸਤੀਸ਼ ਸਾਂਸੀ, "ਅਸ਼ਿਖਸ਼ਾ ਵਿਕਾਸ ਮੈਂ ਬਾਧਕ ਹੈ", *ਵਿਮੁਕਤ-ਘੁਮੰਤੂ ਆਦਿਵਾਸੀਓਂ ਕਾ ਮੁਕਤੀ-ਸੰਘਰਸ਼*, (ਸੰਪਾ. ਰਮਣਿਕਾ ਗੁਪਤਾ), ਕਲਿਆਣੀ ਸਿਖਿਆ ਪਰਿਸ਼ਦ, ਦਿੱਲੀ, ਪੰਨਾ 109.
- 14 ਵਹੀ, ਪੰਨਾ 10.
- 15 ਵਹੀ, ਪੰਨਾ 11.
- 16 ਰਮਣਿਕਾ ਗੁਪਤਾ, ਆਦਿਵਾਸੀ ਅਸਮਿਤਾ ਕਾ ਸੰਕਟ, ਪੰਨਾ 23.
- 17 ਵਹੀ, ਪੰਨਾ 50.
- 18 ਮਹਾਂਸ਼ਵੇਤਾ ਦੇਵੀ, "ਤੁਮ ਸਭ ਦਲਿਤ ਹੋ, ਏਕ ਸਾਥ ਹੋ ਜਾਓ!", *ਵਿਮੁਕਤ-ਘੁਮੰਤੂ ਆਦਿਵਾਸੀਓਂ ਕਾ ਮੁਕਤੀ-ਸੰਘਰਸ਼*, (ਸੰਪਾ. ਰਮਣਿਕਾ ਗੁਪਤਾ), ਪੰਨਾ 77.

19 ਆਰੁੰਧਤੀ ਰਾਏ, ਆਪਣੇ ਹੀ ਲੋਕਾਂ ਖ਼ਿਲਾਫ ਜੰਗ, (ਸੰਪਾ. ਅਤੇ ਅਨੁ. ਬੂਟਾ ਸਿੰਘ), ਬਾਬਾ ਬੂੜਾ ਸਿੰਘ ਪ੍ਰਕਾਸ਼ਨ, ਮਹਿਮੂਦਪੁਰ, 2015, ਪੰਨਾ 29.

20 ਰਮਣਿਕਾ ਗੁਪਤਾ, ਆਦਿਵਾਸੀ ਅਸਮਿਤਾ ਕਾ ਸੰਕਟ, ਪੰਨਾ 60.

21 ਵਰੀ, ਪੰਨਾ 20.

ਸਿੱਖ ਧਰਮ ਦੀ ਕੀਰਤਨ ਚੋਕੀ ਪਰੰਪਰਾ

ਏ ਪੀ ਸਿੰਘ

ਗੁਰਮਤਿ ਸੰਗੀਤ ਵਿਭਾਗ, ਯੂਨੀਵਰਸਿਟੀ ਕਾਲਜ ਘਨੋਰ, ਪਟਿਆਲਾ

ਭਾਰਤੀ ਧਰਮ ਅਤੇ ਸੰਗੀਤ ਇਕ ਦੂਜੇ ਦੇ ਪੂਰਕ ਕਰਦੇ ਜਾ ਸਕਦੇ ਹਨ। ਭਾਰਤੀ ਸੰਗੀਤ ਦਾ ਵਿਕਾਸ ਧਾਰਮਿਕ ਰਹੁਰੀਤਾਂ ਅਤੇ ਆਯੋਜਨਾਂ ਦਾ ਹਾਥੀ ਹੈ। ਸਿੰਧੂ ਘਾਟੀ ਦੀ ਸਭਿਅਤਾ ਦੇ ਅਵਸ਼ੇਸ਼ਾਂ ਤੋਂ ਧਰਮ ਅਤੇ ਸੰਗੀਤ ਦੀ ਅਟੁਟ ਸਾਂਝ ਪ੍ਰਗਟ ਹੁੰਦੀ ਹੈ। ਵੈਦਿਕ ਕਾਲ ਵਿਚ ਰਿਚਾ ਗਾਇਣ, ਸਾਮ ਗਾਇਣ ਨਾਲ ਸੰਗੀਤ ਦਾ ਵਿਕਾਸ ਹੋਇਆ। ਪ੍ਰਬੰਧ ਗਾਨ, ਅਸ਼ਟਪਦੀ ਗਾਇਣ, ਧਰੁਪਦ-ਧਮਾਰ, ਖਿਆਲ, ਹੋਰੀ, ਕਜਰੀ, ਚੇਤੀ ਆਦਿ ਦਾ ਸਬੰਧੀ ਧਾਰਮਿਕ ਆਯੋਜਨਾਂ ਨਾਲ ਰਿਹਾ ਹੈ।

ਸਿੱਖ ਧਰਮ ਦੇ ਬਾਣੀ ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ ਨੇ ਸੰਗੀਤ ਦੀ ਸੰਚਾਰ ਸ਼ਕਤੀ ਨੂੰ ਪਹਿਚਾਣਦੇ ਹੋਏ ਇਸ ਨੂੰ ਇਕ ਸੰਚਾਰ ਜੁਗਤ ਵਜੋਂ ਪ੍ਰਯੋਗ ਕੀਤਾ। ਉਨ੍ਹਾਂ ਨੇ ਕਾਵਿਮਈ ਇਲਾਹੀ ਬਾਣੀ ਦੀ ਰਾਗਬੱਧ ਰਚਨਾ ਨਾਲ ਸੰਗੀਤ, ਸਾਹਿਤ ਅਤੇ ਕਾਵਿ ਦੇ ਸੰਚਾਰ ਗੁਣਾਂ ਨੂੰ ਸੰਮਿਲਤ ਰੂਪ ਵਿਚ ਪ੍ਰਯੋਗ ਕਰਦਿਆਂ ਇਕ ਨਵੇਂ ਸੰਗੀਤ ਵਿਧਾਨ ਦੀ ਨੀਂਹ ਰੱਖੀ, ਜਿਸ ਵਿਚ ਬੇਲੋੜੇ ਕਲਾਤਮਿਕ ਪ੍ਰਗਟਾਵੇ ਨਹੀਂ ਸਨ। ਸਮੂਹ ਗੁਰੂ ਸਾਹਿਬਾਨ ਨੇ ਇਸ ਪਰੰਪਰਾ ਦੇ ਪ੍ਰਚਾਰ-ਪਾਸਾਰ ਲਈ ਭਰਪੂਰ ਯੋਗਦਾਨ ਪਾਇਆ। ਬਾਣੀ ਰਚਨਾਵਾਂ ਕੀਤੀਆਂ। ਕੀਰਤਨੀਆਂ ਨੂੰ ਸਰਪ੍ਰਸਤੀ ਪ੍ਰਦਾਨ ਕੀਤੀ। ਸ਼ਬਦ ਕੀਰਤਨ ਨੂੰ ਗੁਰੂ ਘਰ ਦੀ ਨਿੱਤ ਦੀ ਮਰਿਆਦਾ ਦਾ ਅਭਿੰਨ ਅੰਗ ਬਣਾਇਆ। ਸਿੱਖ ਧਰਮ ਦੇ ਵਿਭਿੰਨ ਸੰਸਕਾਰਾਂ ਨਾਲ ਸ਼ਬਦ-ਕੀਰਤਨ ਪ੍ਰਸਤੁਤੀਆਂ ਜੋੜਦਿਆਂ ਬਾਣੀ ਅਤੇ ਸੰਗੀਤ ਦੇ ਸੁਮੇਲ ਨਾਲ ਧੁਰ ਕੀ ਬਾਣੀ ਦੇ ਸੰਦੇਸ਼ ਨੂੰ ਘਰ ਘਰ ਪਹੁੰਚਾਇਆ।

- ਧੁਰ ਕੀ ਬਾਣੀ ਆਈ॥ ਤਿਨਿ ਸਗਲੀ ਚਿੰਤ ਮਿਟਾਈ॥

(ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ, ਪੰਨਾ 627)

- ਘਰਿ ਘਰਿ ਅੰਦਰਿ ਧਰਮਸਾਲ ਹੋਵੈ ਕੀਰਤਨੁ ਸਦਾ ਵਿਸੇਆ॥

(ਭਾਈ ਗੁਰਦਾਸ, ਵਾਰ ਪਹਿਲੀ, ਪਉੜੀ 27)

ਉਸ ਸਮੇਂ ਹਿੰਦੁਸਤਾਨੀ ਸੰਗੀਤ ਵਿਚ ਕਲਾਤਮਿਕ ਪ੍ਰਦਰਸ਼ਨਾਂ ਦਾ ਦੌਰ ਚਲ ਰਿਹਾ ਸੀ। ਗੁਰੂ ਸਾਹਿਬਾਨ ਨੇ ਸੰਗਤ ਨੂੰ ਕਲਾਤਮਿਕਤਾ ਨੂੰ ਸ਼ਬਦ ਸੰਚਾਰ ਦੇ ਇਕ ਸਾਧਨ ਦੇ ਰੂਪ ਵਿਚ ਪ੍ਰਯੋਗ ਕਰਦਿਆਂ ਬਾਣੀ ਨਾਲ ਜੋੜਿਆ। ਬਾਣੀ ਪ੍ਰਧਾਨ ਕੀਰਤਨ ਨਾਲ ਸਰਬ ਲੋਕਾਈ ਦੇ ਤਪਦੇ ਹਿਰਦੇ ਸ਼ਾਂਤ ਹੋ ਰਹੇ ਸਨ।

- ਤਪਤਿ ਮਾਹਿ ਠਾਢਿ ਵਰਤਾਈ॥ ਅਨਦੁ ਭਇਆ ਦੁਖ ਨਾਠੇ ਭਾਈ॥ ...

ਥਿਤਿ ਪਾਈ ਚੂਕੇ ਭ੍ਰਮ ਗਵਨ॥ ਸੁਨਿ ਨਾਨਕ ਹਰਿ ਹਰਿ ਜਸ ਸ੍ਰਵਨ॥ 7॥

(ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ, ਪੰਨਾ 287)

ਕੀਰਤਨ ਚੋਕੀ ਤੋਂ ਭਾਵ ਇਕ ਸਮੇਂ ਕਿਸੇ ਖਾਸ ਪ੍ਰਕਾਰਣ ਜਾਂ ਆਸ਼ੇ ਅਧੀਨ ਇਕ ਸੰਪੂਰਨ ਕੀਰਤਨ ਪ੍ਰਸਤੁਤੀ। ਗੁਰਮਤਿ ਦੇ ਵਿਦਵਾਨ ਜਨ ਚੋਕੀ ਤੋਂ ਭਾਵ ਚਾਰ ਰਾਗੀਆਂ ਦੀ ਮੰਡਲੀ ਤੋਂ ਲੈਂਦੇ ਰਹੇ ਹਨ, ਜਿਸ ਵਿਚ ਇਕ ਕੀਰਤਨੀਆਂ, ਦੂਜਾ ਸੁਰ ਰਚਾਉਣ ਵਾਲਾ, ਤੀਜਾ ਸਾਜ਼ ਵਜਾਉਣ ਵਾਲਾ ਅਤੇ ਚੌਥਾ ਤਾਲ ਸਾਜ਼ ਵਾਦਨ ਗਿਣਿਆਂ ਗਿਆ ਹੈ। ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਵਿਚ ਕਿਤੇ ਵੀ ਕੀਰਤਨਕਾਰਾਂ ਦੀ ਗਿਣਤੀ ਦਾ ਉਲੇਖ ਨਹੀਂ ਹੋਇਆ ਹੈ। ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ ਅਤੇ ਭਾਈ ਮਰਦਾਨਾ, ਦੋਵੇਂ ਸ਼ਬਦ ਕੀਰਤਨ ਰਾਹੀਂ ਇਲਾਹੀ ਸੰਦੇਸ਼ ਦਾ ਪ੍ਰਚਾਰ ਕਰਦੇ ਰਹੇ ਹਨ। ਵਰਤਮਾਨ ਸਮੇਂ ਇਕ ਕੀਰਤਨੀ ਜੱਥੇ ਵਿਚ ਤਿੰਨ ਸਿੰਘ ਹੀ ਨਜ਼ਰੀ ਆਉਂਦੇ ਹਨ। ਨਗਰ ਕੀਰਤਨ ਦੌਰਾਨ ਸ਼ਬਦ ਗਾਇਣ ਕਰਨ ਵਾਲਿਆਂ ਦੀ ਗਿਣਤੀ ਸੰਭਵ ਨਹੀਂ। ਇਸਲਈ ਚੋਕੀ ਨੂੰ ਕੀਰਤਨੀਆਂ ਦੀ ਗਿਣਤੀ ਨਾਲ ਨਾ ਜੋੜਦੇ ਹੋਏ, ਗੁਰਮਤਿ ਸੰਗੀਤ ਦੇ ਵਿਦਵਾਨਾਂ ਨੇ ਸ਼ਬਦ ਕੀਰਤਨ ਵਿਚ ਪ੍ਰਯੋਗ ਹੋਣ ਵਾਲੇ ਚਾਰ ਸੰਗੀਤਕ ਤੱਤਾਂ ਨੂੰ ਕੀਰਤਨ ਚੋਕੀ ਦਾ ਆਧਾਰ ਮੰਨਿਆ ਹੈ।

1. ਸ਼ਾਨ
2. ਮੰਗਲਾਚਰਨ
3. ਸ਼ਬਦ ਗਾਇਣ

4. ਪਉੜੀ ਗਾਇਣ

ਸ਼ਬਦ ਕੀਰਤਨ ਪ੍ਰਸਤੁਤੀ ਦੇ ਆਰੰਭ ਵਿਚ ਵਜਾਏ ਜਾਣ ਵਾਲੀ ਸਾਜ਼ਾਂ 'ਤੇ ਆਧਾਰਿਤ ਰਚਨਾ ਨੂੰ ਸ਼ਾਨ ਕਹਿੰਦੇ ਹਨ। ਸ਼ਾਨ ਵਿਚ ਤੰਤੀ ਅਤੇ ਤਾਲ ਸਾਜ਼ਾਂ ਦਾ ਪ੍ਰਯੋਗ ਹੁੰਦਾ ਆਇਆ ਹੈ। ਵਰਤਮਾਨ ਸਮੇਂ ਜਿੱਥੇ ਤੰਤੀ ਸਾਜ਼ ਉਪਲਬਧ ਨਾ ਹੋਣ ਉੱਥੇ ਹਾਰਮਨੀਅਮ ਨਾਲ ਸ਼ਾਨ ਦਾ ਵਾਦਨ ਕੀਤਾ ਜਾ ਰਿਹਾ ਹੈ। ਸ਼ਾਨ ਵਾਦਨ ਵਿਚ ਤਾਲ ਸਾਜ਼ ਵਾਦਕ ਅਤੇ ਸੁਰ ਸਾਜ਼ ਵਾਦਕ ਕਲਾਤਮਿਕ ਜ਼ੋਰ ਦਿਖਾਉਂਦੇ ਹਨ।

ਸ਼ਾਨ ਤੋਂ ਬਾਅਦ ਮੰਗਲਾਚਰਨ ਕੀਤਾ ਜਾਂਦਾ ਹੈ, ਜਿਸ ਵਿਚ ਅਕਾਲ ਪੁਰਖ ਦਾ ਮੰਗਲ ਗਾਇਨ ਕਰਦੇ ਹੋਏ, ਸ਼ਬਦ ਚੌਕੀ ਦੇ ਪ੍ਰਕਰਣ ਅਨੁਸਾਰ ਬਾਣੀ ਦੀ ਚੋਣ ਕਰਦਿਆਂ, ਵਿਲੰਬਿਤ ਜਾਂ ਮੱਧ ਲੈਅ ਵਿਚ ਅਰਾਧਨਾ ਕੀਤੀ ਜਾਂਦੀ ਹੈ। ਇਸ ਦੌਰਾਨ 'ਡੰਡਉਤਿ ਬੰਦਨ ਅਨਿਕ ਬਾਰ ਸਰਬ ਕਲਾ ਸਮਰਥ। ਡੋਲਨ ਤੇ ਰਾਖਹੁ ਪ੍ਰਭੂ ਨਾਨਕ ਦੇ ਕਰਿ ਹੱਥ॥' ਦਾ ਸਲੋਕ ਸੈਲੀ ਵਿਚ ਗਾਇਣ ਕੀਤਾ ਜਾਂਦਾ ਹੈ। ਇਹ ਤੁੱਕ ਭਾਵੇਂ ਗੁਉੜੀ ਰਾਗ ਅਧੀਨ ਦਰਜ ਬਾਣੀ ਦਾ ਹਿੱਸਾ ਹੈ, ਲੇਕਿਨ ਇਸ ਦਾ ਗਾਇਨ, ਕੀਰਤਨ ਪ੍ਰਸਤੁਤੀ ਵਿਚ ਪੜ੍ਹੇ ਜਾਣ ਵਾਲੇ ਪਹਿਲੇ ਸ਼ਬਦ ਵਾਲਾ ਹੁੰਦਾ ਹੈ। ਮੰਗਲਾਚਰਨ ਦੇ ਸਮਾਪਨ ਵਿਚ 'ਆਨੰਦ ਗੁਣੀ ਨਿਧਾਨ, ਗੁਰੂ ਗ਼ਰੀਬ-ਨਿਵਾਜ਼' ਕੀਤਾ ਜਾਂਦਾ ਹੈ।

ਮੰਗਲਾਚਰਨ ਤੋਂ ਬਾਅਦ ਸ਼ਾਸਤਰੀ ਗਾਇਣ ਸੈਲੀ ਵਿਚ ਸ਼ਬਦ ਗਾਇਣ ਕੀਤਾ ਜਾਂਦਾ ਹੈ। ਸ਼ਬਦ ਗਾਇਣ ਦਾ ਰਾਗ ਇਸ ਤੋਂ ਪਹਿਲਾਂ ਸ਼ਾਨ ਅਤੇ ਮੰਗਲਾਚਰਨ ਵਿਚ ਪ੍ਰਯੋਗ ਹੋ ਜਾਂਦਾ ਹੈ। ਸੰਪੂਰਨ ਕੀਰਤਨ ਪ੍ਰਸਤੁਤੀ ਦੌਰਾਨ ਇਕ ਤੋਂ ਵੱਧ ਰਾਗਾਂ ਦਾ ਪ੍ਰਯੋਗ ਕਰਦਿਆਂ ਗੁਰਬਾਣੀ ਗਾਇਣ ਕੀਤਾ ਜਾਂਦਾ ਹੈ। ਇਨ੍ਹਾਂ ਸ਼ਬਦਾਂ ਦੀ ਚੋਣ ਕੀਰਤਨ ਚੌਕੀ ਦੇ ਪ੍ਰਕਰਣ ਅਤੇ ਵਿਸ਼ੇ ਅਨੁਸਾਰ ਹੁੰਦੀ ਹੈ।

ਕੀਰਤਨ ਚੌਕੀ ਦੇ ਅੰਤਿਮ ਤੱਤ ਵਜੋਂ ਪਉੜੀ ਗਾਇਣ ਮੰਨਿਆ ਜਾਂਦਾ ਹੈ, ਜਿਸ ਦੌਰਾਨ ਲੋਕ ਅੰਗ ਤੋਂ ਵਾਰ ਦੇ ਨਾਲ ਸਬੰਧਤ ਪਉੜੀਆਂ ਦਾ ਗਾਇਣ ਕਰਨ ਦੀ ਪਰੰਪਰਾ ਹੈ। ਵਰਤਮਾਨ ਸਮੇਂ ਬਹੁਤੇ ਕੀਰਤਨਕਾਰ ਰਾਮਕਲੀ ਰਾਗ ਵਿਚ ਗੁਰੂ ਅਰਜਨ ਦੇਵ ਦੁਆਰਾ ਰਚਿਤ ਪਉੜੀ 'ਵਡੀ ਹੂ ਵਡਾ ਅਪਾਰੁ ਤੇਰਾ ਮਰਤਬਾ' ਦਾ ਗਾਇਣ ਕਰਦੇ ਹਨ। ਇਸ ਦੌਰਾਨ ਰਾਮਕਲੀ ਰਾਗ ਤੋਂ ਬਿਨਾਂ ਜਿਸ ਵੀ ਰਾਗ ਵਿਚ ਅੰਤਿਮ ਸ਼ਬਦ ਪੜ੍ਹਿਆ ਗਿਆ ਹੋਵੇ ਉਸੇ ਵਿਚ ਪਉੜੀ ਗਾਇਣ ਕਰ ਲਿਆ ਜਾਂਦਾ ਹੈ।

ਕੀਰਤਨ ਚੌਕੀ ਪਰੰਪਰਾ ਦਾ ਆਰੰਭ ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ ਦੇ ਸਮੇਂ ਨਣਕਾਣਾ ਸਾਹਿਬ ਵਿਖੇ ਹੋ ਗਿਆ ਸੀ। ਗੁਰੂ ਜੀ ਜਦੋਂ ਉਦਾਸੀਆਂ 'ਤੇ ਜਾਂਦੇ ਤਾਂ ਭਾਈ ਲਹਿਣਾ ਜੀ ਅਤੇ ਭਾਈ ਮਰਦਾਨਾ ਦਾ ਸਪੁੱਤਰ ਭਾਈ ਸਾਜਾਦਾ 'ਆਸਾ ਦੀ ਵਾਰ' ਅਤੇ 'ਆਰਤੀ' ਗਾਇਣ ਦੁਆਰਾ ਸੰਗਤਾਂ ਨੂੰ ਅੰਮ੍ਰਿਤ ਵੇਲੇ ਅਤੇ ਸੰਧਿਆ ਸਮੇਂ ਨਿਹਾਲ ਕਰਦੇ ਸਨ। ਇਸ ਪ੍ਰਥਾਇ ਭਾਈ ਗੁਰਦਾਸ ਲਿਖਦੇ ਹਨ:

- ਸੇਦਰੁ ਆਰਤੀ ਗਾਵੀਐ ਅੰਮ੍ਰਿਤ ਵੇਲੇ ਜਾਪੁ ਉਚਾਰਾ॥ (ਭਾਈ ਗੁਰਦਾਸ, ਵਾਰ ਪਹਿਲੀ, ਪਉੜੀ 38)

ਭਾਈ ਕਾਨ੍ਹ ਸਿੰਘ ਨਾਭਾ ਅਨੁਸਾਰ, ਗੁਰੂ ਅਰਜਨ ਦੇਵ ਜੀ ਨੇ ਹਰਿਮੰਦਰ ਸਾਹਿਬ ਵਿਖੇ ਚਾਰ ਚੌਕੀਆਂ ਦੀ ਰੀਤ ਸਥਾਪਤ ਕੀਤੀ। ਇਹ ਕੀਰਤਨ ਚੌਕੀਆਂ ਇਸ ਪ੍ਰਕਾਰ ਸਨ:

1. ਆਸਾ ਦੀ ਵਾਰ ਦੀ ਚੌਕੀ
2. ਚਰਨ ਕਮਲ ਦੀ ਚੌਕੀ
3. ਸੇਦਰੁ ਦੀ ਚੌਕੀ
4. ਸੁੱਖ ਆਸਣ / ਕਲਿਆਨ ਦੀ ਚੌਕੀ

ਭਾਈ ਵੀਰ ਸਿੰਘ ਨੇ ਚਰਨਕਮਲ ਦੀ ਚੌਕੀ ਤੋਂ ਪਹਿਲਾਂ ਅਨੰਦ ਦੀ ਚੌਕੀ ਦਾ ਹਵਾਲਾ ਦਿੰਦੇ ਹੋਏ ਚੌਕੀਆਂ ਦੀ ਗਿਣਤੀ ਪੰਜ ਦੱਸੀ ਹੈ। ਸਮੇਂ ਦੇ ਨਾਲ-ਨਾਲ ਜਿਵੇਂ-ਜਿਵੇਂ ਗੁਰੂ ਘਰਾਂ ਵਿਚ ਸੰਗਤ ਦੀ ਆਮਦ ਵਧਦੀ ਗਈ, ਉਵੇਂ-ਉਵੇਂ ਕੀਰਤਨ ਚੌਕੀਆਂ ਦੀ ਗਿਣਤੀ ਵਿਚ ਵਾਧਾ ਹੁੰਦਾ ਗਿਆ। ਇਸ ਦੌਰਾਨ ਭਾਵੇਂ ਮੂਲ ਕੀਰਤਨ ਚੌਕੀਆਂ ਵਿਚ ਕੋਈ ਬਦਲਾਅ ਨਹੀਂ ਆਇਆ, ਪਰ ਬਿਲਾਵਲ ਅਤੇ ਚਰਨਕਮਲ ਦੀਆਂ ਕੀਰਤਨ ਪ੍ਰਸਤੁਤੀਆਂ ਨੂੰ ਕੀਰਤਨ ਚੌਕੀ ਜਾਂ ਕੀਰਤਨ ਡਿਉਟੀ ਦੇ ਰੂਪ ਵਿਚ ਜਾਣਿਆ ਜਾਣ ਲੱਗਾ। ਵਰਤਮਾਨ ਸਮੇਂ ਸ੍ਰੀ ਹਰਿਮੰਦਰ ਸਾਹਿਬ ਵਿਚ ਪ੍ਰਚੱਲਿਤ ਕੀਰਤਨ ਚੌਕੀਆਂ ਇਸ ਪ੍ਰਕਾਰ ਹਨ:

ਤਿੰਨ ਪਹਿਰੇ ਦੀ ਚੌਕੀ: ਤਿੰਨ ਪਹਿਰੇ ਦੀ ਕੀਰਤਨ ਚੌਕੀ ਸ੍ਰੀ ਹਰਿਮੰਦਰ ਸਾਹਿਬ ਵਿਖੇ ਰਾਤ ਦੇ ਤੀਜੇ ਪਹਿਰ ਲਗਾਈ ਜਾਂਦੀ ਹੈ। ਇਹ ਚੌਕੀ ਬਾਬਾ ਸ਼ਾਮ ਸਿੰਘ ਦੀ ਯਾਦ ਵਿਚ ਆਰੰਭੀ ਗਈ, ਜੋ ਨਿਰੰਤਰ 70 ਵਰ੍ਹੇ ਕਿਵਾੜ ਖੁੱਲ੍ਹਣ ਤੋਂ ਪਹਿਲਾਂ ਸਰੰਦਾ ਵਜਾ 'ਕੇ ਕੀਰਤਨ ਦੀ ਸਾਰਦਾ' ਦਿੰਦੇ ਹੋਏ, ਸੰਗਤਾਂ ਨੂੰ ਹਰਿ ਜੱਸ ਨਾਲ ਜੋੜਦੇ ਰਹੇ। ਇਸ ਕੀਰਤਨ ਚੌਕੀ ਵਿਚ ਸੋਰਠਿ, ਭੈਰਉ, ਆਸਾ, ਮਲ੍ਹਾਰ, ਬਸੰਤ-ਹਿੰਡੋਲ, ਪ੍ਰਭਾਤੀ, ਪ੍ਰਭਾਤੀ-ਬਿਭਾਸ, ਪ੍ਰਭਾਤੀ ਬਿਭਾਸ ਰਾਗਾਂ ਅਧੀਨ ਬਾਣੀ ਗਾਇਣ ਦੀ ਪਰੰਪਰਾ ਹੈ।

ਆਸਾ ਦੀ ਵਾਰ ਦੀ ਚੋਂਕੀ: ਆਸਾ ਦੀ ਵਾਰ ਦਾ ਗਾਇਣ ਭਾਈ ਲਹਿਣਾ ਜੀ (ਬਾਅਦ ਵਿਚ ਗੁਰੂ ਅੰਗਦ ਵਜੋਂ ਸਰੂਪਿਤ ਹੋਏ) ਅਤੇ ਮਰਦਾਨਾ ਦੇ ਸਪੁੱਤਰ ਭਾਈ ਸਜਾਦਾ, ਨਨਕਾਣਾ ਸਾਹਿਬ ਵਿਖੇ ਆਸਾ ਦੀ ਵਾਰ ਦਾ ਕੀਰਤਨ ਕਰਦੇ ਰਹੇ। ਬਾਅਦ ਵਿਚ ਗੁਰੂ ਰਾਮਦਾਸ ਜੀ ਦੇ ਛੰਤ ਮਿਲਾ 'ਕੇ ਆਸਾ' ਦੀ ਵਾਰ ਦੇ ਗਾਇਣ ਦੀ ਵਿਧੀ ਅਪਣਾਈ ਗਈ। ਆਸਾ ਦੀ ਵਾਰ ਦੀ ਕੀਰਤਨ ਚੋਂਕੀ ਦਾ ਆਰੰਭ ਰਾਤ ਦੇ ਚੌਥੇ ਪਹਿਰ ਸ਼ੁਰੂ ਹੋ ਜਾਂਦਾ ਹੈ, ਜੋ ਦਿਨ ਦੇ ਪਹਿਲੇ ਪਹਿਰ ਤਕ ਚਲਦਾ ਹੈ। ਇਸ ਕੀਰਤਨ ਚੋਂਕੀ ਵਿਚ ਆਸਾ, ਆਸਾਵਰੀ, ਆਸਾਵਰੀ ਸੁਧੰਗ (ਕੋਮਲ ਰਿਸ਼ਭ ਆਸਾਵਰੀ), ਆਸਾ ਆਸਾਵਰੀ, ਬਿਲਾਵਲ, ਭੈਰਉ, ਗਉੜੀ ਦੱਖਣੀ, ਗਉੜੀ ਬੈਰਾਗਣਿ, ਟੋਡੀ (ਤੋੜੀ), ਗੂਜਰੀ, ਰਾਮਕਲੀ, ਰਾਮਕਲੀ ਦੱਖਣੀ, ਬਸੰਤ, ਪ੍ਰਭਾਤੀ, ਪ੍ਰਭਾਤੀ ਬਿਭਾਸ, ਪ੍ਰਭਾਤੀ ਦੱਖਣੀ, ਬਿਭਾਸ ਪ੍ਰਭਾਤੀ, ਦੇਵਗੰਧਾਰੀ, ਮਾਰੂ ਦੱਖਣੀ, ਬਸੰਤ ਹਿੰਡੋਲ ਰਾਗਾਂ ਦਾ ਪ੍ਰਯੋਗ ਕੀਤਾ ਜਾਂਦਾ ਹੈ।

ਬਿਲਾਵਲ ਦੀ ਚੋਂਕੀ: ਦਿਨ ਦੇ ਦੂਜੇ ਪਹਿਰ ਆਰੰਭ ਹੋਣ ਵਾਲੀ ਬਿਲਾਵਲ ਦੀ ਚੋਂਕੀ ਦਾ ਪ੍ਰਚਲਣ ਗੁਰੂ ਕਾਲ ਤੋਂ ਚੱਲਿਆ ਆ ਰਿਹਾ ਹੈ। ਬਿਲਾਵਲ ਦੀ ਚੋਂਕੀ ਦਾ ਸਮਾਂ ਆਸਾ ਦੀ ਵਾਰ ਦੀ ਚੋਂਕੀ ਤੋਂ ਬਾਅਦ ਦਿਨ ਦੇ 12 ਵਜੇ ਤੀਕ ਹੁੰਦਾ ਹੈ। ਇਸ ਸਮੇਂ ਦੌਰਾਨ ਵਰਤਮਾਨ ਸਮੇਂ ਤਿੰਨ ਵੱਖ-ਵੱਖ ਜਥੇ ਕੀਰਤਨ ਕਰਦੇ ਹਨ। ਇਸ ਆਧਾਰ 'ਤੇ ਬਿਲਾਵਲ ਦੀ ਪਹਿਲੀ ਚੋਂਕੀ, ਦੂਜੀ ਚੋਂਕੀ, ਤੀਜੀ ਚੋਂਕੀ, ਚੌਥੀ ਚੋਂਕੀ ਕਿਹਾ ਜਾਂਦਾ ਹੈ। ਇਨ੍ਹਾਂ ਕੀਰਤਨ ਪ੍ਰਸਤੁਤੀਆਂ ਵਿਚ ਬਿਲਾਵਲ, ਆਸਾਵਰੀ, ਆਸਾਵਰੀ ਸੁਧੰਗ (ਕੋਮਲ ਰਿਸ਼ਭ ਆਸਾਵਰੀ), ਸੂਹੀ, ਦੇਵ ਗੰਧਾਰੀ, ਰਾਮਕਲੀ, ਬਸੰਤ, ਬਿਹਾਗੜਾ, ਟੋਡੀ (ਤੋੜੀ), ਗੱਡ, ਤਿਲੰਗ ਕਾਫ਼ੀ, ਸੂਹੀ ਕਾਫ਼ੀ, ਸੂਹੀ ਲਲਿਤ, ਬਿਲਾਵਲ ਮੰਗਲ, ਰਾਮਕਲੀ ਦੱਖਣੀ ਰਾਗਾਂ ਵਿਚ ਬਾਣੀ ਦਾ ਗਾਇਣ ਕੀਤਾ ਜਾਂਦਾ ਹੈ।

ਅਨੰਦ ਦੀ ਚੋਂਕੀ: ਦੁਪਹਿਰ 12 ਵਜੇ ਸ੍ਰੀ ਹਰਿਮੰਦਰ ਸਾਹਿਬ ਵਿਖੇ ਅਰਦਾਸ ਕਰਨ ਦਾ ਵਿਧਾਨ ਹੈ। ਇਸ ਸਮੇਂ ਕਤਾਰ ਪ੍ਰਸਾਦਿ ਦੀ ਦੇਗ ਵੀ ਚੜ੍ਹਾਈ ਜਾਂਦੀ ਹੈ। ਇਸ ਚੋਂਕੀ ਦੇ ਸਮਾਪਨ 'ਤੇ ਅਨੰਦ ਸਾਹਿਬ ਦੀਆਂ ਛੇ ਪਉੜੀਆਂ ਦਾ ਸਮੂਹਿਕ ਕੀਰਤਨ ਕੀਤਾ ਜਾਂਦਾ ਹੈ। ਇਸ ਬਾਣੀ ਦੇ ਆਧਾਰ 'ਤੇ ਇਸ ਚੋਂਕੀ ਨੂੰ ਅਨੰਦ ਦੀ ਚੋਂਕੀ ਕਿਹਾ ਜਾਂਦਾ ਹੈ। ਇਸ ਕੀਰਤਨ ਚੋਂਕੀ ਨੂੰ ਬਿਲਾਵਲ ਦੀ ਚੌਥੀ ਹਾਜ਼ਰੀ/ਡਿਊਟੀ/ਚੋਂਕੀ ਦੇ ਨਾਂ ਨਾਲ ਵੀ ਜਾਣਿਆ ਜਾਂਦਾ ਹੈ। ਇਸ ਕੀਰਤਨ ਚੋਂਕੀ ਵਿਚ ਬਿਲਾਵਲ, ਸੂਹੀ, ਰਾਮਕਲੀ ਅਤੇ ਗੱਡ ਰਾਗਾਂ ਦਾ ਪ੍ਰਯੋਗ ਕੀਤਾ ਜਾਂਦਾ ਹੈ।

ਸਾਰੰਗ ਦੀ ਚੋਂਕੀ: ਦੁਪਹਿਰ ਸਮੇਂ ਦੀ ਮੁੱਖ ਚੋਂਕੀ ਵਜੋਂ ਜਾਣੀ ਜਾਂਦੀ ਸਾਰੰਗ ਦੀ ਚੋਂਕੀ ਦਾ ਸਮਾਂ ਅਨੰਦ ਦੀ ਚੋਂਕੀ ਤੋਂ ਬਾਅਦ ਆਉਂਦਾ ਹੈ। ਇਸ ਚੋਂਕੀ ਵਿਚ ਸਾਰੰਗ (ਸਾਰਗ), ਵਡਹੰਸ ਅਤੇ ਬਿਲਾਵਲ ਗੱਡ ਰਾਗਾਂ ਦਾ ਪ੍ਰਯੋਗ ਹੁੰਦਾ ਹੈ।

ਚਰਨਕਮਲ ਦੀ ਚੋਂਕੀ ਦੇ ਰਾਗ: ਚੋਂਕੀ ਦਾ ਨਾਮਕਰਨ ਇਸ ਵਿਚ ਗਾਇਣ ਕੀਤੇ ਜਾਣ ਵਾਲੇ, ਗੁਰੂ ਅਰਜਨ ਦੇਵ ਜੀ ਦੁਆਰਾ ਬਿਲਾਵਲ ਰਾਗ ਵਿਚ ਉਚਾਰੇ ਸ਼ਬਦ 'ਚਰਨ ਕਮਲ ਪ੍ਰਭ ਕੇ ਨਿਤ ਧਿਆਵਉ' ਦੇ ਆਧਾਰ 'ਤੇ ਹੋਇਆ ਹੈ। ਇਸ ਕੀਰਤਨ ਚੋਂਕੀ ਦਾ ਸਮਾਂ ਵੱਧ ਜਾਣ ਕਾਰਨ ਇਸ ਨੂੰ ਚਰਨਕਮਲ ਦੀ ਪਹਿਲੀ, ਦੂਜੀ ਅਤੇ ਤੀਜੀ ਚੋਂਕੀ ਵਜੋਂ ਵੀ ਜਾਣਿਆ ਜਾਂਦਾ ਹੈ। ਇਸ ਕੀਰਤਨ ਚੋਂਕੀ ਵਿਚ ਬਿਲਾਵਲ, ਬਿਲਾਵਲ ਦੱਖਣੀ, ਬਿਲਾਵਲ ਗੱਡ, ਵਡਹੰਸ, ਅਤੇ ਸਾਰੰਗ ਰਾਗ ਦਾ ਪ੍ਰਯੋਗ ਹੁੰਦਾ ਹੈ।

ਜੈਤਸਰੀ / ਧਨਾਸਰੀ ਦੀ ਚੋਂਕੀ: ਇਸ ਚੋਂਕੀ ਦਾ ਸਮਾਂ ਸੇਦਰੂ ਤੋਂ ਪਹਿਲਾਂ ਲਗਾਈ ਜਾਣ ਵਾਲੀ ਚੋਂਕੀ ਵਜੋਂ ਹੁੰਦਾ ਹੈ। ਇਸ ਦਾ ਨਾਮਕਰਨ ਹਿੰਦੁਸਤਾਨੀ ਸੰਗੀਤ ਪਰੰਪਰਾ ਅਨੁਸਾਰ ਜੈਤਸਰੀ ਅਤੇ ਧਨਾਸਰੀ ਰਾਗਾਂ ਦੇ ਸਮੇਂ ਦੇ ਆਧਾਰ 'ਤੇ ਹੋਇਆ ਹੈ। ਇਸ ਕੀਰਤਨ ਚੋਂਕੀ ਦੌਰਾਨ ਸਿਰੀ, ਜੈਤਸਰੀ, ਧਨਾਸਰੀ, ਮਾਝ, ਬਿਲਾਵਲ ਦੱਖਣੀ, ਬੈਰਾਤੀ, ਮਾਰੂ, ਮਲ੍ਹਾਰ, ਗਉੜੀ ਚੇਤੀ, ਵਡਹੰਸ ਦੱਖਣੀ, ਬਿਲਾਵਲ ਦੱਖਣੀ ਅਤੇ ਬਿਲਾਵਲ ਗੱਡ ਰਾਗ ਦਾ ਪ੍ਰਯੋਗ ਕੀਤਾ ਜਾਂਦਾ ਹੈ।

ਕਲਿਆਣ ਦੀ ਚੋਂਕੀ: ਆਮ ਦਿਨਾਂ ਵਿਚ ਜੈਤਸਰੀ / ਧਨਾਸਰੀ ਦੀ ਚੋਂਕੀ ਤੋਂ ਬਾਅਦ ਸੇਦਰੂ ਦੀ ਚੋਂਕੀ ਆਉਂਦੀ ਹੈ, ਪਰ ਗਰਮੀ ਦੇ ਦਿਨਾਂ ਵਿਚ ਭਾਰਤ ਵਿਚ ਦਿਨ ਵੱਡੇ ਹੋ ਜਾਂਦੇ ਹਨ ਅਤੇ ਰਾਤਾਂ ਛੋਟੀਆਂ ਹੋ ਜਾਂਦੀਆਂ ਹਨ। ਸੰਗਤ ਦੀ ਆਮਦ ਅਤੇ ਕੀਰਤਨ ਹਾਜ਼ਰੀ ਦਾ ਸਮਾਂ ਵੱਧ ਜਾਂਦਾ ਹੈ। ਇਸ ਲਈ ਗਰਮੀਆਂ ਵਿਚ ਕਲਿਆਣ ਦੀ ਚੋਂਕੀ ਵੀ ਲਗਾਈ ਜਾਂਦੀ ਹੈ। ਇਸ ਚੋਂਕੀ ਵਿਚ ਕਲਿਆਣ, ਗਉੜੀ ਗੁਆਰੇਰੀ, ਗਉੜੀ ਚੇਤੀ, ਗਉੜੀ ਪੂਰਬੀ, ਗਉੜੀ ਪੂਰਬੀ ਦੀਪਕੀ, ਗਉੜੀ ਦੀਪਕੀ, ਗਉੜੀ ਮਾਝ, ਗਉੜੀ ਮਾਲਵਾ, ਆਸਾ ਕਾਫ਼ੀ, ਮਾਝ, ਤੁਖਾਰੀ, ਜੈਤਸਰੀ, ਬੈਰਾਤੀ, ਤਿਲੰਗ, ਮਾਲੀ ਗਉੜਾ, ਮਾਰੂ ਕਾਫ਼ੀ ਅਤੇ ਕਲਿਆਣ ਭੋਪਾਲੀ ਰਾਗਾਂ ਦਾ ਪ੍ਰਯੋਗ ਕੀਤਾ ਜਾਂਦਾ ਹੈ।

ਸੇਦਰੂ ਦੀ ਚੋਂਕੀ: ਇਸ ਚੋਂਕੀ ਦਾ ਨਾਮਕਰਨ 'ਸੇ ਦਰੂ' ਬਾਣੀ ਦੇ ਅਧਾਰ 'ਤੇ ਹੋਇਆ ਹੈ। ਸੰਧਿਆ ਵੇਲੇ ਰਹਿਰਾਸ ਸਾਹਿਬ ਦੇ ਪਾਠ ਤੋਂ ਪਹਿਲਾਂ ਦੀ ਕੀਰਤਨ ਪ੍ਰਸਤੁਤੀ ਨੂੰ 'ਸੇ-ਦਰੂ ਦੀ ਚੋਂਕੀ' ਦਾ ਸਮਾਂ ਹੁੰਦਾ ਹੈ। ਇਸ ਕੀਰਤਨ ਚੋਂਕੀ ਵਿਚ ਆਸਾ, ਆਸਾ ਕਾਫ਼ੀ, ਮਾਝ,

ਗਉੜੀ, ਗਉੜੀ ਗੁਆਰੇਰੀ, ਗਉੜੀ ਪੂਰਬੀ, ਗਉੜੀ ਪੂਰਬੀ ਦੀਪਕੀ, ਗਉੜੀ ਮਾਝ, ਗਉੜੀ ਮਾਲਵਾ, ਗਉੜੀ ਮਾਲਾ, ਗਉੜੀ ਸੋਰਠਿ, ਤੁਖਾਰੀ, ਤਿਲੰਗ, ਨਟ ਨਾਰਾਇਣ, ਮਾਲੀ ਗਉੜਾ, ਕੇਦਾਰਾ, ਮਾਰੂ ਕਾਫ਼ੀ, ਕਲਿਆਣ ਭੋਪਾਲੀ ਰਾਗਾਂ ਦਾ ਪ੍ਰਯੋਗ ਕੀਤਾ ਜਾਂਦਾ ਹੈ।

ਆਰਤੀ ਦੀ ਚੋਕੀ: ਰਹਿਰਾਸ ਸਾਹਿਬ ਦੇ ਪਾਠ ਤੋਂ ਬਾਅਦ ਸੰਗਤਾਂ ਸਮੂਹਿਕ ਰੂਪ ਵਿਚ ਆਰਤੀ ਦਾ ਗਾਇਣ ਕਰਦੀਆਂ ਹਨ। ਇਸ ਲਈ ਇਸ ਕੀਰਤਨ ਚੋਕੀ ਦਾ ਨਾਂ ਆਰਤੀ ਦੀ ਚੋਕੀ ਹੋ ਗਿਆ। ਇਸ ਚੋਕੀ ਵਿਚ ਧਨਾਸਰੀ, ਗਉੜੀ ਪੂਰਬੀ, ਗਉੜੀ ਪੂਰਬੀ ਦੀਪਕੀ, ਗਉੜੀ ਦੀਪਕੀ, ਗਉੜੀ ਮਾਲਾ, ਗਉੜੀ ਸੋਰਠਿ, ਸੋਰਠਿ, ਤਿਲੰਗ, ਨਟ ਨਾਰਾਇਣ ਅਤੇ ਕੇਦਾਰਾ ਰਾਗਾਂ ਦਾ ਗਾਇਣ ਕੀਤਾ ਜਾਂਦਾ ਹੈ।

ਕਾਨ੍ਹੜੇ / ਸਮਾਪਤੀ / ਕੀਰਤਨ ਸੋਹਿਲੇ ਦੀ ਚੋਕੀ: ਸ੍ਰੀ ਹਰਿਮੰਦਰ ਸਾਹਿਬ ਵਿਖੇ ਕੀਰਤਨ ਪ੍ਰਸਤੁਤੀਆਂ ਨੂੰ ਵਿਸਰਾਮ ਦਿੰਦੇ ਹੋਏ, ਹਰਿਮੰਦਰ ਦੀ ਸੇਵਾ ਸੰਭਾਲ ਦਾ ਕਾਰਜ ਆਰੰਭਿਆ ਜਾਂਦਾ ਹੈ। ਇਸ ਲਈ ਆਰਤੀ ਦੀ ਚੋਕੀ ਤੋਂ ਬਾਅਦ ਕਾਨ੍ਹੜੇ ਦੀ ਚੋਕੀ ਨੂੰ ਸਮਾਪਤੀ ਦੀ ਚੋਕੀ ਵੀ ਕਿਹਾ ਜਾਂਦਾ ਹੈ। ਇਸ ਕੀਰਤਨ ਚੋਕੀ ਤੋਂ ਬਾਅਦ ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਦਾ ਸੁਖ ਆਸਣ ਕੀਤਾ ਜਾਂਦਾ ਹੈ ਅਤੇ ਕੀਰਤਨ ਸੋਹਿਲੇ ਦਾ ਪਾਠ ਕੀਤਾ ਜਾਂਦਾ ਹੈ, ਇਸ ਲਈ ਇਸ ਨੂੰ ਕੀਰਤਨ ਸੋਹਿਲੇ ਦੀ ਚੋਕੀ ਵੀ ਆਖਿਆ ਜਾਂਦਾ ਹੈ। ਇਸ ਕੀਰਤਨ ਚੋਕੀ ਵਿਚ ਕਾਨ੍ਹੜਾ, ਸੋਰਠਿ, ਜੈਜਾਵੰਤੀ, ਨਟ ਰਾਗਾਂ ਦਾ ਪ੍ਰਯੋਗ ਹੁੰਦਾ ਹੈ।

ਬਸੰਤ ਦੀ ਚੋਕੀ: ਸਿੱਖ ਧਰਮ ਵਿਚ ਬਸੰਤ ਰਾਗ ਦੇ ਗਾਇਣ ਦੀ ਵਿਸ਼ੇਸ਼ ਮਹਿਮਾ ਦਿੱਤੀ ਹੈ। ਪ੍ਰਚੱਲਿਤ ਮਹਿਮਾ ਦਾ ਅਨੁਸਾਰ ਮਾਘੀ ਤੋਂ ਇਕ ਦਿਨ ਪਹਿਲਾਂ ਲੋਹੜੀ ਵਾਲੀ ਰਾਤ ਨੂੰ ਸਮਾਪਤੀ ਦੀ ਕੀਰਤਨ ਚੋਕੀ ਤੋਂ ਬਸੰਤ ਰਾਗ ਦਾ ਗਾਇਣ ਸ਼ੁਰੂ ਹੁੰਦਾ ਹੈ, ਜੋ ਹੋਲੇ ਮੁਹਲੇ ਨੂੰ ਸ੍ਰੀ ਅਨੰਦਪੁਰ ਸਾਹਿਬ ਵਿਖੇ ਸੁਸ਼ੋਭਿਤ ਹੋਣ ਵਾਲੇ ਕੀਰਤਨ ਦਰਬਾਰ ਤਕ ਚਲਦਾ ਹੈ। ਇਸ ਤਰ੍ਹਾਂ ਪੂਰੇ ਦੇ ਮਹੀਨੇ ਬਸੰਤ ਰਾਗ ਦਾ ਗਾਇਣ ਕੀਤਾ ਜਾਂਦਾ ਹੈ। ਇਸ ਦੌਰਾਨ ਬਸੰਤ ਅਤੇ ਬਸੰਤ ਹਿੰਡੋਲ ਵਿਸ਼ੇਸ਼ ਰੂਪ ਵਿਚ ਗਾਏ ਜਾਂਦੇ ਹਨ। ਟਕਸਾਲੀ ਕੀਰਤਨਕਾਰ ਇਨ੍ਹਾਂ ਦਿਨਾਂ ਵਿਚ ਸਾਰੰਗ ਰਾਤ ਦਾ ਤਿਆਗ ਕਰਦੇ ਹਨ।

ਜਨਮ ਸਮੇਂ ਦੀ ਕੀਰਤਨ ਚੋਕੀ: ਘਰ ਵਿਚ ਨਵ ਜੰਮੇ ਬੱਚੇ ਦੀ ਖੁਸ਼ੀ ਵਿਚ ਆਯੋਜਿਤ ਹੋਣ ਵਾਲੀ ਕੀਰਤਨ ਚੋਕੀ ਵਿਚ ਗੁਜਰੀ, ਤੋੜੀ, ਬਿਲਾਵਲ, ਰਾਮਕਲੀ ਆਦਿ ਰਾਗਾਂ ਅਧੀਨ ਬਾਣੀ ਦਾ ਗਾਇਣ ਕੀਤਾ ਜਾਂਦਾ ਹੈ।

ਕੁੜਮਾਈ ਦੀ ਚੋਕੀ: ਵਿਆਹ ਦੀਆਂ ਰਸਮਾਂ ਵਿਚ ਕੁੜਮਾਈ ਦੀ ਰਸਮ ਵੀ ਸ਼ਾਮਿਲ ਹੁੰਦੀ ਹੈ। ਜਦੋਂ ਦੋਵੇਂ ਪਰਵਾਰਾਂ ਦੇ ਰਿਸ਼ਤੇਦਾਰ ਆਪਸ ਵਿਚ ਮਿਲਦੇ ਹਨ, ਤਾਂ 'ਕੁੜਮੁ ਕੁੜਮਾਈ ਆਇਆ' ਦੇ ਭਾਵ ਦੇ ਸ਼ਬਦਾਂ ਲਈ ਸੂਹੀ, ਬਿਲਾਵਲ, ਵਡਹੰਸ, ਆਦਿ ਰਾਗਾਂ ਦੀ ਵਰਤੋਂ ਕੀਤੀ ਜਾਂਦੀ ਹੈ।

ਮਿਲਣੀ ਦੀ ਚੋਕੀ: ਜਦੋਂ ਦੋਵੇਂ ਪਰਵਾਰਾਂ ਦੇ ਰਿਸ਼ਤੇਦਾਰ ਆਪਸ ਵਿਚ ਮਿਲਦੇ ਹਨ, ਤਾਂ ਇਸ ਨੂੰ ਮਿਲਣੀ ਕਿਹਾ ਜਾਂਦਾ ਹੈ। ਇਸ ਸਮੇਂ ਬਰਾਤ ਦਾ ਸੁਆਗਤ ਕਰਦਿਆਂ ਗਾਏ ਜਾਣ ਵਾਲੀ ਬਾਣੀ ਲਈ ਸੂਹੀ, ਬਿਲਾਵਲ ਆਦਿ ਰਾਗਾਂ ਦਾ ਪ੍ਰਯੋਗ ਹੁੰਦਾ ਹੈ।

ਅਨੰਦ ਕਾਰਜ ਦੀ ਚੋਕੀ: ਵਿਆਹ ਦੀਆਂ ਰਸਮਾਂ ਦੀ ਵਿਚ ਅਨੰਦ ਕਾਰਜ ਪ੍ਰਮੁੱਖ ਮੰਨਿਆ ਜਾਂਦਾ ਹੈ। ਇਸ ਸਮੇਂ ਦੋਵੇਂ ਪਰਵਾਰ ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਦੀ ਹਜ਼ੂਰੀ ਵਿਚ ਇਕੱਠੇ ਹੁੰਦੇ ਹਨ। ਕੀਰਤਨੀ ਜਥਾ ਮੰਗਲ ਦੇ ਸ਼ਬਦਾਂ ਦਾ ਗਾਇਣ ਕਰਦਾ ਹੈ। ਇਸ ਦੌਰਾਨ ਗੁਰੂ ਰਾਮਦਾਸ ਜੀ ਦੀਆਂ ਸੂਹੀ ਰਾਗ ਵਿਚ ਉਚਾਰੀਆਂ ਚਾਰ ਲਾਵਾਂ ਦਾ ਗਾਇਣ ਕੀਤੇ ਜਾਣ ਦੀ ਪਰੰਪਰਾ ਹੈ। ਇਸ ਕੀਰਤਨ ਚੋਕੀ ਦੌਰਾਨ ਸਿਰੀ, ਸੂਹੀ, ਆਸਾ, ਵਡਹੰਸ, ਰਾਮਕਲੀ ਆਦਿ ਰਾਗਾਂ ਦਾ ਪ੍ਰਯੋਗ ਹੁੰਦਾ ਹੈ।

ਅਕਾਲ ਚਲਾਣੇ ਦੀ ਚੋਕੀ: ਪ੍ਰਾਣੀ ਦੇ ਇਸ ਨਾਸ਼ਵਾਨ ਸੰਸਾਰ ਨੂੰ ਅਲਵਿਦਾ ਕਹਿ ਜਾਣ 'ਤੇ ਅਕਾਲ ਚਲਾਣੇ ਦੀ ਚੋਕੀ ਲਗਾਈ ਜਾਂਦੀ ਹੈ, ਜਿਸ ਵਿਚ ਮਾਰੂ, ਮਾਰੂ ਦੱਖਣੀ, ਤਿਲੰਗ, ਤਿਲੰਗ ਕਾਫ਼ੀ, ਸੋਰਠਿ ਆਦਿ ਰਾਗਾਂ ਦਾ ਪ੍ਰਯੋਗ ਹੁੰਦਾ ਹੈ।

ਉਪਰੋਕਤ ਤੋਂ ਇਲਾਵਾ ਸਿੱਖ ਧਰਮ ਦੇ ਹਰ ਸੰਸਕਾਰ ਅਤੇ ਅਵਸਰ 'ਤੇ ਸਾਹਿਬ ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਦਾ ਓਟ ਆਸਾਰਾ ਲੈਂਦਿਆਂ ਸ਼ਬਦ ਕੀਰਤਨ ਦੀ ਹਾਜ਼ਰੀ ਲਗਾਈ ਜਾਂਦੀ ਹੈ। ਇਸ ਦੇ ਆਧਾਰ 'ਤੇ ਸਿੱਖੀ ਸੰਸਕਾਰਾਂ ਨਾਲ ਸਬੰਧਤ ਹੋਰ ਵੀ ਕੀਰਤਨ ਚੋਕੀਆਂ ਪ੍ਰਚਾਰ ਵਿਚ ਹਨ, ਜਿਨ੍ਹਾਂ ਸਬੰਧੀ ਹੋਰ ਖੋਜ ਅਤੇ ਚਰਚਾ ਲੋੜੀਂਦੀ ਹੈ।

ਖੋਜ ਸਰੋਤ

- ਹਰਿਮੰਦਰ ਸਾਹਿਬ ਦਾ ਸੁਨਿਹਰੀ ਇਤਿਹਾਸ, ਸਿੱਖ ਸਾਹਿਬ ਕ੍ਰਿਪਾਲ ਸਿੰਘ, ਹੈਡ ਗ੍ਰੰਥੀ, ਸ਼੍ਰੋਮਣੀ ਗੁਰਦੁਆਰਾ ਪ੍ਰਬੰਧਕ ਕਮੇਟੀ
- ਗੁਰਮਤਿ ਸੰਗੀਤ ਪਰਬੰਧ ਤੇ ਪਾਸਾਰ, ਡਾ. ਗੁਰਨਾਮ ਸਿੰਘ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ ਪਟਿਆਲਾ।

- ਗੁਰਮਤਿ ਸੰਗੀਤ ਦਰਪਣ, ਪ੍ਰੋ. ਕਰਤਾਰ ਸਿੰਘ, ਸ਼੍ਰੋਮਣੀ ਗੁਰਦੁਆਰਾ ਪ੍ਰਬੰਧਕ ਕਮੇਟੀ।
 - ਪੜਤਾਲ ਸ਼ਬਦ ਗਾਇਣ, ਡਾ. ਕੰਵਲਜੀਤ ਸਿੰਘ, ਗੁਰਮਤਿ ਪ੍ਰਕਾਸ਼ਨ ਪਟਿਆਲਾ।
 - ਦ ਗੋਲਡਨ ਟੈਪਲ, ਡਾ. ਮਦਨਜੀਤ ਕੌਰ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।।
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ਗੁਰਮਤਿ ਸੰਗੀਤ ਵਿੱਚ ਖੋਜ ਦਾ ਮਹੱਤਵ ਅਤੇ ਉਪਯੋਗਤਾ

ਸਵਰਲੀਨ ਕੌਰ

ਸੰਗੀਤ ਵਿਭਾਗ, ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਵਰਲਡ ਯੂਨੀਵਰਸਿਟੀ, ਸ੍ਰੀ ਫਤਿਹਗੜ੍ਹ ਸਾਹਿਬ

ਗੁਰਬਾਣੀ ਗਾਇਣ ਹਿਤ ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਤੋਂ ਉਦੇ ਹੋਣ ਵਾਲਾ ਸੰਗੀਤ ਵਿਧਾਨ ਗੁਰਮਤਿ ਸੰਗੀਤ ਹੈ। ਗੁਰੂ ਅਰਜਨ ਦੇਵ ਜੀ ਨੇ ਬਾਣੀ ਨੂੰ 31 ਰਾਗਾਂ ਦੇ ਆਧਾਰ 'ਤੇ ਵੰਡਦੇ ਹੋਏ, ਗ੍ਰੰਥ ਸਾਹਿਬ ਦਾ ਸੰਕਲਨ ਕੀਤਾ, ਜੋ ਤਤਕਰੇ ਤੋਂ ਭਲੀਭਾਂਤ ਸਪਸ਼ਟ ਹੈ। ਬਾਣੀਕਾਰਾਂ ਵੱਲੋਂ 31 ਮੁੱਖ ਰਾਗਾਂ ਦੇ ਨਾਲ 31 ਰਾਗ-ਪ੍ਰਕਾਰ ਵੀ ਪ੍ਰਯੋਗ ਕੀਤੇ ਗਏ ਹਨ। ਬਾਣੀ ਲਈ ਜਿਹੜੇ ਕਾਵਿ-ਰੂਪ ਪ੍ਰਯੋਗ ਹੋਏ ਹਨ, ਵਿਭਿੰਨ ਸੰਗੀਤਕ ਤੱਤਾਂ ਦੇ ਸੁਮੇਲ ਨਾਲ ਇਹ ਗਾਇਣ ਸ਼ੈਲੀਆਂ ਵਜੋਂ ਸਰੂਪਿਤ ਹੋ ਰਹੇ ਹਨ। ਗੁਰਮਤਿ ਸੰਗੀਤ ਦੇ ਰਾਗ, ਗਾਇਣ ਸ਼ੈਲੀਆਂ, ਤੰਤੀ ਤੇ ਤਾਲ ਸਾਜ਼ ਅਤੇ ਉਨ੍ਹਾਂ ਦੀ ਪ੍ਰਯੋਗ ਵਿਧੀ ਆਦਿ ਦਾ ਪ੍ਰਚਲਣ 500 ਸਾਲਾਂ ਤੋਂ ਵਧੇਰੇ ਸਮੇਂ ਤੋਂ ਸਿੱਖ ਰਹੁ-ਰੀਤਾਂ ਦਾ ਅਭਿੰਨ ਅੰਗ ਹੈ। ਗੁਰਮਤਿ ਸੰਗੀਤ ਵਿਧਾਨ ਦਾ ਉਦੇ ਸ੍ਰੀ ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ ਦੁਆਰਾ ਹੋਇਆ, ਜੋ ਸਮੂਹ ਉੱਤਰਾਧਿਕਾਰੀ ਗੁਰੂ ਸਾਹਿਬਾਨ ਦੀ ਸਰਪ੍ਰਸਤੀ ਸਦਕਾ ਪ੍ਰਫੁੱਲਿਤ ਹੋਇਆ।

ਗੁਰਮਤਿ ਸੰਗੀਤ ਦੀ ਰਾਗ ਪਰੰਪਰਾ, ਵਿਭਿੰਨ ਸੰਗੀਤਕ ਤੱਤ, ਗਾਇਣ ਸ਼ੈਲੀਆਂ, ਸਾਜ਼ਾਂ ਅਤੇ ਉਨ੍ਹਾਂ ਦੀ ਵਾਦਨ ਵਿਧੀ ਆਦਿ 'ਤੇ ਭਾਰਤੀ ਸੰਗੀਤ ਦਾ ਪ੍ਰਭਾਵ ਸਪਸ਼ਟ ਦਿਖਾਈ ਦਿੰਦਾ ਹੈ। ਗੁਰਮਤਿ ਸੰਗੀਤ ਪਰੰਪਰਾ ਵਿੱਚ ਪ੍ਰਯੋਗ ਹੋਣ ਵਾਲੇ ਬਹੁਤੇ ਰਾਗ ਹਿੰਦੁਸਤਾਨੀ ਰਾਗ ਪਰੰਪਰਾ ਵਿੱਚ ਵੀ ਪ੍ਰਯੋਗ ਹੋ ਰਹੇ ਹਨ। ਇਨ੍ਹਾਂ ਵਿੱਚ ਛੇ ਰਾਗ ਦੱਖਣੀ ਸੰਗੀਤ ਦੇ ਵੀ ਸ਼ਾਮਿਲ ਹਨ। ਇਸ ਤੋਂ ਇਲਾਵਾ ਕੁਝ ਰਾਗ ਅਜਿਹੇ ਵੀ ਹਨ ਜੋ ਸਮਕਾਲੀ ਲੋਕ ਸੰਗੀਤ ਦੀਆਂ ਪਰੰਪਰਾਗਤ ਧੁਨਾਂ ਤੋਂ ਵਿਕਸਿਤ ਹੋਏ ਹਨ। ਇਨ੍ਹਾਂ ਰਾਗਾਂ ਵਿੱਚ ਗਉੜੀ ਮਾਲਾ, ਗਉੜੀ ਮਾਲਵਾ, ਗਉੜੀ ਮਾਝ, ਗਉੜੀ ਬੈਰਾਗਣਿ, ਆਸਾ, ਵਡਹੰਸ, ਸੋਰਠਿ, ਸੂਹੀ, ਤੁਖਾਰੀ ਆਦਿ ਸ਼ਾਮਿਲ ਹਨ।

ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਦੇ ਬਾਣੀਕਾਰਾਂ ਹਿੰਦੁਸਤਾਨੀ ਸ਼ਾਸਤਰੀ ਸੰਗੀਤ ਦੀਆਂ ਗਾਇਣ ਸ਼ੈਲੀਆਂ ਦੇ ਨਾਲ-ਨਾਲ ਲੋਕ ਧੁਨਾਂ ਤੋਂ ਵਿਕਸਿਤ ਸ਼ੈਲੀਆਂ ਦਾ ਪ੍ਰਯੋਗ ਵੀ ਕੀਤਾ ਹੈ। ਸ਼ਾਸਤਰੀ ਗਾਇਣ ਸ਼ੈਲੀਆਂ ਵਿੱਚ ਖਿਆਲ ਅੰਗ, ਧਰੁਪਦ ਅੰਗ, ਪੜਤਾਲ ਗਾਇਣ, ਮੰਗਲਾਚਰਨ ਸ਼ਾਮਿਲ ਹੈ। ਸ਼ਾਨ ਵਾਦਨ ਵੀ ਹਿੰਦੁਸਤਾਨੀ ਸ਼ਾਸਤਰੀ ਸੰਗੀਤ ਦੇ ਵਿੰਦਵਾਦਨ ਤੋਂ ਪ੍ਰਭਾਵਿਤ ਹੈ। ਸਮਕਾਲੀ ਲੋਕ ਸੰਗੀਤਕ ਗਾਇਣ ਸ਼ੈਲੀਆਂ ਵਿੱਚ ਰਾਗ ਦੇ ਅੰਕੁਸ ਸਹਿਤ ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਵਿੱਚ ਪ੍ਰਯੋਗ ਹੋਇਆ ਹਨ। ਭਾਵੇਂ ਲੋਕ ਧੁਨਾਂ ਕਿਸੇ ਵਿਸ਼ੇਸ਼ ਸੰਗੀਤ ਵਿਧਾਨ ਦੀਆਂ ਮੁਥਾਜ ਨਹੀਂ ਹੁੰਦੀਆਂ, ਪਰ ਗੁਰੂ ਸਾਹਿਬਾਨ ਨੇ ਇਨ੍ਹਾਂ 'ਤੇ ਰਾਗ ਦਾ ਅੰਕੁਸ ਲਗਾਉਂਦਿਆਂ ਹੋਇਆਂ, ਰਹਾਉ ਅਤੇ ਅੰਕ ਵਿਧਾਨ ਰਾਹੀਂ ਅੰਤਰਿਆਂ ਦੀ ਵੰਡ ਨਾਲ ਸੁਸੰਜਿਤ ਕੀਤਾ ਹੈ।

ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਵਿੱਚ ਘੋੜੀਆਂ ਅਤੇ ਅਲਾਹੁਣੀਆਂ ਰਾਗ ਵਡਹੰਸ ਅਧੀਨ ਦਰਜ ਹਨ। ਇਸ ਰਾਗ ਦਾ ਲੋਕ ਅਤੇ ਸ਼ਾਸਤਰੀ ਸੰਗੀਤ ਪਰੰਪਰਾ ਵਿੱਚ ਇੱਕੋ ਜਿਹਾ ਪ੍ਰਯੋਗ ਕਿਵੇਂ ਸੰਭਵ ਹੋਇਆ? ਕੀ ਇਹ ਰਾਗ ਕਿਸੇ ਲੋਕ ਧੁਨ ਤੋਂ ਵਿਕਸਿਤ ਹੋਇਆ ਹੈ? ਬਾਹਰਮਾਹ ਦੀ ਰਚਨਾ ਰਾਗ ਮਾਝ ਅਤੇ ਤੁਖਾਰੀ ਵਿੱਚ ਹੋਈ ਹੈ, ਜਿਸ ਤੋਂ ਸਿੱਧ ਹੁੰਦਾ ਹੈ ਕਿ ਇਹ ਰਾਗ ਲੋਕ ਸੰਗੀਤ ਤੋਂ ਉਪਜੇ ਹਨ। ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਵਿੱਚ ਦਰਜ 22 ਵਾਰਾਂ ਲਈ ਜੇ ਰਾਗ ਪ੍ਰਯੋਗ ਕੀਤੇ ਗਏ ਹਨ, ਉਨ੍ਹਾਂ ਦਾ ਲੋਕ ਸੰਗੀਤ ਨਾਲ ਕੀ ਸਬੰਧ ਰਿਹਾ ਹੈ। ਇਹ ਰਾਗ ਕਦੋਂ ਅਤੇ ਕਿਵੇਂ ਸ਼ਾਸਤਰੀ ਸਰੂਪ ਧਾਰਨ ਕਰਦੇ ਹੋਏ ਨਵ ਸਰੂਪ ਵਿੱਚ ਪ੍ਰਗਟੇ ਤੇ ਪ੍ਰਯੋਗ ਵਿੱਚ ਆਏ? ਇਨ੍ਹਾਂ ਵਿੱਚੋਂ 9 ਧੁਨੀਆਂ ਉੱਪਰ ਸਿਰਲੇਖ ਰੂਪ ਵਿੱਚ ਵਾਰ ਗਾਇਣ ਹਿਤ ਪ੍ਰਯੋਗ ਹੋਣ ਵਾਲੀ ਧੁਨ ਸਬੰਧੀ ਦੱਸਿਆ ਗਿਆ ਹੈ। ਉਦਾਹਰਨ ਵਜੋਂ, ਆਸਾ ਦੀ ਵਾਰ 'ਤੇ ਗਾਇਣ ਧੁਨ ਦੀ ਸੂਚਨਾ ਦਿੰਦੇ ਹੋਏ 'ਟੁੰਡੇ ਅਸਰਾਜੈ ਕੀ ਧੁਨੀ' ਦਾ ਜ਼ਿਕਰ ਮਿਲਦਾ ਹੈ। ਇਸ ਤੋਂ ਗਿਆਤ ਹੁੰਦਾ ਹੈ ਕਿ ਵਾਰ ਬਾਣੀ ਵਿੱਚ ਵਰਤੇ ਗਏ ਰਾਗ ਲੋਕ ਪਰੰਪਰਾ ਤੋਂ ਵਿਕਸਿਤ ਹੋਏ ਹਨ।

ਸ਼ਬਦ ਕੀਰਤਨ ਪ੍ਰਸਤੁਤੀਆਂ ਨਾਲ ਪ੍ਰਯੋਗ ਹੋਣ ਵਾਲੇ ਤੰਤੀ ਤੇ ਤਾਲ ਸਾਜ਼ਾਂ ਦੇ ਸਰੂਪ, ਪਕੜ, ਬੈਠਕ, ਵਾਦਨ ਤੇ ਪ੍ਰਯੋਗ ਵਿਧੀ ਸਬੰਧੀ ਜਾਣਕਾਰੀ ਲਈ ਸਿੱਖ ਧਰਮ ਦੇ ਵਿਭਿੰਨ ਸਰੋਤਾਂ ਦਾ ਅਧਿਐਨ ਕਰਨ ਦੀ ਲੋੜ ਮਹਿਸੂਸ ਹੁੰਦੀ ਹੈ। ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ ਨਾਲ ਭਾਈ ਮਰਦਾਨਾ ਜੀ ਦੁਆਰਾ ਵਜਾਏ ਜਾਣ ਵਾਲੀ ਰਬਾਬ ਕੋਈ ਆਮ ਰਬਾਬ ਨਹੀਂ ਸੀ। ਇਹ ਰਬਾਬ ਕਸ਼ਮੀਰੀ, ਕਾਬਲੀ ਅਤੇ ਧਰੁਪਦੀ

ਰਬਾਬ ਨਾਲੋਂ ਭਿੰਨ ਸੀ। ਗੁਰੂ ਅਮਰਦਾਸ ਜੀ ਨੇ ਸਰੰਦੇ ਦਾ ਆਵਿਸ਼ਕਾਰ ਕੀਤਾ। ਗੁਰੂ ਅਰਜਨ ਦੇਵ ਜੀ ਇਸ ਵਿਚ ਕੁਝ ਸੋਧ ਕਰਨ ਉਪਰੰਤ ਖੁਦ ਵਜਾ 'ਕੇ ਸ੍ਰੀ ਹਰਿਮੰਦਰ ਸਾਹਿਬ ਵਿਖੇ ਕੀਰਤਨ ਦੀ ਹਾਜ਼ਰੀ ਭਰੀ। ਗੁਰੂ ਹਰਿਗੋਬਿੰਦ ਸਾਹਿਬ ਵੱਲੋਂ ਸਿੱਖ ਕੀਰਤਨਕਾਰਾਂ ਦੀ ਝੋਲੀ ਵਿਚ ਤਾਉਸ ਦੀ ਦਾਤ ਪਾਉਣੀ। ਗੁਰੂ ਤੇਗ਼ ਬਹਾਦਰ ਸਾਹਿਬ ਦੁਆਰਾ ਭਾਈ ਗੁਰਬਖਸ਼ ਨੂੰ ਮਿਰਦੰਗ ਦੇਣਾ। ਗੁਰੂ ਗੋਬਿੰਦ ਸਿੰਘ ਜੀ ਦੇ ਸਮੇਂ ਇਸਰਾਜ, ਤਾਨਪੂਰਾ ਆਦਿ ਦਾ ਪ੍ਰਯੋਗ ਹੋਣਾ। ਇਹ ਸਭ ਉਦਾਹਰਨਾਂ ਗੁਰਮਤਿ ਸੰਗੀਤ ਦੀ ਸਾਜ਼ ਵਾਦਨ ਪਰੰਪਰਾ ਦੇ ਵਿਕਾਸ ਦੀ ਗਾਥਾ ਬਿਆਨ ਕਰਦੀਆਂ ਹਨ। ਇਨ੍ਹਾਂ ਤੋਂ ਬਿਨਾਂ ਕਿਹੜੇ-ਕਿਹੜੇ ਹੋਰ ਸਾਜ਼ ਗੁਰੂ-ਘਰ ਦੀ ਕੀਰਤਨ ਮਰਿਆਦਾ ਦਾ ਹਿੱਸਾ ਰਹੇ ਹਨ। ਕਿਹੜੇ ਕੀਰਤਨੀ ਕਲਾਕਾਰ ਇਨ੍ਹਾਂ ਸਾਜ਼ਾਂ ਦਾ ਵਾਦਨ ਕਰਦੇ ਰਹੇ ਹਨ। ਰਾਗੀ ਅਤੇ ਰਬਾਬੀ ਕੀਰਤਨ ਕਾਰਾਂ ਦੀ ਗਾਇਣ ਅਤੇ ਸਾਜ਼ ਸੰਗਤ ਕਰਨ ਦੀ ਸ਼ੈਲੀ ਦੀਆਂ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ ਅਤੇ ਸੀਮਾਵਾਂ ਸਬੰਧੀ ਜਾਣਕਾਰੀ ਅਜੇ ਅਧੂਰੀ ਜਾਪਦੀ ਹੈ।

ਇਸ ਪਰੰਪਰਾ ਦੇ ਵਿਕਾਸ ਵਿਚ ਵਿਭਿੰਨ ਕੀਰਤਨ ਕਾਰਾਂ ਦਾ ਵਿਸ਼ੇਸ਼ ਯੋਗਦਾਨ ਰਿਹਾ ਹੈ। ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ ਦੇ ਸਮੇਂ ਭਾਈ ਲਹਿਣਾ ਜੀ, ਭਾਈ ਸਜਾਦਾ, ਭਾਈ ਰਜਾਦਾ, ਭਾਈ ਸੱਤਾ ਅਤੇ ਭਾਈ ਬਲਵੰਡ, ਭਾਈ ਡਾਲਾ, ਭਾਈ ਸਾਦੂ, ਭਾਈ ਬਾਦੂ, ਭਾਈ ਨਗੋਰੀ ਮਲ, ਭਾਈ ਸੱਦੂ, ਭਾਈ ਮੱਦੂ, ਭਾਈ ਬਾਬਕ, ਭਾਈ ਨੱਥ, ਭਾਈ ਅਬਦੁੱਲਾ ਆਦਿ ਅਨੇਕਾਂ ਰਬਾਬੀ ਕੀਰਤਨ ਕਾਰਾਂ ਸਬੰਧੀ ਸਾਨੂੰ ਕੁਝ ਵੇਰਵੇ ਪ੍ਰਾਪਤ ਹੁੰਦੇ ਹਨ। ਗੁਰੂ ਅਰਜਨ ਦੇਵ ਜੀ ਦੁਆਰਾ ਸਾਧਾਰਨ ਸਿੱਖਾਂ ਨੂੰ ਕੀਰਤਨ ਕਰਨ ਸਬੰਧੀ ਦਿੱਤੇ ਗਏ ਆਦੇਸ਼ ਉਪਰੰਤ ਕਿਹੜੇ-ਕਿਹੜੇ ਰਾਗੀ ਸਿੱਖਾਂ ਨੇ ਸੰਗਤਾਂ ਨੂੰ ਨਿਹਾਲ ਕੀਤਾ। ਰਾਗੀ ਕੀਰਤਨ ਕਾਰਾਂ ਦਾ ਮੁੱਢ ਕਿਹੜੇ ਕੀਰਤਨ ਕਾਰਾਂ ਦੁਆਰਾ ਬੱਝਾ? ਇਸ ਸਬੰਧੀ ਪੂਰਨ ਵੇਰਵੇ ਪ੍ਰਾਪਤ ਕਰਨ ਲਈ ਪੁਰਾਤਨ ਗ੍ਰੰਥ ਮੁੜ ਤੋਂ ਫਰੇਲਨੇ ਪੈਣਗੇ।

ਵਰਤਮਾਨ ਸਮੇਂ ਸ਼ਬਦ ਕੀਰਤਨ ਦੀ ਸਿਖਲਾਈ ਕੇਵਲ ਖ਼ਿਆਲ ਅੰਗ ਦੀਆਂ ਸ਼ਬਦ-ਰੀਤਾਂ ਦੁਆਰਾ ਕਰਵਾਈ ਜਾ ਰਹੀ ਹੈ। ਇਸ ਵਿਚ ਧਰੁਪਦ ਅੰਗ ਦਾ ਗਾਇਣ ਕਿਵੇਂ ਹੁੰਦਾ ਰਿਹਾ ਹੈ? ਸਾਧਾਰਨ ਤਾਲਾਂ ਵਿਚ ਗਾਇਣ ਕੀਤੇ ਜਾਣ ਵਾਲੀਆਂ ਸ਼ਬਦ ਰੀਤਾਂ, ਰਬਾਬੀ ਕੀਰਤਨ ਕਾਰਾਂ ਦੁਆਰਾ ਪ੍ਰਯੋਗ ਹੋਣ ਵਾਲੀਆਂ ਧੁਨਾਂ ਅਤੇ ਪ੍ਰਮਾਣ ਦੇਣ ਦੀ ਪਰੰਪਰਾ ਅਤੇ ਵਿਧੀ ਸਾਡੇ ਵਿੱਚੋਂ ਮਨਫ਼ੀ ਹੁੰਦੀ ਜਾ ਰਹੀ ਹੈ। ਸ਼ਬਦ ਵਿਚਲੇ ਹਰ ਭਾਵ ਨੂੰ ਬਾਣੀ ਪ੍ਰਮਾਣਾਂ ਰਾਹੀਂ ਸਾਮੂਹਿਕ ਕਰਨ ਦੀ ਵਿਧਾ ਰਬਾਬੀ ਕੀਰਤਨ ਕਾਰਾਂ ਦੇ ਹਿੱਸੇ ਆਈ ਹੈ। ਇਸ ਕੀਰਤਨ ਵੰਨਗੀ ਦੇ ਕੀਰਤਨ ਕਾਰਾਂ ਵਿਚ ਭਾਈ ਚਾਂਦ ਅਤੇ ਭਾਈ ਲਾਲ ਦਾ ਨਾਂ ਵਿਸ਼ੇਸ਼ ਵਰਨਣਯੋਗ ਹੈ। ਉਨ੍ਹਾਂ ਦੀ ਗਾਇਕੀ ਦੇ ਨਮੂਨੇ ਅਤੇ ਪ੍ਰਮਾਣ ਤਰਤੀਬ ਅੱਜ ਵੀ ਸਾਡਾ ਮਾਰਗ-ਦਰਸ਼ਨ ਕਰ ਸਕਦੀ ਹੈ। ਲੋੜ ਹੈ ਇਸ ਸਬੰਧੀ ਉਪਲਬਧ ਸਰੋਤਾਂ ਤੋਂ ਜਾਣਕਾਰੀ ਪਹਿਲ ਦੇ ਆਧਾਰ 'ਤੇ ਇਕੱਤਰ ਕੀਤੀ ਜਾਵੇ, ਤਾਂ ਜੋ ਗੁਰਮਤਿ ਸੰਗੀਤ ਦੀ ਸ਼ਬਦ ਰੀਤਾਂ ਦਾ ਕਿਰਿਆਤਮਿਕ ਸਰਮਾਇਆ ਸਾਡੇ ਪਹੁੰਚ ਤੋਂ ਬਾਹਰ ਨਾ ਹੋ ਜਾਵੇ।

ਸ਼ਬਦ ਰੀਤਾਂ ਦੀ ਸੰਭਾਲ ਅਤੇ ਪ੍ਰਚਾਰ ਲਈ ਸਮੇਂ-ਸਮੇਂ ਅਨੇਕਾਂ ਯਤਨ ਹੁੰਦੇ ਆ ਰਹੇ ਹਨ। ਸ਼੍ਰੋਮਣੀ ਗੁਰਦੁਆਰਾ ਪ੍ਰਬੰਧਕ ਕਮੇਟੀ ਨੇ ਕੁਝ ਪ੍ਰਕਾਸ਼ਨਾਵਾਂ ਕੀਤੀਆਂ ਹਨ, ਜਿਨ੍ਹਾਂ ਵਿਚ ਕੀਰਤਨ ਰੀਤਾਂ ਦੀ ਸੁਰਲਿਪੀ ਦਿੱਤੀ ਹੋਈ ਹੈ। ਇਹ ਸੁਰਲਿਪੀਆਂ ਕੇਵਲ ਪੁਸਤਕਾਂ ਦਾ ਸਿੰਗਾਰ ਹੀ ਹਨ, ਉਨ੍ਹਾਂ ਦੇ ਗਾਇਣ ਰੂਪ ਉਘਾੜਨ ਲਈ ਵਿਸ਼ੇਸ਼ ਯਤਨਾਂ ਦੀ ਲੋੜ ਹੈ। ਇਹ ਸ਼ਬਦ ਰੀਤਾਂ ਦੀਆਂ ਰਿਕਾਰਡਿੰਗ ਕਰਵਾ 'ਕੇ ਸਮੂਹ ਕੀਰਤਨ ਅਭਿਲਾਸੀਆਂ ਲਈ ਉਪਲਬਧ ਕਰਵਾਉਣੀਆਂ ਲਾਜ਼ਮੀ ਹਨ। ਇਸ ਤੋਂ ਬਿਨਾਂ ਕੁਝ ਵਿੱਦਿਆ ਸੰਸਥਾਵਾਂ, ਟਕਸਾਲਾਂ, ਪਬਲਿਸ਼ਰਾਂ ਅਤੇ ਵਿਦਵਾਨਾਂ ਵੱਲੋਂ ਪ੍ਰਕਾਸ਼ਨਾਵਾਂ ਕੀਤੀਆਂ ਗਈਆਂ ਹਨ, ਜਿਨ੍ਹਾਂ ਦੀਆਂ ਸੁਰਲਿਪੀਆਂ ਰਾਗ ਅਤੇ ਸ਼ਾਸਤਰੀ ਤਾਲਾਂ 'ਤੇ ਆਧਾਰਿਤ ਹਨ। ਸਾਧਾਰਨ ਸ਼ਬਦ ਰੀਤਾਂ, ਰਬਾਬੀਆਂ ਦੀਆਂ ਸ਼ਬਦ ਧੁਨਾਂ, ਟਕਸਾਲੀ ਅਤੇ ਘਰਾਨੇਦਾਰ ਕੀਰਤਨ ਕਾਰਾਂ ਦੀਆਂ ਵੰਨਗੀਆਂ ਸਬੰਧੀ ਅਜੇ ਕੋਈ ਕਾਰਜ ਸੰਭਵ ਨਹੀਂ ਹੋ ਸਕਿਆ, ਜਿਸ ਰਾਹੀਂ ਵਿਭਿੰਨ ਕੀਰਤਨ ਘਰਾਨਿਆਂ, ਟਕਸਾਲਾਂ ਦੀ ਕੀਰਤਨ ਸ਼ੈਲੀ, ਗਾਇਕੀ ਅਤੇ ਸ਼ਬਦ ਚੋਣ ਨੂੰ ਨਵੀਂ ਪੀੜ੍ਹੀ ਤਕ ਪਹੁੰਚਾਉਣ ਦੇ ਯਤਨ ਹੋ ਸਕਣ।

ਗੁਰਮਤਿ ਸੰਗੀਤ ਦੀ ਕੀਰਤਨ ਚੌਕੀ ਪਰੰਪਰਾ ਸਬੰਧੀ ਕਾਫ਼ੀ ਚਰਚਾ ਮਿਲਦੀ ਹੈ। ਸਿੱਖੀ ਜੀਵਨ ਨਾਲ ਸਬੰਧਿਤ ਜਨਮ, ਅਨੰਦ ਕਾਰਜ ਅਤੇ ਅਕਾਲ ਚਲਾਣੇ ਸਮੇਂ ਦੀ ਪ੍ਰਚੱਲਿਤ ਕੀਰਤਨ ਮਰਿਆਦਾ ਸਬੰਧੀ ਜਾਣਕਾਰੀ ਪ੍ਰਾਪਤ ਹੁੰਦੀ ਹੈ। ਇਨ੍ਹਾਂ ਤੋਂ ਇਲਾਵਾ ਸਾਡੇ ਜੀਵਨ ਵਿਚ ਬਹੁਤ ਸਾਰੇ ਅਜਿਹੇ ਮੌਕੇ ਵੀ ਆਉਂਦੇ ਹਨ, ਜਦੋਂ ਅਸੀਂ ਮਹਾਰਾਜ ਦਾ ਸ਼ੁਕਰਾਨਾ ਕਰਦੇ ਹਾਂ। ਘਰ ਵਿਚ ਗੁਰਸਿੱਖਾਂ ਦਾ ਆਗਮਨ, ਰੈਣ ਸਬਾਈ ਕੀਰਤਨ, ਵਿੱਦਿਆ ਪ੍ਰਾਪਤੀ, ਵਪਾਰ ਵਿਚ ਤਰੱਕੀ ਦੀ ਅਰਦਾਸ ਅਤੇ ਸ਼ੁਕਰਾਨਾ, ਅਕਾਲ-ਪੁਰਖ ਤੋਂ ਕਿਸੇ ਵਿਸ਼ੇਸ਼ ਪ੍ਰਾਪਤੀ ਦੀ ਜਾਚਣਾ ਕਰਨੀ, ਦੇਹ ਅਰੋਗਤਾ ਸਬੰਧੀ ਅਰਦਾਸਾਂ, ਸਮਾਜਿਕ ਤੇ ਪਰਵਾਰਿਕ ਰਿਸ਼ਤਿਆਂ ਸਬੰਧੀ ਸਮਝਾਉਣੀਆਂ ਰਚੀ ਗਈ ਬਾਣੀ ਦਾ

ਗਾਇਣ ਆਦਿ ਅਨੇਕਾਂ ਅਜਿਹੇ ਉਦਾਹਰਨ ਹਨ, ਜੋ ਕੀਰਤਨ ਪ੍ਰਸਤੁਤੀਆਂ ਲਈ ਅਵਸਰ ਦਿੰਦੇ ਹਨ। ਅਜਿਹੇ ਸਮੇਂ ਸ਼ਬਦ ਚੋਣ, ਕੀਰਤਨ ਸ਼ੈਲੀ, ਸਾਜ਼ ਵਾਦਨ ਸ਼ੈਲੀ, ਪ੍ਰਮਾਣਾਂ ਦੀ ਚੋਣ ਆਦਿ ਸਬੰਧੀ ਜਾਣਕਾਰੀ ਅਜੇ ਅਧੂਰੀ ਜਾਪਦੀ ਹੈ।

ਇਨ੍ਹਾਂ ਸ਼ਬਦ ਰੀਤਾਂ ਨਾਲ ਕੀਰਤਨਕਾਰ ਤਾਲ ਸਾਜ਼ ਵਾਦਕਾਂ ਵੱਲੋਂ ਵਿਸ਼ੇਸ਼ ਕਿਸਮ ਦੀ ਵਾਦਨ ਵਿਧੀ ਅਤੇ ਬੋਲ ਨਿਕਾਸ ਦੀ ਵਰਤੋਂ ਕੀਤੀ ਜਾਂਦੀ ਰਹੀ ਹੈ, ਜਿਸ ਨਾਲ ਬਾਣੀ ਨੂੰ ਪ੍ਰਥਮ ਸਥਾਨ 'ਤੇ ਰੱਖਦਿਆਂ ਰਾਗ ਤੇ ਤਾਲ ਤੱਤਾਂ ਦੀ ਵਰਤੋਂ ਸਹਾਇਕਾਂ ਵਜੋਂ ਕੀਤੀ ਜਾਂਦੀ ਸੀ। ਅਜਿਹੀ ਸ਼ੈਲੀ ਦੇ ਦਰਸ਼ਨ ਭਵਿੱਖ ਦੇ ਕੀਰਤਨ ਕਾਰਾਂ ਨੂੰ ਪੁਸਤਕਾਂ ਰਾਹੀਂ ਨਹੀਂ ਹੋ ਸਕਦੇ। ਰਬਾਬੀ ਜੋੜੀ ਤੇ ਪਖਾਵਜ ਵਾਦਕਾਂ ਵੱਲੋਂ ਜੋ ਬੋਲ ਵਜਾਏ ਜਾਂਦੇ ਸਨ, ਜਿਵੇਂ ਉਨ੍ਹਾਂ ਦੇ ਹੱਥ ਦਾ ਰਖਾਓ ਸੀ, ਜੋ ਉਨ੍ਹਾਂ ਦਾ ਬੋਲ ਨਿਕਾਸ ਸੀ, ਇਸ ਸਬੰਧੀ ਅਜੇ ਮੁੱਢਲੀ ਖੋਜ ਲੋੜੀਂਦੀ ਹੈ।

ਰਖਵਾ ਕੀਰਤਨ ਲਈ ਵਰਤਮਾਨ ਸਮੇਂ ਪ੍ਰਯੋਗ ਹੋਣ ਵਾਲਾ ਹਰਮੋਨੀਅਮ ਅਤੇ ਤਬਲਾ ਸਾਡੀ ਪਰੰਪਰਾ ਦਾ ਹਿੱਸਾ ਨਹੀਂ ਸਨ। ਜੋੜੀ ਵਾਦਨ ਸਬੰਧੀ ਜਾਣਕਾਰੀ ਉਪਲਬਧ ਹੁੰਦੀ ਹੈ, ਪਰ ਇਸ ਤੋਂ ਬਿਨਾਂ ਹੋਰ ਵੀ ਅਨੇਕਾਂ ਤਾਲ ਹਾਰਮੋਨੀਅਮ ਇਸ ਪਰੰਪਰਾ ਦਾ ਹਿੱਸਾ ਰਹੇ ਹਨ, ਜਿਨ੍ਹਾਂ ਸਬੰਧੀ ਵੇਰਵੇ ਇਕੱਤਰ ਕਰਨ ਲਈ ਸਿੱਖ ਧਰਮ ਦੇ ਵਿਭਿੰਨ ਸਰੋਤਾਂ ਨੂੰ ਸੰਗੀਤਕ ਦ੍ਰਿਸ਼ਟੀ ਤੋਂ ਮੁੜ ਵਾਚਣਾ ਪਵੇਗਾ।

ਗੁਰਮਤਿ ਸੰਗੀਤ ਦੇ ਪ੍ਰਚਾਰ ਲਈ ਧਾਰਮਿਕ ਪੱਧਰ 'ਤੇ ਸਿੱਖ ਸੰਗਤਾਂ ਵੱਲੋਂ ਯਤਨ ਤਾਂ ਕੀਤੇ ਜਾ ਰਹੇ ਹਨ, ਪਰ ਉਨ੍ਹਾਂ ਵਿਚ ਸਿਧਾਂਤਿਕ ਇਕਸਾਰਤਾ ਦੀ ਕਮੀ ਨਜ਼ਰ ਆਉਂਦੀ ਹੈ। ਸ਼ਬਦ ਕੀਰਤਨ ਦੀ ਸਿਖਲਾਈ ਅਧਿਆਪਕ ਦੀ ਸੰਗੀਤਕ ਸੂਝ ਅਤੇ ਬਾਣੀ ਅਭਿਆਸ ਤਕ ਸੀਮਤ ਹੈ। ਗੁਰ ਗ੍ਰੰਥ ਸਾਹਿਬ ਤੋਂ ਉਦੇ ਹੋਣ ਵਾਲੇ ਸੰਗੀਤ ਵਿਧਾਨ, ਰਾਗਾਂ ਦੀ ਸੁੱਧਤਾ 'ਤੇ ਮੌਲਿਕਤਾ, ਹਿੰਦੁਸਤਾਨੀ ਸੰਗੀਤ ਪਰੰਪਰਾ ਦੇ ਸਨਮੁੱਖ ਗੁਰਮਤਿ ਗਾਇਣ ਸ਼ੈਲੀਆਂ ਵਿਚ ਸੰਗੀਤਕ ਤੱਤਾਂ ਦੀ ਕਾਰਜਸ਼ੀਲਤਾ, ਸਾਜ਼ਾਂ ਦਾ ਵਾਦਨ ਕੇਵਲ ਸੰਗਤ ਦੇ ਰੂਪ ਵਿਚ ਹੋਵੇ, ਇਸ ਸਬੰਧੀ ਵਿਸਤਰਿਤ ਵਿਚਾਰ ਚਰਚਾ ਲੋੜੀਂਦੀ ਹੈ। ਇਸ ਦਿਸ਼ਾ ਵਿਚ ਜਵੱਦੀ ਟਕਸਾਲ ਨੇ ਬਾਬਾ ਸੁੱਚਾ ਸਿੰਘ ਦੀ ਅਗਵਾਈ ਵਿਚ ਯਤਨ ਆਰੰਭ ਕੀਤੇ ਸਨ। ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ ਨੇ ਵੀ ਇਸ ਦਿਸ਼ਾ ਵਿਚ ਕੁਝ ਕਾਰਜ ਆਰੰਭਿਆ ਹੈ। ਸ਼੍ਰੋਮਣੀ ਗੁਰਦੁਆਰਾ ਪ੍ਰਬੰਧਕ ਕਮੇਟੀ ਵੱਲੋਂ ਆਪਣੀਆਂ ਅਕਾਦਮਿਕ ਸੰਸਥਾਵਾਂ ਰਾਹੀਂ ਗੁਰਮਤਿ ਸੰਗੀਤ ਦੀ ਵਿੱਦਿਆ ਦਿੱਤੀ ਜਾ ਰਹੀ ਹੈ। ਲੋੜ ਹੈ ਸਾਰੇ ਮਿਸ਼ਨਰੀ ਕਾਲਜਾਂ, ਗੁਰਮਤਿ ਸੰਗੀਤ ਅਕੈਡਮੀਆਂ ਦਾ ਪਾਠਕ੍ਰਮ ਹਿੰਦੁਸਤਾਨੀ ਸੰਗੀਤ ਦੇ ਰਾਗਾਂ 'ਤੇ ਨਹੀਂ ਬਲਕਿ ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਦੇ 31 ਮੁੱਖ ਰਾਗਾਂ ਅਤੇ ਰਾਗ-ਪਰਕਾਰਾਂ 'ਤੇ ਆਧਾਰਿਤ ਹੋਵੇ। ਬਾਣੀ ਲਈ ਪ੍ਰਯੋਗ ਹੋਈਆਂ ਵਿਭਿੰਨ ਗਾਇਣ ਸ਼ੈਲੀਆਂ ਸਬੰਧੀ ਖੋਜ ਅਤੇ ਚਰਚਾ ਉਪਰੰਤ ਕੀਰਤਨ ਪ੍ਰਸਤੁਤੀਆਂ ਅਤੇ ਪ੍ਰਤੀਯੋਗਤਾਵਾਂ ਆਯੋਜਿਤ ਕਰਨ ਦਾ ਉਪਰਾਲਾ ਕੀਤਾ ਜਾਵੇ। ਗੁਰੂ ਘਰਾਂ ਵਿਚ ਕਿੱਤਾਕਾਰ ਕੀਰਤਨੀਆਂ ਤੋਂ ਇਲਾਵਾ ਅਕਾਦਮਿਕਤਾ ਦੇ ਖੇਤਰ ਵਿਚ ਕਾਰਜਸ਼ੀਲ ਜਥਿਆਂ ਪਾਸੋਂ ਸਮੇਂ-ਸਮੇਂ ਕੀਰਤਨ ਰਾਜ਼ਰੀਆਂ ਭਰਵਾਈਆਂ ਜਾਣ ਤਾਂ ਜੋ ਗੁਰਮਤਿ ਸੰਗੀਤ ਵਿਧਾਨ ਨਾ ਉਤ-ਪੇਤ ਕੀਰਤਨ ਪ੍ਰਸਤੁਤੀਆਂ ਸੰਗਤਾਂ ਤਕ ਪਹੁੰਚ ਸਕਣ ਅਤੇ ਪਰੰਪਰਾਗਤ ਕੀਰਤਨ ਦਾ ਹਿੱਸਾ ਬਣ ਸਕਣ।

ਵਰਤਮਾਨ ਸਮੇਂ ਸੰਗਤ ਵਿਚ ਮਕਬੂਲ ਕੀਰਤਨ ਕਾਰਾਂ ਦੁਆਰਾ ਗੀਤ-ਸੰਗੀਤ ਵਿਚ ਪ੍ਰਚੱਲਿਤ ਧੁਨਾਂ ਨੂੰ ਆਧਾਰ ਬਣਾ 'ਕੇ ਗੁਰਬਾਣੀ ਗਾਇਣ ਕੀਤਾ ਜਾ ਰਿਹਾ ਹੈ, ਜੋ ਸੰਗਤਾਂ ਨੂੰ ਕਰਣਪਿਆ ਲਗਦਾ ਹੈ। ਮਧੁਰ ਪ੍ਰਤੀਤ ਹੁੰਦਾ ਹੈ। ਕਿਉਂਜੋ ਇਹ ਧੁਨਾਂ ਉਨ੍ਹਾਂ ਦੀਆਂ ਸਿਮ੍ਰਿਤੀਆਂ ਦਾ ਹਿੱਸਾ ਹੁੰਦੀਆਂ ਹਨ, ਇਸ ਲਈ ਇਨ੍ਹਾਂ 'ਤੇ ਆਧਾਰਿਤ ਸ਼ਬਦ ਕੀਰਤਨ ਵਧੇਰੇ ਅਨੰਦ ਦਾਇਰ ਲਗਦਾ ਹੈ। ਪਰ ਇਸ ਨਾਲ ਅਸੀਂ ਗੁਰੂ ਸਾਹਿਬ ਵੱਲੋਂ ਦਰਸਾਏ ਗਏ ਸੰਗੀਤ ਵਿਧਾਨ ਤੋਂ ਦੂਰ ਹੁੰਦੇ ਜਾ ਰਹੇ ਹਾਂ।

ਅੱਜ ਕਲ ਇੰਟਰਨੈੱਟ ਦਾ ਯੁੱਗ ਹੈ। ਪੁਸਤਕਾਂ, ਰਿਕਾਰਡਿੰਗ, ਕੀਰਤਨ ਕਾਰਾਂ ਨਾਲ ਸੰਪਰਕ, ਇੰਟਰਵਿਊ, ਵਰਤਾਵਾਂ, ਆਨ-ਲਾਈਨ ਮਿਲਣੀਆਂ, ਸਭ ਕੁਝ ਸੰਭਵ ਹੈ। ਆਉ, ਗੁਰਮਤਿ ਸੰਗੀਤ ਨੂੰ ਕੇਵਲ ਗੁਰੂ ਘਰਾਂ ਦਾ ਸ਼ਿੰਗਾਰ ਨਾ ਬਣਾਉਂਦੇ ਹੋਏ, ਇਸ ਨੂੰ ਅਕਾਦਮਿਕ ਪੱਧਰ 'ਤੇ ਹੋਰ ਮਜ਼ਬੂਤ ਕਰੀਏ। ਵਿਸ਼ਵਾਸ ਦੀਆਂ ਅਕਾਦਮਿਕ ਸੰਸਥਾਵਾਂ ਗੁਰਮਤਿ ਸੰਗੀਤ ਦੀ ਅਕਾਦਮਿਕਤਾ ਨਾਲ ਜੋੜੀਏ। ਸਿੱਖ ਧਰਮ ਨਾਲ ਸਬੰਧਿਤ ਉਪਲਬਧ ਸਮੂਹ ਗ੍ਰੰਥਾਂ ਨੂੰ ਸੰਗੀਤਕ ਦ੍ਰਿਸ਼ਟੀ ਤੋਂ ਮੁੜ ਤੋਂ ਵਾਚੀਏ। ਗੁਰਮਤਿ ਸੰਗੀਤ ਦੇ ਵਿਭਿੰਨ ਸਿਧਾਂਤਾਂ ਸਬੰਧੀ ਟਕਸਾਲੀ ਤੇ ਘਰਾਨੇਦਾਰ ਕੀਰਤਨ ਕਾਰਾਂ ਨਾਲ ਮੁਲਾਕਾਤਾਂ ਰਾਹੀਂ ਉਪਲਬਧ ਗਿਆਨ ਨੂੰ ਸੰਜੋਅ 'ਕੇ ਭਵਿੱਖ ਹੋਰ ਉਜਲਾ ਕਰਨ ਦਾ ਯਤਨ ਕਰੀਏ।

ਖੋਜ ਸਰੋਤ

- ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ।
- ਦਸਮ ਬਾਣੀ।
- ਸਰਬਲੋਹ ਗ੍ਰੰਥ।
- ਮਹਾਨ ਕੋਸ਼, ਭਾਈ ਕਾਨ੍ਹ ਸਿੰਘ ਨਾਭਾ, ਭਾਸ਼ਾ ਵਿਭਾਗ ਪੰਜਾਬ।
- ਸਿੱਖ ਐਨਸਾਈਕਲੋਪੀਡੀਆ, ਰਤਨ ਸਿੰਘ ਜਗੀ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ ਪਟਿਆਲਾ।
- ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ ਰਾਗ ਰਤਨਾਵਲੀ, ਪ੍ਰੋ. ਤਾਰਾ ਸਿੰਘ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
- ਸੁਰ ਸਿਮਰਣ ਸੰਗੀਤ (ਪੁਸਤਕ ਲੜੀ), ਸੰਤ ਸਰਵਣ ਸਿੰਘ ਗੰਧਰਵ, ਡੁਮੇਲੀ।
- ਕੀਰਤਨੀ ਆਸਾ ਦੀ ਵਾਰ, ਡਾ. ਕੰਵਲਜੀਤ ਸਿੰਘ, ਏ ਪੀ ਸਿੰਘ, ਗੁਰਮਤਿ ਪ੍ਰਕਾਸ਼ਨ, ਪਟਿਆਲਾ।
- ਗੁਰਮਤਿ ਸੰਗੀਤ ਦਰਪਣ (ਪੁਸਤਕ ਲੜੀ), ਸ਼੍ਰੋਮਣੀ ਗੁਰਦੁਆਰਾ ਪ੍ਰਬੰਧਕ ਕਮੇਟੀ, ਸ੍ਰੀ ਅੰਮ੍ਰਿਤਸਰ ਸਾਹਿਬ।
- ਗੁਰਮਤਿ ਸੰਗੀਤ ਪਰਬੰਧ ਤੇ ਪਾਸਾਰ, ਡਾ. ਗੁਰਨਾਮ ਸਿੰਘ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
- ਗੁਰਮਤਿ ਸੰਗੀਤ ਕੀ ਰਾਗ ਪਰੰਪਰਾ, ਪ੍ਰੋ. ਸਵਰਲੀਨ ਕੌਰ, ਭਾਰਤੀਯ ਲਲਿਤ ਕਲਾ ਸੰਸਥਾਨ, ਦਿੱਲੀ।
- ਗੁਰਮਤਿ ਸੰਗੀਤ ਦਰਪਣ (ਪੁਸਤਕ ਲੜੀ), ਪ੍ਰੋ. ਕਰਤਾਰ ਸਿੰਘ ਪਦਮਸ਼੍ਰੀ, ਸ਼੍ਰੋਮਣੀ ਗੁਰਦੁਆਰਾ ਪ੍ਰਬੰਧਕ ਕਮੇਟੀ, ਸ੍ਰੀ ਅੰਮ੍ਰਿਤਸਰ ਸਾਹਿਬ।
- ਗੁਰਮਤਿ ਸੰਗੀਤ ਸਾਗਰ (ਪੁਸਤਕ ਲੜੀ), ਪ੍ਰਿੰਸੀਪਲ ਦਿਆਲ ਸਿੰਘ, ਗੁਰਮਤਿ ਵਿਦਿਆਲਾ, ਗੁਰਦੁਆਰਾ ਰਕਾਬ ਗੰਜ, ਦਿੱਲੀ।
- ਗੁਰਬਾਣੀ ਸੰਗੀਤ (ਪੁਸਤਕ ਲੜੀ), ਸ. ਗਿਆਨ ਸਿੰਘ ਐਬਟਾਬਾਦ, ਸ਼੍ਰੋਮਣੀ ਗੁਰਦੁਆਰਾ ਪ੍ਰਬੰਧਕ ਕਮੇਟੀ, ਸ੍ਰੀ ਅੰਮ੍ਰਿਤਸਰ ਸਾਹਿਬ।
- ਗੁਰਮਤਿ ਸੰਗੀਤ ਦੀ ਤਾਲ ਪਰੰਪਰਾ, ਸ. ਤਰਨਜੀਤ ਸਿੰਘ, ਭਾਰਤੀਯ ਲਲਿਤ ਕਲਾ ਸੰਸਥਾਨ, ਦਿੱਲੀ।
- ਪੜਤਾਲ ਸ਼ਬਦ ਗਾਇਣ, ਡਾ. ਕੰਵਲਜੀਤ ਸਿੰਘ, ਸਵਰਲੀਨ, ਗ੍ਰੇਸੀਅਸ ਪਬਲੀਕੇਸ਼ਨਜ਼, ਪਟਿਆਲਾ।

Dimensions of Burnout: A Review of the Literature

***Naveela **Kanchan Rani**

*Research scholar** Assistant Professor Sri Guru Granth Sahib World University, Fatehgarh Sahib
chaudharynaveela@gmail.com

Abstract

Burnout is a well-known phenomenon that can affect individuals in various fields, including healthcare, education, and social services. Burnout is a syndrome that is characterized by three dimensions: emotional exhaustion, depersonalization, and reduced personal accomplishment. This paper aims to review the literature on the dimensions of burnout, including their definitions, measurement, and relationships with individual and organizational factors.

Keywords: Burnout, Emotional exhaustion, Depersonalization, Personal accomplishment

Introduction

In today's technological era, the regular developments in the job field create job pressure for employees and organizations to manage the work environment and survive in the competitive world. The unsuitable conditions of the job place affect the physical and mental health of the employee, which generates stress. When this stress continues for a long time, it turns into job burnout. Burnout is a well-known phenomenon that can affect individuals in various fields, including healthcare, education, and social services. Burnout is a psychological syndrome that results from chronic workplace stress. It is characterized by a combination of emotional exhaustion, depersonalization, and reduced personal accomplishment. Burnout is often associated with occupations that require emotional labour, such as healthcare providers who work with patients who are critically ill or educators who work with disadvantaged students. Burnout can have negative effects on both individuals and organizations. For individuals, burnout can lead to decreased job satisfaction, increased turnover intentions, and mental health problems such as depression and anxiety. For organizations, burnout can result in increased absenteeism, decreased productivity, and decreased quality of care or service. Burnout is a complex and multifaceted phenomenon that is influenced by both individual and organisational factors. Addressing burnout requires a comprehensive approach that considers both the individual and organisational factors that contribute to burnout. By promoting the well-being of employees and addressing the root causes of burnout, organisations can improve the quality of care or service they provide and promote the overall health and well-being of their workforce.

Objective of the study

To review the literature on the dimensions of burnout, including their definitions, measurement, and relationships with individual and organizational factors

Research methodology

In this study the methodology was literature survey. Many studies were conducted in the field of the burnout. Some of the studies were compiled together for the purpose of research. Both empirical and theoretical studies were the part of the study. The studies were collected from various journals.

Burnout

"Burnout" is defined as "fatigue, frustration, or overwork caused by prolonged stress or overwork." This word comes from the verb phrase "burn out," which means to burn out until fuel is exhausted. In the 1900s, this word was metaphorically extended to burn an individual out or "exhaust the energy of an individual through overwork. In 1974, Herbert Freudenberger, a psychologist, defined burnout as "the extinction of motivation or incentive, especially where one's devotion to a cause or relationship fails to produce the desired results. Burnout was considered a multi-component construct, but there is one commonly accepted model that was given by Maslach and Jackson (1986) that is characterised by three interrelated components that are also known as "dimensions of burnout." These are discussed later in this paper.

Dimensions of Burnout

1. Emotional Exhaustion: Emotional exhaustion is the most widely studied dimension of burnout. Emotional exhaustion is defined as the feeling of being emotionally drained and depleted due to chronic stress. Emotional exhaustion is typically measured using the Maslach Burnout Inventory (MBI), which assesses the frequency and intensity of feelings of emotional exhaustion. Emotional exhaustion has been associated with a range of negative outcomes, including decreased job satisfaction, increased turnover intention, and decreased quality of care.

2. Depersonalization: Depersonalization is the development of negative and cynical attitudes towards clients or coworkers. Depersonalization is often seen as a coping mechanism for individuals experiencing emotional exhaustion. Depersonalization is typically measured using the MBI, which assesses the frequency and intensity of

feelings of depersonalization. Depersonalization has been associated with a range of negative outcomes, including decreased job satisfaction, increased turnover intention, and decreased quality of care.

3.Reduced Personal Accomplishment: Reduced personal accomplishment refers to the feeling of being ineffective and incompetent in one's work. Reduced personal accomplishment is typically measured using the MBI, which assesses the frequency and intensity of feelings of reduced personal accomplishment. Reduced personal accomplishment has been associated with a range of negative outcomes, including decreased job satisfaction, increased turnover intention, and decreased quality of care MBI Scaling:-

The above-mentioned dimensions were measured by the MBI scaling (Maslach burnout inventory), which was given by Maslach and Jackson in 1981–1986, It contains 22 items pertaining to occupational burnout. It helps to assess an individual's level of burnout. It has three scales: emotional exhaustion (9 items), personal accomplishment (8 items), and depersonalization (5 items). Below is an example of MBI scaling based on the five items of the Likert scale.

Emotional Exhaustion (EE)	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Emotionally drained					
2. Used up					
3. Fatigued in the morning					
4. Working with people					
5. Burned out					
6. Frustrated					
7. Working too hard					
8. Stress					
9. End of my rope					
Personal Accomplishment (PA)					
1. I can understand					
2. I deal effectively					
3. I'm positively influencing					
4. Energetic					
5. Relaxed atmosphere					
6. I feel exhilarated					
7. Accomplished					
8. Deal with emotional problems					
Depersonalization (DP)					
1. Impersonal objects					
2. Callous toward people					
3. Hardening me emotionally					
4. I don't really care					
5. Recipients blame me					

Relationships of Dimensions with Individual and Organizational Factors:

The dimensions of burnout, emotional exhaustion, depersonalization, and reduced personal accomplishments, which are influenced by both individual and organizational factors. Here are some examples of how individuals and Organizational factors are related to the dimensions of burnout:

1.Individual factors:

- (a) Personality traits: Individuals with high levels of neuroticism or low levels of Resilience maybe more prone to emotional exhaustion and depersonalization.
- (b) Coping styles: Individuals who use maladaptive coping strategies, such as avoidance or substance use, may be at higher risk of burnout.
- (c) Demographic characteristics: Research has found that younger workers, female workers and workers with less experience may be at higher risk of burnout.

2.Organizational factors:

- (a) Workload: High job demands, such as long work hours or excessive Paperwork , can contribute to emotional exhaustion and reduced personal accomplishment.
- (b) Social support: Social support from colleagues and supervisors can buffer the negative effects of burnout, particularly emotional exhaustion.
- (c) Job control: Workers with more autonomy and control over their work may be less likely to experience

burnout.

It is important to note that the relationship between these factors and the dimensions of burnout is complex. For example, while a high workload may contribute to emotional exhaustion, workers who feel a sense of purpose in their work may be more resilient to the effects of a high workload. Similarly, while social support can buffer the effects of emotional exhaustion, workers who feel stigmatized or unsupported by their colleagues may experience depersonalization.

Conclusion

Burnout is a psychological syndrome that is characterized by three dimensions: emotional exhaustion, depersonalization, and reduced personal accomplishment. The dimensions of burnout are influenced by both individual and organizational factors. The relationship between individual and organizational factors and the dimensions of burnout is complex and multifaceted. Organizations can reduce the risk of burnout by implementing interventions that target the individual and organizational factors that contribute to burnout.

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Say Yes To Digital Marketing and Increase Your Sales: A Study of Firms in Punjab

***Kiran Saroe**

*Research Fellow, Department of Commerce, Punjabi University Patiala

saroe.kiran12@gmail.com

Abstract

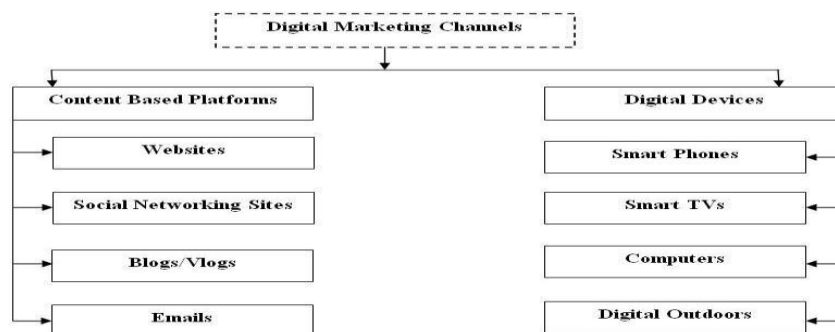
As the government of India has launched many programmes such as "Start-up India," "Make in India," and "Digital India," people are considering launching their own businesses. In this case, digital marketing may be a very effective, efficient, and beneficial component of their start-up or business's growth. Digital marketing is serving as a catalyst and facilitator to increase the organization's marketing and promotional operations. In the consideration of these facts; business firms' motivating drivers for adopting digital marketing are studied along with problems faced in the implementation. A sample of 420 business firms is selected by snowball sampling technique in Punjab State. To analyze the collected data; descriptive statistics and factor analysis are used. The study revealed that there are five main drivers which induce firms to implement digital marketing namely; organization, technology, floating customer attitude, business environment, and management to promote and sell their products and services. Further, businessmen are facing data-security-related issues in the implementation of digital marketing. In addition to this respondents' most effective mode of digital marketing is social media marketing and the highly preferred social media channel is Facebook.

Keywords: digital marketing, digital marketing channels, social media, business firm

Introduction

The word "digital marketing" is used differently by everyone as E-marketing, online marketing, and internet marketing and other terms are also used for it. Even though all of these expressions are related in some manner, they are distinct (Rowan, 2002). The use of the internet to promote and advertise goods and services is referred to as internet marketing (Hanson and Kalyanam 2007). E-marketing is also known as electronic marketing where a live internet connection can be used to promote and sell products and services (Hoge, 1993). Simply put, digital marketing is the digitally marketing of various products and services, as well as the use of various IT technologies and techniques for the advertisement and promotion of products and services. Digital marketing is the practice of building and sustaining client relationships using electronic media and numerous online activities. It's a different process from traditional marketing. Unlike traditional marketing, digital marketing is a dynamic process that is always changing (Wymbs, 2011). Digital marketing is effective because its facts, stats, and data can be measured. It reduces the quantity of hectic door-to-door activities. It's also a cheap and easy way to interact with people without bothering them. People believe it is an easy, convenient, and effective way to obtain information. There is an increasing demand for specialists who can deal with electronic media challenges. Everyone nowadays has a cell phone, especially a smartphone. The industry is developing regularly, and so is the breadth of digital marketing. The important point is that traditional marketing does not allow us to be everywhere, whereas digital marketing (through the internet and electronic media) allows us to be everywhere, at any time, and from any location on the planet. Businesses use digital marketing channels to carry out various digital marketing activities by using digital marketing channels such as websites, blogs, emails, social networking websites, digital TVs, smartphones, and other popular digital marketing platforms (Wertime and Fenwick 2011).

Digital Marketing Channels



Review of Literature

The following literature is studied in order to meet the objectives of the study.

Dunne et al. (2010) attempted to discover the reasons behind young people's use of online social networking sites-a uses and gratifications perspective in their study Young people's use of online social networking sites-a uses and gratifications perspective with special reference to Bebo. The study's findings revealed that individuals used Bebo for personal reasons as well as to retain a certain persona and identity in social contexts. Because of the impersonal nature of social media, young people may now negotiate practicalities, build identities, and sustain relationships. Edosomwan et al. (2011) also investigated the evolution of social media and its implications for business. They addressed how social media has influenced human communication and interaction. They studied the history of social media. They found that for businesses, social media sites generate a buzz about the brand. They have also found that social media is popular due to its low cost. Whereas; Chugh (2012) examined if social networking is a boon or a curse for corporate enterprises. He has explored the benefits and drawbacks of social networking for corporate companies. The study revealed that social networking networks are a noble approach to expanding a firm globally and have completely transformed the commercial sector. They also decided that there is a big future potential for these, as the internet is itself a future. In addition to this, Hajli (2014) studied the influence of social media on customers. He has emphasized how social media has given customers new ways to interact and communicate on a global scale. Online communities are increasingly playing an important part in business growth and development. He stated that current improvements and technological innovations on the internet have benefited both consumers and businesses. Sharma et al. (2020) explored the use of digital marketing in travel firms. The study's goal is to determine whether or not travel firms employ internet marketing to grow their businesses. According to the findings of this study, some travel companies employ conventional marketing while the majority of travel agencies use both traditional and digital marketing techniques.

The literature review depicted that digital marketing is emerging as a significant aspect for commercial organizations in all sectors as technological upgrades and breakthroughs continue to accelerate. This excites one's interest in examining reasons for adopting digital marketing as well as hurdles in the adoption process encountered by businesses and enterprises; hence, the following objectives are established to undertake the current study:

- To identify the drivers behind the adoption of digital marketing.
- To study the hindrances in the adoption of digital marketing.
- To identify the most effective digital marketing mode.
- To identify the most preferred social media channel for digital marketing.

Research Methodology

Sampling

For the aim of the study, a sample of 420 businesses in Punjab that use digital marketing or different forms of digital marketing for promotion, advertisement, and selling of their products and services are chosen using a snowball sampling technique. For data collection, businesses engaged in the food and hospitality, IT, legal, automobile, retail, telecom, consultant services, real estate, agricultural, education, production and manufacturing, healthcare, tour and travel, and banking sectors are approached. Because Punjab is the area of study, districts with a high number of business firms are chosen for the research, with equal representation given to each district; therefore the selected districts are Ludhiana, Jalandhar, Amritsar, and Mohali.

Data Collection and Statistical Tools

The current study was based on both primary as well as secondary data. Secondary data was collected through existing literature on digital marketing, different subsets of digital marketing, magazines, reputed journals, and official websites. Primary data of the study is collected with the help of a well-designed questionnaire. The collected data is analyzed by using different appropriate statistical methods to achieve the objectives of the study. SPSS software 20.0 version is used to apply tools such as mean, standard deviation, and exploratory factor analysis.

Results and Discussions

Drivers behind the Adoption of Digital Marketing for Business Firms

To identify the drivers which motivate business minds to adopt digital marketing; a comprehensive literature survey is conducted and twenty-one statements are framed to achieve this objective. Further, the reliability of the statements is checked with the help of Cronbach alpha and the results are highlighted in the following table.

Table. 1: Reliability Statistics

Cronbach's Alpha	N of Items
0.843	21

Source: Primary Data

Table 1 depicts the alpha value as 0.843, which is a sign of high consistency among the statements therefore the statements' data can be used further for exploratory factor analysis to find out the drivers behind the adoption of digital marketing. To check the fit of factor analysis the KMO and Bartlett test is performed in the table below.

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.809
Bartlett's Test of Sphericity:	
Approx. Chi-Square	2805.70
Df	210
Sig.	0.000

Source: Primary Data

Table 2 shows that KMO value is 0.809, with a chi-square value of 2805.70 which is an indication of sample adequacy with a strong relationship among the statements in the data. To extract digital marketing adoption drivers for firms; the Varimax method of rotation and Principal Component Analysis are used. The undermentioned table 3 shows the percentage of cumulative variance explained along with eigenvalues, factor loading, and reliability. As the eigenvalue controls the number of retrieved factors, so factors with values greater than one are considered for factor analysis. Table 3 shows that five factors are there with a value of more than one. Further, the overall cumulative percentage variance is also larger than 60 percent which indicates that every factor is eligible for consideration. The rotation sum of squared loading analysis is used to find variables with the highest loading values on the same component or factor. Factor loadings larger than or equal to 0.5 are also considered for variable reduction.

Interpretation of Drivers Motivating Business Firms to Adopt Digital Marketing

The exploratory factor analysis has extracted five drivers which motivate the respondents to use digital marketing to promote and advertise their products and services. It can be seen in table 3 that the most important driver which influences the business to use digital marketing is Organization. It contains four statements with 4.968 eigenvalues and 0.846 of Cronbach alpha along with 15.861 total variance. In addition to this respondents do agree that the organization's modern technological infrastructure demands the use of digital marketing and the Organization's productivity has grown as a result of the adoption of digital marketing technologies. Moreover, the Availability of funds enables the business to implement digital marketing. Technology is the second most influential driver for using digital marketing for the promotion and selling of products. Five statements are clustered in this driver since its eigenvalue is 3.318 along with 0.831 reliability among statements. in today's time, digital marketing has completely replaced traditional marketing wherein organizations can't ignore the prerequisite of a digital marketing strategy because of being faster, more effective, and cheaper than the old style of marketing The floating Customer Attitude driver consists of four statements with 2.059 of eigenvalue and 0.794 Cronbach alpha. It is the third important driver which stimulates firms to adopt digital marketing for their business purpose. only extraordinary and worth-sharing advertisements should be visible to customers on digital platforms reason being good and creative advertisements will significantly increase brand awareness and sales.

Table. 3: Extraction of Drivers behind the Adoption of Digital Marketing for Businesses

Drivers	Statements	Factor Loadings	Eigen values	Reliability	Total Variance
Organization	Organization's modern technological infrastructure demands the use of digital marketing	0.812	4.968	0.846	15.861
	Organization's productivity has grown as a result of the adoption of digital marketing technologies	0.738			
	Due to the ongoing influence of the internet and technology, digital marketing is emerging as a component of the work style	0.655			
	Availability of funds enables the business to implement digital marketing	0.574			
Technology	Adoption of contemporary technologies minimizes the cost of digital marketing	0.817	3.318	0.831	30.318
	Utilization of Artificial Intelligence, chatbots, etc. tailored digital marketing campaigns	0.798			
	Technological innovations make it easy to adopt digital marketing	0.735			
	Data management of activities is easier in digital marketing adoption	0.648			
	Technological advancements in digital marketing aid in boosting the effectiveness of promotional and marketing operations conducted on a digital platform	0.511			
Floating Customer Attitude	Clients like to engage with businesses via digital marketing	0.843	2.059	0.794	43.169
	Preferences of consumers have shifted from conventional media (newspapers, TV, radio, etc.) to digital media (social media, blogs, websites, apps, etc.)	0.820			
	Customers spend enough time on the internet as it is convenient	0.740			
	Digital marketing allows for more personalized messages to be delivered	0.650			
Business Environment	Usage of digital marketing is required in the corporate environment	0.770	1.414	0.769	53.223
	Social networks inspire organizations to implement digital marketing	0.725			
	Digital marketing is adopted to gain a Competitive advantage	0.659			
	Government programmes, policies, and security encourage the use of digital marketing	0.619			
Management	Management recognizes the significance of digital marketing adoption	0.758	1.350	0.738	62.144
	Digital marketing is inexpensive as well as simple to execute and requires little effort	0.553			
	Management was ready to provide help for training in digital marketing as well as its activities	0.518			
	Management expects good returns from the implementation of digital marketing	0.476			

Source: Primary Data

The fourth important driver to use digital marketing is the business environment by administrating 1.414 as eigenvalue and 0.769 consistency among grouped four statements. As per the participants, areas like competitive advantage, social networks, government schemes, and policies do encourage business

enterprises to implement digital marketing to promote products and services in the new digital age. The fifth and least influencing driver in the adoption of digital marketing is management, with a 13.50 eigenvalue and alpha value of 0.738. As per the participants, management provides excellent support in training digital marketing because this is cost-effective and easy to implement with high maintenance. Participants further said that organizations do understand the importance of the adoption of digital marketing. Here the understanding is based on the belief in getting good returns from digital marketing.

Hindrances Faced in the Adoption of Digital Marketing by Business Firms

Adoption of digital marketing creates some hurdles, and these problems assist organizations in realizing their full potential (V. Kumar, S. Sunder, A. Sharma, 2015). Some obstacles are discovered in the literature survey (El-Gohary et al. 2009) (Leeflang et al., 2014) and business firms are asked to give their viewpoint in this regard on five points Likert scale. To present the responses of the respondents, mean values have been computed and shown in the following table.

Table. 4: Descriptive Statistics of Hindrances in Adoption of Digital Marketing

Sr. No.	Hindrances	Mean	Ranking
1	Data Security	4.06	1
2	Lack of creation in engaging content	3.86	2
3	Selection of appropriate Technology	3.81	3
4	Strategy Development	3.78	4
5	Insufficient Finance	3.76	5
6	Training of Staff	3.65	6
7	Competition Analysis	3.64	7
8	Government Plans/ Policies	3.23	8

Source: Primary Data

Table 4 displays descriptive statistics on the hurdles that businessmen experience while adopting digital marketing. According to the table, problem in Data Security is highly faced by the business firm with a 4.06 mean score followed by lack in the creation of engaging content, Selection of appropriate Technology, Strategy Development, and Insufficient Finance; entailing 3.86, 3.81, 3.78 and 3.76 respective mean scores. However least problematic hindrance faced by the organizations is Government Plans/ Policies with a 3.23 mean value followed by Competition Analysis, and Training of Staff since their mean scores are 3.64 and 3.65 respectively.

Most Effective Digital Marketing Mode for Business Organizations

Respondents in the survey are asked to rate the most effective digital marketing mode on a five-point Likert scale. To draw a conclusion from the responses; mean scores and standard deviation are calculated and displayed below:

Table. 5: Descriptive Statistics of Most Effective Mode of Digital Marketing

Sr. No.	Digital Marketing Modes	Mean	Standard Deviation
1	Social Media Marketing	4.410	0.913
2	Search Engine Marketing	3.848	0.945
3	Email Marketing	3.629	0.908
4	Search Engine Optimization	3.724	0.972
5	Content Marketing	3.562	0.850
6	Affiliate Marketing	2.419	1.316

Source: Primary Data

Table 5 states that social media marketing (4.410; 0.913) is one of the most effective digital marketing tactics, followed by search engine marketing (3.848; 0.954). whereas E-mail marketing (3.629; 0.908) and search engine optimization (3.724; 0.972) are averagely effective modes. In addition to this, affiliate Marketing was discovered to be the least effective digital marketing mode, with a Mean score value of (2.419; 1.316) followed by content marketing (3.562; 0.850). As a result of the findings, we can conclude that commercial

enterprises have selected Social Media Marketing as the most effective way of digital marketing therefore, their strategies lean toward the use of social media marketing for promotion, advertising, and selling products and services.

Most Preferred Social Media Channel by Business Firms for Digital Marketing

Various kinds of social media channels are used by businesses to promote and sell their products as well as services so here an attempt has been made to know the most preferred social media which is widely used and preferred by the organizations. To achieve this objective diverse channels are identified with the help of a literature survey and respondents are asked about their most preferred social channel for digital marketing on the Likert scale. The following table shows the mean values of the collected responses:

Table 6: Mean Scores of Most Preferred Social Media Channels for Digital Marketing

Sr. No.	Social Media Channels	Mean	Ranking
1	Facebook	3.93	1
2	Instagram	3.76	2
3	YouTube	3.72	3
4	LinkedIn	3.45	4
5	WhatsApp	3.28	5
6	Twitter	3.24	6
7	Telegram	2.47	7

Source: Primary Data

As per table 6, Facebook (3.93) is the most preferred social media channel for digital marketing followed by Instagram (3.76) and Youtube (3.72). LinkedIn (3.45) comes in between the highest and least preferred social channels. However, Telegram is the least preferred social mode for the promotion of products and services by business firms followed by Twitter (3.24) and WhatsApp (3.28).

Conclusion

As the world becomes more digital, businesses have begun to search for online platforms to help them grow. They see a lot of potential in digitalization as a result businesses have begun to use digital technology for advertising and promotional purposes. The current research paper found that there are five influential drivers namely, organization, technology, floating customer attitude, business environment, and management which drive firms to adopt digital marketing in business. The most important driver is the organization as it demands innovation to increase its productivity. The second most important one is technology; the reason is tracking customers and their data management is convenient in comparison to traditional methods of marketing as digital marketing is based on technology. However, the least important driver that stimulates businessmen to implement digital marketing to promote and sell products and services is management though it recognizes the importance of digital marketing and provides help in the activities during the implementation process. Further, firms are facing data Security issues in the implementation of digital marketing. The study also found social media marketing as the most effective digital marketing mode whereas; Facebook is the most preferred social media channel by business firms for digital marketing.

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Increasing Role of Artificial Intelligence in Strengthening Financial Markets

***Tejinder Singh, **Dr.Rubeena Bajwa**

*Research Scholar, **Professor (Asst), Department of Commerce and Management, Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab (India)-140406
rednijetchd@gmail.com, rubeenabajwa@gmail.com

Abstract

Algorithmic Trading which is the manifested form of Artificial Intelligence has played a crucial role in reducing the effect of human emotions for the traders and given a deepening effect in financial markets. Using a unique data set from the Austrian equity market, we examine how algorithmic trading and liquidity are related. The sample comes from a market that has not previously been studied, spans approximately 4.5 years, and determines the market share of algorithmic trading at the stock-day level. Instrumental variables technique is used to solve the endogeneity problem. According to findings, an increase in algorithmic trading's market participation lowers quoted and effective spreads while having no impact on quoted depth or price implications. These are in line with the general market-making behaviour of algorithmic traders.

Keywords: AT-Algorithmic Trading, Vienna Stock Exchange (VSE), Financial Markets, Liquidity

Introduction

In algorithmic trading, predetermined rules, such as price triggers, are used to open and close trades automatically using computer code and software. The financial markets have undergone a significant shift in favour of AT. Authorities have taken steps to contain AT because they are worried about potential adverse consequences on market quality. Examples include the Securities and Exchange Commission naked access ban (Chakrabarty et al., 2014), Italy's high frequency trading tax (Rühl and Stein, 2014), and Germany's High Frequency Trading Act (Haferkorn and Zimmermann, 2014). The topic has also received a lot of public attention because to bestseller Flash Boys by Michael Lewis. Both active (liquidity-seeking) and passive (liquidity-supplying) techniques are used by algorithmic traders. Active AT may reduce liquidity, especially when it takes advantage of transient informational advantages and imposes unfavourable selection costs on other traders. Passive AT may boost liquidity (but may displace non-AT liquidity suppliers). This makes the effect of AT on market quality an empirical issue. There is now a mixed bag of evidence. While numerous research (e.g., Hendershott, Jones and Menkveld, 2011; Hasbrouck and Saar, 2013; Jarnećić and Snape, 2014; Boehmer, Fong and Wu, 2015; and Lyle and Naughton, 2015) claim that liquidity increases when there is more AT, other papers indicate the opposite (e.g. Shkilko and Sokolov, 2016; and Brogaard, Hendershott and Riordan, 2017). Accurate identification of AT activity is necessary for analysing the impact of AT on liquidity. Boehmer, Fong, and Wu (2015), Hasbrouck and Saar (2013), and others employ order-to-trade ratios, order lifetimes, or message traffic as potentially noisy proxies for AT activity (e.g. Hendershott, Jones and Menkveld, 2011). National Association of Securities Dealers Automated Quotations provides information on trades and quotations for 120 equities from 26 high frequency trading firms for the years 2008 and 2009. Carrion (2013), Brogaard, Hendershott, and Riordan (2014, 2017), O'Hara, Yao, and Ye (2014), Brogaard et al. (2017), and Zhang are a few authors who have used it (2018). Other writers (such as Breckenfelder, 2013; Hagströmer and Nordén, 2013; Hendershott and Riordan, 2013; Brogaard et al., 2014; Jarnećić and Snape, 2014; Benos and Sagade, 2016;) have access to confidential account-level data on trades executed by AT firms.

The current paper makes several contributions to this body of work. We make advantage of a brand-new stock market data set from Austria. It provides for precise determination of AT's market share at the stock-day level and covers a sample period of 52 months, which is far longer than that of earlier studies. By examining a non-US market that has not previously been studied, we offer out-of-sample proof. The Vienna Stock Exchange's market share has been rather consistent during our sample period, which is another advantage of the Austrian equity market. This stands in stark contrast to incumbent exchanges in other nations, which over the same time period experienced significant decreases in market shares. While AT may influence market quality, it's also possible that market circumstances influence the amount of AT, which could lead to an endogeneity issue. Following Hasbrouck and Saar (2013), we calculate the average AT market share of all other stocks on a given day to determine AT's market share in a particular stock on that day. Our findings show that AT has a favorable impact on liquidity. Increases in algorithmic trading led to decreases in quoted and effective spreads but have no impact on quoted depth. Moreover, we discover that AT has little impact on the pricing impact, suggesting that AT does not primarily trade on private information. Together, our findings do not support the need for regulatory actions to reduce AT. Our paper proceeds as follows. Section 2 introduces data and preliminary

results. Section 3 outlines methodology and presents empirical findings. Section 4 concludes the paper.

Market Structure, Data, And Preliminary Analysis

Austria's sole securities exchange is run by the Vienna Stock Exchange (VSE), one of the oldest exchanges in the world. Using the Xetra® platform, which is also utilised by the exchanges in Germany and Ireland, trading is conducted as an electronic open limit order book. A call auction signals the beginning and end of the ongoing trading session. At noon, a third call auction is held. Stocks listed on the prime market, the top division of the VSE, have one specialist in addition to potentially having one or more authorised market makers, which is the case. Minimum depth, maximum spread, and quote responsibilities apply to specialists and market makers. Compared to market makers, specialists are subject to stricter requirements. 2 Twenty equities make up our sample, which spans 52 months (September 2011 to December 2015). The sample stocks are all listed on the primary market and are almost exact replicas of the component stocks that make up the Austrian benchmark index ATX. In trading ATX member equities over our sample period, the VSE had an average daily market share of around 70% (with a standard variation of 5.5%). As a result, most of the trading in the sample stocks is covered by our sample. So, compared to most other established markets, cross-market trading is less of a problem in the Austrian market.

1.1 Algorithmic trading data

The Austrian Financial Market Authority requested that the VSE compel its members to designate their accounts as either AT or non-AT accounts starting in 2011. Every trading carried out through an account that has been designated "AT" is algorithmic. From 2011 to 2015, the VSE reported the market share of AT for each stock and every day on its website based on this classification. The obligation for reporting did not apply to designated market makers and specialists, who collectively account for about 25–30% of all trading on the VSE⁴. Thus, their trading activity is not included in AT. The sample stocks' descriptive data are shown in Table 1. A market capitalisation of €3.15 billion is the average. A trading day typically has 534 transactions, resulting in an average daily turnover of €626,500. The gap between the means and medians indicates that market capitalisation and turnover are skewed. The final line displays AT's share of total trading volume. In general, it amounts to 17.3%. This percentage is less than that reported for other markets (see, for instance, Brogaard et al., 2014, who reported a 27.7% AT market share for their mid-sized stocks, a sample that is equivalent to ours in terms of market capitalization). As was stated before, however, trades made by market makers and specialists are not included in our sample's definition of AT.

Table 1: Summary statistics - market characteristics

Variable	Unit	Mean	Std. dev.	Median	Q1	Q3
Market cap.	10 ⁶ EUR	3151.2	2475.3	2256.8	1465.4	4477.6
Return	%	-0.005	0.035	-0.005	-0.022	0.013
Std. dev. of return	%	1.873	0.507	1.734	1.604	2.128
Turnover value	10 ³ EUR	626.5	1055.9	316.1	95.1	655.7
Number of trades	1	533.7	440.4	389.8	226.8	781.9
Trading volume	10 ³ #	8374.2	8990.9	4506.7	2707.8	13050.7
Proportion of algo trading	%	17.3	3.7	16.8	15.0	20.2

Source: Vienna Stock Exchange and <https://www.cboe.com/>

1.2 Data on market liquidity

To create common indicators of liquidity, we use trade and quote data from the Vienna Stock Exchange. We use the relative change in the quote midpoint from the time of the trade to 60 seconds after the trade, multiplied by +1 [-1] for buyer-initiated [seller-initiated] trades, and the percentage 1-minute price impact. We also use the percentage quoted spread, the percentage effective spread, the quoted depth in euros, and the quoted depth in dollars. The adverse selection cost is measured by the price impact. We compute transaction-size weighted averages of the effective spreads and price impacts, as well as time-weighted averages of the quoted spreads and depths, to produce daily values.

Methodology, Results and Discussion

Our findings are presented in two stages. We give correlations and OLS estimates in the first step while ignoring the endogeneity problem. In the second phase, we directly address the endogeneity question by using an instrumental variables method. Neglecting endogeneity, The equal-weighted cross-sectional mean and

median are taken into consideration after computing time-series correlations between the AT share and our four liquidity metrics for each stock. We discover that the proportion of daily AT is significantly negatively correlated with the relative quoted spread (mean -0.10; median -0.06), the relative effective spread (mean -0.16; median -0.14), and the relative 1-minute price impact, just like Hendershott, Jones, and Menkveld (2011) and Aggarwal and Thomas (2014). (Mean -0.11; median -0.10). According to the negative correlations, spreads and price impacts are less on days when algorithmic trading is more prevalent. Although it is substantially smaller in scale, the association between algorithmic trading and average Euro depth is negative (mean: -0.04; median: -0.03). Then, we calculate a panel regression with fixed effects of the following:

$$LIQ_{it} = \mu_i + \alpha \cdot AT_{it} + \beta \cdot X_{it} + \varepsilon_{it}$$

One of our liquidity indicators for stock on day, LIQ_{it} , stands for relative AT market share, stock fixed effects, and a vector of control factors. We incorporate return volatility (calculated from 5-minute midpoint fluctuations), log share turnover, log market capitalization, the inverse of the closing stock price, and the lagged market liquidity measure, and we follow Hendershott, Jones and Menkveld (2011) and Boehmer, Fong and Wu (2015). Daily frequencies apply to all variables. The data are clustered along the stock and time dimensions to produce robust standard errors. We re-estimate the model after minorizing the data at the 1% and 99% percentiles to test for robustness. The findings were left out since they are quite like those that are detailed below.

Table 2: Algorithmic trading and market liquidity: OLS estimates

Table : Algorithmic trading and market liquidity: OLS estimates

Variable	RQS		RES		RPI ^{1min}		DEP	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
algo_volume_prop	-3.82E-04**	-4.97	-1.40E-03**	-12.48	-5.11E-04**	-8.98	-4.11E-04**	-5.31
midpoint_vola_5min	7.98E+01**	17.81	1.30E+02**	19.19	1.02E+02**	19.12	-1.95E+01**	-7.58
log(turnover)	-3.43E-04**	-24.98	-3.77E-04**	-19.17	-8.44E-05**	-9.12	2.04E-04**	7.04
log(market cap.)	-3.92E-04**	-12.56	-5.42E-04**	-11.85	-1.02E-04**	-3.29	-1.36E-05	-0.30
1/close_price	2.05E-03**	7.19	3.14E-03**	7.42	1.83E-03**	6.86	-2.59E-03**	-4.37
LIQ_lag1	5.21E-01**	42.37	2.82E-01**	23.95	1.01E-01**	9.94	5.10E-01**	4.26
Adj. R-Squared	0.4839		0.2666		0.2592		0.2859	
F-statistic (p-value)	3335.37 (< 2.2e-16)		1295.89 (< 2.2e-16)		1247.31 (< 2.2e-16)		1426.63 (< 2.2e-16)	

It is clearly evitable from Table 2 above that the obtained values as a part of correlation study match with the table values. In all four models, the AT share coefficient is negative and statistically significant, suggesting that a larger AT share is linked to lower quoted and effective spreads, a smaller price impact, but also lower depth. These findings are consistent with algorithmic traders placing modest limit orders at reasonable costs, helping to reduce depth while simultaneously cutting spreads. The control variable coefficients are consistent with predictions. Significant first-order serial correlation is present for all four market liquidity measures. Higher spreads, greater price effect, and less depth are all indicators of increased volatility. On days with more turnover, spreads are narrower and depth is greater. Market capitalization is experiencing a decline in spreads and price repercussions. The daily closing price's inverse has positive correlations with spread and price effect measures and negative correlations with depth, suggesting that higher price levels are linked to greater liquidity.

Conclusion

This study has focused on the impact of algorithmic trading on liquidity. This study has contributed by providing a number of new ideas to the field. The data set has been used which a classification of traders has been used as the basis for measuring the market share of algorithmic traders. It covers a period of 52 months, making it significantly longer than the data sets used in the majority of earlier investigations. Our data originates from the Austrian stock market, which has not previously been studied. We thus offer extrapolative data. We use an instrumental variables technique to solve the endogeneity problem. Our findings show that a rise in algorithmic trading's market share results in a decrease in quoted and effective spreads, but not in

quoted depth or price impacts (a measure of unfavourable selection costs). Our findings do not support the use of regulatory measures to limit algorithmic trading.

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Human Rights Education in India

Amritpal Singh

UG Student, University School of Law, Sri Guru Granth Sahib World University, Fatehgarh Sahib
singh1999amrit@gmail.com

Abstract

There is a growing consensus that education in and for human rights is essential and can contribute to both the reduction of human rights violations and the building of free, just and peaceful societies. Human rights education is also increasingly recognized as an effective strategy to prevent human rights abuses. Human Rights Education is a process that basically deals with a cognitive and moral transformation, a shaping of one's consciousness, and conscience which in turn, leads to change in one's feelings, thinking and understanding, behavior patterns, attitudes and activities, etc.¹ Human Rights are those inalienable rights given to the individuals of the world which are prevailing in our society and are protected and promoted by the State. In their fundamental constitution human rights are basic and unalienable rights available to all the individuals of a given society. It is difficult to conceive human life in their absence. Human rights are the birthright of every human being. The only pre-condition for acquisition of human rights is that one should be born a human. Human rights are also essential for the fullest and optimum development of the human potentialities because in their absence a man would be reduced to the level of animals. Human Rights are universal and same. They are bestowed without any consideration of caste, creed or religion.

Introduction

The rights of man have been the concern of all ages and all times. Human beings have always been conscious of the notion of fundamental rights. This consciousness may have not been definitive and well defined yet there has been no age in the evolution of human societies that has not shown concern for the rights of man. There are conspicuous references to the rights of man in ancient Indian scriptures.² Even in the Middle East, the Babylonian laws, the Assyrian laws and the little laws upheld the rights of man. Similarly, the notion of Dharma incorporates within itself the importance of preservation of the rights of man. There is evidence that in the jurisprudence of Lao-Tze and Confucius there were elements that promoted preservation of human rights. The Stoics of Greeks also developed a theory of Natural Law with its basis in the idea of human rights as far back as 200 to 300 BC. There is ample evidence to suggest that human rights have remained an integral part of ancient Indian thought. The rights of man or human rights have been given prime importance in almost all forms of Indian historical tradition and culture. Thus, it will be wrong to say that the idea of human rights originated in the west. It is equally wrong to assert that the principle of human rights is a recent phenomenon and as has been said in the beginning the principles may have acquired a definitive and well defined form in the present times. But the concern for human rights is as old history.

Irrespective of place and time the protection of human beings from all possible forms of exploitation and abuse has occupied an important place in religious, traditional and philosophical discourses. Different philosophers and thinkers have affirmed the importance of preserving the basic dignity of human being and curbing exploitative systems and mechanisms. Human history is replete with instances where man has forfeited the rights of man. This forfeiture has had different manifestations like illegitimate rule, unnatural control or denial of rights. With the evolution of the socio-economic order the possibilities of exploitation and denial of rights have not only multiplied but also become intractable.

The Preamble, Fundamental Rights, Directive Principles of State Policy, newly added Fundamental Duties, reservation for scheduled castes and tribes, special provisions for Anglo-Indians and other backward classes, are important constitutional provisions from the human rights point of view. With the introduction of these rights and duties human rights became integral to social and political life in India. The incorporation of human rights in the Indian constitution was in line with similar provisions in the various international conventions, covenants and treaties, such as Universal Declaration of Human Rights, 1948, the International Covenant on Economic, Social and Cultural Rights, 1966 etc. The Constitution also provides for the functional and pragmatic enforcement. Articles 32 and 226 of the Indian Constitution have adequate provisions for the enforcement of fundamental rights as well as other legal rights of the individuals through judicial means.

Education Policy and Human Rights Education in India

The theme of human rights has dominated the formulation of educational policy in India to the extent that all the Commissions and Committees on education well as the policy documents emphasized on human development and social justice.

The recommendations of the three major Education Commissions contained the human rights perspective.

- a) University Education Commission (Radhakrishnan Commission report 1949)
- b) Secondary Education Commission (Mudaliar Commission Report 1952)
- c) Education Commission, (D S Kothari Report 1964-66)

The first National Policy Resolution passed by the Parliament in 1968 was based on the recommendations of the above mentioned Commissions. Some of the major recommendations of the Policy relevant to human rights perspective are:

- I. The Radhakrishnan Commission Report recommended a large number of scholarships, to make it possible for boys and girls with limited resources to pursue higher education.
- II. In the first-degree stage, every university should do its utmost to offer as wide a variety of courses as possible in the near vicinity of homes.
- III. Admissions should not be denied to people, who have been hitherto excluded by their social position or residence. The social cleavage between the rich and poor should not be emphasized.
- IV. It was also recommended that no discrimination should be made because of race, religion, regionalism, language and politics in hostels.
- V. In colleges where a considerable proportion of the students are poor or are living on slender resources, the noon meal would be furnished to students who are non-resident.
- VI. Students should be admitted to hostels strictly on a basis of priority or other desirable impersonal grounds. No discrimination should be made in race, religion, regionalism, language and politics.

The Report of Education Commission (1964-66), which is more emphatic with respect to equality and social justice, states one of the functions of the universities as 'to strive to promote equality and social justice and to reduce social and cultural differences through diffusion of education. It shows that education has always seen a means of social transformation."

Sikri Committee on Human Rights Education, 1980

Since a person is most sensitive and receptive towards the inculcation of human values and development of positive attitudes towards people at a young age, education at all levels was considered to be the most effective medium for the promotion and propagation of human rights. In a highly significant and momentous intervention in the field of human rights education the University Grants Commission (UGC) Constituted a Committee under the chairmanship of Justice S. M. Sikri in 1980. The committee was entrusted with the responsibility of suggesting ways and means through which human rights education could be promoted and disseminated in India. Thus the Committee submitted its report titled 'Blueprint for Promotion of Human Rights in India at All Levels' in 1983. This report suggested a blueprint for teaching human rights in schools, colleges, and universities and in adult and continuing educational centers.ⁱ This Blueprint consisted of proposals for comprehensive and broad based reformulation and restructuring of syllabi and introduction of courses providing elementary education in human rights. Human Rights Education according to the provisions of the committee was to be made essential at under-graduate, graduate levels in both professional and non-professional courses.ⁱⁱ The committee in its report suggested different approaches at different levels of education. At primary level, recommendations were made to impart human rights education through general and non-technical methods like short stories and exhibition of visual material. A more direct approach was to be followed at the higher level. The committee suggested that at higher levels books and lessons on human rights values should be made an integral part of the teaching learning process. The committee felt that even graduate students in science, commerce, medicine and engineering should be exposed to certain perspectives of human rights. Although the Sikri Committee Report was tabled in the year 1980, no effective action was initiated in its wake. The report was sent to all the important bodies governing the system of education in India like UGC, NCERT and all the major universities. An attempt to introduce human rights teaching in all universities was made in 1985 when a national symposium was organized by the Human Rights Centre of the Jawaharlal Nehru University, New Delhi, with support of the UNESCO and the UGC. The Symposium was highly successful. The deliberations of the symposium were aimed at making human rights education and teaching of human rights an inseparable part of the curriculum in schools, colleges and universities. The recommendations of this symposium were sent to all the major universities and educational institutions. The symposium placed special emphasis on the role of University Grants Commission in the promotion of human rights education in the sphere of higher education.ⁱⁱⁱ

Institutional Mechanism For Human Rights Education In India

➤ National Human Rights Commission (Nhrc)

The National Human Rights Commission of India was established under the Protection of Human Rights Act, 1993 (PHR Act) enacted 'for better protection of human rights',^{iv} the PHR Act defines human rights as, 'the

rights relating to life, liberty, equality and dignity of the individual guaranteed by the Constitution or embodied in the International Covenants^v and enforceable by court in India'.^{vi} The NHRC of India was first such commission to be constituted in South Asian region; its formation was essentially a consequence of mounting international pressure and criticism of the government's apathy towards human rights issues.^{vii}

Besides, dealing with the complaints of violation of Human Rights, the NHRC also worked for the promotion of Human Rights Education. In this context National Human Rights Commission in collaboration with the NCERT brought out a Source Book on Human Rights in 1996. The source book is prepared for the promotion of Human Rights Education in the country at School level and Dossiers on Human Rights Education for Beginners (2005) for college and University level. Further, NHRC recommended Modules on Human Rights Education for Teaching Professionals for Primary, Secondary and Higher Secondary levels (2007) and National Curriculum Framework for University Students on Human Rights Education.

National Commission for Women

The National Commission for Women was constituted on January 31, 1992 as a statutory body at the national level, in pursuance of the National Commission for Women Act, 1990 to safeguard the interests of women.^{viii}

Under Section 10(1) (h) of the National Commission for Women Act, 1990, the Commission is required to undertake promotional and educational research so as to suggest ways of ensuring due representation of women in all spheres and identify factors responsible for impeding their advancement. In this regard, the Commission has promoted several seminars, public hearings, workshops and research studies in order to obtain relevant inputs on subjects considered of highest priority on issues related to gender equality and empowerment.^{ix} These activities of the Commission help to promote Human Rights Education specially issues relating to women.

National Commission For Minorities (Ncm)

The Minorities Commission which was set up in January 1978 by a Resolution issued by Ministry of Home Affairs, Government of India became a statutory body with the enactment of the National Commission for Minorities Act, 1992 and renamed as National Commission for Minorities. The first Statutory National Commission was set up on May 17, 1993. Vide a Gazette notification issued on 23 October 1993 by Ministry of Welfare, Government of India, five religious communities viz; the Muslims, Christians, Sikhs, Buddhists and Zoroastrians (Parsis) were notified as minority communities.^x

The main functions of the National Commission for Minorities (NCM) are to monitor the implementation of the Constitutional and legal safeguards provided to the five notified religious communities by the Union and State Governments, to make recommendations to them to ensure effective implementation and enforcement of such safeguards and to look into specific complaints regarding deprivation of such safeguards. Besides these mandatory functions, National Commission for minorities Act, 1993 also makes specific provisions to further human rights education with regard to minorities in India. Section 9(e) and (f) of the Act require Commission to cause studies to be undertaken into problems arising out of any discrimination against Minorities and recommend measures for their removal and to conduct studies, research and analysis on the issues relating to socio-economic and educational development of Minorities.^{xi}

Indian Institute of Human Rights

In order to fulfill the urgent need for the establishment of a national level institution for studies, training, research, publication, conference organization and consultancy in the field of human rights and civil liberties, the Indian Institute of Human Rights was established in March 1990 as a constituent unit of the World Institution Building Programme (WIBP), an International Charity as a Public Charitable Trust at New Delhi. The WIBP decided to accord autonomy to the Indian Institute of Human Rights by advising to get the co-sponsorship of different Universities for launching need based programmes at Bachelor's, Master's as well as Doctoral levels. Accordingly selected Universities in India were contacted by the functionaries and authorities of the Indian Institute of Human Rights inviting them to co-sponsor the birth of IIHR and for registering the IIHR Trust. The Indian institute of Human Rights conducts a two year Post Graduate Programme in Human Rights through correspondence. The admissions for the two years Post Graduate Diploma Programme in Human Rights commences every year for June and December sessions for all such persons who have successfully obtained their Bachelor's Degree or an equivalent qualification in any discipline. The Institute provides 20 volume set on human rights in a span of two years to its students for studying the various facets of human rights.^{xii}

Institute Of Human Rights Education

The Institute of Human Rights Education (IHRE), headquartered in Madurai, Tamil Nadu was set up with the vision of building human rights culture in our society through education.

An experiment started in 1997 in a few schools of Tamil Nadu during the UN Decade for Human Rights Education (1995-2004) has expanded to a National Programme of significance. Today it is part of the United Nations World Programme for Human Rights Education.

The Programme was confined to Tamil Nadu from 1997 to 2005, offered mainly in about 300 SC/ST schools run by the Govt. of Tamil Nadu and about 250 aided and private schools. Since, 2005 it has expanded to other states Odisha, West Bengal, Rajasthan, Tripura, Bihar, Gujarat, Chhattisgarh, Andhra Pradesh, Karnataka, Kerala, Assam, Meghalaya, Arunachal Pradesh, Mizoram, Manipur and Nagaland. The Programme is commencing in Maharashtra, Uttar Pradesh from 2010.

Initiatives For Development Of Human Rights Education At International Level

With regard to the vital role played by the human rights education in the realization of human rights the International Community responded very positively and promptly after the Second World War. Various International and Regional Instruments, Treaties, Covenants, Conventions And Protocols; Charters; Declarations; Recommendations; Decisions; Resolutions; Principles; Guidelines; Rules; Final Documents; Commitments; And Conclusions Or Joint Communiqués Of Intergovernmental Meetings, Congresses and Conferences and documents dealing with human rights education substantiate the consensus of the international community towards adherence of human rights education in their respective countries. Though these documents differ in legal status but collectively these texts delineate the human rights education commitments made by States in the context of international and regional intergovernmental forums, and provide the basis for the right to human rights education. For the purpose of the study, following major initiatives for the development of human rights education at the international level has been taken into account.

Universal Declaration of Human Rights

The Universal Declaration of Human Rights is the first international recognized and acclaimed formulation of the ideals of human rights for the global community. The document is as momentous in its historical significance as Magna Carta or American Declaration of Independence. It is the first concrete step in the direction of universal development of the concepts of human rights and human rights education. It was drafted by representatives from different legal and cultural backgrounds from all the regions of the world and proclaimed by the United Nations General Assembly on December 10, 1948 in Paris through General Assembly Resolution 217(III)A. Citing the importance of this declaration the General Assembly of United Nations proclaimed that,

This declaration of human rights is a common standard of achievement for all peoples and all nations. To this end every individual and every organ of society, keeping this Declaration constantly in mind, shall strive by teaching and education to promote respect for these rights and freedoms and by progressive measures at national and international level, to secure their universal and effective recognition and observance, both among the peoples of Member States themselves and among the peoples of territories under their jurisdiction.^{xiii}

The Universal Declaration of Human Rights, 1948 introduced Human Rights Education for the first time indicating in its Article 26(2). The excerpt of the Article is as following:

Education shall be directed to the full development of the human personality and to the strengthening of respect for human rights and fundamental freedoms. It shall promote understanding, tolerance and friendship among all nations, racial and social groups, and shall further the activities of the United Nations for the maintenance of peace.^{xiv}

United Nations Educational, Scientific And Cultural Organizations (UNESCO)

UNESCO's commitment to the promotion of education for human rights can be traced back to 1948, the year of the adoption of the Universal Declaration of Human Rights. However, it was in 1974 that its involvement with human rights education was concretized most visibly with the adoption of UNESCO's own Recommendations concerning Education for International Understanding, Cooperation and Peace and Education relating to Human Rights and Fundamental Freedoms. It called for the insertion of human rights into various levels of education and for the encouragement of action to ensure the exercise and observance of human rights, including those of refugees; fight against racialism and efforts at its eradication; the fight against discrimination in its various forms'.

Peoples Decade On Human Rights Education (PDHRE)

The organizing committee of the Peoples decade of Human Rights Education (PDHRE) is a popular and global initiative that has played a unique role in the advancement of human rights education. Through the efforts of the committee, developments over the past 5 to 7 years have resulted in the worldwide network of

human rights education and activists collaborating to educate various audiences about human rights education. The design and dissemination of methodologies and materials suited to particular audiences and the preparation of trainers and facilitators to serve the needs of various group and regimes is one of the main objectives.

Conclusion

The present study with its focus on human rights and human rights education has its basis in the premises that respect to and realisation of human rights requires evolving a culture that is sensitive to the basic needs of every human being. The social realities would acquire congeniality if it is made sure that everyone is guaranteed social, economic and political justice. It is equally important to provide fair and equal opportunities for growth and development to every individual and group of people residing in a society. It is a widely accepted principle that the goal of evolving human rights culture requires existence of widespread awareness among the common people particularly the vulnerable group. It is equally important to impart capabilities which are helpful in protecting and safeguarding basic rights. All the sections of the society without any distinction of caste, religion, age or gender need to develop a proper perspective about human rights. All the sections of the society need to be educated and sensitized to human concerns. In its fundamental sense Human Rights Education is a process of passing on the information, knowledge, understanding and awareness about human rights. The present work - delimited to the study of Human Rights Education in India has been carried out as a serious attempt to understand and analyze the nature and extent of the progress of Human Rights Education in India in the period of the study.

There is a growing consensus in the world community that education in and for human rights is essential and can contribute to both the reduction of human rights violations and the building of free, just and peaceful societies. Human rights education has been globally recognized as an effective strategy to prevent and preempt human rights abuses. The increasing relevance of human rights education lies in its ability to not only provide knowledge about human rights and the mechanisms that protect them, but also in its utility in promoting, defending and implementation of human rights in daily life. Moreover, human rights education fosters the attitudes and behaviors needed to uphold human rights for all members of society.

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Juvenile Justice System in India: A Critical Analysis

Pratibha

Assistant Professor, Law, Sri Guru Granth Sahib World University, Fatehgarh Sahib

pratibhasainsaith@gmail.com

Abstract

The world's citizens have welcomed the juvenile justice system as the most vibrant and illuminating framework for the holistic development of children. The main focus should be on reforming the corrupt and caring for the defenceless children. A child should be restored to the family and given the best chance of rehabilitation, if possible. The paper evaluated India's juvenile justice system in light of international standards and protected reasoning. By way of distinction, John Locke maintains that the human identity starts out as a "white paper, devoid of any characters and without any thought." According to this perspective, each "material of reason and learning" actually begins at the beginning. Locke undoubtedly targeted Descartes and the Cartesians in particular when he forbade the teaching of intrinsic considerations. It also suggests abandoning the Platonic notion that knowledge is a memory of Forms that are undeniably known. A few modern experts on mental evolution found Locke's enormous impelling or Plato's or Descartes' forceful occupants to be utterly agreeable. Youth is a fundamentally developing state, according to what we have named the "Aristotelian start." According to this viewpoint, it is not necessary for a child's evaluation to be exceptional in it but rather beneficial for assisting the child in developing into a respectable adult. A possible antidote to this craving is some childish workmanship. The paper tries to discuss about the provisions of Juvenile Justice Act, 2015 and the Lacunae appearing in the above mentioned act.¹

Keywords: Children's Rights, Juvenile Justice System, Constitutional Law.

1. Introduction

The Nehru quote is spot on: "Children are recognised across the world as the highest assets of the state and must be nurtured and protected." In order to achieve its goal of creating a wholesome and healthy society, India's Constitution has given children numerous rights, including protection against various forms of exploitation and abuse as well as rights to education, religious freedom, and cultural and intellectual growth. Due to factors like poverty, broken families, improper upbringing, and lack of parental supervision, India has a large population of street children. If these children are prosecuted and punished like adults at such a young age, there is a risk that they will develop into seasoned criminals, so they need to receive special protection and care because the future of the nation depends on their success.

Juvenile offenders have been much more prevalent over the past few years. Additionally, there has been a significant rise in the number of crimes committed by minors under the age of 16. The National Crime Records Bureau reports that in 2011, juveniles were the victims of 23, 25,575 IPC offences. In 2015, it increased gradually to 29, 49,400.² The child's rearing environment, the economy, lack of education, and parental care and control may all be contributing factors to the rising crime rate. These are just a few of the fundamental causes behind the rise in youth criminality. The most depressing aspect of it is that kids these days, especially those between the ages of 5 and 7, are exploited as tools for crime since their minds are still very immature and naive, making them easy to control.

2. Concept of Child

A person who has not reached the age of eighteen and is not mature enough to discern what is right and wrong is generally referred to as a "child." In the modern era, the penal laws of the majority of nations have embraced the intent to conduct a crime or tort, particularly due to age. The penal code also specifies that only children between the ages of seven and twelve can be found guilty, provided that the act they committed was heinous or serious and that they had the knowledge and acquired the necessary knowledge to comprehend the circumstances surrounding the act and its repercussions.

The Indian Penal Code (IPC) 1860 finds that no youthful underneath the age of seven may be considered criminally in charge of advancement (Sec 82 IPC). By uprightness of mental impediment or frailty to fathom the after effects of one's exercises the criminal obligation age is raised to twelve years (Sec 83 IPC). A young woman must be no under sixteen years remembering the deciding objective to give sexual consent, unless she is

¹ Pratibha, Assistant professor, Swami devi dyal law college, barwala, Haryana.

² <https://citizenmatters.in/ncrb-juvenile-crime-records-delhi-policing-police-policy-31663#:~:text=Across%20the%20country%2C%20a%20total,16%20to%2018%20age%20group.>

hitched, in which case the reinforced age is no less than fifteen. Regarding security against finding, getting, and related offenses the given age is sixteen for energetic associates and eighteen for young women.³

According to the Juvenile Justice (Care and Protection) Act of 2015's section 2(12), a "child" is defined as a person who is under the age of 18 years old. The Juvenile Justice (Care and Protection) Act of 2015 distinguishes between "kid in dispute with the law" and "child in need of care and protection."

The Child Labor (Prohibition and Regulation) Act, 1986 defines a child as a man who has not completed fourteen years of age. The Factories Act, 1948 and Plantation Labor Act 1951 states that a child is one that has not completed fifteen years of age and a juvenile is one who has completed fifteen years of age yet has not completed eighteen years of age. According to the Factories Act, young people are allowed to work in handling plants the length of they are regarded therapeutically fit yet may not for more than four and half hours a day.⁴ In general, a child who is accused of committing or proven to have committed a crime and who was under the age of 18 on the date the crime was committed is referred to as a "kid in confrontation with the law." The "child in need of care and protection" category, which is broken into 12 groups, is the second category of children.

The Motor Transport Workers Act 1961, and The Beedi and Cigar Workers (Conditions of Employment) Act 1966, both portray a child as a man who has not completed fifteenth years and fourteenth years of age respectively.⁵ The Merchant Shipping Act, 1958 and Apprentices Act, 1961 don't describe a youth, yet in acquirements of the acting state that a child underneath fourteen is not permitted to work in occupations of the appear.⁶ The Mines Act, 1952 is the significant trade-related act that depicts an adult as a man who has completed eighteen years of age (thusly a child is a man who has not completed eighteen years of age).⁷

UNCRC : – According to the 1989 UN Convention on the Rights of the Child, a "child" is any human being who has not reached the age of eighteen, unless the child's legal majority is reached earlier.

3. Historical background of Juvenile Justice System in India

There is currently a global trend to treat young criminals differently, including in many affluent nations like the United Kingdom and the United States. The 18th century saw the start of this movement. Before this, juvenile offenders received the same treatment as other criminal offenders. On November 20, 1989, the United Nations General Assembly adopted the Convention on the Rights of the Child. The goal of this treaty is to safeguard the interests of young offenders. According to the Convention, juveniles cannot be the subject of legal proceedings or court trials in order to protect their ability to reintegrate into society. The Juvenile Justice Act of 1986 may be repealed and replaced by a new law under the terms of this convention. As per The Juvenile Justice Act, 1986, the age for a female to be treated as juvenile was 18 years and that of a male was 16 years. Also, apart from the need for a uniform Act regarding children, the Juvenile Justice Act, 1986 was a result of *Sheela Barse v. Union of India*, 1986 (2) Scale 1.⁸

Since, there were few grey areas where this new Act was silent and not expressive in dealing with certain issues most importantly determining the age of a juvenile offender, the landmark judgment of the Hon'ble Supreme Court of India by a Constitutional Bench in the case titled as *Partap Singh v. State of Jharkhand*, 2005(3) SCC 551. was pronounced addressing this issue in detail and held that "reckoning date for the determination of the age of the juvenile is the date of an offence and not the date when he is produced before the authority or in the Court". Thus, in light of the above decision by the Hon'ble Apex Court, the law pertaining this issue was amended.⁹

The Juvenile Justice (Care and Protection of Children) Act, 2000, is a new piece of legislation on this subject that was developed by the Indian Legislature.

³ Section 82 and 83 of the Indian Penal Code, 1860

⁴ Shreyansh Chouradia (2012), Child Labour: The Burning Predicament In The World, Legal Service of India, <http://www.legalserviceindia.com/article/I216-Child-Labour.html> /Accessed 20th July, 2016

⁵ The Motor Transport Workers Act 1961, and The Beedi and Cigar Workers (Conditions of Employment) Act 1966

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[1/Article28.htm?AspxAutoDetectCookieSupport=1#:~:text=INDIAN%20JUVENILE%20JUSTICE%20SYSTEM%20HISTORICAL,in%20their%20rehabilitation%20and%20reformation](https://www.lawfinderlive.com/Articles-1/Article28.htm?AspxAutoDetectCookieSupport=1#:~:text=INDIAN%20JUVENILE%20JUSTICE%20SYSTEM%20HISTORICAL,in%20their%20rehabilitation%20and%20reformation)

The Standard Minimum Rules for the Administration of Juvenile Justice, adopted by the U.N. countries in November 1985, were intended to be put into practise by the Juvenile Justice, 1986, which replaced the earlier Children Act, 1960. The aforementioned Act, which applied to all of India except for the State of Jammu and Kashmir, included 63 Sections and 7 Chapters. The Act's main goal was to provide neglected young offenders with care, protection, therapy, development, and rehabilitation.

The main objectives of the Act were:-

1. The Act basically laid down uniform framework for the juvenile justice in the country in such a way that it protects the rights and interests of juvenile.
2. It talks about the machinery and infra – structure for the care, protection, treatment, development and rehabilitation of the juvenile offenders.
3. It sets out the basic provisions for the proper and fair administration of criminal justice in case of heinous crime done by juvenile offenders.

At present, the Juvenile Justice (care and protection of children) Act, 2015 is in force for dealing with the matters related to the child in conflict with law and child in need of care and protection.

4. Debate on the Juvenile Justice Act of 2015

The horrific and brutal episode of the Delhi gang rape in December 2012 sparked a number of discussions on the sufficiency or deterrent power of the juvenile justice act of 2000. The involvement of the juvenile offender, who was just six months away from becoming an adult, was consequently the main problem among these. Due to the fact that this was governed by the Juvenile Justice (care and protection) Act of 2000, the criminal received just a three-year prison sentence from the court. Many rallies were organised in response to this Apex Court ruling, calling for changes to the current Juvenile Justice Law¹⁰.

Several notable changes to the current juvenile law have been made since The New Juvenile Justice (care and Protection of Children) was enacted in 2015. One of these significant changes is that adolescents between the ages of sixteen and eighteen will now be treated as adults. Additionally, those who have reached the age of 21 while serving a sentence are sent to jail for the duration of the term. However, the Juvenile Justice Board makes these decisions.¹¹

Lacunae in the JJA, 2015

Clause 7 of the JJ Bill, 2014, as it was presented to the Lok Sabha, was clearly unconstitutional because it said that those who were arrested after becoming 18 for an offence they committed before turning 18 would be tried as adults. Article 20 of the Constitution, which states in the clearest possible words that no one may "be subjected to a penalty greater than that which may have been inflicted under the legislation in existence at the time of the conduct of the offence," was directly at odds with this provision. Thankfully, the government removed this clause before the Lok Sabha approved it. However, it still has clauses that are in contravention to the right of equality guaranteed by the Constitution.

Although it does not define a child, Article 15 (3) of the Indian Constitution enables special legislation for children. Children under the age of 14 may not be employed in factories, mines, or other hazardous jobs, as stated in Article 24. Chapter 21 Children between the ages of 6 and 14 are the only ones who can secure the fundamental right to an obligatory and free elementary education. Articles 39(e) and (f), which strive to ensure that young children are not abused and are given the chance and resources to develop in a healthy way, in conditions of freedom, and with dignity, do not mention any particular age range. Children under the age of six must receive early childhood care, according to Article 45. India committed to conforming the definition of a child for all purposes to the CRC's requirements when it signed the convention in December 1992. Children are defined as everyone under the age of 18 in Article 1 of the CRC, unless majority is reached earlier in that nation.

The JJA, 2000 was put into effect expressly to meet this commitment of India by raising the age of juvenility for boys from 16 to 18 years old as girls were already covered by the previous law, the JJA, 1986, until the age of 18.¹² There is no denying that, despite the CRC duty, India retained the right to choose any age as the cutoff for identifying a child, and if it had felt the need, it could have done so by selecting 16 or lower. The JJA of 2015, however, decided to go with the cutoff age of 18 years for the definition of children while still allowing for the

¹⁰ Bhattacharya S (2000) Juvenile Justice: An Indian Scenario, New Delhi Regency Publications

¹¹ Chowdhary R (2005) Law relating to Juvenile Justice in India, Allahabad, Orient Publishing Company

¹² Sheela Barse v. Union of India, 1986 (2) Scale 1

selective transfer of children who are older than 16 but younger than 18 and who are accused of committing heinous crimes to the adult criminal court to be tried as adults. This provision is in direct contravention of the general comment 10 of the UN CRC Committee which specifically prohibits children below the age of 18 years to be tried as adults and exhorts the countries that have been doing so to abolish such provisions.

India is possibly the first nation to decide to include an exception 15 years after it complied with article 1 of the CRC even though it did not originally include one. There is no denying that India, as a state party to the CRC, is not bound by the general comments, but there is also no denying that India is bound by its own Constitution.

All people, including children, are guaranteed "equality before the law or the equal protection of the laws within the territory of India" according to Article 14 of the Constitution.¹³ It is commonly known that this clause forbade class legislation but allowed allow for fair classification using the nexus test. Any classification is appropriate if the standard for classification has some connection to the Act's goal. The criterion for treating children differently depending on their age and the type of offence must be proven to have a direct connection to the JJA, 2015's goals in order to pass this test.

It was contended before the Supreme Court in *Subramanian Swami v. Union of India*¹⁴ that clubbing all children until the age of 18 years, regardless of their mental capacities and the type of offence they committed, was an over-classification and was not permitted by the Constitution. Reiterating the well-established principle that:¹⁵ Classification or categorization need not be the result of mathematical or arithmetical precision in the similarities of the persons included in a class and there may be differences among the members included within a particular class, the Supreme Court rejected the argument of reading down the provision of the JJA, 2000..

Article 14 will not prohibit such a course of action as long as the categorization's broad characteristics are recognisable and discernible and the categorization is rationally related with the object objectives. By defining "child" as a person under the age of 18, the state has acknowledged that general characteristics of children up to that age are distinguishable and identifiable, and the purpose of this classification is to provide for their care and protection, among other things, as previously noted. Any additional sub classification must therefore be logically related to the same objects. The provisions relating to the transfer of 16–18 year old children alleged to have committed a heinous crime to an adult court fail the test of reasonable classification inherent in article 14 of the Constitution because the object of this sub-classification is in no way related to the objects of the JJA, 2015. In the future, we will see the arbitrary decisions that will lead to genuine cases of child transfer because there is no scientific method for judging whether the crime was committed with a childish or adult mind. It is further submitted that after defining children as those who have not completed the age of 18 years, exclusion of 16-18 years old to be tried as adults is also against article 15(3) which permits special legislations only 'for' children and not 'against' them.

Conclusion

States have firmly believed for more than a century that the juvenile justice system may be used to safeguard the public by establishing a system that responds to crimes committed by children who are growing up and becoming adults. States understand that juvenile offenders differ from adult offenders in that they are generally less responsible and more capable of change. States have constructed a juvenile justice system and a different youth-based service delivery system that is available to adults in response to the distinctions. It has been observed that the delinquency rates have dramatically increased in the economies of transitioning nations. The majority of young adults and youngsters in legal trouble have committed.

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¹³ Art. 14 Constitution of India

¹⁴ 2014(4)SCALE305

¹⁵ R.V Kelkar, Criminal Procedure, Sixth Edition, Eastern Book Comp

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Advancements and Challenges in Food Packaging

*Shivangi Jain , ** Dr. Ramandeep Singh

*JRF, School of Business Studies, Punjab Agricultural University, Ludhiana.

** Professor, School of Business Studies, Punjab Agricultural University, Ludhiana.
sheevangi2202@gmail.com

Abstract

Packaging is crucial in promoting food safety, extending shelf life, and ensuring food security. Packaging is a powerful marketing tool that helps brands differentiate their products in the cluttered marketplace and effectively showcase them on store shelves. The packaging industry is experiencing rapid growth, driven by increased demand for processed and packaged foods due to changing consumer lifestyles, global trends, technological advancements, and sustainability issues. As a result, several advancements in food packaging technologies have transformed the packaging industry from mere packaging to a complete experience today. However, growing environmental concerns such as landfill overcrowding, greenhouse gas emissions, litter pollution, and the depletion of finite resources call for a more sustainable approach to food packaging materials. This paper reviews the importance of food packaging in marketing, several advancements in food packaging technology, and challenges associated with the food packaging industry. Despite the growing awareness of biodegradable materials in the food packaging industry, it is currently not feasible to completely replace plastics on a global level due to their high cost of production, inadequate properties, and processing challenges. However, like most technological developments, it is realistic to believe that these issues can be resolved in the future. Therefore, future research should focus on improving the use of current packaging materials as well as developing new biobased packaging materials with enhanced properties at a low cost. Since biodegradable materials have the potential to better address multiple environmental and social issues, they can better contribute to a sustainable environment, economy, and society.

Keywords: Food packaging, marketing tool, biobased packaging, challenges

Introduction

All living organisms require food to sustain their life processes. The fast-growing population, rapid pace of industrialization and changing lifestyles have all contributed to an increase in the demand for processed and packaged foods. In India, the market value of packaged food was estimated at around 4 trillion rupees in 2021 and is expected to exceed 5 trillion rupees in 2025 (Statista 2022). The food packaging industry plays a significant role in the global market and is highly lucrative. The key motive of all the players in the food supply chain is to guarantee the safe and secure delivery of food to end consumers. Food safety has become even more important, particularly after the arrival of COVID-19. People have now started adopting a healthier lifestyle to protect themselves and strengthen their immune systems. In this context, the packaging is crucial in ensuring the quality and safety of food products throughout their transportation, distribution, storage, sale, and use. The primary goal of food packaging is to securely contain food in a manner that meets both the economic needs of the industry and the preferences of consumers. Additionally, it aims to maintain the quality and safety of the food while minimizing its impact on the environment (Sharma and Ghoshal 2018). Food is wasted throughout the entire supply chain. About 14% of the world's food is lost between harvest and the retail market, and 17% is wasted at the retail and consumer levels (FAO 2023). Therefore, food waste is a serious economic, social, and environmental issue. Reducing food wastage is an efficient way to minimize production costs, improve food safety and quality, increase the efficiency of the food system, and move towards an environmentally sustainable food system. Food packaging offers innovative solutions for reducing food waste by extending shelf life, offering appropriate portion sizes, and furnishing complete label information (Brennan et al. 2021). Packaging now serves as a powerful marketing tool rather than just being a container. In a competitive market, firms need innovative solutions to survive and remain competitive in the long term. As a result, packaging and packaging design are now being viewed by companies as an effective strategy for distinguishing their product offerings from that of competitors (Rundh 2012). From a marketing viewpoint, several authors have identified packaging as the fifth "P" of the marketing mix that acts as a brand differentiation tool, a channel of communication, enhances the customer experience, and helps to build brand narrative (Gómez et al. 2015). The objective of this review paper is to present an overview of the various advancements in food packaging technologies and to highlight the challenges that are inherent in the food packaging industry, with a primary focus on environmental concerns. To achieve this, a systematic search of various research papers, review papers, and official websites was conducted using relevant keywords and phrases linked to the topic of interest. The retrieved literature was carefully assessed and synthesized to present the summary of food packaging technologies, associated challenges, and their potential impact on the environment.

Food Packaging as an Important Tool of Marketing

Food packaging safeguards the food against physical, chemical, and biological degradation, thereby preserving its desired quality. Essentially, packaging can be defined as “the wrapping material around a consumer item that serves to contain, identify, describe, protect, display, promote, and otherwise make the product marketable and keep it clean” (Agariya et al. 2012). Packaging has now become a sales promotion tool for business organizations. The first thing that a consumer comes across regarding a product is its packaging (Simmonds and Spence 2017). A powerful brand and appropriate packaging manipulate the customer's mind. Packaging has evolved from merely providing protection and facilitating distribution to serving several other marketing objectives (Rundh 2012).

- Packaging is like a "silent salesperson" that influences the consumer's buying decision (Gómez et al. 2015). Since it is the first thing a customer encounters when browsing store shelves, it captures attention, describes product features, and creates a positive impression on potential buyers.
- Differentiation is the key factor that distinguishes your brand from the competition, and packaging serves as a means of differentiation. To achieve this, the packaging design should be distinctive and reflect the company's theme, allowing for easy identification by consumers (Rundh 2016).
- The significance of packaging has increased with the growing competition for shelf space. Attractive packaging stimulates impulse buying, as most purchases are made at the point of sale (Simmonds and Spence 2017).
- Packaging is incredibly crucial, to the extent that it can be the sole reason for a brand's existence. It conveys the brand identity, image, and product's value, captures attention in commercial settings, and positions the product within a specific category (Gómez et al. 2015 and Rundh 2012).
- The shopping experience has changed as emerging technologies continue to transform the way products are packaged and presented to consumers. Unique packaging plays a critical role in improving the consumer's experience and encouraging repeat purchases.

Advancements in Food Packaging

Changes in demand patterns, industrial production practices, retailing trends, and on-the-go consumer lifestyles are key drivers that influence the evolution of novel food packaging technologies. Food processing industries have embraced these latest technologies to cater to the needs of the modern world.

1. **Active packaging:** Active packaging is a novel strategy that aims to extend the shelf-life of food products while preserving their quality, safety, and integrity. It involves “using packaging systems that can deliberately interact with the food by incorporating components that release or absorb substances into or from the food or its surrounding environment.” This interaction between the packaging material, the food product, and the environment alters the intrinsic conditions of the package.

Table1: Types of Active Packaging (Yildirim et al. 2018)

Type	Benefits
Active scavenging systems (Absorbers)	
• Oxygen scavenger	Prevents discoloration, microbial growth, odor formation, and nutrient loss.
• Moisture scavenger	Controls excess moisture and prevents browning or discoloration
• Ethylene absorber	Improves quality and extends shelf life by reducing ripening and senescence
Active releasing systems (Emitters)	
• Antioxidant releaser	Improves oxidative stability
• Carbon dioxide emitter	Increases microbiological shelf life and reduces headspace volume of modified atmosphere packaging
• Antimicrobial packaging systems	Inhibits or slows bacterial growth, thereby extending shelf life

2. **Intelligent packaging:** According to EFSA, intelligent packaging materials are defined as “materials and articles that monitor the condition of packaged food or the environment surrounding the food”. The focus of intelligent packaging is to monitor food quality in real-time throughout the supply chain, with the aim of preventing food-borne illnesses.

Table.2: Types of Intelligent packaging (Muller and Schmid 2019)

Type	Purpose	Example
• Data carriers	Ensures efficient information flow throughout the supply chain. Guarantees traceability, automation, theft protection, and counterfeit protection	Barcodes, QR codes, and RFID (Radio Frequency Identification) tags
• Indicators	Detect the absence or presence of a specific substance, its concentration, and the extent of reaction among various substances.	Time Temperature, Freshness, and Gas indicators
• Sensors	It is a device that responds to physical or chemical properties by detecting, locating, or measuring energy or matter and providing a signal for detection or measurement.	Gas sensors and Biosensors

3. **Smart packaging:** It offers a complete packaging solution that can monitor changes in a product or its surroundings (intelligent) and respond to those changes accordingly (active). Thus, smart packaging entails the benefits of both active and intelligent packaging. It enables the tracking and tracing of a product during its entire lifecycle. Additionally, it provides the ability to analyze and manage the environment both within and outside the package, thereby informing all the concerned parties about the condition of the product at any given moment. The global smart packaging market is projected to reach \$26.7bn by 2024. Smart packaging incorporates sensor technology and is used to enhance shelf life, monitor freshness, and display quality information. Additionally, smart packaging provides opportunities for businesses based on digitization and aligns with the Industry 4.0 trend (Schaefer and Cheung 2018).
4. **Nanotechnology:** Nanotechnology has revolutionized various scientific and industrial domains, including the food industry. Due to their exceptional properties, nanomaterials have become a subject of great interest in recent times. They are highly suitable for food packaging purposes since they enhance various physical, mechanical, and thermal properties of packaging, such as gas barrier properties, resistance to temperature and humidity, mechanical robustness, and flexibility. Nano-coatings are extensively used to improve food packaging by forming a thin layer or film on the food in order to provide a mass transfer barrier. Another type of nanomaterial used in food packaging is nanoclays, which have low-cost thermal and mechanical barrier properties that improve the physical qualities of packaging. Further, Nanosensors possess significant potential for rapid identification, detection, and quantification of pathogenic microorganisms, chemical contaminants, adulterants, allergenic proteins, and decaying substances (Primožič et al. 2021).
5. **Biobased packaging:** Growing environmental concerns have made it necessary to study biobased materials as an alternative to petrochemical-based packaging applications. These materials are derived from different sources like biomass/natural sources, microorganisms, or biobased monomers and can be biodegradable or compostable at the end of their lifecycle, reducing dependence on fossil-based plastics and potential ocean pollution from microplastics. Considering the non-renewable nature of petroleum-based plastics and their waste disposal issues, the idea of using bioplastics emerged. Bioplastics are made from renewable resources, specifically from agricultural or food sources like starch, cellulose, and proteins, and are safe for use in food applications (Asgher et al. 2020). Presently, bioplastics account for just 1% of the 320 million tonnes of plastic produced every year. Although bioplastics have drawbacks such as high production costs and inadequate mechanical and barrier properties, these limitations can be mitigated through innovative techniques such as blending, chemical or physical modifications, coatings, or nanotechnology. Considering their benefits, it is worth exploring these strategies and conducting further research to enhance their performance (Rahman et al. 2019).
6. **Edible packaging:** Edible packaging refers to a type of packaging that is made from food-grade biopolymers, including proteins, lipids, and polysaccharides. These biopolymers are sourced from a variety of sources, including plants, animals, marine life, and food processing by-products. Edible packaging is increasingly being used in commercial settings to package a range of food products, including fruits, vegetables, dairy products, and meats. It is still in its early stages of development. Researchers have explored the potential benefits of nanotechnology in edible food packaging, such as edible nano-coatings. However, the commercialization of edible packaging is hindered by its limited barrier properties, mechanical strength, and high production costs. So, further research is necessary to

enhance quality and minimize production costs before it can be widely adopted by the industry (Kumar et al. 2022).

Challenges in Food Packaging

The global consumer packaging market is valued at around US\$400 billion and is still growing. Countries like Brazil, Russia, India, and China make up about 30% of the global demand, which is increasing as their economies continue to develop. The packaging market is expected to grow continuously due to increased consumption and the demand for sophisticated packaging. Paperboard is the most widely used packaging material globally, comprising around 33% of the total packaging material consumption followed by flexible and rigid plastics (Statista 2022). Emerging markets have presented both opportunities and threats to the packaging industry due to a challenging macroeconomic environment in recent years. Some of the major challenges followed by the packaging industry are given below:

- Food packaging contributes significantly to environmental issues such as landfill overcrowding, greenhouse gas emissions, litter pollution, and depletion of finite resources. Each packaging material consumes significant resources in its manufacturing, such as water, energy, chemicals, petroleum, minerals, wood, and fibers. Even their production results in huge emissions, wastewater, and toxic contaminants. Most packaging is discarded after use and can end up as a landfill or litter, causing harm to the environment. Plastic packaging in particular does not degrade easily and can release harmful chemicals into the environment. Although recycling can reduce waste, conserve resources, and contribute to mitigating the impact of climate change, it is not sufficient to entirely eliminate the environmental impact of packaging. Globally, only 9% of plastic gets recycled, while 19% is incinerated, 50% ends up in landfills, and 22% is mismanaged (OECD 2022). Therefore, there is a need to replace petroleum-based plastic packaging with biobased packaging materials or responsibly sourced plant-based materials. Using biodegradable polymers can be helpful by utilizing agricultural waste, solving environmental issues related to petroleum-based plastics, and promoting a circular economy (Ncube et al., 2020).
- Another challenge faced by the food packaging industry is the significant surge in packaging prices caused by soaring input costs due to high demand. The packaging prices are going up because the cost of raw materials like paper and aluminium foil has gone up by 70% during the pandemic, and shipping costs to other countries have gone up by five times as well.
- Due to unstable raw material prices, fast-changing technology, and sustainability concerns, it has become imperative for packaging companies to reduce the material used in their production so as to further reduce process waste. To stay competitive, manufacturers have to improve their processes and invest in new technologies and equipment to meet the demand for high-quality packaging. Failing to upgrade outdated equipment in a timely manner leads to decreased competitiveness and flexibility in supply capabilities.
- Changing consumer preferences, on-the-go lifestyles, and new developments have increased demand for personalized, eye-catching, and convenient packaging. Additionally, as consumers become more environmentally conscious, there is a rising demand for sustainable or biodegradable packaging. To stay competitive, packaging companies must upgrade themselves to align with changing consumer needs, which presents another challenge for them.
- Adopting new packaging technologies requires investment in both new capital equipment and training. Packaging companies that fail to invest in the right technologies and capabilities face a competitive disadvantage. However, insufficient credit flow limits the capacity of packaging companies to invest in new technology, equipment, and trained labor. Insufficient funds further hinder their capacity to invest in research and development, which is crucial for long-term growth.

Conclusion

Most brands want to acquire and retain customers, increase brand awareness and loyalty, and lower acquisition costs. However, packaging is often an underutilized strategy for many brands. Innovative food packaging technologies, driven by the global marketing environment and technological advancements, offer new opportunities for the food industry to use these innovations for a better future. In today's world, consumers desire smart packaging that preserves the nutritional value of food without compromising sustainability. Growing environmental awareness has stimulated the global demand for sustainable or biodegradable packaging. Hence, there is a need to develop food packaging materials that guarantee food safety while promoting a low-carbon, circular economy. Although biobased packaging serves as an eco-friendly substitute for petroleum-based plastics, biodegradable polymers currently replace only about 1% of plastics due to their lower performance and higher production costs. Therefore, a more in-depth research is needed to reduce costs, facilitate ease of production and improve the physical, chemical, and thermal properties of biobased packaging

materials. Future research should focus on improving the usage of current packaging materials like nanotechnology, and smart sensors, and the development of new biobased packaging materials with enhanced properties at low cost. Biodegradable polymers have the potential to better utilize agricultural waste, address issues like solid waste management, shortage of fossil fuels, health hazards, and the environmental impact of plastics, and can better contribute to a sustainable environment, economy, and society.

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Role of Social Media in Consumer Buying Behavior: A Literature Review

Parvinder Singh Bajwa, Kanchan Rani

Research Scholar, Assistant Professor, Sri Guru Granth Sahib World University, Fatehgarh Sahib
parvindersingh10@hotmail.com

Abstract

Social media's advent has had a profound impact on both consumers and businesses. To better influence customers and harness the power of their social ties, businesses must therefore understand consumer behaviour in the context of social media and its impact. Marketing professionals now have a new way to reach clients thanks to the social media and social networking industry's explosive expansion, particularly in emerging nations like India. Theoretically, it will be crucial to assess the results of the research and draw practical conclusions from a systematic study of the literature. With the goal of elucidating consumer behaviour on social networking sites, we perform a systematic review of the impact of social media on customers' purchasing decisions in this study. The essay also tries to analyse numerous social media marketing methods by reviewing many books, journals, studies, published papers, researches, etc. The secondary resources used to compile the literature review come from both domestic and foreign sources.

Keywords: Social Media, Social Networking, Purchase Decision

Introduction

Users have recently begun to see the internet environment from a more business-oriented angle. Users have changed into consumers as a result of its development and the rise of online retailers. Additionally, social media's most significant impact has altered how consumers and advertisers interact. Also, by posting reviews of the goods and services they have used on social media, users have the chance to influence other customers. Other psychosocial characteristics, such as online or physical), etc., also have an impact on consumers.

The majority of young people in today's globe use social media. As the majority of children and teenagers buy their necessities online and spend the majority of their free time on social networking, it is crucial for me to investigate the effects of social media on their purchasing behaviours (Jain, Rakesh, and Chaturvedi, 2018).

In the modern world, everyone engages in internet shopping. This study's primary focus is on Indian consumers' internet purchasing habits in North India. Some of them have a negative effect on consumers' online purchasing behaviour, while others are positive results of web-based social networking and systems. The purpose of the exploration study is to take into account how social media may affect online consumer purchasing. This investigation will provide details about how consumers use the internet to make purchases, or "online purchasing" (Gupta 2018).

Web-based living is the online transformation tool that made it possible for people to access various types of information, communicate, and share materials. Websites and applications, social media, social bookmarking, and other internet platforms are quick to reach audiences. Instagram, YouTube, LinkedIn, Facebook etc. Due to the use of new innovative technologies by websites and applications, online purchases are growing quickly (Agrawal and Jaliwala 2013). Numerous websites use the customer comments section on the post-purchase feedback page to innovate their offers in their respective fields. The purpose of this study is to determine how online networking affects urban consumers' purchase decisions. With the rise of internet-based consumers, buyers and associations from all over the world are quite active (Gupta 2018). In 2018, there were 315 million internet users in urban India, a growth of 7%, representing a 35% increase in web users over the previous year. According to a new survey called "India Internet 2019" conducted by IMAI (Internet and Mobile Association of India) in partnership with Nielsen Holdings, it is now estimated that there are 564.5 million online consumers in popular India, starting with the 2020 forecast. India has 451 million diverse cloud users as of March 31, 2019, which is second only to China, 800 million+ user base. One of the best channels for bringing people together globally is social media, which has grown to be an essential part of the marketing process. Social media have developed into a thriving industry for marketing and communicating any products or services to target consumers as a result of the internet's widespread use. Around the world, businesses use social media extensively, and their numbers are rising daily. Utilizing social media, the Indian e-commerce industry may swiftly contact its customers and gradually grow to be a massive online enterprise. Businesses in India may successfully and efficiently draw in more customers by utilising social media technology. This study's primary objective is to ascertain the influence social media has on Indian customers' choice-making processes.

In 2005, as the commercial use of social networking sites and other social media websites increased, the idea of social commerce began to take shape. It introduces a brand-new type of electronic trade (ecommerce). Social commerce involves online communities that support user interactions and user-generated content, in contrast to traditional e-commerce where customers often engage with online shopping sites individually. According to a recent poll, social commerce has already produced \$5 billion in revenue in the United States, and sales are

projected to reach \$9 billion in 2014 and \$15 billion in 2015. Due to its importance, social commerce has been the focus of numerous research. For instance, earlier study suggests that social media reviews are a crucial source of knowledge that supports consumers' decision-making. Liang et al.(2014) showed that social support from online friends is critical in driving consumers to adopt social commerce. According to Edelman, corporations should change their marketing strategy from raising customer awareness (the pre-purchase stage) to building relationships with consumers after their purchases since social media enables consumers to interact with brands in radically new ways (post-purchase stage). Studying the process and distinctive characteristics of consumer behaviour in this environment is crucial if social commerce is to be fully utilised.

Literature Review

Babu, J., Srivastava, S., and Gaikwad, S. (2020) focused about the influence of social media marketing on buying behavior of millennial towards smart phones in Bangalore City. The exploratory research done with primary data from consumers of social media in their Millennial. The major objective of the study was demographic variables and the perception of the Millenials on social media marketing and also to analyze the impact of social media marketing on buying behavior of the Millenials towards smart phones. The data collected from 165 respondents are estimated on the basis of the Cochran Method of uncertain population sample size. Study findings revealed that Facebook is the most preferred platform for social media, and that YouTube is the most reliable. On social media marketing the Millenials expressed strong positive perceptions. The majority of the respondents said that the social media marketing influences their buying behavior. Regardless of the demographic features, social media usage among millenials remains the same.

Mahapatra, N. (2016) explored the perception, preference and usage of social network sites among the young population. The data was collected by a self-administered questionnaire through personal survey. Data analysis revealed respondents' perception and preference for various social networking sites on parameters categorized as functional dimension and association dimension. The finding of the study provides useful insights for web designers regarding web features, design and content that would increase usage and preference. The research finding provides suggestions and directions for making social networking sites attractive, unique, engaging and user's friendly.

Prakash, G. (2016) emphasized that social networking sites are nowadays playing an increasing role in people's everyday life and the use of the social networking sites has become more and more important as a way of communicating in the last couple of years. Social networking sites like Twitter, Facebook, YouTube and MySpace etc. have gained more and more popularity. From the social networking sites especially the “big tree” services as Facebook, Twitter and YouTube have grown tremendously in the last couple of years. Politicians are now using social media and the Internet and in turn are permitting a new arena of grassroots politics. The main objective of this article is to study the role of social networking sites like Facebook, Twitter, and YouTube etc. on Indian politics.

Hashim et al (2016) focused that emergence of social media has made it possible for a person with internet connection to communicate with thousands of other people. Because of the heavy usage of social media there is substantial interest in making this medium a commercial site, particularly among entrepreneurs who want to explore the potential of their businesses. Any entrepreneur can experience various benefits and effects from advertising their products and services on social media, including an increase in the number of fans and advertisement views and/or an increase in sales and return on investment as social media channel product and business information to targeted customers at a minimal cost.

Sharma, P and Vishvakarm, S., (2016) recommended reexamining the impact of social networking sites on academic performance. This study will give some hints on both the positive and negative effects of social media on kids' academic success. On the one hand, students use it to complete their assignments, to facilitate information exchange, to blog, Research Gate, Facebook, Twitter, YouTube, join learning communities, and follow one another's research. On the other hand, they use it to form forums where teachers can provide various materials to students to clear their doubts on specific topics and share academic resources.

Vinod, C., and Kumar, S., (2016) documented in his thesis on impact of social media marketing on consumer buying behavior with reference to Thane district. He evaluated the various channels preferred by consumers for buying decision over traditional channels. He also analyzed the impact of social media on consumer buying behavior in his thesis. He pointed the best social media preferred by customers. The respondents of the age ranging from 18 to 55 years and above also taken into consideration. A sample 2000 respondents were taken that is 30% of the population was selected for the study in Thane city. The researcher has considered various Social Websites which are doing the Job of Networking that is Facebook, Whatsapp, Twitter and many more. The research shows that Facebook usage is 19% who are using very rarely whereas 40.3% are using very frequently whereas 29.8% are using average use. In case of Twitter the number is 32.1% who are using very rarely whereas 33.3% are using very frequently and 27.5% are using Average. In case of LinkedIn 40.5% are users who are using very rarely and 11.8% who are using frequently and 33.8% are these who are using Average use. Others

like YouTube, Google etc. the number of very rarely users 8.3% and in the case of very frequently the number is 14.7% and average number of users are 8.8%. The total numbers of respondents are 1675 which are divided into various use like Facebook 600, Twitter 513, LinkedIn 412, others are 150. So it shows the highest users are Facebook whereas Twitter and finally LinkedIn at last.

Shetty et al (2015) carried up a poll to find out how social media networking affected young people's schooling. Facebook, Skype, YouTube, Twitter, and Myspace are the social media sites that the study instrument refers to. This researcher interviewed 100 teenagers for the poll. Every participant in this survey actively responds to it. Male participation is generally lower than female engagement. The typical age ranges that this researcher contacted were from 18 to 30 years. Students made up the majority of the responses in this case, while members of various employee groups made up a lesser share. After getting all findings and discussed the conclusion of collected data the researcher recommend some measures to use of social media in right direction and utilize social media favorable and appropriate manner to its users. Positive use of social media can develop the youth's academic career, their skills, better living style, to adopt new trends, fashion, and anthropology so on.

Mishra, S. and Tyagi, A. (2015) pointed out that establishing personal fit with consumers and providing user-friendly web sites, and reducing the perceived risk has impact on developing positive attitudes. Social networking sites in India are in the limelight because of the explosion in social media among the youth. Next to the importance of SNS as social phenomena, they are a domain of interesting marketing opportunities for businesses engaged in internet marketing.

Ojhi et al (2015) concluded the effect of facebook usage on the academic performance of students of tertiary institutions in Kogi state. The observations drawn from empirical data revealed that students have embraced the use of face book, and its academic application is on the increase, even though some of the students still see face book as outright distraction, a good number of them have embedded it in their tools of learning like research, doing home work, linking up with mates and lecturers alike among others.

Mehla et al (2015) explored the impact of social networking sites on student's attitude towards purchase, and suggest some points to overcome such problem. The study is based on the sample of 200 respondents from different colleges of Hisar district of Haryana state. The study employs factor analysis, where the 17 statements are reduced to six principal components through varimax rotation. The study shows that derived factors have been assigned appropriate names according to the variables that have been loaded on each factor.

Adaugo et al (2015) examined the influence of the social media on the Nigeria Youths: Aba Residents Experience. In carrying out this study, the researcher employed survey method in which she used questionnaire to gather her data. The population of the study was Aba metropolis from which a sample of 400 was drawn. The researcher asked research questions and formulated research hypotheses to guide the study. Relevant literatures were reviewed for the study.

Chowdhury and Saha (2015) highlighted that Social networking Site like Face book is becoming more popular among the young generation in Kolkata. However this SNS (Social Networking Site) has become a touchy part of the daily life of the youth's and they are used to access regularly for a prolong time periods to share their ideas, comments, thoughts or giving any statement regarding commendable and contemporary situation. Facebook has a lot of interesting features through which mid generations are attracted more and they are becoming more Facebook seeker and however it effects on their social life in a positive and negative way.

Singh And Laxmi (2015) found the growth of social networking sites shows a significant change in the social and personal behaviour of Internet users. SNS has become an essential medium of communication and entertainment among the young adults. Though it has started to affect the daily activities of normal human beings, the popularity of SNS is not going to reduce in near future. Everything in this world can be used for a bad purpose as well as for good. It's us who can make the difference and utilize social networking sites wisely for the benefit of developing social bonds across the geographical borders. However, nefarious act of cyber criminals discussed in the article has to be brought to the fore and stringent measures should be taken to curb the menace. Cyber laws have to be fortified with advancement of rules as if violators cannot escape committing a crime, at the cost of societal values.

Sheopuri, A. and Sheopuri, A. (2015) focused on student's academic performance and their behaviour. Secondly this study points will help to know the popularity of social sites among students, and the effect caused by them on their studies, etc. Lastly it will analyze the pros and cons aspects of social networking on education.

Livingstone, S. And Brake, D., (2010) reviewed recent articles and findings regarding children and teenagers' social networking practices in order to identify implications for future research and public policy. These focus on the interdependencies between opportunities and risks, the need for digital or media literacy education, the importance of building safety considerations into the design and management of social networking sites, the imperative for greater attention to „at risk“ children in particular, and the importance of a children's rights framework in developing evidence-based policy in this area.

Objectives of the Study

1. To analyze the proximity of purchase through social media of consumers.
2. To study the level of awareness of e-consumers about social media sites.
3. To assess the impact of social media on purchase decision of Indian consumers
4. To study the relationship between personal characteristics of social media users and impact of social media on their purchase decision.

Conclusions And Recommendations

The goal of this research is to identify and investigate the psychological elements of societal impact, product choice, variety availability and convenience on online purchasing intention of customers. The findings of this study suggest a beneficial association between societal impact and the intention to make an online purchase. Although online shoppers seem to be socially analogous and receptive to social contact, the societal influence indicator was taken into account for the research because it has been a key criteria for determining the social acceptance of online transactions. This variable is being used as a major feature in the analysis. Regarding the social influence, other elements, such as recommendations from friends, family, and the media, as well as other considerations, have a key part in consumer demand tendencies.

According to research, a consumer's preference for a product influences their decision to make an online purchase. Previous study on "low touch" items like computer software, airline tickets, etc. revealed that consumers frequently chose online purchasing portals because of their quick delivery services. Due to the alternative feedback provided by others on the products, it also serves as a component of the gathering of clients using the online shopping method. In fact, this variable was selected for this study as well because it was expected that customers could favour online buying as a way of shopping because of the reasons given in the prior studies.

Research has shown that the variety of the product range has a positive impact on customer online buying intentions. A main category of respondents is the variety seekers since the bulk of customers being surveyed are young people. This is the basis for considering the element in the production of questionnaire objects. From previous studies with various perspectives, most online grocery shoppers have been performed on the basis of varieties and convenience.

Research studies have shown that shopping convenience has a positive impact on customer online buying intentions. From earlier studies it has been shown that online consumers are likely to be comfortable, and economic buyers have emerged to be dominant in recent times. There are no differences between various directions in online shopping between consumers who like to buy products online.

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