Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:6(3), June: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd June 2023
Publication Date:30th June 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.06.54
www.ijmer.in

AWARENESS ABOUT PROTECTIVE DEVICES AMONG BASKETBALL PLAYERS (AGED 20 – 30 YEARS)

[1]Nupur, S. and [2]R. Rao
[1]Student and [2]Assistant Professor
[1]Department of Foods, Nutrition and Dietetics and [2]Department of Community Resource Management
[1&2]College of Home Science
Nirmala Niketan, Affiliated to the University of Mumbai
Mumbai, Maharashtra State, India

Abstract

Protective devices play a crucial role in preventing injuries, limiting faulty movements, and supporting the recovery phase for basketball players. Given the high-intensity nature of basketball and the susceptibility to injuries associated with the sport, it becomes imperative for players to be aware of and utilize protective devices. However, there is a lack of studies examining the awareness and use of protective devices specifically among Indian basketball players. Considering the growing popularity of basketball in India, with initiatives such as the NBA working towards its establishment, this study aimed to assess the level of awareness and utilization of protective devices among basketball players. The study involved 77 basketball players (both male and female) aged 20-30 years from five different basketball academies in Mumbai and its suburbs. Participants were interviewed regarding their awareness of protective devices, and their clothing gear was observed. Data analysis was conducted using MS Excel, with various parameters measured against each other to derive meaningful results and draw appropriate conclusions. Results revealed that while half of the subjects were aware of protective devices, only 23% of them reported using them. Notably, the age group of 20-23 years demonstrated higher usage of protective devices compared to other age groups. Female players exhibited a higher propensity for utilizing protective devices than their male counterparts. Additionally, the majority of players preferred to employ protective devices during training rather than in competitive matches.

Keywords: Basketball, Injuries, Prevention, Protective Equipment.

I. Introduction

Sports protective devices are products that are developed to protect the player from any type of injury. Sports can cause various hazards to the players, it could be the playing equipment, wrong technique, and movements, contact with other players, and due to obstacles and barriers. These devices are supposed to be used as preventive measures. Protective devices act as shields against any injury, they can restrict faulty movements like over-twisting of the ankle or knee. It can also be used as a supportive device for post-injury. It is important to choose the correct and most appropriate protective device. It can be according to the main body parts involved in sports, protection against equipment and parts, and degree of contact with other players in the sports.

Basketball being a contact sport necessitates the use of protective devices. Also, it is high-intensity intermittent sports which means there are high chances of executing faulty movements in the heat of the moment. Awareness is crucial for using the correct protective device. Players and coaches need to have knowledge about protective devices and choose the correct device wisely.

Protective devices in basketball can provide several benefits to players. A few benefits of using protective devices in the sport are: injury prevention, enhances confidence, increases performance, and aids in quicker recovery. By minimizing the risk of injuries, players can maintain their physical condition over the long term, allowing them to continue playing and enjoying basketball.

The benefits of using protective devices by basketball players can be multi-fold. The primary motivation for studying the awareness of protective devices among basketball players is to assess their knowledge and understanding of the benefits of using these devices for injury prevention. By understanding players' awareness levels, researchers can identify any gaps in knowledge and develop targeted education programs or interventions to improve awareness and promote the use of protective devices. The study also aims to explore the players' perception of injury risks and their attitudes toward protective devices. This information can help researchers understand why some players may be hesitant to use protective gear or underestimate the importance of these devices. By addressing misconceptions or concerns, researchers can promote a more accurate understanding of the risks involved in basketball and the role of protective devices in mitigating those risks. Ultimately, conducting a research study on the awareness of protective devices and their benefits among basketball players can contribute to injury prevention strategies, promote player safety, and inform educational initiatives to enhance players' understanding of the importance and advantages of using protective gear.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:6(3), June: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd June 2023
Publication Date:30th June 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.06.54
www.ijmer.in

II. Specific Objectives: The objectives of the study were to (i) study the demographic profile of basketball players from Mumbai city and its suburbs; (ii) conduct an awareness assessment; and (iii) explore the players' perception of injury risks and their attitudes towards protective devices.

III. Research Methodology: An exploratory was conducted among 77 basketball players aged 20-30 years, including both male and female participants. The age range of 20 - 30 years was selected to focus on young adult players. The participants were randomly selected from five different basketball academies located in Mumbai and its suburbs. This sampling approach aimed to capture a diverse representation of basketball players in the region.

Two methods were employed for data collection: interviews and observation of clothing gear. Participants were individually interviewed to assess their awareness of protective devices. The interviews were conducted using a self-constructed validated questionnaire designed specifically for this study. Additionally, the clothing gears worn by the players were observed to gather information on their usage of protective devices.

The collected data was analyzed using MS Excel software. The analysis involved examining various parameters and comparing them against each other to derive meaningful insights. The objective of the analysis was to assess the level of awareness and utilization of protective devices among the basketball players in the sample. The researchers measured several parameters to evaluate the awareness and utilization of protective devices. These parameters included the percentage of subjects aware of protective devices, the percentage of subjects using protective devices, the distribution of usage across different age groups, and a comparison of usage between male and female players. By analyzing these parameters, the researchers aimed to obtain comprehensive findings.

Based on the data analysis, the study's results were derived. The findings revealed the level of awareness and utilization of protective devices among the basketball players in the sample. The results were interpreted concerning the research objectives and the specific parameters measured. Conclusions were drawn based on the outcomes of the analysis and the overall trends observed in the data.

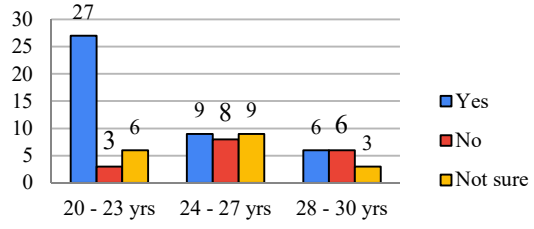
The study's implications were discussed, highlighting the challenges and gaps identified in terms of awareness and utilization of protective devices among Indian basketball players. The researchers emphasized the importance of educating both players and coaches about the benefits and proper usage of protective devices. Recommendations were made to address the identified challenges and promote greater awareness and utilization of protective devices among basketball players in India. Overall, the research methodology employed in this study aimed to gather relevant data, analyze it effectively, and draw meaningful conclusions to address the research objectives and contribute to the existing body of knowledge on the subject matter.

IV. Results and Discussion

Profile of the Sample: 42(54%) were males and 35(46%) were females. The selected age group was 20 – 30 years, from which 36(46%) belonged to the 20 – 23 years age group, 26(33%) were from the 24 – 27 years age group, and the remaining 15(19%) were between the age of 28 to 30 years. From the pool of subjects, 40(51%) players had training of 3 to 5 years and 36(46%) had more than 5 years of basketball training. 39(50%) participants were training for 2 to 3 hours a day and 17(22%) and 21(27%) participants were training for 3 to 4 hours and 4 to 5 hours a day respectively.

Around 42(54 %) of players were aware of the protective devices. But the data showed that only 18(23 %) of players were using protective devices and 25(32%) were using them occasionally (Mostly as post-injury support and not as preventive measures).

Fig 2: Awareness about Benefits of Protective Devices



Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:6(3), June: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd June 2023
Publication Date:30th June 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.06.54
www.ijmer.in

More female players than male players were using protective devices. This could be because females are more prone to injuries due to lesser intake of calories and calcium, having lower muscle mass, brittle bone, small ligament size, increased rotation around joints, and increased laxity of the ligaments because of estrogen. Players from the age group 20 – 23 years were using protective devices more as compared to players from 24 – 30 years. Younger players have been exposed to technology at earlier stages of their lives and all information is at their disposal, this makes them more aware of protective devices as they can get information regarding such devices. Players from 24 – 30 years have been less exposed to such technology and the internet. Through all age groups and among both genders, Protective devices were used more during training sessions than during competition.

Table 1: Use of Protective Devices During Competition

Use of Protective Devices when Training	No		Sometimes		Yes		Total	
	f	%	f	%	f	%	f	%
No	34	26.1	0	0	1	1.3	35	45.4
Sometimes	6	4.6	15	19.7	1	1.3	22	28.6
Yes	1	1.3	9	6.9	10	7.7	20	26
Total	41	53.2	24	31.7	12	15.6	77 (100%)	

Players have expressed that they feel restricted movements while using protective devices and hence ditched wearing such devices during such competition to perform up to their complete potential. Coaches have not used protective devices during their initial years of training and are not accustomed to playing with protective devices. Hence, they are not able to strongly recommend the correct device to their players. There are no introductory sessions that are conducted especially on safety and protective devices. Throughout the training, they are mainly focusing on techniques and tactics of the game which is undeniably important but paying attention to players' safety is also essential for a healthy and progressive career.


Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:6(3), June: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd June 2023
Publication Date:30th June 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.06.54
www.ijmer.in

V. Suggestion: It is important to increase awareness as it will be the first step towards using these protective devices by the players. This can be done by conducting seminars/webinars on protective devices in basketball academies. It is important to reach out to coaches and management and make them aware of the benefits of such devices so that they can pass on this information to their players. The advice of coaches and management plays a crucial role.

Academies with good financial capacities can also hire supervisors who have expertise in the field of ergonomics. Posters regarding protective device benefits and use can be displayed in the academy. Infographics can also be on digital platforms, especially with the community of coaches on social media. Training with protective devices should be mandatory, it will help in making protective devices part of players' clothing and the player will get used to the device and will not feel restricted or uncomfortable while using it during competitions.

VI. Scope of the Study: Results of this study can be used to extend the study to understand the effectiveness of existing protective devices and to assess their ability to mitigate injuries. The scope of the study encompasses several areas of application and opportunities for further research.

The study highlights the need for increased awareness and knowledge about the benefits and proper use of protective devices among basketball players. The findings can be used to develop educational programs and interventions aimed at educating players about the importance of protective devices, their proper usage, and the potential impact on injury prevention and performance enhancement.

Coaches play a significant role in shaping player behavior and promoting safety in sports. The study results can be utilized to educate coaches on the significance of protective devices and encourage them to incorporate the use of such devices into training sessions and competitive play. Coaches can also be trained on how to guide players in selecting appropriate protective gear and incorporating them into their routines effectively. The findings can provide insights for sports organizations and governing bodies to develop policies and guidelines regarding the mandatory use of protective devices in basketball. This can help ensure player safety, minimize the risk of injuries, and create a standardized approach across various basketball academies and organizations.

The study results can provide valuable feedback to manufacturers and designers of protective devices, helping them understand the specific needs and preferences of basketball players. This can lead to the development of improved and more suitable protective gear that meets the demands of the sport.

This study serves as a foundation for further research in the field of sports injury prevention and player safety. Subsequent studies can explore the reasons behind the low utilization of protective devices among basketball players and investigate potential barriers, such as cost, comfort, and cultural factors. Longitudinal studies can also be conducted to evaluate the long-term impact of protective device usage on injury rates and player performance. Additionally, comparative studies can be conducted across different regions and basketball populations to assess the awareness and utilization of protective devices on a broader scale. Research can also focus on evaluating the effectiveness of various protective devices in preventing specific types of injuries common in basketball.

Further studies can be conducted to explore the material and technological advancements that can enhance the performance and safety of protective gear. Investigate the impact of innovative designs, materials, and manufacturing techniques on injury prevention and overall athlete well-being. The psychological factors associated with wearing protective gear need to be investigated. Studies exploring the relationship between gear design, ergonomics, and athlete performance will help evaluate how gear design influences an athlete's range of motion, agility, and overall performance while ensuring adequate protection.

In conclusion, the scope of this study extends to player education, coaching practices, policy development, product innovation, and opportunities for further research in the area of protective device utilization among basketball players. The results of this study lay the groundwork for interventions and initiatives that promote player safety and well-being in the sport of basketball.


Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:6(3), June: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd June 2023
Publication Date:30th June 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.06.54
www.ijmer.in

References

- Andreoli, C. V. (December 2018). Epidemiology of sports injuries in basketball: integrative systematic review. BMJ Journals. https://bmjopensem.bmj.com/content/4/1/e000468.info
- Cronkleton, E. (2020, June 12). 10 Physical and Mental Benefits of Basketball. https://www.healthline.com/health/exercise-fitness/benefits-of-basketball
- E.Cumps. (2007, June 1). Prospective Epidemiological Study of Basketball Injuries During One Competitive Season: Ankle Sprains and Overuse Knee Injuries, NCBI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3786241/
- Herzog, W. (2008). Do recreational team sports provide fitness and health benefits?, Journal of sports and health science: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6180537/
- B. F. (2020, july 30). Basketball Federation of India. https://www.basketballfederationindia.org/newsDetails/?q=Basketball+Federation+of+India+to+host+First+Round+of+the+FIBA+Asia+Cup+2025+Pre-Qualifiers+for+Groups+C&p=110
- Jeffrey B. Taylor. (2018). Prevention of Lower Extremity Injuries in Basketball: A Systematic Review and Meta-Analysis, NCBI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4547118/
- Kofotolis, N. (n.d.). Ankle Sprain Injuries: A 2-Year Prospective Cohort Study in Female Greek Professional Basketball Players, NCBI https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1978460/
- László Rátgéber, P. (2018, 11 10). Basketball for Health: Should We Hop and Shoot for a Remedy?, mayo clinic proceedings https://www.mayoclinicproceedings.org/article/S0025-6196(18)30901-7/fulltext
- Leppänen M. (2015, May 22). Overuse injuries in youth basketball and floorball, NCBI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4447174/
- McKay, G. D. (2001, February 26). 'Ankle injuries in basketball: injury rate and risk factors,: https://bjsm.bmj.com/content/35/2/103
- O.B.A Owoeye. (2022, February 26). incidence and pattern of injuries among adolescent basketball players in Nigeria', https://link.springer.com/article/10.1186/1758-2555-4-15
- P., J. (2018). The NBA and Youth Basketball: Recommendations for Promoting a Healthy and Positive Experience, Sports Medicine (Auckland, N.z.): https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6096539/
- Randers, M. B. (2018). Effects of 3 months of full-court and half-court street basketball training on health profile in untrained men, Journal of Sport and Health Science: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6180545/
- S Andrew Cage. (2018). Flossing bands to treat keinböck's disease in a collegiate men's basketball player: a case report. International Physical Medicine & Rehabilitation Journal.
- Thomas Reilly (2009), Ergonomics in Sports and Physical Activity: Enhancing Performance and Improving Safety 1st edition, Human Kinetics.

Cover Page

DOI: http://ijmer.in.doi./2023/12.06.27
www.ijmer.in

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:6(2), June: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd June 2023
Publication Date:30th June 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

OCCUPATIONAL HAZARDS AMONG FISHERMEN IN MUMBAI

[1]Melann, P. and [2]Roopa R
[1]Student and [2]Assistant Professor
[1&2]Department of Community Resource Management
College of Home Science, Nirmala Niketan (Affiliated to the University of Mumbai)
Mumbai, Maharashtra State, India

Abstract

This study aimed to assess the occupational hazards faced by fishermen in Mumbai, India, to identify potential strategies to mitigate these risks. Over a period of six months, a comprehensive investigation was conducted, encompassing a large sample of fishermen representative of the population. Through structured interviews and surveys, fishermen were queried about the nature and severity of hazards encountered in their work environment. The findings revealed an array of high-risk situations, revealing critical life-threatening conditions faced by the fishermen. Considering that approximately 60% of the country's population consumes fish, the significance of this study extends to its potential impact on the national economy. The primary focus was to shed light on the occupational health risks specific to this population and to propose effective interventions to address and eliminate these hazards. The outcomes of this study are expected to inform policies, guidelines, and practical measures aimed at safeguarding the well-being and safety of fishermen, ultimately contributing to the sustainability and prosperity of the fishing industry.

Keywords: Ergonomics, Fishermen, Hazards Faced, Occupational Health, Safety at Work,

I. INTRODUCTION

The fisheries sector in India holds immense economic importance and provides livelihood to a large population engaged in fishing activities. India ranks among the top fish-producing and aquaculture-producing nations globally, with Maharashtra's extensive 720 km coastline contributing significantly to the country's fish production. Marine fisheries play a predominant role, accounting for 82% of the state's fish production, while inland fisheries contribute the remaining 18% (CSR, 2023). Despite its significance, the fishing industry has a high fatality rate, yet limited attention has been given to understanding the occupational hazards faced by the courageous fishermen who venture into the seas daily in pursuit of a bountiful catch.

The fisheries industry is associated with a range of common hazards and injuries, including eye swelling, sunburns, falls, mechanical accidents, and electrical incidents. Moreover, the prevalence of noise-induced hearing loss, allergic respiratory conditions, and work-related stress issues are expected to rise significantly in the absence of organized and effective interventions (Amadou Barrow, March 2022). These hazards faced by fishermen span a wide spectrum, ranging from minor fish hook punctures to life-threatening incidents like accidental slips and drownings during work. Adding to the challenge is the limited familiarity of Indian fishermen with the concept of personal protective equipment and safety gear, leading to a higher frequency of mishaps (Neethiselvan R, 2021;8:732).

Therefore, this study aims to comprehensively understand the various occupational hazards encountered by the Koli community residing in Mumbai's renowned Koliwadas (fishing villages). Many individuals in this community continue to follow the traditional profession passed down through generations and derive contentment from it. They acquired fishing skills from their grandfathers and fathers at a young age, considering it as the sole means of livelihood. However, a significant shift in mindset is observed among the younger generation, as education has gained prominence and many fishermen now prioritize formal schooling alongside their fishing occupation.

II. REVIEW OF LITERATURE: The existing literature provides valuable insights into the occupational hazards faced by fishermen in coastal villages of Mumbai. The study by Jensen et al. (2008) investigated hospital contacts for injuries and musculoskeletal diseases among Danish seamen and fishermen. The findings revealed that certain musculoskeletal disorders, such as thoracic lumbar disc disorders, arthrosis of the knee and hip, rotator cuff syndrome, and carpal tunnel syndrome, were more prevalent among seafarers. This study highlights the importance of examining the prevalence and impact of occupational hazards on the health of fishermen. Another study by Pukkalla and Sharma (2018) focused on the occupational health risks and etiologies among the Jalari community in Andhra Pradesh, India, which includes fishermen. The research highlighted the frequent occurrence of injuries while carrying boats into the sea and the associated risks of leg fractures and torn muscles. This study underscores the physical hazards faced by fishermen during their fishing expeditions. Additionally, Zytoon (2011) conducted a study on occupational injuries and health problems in the Egyptian Mediterranean fisheries. The research revealed the presence of specific illnesses and associated deaths among fishermen in the area. This study sheds light on the severity and potential consequences of occupational hazards in the fishing industry. Collectively, these studies emphasize the need for research on occupational hazards faced by fishermen in Mumbai coastal villages. There are very few

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:6(2), June: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd June 2023
Publication Date:30th June 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.06.27
www.ijmer.in

studies on Indian fisherfolk and none on the occupational health of fishermen (kolis) from the Mumbai region. By conducting a comprehensive study, the researchers can better understand the specific hazards prevalent in this context, assess their impact on the health and well-being of fishermen, and develop effective strategies to mitigate these hazards. The findings of such a study can contribute to the development of targeted interventions and policies aimed at improving the occupational health and safety of fishermen in Mumbai coastal villages

III. OBJECTIVES: The specific objectives of this study are to (i) gain knowledge on the demographic profile of fishermen (kolis) in Mumbai city; (ii) understand the occupational hazards faced by Mumbai fishermen; and (iii) suggest strategies to reduce/lower risks from these occupational hazards faced by Fishermen in Mumbai

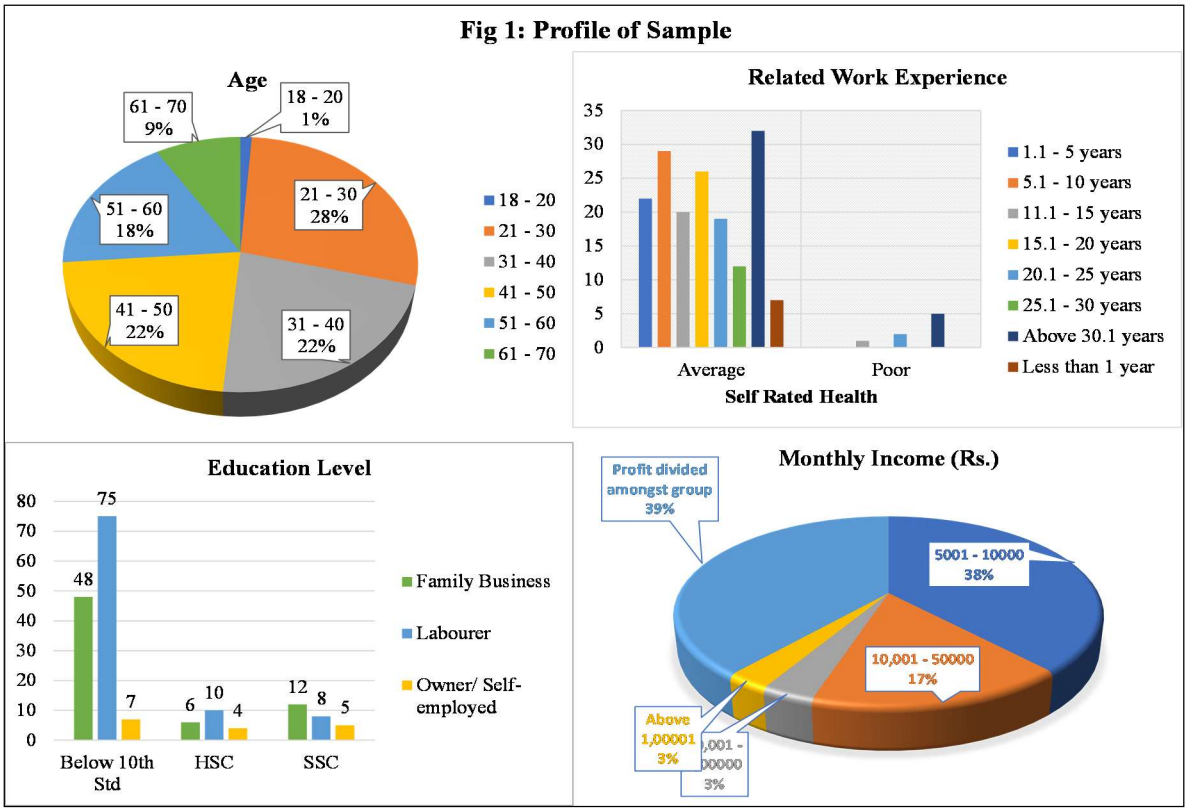
IV. METHODOLOGY: An Exploratory study was conducted among 176 Fishermen (20 - 70 years) to understand the various hazards that exist in this profession. A convenient sampling technique was used to select the participants after the informed consent was signed. Permission was first sought from the police to enter the fishing villages and then from the village chief. Few village chiefs denied allowing this interaction upfront. Pre-decided Inclusion-Exclusion criteria (which help decide the basic characteristics needed in the sample), specific ergonomic research tools (such as Quick Exposure Checklist - a checklist wherein a risk assessment is done to identify the different hazards in the workplace), Self-Constructed Questionnaire (a list of questions that the researchers have specifically constructed to elect the desired information) & the Observation method are used to gather the required data throughout the study.

The study focused on the Fishermen in Mumbai-the Metropolitan City, its southern region, and its coastline, (Sassoon Dockyard, Bhaucha Dhakka, Worli Lotus, and Khar Danda Koliwada). The reason behind the selection of these regions was to explore and become aware of the hurdles they face as little-to-none research had been conducted on these fishermen. The data collected was coded to interpret the results. The results were then graphically represented using pivot table tools.

V. RESULTS AND DISCUSSION

Sample Profile: The sample profile of the fishermen that have been recorded states some quite distinctive facts:

Fig 1: Profile of Sample



The average age of the sample is 41.2 years. With 88 (50%) being in the age group of 21 - 40 years. There is a noticeable difference between the number of young fishermen and older, fishermen of older age were bought up with the notion of 'becoming a part of the family business mindset and therefore accepted this profession early in life. The younger generation quite oppositely not

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:6(2), June: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd June 2023
Publication Date:30th June 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.06.27
www.ijmer.in

wanting to follow/join the family business, hence there is a reasonable decline in younger fishermen. Very few 25 (14.2%) have completed their 10th std/ SSC, and about 20 (11.36%) have their 12th std/HSC; a vast majority of 130 (77.27%) of the participants are barely educated fishermen.

The marital status of large majority [133 (75.57%)] is married. They reported on inquiring that often work to support the entire (joint) family and commonly are the only breadwinners of the household. The fisher womenfolk set up their space in big market spaces and are the ones who sell the fish at a profitable price. Many [67 (38%)] reported that they earn anywhere between Rs. 5,000 – 10,000 per month on average. With such low-stated earnings and tedious work hours, supporting an entire family becomes quite a fete!

Types Of Hazards Faced: Fishermen in Mumbai face a range of hazards across different categories, including biological, chemical, physical, psychosocial, and safety hazards. The results when analyzed states:

- **Ergonomic Hazards:** The fishing industry presents various ergonomic hazards that can have detrimental effects on the health and safety of fishermen. The physically demanding nature of their work, which involves tasks such as heavy lifting, repetitive motions, and awkward postures, puts them at risk of developing musculoskeletal disorders. The weight of the fishing nets with the bountiful catch can be between 100 – 250 kgs as reported by 132 (75%). These disorders, including repetitive strain injuries, back pain, neck pain, and fatigue, can have a significant impact on fishermen's well-being and their ability to perform their jobs effectively.
- **Musculoskeletal injuries:** The physically demanding nature of fishing tasks, such as heavy lifting, repetitive motions, and awkward postures, can contribute to musculoskeletal disorders and injuries.
- **Heavy lifting:** Fishermen frequently engage in heavy lifting activities, such as lifting and carrying heavy fishing gear, equipment, or catch. Improper lifting techniques and overexertion can lead to muscle sprains, strains, and back injuries.
- Repetitive motions, such as casting nets and pulling in fishing lines, can lead to repetitive strain injuries, causing pain, swelling, and weakness in the affected muscles and tendons. Maintaining awkward postures while hauling nets or sorting fish can contribute to back and neck pain among fishermen.
- **Awkward postures:** Fishermen often have to maintain awkward and uncomfortable positions while performing various tasks such as hauling in nets, sorting fish, or repairing equipment. Prolonged periods in these positions can lead to muscle strain, back pain, and joint problems.

Additionally, long working hours and challenging conditions often result in fatigue, increasing the risk of injuries and accidents while impairing performance.

- **Chemical hazards:** This confirms that fishermen certainly do not work in safe environments.
- **Contaminated water and seafood**: Fishermen may encounter water bodies contaminated with pollutants, heavy metals, pesticides, or herbicides, which can lead to long-term health effects if they consume contaminated seafood.
- **Cleaning agents:** Fishermen often utilize cleaning agents to maintain and sanitize their equipment, such as nets and boats. These cleaning agents may contain hazardous chemicals like solvents, acids, or alkalis, which can cause skin irritation, respiratory problems, or other detrimental health effects if proper precautions are not taken.
- **Fuel and oil exposure**: Handling and being near fuels, oils, and lubricants used in boats and engines can result in inhalation of fumes or skin contact, leading to health issues. Petrol/diesel are highly flammable, leaks or natural disastrous encounters with the fuels cause fires, spills, and thereby putting the fishermen's lives at high risk at the same time destroying the surrounding marine ecosystem.
  Fishermen work often near these chemicals and can eventually face irritation, allergic reactions, or chemical burns. The type and concentration of chemicals play an important role, there is an increased risk of chemical peeling and water contamination. These can also be accidentally ingested by fish and thereby ingested by humans who consume these fish.

- **Safety hazards**
- **Drowning and accidents at sea**: Working in unpredictable and potentially dangerous environments exposes fishermen to risks of drowning, falls overboard, or accidents related to handling equipment.
- **Lack of proper safety equipment**: Insufficient access to or non-compliance with safety equipment, such as life jackets or emergency signaling devices, increases the risk of accidents and fatalities.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:6(2), June: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd June 2023
Publication Date:30th June 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.06.27
www.ijmer.in

- Slips, Trips & Falls occur more often than one knows, as fishermen have a workstation that is moving constantly and therefore can cause fatal type trips and falls, occurrences such as climbing on/off the boat, rapid movements, and slippery floor, can be highly accidental.
- Machinery often turns rusty, when it is not well- maintained the machinery that we're talking about would be engines, and motors where frequent oils fills are done, even machinery used to operate the boat itself must be included in this category, if poorly maintained these prove to be dangerous and can cause traumatic amputations.
- Fishermen face cuts that can range from small minor to deep cuts, the weight of the fishing net is much higher than that of the men pulling it, and a small mistake can very easily lead to chances of deep cuts that can pierce the skin bone-deep. Equipment that is rusted and not very strong and durable which often happens due to poor maintenance also can cut through the skin of a fisherman.

- **Physical hazards:** these types of hazards are the most life-threatening to the lives of Fishermen and have various ways and means to affect the lives of fisher-folk They are
- **Noise**: Operating loud machinery or working in noisy environments can lead to hearing loss and other related health problems. This occurs during working hours mainly in the form of constant revving of the engine, severity of the vibrations can be influenced by factors such as the engine's balance, the number of cylinders, and the quality of engine mounts. Any of these if faulty can increase the risk of musculoskeletal disorders such as hand-arm vibration syndrome, back pain, and joint pain, it causes an increase in the instability of the boat which causes the fisherman to lose his balance.
- **Vibrations:** Fishermen operating motorized boats or machinery may be exposed to whole-body vibrations or hand-arm vibrations. Prolonged exposure to these vibrations can cause musculoskeletal disorders, circulatory problems, and nerve damage.
- Weather changes are one of the fishermen's greatest challenges. These changes are highly unpredictable and so is the damage that they can cause. Strong storms are more than capable of destroying the entire boat and the fishermen on it.
- Fire hazards also come into this category as chemical hazards like oil spills and leaks can lead to fire and thereby cause the destruction of life.

- **Psychological hazards**: psychological hazards affect mental and emotional well-being mainly affecting productivity and attention levels, and they are
- **Work-related stress**: Fishermen often face long working hours, unpredictable income, and challenging working conditions, leading to mental and emotional stress. Other related factors are safety at sea, family, and social pressure to keep their legacy alive is an issue that is the lesser spoken about.
- **Isolation and separation**: Extended periods at sea can result in isolation from family and social networks, leading to feelings of loneliness and emotional strain.
- Fatigue can be caused due to various reasons, some of them being disrupted circadian rhythm that often occurs because of constantly-changing work schedules, long working hours, multiple days at sea, harsh weather conditions, and physical exertion. These can very often lead to tiredness, lack of energy, lack of productivity and therefore putting the fishermen's lives at high risk.

- **Biological hazards**: are substances, or organisms that cause damage to human beings, such as
- Skin infections are very commonly seen among fishermen. These occur due to two reasons, the first again being cuts, as we have already established that fishermen experience various types of cuts, now these cuts after being in constant contact with seawater and seawater, in turn, being highly polluted with various bacterial, fungal and parasitic agents growing on them. These agents once come in contact with these cuts, enter them and cause an infection and therefore create a repeatedly occurring biological hazard.

It is important to note that these hazards may overlap or interact with each other, leading to complex and compounded risks for fishermen. Implementing safety measures, providing proper training and education, promoting health awareness, and ensuring access to necessary safety equipment are crucial steps in mitigating these hazards and safeguarding the well-being of fishermen in Mumbai.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:6(2), June: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd June 2023
Publication Date:30th June 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.06.27
www.ijmer.in

Accidents and Injuries Experienced: There are various types of accidents that Fishermen come across daily. 35 (19.89%) have reported honestly that they experience many accidents frequently (almost weekly). The accidents that occur during work can be highly fatal and range from high risk to low risk, these fishermen complained about deep cuts and bruises, boats coming in contact with big ships, and big rocks. Fishermen also complained about the loss of colleagues after spending long hours in the deep sea where various weather change conditions, falling off the boat, etc.

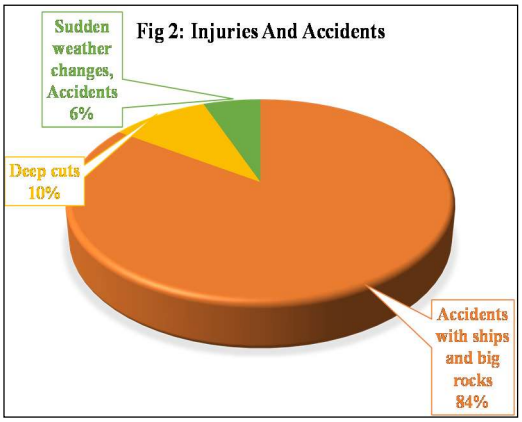


Fig 2: Injuries And Accidents

Cuts can also have many consequences as once the skin is open, there are very many chances that contaminated water, and fish diseases can enter the bloodstream, in turn, causing many diseases to lower the health of the Fishermen. They also come across disorders such as trench feet- a condition that is caused by constantly moving in and out of extreme temperatures like freezer units that are maintained on the boat to keep the fish fresh, Jellyfish stings- they are extremely painful and can cause a Fisherman to take big breaks between working hours which in turn can intensify the problem.

To summarise the study conducted in and around Mumbai's coastal regions highlighted the occupational hazards faced by fishermen and their impact on occupational health. The findings indicate that fishermen often have a family-oriented approach to their work, with wives playing an active role in selling the caught fish and contributing to the family income. The mindset of ultimately becoming part of the family business is prevalent among fishermen, leading to a majority of older fishermen in the industry.

Regarding occupational injuries, the study focused on factors related to the engineering aspects of the workstations, specifically the fishing boats. Financial constraints often limit the fishermen's ability to invest in better equipment and mechanics, which can compromise their safety. The study identified various hazards faced by fishermen, including chemical hazards from petrol/diesel leaks and exposure to paints and thinners. Physical hazards such as noise, vibration, manual material handling, slips, trips, falls, traumatic amputations, fires, falling overboard, flooding, and large cuts and bruises were also observed. One significant finding was that fishermen generally use minimal to no safety equipment, which can prevent accidents. This behavior can be attributed to a lack of emphasis on safety measures by their predecessors, leading to a disregard for personal protective equipment. Psychological issues were identified among fishermen due to factors such as fatigue, stress, disruption of circadian rhythm, and sleep deprivation. Spending multiple days and nights at sea in search of a good catch, while financially beneficial, takes a toll on their overall health. Lastly, the study highlighted the biological hazard of skin infections, which can pose significant risks to fishermen. These infections can result from exposure to various elements in the marine environment.

Overall, the study shed light on the occupational hazards faced by fishermen in Mumbai, including physical, chemical, psychological, and biological hazards. The findings underscore the importance of addressing these hazards through improved safety measures, financial support for better equipment, and initiatives promoting the well-being of fishermen in the industry.

VI. RECOMMENDATIONS BASED ON THE RESULTS OF THE STUDY: To help eliminate these difficulties faced by Fishermen, the researchers had to first understand how these difficulties occur, how severe their damage can be, and what kind of risk/damage can they cause to these fishermen during working hours.

Controlling the various hazards experienced by fishermen in Mumbai requires a combination of preventive measures and interventions tailored to specific types of hazards. Here are some control methods that are suggested and applicable to each type of hazard based on the results of this study:

- **For Ergonomic Hazards**
  - **Manual handling and lifting:** Promoting safe lifting techniques, providing mechanical aids (e.g., hoists, lifting equipment), and implementing ergonomically designed workstations to minimize the risk of musculoskeletal injuries.
  - Addressing these ergonomic hazards is crucial for ensuring the health, safety, and well-being of fishermen in Mumbai. Implementing ergonomic interventions, such as providing proper training on lifting techniques, promoting regular breaks and rest periods, improving workstation design and ergonomics, and raising awareness about the importance of ergonomic practices, can help mitigate these hazards and reduce the risk of occupational injuries and musculoskeletal disorders among fishermen.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:6(2), June: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd June 2023
Publication Date:30th June 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.06.27
www.ijmer.in

- **For Chemical Hazards**
  - **Pesticides and herbicides**: Educating fishermen about the potential risks and promoting the use of protective clothing and equipment when working in areas where these substances are used. Encouraging proper waste disposal practices to prevent contamination of water bodies.
  - **Heavy metals**: Monitoring and testing fish and water samples for heavy metal contamination, implementing fishing restrictions in polluted areas, and providing education on safe fish consumption practices.
  - Fuel and oil: Ensuring proper ventilation in boats, providing personal protective equipment (PPE) such as gloves and coveralls, and promoting regular maintenance of engines and fuel systems to minimize the risk of exposure to fuel and oil.
  - To mitigate these hazards, fishermen must receive proper training on chemical safety, use appropriate personal protective equipment, follow guidelines for handling and storage of hazardous substances, and be aware of any local advisories or restrictions on fishing in contaminated areas. Regular monitoring of water quality and fish contamination levels can also help identify potential risks and inform fishermen about safe consumption practices.
- **For Safety Hazards**
  - **Boat capsizing and drowning incidents:** Promoting the use of life jackets or personal flotation devices, conducting regular safety drills, and providing training on water safety and rescue techniques.
  - Slips, trips, and falls: Implementing good housekeeping practices, such as keeping work areas clean and free from clutter, and ensuring proper lighting and signage to prevent accidents.
- **For Physical Hazards**
  - **Mechanical accidents**: Providing training on proper handling and maintenance of equipment, conducting regular inspections, and implementing safety protocols to minimize the risk of machinery-related injuries.
  - **Noise-induced hearing loss**: Using hearing protection devices, such as earplugs or earmuffs, and implementing engineering controls, such as noise barriers or soundproof enclosures, to reduce exposure to excessive noise levels.
  - **Electrical hazards**: Ensuring proper maintenance and inspection of electrical systems on fishing vessels, providing electrical safety training, and implementing appropriate grounding and insulation measures.
- **For Psychosocial Hazards**
  - **Work-related stress**: Implementing measures to address work-life balance, promoting open communication and support networks among fishermen, and providing access to mental health support services.
  - Fatigue and long working hours: Implementing regulations or guidelines on working hours, encouraging rest breaks and adequate sleep, and promoting awareness about the importance of managing fatigue.
- **For Biological Hazards**
  - **Infectious diseases:** Promoting personal hygiene practices, such as frequent handwashing, and providing vaccinations or prophylactic treatments for common infectious diseases. Implementing proper waste management and sanitation practices on fishing vessels.
  - **Marine organisms and venomous species**: Providing education on the identification and handling of hazardous marine organisms, promoting the use of protective clothing and gloves, and implementing protocols for first aid and medical treatment in case of bites or stings.

It is very important that control methods should be tailored to the specific hazards identified in each fishing operation, and regular monitoring and evaluation should be conducted to assess the effectiveness of these control measures. Ergonomic re-assessment after 6 months of intervention can prove to give them a constant reminder of the importance of good occupational health and well-being.

SCOPE OF STUDY: The study on hazards experienced by fishermen in Mumbai has a wide scope and applicability for social causes. Understanding and addressing the occupational hazards faced by fishermen can have several positive implications for both the fishing community and society as a whole. Here are some key aspects of the study's scope and applicability:

- **Occupational health and safety improvement**: By identifying and analyzing the specific hazards faced by fishermen in Mumbai, the study can contribute to the development of targeted interventions and strategies to improve occupational health and safety in the fishing industry. This can help reduce the number of work-related accidents, injuries, and illnesses, promoting the well-being of fishermen.
- **Economic stability and sustainability**: The fishing industry is a significant source of livelihood for many fishermen and their families in Mumbai. By addressing the hazards and improving working conditions, the study can contribute to enhancing the economic stability and sustainability of the fishing community. Improved occupational health and safety measures can lead to increased productivity, better work efficiency, and reduced absenteeism due to injuries or health issues.

Cover Page

DOI: http://ijmer.in.doi./2023/12.06.27
www.ijmer.in

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:6(2), June: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd June 2023
Publication Date:30th June 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

- **Social well-being and quality of life:** Occupational hazards not only impact physical health but also have broader implications for the overall well-being and quality of life of fishermen and their families. By mitigating these hazards, the study can contribute to reducing physical pain, improving mental health, and enhancing the social well-being of fishermen. This, in turn, can have positive ripple effects on the community as a whole.
- **Policy development and advocacy**: Findings from the study can serve as valuable evidence for policy development, advocacy, and regulatory efforts aimed at improving the working conditions and safety standards for fishermen. It can inform policymakers, government agencies, and non-governmental organizations about the specific challenges faced by fishermen in Mumbai and guide the formulation of appropriate measures to protect their rights and ensure their well-being.
- **Knowledge dissemination and capacity building:** The study's findings can be disseminated through various channels, including scientific publications, workshops, and training programs. By sharing knowledge about the hazards and their mitigation strategies, the study can contribute to building the capacity of fishermen, fishing communities, and relevant stakeholders to address occupational hazards effectively. This empowers them to take proactive steps towards creating safer working environments and adopting best practices.

The study on hazards experienced by fishermen in Mumbai has the potential to make a meaningful impact on the occupational health and well-being of fishermen, promote economic stability, enhance social welfare, inform policies, and empower the fishing community. Its applicability for social good lies in improving the lives and livelihoods of fishermen and creating a safer and more sustainable fishing industry.

Biomechanical studies on various manual material handling tasks can be done to correlate it with the extent of back pain. Such studies can prove to be highly to further improve the occupational well-being of the city's fisherfolk.

References

- Amadou Barrow, A. K. (March 2022). Epidemiology of occupational hazards and injuries among fishermen at Tanji fishing site in The Gambia: an analytical cross-sectional study design. Environmental Health Insights.
- Bridger, R. S. (2003). Introduction to Ergonomics (3rd edition).
- CSR, I. (2023, May). Significance of the Fisheries Sector in the Indian Economy. Retrieved from https://indiacsr.in/significance-of-the-fisheries-sector-in-the-indian-economy/#:~:text=Maharashtra%20ranks%207th%20in%20fish,to%20inland%20fisheries%20(18%25).&text=The%20fisheries%20sector%20holds%20a,its%20overall%20growth%20and%20development
- Health and Safety Authority Booklet. Managing Health and Safety in Fishing. HSA publications available at www.hsa.ie
- https://journals.viamedica.pl/international_maritime_health/article/view/35797
- https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=%E2%80%9COccupational+Health+Risks+and+Etiologies+Among+the+Jalari+Community+of+Northern+District+of+Andhra+Pradesh%2C+&btnG=
- https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=A+population-based+cohort+study%2C%E2%80%9D+by+Linda+Kaerlev+%2C+Anker+Jensen%2C+Per+Sabro+Nielsen%2C+J%C3%B8rn+Olsen%2C+Harald+Hannerz+and+Finn+T%C3%BCchsen+.&btnG=
- https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=fisherman+related+to+musculoskeletal+problems+in+researches+in+india&btnG=#d=gs_qabs&t=1660809552864&u=%23p%3DoH0mHJr-pRgJ
- https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=OCCUPATIONAL+INJURIES+AND+HEALTH+PROBLEMS+IN+THE+EGYPTIAN+MEDITERRANEAN+FISHERIES&btnG
- https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=research+ergonomic+on+fisher+men+&btnG=#d=gs_qabs&t=1660288154641&u=%23p%3Dnf28Phm9iLgJ
- Jargen, M.C. and Hovmand S.R. Nordic Council of Ministers (2017). Prevention of Accidents at Work in Nordic Fisheries – what has worked?
- Marshall, S. W., et. al. (2004). Work-related injuries in small-scale commercial fishing. Injury Prevention 10:217-221.
- Neethiselvan R, G. S. (2021;8:732). Assessment of health-seeking behaviour among fishermen community in Puducherry. Int J Community Med Public Health.
- QEC method (Stanton, 2004)
- Rao, R. (2018). Introduction to Ergonomics. ISBN 978-93-5321-450-0.

INTERNATIONAL JOURNAL FOR INNOVATIVE RESEARCH IN MULTIDISCIPLINARY FIELD
ISSN(O): 2455-0620 [Impact Factor: 7.581]
Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value : 86.87
Volume - 9, Issue - 6, June - 2023 Publication Date: 30/06/2023

DOIs:10.2015/IJIRMF/202306032 --:-- Research Paper / Article / Review

Mapping Work- Related Musculoskeletal Discomfort (WRMSDs) Among Employees Of The BPO Sector Using A Body Map.

[1]Khushi. C., [2]Roopa. R.

[1] Corresponding Author, Student
Department of Community Resource Management, College of Home Science Nirmala Niketan, (Affiliated to the University of Mumbai), Mumbai – 400 020, Maharashtra State, India

[2] Assistant Professor
Department of Community Resource Management, College of Home Science Nirmala Niketan, (Affiliated to the University of Mumbai), Mumbai – 400 020, Maharashtra State, India

Email: khushi270203@gmail.com , [2] rooparao72@gmail.com,

Abstract: *The present study investigated the prevalence of Work-Related Musculoskeletal Disorders (WRMSDs) among 160 Business Process Outsourcing (BPO) employees in Mumbai and its suburbs. WRMSDs can arise from repetitive tasks and prolonged periods of sitting. The monotony of the workplace can negatively impact performance due to reduced concentration and boredom. BPO employees in Mumbai, akin to their counterparts in other cities, encounter various Musculoskeletal Disorders (MSDs) as a result of their job demands. The Cornell Musculoskeletal Disorder Questionnaire (CMDQ) was employed to assess the experienced discomfort. Findings demonstrated that the participants were prone to developing WRMSDs, with the lower back and neck being the most affected regions. Additionally, the study identified other work-related health issues such as Repetitive Strain Injuries (RSI), neck-shoulder pain, visual fatigue, and associated discomfort. To address these concerns, BPO companies should prioritize the provision of ergonomic workstations, adjustable furniture, regular breaks, training in proper posture, and education on the significance of maintaining a healthy work-life balance.*

Key Words: *BPO Employees, CMDQ, Ergonomics, Occupational Health, WRMSDs.*

1. INTRODUCTION:

In today's rapidly changing, extremely competitive business environment, many businesses from small startups to established corporations – choose to outsource certain services. This is where Business Process Outsourcing (BPO) comes in handy. BPO centers are also known as a call. In many BPO call centers, some agents may stand in for a variety of different businesses, frequently within certain expertise, and individually handle consumer complaints or inquiries. Picking up calls and talking to various customers can be very monotonous. Workplace monotony can lead to poor performance because of lack of concentration and boredom, as well as Work-related Musculoskeletal Disorders (WRMSDs) because of repetitive tasks and prolonged sitting hours. WRMSDs or work–related Musculoskeletal Disorders, are a class of acute conditions affecting the muscles, tendons, and nerves. Examples include tension neck syndrome, thoracic outlet syndrome, tendinitis, and carpal tunnel syndrome. It is difficult to pay attention and be productive due to physical discomfort brought on by elements at work (repetitive motion, poor workstation design, prolonged sitting hours, etc.), which can influence the employee's productivity, which in turn can harm the organization. So, it is crucial to ensure that staff are at ease at work.

2. LITERATURE REVIEW:

The rationale for the above study lies in the need to investigate and understand the prevalence of Work-Related Musculoskeletal Disorders (WRMSDs) among Business Process Outsourcing (BPO) employees in Mumbai. BPO work often involves repetitive tasks and prolonged periods of sitting, which can contribute to the development of

musculoskeletal issues. By examining the occurrence of WRMSDs and associated discomfort, the study aims to shed light on the specific areas of vulnerability within the BPO workforce in Mumbai and its suburbs. Work-related musculoskeletal problems comprise a substantial cause of employee disability and lost income. Here, the employee's BMI was considered the primary factor when conducting the study (Sethi, J., et al., 2011). There are no studies that concentrate on the WRMSDs that could be brought on by poor workstation design, excessive hours, insufficient breaks, the workplace environment

Understanding the prevalence of WRMSDs is crucial for several reasons. Firstly, it helps identify the extent of the problem and its impact on the well-being and productivity of BPO employees. This information can guide the development and implementation of targeted interventions to mitigate the risk of WRMSDs. Secondly, by pinpointing the most affected areas, such as the lower back and neck, the study can provide valuable insights into the specific ergonomic challenges faced by BPO employees. This knowledge can inform the design of ergonomic workstations and the provision of appropriate furniture to alleviate discomfort and reduce the occurrence of WRMSDs.

Moreover, investigating the relationship between workplace monotony and WRMSDs contributes to the broader understanding of how psychosocial factors can influence musculoskeletal health. The study recognizes that monotonous work environments can impact performance, concentration, and overall job satisfaction, potentially exacerbating the risk of WRMSDs. By highlighting this connection, the study underscores the importance of addressing not only physical ergonomic factors but also psychosocial aspects to promote a healthier and more productive work environment. Ultimately, the study aims to improve the well-being, health, and performance of BPO employees by identifying the prevalence of WRMSDs and informing the development of appropriate interventions and preventive measures.

3. SPECIFIC OBJECTIVES:

The specific objectives are to (i) understand the demographic profile of the employees in the BPO sector from Mumbai city and its suburbs; (ii) analyze the prevalence of musculoskeletal discomfort experienced with the help of Cornell Musculoskeletal Disorder Questionnaire (CMDQ); and (iii) provide strategies to mitigate its occurrence.

4. METHOD:

A survey-based exploratory study was conducted among 160 employees (70 female and 90 male) from 4 major BPO offices in Mumbai city and its suburbs. An exploratory study investigates problems that have not been thoroughly examined before. A self-constructed and validated questionnaire was employed to conduct structured interviews with each randomly selected participant. The questionnaire was divided into 3 sections; demographic profile, work-related profile, and body map (CMDQ). CMDQ is an open-to-use source ware prepared by Dr. Alan Hedge and his students at Cornell University (https://ergo.human.cornell.edu/ahmsquest.html). Simple statistics were used to analyze data in an MS Excel sheet (version 2009). The analyzed results were presented using pivot tables, graphs, and charts.

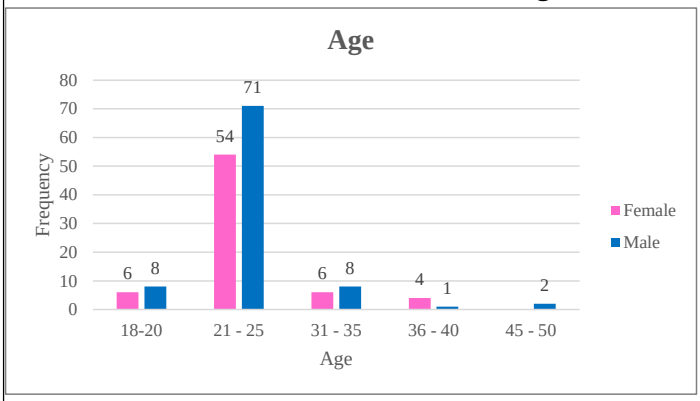
5. DISCUSSION & RESULT:

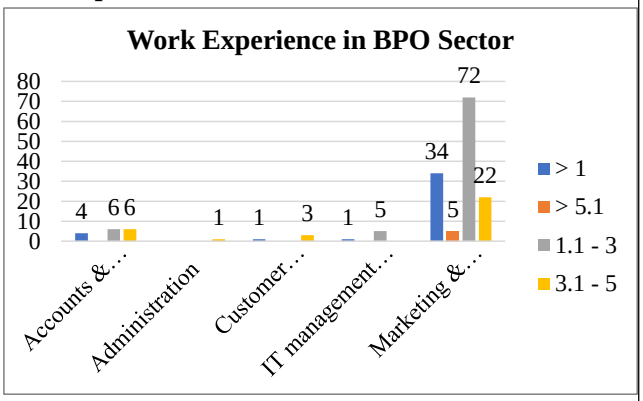
Demographic Profile:

The profile analysis offers comprehensive facts regarding research participants who are a representative sample of the whole target group. The researchers can use it to determine how closely the sample represents the population. The highlights of the profile of the sample are as follows:

- The average age of the sample is _____ years.
- 90 (56%) of the participants were male and 70 (43%) females.
- 86 (53%) are graduates having 19 (11%) have less than one year of related work experience.
- 46 (28%)] have 1.1 - 3 years of experience and, a few [3 (1%)] have more than 5.1 years of related work experience.
- Of all the participants the most affected age group is 21-25 years, of which [91(%)] face no health issues but 31 (19.4%) of them face health issues. Health issues such as headache, eye strain, strained vocal cords, and any psychological disorders, etc. were reported.

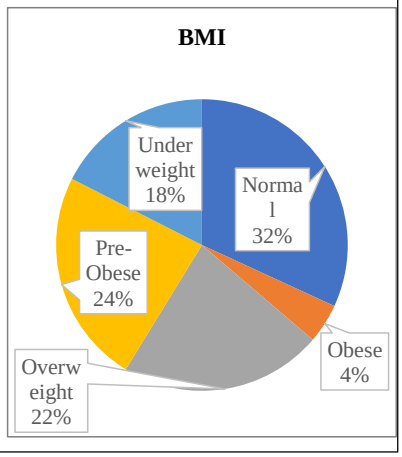
Fig 1: Profile of the Sample





Common Health Complaints

Health Complaints	Yes		No	
	f	%	f	%
Headaches	81	50.6	79	49.4
Strained Vocal Cords	39	24.4	121	75.6
MS Pains/Discomfort	96	60.0	64	40.0
Eye Strain	63	39.4	97	60.6
Insomnia	44	27.5	116	72.5
Mental weariness	8	5.0	152	95.0
Digestive tract issues	10	6.3	150	93.8



Musculoskeletal Discomfort Experienced

The musculoskeletal discomfort was mapped using the Cornell Modified Discomfort Questionnaire (CMDQ - Cornell University, 1999). The Cornell Musculoskeletal Disorder Questionnaire (CMDQ) can be successfully used to map Musculoskeletal Disorders (MSDs) by following a systematic and comprehensive approach. The CMDQ can be effectively used to map MSDs among BPO employees in Mumbai and its suburbs. The questionnaire provides a standardized approach to collecting data on discomfort and enables a comprehensive assessment of the prevalence and severity of MSDs in different body areas, facilitating evidence-based decision-making for interventions and preventive measures.

Fig 2: Prevalence of MS Discomfort

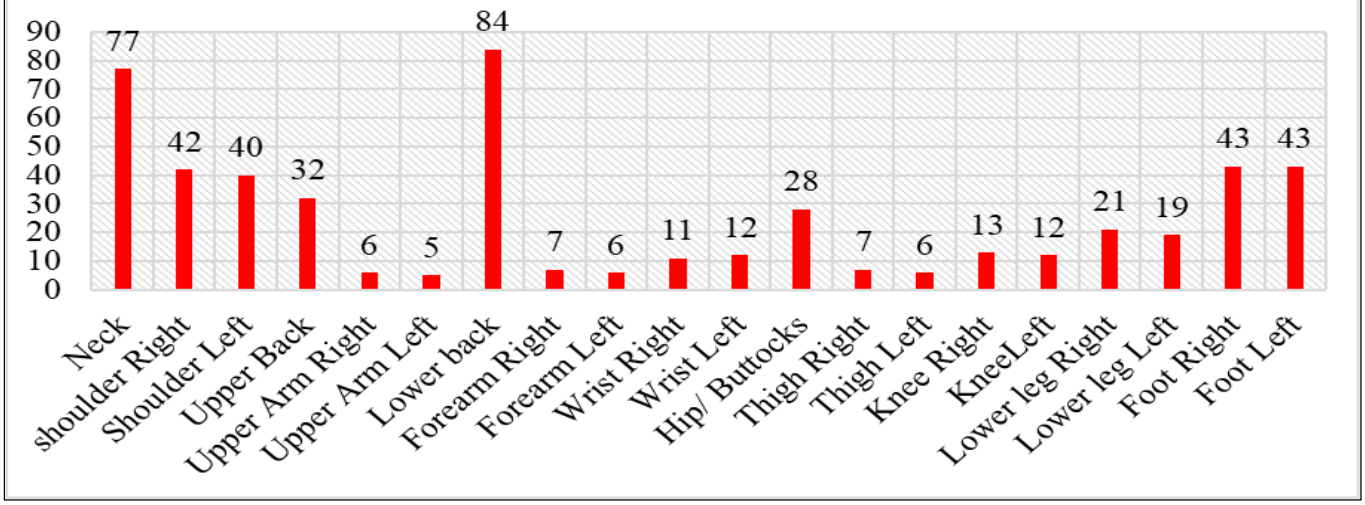


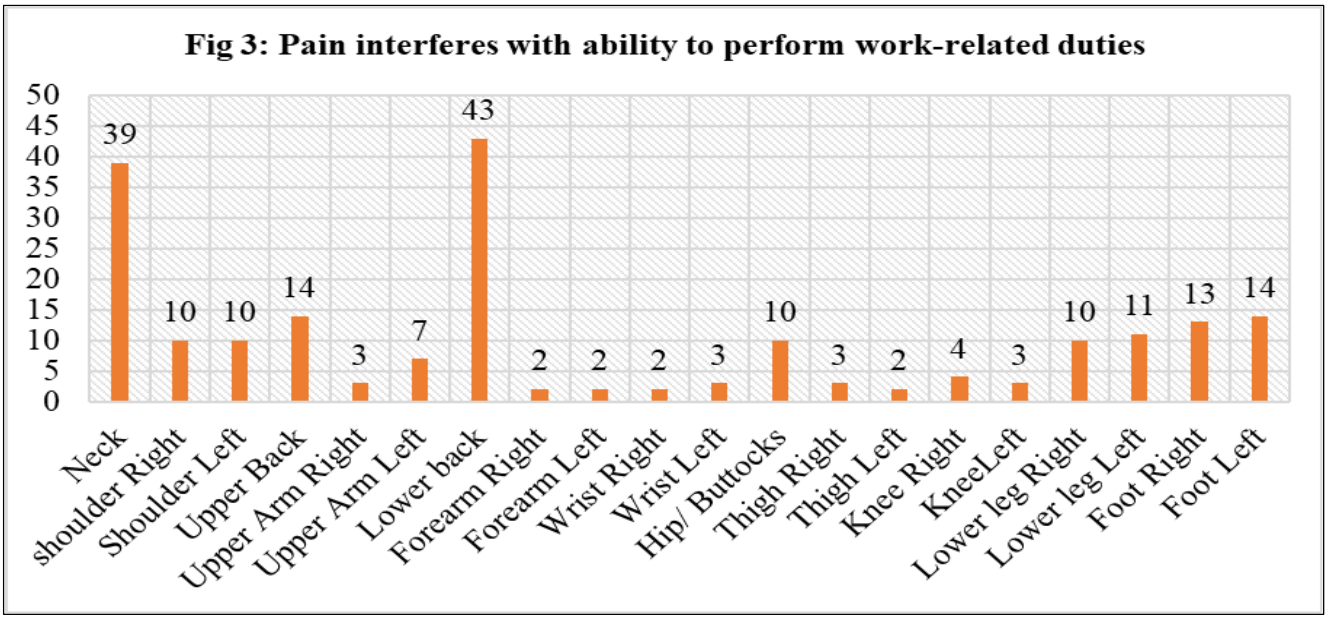
Table A: Prevalence of Body Pains/Aches										
	0		1		2		3		4	
Body site	f	%	f	%	f	%	f	%	f	%
Neck	83	51.9	32	20.0	19	11.9	16	10.0	10	6.3
shoulder (R)	118	73.8	18	11.3	16	10.0	6	3.8	2	1.3
Shoulder (L)	120	75.0	18	11.3	13	8.1	5	3.1	4	2.5
Upper Back	128	80.0	16	10.0	12	7.5	3	1.9	1	0.6
Upper Arm (R)	154	96.3	2	1.3	3	1.9	0	0.0	1	0.6
Upper Arm (L)	155	96.9	1	0.6	4	2.5	0	0.0	0	0.0
Lower back	76	47.5	20	12.5	35	21.9	23	14.4	6	3.8
Forearm (R)	153	95.6	2	1.3	3	1.9	0	0.0	2	1.3
Forearm (L)	154	96.3	4	2.5	2	1.3	0	0.0	0	0.0
Wrist (R)	149	93.1	5	3.1	5	3.1	1	0.6	0	0.0
Wrist (L)	148	92.5	7	4.4	4	2.5	1	0.6	0	0.0
Hip/ Buttocks	132	82.5	8	5.0	11	6.9	9	5.6	0	0.0
Thigh (R)	153	95.6	5	3.1	21	13.1	0	0.0	0	0.0
Thigh (L)	154	96.3	5	3.1	1	0.6	0	0.0	0	0.0
Knee (R)	147	91.9	6	3.8	1	0.6	4	2.5	2	1.3
Knee (L)	148	92.5	5	3.1	1	0.6	4	2.5	2	1.3
Lower leg (R)	139	86.9	9	5.6	8	5.0	4	2.5	0	0.0
Lower leg (L)	141	88.1	8	5.0	7	4.4	4	2.5	0	0.0
Foot (R)	117	73.1	20	12.5	16	10.0	7	4.4	0	0.0
Foot (L)	117	73.1	20	12.5	16	10.0	7	4.4	0	0.0

In the study involving 160 participating employees, it was observed that a significant proportion experienced discomfort in various areas of their bodies. Specifically, 77 individuals (48%) reported neck pain, while 84 employees (52%) indicated lower back pain. Moreover, 42 employees (26%) expressed discomfort in their right shoulder, and 40 employees (25%) reported pain in their left shoulder. Upper back pain was reported by 32 employees (20%), while 28 employees (17%) experienced discomfort in their hip and buttocks region.

Regarding the perceived level of discomfort, it was found that 75 employees (46%) found the pain in their neck area to be uncomfortable. In addition, 42 employees (26%) experienced discomfort in their right shoulder, whereas 40 employees (25%) suffered from pain in their left shoulder. Lower back discomfort was reported by 82 employees (26.9%). Furthermore, a smaller proportion of employees (6%) found the pain in their upper arm to be uncomfortable, while 43% expressed that foot pain caused significant discomfort.

Additionally, the study revealed that the reported pain experienced by employees had a noticeable impact on their workability. Specifically, 43% of the employees attributed their reduced workability to lower back pain. Furthermore, 39% of employees reported that neck pain adversely affected their workability. Concerning shoulder pain, 10% of the employees indicated that their workability was disrupted by pain in their right or left shoulder.

These findings underscore the significant correlation between musculoskeletal pain and work ability among BPO employees. By recognizing the impact of pain on work performance, it becomes crucial for organizations to prioritize interventions that address these specific areas of discomfort. Improving work conditions and providing necessary support can help alleviate pain and enhance the overall workability and productivity of employees. Such information can inform targeted interventions and strategies aimed at addressing these musculoskeletal issues and improving the overall well-being of the employees.



6. SUGGESTIONS BASED ON THE RESULTS OF THE STUDY:

The control hierarchy can be utilized to effectively mitigate health issues among employees in the BPO sector. The control hierarchy is a systematic approach that prioritizes strategies to control and eliminate workplace hazards. Based on the results of the study, here are a few effective solutions to mitigate the occurrence of bodily discomfort:

a. Elimination/Substitution:

The highest level of control is to eliminate or substitute the hazard altogether. BPO companies can assess the work processes and identify tasks that contribute to musculoskeletal issues. By eliminating or substituting these tasks with less physically demanding alternatives, the risk of developing health issues can be significantly reduced. For example, implementing voice recognition software or automated systems to reduce excessive typing and mouse usage can help alleviate repetitive strain injuries.

b. Engineering Controls:

If elimination or substitution is not feasible, engineering controls should be implemented. This involves modifying the work environment or equipment to reduce the risk of injury. BPO companies can:

- Provide ergonomic workstations and adjustable furniture to ensure proper posture and reduce strain on the body.
- Use ergonomically designed keyboards, mouse, and other input devices that minimize stress on the hands and wrists.
- Install adjustable monitor stands to promote proper eye level and reduce neck strain.
- Implement proper lighting and glare reduction measures to minimize visual fatigue.
- Identify the hazards in the work environment. Implement appropriate changes into action.

c. Administrative Controls:

Administrative controls focus on modifying work practices and policies to reduce exposure to hazards. BPO companies can:

- Implement regular breaks and rotation of tasks to minimize prolonged sitting and repetitive motions. Provide training and education on proper posture, ergonomics, and the importance of taking breaks.
- Encourage employees to report any discomfort or early signs of musculoskeletal issues for prompt intervention.
- Promote a culture of health and wellness, including initiatives like exercise programs and stress management.
- To avoid or lessen monotony, diversify tasks using two main strategies: job rotation and job enlargement
- Change your work hours, pace, or procedures. Limit the amount of time an employee is required to work
- To organize workshops for the employees where they are given information regarding MSDs and their harmful impact on the body.

d. Personal Protective Equipment (PPE):

Personal protective equipment should be considered as the last line of defence. While PPE may not directly address MSDs, it can provide additional support and protection. BPO companies can:

- Provide employees with wrist supports, lumbar cushions, and other ergonomic aids as necessary.
- Select proper PPE while working
- Do not spend extended periods sitting or performing repetitive tasks. Every 30 minutes, take a short break to stand, stretch, and move.
- Adjust the workstation according to the employee.

It is important to note that the control hierarchy should be implemented in a holistic and integrated manner. A combination of multiple control measures is often necessary to effectively mitigate health issues among BPO employees. Regular monitoring, evaluation, and feedback from employees can help refine and improve these control measures over time.

7. SCOPE OF THE STUDY:

This study on Musculoskeletal Disorders (MSDs) among Business Process Outsourcing (BPO) employees in Mumbai city and its suburbs is primarily focused on investigating the prevalence of Work-Related Musculoskeletal Disorders (WRMSDs) within this specific population. The study aims to assess the extent of MSDs among BPO employees and identify the areas of the body that are most affected by these disorders. Furthermore, the study seeks to explore the impact of workplace monotony on MSDs and employee performance. It examines how repetitive tasks and prolonged sitting hours contribute to the development of MSDs and the potential consequences on concentration, job satisfaction, and overall productivity. The study acknowledges the importance of addressing the identified issues and suggests potential measures to mitigate MSDs among BPO employees. It highlights the significance of ergonomic workstations, adjustable furniture, regular breaks, training on proper posture, and promoting a healthy work-life balance as possible interventions to alleviate discomfort and reduce the occurrence of WRMSDs.

The scope of the study is limited to BPO employees in Mumbai City and its suburbs, providing insights into the specific challenges faced by this workforce concerning MSDs. The findings and recommendations from this study can potentially be utilized by BPO companies in the region to enhance their work environments and support the well-being of their employees. However, it is important to note that the study's scope does not extend to evaluating the effectiveness of implemented interventions or exploring the long-term outcomes of addressing MSDs in this context.

AUTHOR'S STATEMENTS:

- Acknowledgment: The authors express their sincere gratitude to the BPO offices and their employees for their invaluable contributions to this research study.
- Informed Consent: Before their participation, all 160 participants provided written informed consent, demonstrating their understanding of the study's objectives, procedures, and potential risks.
- Conflict of Interest: The authors disclose that they have no conflicting interests that could potentially influence the objectivity or integrity of the research conducted.

REFERENCES:

1. Karthikeyan, K. et. al. (2023). Journal of Industrial Pollution Control. Available at https://www.icontrolpollution.com/articles/occupational-health-hazards-in-bpoprofessionals--case-study-.php?aid=37447#0
2. Cornell Musculoskeletal Discomfort Questionnaires (CMDQ). https://ergo.human.cornell.edu/ahmsquest.html
3. Raja JD, Bhasin SK. Health issues amongst call center employees, an emerging occupational group in India. Indian J Community Med. 2014 Jul;39(3):175-7
4. Rao, R. (2018). Introduction to Ergonomics. ISBN 978-93-5321-450-0.
5. https://bmcsportsscimedrehabil.biomedcentral.com/articles/10.1186/1758-2555-3-22
6. https://www.cdc.gov/workplacehealthpromotion/health-strategies/musculoskeletal disorders/index.html
7. https://www.cdc.gov/workplacehealthpromotion/health-strategies/musculoskeletal-disorders/evaluation-measures/index.html

Certificate of Publication

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

E-ISSN: 2348-1269, P-ISSN: 2349-5138

The Board of

International Journal of Research and Analytical Reviews (IJRAR)

Is hereby awarding this certificate to

Roopa Rao

In recognition of the publication of the paper entitled

ASSESSMENT OF WORKPLACE ENVIRONMENT OF BPO EMPLOYEES

Published In IJRAR (www.ijrar.org) UGC Approved - Journal No : 43602 & 7.17 Impact Factor

Volume 10 Issue 2 June 2023, Date of Publication: 08-June-2023

PAPER ID : IJRAR23B4010

Registration ID : 268386

R.B.Joshi

EDITOR IN CHIEF

UGC and ISSN Approved - Scholarly open access journals, Peer-reviewed, and Refereed Journals, Impact factor 7.17 (Calculate by google scholar and Semantic Scholar | AI-Powered Research Tool) , Multidisciplinary, Monthly Journal

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS | IJRAR

An International Scholarly, Open Access, Multi-disciplinary, Indexed Journal

Website: www.ijrar.org | Email: editor@ijrar.org | ESTD: 2014

Manage By: IJPUBLICATION Website: www.ijrar.org | Email ID: editor@ijrar.org

IJRAR | E-ISSN: 2348-1269, P-ISSN: 2349-5138

Certificate of Publication

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

E-ISSN: 2348-1269, P-ISSN: 2349-5138

The Board of

International Journal of Research and Analytical Reviews (IJRAR)

Is hereby awarding this certificate to

Falguni parmar

In recognition of the publication of the paper entitled

ASSESSMENT OF WORKPLACE ENVIRONMENT OF BPO EMPLOYEES

Published In IJRAR (www.ijrar.org) UGC Approved (Journal No : 43602) & 7.17 Impact Factor

Volume 10 Issue 2 June 2023, Date of Publication: 08-June-2023

PAPER ID : IJRAR23B4010

Registration ID : 268386

R.B.Joshi

EDITOR IN CHIEF

UGC and ISSN Approved - Scholarly open access journals, Peer-reviewed, and Refereed Journals, Impact factor 7.17 (Calculate by google scholar and Semantic Scholar | AI-Powered Research Tool) , Multidisciplinary, Monthly Journal

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS | IJRAR

An International Scholarly, Open Access, Multi-disciplinary, Indexed Journal

Website: www.ijrar.org | Email: editor@ijrar.org | ESTD: 2014

Manage By: IJPUBLICATION Website: www.ijrar.org | Email ID: editor@ijrar.org

IJRAR | E-ISSN: 2348-1269, P-ISSN: 2349-5138

IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

ASSESSMENT OF WORKPLACE ENVIRONMENT OF BPO EMPLOYEES

[1]Falguni K. P., and [2]Roopa R.

Department of Community Resource Management, College of Home Science Nirmala Niketan, (Affiliated to the University of Mumbai), Mumbai – 400 020, Maharashtra State, India

Abstract: The Business Process Outsourcing (BPO) industry has witnessed significant growth, driven by cost reduction, enhanced efficiency, and improved service quality. However, the health and well-being of employees often receive inadequate attention, leading to poor workstations and working environments. This study aims to assess the workplace environment of BPO employees, focusing on factors such as noise levels, illumination, indoor air quality, and ventilation. A thorough evaluation was conducted to understand the existing conditions and identify areas of improvement. The assessment revealed a lack of acoustic treatment in the majority of BPO companies, resulting in significant sound-related issues for employees. Indoor air quality and ventilation systems also demand attention. Ensuring proper air circulation, ventilation, and efficient removal of pollutants is essential to safeguard the respiratory health of employees. Regular maintenance and cleaning of ventilation systems, as well as the implementation of air filtration mechanisms, are strongly advised. This study highlights the significance of creating a supportive and healthy workplace environment for BPO employees. By addressing the identified shortcomings and implementing the suggested measures, BPO companies can enhance employee well-being, job satisfaction, and overall productivity. Additionally, fostering a culture of employee health and safety will contribute to the long-term success and sustainability of the BPO industry. It is recommended that BPO companies proactively invest in improving their workplace environments, integrating ergonomic principles, and adhering to occupational health and safety standards. The findings of this study can serve as a valuable guide for decision-makers, human resource professionals, and facility managers in the BPO sector to develop effective strategies and policies that prioritize employee health and create a conducive work environment.

Keywords: **BPO employees, Ergonomics, Occupational Health, Work Environment**

I. INTRODUCTION

India has the highest number of Business Process Outsourcing (BPO) services with a high work delivery rate, catering mainly to Western operations of multinational corporations. The Indian BPO industry has been a global leader in offshore outsourcing since the early 1990s. India has emerged as one of the world's leading outsourcing destinations. It was driven primarily by the Indian IT services sector. Multiple factors that have contributed to India's success in the BPO space are: India's highly skilled and educated workforce; Lower cost of services provided than any other country; delivery of a wide range of services that are in high demand; favourable and liberalized policy framework also helps boost the Indian IT outsourcing market. The industry is expected to grow at an 8% CAGR and reach US$225-250 billion by 2025 (India's ITES-BPO industry is expected to grow at 8 percent CAGR, reaching US$225-250 bn by 2025 (theprint.in). This growth is being propelled by the increasing demand for digital services, which is being driven by the growth of new technology-focused businesses and the explosion in data volumes.

However, the employees in the BPO sector in Mumbai face several challenges that can impact their well-being and work experience. These challenges include Workload and Work Pressure due to the strict deadlines in handling large volumes of work; Shift Work and Irregular Schedules that typically involve round-the-clock service leading to rotating shifts and irregular work schedules; Monotonous and Repetitive Tasks which often involve performing repetitive tasks, such as data entry or customer support, for extended periods; Health Risks and Sedentary Lifestyle; Technological Challenges; Communication and Language Barriers which presents itself while interacting with clients and customers from different regions and cultures; Stressful Customer Interactions; Career Growth and Job Insecurity due to high attrition rates and limited career growth opportunities; Transport and Commuting Issues due to Mumbai's traffic congestion and long commuting times.

Addressing these challenges requires a multi-faceted approach, including implementing employee support programs, promoting work-life balance, providing training and career development opportunities, ensuring a healthy work environment, and fostering a positive organizational culture. By addressing these challenges, BPO companies can enhance employee well-being, engagement, and overall job satisfaction. Implementing measures such as workload management, ergonomic interventions, improved shift scheduling, supportive work environments, and stress reduction initiatives can help mitigate the negative impact of these factors on employee health.

II. JUSTIFICATION FOR THE STUDY

BPO employees spend a substantial portion of their lives in the workplace, and their well-being is crucial for their overall quality of life. Understanding the factors that impact their occupational health can help identify areas where improvements can be made to enhance their well-being. Employee health and well-being directly influence productivity and performance levels. A conducive work environment promotes employee engagement, reduces absenteeism, and enhances job satisfaction, leading to increased productivity and improved overall performance of the organization. The reputation of the BPO sector as a whole can be influenced by the well-being and occupational health of its employees. Organizations that demonstrate a commitment to creating a healthy work environment can contribute to improving the industry's image and attracting more clients and business opportunities.

Addressing the physical work environment factors requires proactive measures from employers. Conducting regular assessments and audits of the workplace, seeking employee feedback, and implementing appropriate modifications and improvements can help create a safer and more supportive work environment for BPO employees, thereby promoting their overall occupational health and well-being.

III. SPECIFIC OBJECTIVES

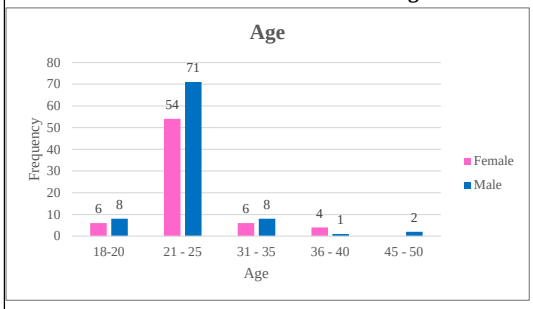
The study aims to identify the factors that affect the occupational health of the employees from the BPO sector, with the specific objectives being: to (i) learn about the demographic profile of employees in the BPO industry; (ii) evaluate the working environment, and its effects on BPO employees; and (iii) provide ergonomic suggestions to improve the working environment of BPO sector.

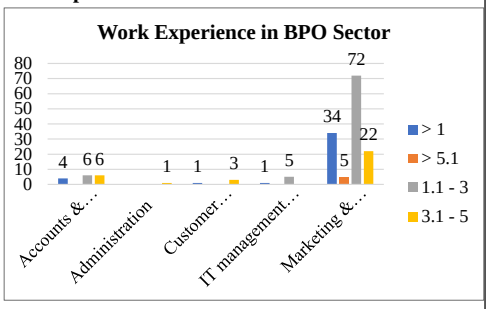
IV. METHODOLOGY

An exploratory study was conducted among 160 (90 male and 70 female) employees from 4 major BPO centres located in Mumbai city & its suburbs. An exploratory research design is mainly used when conducting research where there is no pre-existing knowledge. A non-probability sampling technique was used to select the participants (aged 19 -4 5 years).

A Self-constructed and validated questionnaire was used to elicit demographic data such as age educational qualification, years of experience, and general health status. The work environment was assessed using the Ergonomic Work Environment Assessment (EWA) checklist. The questionnaire was divided into 3 sections; Part A included questions about the demographic profile of the BPO employees; Part B consisted of work-related information and Part C included the ERA checklist. A structured interview on-site helped collect the required information. The data was coded and systematically analyzed using the pivot table tools in an MS Excel sheet (version 2009) and simple statistics such as average, median, and percentages. The analyzed results were presented using pivot tables, graphs, and charts.

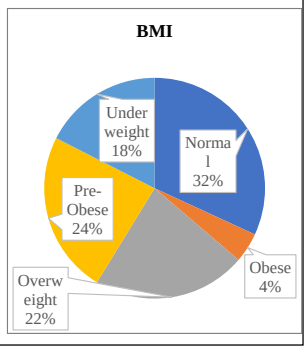
Fig 1: Profile of the Sample





Common Health Complaints

Health Complaints	Yes		No	
	f	%	f	%
Headaches	81	50.6	79	49.4
Strained Vocal Cords	39	24.4	121	75.6
MS Pains/Discomfort	96	60.0	64	40.0
Eye Strain	63	39.4	97	60.6
Insomnia	44	27.5	116	72.5
Mental weariness	8	5.0	152	95.0
Digestive tract issues	10	6.3	150	93.8



V. RESULTS AND DISCUSSION:

- **Profile of the Sample:** Demographic profile includes personal and common information about individuals like age, sex, Marital status, and educational qualification. This information helps the researcher to study the individual's background.

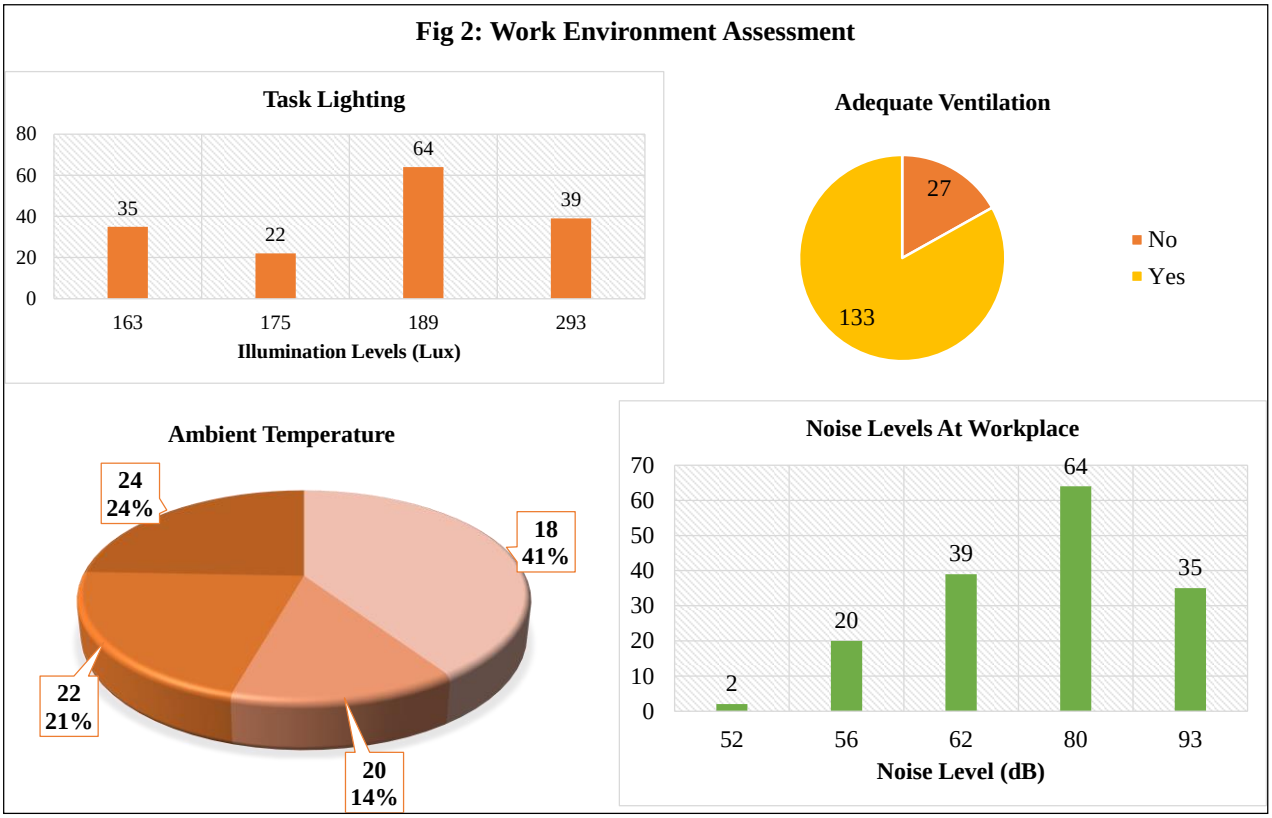
As observed in Fig. 1 the average age of the sample is 25 years, with a majority of [125 (78.1%)] participants belonging to the young age group 21 – 25 years. [90 (56%)] are male participants and [70 (44%)] are female participants. A larger section of the sample [126 (78.8 %)] are not married and [34(21%)] married. The educational qualification of BPO employees is majorly graduation [86(54%)], with a small percentage being [5(9%)] being post-graduates. [138 (86.3%)] earned approximately Rs. 15,000 – 30.000 per month, whereas [12 (7.5%)] earned upto Rs. 45,000/-

Work Environment Assessment: The Ergonomic Work-Environment Assessment (EWA) was done by using the open-to-use checklist The checklist included questions regarding the illumination, noise, ventilation, and ambient temperature of the workplace. The responses were either Yes or No. The illumination and noise levels were measured by a lux meter and sound meter.

The average task lighting is 206.7 lux whereas the recommended illumination level for any desk work is up to 300 lux. Despite having highly illuminated general lighting, the task lighting was below the recommended levels. The majority of employees [64 (40 %)] had a task lighting of 189 lux whereas [39 (24.3%)] had 293 lux. 293 lux is an almost adequate illumination level, but quite contrary to this only [2(1.3%)] reported that the illumination levels at the workplace are inadequate.

The average noise level was recorded as 75 dB which is well within the recommended levels for any workplace. The lowest recorded was 52 dB and the highest was 93 dB. 93 dB is above the recommended levels and was recorded at [35 (21.9%)] participants' workplaces.

Fig 2: Work Environment Assessment



Many employees [133 (83%)] reported adequate ventilation in their workplace and [27 (17%)] reported inadequate ventilation. [129 (81%)] claimed that they have clean & unobstructed ventilation ducts installed in the workplace whereas [31 (20%)] said they do not have clean & unobstructed ventilation ducts. At [65 (41%)] workplaces 18 degrees Celsius was recorded as the ambient temperature followed by 24 degrees Celsius at [39 (24.3%)] workplaces and 22 degrees Celsius in [34 (21.2%)] workplaces. [22 (14%)] Workplaces recorded the ambient temperature as 20 degrees Celsius. 22oC – 24oC is recommended as the ideal workplace temperature. This is evident when the participants were asked if the work environment was comfortable - the majority [98 (61.2%)] reported that they did not do not have a comfortable indoor temperature at their workplace whereas [62 (39%)] that their workplace temperature was comfortable.

To summarize the findings, the study involved 160 participants from the BPO sector, with an average age of 25 years. Many employees (82%) belonged to the age group of 21-25 years, with a higher representation of males (56%) compared to females (44%) among the participants. Education-wise, most participants were graduates (54%), followed by 12th pass (35%), post-graduates (9%), and a small percentage with diplomas and 10th pass qualifications (1%).

Regarding the physical work environment, all the surveyed companies had visible illumination in their work areas. However, the recommended lux level of 200 for tasks like reading and writing was not met. Many employees (64) had an illumination level of 189 lux, followed by 39 employees with 293 lux, 35 employees with 163 lux, and 22 employees with 175 lux.

In terms of ventilation, most companies had clean and unobstructed ventilation ducts in place, providing fresh and clean air for 133 out of 160 participants. However, 31 employees reported inadequate ventilation, which could be attributed to obstructed ducts or proximity to smoking zones.

The study also revealed that a significant number of employees (98) did not have a comfortable indoor temperature due to low Air Conditioner settings of 18 degrees Celsius in most companies. In terms of sound levels, many companies had a noise level of 80 dB, which exceeds the recommended limit for employee safety. Prolonged exposure to noise levels above 70 dB can potentially cause hearing damage.

These findings highlight the need for improvements in the work environment of BPO employees, such as ensuring appropriate illumination levels, addressing ventilation issues, regulating indoor temperatures, and implementing measures to reduce excessive noise. By addressing these factors, employers can create a healthier and more conducive workplace environment, promoting the well-being and safety of their employees.

VI. SUGGESTIONS BASED ON THE RESULTS OF THE STUDY

Workplace safety & knowledge of ergonomics has three levels that can help the workers to have a healthy work profile. Based on the findings of the study, the following control methods can be suggested according to the control hierarchy to address the workplace environment factors and promote the occupational health of BPO employees in Mumbai:

Elimination/Substitution:

- Implementing noise control measures, such as using soundproofing materials, to reduce noise levels in the work area.
- Exploring the use of alternative technologies or equipment that produce lower noise levels.

Engineering Controls: Engineering control reduce or prevent hazards from encountering workers.

- Installing acoustic treatment walls or barriers to minimize sound transmission.
- Improving the illumination levels by increasing the number of light sources or using brighter bulbs to meet the recommended lux levels for reading and writing tasks.
- Enhancing ventilation systems by ensuring clean and unobstructed ventilation ducts throughout the workplace.
- Optimizing the indoor temperature settings to provide a comfortable working environment, considering the preferences and thermal comfort needs of employees.

Administrative Controls:

- Adequate rest breaks involve reducing the time during the working day that an employee is exposed to the hazards, by giving the employee either other work or rest periods. Overall One hour break should be provided to the employees which includes mid-morning, lunch, and tea breaks.
- Training & Development, training helps people acquire the skills, knowledge, and attitude to make them competent in the health and safety aspect of their work.
- Conducting regular training and information dissemination workshops/seminars on the importance of good occupational health and well-being.
- Educating employees on the proper use and maintenance of PPE and promoting their consistent use in noisy environments
- Implementing policies and procedures to regulate noise levels and minimize exposure time to high-noise environments.
- Establishing designated smoking areas away from the main work areas to reduce the impact of secondhand smoke on ventilation quality.
- Regularly monitoring and maintaining ventilation systems to ensure proper functioning and air quality.

Personal Controls:

- Providing employees with suitable hearing protection devices, such as earplugs or earmuffs, to mitigate the effects of high noise levels.
- Proper use and maintenance of PPE and promote their consistent use in noisy environments.
- Exercising, yoga, and fun activities like games to lower the workload, light up the pressure and maintain a loving and friendly working environment.

VII. SCOPE OF THE STUDY

The study results can contribute to the formulation of policies and guidelines focused on occupational health and safety in the BPO sector. These policies may include provisions for ergonomic standards, shift scheduling practices, break durations, and overall well-being initiatives. By integrating the study findings into policy development, organizations can create a supportive framework that prioritizes employee health and reduces occupational health risks.

Effective Training and Education programs can be designed. Employees can receive training on ergonomics, workstation setup, proper lifting techniques, and stress management techniques. Education can also focus on raising awareness about the importance of maintaining a healthy work-life balance, managing work-related stress, and recognizing early signs of health issues. By providing employees with knowledge and skills, they can actively participate in maintaining their health and well-being.

Based on the study findings, employers can implement physical modifications in the workplace to address identified health issues. The study results can also foster a culture of employee engagement and support. By sharing the findings with employees, organizations can demonstrate their commitment to their well-being. Employee feedback can be sought to gain insights into their experiences and preferences, allowing organizations to tailor interventions and initiatives to meet their specific needs.

Overall, the implementation of study results requires a collaborative effort between management, human resources, and employees. It is essential to communicate findings effectively, involve employees in decision-making processes, and continually monitor and evaluate the effectiveness of interventions. By utilizing the study results to inform strategies, policies, and workplace modifications, organizations can create a healthier and more supportive work environment that enhances the overall occupational health and well-being of BPO employees in Mumbai.

VIII.

- *Acknowledgment:* The authors express their sincere gratitude to the BPO offices and their employees for their invaluable contributions to this research study.

- *Informed Consent:* Before their participation, all 160 participants provided written informed consent, demonstrating their understanding of the study's objectives, procedures, and potential risks.
- *Conflict of Interest:* The authors disclose that they have no conflicting interests that could potentially influence the objectivity or integrity of the research conducted.

IX. REFERENCES

- https://aip.scitation.org/doi/abs/10.1063/5.0001919
- https://cio-wiki.org/wiki/Business_Process_Outsourcing_(BPO)
- https://mymanagementguide.com/basics/project-methodology-definition/
- India's ITES-BPO industry is expected to grow at 8 percent CAGR, reach US$225-250 bn by 2025 (theprint.in)
- Phoochada, W. and Chaiklieng, S. (2015). Ergonomic Risk Assessment among Call Center Workers. Procedia Manufacturing. 3:4613-4620
- Raja JD, Bhasin SK. Health issues amongst call center employees, an emerging occupational group in India. Indian J Community Med. 2014 Jul;39(3):175-7
- Rao, R. (2018). Introduction to Ergonomics. ISBN 978-93-5321-450-0.

International Journal of All Research Education and Scientific Methods (IJARESM),
ISSN: 2455-6211, Volume 11, Issue 6, June-2023, Available online at: www.ijaresm.com

Effect of Noise on the Occupational Health of Bartenders

Amna K[1], Roopa R[2]

[1]Student, Department of Community Resource Management, College of Home Science Nirmala Niketan, (Affiliated to the University of Mumbai), Mumbai – 400 020, Maharashtra State, India
[2]Assistant Professor, Department of Community Resource Management, College of Home Science Nirmala Niketan, (Affiliated to the University of Mumbai), Mumbai – 400 020, Maharashtra State, India

---

ABSTRACT

Bartenders in India, including those in Mumbai, face numerous challenges in their profession, including long working hours, high competition, demanding customers, inventory management, and adapting to changing trends. Despite these challenges, bartending in Mumbai can be a rewarding career, offering opportunities to work in renowned establishments, gain recognition for craftsmanship, and build a loyal customer base. However, the impact of noise on the occupational health of bartenders remains insufficiently recognized. This study focuses on the effects of noise on the occupational health of bartenders in Mumbai. Noise intensity in bars can reach high levels, potentially leading to noise-induced hearing loss (NIHL) for both bartenders and patrons. This exploratory study aims to assess the extent of the effect of noise on the occupational health of bartenders. The study collected data on the average intensity of sound (measured in decibels, dB) in various bars across Mumbai. Preliminary findings indicate that the average intensity of sound in these bars exceeded 120 dB, a level considered extremely high. This suggests that bartenders are exposed to potentially harmful levels of noise during their working hours. The study employs a mixed-methods approach, combining quantitative measurements of noise levels with qualitative assessments of bartenders' experiences and perceptions regarding the impact of noise on their occupational health. Data collection includes surveys, interviews, and objective measurements of noise intensity. The study aims to investigate the prevalence of noise-related health issues among bartenders, such as hearing loss, tinnitus, and associated physical and psychological symptoms. The findings of this study are expected to contribute to a better understanding of the occupational health risks posed by noise in the bartending profession. The results will serve as a basis for developing evidence-based interventions and recommendations to mitigate the adverse effects of noise on bartenders' health and well-being. Such interventions may include implementing noise control measures, providing personal protective equipment, and raising awareness among bartenders and employers about the importance of hearing conservation practices. Eventually, this research aims to improve the occupational health and well-being of bartenders in Mumbai by addressing the often-overlooked issue of noise exposure. By promoting a safer and healthier work environment, this study's findings have the potential to enhance the overall quality of life for bartenders, leading to a more sustainable and rewarding bartending profession in Mumbai City.

Keywords: Bartenders, Hearing Loss (NIHL), Noise, Occupational Health, Workplace Safety.

INTRODUCTION

Bartenders also called mixologists are professionals who are usually associated with entertainment and leisure. Bartenders are those people who make drinks not as a passive act of service but as an active exchange. But there are many untold challenges faced by them. Long working hours involve uncomfortable work surroundings, repetitive work, repetitive movement of muscles, awkward posture, chemical burns, and dealing with nasty guests. This defines the framework of the bartenders. Ideally, earlier bartenders were the ones who use to run the actual bar now service industries have expanded to accommodate their needs of them but, some of them are yet to be fulfilled.

Their main purpose is to serve the patrons at the bar which includes standing the whole time apart from the break hour, staying active, and physical injury caused to the body. Bartenders are exposed to many work-related hazards and several challenges such as long working hours, high competition, dealing with demanding customers, handling diverse drink preferences, managing wastage, and adapting to fast-changing trends dealing with work-related stress, chemical hazards, safety, and ergonomic hazards.

The finding of this study can contribute to evidence-based interventions, policies & industry practices.

Rationale: Bartending is a highly demanding profession that rescues bartenders to work long hours in a fast-paced and often stressful environment Mumbai is a bustling metro city with a vibrant nightlife and a thriving hospitality industry that present a unique demand on its employees. The lack of comprehensive research on bartenders especially in the selected geographical area is the main reason for conducting this study. The profession involves many physical and psychological demands, such as standing for long periods, repetitive movements, and exposure to loud noise levels. Exploring the impact of these factors on the health and well-being of bartenders is crucial. Investigating the prevalence and impact on the health of bartenders in Mumbai can provide insights into potential preventive measures and safety protocols. The findings of this study can contribute to evidence-based interventions, policies, and industry practices to the welfare of bartenders ultimately creating a more sustainable and supportive work environment.

Specific Objectives: The specific objectives of the study are to (i) gain knowledge about the demographic profile of bartenders in Mumbai city & its suburbs; (ii) analyze the impact of noise on the occupational health of bartenders; (iii) suggest strategies to mitigate the ill-effects of loud noise on their health.

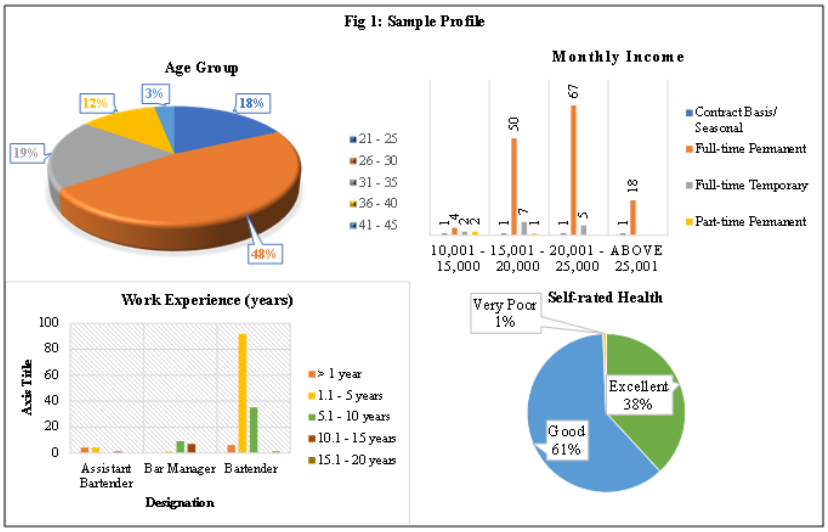
METHODOLOGY

A survey-based exploratory study was conducted among 160 bartenders from more than seventy bars & resto-bars belonging to different economic strata from Mumbai & its suburbs. The participants were selected througha random sampling technique. A self-constructed andvalidated questionnaire helped conduct a one-on-one structured interview (20-25 min each). The questionnaire consisted of three sections: Part A included questions related to the demographic profile; Part B probed the work-related profile (such as designation, work experience, annual income, etc.) and Part C consisted of the EWA (Ergonomic Workstation Analysis Checklist). The questionnaire included open-ended questions on how they are comfortable working in such an environment.Data was coded systematically and analysed using an MSExcel spreadsheet. Simple statistics such as percentage mean were used to analyseand interpret the results.

RESULTS AND DISCUSSION

Profile of Sample: Average age of the sample is 30 years and the average work experience is 5 years. It is observed that among 160 bartenders age group of 26-35 years is most involved in this profession. [4(2.5%)] from the 41-45 years age had an experience of 5.1-10 years,whereas 4 (2.5%) bartendersof the age group 36-40 years had an experience of 10+ years.99 (61.2%) of bartenders work in rotational shifts whereas 62(38.8%) of them work fixed straight shifts. 98 (61%) is the average self-rated health condition.

Age-group 26-30 reported more than 8 hours of work daily. Exposure of more than 8 hours to such an environment with loud noise may cause a threshold shift or ringing sensation in the ears(tinnitus). Average monthly income varies from Rs. 20,001-25,000. Depending on the designation and the place of work. 18(11%) of bartenders stated their monthly income was Rs. 26,000-30,000.



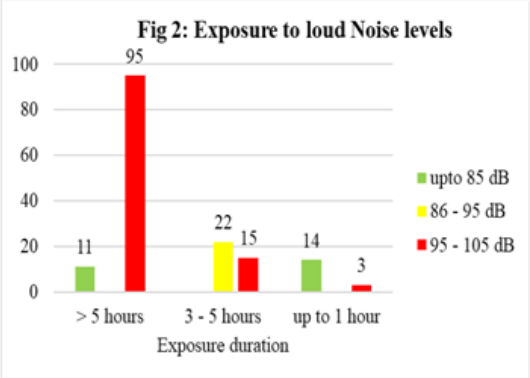
It is observed that due to high noise levels at work and poor thermal comfort, it makes work uncomfortable for bartenders. As seen (table 1) most of the workers report that though the noise levels are on an average above 110 dB, it is comfortable [123 (76.9%)]. Many [155 (96.9%)] are aware of the illeffects of noise such as tinnitus (constant ringing sensation in ears) and temporary/permanent deafness.128(82%)of bartenders'reported that Personal Protective Equipment (such as ear plugs, ear muffs, ear canals, etc) were not provided to them.

Table 1: Parameters of EWA to assess Noise Levels in Workplace

	Yes		No	
	f	%	f	%
Noise levels are comfortable to work	123	76.9	37	23.1
Sound absorbing materials used	146	91.3	14	8.8
Knowledge of benefit of using hearing protection	155	96.9	5	3.1
Do they use hearing protection	74	46.3	86	53.8

The effect of loud noise on bartenders occupational health can be detrimental. Results of this study have reported that bartenders are exposed to loud music conversations and the operation of blenders, glassware, mixers, and other equipment. Prolonged (8 hours and more) exposure to loud noise daily increases the risk ofNoise Induced Hearing Loss (NIHL). Bartenders who consistently work in noisy environmentshave reported experiencing a gradual decline in their hearing ability over time.

Tinnitus is a noise-induced disorder that causes a ringing or buzzing sound in the ears. Bartenders who face this issue find it difficult to concentrate, sleep, or enjoy quiet moments due to persistent noise perception. Literature too records that constant exposure to loud noise can lead to increased fatigue and stress levels among bartenders. This also hinders effective communication with colleagues, order-takers, customers, etc. Loud noise decreases concentration levels leading to impaired hearing ability which could be a reason for increased accidents, trips and falls, and near misses, especially during daily rush hours.



Mood swings, difficulty in concentrating, irritability, and increased anxiety due to frequent long exposure to loud noises (music) can be contributors to low emotional & mental health among bartenders too.

RECOMMENDATIONS BASED ON RESULTS

To mitigate the effects of loud noise on the occupational healthof bartenders, several control strategies can be taken.

- **Elimination:** Elimination means to physically remove the source of noise if possible. E.g.; eliminating impact between hard objects or surfaces.

- **Substitution:** means a process of replacing noisy equipment or method with quieter alternatives. E.g.; the use of hydraulic processing on mechanical shakers. Mixing of drinks can be done by using a mechanical shaker instead of manually using the (noisy) Boston-style shaker.

- **Engineering control:** making changes to mechanical processes, and equipment so that the bartenders are exposed to less noise. E.g.,Implementing noise control measures, such as soundproofing, installing acoustic panels, or using quieter equipment, can help reduce the overall noise levels in the bar environment.

- **Administrative control:** would be where job rotation is required training and development must be provided to every employee.E.g.

- Providing rest breaks in areas away from the noisy work environment, implementing a rotational schedule that allows bartenders to have periodic breaks, and providing them with work opportunities for rest and recovery.
- Conducting frequent and regular health check-ups to monitor the effects of noise or hearing.
- Work Schedule and Breaks: Implementing a rotational schedule that allows bartenders to have periodic breaks from the noisy environment can provide them with opportunities for rest and recovery.
- Training and Awareness: Educating bartenders about the potential risks of loud noise exposure, the importance of hearing protection and techniques for effective communication in noisy environments can promote awareness and encourage proactive measures.
- Environmental Design: Considering acoustics and noise control during the design or renovation of bar spaces can create a more conducive work environment for bartenders.

- **Personal Controls:** includes also the use of Personal Protective Equipment (PPE) such as safety gloves, and noise reduction earmuffs. Behavioural modification is one of the most effective personal controls.

Scope of the Study

The results of this study can be used to evaluate the physical aspect of the bar environment.it can be used to examine the effects of shift work and noise on the sleep-wake cycle which impacts their overall health. It can help investigate the opportunities for career growth, learning, and development within the bartending profession. More important the results can have huge implications and provide valuable insights for policymakers, industry stakeholders, and bar/resto-bar owners not only in Mumbai but across the country. These insights can help improve working conditions thereby involving employee well-being and fostering a healthier bartending profession.

The researchers, plan to share the study findings with bar owners, managers, and industry associations can encourage the adoption of best practices that prioritize the health and well-being of bartenders. This may involve implementing policies and procedures aimed at reducing occupational hazards, promoting work-life balance, and fostering a positive and supportive work environment.

Further studies on the mental health and well-beingof bartenders are recommended. Factors such as work-related stress, burnout, anxiety, and job satisfaction that impact personal and overall Quality of Lifeshould be conducted.

Author's Statements

- Acknowledgment: The authors express their sincere gratitude to the Bartenders and the Heads/Owners of the various bars/resto-bar/ restaurants/ other hospitality establishments for their invaluable contributions to this research study.
- Informed Consent: Before their participation, all 160 participants provided written informed consent, demonstrating their understanding of the study's objectives, procedures, and potential risks.
- Conflict of Interest: The authors disclose that they have no conflicting interests that could potentially influence the objectivity or integrity of the research conducted.
- Funding: This study did not receive any financial grants or support from either governmental or non-governmental funding agencies.

REFERENCES

[1]. https://en.wikipedia.org/wiki/Bartender
[2]. https://www.researchgate.net/profile/Oguzhan-Erdinc/publication/51253827/figure/fig1/AS:277376991809536@1443143236385/Male-version-of-the-CMDQ-for-standing-workers.png
[3]. Konz, S. (2007). Work Design: Occupational Ergonomics.
[4]. Kromer, K. H. E., (2020). Fitting the Task to the Human: A Textbook of Occupational Ergonomics.
[5]. Pheasant, S. (2003). Body Space (third edition).
[6]. Rao, R., (2018). Introduction to Ergonomics. ISBN 978-93-5321-450-0.

International Journal of All Research Education and Scientific Methods (IJARESM),
ISSN: 2455-6211, Volume 11, Issue 6, June-2023, Available online at: www.ijaresm.com

Work-Induced Morbidity of Skin Injuries among Fishermen

Zainab P.[1], Roopa R.[2]

[1]Student, Department of Community Resource Management, College of Home Science Nirmala Niketan, (Affiliated to the University of Mumbai), Mumbai – 400 020, Maharashtra State, India
[2]Assistant Professor, Department of Community Resource Management, College of Home Science Nirmala Niketan, (Affiliated to the University of Mumbai), Mumbai – 400 020, Maharashtra State, India

----------**********----------

ABSTRACT

This exploratory study aimed to provide a comprehensive understanding of the extent of skin injuries and associated morbidity among fishermen, focusing on the occupational hazards they encounter in their daily work. A sample of 175 fishermen was randomly selected from seven fishing villages (koliwadas) along the coastal belt of Mumbai and its suburbs. Data were collected through focused group interviews utilizing a self-constructed questionnaire. The findings revealed that 54% of the fishermen experienced calluses on their skin as a result of the daily handling of carts, ropes, baskets, and rusted equipment. These calluses indicate the presence of repetitive mechanical stress on their hands and fingers. Additionally, 46% of the fishermen reported multiple bites from jellyfish, highlighting the potential for life-threatening complications. By addressing the work-induced morbidity of skin injuries among fishermen, significant improvements can be made in their occupational health and well-being, productivity, and livelihoods. Efforts to mitigate these injuries will contribute to the overall sustainability of the fishing industry. Implementing preventive measures, such as providing suitable protective equipment, training in safe handling practices, and raising awareness about the risks associated with jellyfish encounters, can enhance the overall health and safety conditions for fishermen. These interventions have the potential to reduce the prevalence of calluses and minimize the occurrence of jellyfish bites, thereby improving the quality of life and occupational outcomes for fishermen in Mumbai.

Keywords: Fishing, Infection, Skin Injuries, Occupational Health, Workplace Safety.

INTRODUCTION

India consists of 7,516km of marine coastline with 3827 fishing villages and 1914 traditional fishing landing centers (https://en.wikipedia.org/wiki/Fishing_in_India).Fisheries is the largest agriculture industry in India and it ranks 3rd position globally and it contributes 1.07% of its total GDP to the country's economy. The success of this agriculture industry is in the hands of the biggest community of people known as "Koli also the original inhabitants of Mumbai city; the Kolior the fishermen are the people who run the chain of fishing import and export businesses right from hunting fishes to selling it.The Koli community of Mumbai flourished in the hidden quarters of the city, known as "koliwadas" meaning, A Home that opens to the Sea."

The work-induced morbidity of skin injuries among fishermen refers to the negative impact on their health and well-being caused by skin injuries resulting from occupational activities in the fishing industry. Fishermen are prone to various skin injuries due to the nature of their work, which involves handling sharp tools, fishing equipment, and marine organisms that may have abrasive or toxic properties.

Skin injuries among fishermen can range from minor cuts, abrasions, and punctures to more severe wounds, lacerations, and infections. These injuries can occur when handling fishing nets, ropes, and hooks, or when coming into contact with marine species that have sharp spines or rough scales. In addition, exposure to saltwater, sunburn, and prolonged moisture can contribute to skin problems such as dermatitis and fungal infections.

The work-induced morbidity of skin injuries can have several adverse effects on fishermen. Firstly, these injuries can cause pain, discomfort, and limitations in performing work-related tasks, which can lead to reduced productivity and potential income loss.

Secondly, open wounds and infections increase the risk of complications and delayed healing, further impacting their ability to work. Additionally, chronic skin conditions resulting from repeated injuries or exposure to harmful substances can have long-term consequences on their overall health and quality of life.

Rationale

As much as the fishermen's community has contributed to the development and the upbringing of the city, little to the focus or appreciation of their hard work, this research hence studies challenges faced, specifically focused on the work-induced skin injuries faced by the fishermen in their day-to-day life.

Skin injuries are a common problem among fishermen due to the nature of their work, which involves handling various equipment, exposure to marine organisms, and working in harsh environmental conditions. By investigating the extent and impact of skin injuries among fishermen, this study aims to provide a solid foundation for understanding the occupational hazards they face and their associated morbidity. The study will specifically focus on the work-induced morbidity of skin injuries, such as calluses and jellyfish bites, which have significant implications for the health and well-being of fishermen.The rationale for conducting this study in Mumbai is particularly relevant due to its large fishing industry, the high number of fishermen employed in the region, and limited information on their occupational health. Understanding the prevalence and consequences of work-induced skin injuries among fishermen in Mumbai can help identify key areas for intervention and develop targeted strategies to mitigate these hazards.

By addressing the work-induced morbidity of skin injuries among fishermen, the study aims to improve their occupational health outcomes, enhance their productivity and livelihoods, and contribute to the overall sustainability of the fishing industry. The findings from this study can guide the development of preventive measures, safety protocols, and training programs to minimize the occurrence of skin injuries and promote a healthier work environment for fishermen in Mumbai.

Objectives

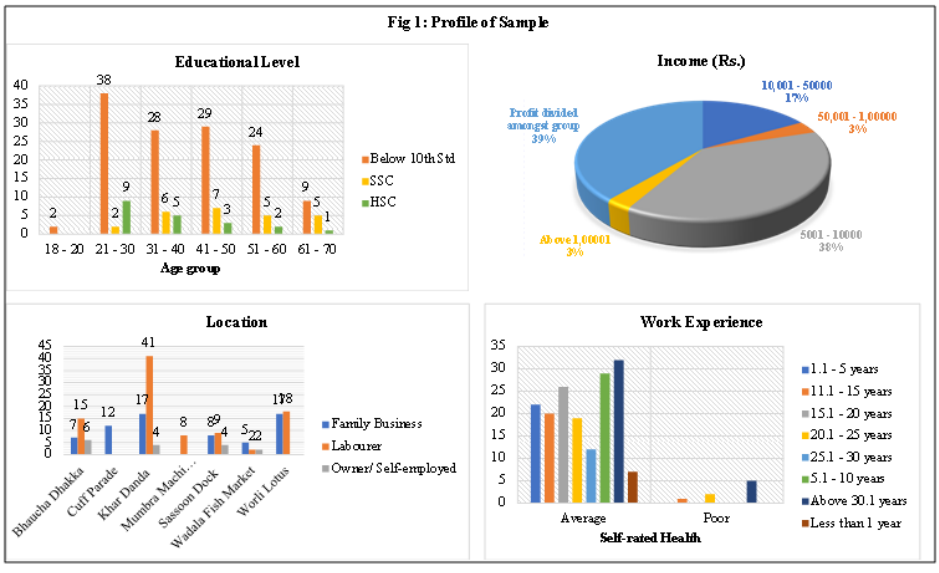
The specific objectives of this study are to (i) understand the demographic profile of the Mumbai Fishermen; (ii) gain knowledge specifically about skin injuries caused due to work-related reasons; and (iii) suggeststrategies to mitigate their occurrence.

METHODOLOGY

An exploratory survey-based study was conducted among 175(18 - 70 years) fishermen from seven fishing villages in Mumbai and its suburb coastal belt. The participants were interviewed afterseeking permission to enter the dock area and village from the village head(explaining the purpose of the interview) with the help of a police officer. The participants were selected using a random sampling technique initially, but as the study progressed snowball technique was employed as they did not want to participate in the study for various reasons.The data was collected with the help of a self-constructed and ratified questionnaire. Demographic Profile(age group, educational qualification, and general health status), Work related information (hours spent on-boat and off-boat, daily work schedule, work experience, and monthly income); and Work-related Injuries (causes of skin injuries) were the three sections of the questionnaire. The data so collected were coded and systematically analyzed using simple statistics such as mean and percentages.

RESULTS AND DISCUSSION

The demographic profile (Fig 1) helps in better understanding the background characteristics of the targeted group, such as age, income, type of employment, self-rated health status, etc.



The age distribution within this business demonstrates a higher proportion of individuals between 31 and 60 years old, indicating a mature workforce. The younger age group, ranging from 18 to 30 years old, mainly consists of newly employed individuals. On the other hand, the 61 to 70 years old age group is less represented as many are reaching retirement age. In terms of work experience, those aged 31 to 70 years old have accumulated 15 to over 35 years of experience, whereas the 18 to 30 years old age group has 3+ to 5+ years of work experience.

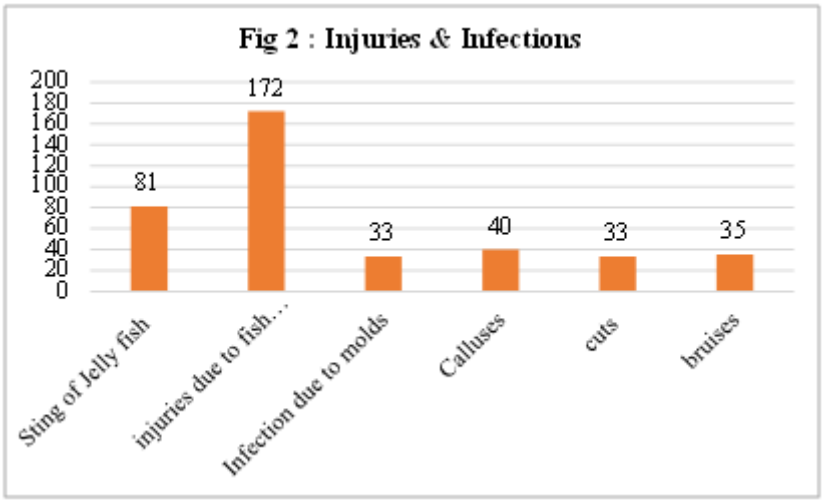
An interesting finding is that 73% (130) of the fishermen have an education level below SSC (Secondary School Certificate), indicating that they have acquired substantial expertise in their field without pursuing higher education. Among them, 14% (25) have managed to complete their education till SSC before focusing solely on their business. Only 11% (20) of the fishermen have pursued education till HSC (Higher Secondary Certificate), which is currently the highest level of education attained within the fishing community. This group consists mainly of the children of fishermen who prioritize their education alongside their fishing activities. The monthly income of 134 (76%) fishermen is up to Rs 10,000/-, and the annual income of family boat owners or business holders who owns more than one boat, 38 (21%) earn between Rs. 50,000/- to 2 lakhs.

The self-rated general health of the fishermen was found to be average. Harsh weather conditions and long hours at sea contribute to this assessment. Interestingly, newly joined individuals or those with less than 5 years of experience were most affected by climatic changes, highlighting their vulnerability during the early stages of their fishing careers. Theeffects of the harsh climate faced by the fishermen are red eyes mainly due to sun rays or splashing of contaminatedwater, air pollution, etc.), diarrhea (due to indirect intake of contaminated water while working and personal hygiene, etc.), and dizziness/ syncope/ dehydration (experienced during hot summers).

The day of the Koli menfolk starts at 3 till 10 am they are in the sea after which they involve themselves in selling and transporting fish post lunch, at about 4pm they get the boat ready for the next day. The average hours spent on boats are 5-6 hours daily and depending on the waves, climatic conditions, and seasons it further gets extended up to 10 hours to 10 days to even months. 108 (62%) of fishermen start their day at 3:00 am and have their fixed work schedule till 10:00am and 68 (38%) of fishermen have no fixed work schedule as it depends on the external environmental conditions and the workload.On-boat and off-boat working fishermen groups consist of 90 (51%) laborer fishermen, 4 (2%) boat owners,and 45 (25%) fishermen are the ones who carry the lineage of the family business, which is passed on from one generation to the other.

Work Induced Skin Injuries

Skin injury is an injury caused by multiple layers of the epithelial tissues. Fishermenreported performing multiple taskssuch as handling fishing equipment (fishing net, hooks, ropes, machinery), fillet knives, pulling a hand cart, carrying fish baskets, etc. These tasks expose them to various skin injuries and infections due to the very nature of their work. These hazards arise from direct contact with marine organisms, equipment, and environmental factors.



Some of the common skin injuries and infections faced by fishermen include:

- Cuts and lacerations: Handling sharp tools, such as knives and fishing hooks, can lead to cuts and *lacerations* on the hands and fingers.
- Abrasions and scrapes: rough surfaces, like fish scales, nets, and boat surfaces, can cause *abrasions and scrapes* on the skin.

- Puncture wounds: Fishermen can sustain puncture wounds from fish spines, sea urchins, or other marine creatures, which can *introduce bacteria into the skin*.
- Burns: Exposure to hot surfaces, hot liquids, or chemicals can result in *thermal or chemical burns*.
- Allergic reactions: Some fishermen may *develop skin allergies or contact dermatitis* due to exposure to marine organisms, such as certain species of fish or jellyfish.
- Sunburn: Prolonged exposure to the sun without adequate protection can lead to sunburn, which can cause *redness, pain, and skin peeling*.
- Bacterial infections: Open wounds or cuts that come into contact with contaminated water or marine life can lead to bacterial infections, such as *cellulitis or septicemia*.
- Fungal infections: Moist and humid environments on boats or in fishing gear can promote the growth of fungi, leading to conditions like *athlete's foot or fungal nail infections*.
- Parasitic infections: Fishermen may encounter parasites, such as sea lice or marine worms, which can cause skin irritation, itching, and inflammation.
- Dermatitis: Constant exposure to saltwater, weather elements, and chemicals can contribute to dryness, chapping, and inflammation of the skin.

81 (46%) reported experiencing jellyfish stings, 33 (19%) had cuts, 33 (19%) suffered from infections caused by molds, 40 (23%) developed calluses, and 35 (20%) had bruises resulting from handling sharp and rusted equipment, pulling ropes/fishing nets, and using Hattian hand carts. The frequent handling of fish, such as pulling nets/ropes or counting and transferring fish, was identified as a major cause of injuries. Friction between the fishermen's hands and the fish's body often led to puncture wounds from the fish's scales or whiskers. Additionally, when separating fish, the exposed skin came into contact with harmful microorganisms, leading to various skin diseases and mold infections.

Furthermore, fishermen commonly work barefoot in open spaces, increasing the risk of scrapes, bruises, mold infections, and calluses on their feet from stepping on sharp objects like scales, fishbones, and nails.

Jellyfish stings pose a significant threat to fishermen. The long tentacles of jellyfish are equipped with thousands of microscopic barbed stingers that inject venom. These stings cause localized pain, inflammation, and skin marks, but in severe cases, they can result in systemic illness and even life-threatening situations. Direct contact between bare skin and the jellyfish's tentacles is the primary cause of jellyfish stings, with each stinger containing venom within a coiled sharp-tipped tube.

Moreover, prolonged exposure to the sun is a common occupational hazard for fishermen, with 99% of participants in our study reporting severe sunburn due to extended hours of work under the sun. Sunburn is classified as a chemical injury by the Bureau of Labor Statistics (BLS) and the Occupational Safety and Health Administration (OSHA). It is an inflammatory response triggered by direct damage from ultraviolet radiation.

Given the prevalence and severity of these skin injuries and infections among fishermen, it is essential to implement preventive measures, raise awareness about the risks, and promote occupational safety practices to safeguard the well-being and health of fishermen in the industry.

Summary of Findings: This study aimed to examine the patterns of occupational injuries among fishermen in the Mumbai Koli Wada area and investigate the effectiveness of preventive measures in promoting safety and injury prevention.The findings revealed that a significant proportion of fishermen, specifically 73% (130 individuals), had an education level below the 10th standard. The average age of the sample is 40.2 years. In terms of occupation, 51% (90 individuals) of the fishermen worked as laborers, 37.5% (66 individuals) ran their family fishing businesses, and 6% (12 individuals) were self-employed fishermen who had started their fishing enterprises.

Fishermen commonly experienced adverse climatic effects such as red eyes, dizziness, syncope (fainting), dehydration, diarrhea, and sickness resulting from the indirect intake of contaminated water. These effects were particularly prominent among fishermen who had taken a long break from fishing or were in the initial stages of their fishing career.

The study identified specific types of occupational injuries among the fishermen. Around 54% (96 individuals) reported calluses on their hands caused by the handling of carts, ropes, baskets, and rusted equipment. Additionally, 46% (80 individuals) experienced cuts, molds, and bruises resulting from handling sharp and rusted equipment, as well as fishbones.Venomous injections from jellyfish stings were reported by 46% (81 individuals) of the fishermen, highlighting the potential for life-threatening problems associated with such encounters. Moreover, an overwhelming majority of fishermen, 99%, suffered from major sunburn, which could lead to photo-aging, actinic keratosis, and skin cancer.

These findings emphasize the need for implementing effective preventive measures and safety practices among fishermen to mitigate the risks of occupational injuries. Strategies should include education and awareness programs, improved handling techniques, proper use of personal protective equipment, and measures to address the adverse effects of climatic conditions. By addressing these challenges, the overall occupational health and well-being of fishermen can be significantly enhanced.

Suggestions Based on the Results of This Study

These skin injuries and infections among fishermen can range in severity, from minor irritations to more serious conditions requiring medical attention. It is important to implement proper hygiene practices, utilize personal protective equipment, regularly clean, and maintain fishing gear, and promptly treat any wounds to effectively prevent and manage these occupational hazards.

The hierarchy of control is a method for keeping employees safe from occupational hazards. Even though there are safety guards and a good supply of safe and well-designed tools are available, the passed-on practice of working has been carried forward through which they have the perception that as old the tools are as good they work which leads to skin injuries due to rusted equipment and even though there are safety gears; fishermen have always seen there elderly working bare hand and with bare feet which makes them carry the attitude that safety gears are not comfortable to use which leads to exposure to harmful and toxic substances.

Ergonomic and workplace safety principles suggest a 5-level hierarchy of control methods.

Workplace hazards can be controlled by the suggested hierarchy of controls method

- Elimination method: Physically removing the hazards. For example.
  - Regular inspection and removal of rusted or damaged equipment to prevent cuts and bruises.
  - Proper disposal of hazardous materials to eliminate the risk of contamination.

- Substitution method: Replacing the hazards.
  - Replacement of old or defective tools with safer and more ergonomic alternatives.
  - Use of non-toxic or less hazardous substances in paints, solvents, and cleaning agents.

- Engineering Control: Isolating people from hazards.
  - Installation of safety guards on machinery and equipment to prevent accidental contact with moving parts.
  - Implementing effective ventilation systems to control exposure to harmful fumes or dust.
  - Installation of non-slip surfaces or grip handles to prevent slips and falls.

- Administrative control: Changing the way people work.
  - Conducting regular ergonomic assessments of workstations and implementing necessary modifications to reduce strain and prevent skin injuries.
  - Providing comprehensive training programs on safe work practices, including proper handling techniques and awareness of potential hazards.
  - Establishing clear protocols for reporting and addressing injuries and near-miss incidents.

- Personal Protective Equipment: Protecting the workers with the use of PPE.
  - Providing appropriate hand gloves to protect against cuts, punctures, and contact with fishbones or toxic substances.
  - Supplying gumboots or waterproof footwear to protect against injuries caused by stepping on sharp objects or fishbones.
  - Ensuring the availability and proper use of eye and face protection to prevent injuries from flying debris or splashes of contaminated water.

By applying these control measures, along with the hierarchy of controls method, the risk of work-related injuries among fishermen can be significantly reduced, promoting a safer working environment, and enhancing the overall well-being of the fishermen in Mumbai.

Scope of the Study

Addressing the work-induced morbidity of skin injuries among fishermen requires implementing preventive measures and providing appropriate medical care. This includes promoting the use of personal protective equipment such as gloves, protective clothing, and footwear to minimize the risk of skin injuries.

Training and education programs should be implemented to raise awareness about safe work practices and proper wound care. Access to healthcare services and timely treatment for skin injuries are also crucial to prevent complications and promote prompt healing.

By addressing the work-induced morbidity of skin injuries among fishermen, the researchers hope to improve their occupational health and well-being, enhance their productivity and livelihoods, and contribute to the overall sustainability of the fishing industry.

Author's Statements

- **Acknowledgment:** The authors express their sincere gratitude to the fishermen and the Heads of the fishing community/villages for their invaluable contributions to this research study.
- **Informed Consent:** Before their participation, all 175 participants provided written informed consent, demonstrating their understanding of the study's objectives, procedures, and potential risks.
- **Conflict of Interest:** The authors disclose that they have no conflicting interests that could potentially influence the objectivity or integrity of the research conducted.
- **Funding:** This study did not receive any financial grants or support from either governmental or non-governmental funding agencies.

REFERENCES

[1]. https://en.wikipedia.org/wiki/Fishing_in_India
[2]. International Labour Organization. Safety and health training manual for the commercial fishing industry in Thailand(2014).ISBN: 9789221284697
[3]. OSHA Commercial Fishing. OSHA Fall Protection Safety Fact Sheet. Fall protection safety-commercial fishing-factsheet.pdf (osha.gov). U.S. Department of Labor
[4]. Benedetti, "https://www.msdmanuals.com/en-in/home/skin-disorders/sunlight-and-skin-damage/actinic-keratoses," actinic keratosis, 2022.
[5]. M. H. M. S. By Julia Benedetti, "https://www.msdmanuals.com/en-in/home/skin-disorders/sunlight-and-skin-damage/photosensitivity-reactions," Photosensitivity Reactions, 2022.
[6]. J. Benedetti, "Overview of Sunlight and Skin Damage," https://www.msdmanuals.com/en-in/home/skin-disorders/sunlight-and-skin-damage/overview-of-sunlight-and-skin-damage#v793772, 2022.
[7]. Rao, R. (2018). Introduction to Ergonomics. ISBN 978-93-5321-450-0.

IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

MUSCULOSKELETAL DISORDERS AND SELF-REPORTED DISCOMFORT AMONG FISHERMEN IN MUMBAI KOLIWADAS

*Zahra, H., R. and **Roopa, R.

* Corresponding Author, Student

Department of Community Resource Management, College of Home Science Nirmala Niketan, (Affiliated to the University of Mumbai), Mumbai – 400 020, Maharashtra State, India

** Assistant Professor

Department of Community Resource Management, College of Home Science Nirmala Niketan, (Affiliated to the University of Mumbai), Mumbai – 400 020, Maharashtra State, India

Abstract: An exploratory study was conducted to investigate the prevalence of Musculoskeletal Disorders (MSDs) and self-reported discomfort among fishermen residing in the Koliwada communities of Mumbai. MSDs are recognized as significant occupational health issues affecting the muscles, tendons, ligaments, nerves, joints, and surrounding soft tissues of the body. These conditions often manifest as pain, discomfort, and limitations in mobility. Fishermen, in particular, face an elevated risk of developing MSDs due to the repetitive and physically demanding nature of their work, as well as the prolonged periods spent in awkward postures. The study revealed that the most commonly affected areas among fishermen are the back, neck, shoulders, arms, and hands. Symptoms associated with MSDs can range from mild discomfort to severe pain, significantly impacting the fishermen's ability to perform their work tasks and engage in daily activities. It is crucial to adopt a multifaceted approach to prevent MSDs among fishermen, encompassing ergonomic interventions aimed at improving work practices and reducing physical strain. Additionally, education and training on proper lifting techniques and body mechanics play a vital role in preventing these disorders. Early recognition and timely treatment of MSDs are also essential to prevent long-term disability and chronic pain among fishermen. By addressing these occupational health challenges, the overall well-being and productivity of fishermen can be enhanced, contributing to the sustainability of the fishing industry. The findings of this study underscore the importance of implementing preventive measures and providing necessary support to mitigate the impact of MSDs on the occupational health of fishermen in Mumbai Koliwadas.

Keywords: Ergonomics, Fishermen, Musculoskeletal Discomfort, Occupational Health, Safe Work.

I. INTRODUCTION:

Musculoskeletal disorders (MSDs) are a common health issue among fishermen, and are often caused by repetitive strain injuries, awkward postures, and heavy lifting associated with their work. MSDs can affect various parts of the body including the neck, shoulders, back, hips, knees, and hands, and can lead to chronic pain, disability, and loss of function.

Work-Related Musculoskeletal Disorders (WRMSDs) are common among fishermen due to the physically demanding nature of their work. Fishermen are exposed to a range of physical stressors that increase their risk of developing MSDs, including prolonged periods of standing, frequent bending and twisting, exposure to cold and damp conditions, and the use of vibrating equipment. These disorders affect the muscles, tendons, ligaments, and other soft tissues of the body. The main causes of WRMSDs among fishermen include repetitive motions, forceful exertions, awkward postures, and prolonged periods of static positioning. Additionally, fishermen may work long hours with little time for rest or recovery, which can exacerbate existing injuries and lead to further damage. Prevention and management of MSDs in fishermen can involve a range of strategies including ergonomic interventions, exercise programs, and education and training on safe lifting and handling techniques.

A major reason to conduct this study is to highlight the many challenges that fishermen face daily. Also, a knowledge gap exists as very few studies have been conducted on the fishermen of Mumbai. In comparison to fishermen across the world, Indian fishermen majorly belong to a lower economic class (Khatua, 2022), therefore the financial factor plays a major role (Jayaselvi, 2016). When the financial status is taken into consideration, necessities such as life jackets, safety equipment, getting medical treatment for when injuries occur, etc. turn into liabilities. These are some of the main necessities that are needed while working a job full of hazards such as this one and are taken into consideration by fishermen over the world. The population of our study is many a time the sole breadwinners for the entire family and therefore bringing in the factor of dependency which can indirectly

lead to over-working which can over some time worsen issues. Moreover, this is a male-dominated field. Being in the lower part of the economy and as sole breadwinners, this population had struggled to climb the economic ladder which eventually led to kin of these fishermen taking over their father's occupation and turning into a family's profession.

Having lived in the coastal metropolitan city the researchers are aware of the various hazards faced daily, polluted sea waters, and densely populated areas, to name a few leads to difficulties in making decent catches, requiring an increase in working hours to travel further to find good quality fish. Working with polluted water can have consequences such as skin disorders, skin infections, and ingestion of harmful chemicals can prove extremely hazardous. Health takes a major setback in situations where the money factor is not supportive, similarly, fishermen start getting into the business young and retire quite old and therefore go through a lot of different phases in their life while being at the same job and have to think about supporting their family during most of their lifetime, so even if they get injured at work, doctors' visits can create holes in their already low income.

Some of the problems faced: financial, physical as well as health-related. All these aspects are completely important, nevertheless, the focus of this study would be the Occupational health hazards that fishermen have to face especially Musculoskeletal disorders which are the result of heavy physical work such as pulling, throwing of heavy nets into the ocean, awkward body postures while transferring the fish from one place to another. Other occupational challenges are skin diseases that occur because of contaminated water, various harmful marine life, and direct contact with sunlight for long periods. Irregular sleep schedule caused due to various reasons such as not following a proper diet or having improperly planned work timings, for example, long hours of work which can increase up to 2-3 weeks at a time, excluding the duration of travel needed to reach distant places in the ocean to obtain the desired fish. Awkward sleeping postures mentioned in said situation, at a time 7 to 8 workers sleeping in a small cabin can result in major body aches and pains. Body injuries such as cuts that are more or less quite common in this occupation take more time to heal due to the daily contact of salt present in the water as well as contamination in the ocean water can increase the risk of infections. These are a few of the many health issues that fishermen come across while working.

II. OBJECTIVES:

The specific objectives of this study are to (i) understand the demographic profile of fishermen in Mumbai's coastal region; (i) associate body pains/aches experienced with specific tasks; and (iii) recommend ergonomic solutions to alleviate bodily discomfort and the onset of occupational disorders among fishermen.

III. MATERIALS AND METHOD:

An exploratory study was conducted among 175 (18 – 70 years) randomly selected fishermen from Mumbai and its coastal fishing villages to identify the prevalence of bodily discomfort due to work-related reasons. A self-constructed and validated questionnaire was used to collect data. A self-constructed and validated questionnaire was used to collect information. The questionnaire was divided into three sections each for collecting General information; Work-related information; and the QEC (Quick Exposure Checklist). The QEC was designed at the Robens Centre for Health Ergonomics and is an open-source practical method of assessing exposure to WRMSD risk factors in the workplace (www.surrey.ac.uk/robens/erg).

The self-constructed and validated questionnaire was used to conduct a focussed interview through which the information was elicited. The data so collected were coded and systematically entered in the MS Excel spreadsheet. Pivot charts were constructed to analyze the data to draw out the relation between the several aspects of the research.

IV. RESULTS AND DISCUSSION:

Demographic profile: Demographic profile includes personal and common information about individuals that as age, and education level. This information helps the researchers to study the background of the participants.

The data provide insights into the demographics, education qualifications, musculoskeletal disorders, and work schedules of fishermen.

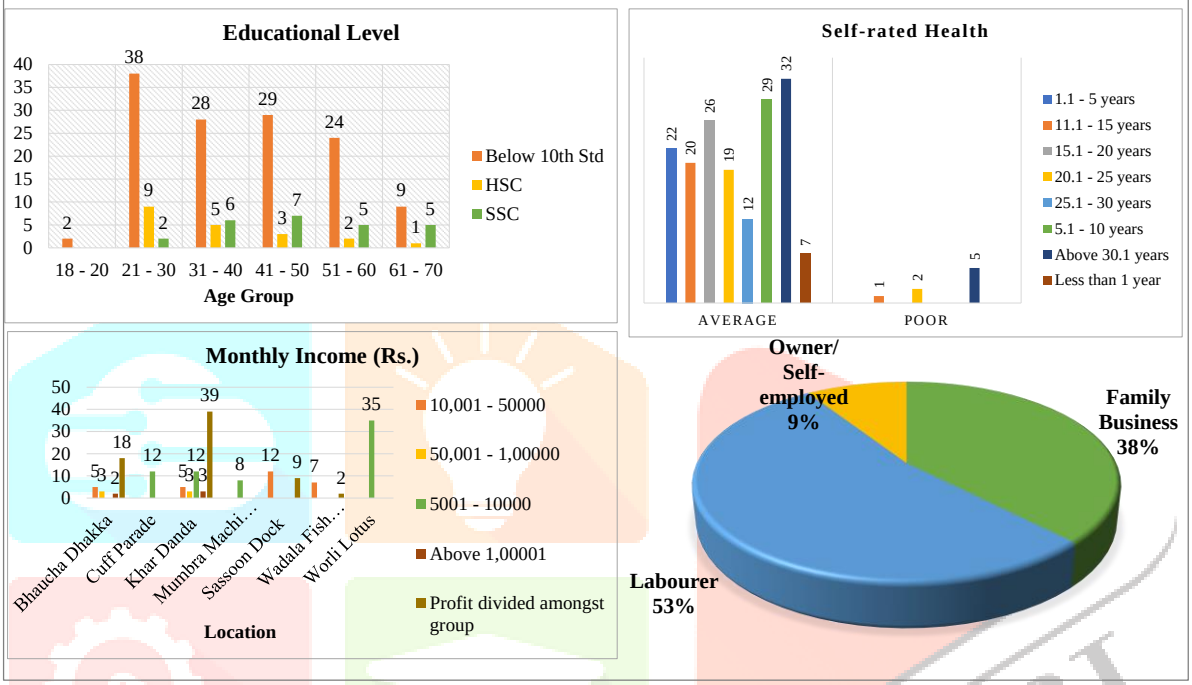
- The age groups of 21-30, 31-50, 51-60, and 61-70 accounted for 49(28%), 38(22%), 32(18%), and 16(9%) of participants, respectively.
- The highest percentage of participants 49(28%), belonged to the age group of 21-30, indicating a significant representation of younger individuals in the fishing community.
- The majority [130 (74.3%)] of surveyed fishermen had education qualifications below the 10th standard, and 35(20%) had completed education up to the Higher Secondary Certificate (HSC) level.

Work Schedule: Fishermen spend most of their time on boats, with an average duration ranging from 10 hours to 10 days. When off the boat, they typically have a break of 5-10 hours. Understanding these aspects helps us grasp the demographic composition, educational diversity, occupational challenges, and work-life dynamics within the fishing community. This knowledge can guide the development of targeted interventions, educational programs, injury prevention measures, and improved working conditions for the well-being and productivity of fishermen.

Fishermen engage in various tasks and activities during their daily fishing operations. Some of these tasks include:

- Throwing nets: Fishermen throw nets into the water to catch fish. This requires strength and coordination to ensure the net is properly spread out and positioned.
- Lifting heavy equipment: Fishermen lift heavy equipment such as fishing nets, ropes, and gear. These items can be bulky and weigh a significant amount, requiring physical strength and exertion.
- Operating engines or other equipment: Fishermen operate engines and other equipment on their boats to navigate the waters, set up fishing gear, and haul in their catch. This involves handling controls, monitoring equipment, and performing maintenance tasks.
- Setting and retrieving fishing gear: Fishermen set up and retrieve various types of fishing gear, such as traps, lines, or pots, depending on the fishing method used. This involves deploying and retrieving the gear with precision and strength.
- Sorting and processing the catch: Once the fish are caught, fishermen sort and process the catch, which may include removing unwanted species, cleaning, gutting, and storing the fish properly.
- Repairing and maintaining equipment: Fishermen regularly maintain and repair their fishing gear, nets, boats, and other equipment to ensure their effectiveness and longevity. This may involve tasks such as mending nets, fixing engine issues, or replacing worn-out parts.

Fig 1: Profile of Sample



Musculoskeletal Disorders: Musculoskeletal disorders (MSDs) commonly faced by fishermen include lower back pain (LBP), shoulder pain, elbow pain, wrist pain, and knee pain.

- Lower back pain is highly prevalent [161 (92%)]among fishermen due to the strain from lifting heavy nets filled with fish and engaging in repetitive bending, twisting, and lifting movements.
- Shoulder pain [144 (82.3%)] is the next most affected body site according to the QEC results. This can again be attributed to the repetitive motions involved in lifting heavy nets and performing tasks requiring shoulder engagement.
- Wrist pain [98 (56%)] and elbow pain [93 (53.1%)] are caused by the repetitive nature of handling and managing heavy nets, while knee pain may result from prolonged kneeling, crouching, and working on uneven surfaces aboard vessels.
- Manual handling is a physical activity that commonly takes place in all fishing activities. such manual handling involves lifting, pulling, pushing, caring, or moving loads. Incorrect manual handling may result in back injury or other musculoskeletal problems among fishermen

The specific body area sites depend on the nature of the tasks performed by the fishermen. For example, lifting heavy equipment and throwing nets may predominantly affect the upper body, including the shoulders, back, and arms. Operating engines or performing repetitive tasks could affect the hands, wrists, and fingers. The body site affected would vary depending on the physical demands and movements associated with the specific tasks performed by the fishermen.

Summary of Results: The analysis of data obtained from 175 participants revealed key findings regarding the factors contributing to discomfort among fishermen in their occupational setting. The average age of the participants was determined to be 40.2 years, with the highest number of fishermen falling within the age range of 21 - 30 years. It was observed that their circadian rhythm was disrupted due to irregular work schedules, leading to potential adverse effects on their overall well-being.

Musculoskeletal disorders (MSDs), including cuts and bruises, were frequently reported among fishermen, primarily attributed to the use of rusted and sharp fishing equipment. The strenuous task of handling heavy nets after fishing rounds was identified as a major cause of multiple MSDs, such as lower back pain (LBP), shoulder pain, neck pain, wrist pain, and arm pain.

Furthermore, prolonged exposure to the sun during fishing activities resulted in fatigue, sunburn, and dehydration among the fishermen. This highlights the significance of implementing measures to protect them from the harmful effects of sun exposure.

One of the major accidents reported by fishermen was the collision of their ships with submerged rocks, posing significant risks to their safety and the integrity of their vessels.

Considering these findings, it becomes evident that the discomfort experienced by fishermen can be attributed to a combination of factors related to their work environment and tasks. To address these issues, intervention strategies should be implemented, such as promoting proper work schedules to regulate circadian rhythm, ensuring the use of safe and well-maintained equipment, providing ergonomic training, emphasizing sun protection and hydration practices, and raising awareness about the risks associated with underwater rock collisions.

By adopting preventive measures and addressing these factors, the aim is to improve the occupational health and well-being of fishermen, reducing discomfort and enhancing their overall work performance.

V. RECOMMENDATIONS:

The hierarchy of control is a method to mitigate the onset of work-related musculoskeletal disorders (WRMSDs) among fishermen in Mumbai:

- **Elimination:** Physically removing the hazards.

- Implement safer work practices that eliminate the need for high-risk activities, such as finding alternative methods for handling heavy loads.

- **Substitution:** Replacing the hazards such as old tools can be replaced with new and well-designed tools which avoid injuries.

- Using mechanical lifting equipment such as a crane lifting device
- Replace old and unsafe tools with newer, well-designed alternatives that prioritize ergonomic factors and reduce the risk of injuries.
- Introduce mechanical lifting equipment, such as crane lifting devices, to minimize manual handling and strain on fishermen's bodies.

- **Engineering Controls:** Engineering controls in the context of fishermen refer to physical modifications or interventions designed to minimize hazards and improve safety in the fishing environment. E.g.,

- Safety equipment and devices: Installing and regular maintenance of safety equipment such as guardrails, handrails, non-slip surfaces, and safety nets on fishing vessels to prevent falls overboard and provide a safe working environment.
- Automated and mechanized systems: These systems can reduce physical exertion and minimize the risk of musculoskeletal injuries
- Ergonomic equipment design: Incorporate ergonomic design principles into the development of fishing equipment, tools, and workstations. This may involve designing equipment with adjustable heights, ergonomic handles, and proper weight distribution to reduce strain and fatigue.
- Noise and vibration control: This can involve the use of sound insulation, vibration-damping materials, and regular maintenance of machinery.

- **Administrative Controls:** Changing the way people work such as

- Training fishermen with good practice and the use of good handling techniques.
- Adoption of good posture and proper biomechanics
- Providing comprehensive training programs for fishermen, focusing on good work practices, proper handling techniques, and the importance of maintaining good posture and biomechanics.
- Establishing regular breaks and rotation of tasks to prevent prolonged exposure to repetitive or strenuous activities.
- Encouraging the use of stretching exercises and warm-up routines before starting work to prepare the body for physical exertion and reduce the risk of injury.

- **Personal Protective Equipment** and Other **Personal Controls**: Protecting the workers

- Ensuring that fishermen are provided with appropriate personal protective equipment, such as gloves and headgear, to protect them from specific hazards encountered in their work.
- Promoting the adoption of stretching exercises as a routine practice before starting work to improve flexibility and reduce the risk of strains or sprains.

By implementing these control measures in conjunction with the hierarchy of control, the risk of WRMSDs can be significantly reduced among fishermen, enhancing their occupational health and well-being.

VI. SCOPE OF THE STUDY:

The scope of the study on work-related musculoskeletal disorders (WRMSDs) among Mumbai fishermen extends beyond the mere understanding of the prevalence and factors contributing to these disorders. The study holds the potential to benefit the fisher community by informing targeted interventions and improvements in occupational health and safety practices. Furthermore, it also identifies areas for further research and exploration.

One important aspect is the possibility of conducting a biomechanical study on fishing activities, aiming to develop a safe handling module that can be incorporated into training programs for fishermen. This module would provide them with essential knowledge and techniques to handle materials in a better, more efficient, and effective manner, reducing the risk of musculoskeletal injuries.

Moreover, the results of the study can be utilized to design and implement comprehensive ergonomic training programs for fishermen. By incorporating the study findings into training initiatives, the fisher community can be empowered with practical skills to improve their work practices and reduce the occurrence of WRMSDs.

Additionally, further research opportunities arise from this study. In-depth investigations can be conducted to explore the extent of injuries and infections experienced by fishermen following the identified WRMSDs. This would contribute to a deeper understanding of the long-term consequences and impact on the fisher community's health.

Furthermore, a biomechanical analysis of handling nets after fishing rounds could shed light on specific ergonomic challenges and suggest strategies for reducing strain and musculoskeletal disorders in this particular task.

Researchers could delve into studying the nature and extent of occupational health disorders among fishermen in more detail. This would involve investigating various aspects of their work environment, including physical demands, exposure to hazards, and the prevalence of different health conditions, leading to a comprehensive understanding of the occupational health landscape within the fisher community.
Lastly, the findings of this study can be valuable for policymakers and lawmakers in developing policies and regulations aimed at safeguarding the occupational health and well-being of fishermen. By understanding the specific challenges faced by the fisher community and the impact of WRMSDs, policymakers can create targeted measures to support and protect their interests.

In summary, this study on WRMSDs among Mumbai fishermen not only provides insights into the prevalence and causes of musculoskeletal disorders but also offers opportunities for practical interventions, further research, and policy development. By leveraging the study's results, the fisher community can benefit from improved training programs, enhanced ergonomics, and better occupational health practices, ultimately fostering a safer and healthier working environment for fishermen.

VII. AUTHOR STATEMENT:

- Acknowledgment: The authors would like to extend their heartfelt appreciation to the fishermen and the leaders of the fishing community/villages for their indispensable collaboration and support throughout this research endeavour.
- Informed Consent: Before their involvement, a total of 160 participants voluntarily provided written informed consent, affirming their comprehension of the research goals, methods, and possible implications.
- Declaration of Conflict of Interest: The authors declare that there are no competing interests that could compromise the impartiality or credibility of the conducted research.
- Funding: This study was self-funded, and no external financial grants or assistance from governmental or non-governmental organizations were received. The authors independently carried out the research without any external influence or sponsorship.

VIII. REFERENCES:

[1]https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=research+ergonomic+on+fisher+men+&btnG=#d=gs_qabs&t=1660288154641&u=%23p%3Dnf28Phm9iLgJ

[2]https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=research+on+fishermen&oq=research+on+fisherm#d=gs_qabs&t=1660291084890&u=%23p%3DBQwdU1b4s4kJ

[3]https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=journal+articles+about+fisherman+health+problems&oq=journal+articles+about+fishermen+he#d=gs_qabs&t=1660397063873&u=%23p%3D-Y4V2SfR4nMJ

[4] research on fishermen safety in India - Google Scholar

[5] International Labour Organization. S*afety and health training manual for the commercial fishing industry in Thailand (*2014). ISBN: 9789221284697

[6] OSHA *Commercial Fishing. OSHA Fall Protection Safety Fact Sheet*. fall protection safety-commercial fishing-factsheet.pdf (osha.gov). U.S. Department of Labor

[7] Rao, R. (2018). Introduction to Ergonomics. ISBN 978-93-5321-450-0.

IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

WORK STRESS AND COPING MECHANISM AMONG FOOD DELIVERY BOYS: UNRAVELING HEALTH CONCERNS IN THE INDUSTRY

Iram, K, and Roopa. R

* Corresponding Author, Student

Department of Community Resource Management, College of Home Science Nirmala Niketan, (Affiliated to the University of Mumbai), Mumbai – 400 020, Maharashtra State, India

** Assistant Professor

Department of Community Resource Management, College of Home Science Nirmala Niketan, (Affiliated to the University of Mumbai), Mumbai – 400 020, Maharashtra State, India

Abstract

The food delivery industry is the fastest growing industry and its employees are mainly the delivery boys exposed to many work-related health issues, which are often ignored and the reason for a chronic or acute illness that in succession impacts their lives, finances, and personal life. The very nature of the work contributes to health risks due to musculoskeletal discomfort, psychological stress, and the pressure for delivering on time. An increasing number of injuries, accidents, and occupational-related disorders are experienced by them. A study was hence conducted among 120 food delivery boys (18 - 40 years) to study the work-related stress factors and recommend ergonomics solutions to alleviate them. A self-constructed and validated questionnaire was used to elicit demographic and work-related information, and the Quick Exposure Checklist to collect the data on their occupational health. The average age of the sample is 24.8 years. There is an urgent need for positive intervention methods to reduce occupational work stress. Ergonomics and occupational health studies can greatly benefit food delivery boys by addressing their physical and mental well-being, improving their work conditions, and reducing the risk of work-related injuries

Keywords : Ergonomics,Food delivery,Occupational Health, Work related stress and Work safety .

INTRODUCTION: Food delivery has become an integral part of our daily lives, with goods being transported globally regularly. This sector has witnessed significant evolution, particularly with the advent of smart technology and user-friendly interfaces. Food delivery services have gained immense popularity, and the industry is experiencing rapid growth (Order Meal, 2022). However, behind the convenience lies a multitude of challenges faced by food delivery boys, including manual material handling, time constraints, financial implications, and increasing work-related stressors.

Food delivery boys are responsible for delivering orders promptly while carrying heavy loads, often continuously. They face the pressure of meeting delivery deadlines and encounter risks such as falls, leading to potential financial repercussions for damaged or lost items. Alongside these physical challenges, they also encounter disrespectful or misbehaving clients, further adding to their work-related stress.

Following the COVID-19 pandemic, delivery associates working for e-commerce retailers and food delivery apps became essential frontline workers, providing vital services across the country. Despite their unwavering dedication, delivery boys often face the wrath of customers who fail to recognize the challenges they encounter. These challenges include uncertainty about their responsibilities, career prospects, and increasing work-related demands.

The health concerns of food delivery boys within the e-commerce industry have drawn the attention of researchers. Studies such as Nasreen A. et al.'s assessment of workers in the e-commerce industry (reference) have aimed to explore work-related stress and coping mechanisms among individuals in the food delivery and kitchen sectors. The findings highlight the impact of occupational stress on employees' personalities and overall health (Ahmad & Ashraf, 2017).

The human, social, and economic costs associated with poor occupational health have long been a concern at various levels, from individual workplaces to national and international contexts. Many of these health concerns are preventable, given the recognition and implementation of known and available measures and methods. Therefore, this study aims to address and reduce work-related risks among food delivery boys by examining work stress factors and identifying effective coping mechanisms.

By conducting this study, the researchers hope to shed light on the pressing health concerns faced by food delivery boys within the e-commerce industry. Furthermore, the study aims to identify strategies and interventions that can improve their well-being and promote a safer and more supportive work environment. Ultimately, the findings of this research have the potential to benefit not only the food delivery workforce but also the e-commerce industry as a whole by fostering healthier work conditions and enhancing overall job satisfaction.

I. **RATIONALE:** The study on work stress and coping mechanisms among food delivery boys is important and justified. The Food delivery boys face unique work-related challenges and stressors, such as long working hours, high workload, time pressure, traffic congestion, and customer demands. These factors can significantly impact their physical and mental well-being. Understanding the nature and extent of work stress experienced by food delivery boys is crucial for identifying potential health risks and designing appropriate interventions to promote their occupational health and well-being.

Work stress can have a profound impact on job performance and productivity. Food delivery boys who experience high levels of stress may face difficulties in maintaining efficiency, accuracy, and customer satisfaction. By studying work stress among food delivery boys, we can gain insights into the factors that affect their job performance and identify coping mechanisms that can enhance their ability to handle work-related stressors effectively. Work stress has been linked to various mental health issues, including anxiety and depression. Food delivery boys, who often work in high-pressure environments and face demanding schedules, may be particularly vulnerable to these mental health challenges. Investigating the impact of work stress on their mental well-being can help identify the need for mental health support and develop appropriate coping strategies to mitigate these risks.

Understanding the coping mechanisms employed by food delivery boys to manage work-related stress is essential. By identifying effective coping strategies, such as social support networks, time management techniques, or stress-reduction activities, we can provide recommendations and interventions to enhance their resilience and ability to cope with work stress effectively. This can have long-term benefits for their overall well-being and job satisfaction.

In summary, the study on work stress and coping mechanisms among food delivery boys is justified based on the significance of their occupational health and well-being, the implications for job performance and mental health, the need for effective coping strategies, the development of occupational health and safety guidelines, and the potential impact on the food delivery industry. By addressing these aspects, the research aims to contribute to the improvement of work conditions, resilience, and overall well-being of food delivery boys.

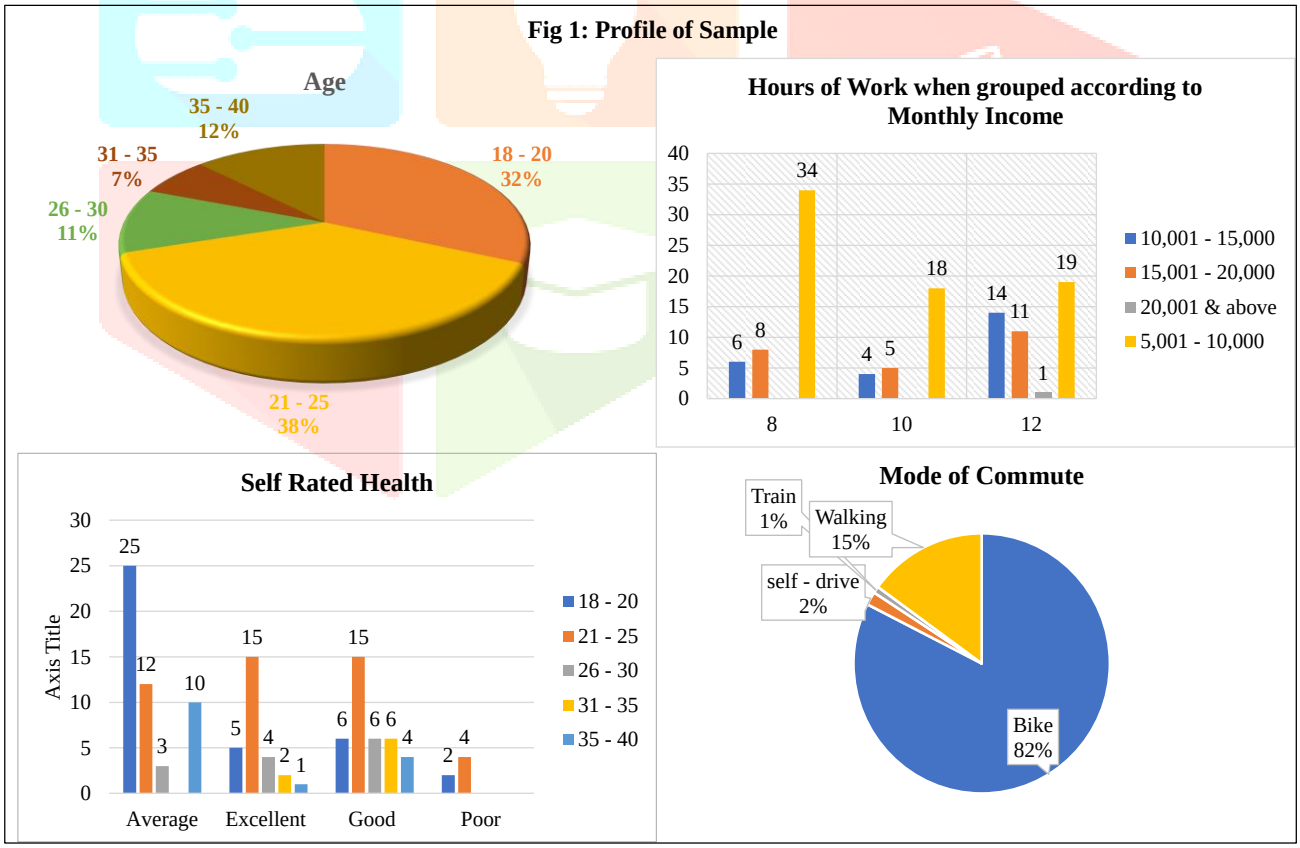
II. SPECIFIC OBJECTIVES: The specific objectives of the study are to (i) understand the demographic profile of employees of Food Delivery Services; (ii) examine the job stress factors and the coping mechanism of the employees of Food Delivery Services; and (iii) suggest ergonomics interventions protect occupational health.

III. METHODOLOGY: A survey-based exploratory study was conducted among 124 randomly selected food delivery boys, from Mumbai city and its suburbs. A self-constructed validated Questionnaire was employed to collect data via a structured (one-on-one) interview. The self-constructed Questionnaire consisted of three sections, which included questions on the demographic profile, work-related information, and The Work Stress Questionnaire (WSQ - Kristina Holmgren, 2008). The 124 participants belonging to different Food delivery companies like Swiggy, Zomato, Zepto, Uber, and other restaurants were contacted for a pre-fixed interview. Once they signed the informed consent, the and informed consent was signed the data was collected.

The Work Stress Questionnaire (WSQ) has been designed specifically for the early identification of people at risk for sick leave due to work-related stress. The questionnaire is developed in the context of primary health care, and from the perspective of the sick-listed person. The WSQ consists of 21 main questions on perceived stress due to indistinct organization and conflicts, individual demands and commitment, influence at work, and work interference with leisure time (The development of the Work Stress Questionnaire (WSQ) | University of Gothenburg (gu.se)). The data so collected were coded and systematically analyzed using simple statistics such as mean and percentages.

IV. RESULTS AND DISCUSSION: The demographic profile helps the researcher to better understand the background characteristics of the participants. The demographic profile includes age group, monthly income, self-rated health status, mode of commute to work, marital status, and work experience.

Fig 1: Profile of Sample



The majority of the participants 84 (70%) belong to the young age group of 18 - 25 years (Fig 1). The average age of the sample is 24.8 years. 99 (82%) commuted to work by bike/two-wheeler. This also is the vehicle that they use for delivery. Many [25(20.1%)] of the young participants self-rated their health as being average. 37 (31%) rated their health as being good. Only one participant out of the 124 total reported earning more than Rs. 20,001 monthly. 48(40%) stated that their monthly income was in the range of Rs. 10,000 /- to 20, 000/- 100% reported that working overtime bring them additional bonus earnings, but only 102 (85%) stated that they were satisfied with the amount received for working overtime.

Work-Related Stress: Job and work stress factors are crucial aspects to consider when studying the occupational health of food delivery boys. These factors can significantly impact their physical and mental well-being. Some specific stress factors that were assessed in this study such as Time Pressure (Food delivery boys often face tight delivery schedules and time constraints.100% of the participants reported that delivering on time is the most stressful aspect of the job), traffic congestion (dealing with heavy traffic can be stressful and increase the risk of accidents), customer interactions (frequently interact with customers, which can sometimes be challenging), workload management (high workloads can lead to stress and fatigue), and safety concerns. By investigating and addressing these job and work stress factors, research, and interventions can contribute to creating a healthier and more supportive work environment for food delivery boys, reducing their stress levels, and promoting their well-being.

Table 1: Work Stress Parameters

Work Stress Questions @ WSQ	Yes		No		Partly	
	f	%	f	%	f	%
Time is given to finish the assignments	70	56.5	50	40.3	4	3.2
Can decide on the work pace	75	60.5	49	39.5	0	0.0
Involved in conflicts at the workplace	28	22.6	74	59.7	22	17.7
High demands on self at work	63	50.8	61	49.2	0	0.0
High-stress demands at work are stressful	49	39.5	40	32.3	35	28.2
Do you think about work after your working day?	66	53.2	58	46.8	0	0.0
Worrying about work after work hours is stressful	35	28.2	40	32.3	49	39.5
Have a second job to increase income	35	28.2	40	32.3	49	39.5
Working after work hours is stressful	35	28.2	40	32.3	49	39.5
Difficulty in sleeping (mind occupied with work matters)	62	50.0	30	24.2	32	25.8
Hard to find time to be with family	35	28.2	59	47.6	30	24.2
Hard to find time to mingle with friends	19	15.3	77	62.1	28	22.6
Hard to find time for leisure and recreational activities	36	29.0	45	36.3	43	34.7

Table 1 reports 75,8% finding it difficult to sleep due to work and work-related matters always playing on their mind. The yellow bands in Table 1 indicate that more than 50% of the participants stated the reasons for work-related stress. Work and work-related stress have a significant impact on the well-being of food delivery boys in Mumbai. The nature of their job, combined with various stressors, can lead to adverse effects on their physical, mental, and emotional health.

Food delivery boys often work long hours, continuously being on their feet and engaging in physically demanding tasks. They may experience fatigue, muscular strains, and injuries due to repetitive motions, heavy lifting, and extended periods of standing or walking. Physical exertion, coupled with inadequate rest and recovery time, can increase the risk of musculoskeletal disorders and other health issues.

The high-pressure nature of the job, strict time constraints, and the need to meet customer expectations can contribute to increased stress levels among food delivery boys affecting their mental and emotional well-being. They may face challenges in managing their workload effectively, dealing with traffic congestion, and delivering orders within the designated time frames. This constant pressure can lead to heightened anxiety, frustration, and emotional exhaustion, potentially impacting their mental health.

Food delivery boys often work during non-standard hours, including evenings, nights, and weekends, to cater to the demands of customers. This irregular work schedule disrupts their circadian rhythm, making it challenging to maintain a consistent sleep pattern. Sleep deprivation or poor-quality sleep can have detrimental effects on their cognitive function, mood regulation, and overall well-being.

Food delivery boys are often paid based on the number of deliveries they make or through a commission-based system. This pay structure, coupled with fluctuations in customer demand and potential penalties for damaged or lost items, can create financial insecurity and stress. They may experience pressure to meet income targets, leading to longer work hours and an increased risk of burnout. Hence 67.8% of participants have a second job to make up for the financial constraints they face.

Food delivery boys may face social challenges due to their work schedule and time commitments. The irregular working hours can limit their opportunities for social interactions and participation in personal activities, leading to feelings of isolation and strain on personal relationships. These factors can further contribute to stress and a sense of imbalance in their personal and professional lives.

It is essential to recognize and address these challenges to support the well-being of food delivery boys in Mumbai. Implementing strategies such as providing adequate rest breaks, promoting ergonomic practices, offering mental health support, and fostering a supportive work environment can help mitigate the negative impact of work and work-related stress on food delivery boys. Additionally, creating awareness among employers, policymakers, and the general public about the importance of occupational health and the well-being of food delivery workers can lead to positive changes and improved working conditions in the industry.

v. **RECOMMENDATION BASED ON THE RESULTS:** The major causes of work-related stress are long hours of work, tight deadlines (pace of work), job insecurity, and heavy workload. The benefits of preventing stress in the workplace are plenty. The major being reduced injury rate, reduced seek leave and absenteeism, increased productivity, increased employee/ work engagement, and reduced cost to the organization to state a few benefits. Reducing stressors and controlling exposures to such hazards in the workplace requires a multi-level approach. The hierarchy of controls presents levels of action to reduce or eliminate the risk. Using the can help cope with or prevent the onset of work-related stress and promote better health and well-being among food delivery boys:

- **Engineering Controls:**

- Providing safe vehicles or bicycles
- Exploring the use of electric bicycles or scooters to reduce physical exertion and fatigue during deliveries.
- Using a better-designed bag or a divided bag (carried on shoulders or vehicle carrier) not only keeps the food warm but is also lightweight and comfortable to use.
- Providing proper safety equipment such as helmets, reflective vests, and gloves to ensure the delivery boys' safety while on the road.
- Implementing technology solutions such as GPS navigation systems or route optimization apps to help reduce travel time, optimize routes, and minimize the stress associated with finding addresses or getting lost.
- Regular maintenance and safety checks of vehicles or bicycles to ensure their proper functioning and minimize the risk of accidents.

- **Administrative Controls**

- Identifying strategies to manage time effectively, optimize routes, and reduce the pressure of meeting strict deadlines. This can help alleviate stress and promote a safer and more relaxed work environment.
- Intense training on customer service techniques, conflict resolution strategies, and communication skills training to help delivery boys manage customer interactions effectively and minimize stress.
- Informing delivery boys methods to prevent workplace violence.
- Conducting workshops on safe lifting techniques of food and material handling.
- Creating awareness about risks associated with stress such as number of deliveries per shift, distance to be traveled, total weight of the packets to be delivered, etc.
- Implementing flexible scheduling options to allow for adequate rest breaks and work-life balance.
- Establishing a system for reporting and addressing customer complaints or conflicts promptly, ensuring delivery boys feel supported and valued.
- Providing access to counseling services or employee assistance programs to help address mental health concerns and develop effective coping strategies.
- Promoting a positive and supportive work culture through regular communication, feedback sessions, and team-building activities.
- Encouraging a healthy work-life balance by setting realistic delivery targets and avoiding excessive workloads.
- Implementing a buddy system or peer support network where delivery boys can share their experiences, exchange tips, and provide emotional support to one another.

- **Personal Control**

- Being aware and informed about various hazards at work.
- Being prepared for extreme weather conditions – heat, cold, sunlight, etc.
- Identifying the best routes considering traffic flow one way, parking, constructions, etc
- Attending and implementing the knowledge gained about strategies on stress management techniques, mindfulness, and relaxation exercises to help delivery boys build resilience and cope with work-related pressures.
- Encouraging regular physical exercise and providing information on maintaining a healthy lifestyle, including proper nutrition and hydration.
- Promoting self-care practices such as getting enough sleep, taking regular breaks, and engaging in hobbies or activities that help reduce stress.
- Maintaining good posture and practicing ergonomics while lifting and carrying heavy loads.
- Encouraging open communication and feedback channels between delivery boys and management, allowing them to express their concerns, suggestions, or ideas for improving work conditions.

It is crucial to implement a comprehensive approach that combines engineering, administrative, and personal control methods to effectively address work-related stress and promote the health and well-being of food delivery boys. Regular evaluation and adjustments to these control measures based on feedback from delivery boys can help ensure their effectiveness in creating a safer and more supportive work environment.

VI. SCOPE OF STUDY:

The results of this study can be used to increase awareness among policymakers and supervisory staff to ensure effective and efficient work scheduling, planning training sessions on various aspects such as biomechanics, stress management, soft skills, etc., to reduce anxiety and improve Quality of Work Life (QoWL).

The study can contribute to the development of occupational health and safety guidelines specifically tailored to the needs of food delivery boys. By examining the work stress factors they encounter and the coping mechanisms employed, the findings can inform policy-makers, employers, and relevant stakeholders in formulating guidelines and practices that prioritize the health and safety of food delivery workers.

The study's outcomes can have broader implications for the food delivery industry. By shedding light on work stress and coping mechanisms among food delivery boys, the research can stimulate discussions on improving work conditions, promoting employee well-being, and fostering healthier work environments within the industry. This can ultimately lead to increased job satisfaction, reduced turnover rates, and improved service quality for customers.

Due to multiple constraints, many related aspects could not be included in this study. Further studies could be conducted in the areas such as Psychological health, Posture assessment and correction, and the development of vibration absorption/reduction gloves.

VII. AUTHOR'S STATEMENTS

- Acknowledgment: The authors express their sincere gratitude to the food delivery boys for their invaluable contributions to this research study.
- Informed Consent: Before their participation, all 120 participants provided written informed consent, demonstrating their understanding of the study's objectives, procedures, and potential risks.
- Conflict of Interest: The authors disclose that they have no conflicting interests that could potentially influence the objectivity or integrity of the research conducted.
- Funding: This study did not receive any financial grants or support from either governmental or non-governmental funding agencies

VIII. REFERENCES:

[1] Bridger, R.S.(2017)Introduction to ergonomics (third edition)
[2]https://www.researchgate.net/publication/348776640_Job_Stress_and_Inscecurity_Among_the_Employees_in_Food_Delivery_Services
[3] https://www.hse.gov.uk/stress/causes.htm
[4] https://www.wseas.org/multimedia/journals/environment/2020/b485115-012.pdf
[5] https://www.technoarete.org/common_abstract/pdf/IJSEM/v6/i7/Ext_23549.pdf
[6] International Journal of science engineering and Management (vol- 4, issue 7, July 2019)
[7] Katrodia, A. (2020). Job stress and insecurity among the employees in food delivery services. WSEAS Transactions On Environment And Development. vol 16. p 708-717
[8] R. Rao (2018). Introduction to Ergonomics (ISBN9789353214500).
[9]https://www.taylorfrancis.com/books/mono/10.4324/9781315857893/introduction-health-safety-work-phil-hughes-ed-ferrett
[10] Frantz A, and Holmgren K. The Work Stress Questionnaire (WSQ) - Reliability and face validity among male workers *BMC Public Health 2019 Nov; 27;19(1):1580*

Review Article
ISSN (Online): 2350-0530
ISSN (Print): 2394-3629

International Journal of Research - GRANTHAALAYAH
May 2024 12(5), 32–42

ARTIFICIAL INTELLIGENCE IN TEXTILE AND FASHION WORLD

Purva Bansode [1], Dr. Pratima Goyal [2]

[1] Research Scholar, Textile and Fashion Technology, College of Home Science Nirmala Niketan, University of Mumbai, Mumbai, India
[2] HOD, Textile and Fashion Technology, College of Home Science Nirmala Niketan, University of Mumbai, Mumbai, India

Received 01 April 2024
Accepted 03 May 2024
Published 31 May 2024

Corresponding Author
Purva Bansode,
bansodepurva98@gmail.com

DOI
10.29121/granthaalayah.v12.i5.2024.5626

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

Before 1949, computers lacked intelligence. They could not record commands, but they could carry them out. However, between 1957 and 1974, artificial intelligence flourished. Computer storage has increased, as has speed, cost, and accessibility. Artificial intelligence (AI) means that machines can perform various jobs that humans or animals need to do with their natural intelligence. The fathers of artificial intelligence, Marvin Minsky and John McCarthy, defined artificial intelligence in 1950. Artificial intelligence enables machines to understand and achieve certain goals. Deep learning, on the other hand, makes it possible to absorb huge amounts of unstructured data in the form of text, images and audio. Artificial intelligence is appearing in almost every industry that is the future of humanity. It will also be the driving force behind new technologies such as big data, robotics and the Internet of Things (IoT) in the near future. Computer algorithms and machine learning have been widely used in textile testing since the 1980s. Testing and quality control functions can be handled by image processing, automation, deep learning and neural networks. Most of the textile industry today uses computer-aided machinery to produce certain designs on a larger scale and more efficiently. AI can access maintenance data in real time to provide insights that can be used to increase operational efficiency. Artificial Neural Network (ANN) technology makes it easier to improve the quality of life in the industry and detect defects, check patterns, match colors and classify fabrics for textile production more objectively. It also precisely defines the advantages of fine, solid and staple fiber. The use of artificial intelligence in the manufacture of textiles has emerged with a new possibility, i.e. smart clothes that use the Internet of Things and electronic sensors to create a more pleasant health experience. In this article, the researcher tried to give an overview of the artificial intelligence used in the textile industry.

Keywords: Textile, Fashion World, Internet of Things

1. INTRODUCTION

A Logic Theorist Program was initialized to proof the concept of AI in 1956. It was a program designed to mimic the problem-solving skills of a human. This program was funded by Research and Development (RAND) Corporation. It was considered as the first artificial intelligence program. It was organised by Marvin Minsky and John McCarthy at the Dartmouth Summer Research Project on Artificial Intelligence (DSRPAI). To create an open-ended discussion on artificial intelligence, top researchers from various fields were invited for this historic conference. Unfortunately, McCarthy and Minsky's expectations were not met as people came

and went as they pleased, and no standard methods for the field were agreed upon. Despite this, everyone agreed that AI is achievable. The significance of this event cannot be minimized since it determines the direction of AI research for the next twenty years. Myers (2011)

There are many applications of AI in this modern age. Some of the areas where AI is used are as follows: Thomas & Powers (2022)

1) **Transportation:** It could take some time for autonomous cars to perfect themselves, but one day they will be able to take us anywhere with the use of AI technology.
2) **Manufacturing:** AI-powered robots assist humans with work like gathering, stacking, and predictive analysis through sensors monitor equipment performance.
3) **Healthcare:** AI can help diagnose diseases more quickly and accurately, speed up drug discovery, monitor patients more efficiently, and provide a more personalized patient experience.
4) **Education:** Along with the assistance of AI, the textbooks are digitizing. It provides early-stage virtual tutoring, and analyze facial expressions to understand which students are struggling or bored in order to tailor the learning experience accordingly.
5) **Media:** It is also benefiting journalism, and will continue to do so. Each year, the Associated Press produces nearly four times more earnings, reports and stories using Automated Insights' natural language capabilities.
6) **Customer Service:** Finally, Google is currently developing an AI assistant that can make appointments at businesses, such as hair salons, in a human-like manner. Besides understanding words, the system also understands context and modulation.

Stuart Russell, one of the innovatory thinkers in the field of AI, says that as of yet, AI cannot fully understand language, as it is not equipped to do so. At the present moment this shows a definite difference between humans and artificial intelligence. If, however, AI is capable of understanding our languages, it would be able to read and understand anything that has ever been written. There is a possibility that sooner it will replace human. According to Elon Musk Artificial General Intelligence (AGI) is one of the greatest existential threats to humanity. Thomas & Powers (2022)

1.1. ARTIFICIAL INTELLIGENCE CAN BE WEAK AI AND STRONG AI.

1) **Weak AI:** Alternatively, it is called Narrow AI. It's an AI system that has been programmed to perform a particular task. For example: Alexa and Siri. In this Artificial Intelligence, the information is categorised by using unsupervised programming. They categorize things according to pre-programmed answers. The algorithm will respond to your request by playing the son. Team Leverage Edu (2022)
2) **Strong AI:** It is also called as artificial general intelligence It is similar to the human brain. It executes new tasks and directives with the help of its cognitive abilities. Without relying on a pre-programmed algorithm, it can solve a problem. Visual perception, decision-making, speech recognition, and language translation are some of the strong AI. Team Leverage Edu (2022)

1.2. THERE ARE THREE TYPES OF ARTIFICIAL INTELLIGENCE INTERVIEW BIT (2022)

1) **Artificial Narrow Intelligence (ANI):** It is the only kind of AI which is most effectively created yet. It is often called as narrow AI or weak AI. It is a goal-oriented system, originated to complete a single task. Example: facial recognition, driving, speech recognition/voice assistants or surfing the web.
2) **Artificial General Intelligence (AGI):** It is also called as deep AI or strong AI. Basically, machines with general intelligence can perform a variety of tasks and can solve any problem by applying its intelligence. AGI is capable of thinking, understanding, and acting in a way that is indistinguishable from human behaviour in every situation.
3) **Artificial Super Intelligence (ASI):** It is a hypothetical Artificial Intelligence. This AI goes beyond mimicking or understanding human behavior and intelligence. It is a computer that is conscious and able to excel in human ability and intelligence.

2. REVIEW OF LITERATURE

2.1. USES OF AI IN TEXTILE AND FASHION TECHNOLOGY

By using automation and artificial intelligence, the textile industry can reduce labor costs and improve customer service. The emerging technologies such as the Internet of Things (IoT) and artificial intelligence can enhance the textile industry. Artificial Intelligence is becoming increasingly important to the apparel industry over the last two decades. AI-driven automation in spreading, cutting, sewing, and materials handling can reduce production costs and minimize errors. Prisma (2022)

2.2. THE APPLICATION OF AI IN FIBER AND YARN PRODUCTION

The essential raw material required for the manufacturing of clothing and other textiles are fibers. Visual inspection alone is not always enough to identify unknown fibers because there are many types of textile fibers. The traditional practices for fiber identification includes destructive tests use flame or chemicals to identify fiber whereas in modern times optical microscopes, raman spectroscopy and fourier transforms infrared are used. These are few of the recent advancements. The artificial intelligence can also be used to identify and grade textile fibers based on their color and properties and the consequence of spinning performance on yarn properties. AI has been used in yarn manufacturing for several reasons, such as modeling yarn from fiber properties, predicting yarn tensile properties, and predicting yarn unevenness. TechKnowGram (2021)

2.3. THE APPLICATION OF AI IN FABRIC PRODUCTION

Fabric is the crucial raw material used in clothing industry. The quality of the garment, productivity, and the ease with which garments can be manufactured will be based on the quality of the fabric used. Depending on the type of apparel and their end-use, the fabrics are selected. The fabric features for making any apparel can be categorised as primary and secondary. The main specification will be physical dimensions, secondary forces act on the fabric when it reacts to external forces. The

important parameters that are considered from a consumer perspective are apparel appearance, comfort, and resilience. TechKnowGram (2021)

Artificial Intelligence can be used to handle these parameters:

- **Forecasting fabric properties:**

With the help of AI, the fabric properties are predicted before manufacturing. A neuro-fuzzy model could be applied to fibers, yarns, and fabrics based on their constructional characteristics. However, the cost of production increases as the application of AI is very costly. Investigating the comfort properties can be possible with the help of AI. With sensory comfort in mind, various fabrics can be categorised according to their hand value by applying artificial intelligence. TechKnowGram (2021)

- **Colour solutions:**

Colour is one of the crucial characteristics of textiles. Consumers respond to this element of design first. On the basis of color appearance, the consumers decide whether to buy it or not. Thus, the dyeing and printing processes must be precisely controlled to obtain the right color. As it can impact the volume of sales. The printing and dyeing procedures should aim to achieve the required colourfastness, depth of shade, surface and color matching characteristics. A deviation from these parameters may result in rejection or reprocessing of the entire fabric batch. With AI, these problems can be solved, for example, recipe forecast, matching color, controlling the process during dyeing and printing, shade sorting and assessment of the final dyed or printed fabric. When the roving is converted into yarn, AI is applied during the fiber blending stage for a color solution. It can assist in forecasting the color obtained when fibers of different colors are mixed together. A homogenous blend can be predicted more perfectly using empirical models and theoretical. TechKnowGram (2021)

- **Fabric fault detection:**

During garment manufacturing if a bad-quality fabric is used, its consequences could be substandard garments and also it will reduce productivity. Apparels can be rejected if there is any defect in the fabric. Therefore, before manufacturing the garment, it is important to inspect the quality of the fabric. Experts use lighted tables and equipment to inspect fabrics traditionally. Oftentimes, this process can pass faults from garment to garment due to its time-consuming nature. This will result in a rapid reduction in the efficiency of fabric inspectors. However, because of AI this task can be performed, the rate of work is faster, the accuracy is higher, and the fatigue is lower. TechKnowGram (2021)

Currently, fabric pattern inspections are done manually through visual checks. Working long hours each week can result in fatigue and mistakes when inspecting unique fabrics. Vision-based technology utilizing AI, like the ANN system, can assist Indian fabric producers in eliminating these issues. Damodar Menon International (2023)

2.4. THE APPLICATION OF AI IN APPAREL MANUFACTURING

Pattern making is one of the main steps in manufacturing of apparel. Designers make paper patterns and then digitize them for use on a computer. For a garment, many 2D (two-dimensional) patterns are created, which form the fundamental blocks of a three-dimensional (3D) apparel. A variety of CAD software is used in the apparel industry to digitize, grade, and plan markers. Because of the CAD software, the productivity is high and enhanced quality is achievable. However, the apparel

patterns or designs for a specific style cannot be generated automatically on the CAD software. As well as this, experienced pattern makers continue to make garments by the traditional method in many garment industries. In addition to integrating AI with CAD systems to generate designs automatically, researchers have also tried integrating these systems with AI to aid in the design process. TechKnowGram (2021)

The garment manufacturing process is becoming more automated in order to meet consumer demand, reduce faults, and keep costs low. Production Planning Controlling (PPC), various operations of sewing, and quality control, use AI to forecast the performance of a sewn seam and to design the garment. For predicting the apparel properties after a certain process AI is used as a part of intelligent manufacturing of clothing. Hasan (2020)

Several variables relating to the material and process are present during the production of textiles and clothing. Due to the high variability of raw materials and the multiple processing stages, it is difficult to handle the process specification to attain the desired outcome. Till today human expertise is used to establish a proper relationship between these variables and the properties of a fabric. Many at times, because of human working and due to the complexity of remembering so many variables, there is a possibility of error. This is made easy and accurate by the application of artificial intelligence; various systems have been created to deal with multiple variables due to advances in computation and simulation. To establish an effective relationship between variables and product properties, the model can work with a wide range of datasets during training. Hence, the textile and clothing manufacturing industries have been rapidly integrating AI into various applications over the last decade. TechKnowGram (2021)

Sewability is the term which refer to seam's ability to form and perform. This are the essential parameters. In addition to tensile, shear, bending, and surface properties, low-stress mechanical properties can also affect sewing ability. During garment production, the sew ability of different fabrics can be determined using an AI system. A good quality seam is important for a good quality garment. A seam's performance is evaluated based on its puckering, yarn severance and slippage, which can be forecasted by AI. TechKnowGram (2021)

2.5. THE APPLICATION OF AI IN PRODUCTION PLANNING AND CONTROL (PPC)

It is responsible for coordinating between several production departments to meet delivery dates and deliver orders on time to customers. Majority of the problems are related to the sewing floor, such as machine layout, line balancing, and managing operators. This problem can be solved or optimized using artificial intelligence. In determining the most suitable production facility for a certain customer order, an artificial intelligence-based decision support system was used. To reduce the rejections, inspecting the finished and semi-finished garments during their manufacturing is important. Experienced people determine the final quality of a garment based on the sewing quality and other faults present in it. There is a lot of time spent on it, and it is often subjective. Physical and mental conditions of the inspector affect the results of the inspection. Hence, to attain increased efficiency and accurate results, automated inspection devices are essential. In order to inspect the quality of finished garments, the AI uses image processing. Using machine vision, wrinkle rating is also done. In this the evaluation of wrinkle is done using a laser sensor. TechKnowGram (2021)

2.6. THE APPLICATION OF ARTIFICIAL INTELLIGENCE IN MARKETING AND SUPPLY CHAIN MANAGEMENT

Consumers are difficult to understand and predict, so apparel manufacturers must produce a diverse product mix. Demographics and physiography are highly variable, and their choice is unstable and unpredictable. It is important to understand that the quality of a product is determined by several factors, including the yarns used to manufacture it, the fabric preparation (weaving and knitting), and the fabric chemical processing that takes place. Artificial intelligence can therefore be applied to the whole apparel manufacturing process to better control all these factors. TechKnowGram (2021)

Artificial Intelligence expands its impact on supply chain management by automating various processes like transportation and packaging. Robotic Process Automation (RPA), machine learning, and the Internet of Things (IoT) are utilized to enhance warehouse management, product sorting, and communication, facilitating smooth material flow between suppliers and producers. Additionally, AI improves merchandising through capabilities such as data analysis, personalized customer experiences, tracking behavior, and predicting trends. Yimiao (2024)

2.7. THE APPLICATION OF ARTIFICIAL INTELLIGENCE IN RETAILING

Creating a link between fashion goods manufacturers and consumers is the goal of fashion retailing. Technology advancements and consumer behavioral changes have transformed fashion retailing into one of the most competitive retail sectors in the last couple of decades. Retailing has several applications for AI, the company specializes in a wide range of areas, including sales forecasting, fashion retail forecasting, customer relations management, demand forecasting, customer satisfaction, and fashion coordination. Often, it is nearly impossible to differentiate between two styles that differ so minutely. Therefore, AI can be used to differentiate between two or more styles. Additionally, AI can be used for the selection of clothes that provide comfort, including appearance, that can be used by customers. TechKnowGram (2021)

In the near future, AI will undergo rapid progress. With this system, garment manufacturers will be able to enhance quality, increase production, reduce operating costs, and control overproduction in-house, resulting in quick response and just-in-time operations. Especially in apparel retail, e-commerce is driven by global fashion trends. Using artificial intelligence, images are identified and products are recommended online based on those images that customers are more likely to purchase. Through artificial intelligence, e-commerce platforms are able to leverage customer information, such as their preferences, similarities, and differences in the kinds of products and applications they seek. By using AI in this way, a personalised shopping experience can be created. TechKnowGram (2021)

2.8. THE APPLICATION OF AI IN CLOTHING- SMART CLOTHING

Internet of Things (IoT) and electronic sensors have enabled “smart apparel” or "smart clothes," in order to improve the user experience. This technology can enable smart clothes to offer more comfort and healthcare to their wearers. Due to their larger area of contact with your body, physiological measurements can be taken with smart apparel than something such as a smartwatch. Our heart rate, for

example, is continuously monitored. It can be possible because of Smart clothing. The monitoring of potential cardiac diseases over a long period of time allows physicians to better identify or diagnose them.

During the COVID-19 outbreak, wearable products have become increasingly focused on healthcare and medical attention, and smart apparel is following suit. Embedded Bluetooth Low Energy technology allows clothes to feel, sense, and regulate data. In addition to improving the overall wearing experience, fabric-based sensors will also help reduce abrasions on the fabric. In the textile industry, AI isn't the only technology driving progress. There are also several other essential components, including cloud data, edge computing, highly accurate sensors, and ultra-low-power technologies. BLE and IoT-enabled smart clothes need a long-lasting battery source in order to provide a satisfying and useful experience to consumers. Cermark (2021)

2.9. THE APPLICATION OF AI IN CLOTHING IN FASHION AND TEXTILE INDUSTRY HASAN (2020)

1) **Trend-Spotting:** It takes days or even months for fashion brands to track the **latest fashion trends** before AI made it possible for them to quickly track them in just minutes.
2) **Machine-assisted designs:** By analyzing and learning the interred images, the AI tool can create an entirely new style.
3) **Customers Experience:** Assisting customers with personalized advertising notifications, letting them know when prices drop, answering their questions with chat bots, and providing personal styling services. Fashion brands can elevate their customer experience with AI by offering instant outfit suggestions.
4) **Improve yield and efficiency:** With the help of AI, manufacturing industries can increase overall equipment efficiency, yield, quality and consistency, which helps manufacturers forecast more accurately.
5) **Forecasting:** Utilizing cognitive computing technologies, organizations can improve their analytics capabilities, make better forecasts, and reduce inventory costs. In the future, because of improved analytics capabilities, companies will be able to switch over to predictive maintenance and reduce maintenance costs as well as downtime.

2.10. SOME APPLICATIONS OF AI

A groundbreaking fabric-roll traceability tool is presented at the ITMA by Smartex, a hardware-based software company. Utilizing the success of their Smartex Core product, which incorporates AI for quality control, Smartex Loop allows suppliers to benefit from fabric-roll level data collection, improve supply chain communication, and respond to the demand from fashion brands for more transparent supply chain data.Smartex Loop enables users to quickly scan a fabric roll's Loop Passport or view all rolls on the Smartex Platform via desktop or mobile devices. This access provides detailed information about each fabric roll's production history and quality. Developed by Smartex.ai in Porto, Portugal, this powerful tool empowers textile manufacturers to enhance product value and boost productivity. Smartex (2023)

Walmart is world's largest retailer. In order to patrol its vast aisles, Walmart plans to use robots. Additionally, dozens of its stores are testing shelf-scanning

robots, which can detect missing products, restock items, or change price tags. It will be easier for human employees to spend more time with customers due to robots, and it will be possible to avoid leaving empty shelves on the shelves for customers to browse. McKinnon & Rudolph (2020)

Amazon and its revolutionary Amazon Go store definitely belong on this list of retail AI companies. Without having to go through a cashier, customers can walk into the store and grab what they want off the shelves. In the store, sensors and cameras track customer purchases, and when they leave, Amazon charges their account. Customers no longer have to wait in line for seamless and quick shopping experiences thanks to artificial intelligence. McKinnon & Rudolph (2020)

Creating an exemplary in-store experience, Uniqlo uses science and artificial intelligence. UMood kiosks in select stores exhibit a variety of products and measure customers' reactions through neurotransmitters to the color and style. The kiosk then recommends products based on each individual's reactions. There is no need for customers to push buttons; it is enough for the system to know how they feel about every item based on their brain signals. McKinnon & Rudolph (2020)

Keeping up with trends is key to H&M's success. Using AI, receipts and returns are analyzed for each store to determine the value of each purchase. As a result of the algorithm, the store knows which items to promote and stock more of in certain areas. By analyzing the statistics, urban stores may be able to determine that floral skirts are the most popular item and change their inventory accordingly. McKinnon & Rudolph (2020)

Customers often choose to buy online and pick up in store. They can now pick up their orders using robots at Zara. They can also enter a pickup code in the store to start warehouse robot moving. The robot delivers the order via drop box after finding it. Orders are delivered quickly and efficiently this way. McKinnon & Rudolph (2020)

Nike Fit is a recent addition to Nike's app. To determine a customer's true shoe size, the feature uses augmented reality and artificial intelligence. Users can enable the app's functionality by pointing their phone's camera at their feet. It takes less than a minute for the customer to complete all of this from the comfort of their own home. A customer's shoe size is stored in the app after it has been determined. During an in-store visit, an associate can scan a QR code to determine the customer's size. The app helps customers find the right shoe size since more than 60% wear the wrong size. McKinnon & Rudolph (2020)

GUESS and Alibaba recently opened an AI-based fashion concept store at Hong Kong Polytechnic University. Customers were shown a vision of the future store powered by artificial intelligence (AI). Using their mobile shopping app, customers can check into the store. RFID tags were attached into clothing hangers so customers could use their application to track what they viewed while shopping. Customers picked up merchandise and it immediately appeared on smart mirrors in front of clothing racks. With smart mirrors, customers could combine items from different categories. Additionally, the layout of the store showed customers where complementary goods could be found. By partnering with artificial intelligence platform Findmine, Adidas reduced the time it takes for customers to receive outfit recommendations when shopping digitally. This saved a lot of time. McKinnon & Rudolph (2020)

Customers can try on clothes more easily by using AR-based smart mirrors at retail chain Shoppers Stop. Further, interactive kiosks will be installed and the business's POS system will be upgraded. Additionally, the business plans to use

location technology and heat maps to collect comprehensive customer data so that it can tailor its store to meet the needs of customers. Several technologies have already been implemented to modernize the retail experience of consumers who shop online and in-store. There are a number of pick-up and delivery options available, including shop-near-me and click-and-collect. Recently, Shoppers Stop also launched a Personal Shopper program and a "Browse and Buy" program, both with an omnichannel approach. Crossley (2018) Innoviti Payment Solutions, one of India's largest providers of payment solutions to enterprise merchants, and Shoppers Stop have launched Dual-Display-UPI, which makes it safer and faster for consumers to use UPI while shopping at Shoppers Stop outlets. Additionally, it displays any offers related to UPI payments for that transaction. With the secure transaction token, the bill is reconciled straight-through if the offer is applicable. When the payment and packing steps are parallelized, the transaction time of a typical UPI transaction is reduced from about 20 seconds to 10 seconds. Both the cashier and customer do not touch the display during the transaction, minimizing the surface area of contact between them. Gupta (2021)

3. CONCLUSION

The labour-intensive textile industry has now transformed because of the rise in the new technologies. The majority of textile factories now use machines operated by computer. These machines can make designs on larger scale more effectively than human workers. Cermark (2021) Industrial automation has also led to increasing in textile manufacturing, producing fresh new varieties of clothing, fabrics and fibres, increasing the efficiency of human employees and enhancing their abilities with AI. With the constant inflow of new technologies and innovations, textile technologies will face a lot of change in the future.

Artificial intelligence has been applied to textile industries due to the increasing demand for quality in recent years. In the overall textile production various machines like spreading, cutting, sewing, and material handling is used, which can reduce the manufacturing cost and reduce faults. Many a times there are high chances of error in textiles production. Using AI, the production can be done without error. Hence, various applications of AI are rapidly growing in the textile industry. Hasan (2020)

The use of AI for reinforcement learning allows computers to learn how to take different actions according to situational circumstances. This will save a lot of time and high accuracy can be maintained. The businesses can automate conversations with the buyers using Artificial Intelligence. This will offer customers a more personalised experience. It will suggest you, different prints, colours, silhouettes, etc. that will suit your body shape and personality. Also, it will show you how you will look in that garment without even actually trying it. With artificial intelligence intervention, merchandising operations can be made more accurate and more aligned to customer preferences by analyzing large data volumes as well as predicting consumer trends. Hasan (2020)

The need for smart textile and smart apparel has increased because of the high demands for health concerned products like fitness trackers and wearable technology. Also, it is because people have become more health conscious. Cermark (2021) At present, artificial intelligence in pre-production textile processing appears to be limited to just a few applications, such as identifying and grading textile fibers and yarns. However, in future, fiber identification and grading in terms of color, length, uniformity ratio, tenacity, etc. can also be possible. As a result, various vendors may offer Artificial Intelligence services for applications such as

yarn tensile properties and yarn unevenness prediction (Cornell), as well as virtual modeling of yarn based on fiber properties. Bharadwaj (2019)

Similar to other industries, textiles have a bright future with artificial intelligence. An estimated USD 5.55 billion will be spent on elegant textiles by 2025, according to a recent market report Cermark (2021)

Some of the examples of applications that businesses might see becoming commercialized in the future include: Bharadwaj (2019)

- On the production side, Artificial Intelligence might be used to detect visual defects in shirts or collars, or it may be used to automatically detect and measure the wrinkles on fabric. A garment's visual aesthetics are influenced and determined by measuring wrinkles in fabric material. For measuring fabric wrinkle performance AATCC (American Association of Textile Chemists and Colourists) methods are frequently used. However, this process requires a great deal of time and there may be frequent disagreements between trained experts on the results. Using machine vision for wrinkle measurement can reduce costs and time for textile manufacturers.
- Artificial Intelligence in textiles will also be used to identify previously hidden patterns through machine learning. Textile players may also adopt "transferrable" data science and data mining techniques from the finance or healthcare industries. Example: A large amount of data is generated by the textile industry when it comes to raw materials, machine settings, and quality parameters. Business might be able to find patterns and correlations between fiber properties, process parameters, and yarn properties, or yarn properties, machine settings, and fabric properties using machine learning. Businesses of the future may be able to discover previously unknown relationships, improving efficiency and maintenance. In manufacturing, AI applications can be used to improve production processes by collecting information about the production process.
- In many industries fabrics play a crucial role in design and prototyping. AI might help design engineers to create '3D-model' yarn fibers in their designs and prototypes. Traditional methods of modelling fibers are very time consuming. It's possible to model yarn and fiber properties automatically and realistically without much human intervention using artificial intelligence algorithms developed by Cornell researchers.

4. CHALLENGES BHARADWAJ (2019)

- There might be a challenge in finding system integrators and Artificial Intelligence consultants who are particularly focused on the textile industry.
- Initially, only larger and more tech-savvy textile companies are likely to adopt this technology due to the difficulty of setting up, integrating, and scaling such an application across the company.
- The textile industry uses AI systems for integrating the following features: production, quality, costs, information, applied mathematics method management, just-in-time production, and digital integrated production. The textile industry will be revolutionized and disrupted by artificial intelligence in a way that has not been seen before.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

Bharadwaj, R. (2019). Artificial Intelligence in Textile Industry- Current and Future Applications, Emerj. (Retrieved on 27th July 2022, 9:00pm).

Cermark, D. (2021). How Artificial Intelligence is Transforming the Textile Industry, Iotforall. (Retrieved on 27th July 2022, 8:30pm).

Crossley, I. (2018). Shoppers Stop to Introduce AR Technology solutions in Store, Fashion Network. (Retrieved on 3rd August 2022, 9:37pm).

Damodar Menon International (2023). Applications of AI in The Textile Industry. (Retrieved on 31 January 2024, 12:00pm).

Gupta, V. (2021). Shoppers Stop Uses Advanced Technology to Enhance Customer Payment Experience, Indian Retailer.com. (Retrieved on 3rd August 2022, 10:07pm).

Hasan, M. M. (2020). Application of Artificial Intelligence in Textile Industry", Textile Blog. (Retrieved on 27th July 2022, 7:30pm).

Interview Bit (2022). Top Applications of Artificial Intelligence. (Retrieved on 26th July 2022, 8:00pm).

McKinnon, T., & Rudolph, B. (2020). 20 Innovative Examples of Artificial Intelligence in Retail", Indigo Digital. (Retrieved on 3rd August 2022, 9:15pm).

Myers, A. (2011). "Stanford's John McCarthy, Seminal Figure of Artificial Intelligence, dies at 84", Stanford News. (Retrieved on 24th July 2022, 3:00pm).

Perumal, S. (2021). The top 8 Applications Where Artificial Intelligence Technology Helps in Textile Industry, Texcovery. (Retrieved on 28th July 2022, 8:30pm).

Prisma, A. I. (2022). How Artificial Intelligence Can Transform Textile Industry, Dev Genius. (Retrieved on 28th July 2022, 9:00pm).

Smartex (2023). Modern Textile Production with AI, Textile Technology. (Retrieved on 1 January 2024, 2:00pm).

Team Leverage Edu (2022). Application of Artificial Intelligence", Wings. (Retrieved on 2th July 2022, 9:00pm).

TechKnowGram (2021). Artificial Intelligence (AI) in Apparel Industry-2021. (Retrieved on 26th July 2022, 9:30pm).

Thomas, M., & Powers, J. (2022). The Future of AI: How Artificial Intelligence will Change the World, Builtin. (Retrieved on 24th July 2022, 7:30pm).

Yimiao (2024). How AI is Leading the Textile Industry to a New Lease on Life?", Arts Management and Technological Laboratory. (Retrieved on 17 April 2024, 9:39am).

JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Design and Development of Convertible Lunch Bag Made Using Banana Fibers

Dr. Ritu Madhan, Associate Professor,
Ms. Srushti Patil, Research Student
Department of Textile & Fashion Technology,
College of Home Science Nirmala Niketan
NAAC Accredited "A+" Grade, Affiliated to the University of Mumbai,
49, New Marine Lines, Mumbai – 400020.

ABSTRACT: This research focuses on the sustainability of using natural fibers, particularly banana fibers, in the design and development of eco-friendly products required by working individuals. The study aims to evaluate the scalability and commercial viability of using banana fibers as an environmentally friendly material in the production of various products. The benefits of banana fibers include their biodegradability, which reduces the environmental impact. Additionally, the generation of four tons of biomass for every ton of banana produced creates potential for the use of this waste product in other applications. The cellulose-based composition of banana fibers offers an added advantage as they are natural and renewable compared to synthetic fibers like polyester or nylon, which have adverse environmental effects.

The pilot study conducted in Mumbai, India, identified that 50% of working individuals have their lunch at their desks, resulting in spillages that soil their workstations and devices. With the absence of regular housekeeping services, this creates inconvenience and health risks. Therefore, the study aims to design and develop convertible lunch bags that can serve as mats to address this issue. Five prototypes of convertible lunch bags into mats have been developed and evaluated for scalability and commercial viability. The study has developed and evaluated five prototypes of convertible lunch bags into mats, assessing their potential for commercial viability and scalability.

The use of natural fibers, specifically banana fibers, in the production of sustainable products like convertible lunch bags is a promising approach to reducing environmental impact.

INTRODUCTION: In recent years, there has been a growing awareness of the environmental damage caused by synthetic materials. As a result, there has been a great interest in developing natural materials that

can replace synthetic materials. This trend has led to an increase in the demand for commercial applications of natural fiber-based composites for various industries. Natural fibers are sustainable materials that are readily available in nature and have several advantages such as low cost, light weight, renewability, biodegradability, and high specific properties. The sustainability of natural fiber-based composites has seen a surge in their applications in various manufacturing sectors. One of the major advantages of natural fibers is their environmental friendliness. Unlike synthetic materials, natural fibers do not contain harmful chemicals and are easily biodegradable, thus contributing to a cleaner and healthier environment. All textiles are made of either natural or man-made fibers. Natural fibers are made from natural raw materials that can be classified according to their origin. Vegetable or cellulose fibers include important fibers such as flax (linen), cotton, and jute. Animal or protein-based fibers, such as wool and silk, are not bio-based.

In terms of uses, there are two general classifications of plants that produce natural fibers: primary and secondary fibers. Primary crops are those grown for their fiber content, such as jute, kenaf, hemp, sisal, and cotton. Secondary crops are those in which fiber is obtained as a by-product from other intermediate uses. Examples of secondary crops include pineapple, maize, culm, agave, palm, coir, and banana. The use of natural fibers in the production of sustainable products has gained a lot of attention due to their numerous benefits. These fibers have low environmental impact, are readily available, and can be used to make a wide range of products. Therefore, it is important to explore the potential of natural fibers in various applications to promote sustainable development and protect the environment.

Natural fibers provided comfort and protection from the environment in hot and cold climates. However, with the advent of industrialization in the 20th century, the textile industry underwent a transformation. The demand for synthetic fibers like nylon, polyester, acrylic, and polypropylene increased, owing to their durability and cost-effectiveness. Synthetic fibers were also preferred as they could be easily processed, and the production process could be standardized. However, the production of synthetic fibers relies on non-renewable petroleum products, and their manufacturing process is complex, involving high energy consumption and greenhouse gas emissions. Moreover, synthetic fibers have several negative impacts on the environment, including the release of microplastics into the environment, which pose a threat to marine life.

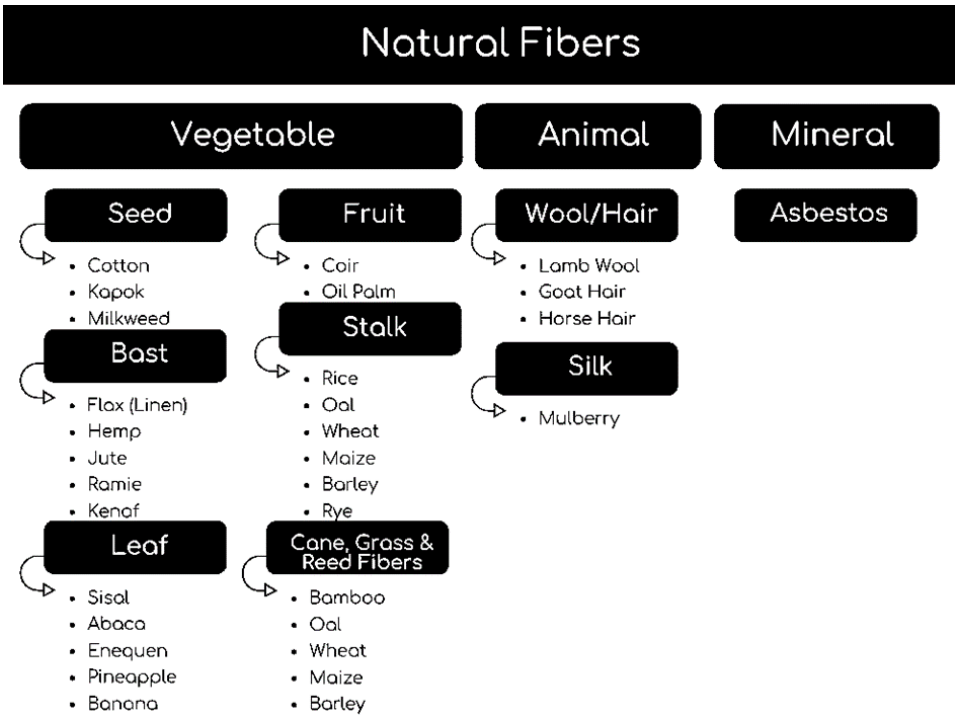


Figure No 1.1 Fiber Classification

The pseudo stem of the banana plant contain good quality textile fibers, commonly known as banana fibers. This fiber is another unexplored natural fiber used for the fashion and technical textile industry to develop sustainable products. than conventional alternative fabrics.

Banana plants are considered to be one of the most useful plants in the world. Almost all parts of this plant can be used, such as the fruit, peel, leaf, pseudo stem and inflorescence. The banana fruit itself is one of the most popular fruits that is a valuable commodity around the world. However, banana pseudo stems usually become biowaste after the banana fruit harvest is complete. So extracting fibers and other components from the stem and using them to create various value-added products. The fibers from the banana pseudo-stem can be extracted by a decorticator machine. The next processes are retting and degumming of the fibers. The fibers derived from the banana pseudo-stem can be made into several value-added products, such as rope, cordage, fishing net, mat, packaging material, paper sheets, textile fabrics, bag, table cloth, handicrafts, absorbent, polymer/fiber composites, etc. Additionally, other components derived from the banana pseudo stem can also be used. The central core can be used for making pickle, candy, and soft drink, whereas banana pseudo stem can be also use for mordant for fixing a color and organic liquid fertilizer, while the scutcher can be used for making compost. Ancient Hindu scriptures have described the banana tree as a kalpak vriksha (a plant that gives food, medicine, protection and clothing) suggests that it was known to make clothes from banana fibers. Perhaps the discovery of other spinnable fibers has made it less popular. Therefore, this neglected fiber, which is abundantly throughout India, can provide us with a natural fiber to make quality products.

According to research, a significant percentage of working individuals opt for fast food or unhealthy snacks due to their busy schedules and time constraints. This dietary habit can have adverse effects on their health, leading to weight gain, increased risk of chronic diseases, and decreased productivity at work.

To address this issue, packing fresh, home-cooked food in a lunch bag is a practical solution. A lunch bag with a personal lunchbox allows individuals to plan and prepare meals in advance, ensuring access to nutritious food while on-the-go. Moreover, carrying a lunch bag reduces the reliance on fast food and unhealthy snacks, which can have a negative impact on health in the long term. Not only does carrying a lunch bag with your own lunchbox promote healthy eating habits, but it also offers a range of other benefits. A durable lunch bag can fully protect your food from germs, ensuring food safety during transportation. It also reduces the need for single-use packaging, making it an eco-friendly option. In conclusion, carrying a lunch bag with your own lunchbox is a simple yet effective way to maintain a healthy diet and avoid unhealthy eating habits while being part of the working population. Investing in a durable and efficient lunch bag is a wise decision for individuals seeking to improve their health and overall well-being.

This research aims to understand the perspectives of working men and women with regards to their food habits and design and develop aesthetically appealing and functional convertible lunch bags to table mats made using Banana fibers which are aesthetic as well as functional to suit the needs of the working population.

The study has used various tools in the methodology like questionnaire to understand the food habits of the working population experimentation and design development for prototype making. The methodology used was convenient and snow-ball sampling method for the working men and women.

The questionnaire was conducted with 110 participants who fulfilled the following criteria:

- Working men and women based in Mumbai and working in Mumbai.
- Participants were included irrespective of their religion and socio-economics status.

On the basis of the data collected, experimentation to create designs for lunch bags was done of which four designs were finalized for the development of prototypes.

The results of the questionnaire form have been detailed below. The questionnaire consisted of 10 open ended questions which concerned around the lunch patterns of the participants on a working day.

1. Lunch patterns:

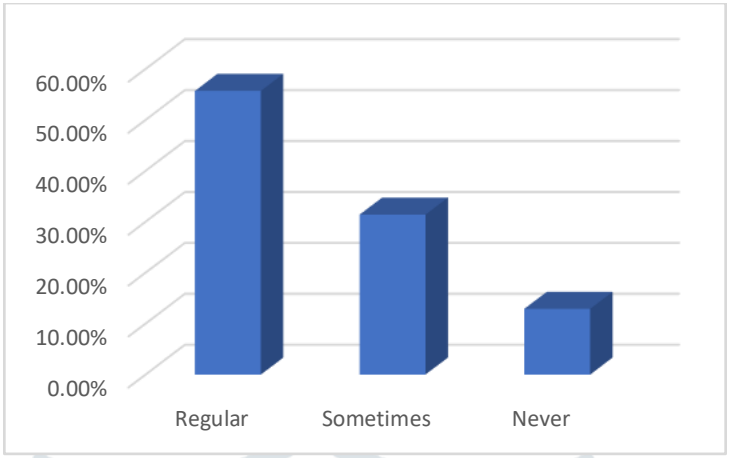


Figure No: 1.1 Lunch patterns

The above figure shows that 55% of the participants carry their lunch from home while the 31% carry sometimes and 13% do not carry packed lunch from home. This implied that more than 50% of the participants have the need for the right lunch bag.

2. **Frequency of having lunch on work table.**

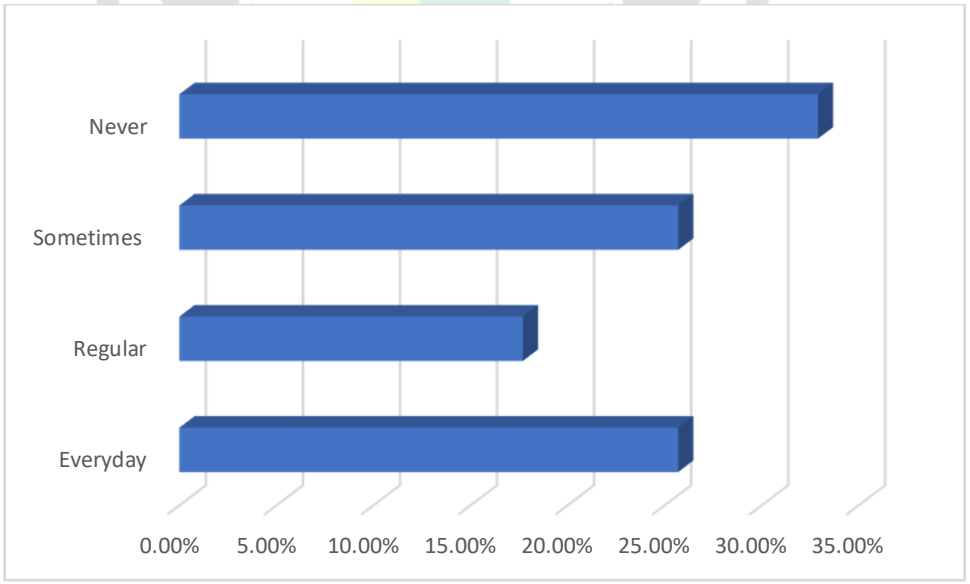


Figure No: 1.2 Frequency of having lunch on work table.

The above graph indicates that more than one fourth of the participants each have lunch on their work desk everyday and on an occasional basis while almost 16% of the participants regularly have their lunch on their workdesk. Only 33.3% never have their meal on their table.

3. **Preference towards the use of convertible bag which opens up as a mat:**

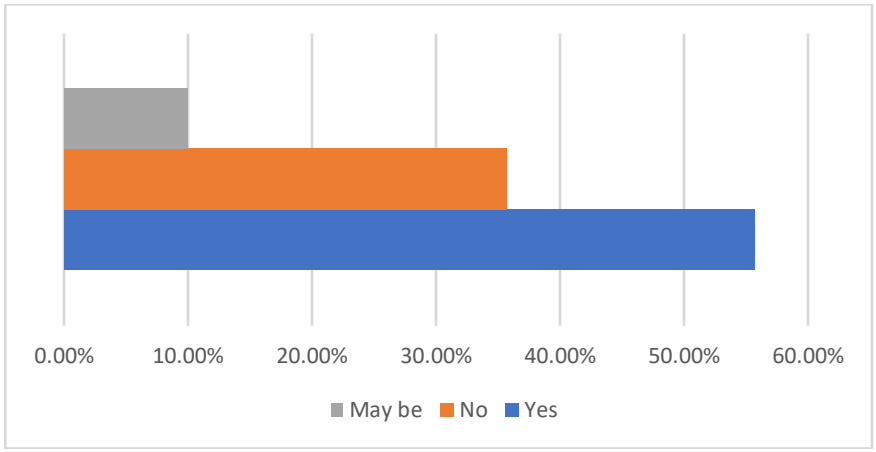


Figure No: 1.3 Preference towards the use of convertible bag which opens up as a mat

The question focused on two aspects, usage of convertible lunch bag as well as the use of banana fibers for the making of the lunch bag. The response to the question was encouraging showing that the 55.1% participants like to use a bag made of banana fibers which can be converted in to a mat for lunch, while the 36% participants are not sure of it and 8% participants are not interested.

4. **Cleaning of the lunch / work table after meals:**

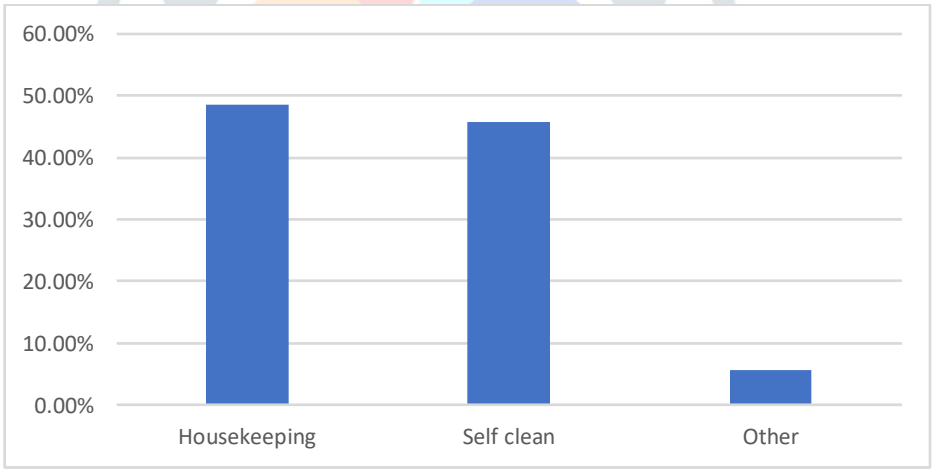


Figure No: 1.4 Cleaning of the lunch / work table after meals

The responses indicate that almost 50% of the participants have housekeeping services in their office to clean their lunch / work table on a regular basis. However, a similar percentage of participants do not have any designated housekeeping services and have to clean their lunch / work tables on their own. Around 5% of the participants have selected other, which may correspond to the participants not carrying lunch from home.

5. **Designated lunch bags**

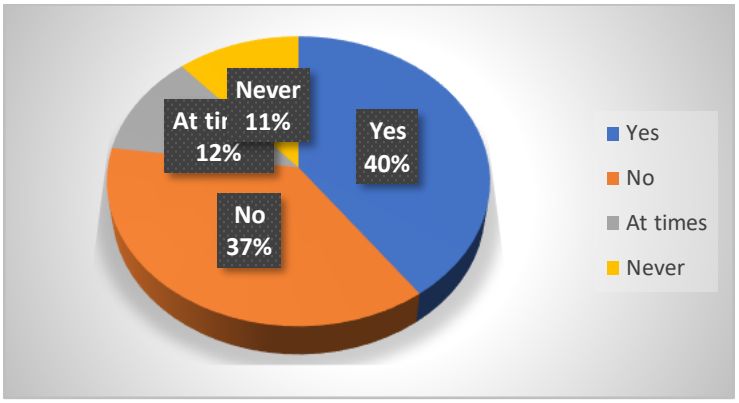


Figure No: 1.5 Designated lunch bags

The above pie chart shows that the 40% of participants have a designated lunch bag. Almost 12% of participants carry the same a similar bag for their lunch while the remaining participants do not have a designated bag to carry their lunch.

6. **Preference towards use of banana fibers for lunch bag:**

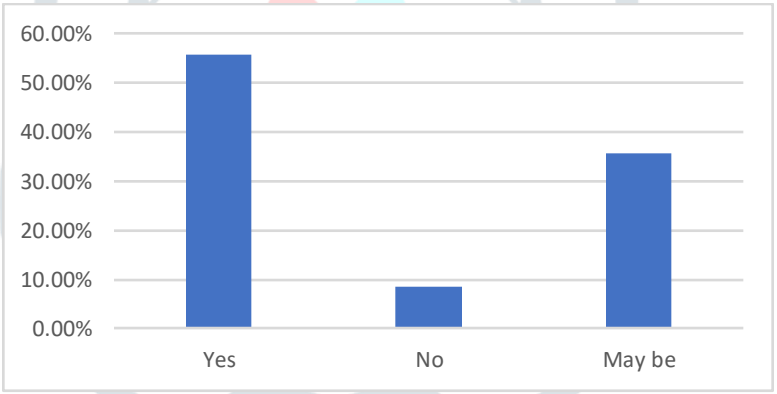


Figure No: 1.6 Preference towards use of banana fibers for lunch bag

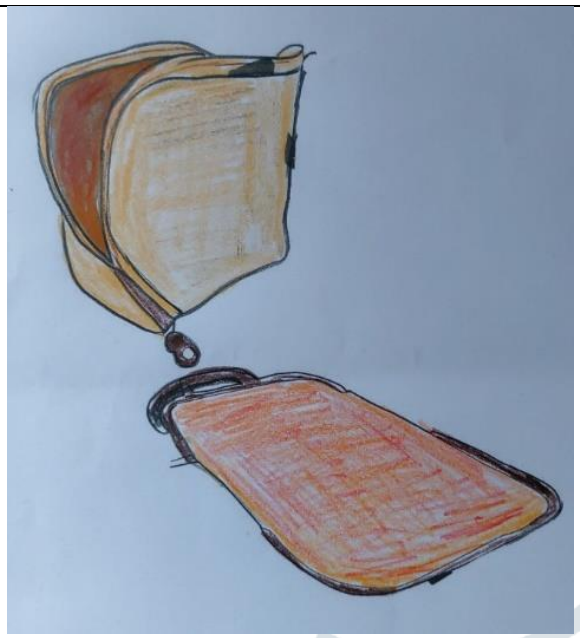
The figure above shows that the 55.1% participants like to use a bag made of banana fibers which can be converted in to a mat for lunch, while the 36% participants are not sure of it and 8% participants are not sure if the change in fibers will be beneficial.

Design and Prototype Development:

On the basis of the responses received from the participants through the questionnaire, a need to develop convertible lunch bags, which can be opened up like a table mat was realized. Such bags are not easily available in the market for sale. Hence the researcher felt a need to develop designs for the same, which could be used for making of convertible bags. The following designs have been developed by the researcher for which prototypes have also been made. The prototypes have been made using banana fibers along with plastic lining and zippers. The researcher also attempted to print / paint the bags with varied methods.

Table 1: Designs and Prototypes of convertible lunch bags:

	  
Design 1	**Prototype 1**
	  
Design 2	**Prototype 2**



Design 3

Prototype 3

Design 4

Prototype 4

Conclusion: The research was conducted in two parts, the first part focused on understanding the usage and preferences of the participants towards the lunch and associated factors. In the second part the researcher focused on creating several designs of which four designs were shortlisted to create prototypes. The convertible lunch bags have been developed using banana fibers. The study is beneficial from many perspectives, usage of banana fibers instead of synthetic fibers, ease of carrying lunch in specific bags, reduced need of cleaning after having lunch.

References:

1. **Md. Ferdus Alam** Banana Fiber: Properties, Manufacturing Process and Applications. Department of Textile Engineering Southeast University. February 18, 2021 by Mazharul Islam Kiron. https://textilelearner.net/banana-fiber-properties-manufacturing/ 12-10-2022

2. **Praveen Pandit,** Textile Value Chain Fibres and Yarns, In-Depth Analysis, News & Insights, Textile Articles Sep 29, 2020 Characteristics & Properties Of Banana Fibers. 22-10-2022

3. **Stephanie Steele**, Sustainable fashion collective, Banana fibers textile Monday, 3rd June 2019. https://www.the-sustainable-fashion-collective.com/2019/06/03/what-is-banana-fibre-and-how-do-you-make-textiles-from-it 08-08-2022

4. **Aayushi Kumar** Home Fibre Banana Fibre for Sustainable Fashion and Beyond, October 22, 2020 https://www.onlineclothingstudy.com/2020/10/banana-fibre-for-sustainable-fashion.html 15-02-2023

5. **Sewport** What is banana fabric properties and how it is made and where, by Sewport Support Team Jan 24, 2023 https://sewport.com/fabrics-directory/banana-fabric 17-02-2023

6. **Marris Journal** Slowly and Simple Natural Fibers: Good for You and Good for the environment. https://maarisstore.com/natural-fibers-good-for-you-and-good-for-the-environment/ 24-09-2022

7. **Jan E.G. van Dam Wageningen University**, The Netherlands Proceedings of the Symposium on Natural Fibres. Environmental benefits of natural fibre production and use. https://www.fao.org/3/i0709e/i0709e03.pdf 10-11-2022

8. **Asmanto Subagyo and Achmad Chafidz,** Banana Nutrition,Banana Pseudo-stem fiber: Preparation, Characteristics and Application, November 28th, 2018. https://www.intechopen.com/chapters/64570.

IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

BEYOND LANDFILLS -: USING POST - CONSUMER WASTE FOR ACCESSORIES AND HOME DÉCOR

[1]Ms. Barthwal Prachi, [2]Dr. (Mrs.) Madhan Ritu and [3]Mrs. Khedekar Vibhuti

[1]Research Student, [2] Associate Professor and [3]Assistant Professor

Department of Textile and Fashion Technology,

College of Home Science Nirmala Niketan,

Mumbai, Maharashtra, India

Abstract:

Textile waste is one of the significant environmental concerns, as discarded textiles often end up in landfills, contributing to pollution. Every year, India accumulates around 7,793 kilotons of textile waste, with approximately 51% coming from consumer usage, 42% from manufacturing leftovers, and 7% from imported sources. This paper develop an innovative process by transforming post-consumer textile waste into high-quality resin-based consumer goods in the category of Accessories and Home décor products. The abstract focuses on post-consumer textile waste in the context of the 17 Sustainable Development Goals (SDGs) and also explores strategies to address these challenges, including recycling and up-cycling. By following the SDGs, we can work towards reducing the environmental impact of textile waste while promoting sustainable economic growth and social well-being.

Keywords: Sustainability, Post – consumer waste, Accessories, Home décor, Entrepreneurship.

Introduction:

Fabric waste, particularly post-consumer waste, has become a pressing global issue. Today the world produces 92 million tons of textile waste every year which are discarded and also contribute to environmental degradation. Between 80 and 100 billion new clothing garments are produced globally every year. Fast fashion, characterized by rapid production and consumption, aggravate this problem by encouraging disposable clothing culture. This trend not only depletes natural resources but also emits greenhouse gases during production and disposal. The impact of fabric waste on the environment is multifaceted. It leads to overflowing landfills, as textiles take a long time to decompose. Synthetic fabrics release microplastics into the environment, further harming ecosystems. Addressing these challenges aligns with the United Nations Sustainable Development Goals. Reusing clothing, extending their lifecycle, and adopting circular economy principles are essential strategies. Furthermore, promoting durable designs and sustainable materials helps mitigate the negative effects of fast fashion. Incorporating circular economy principles involves creating closed-loop systems where products are designed for easy disassembly and recycling. This approach reduces resource consumption and minimizes waste. By

adopting sustainable practices, we can contribute to goals like responsible consumption and production, climate action, and life on land and below water.

This study aims to develop an innovative process by transforming post-consumer waste into high-quality resin-based consumer goods in the category of Accessories and Home décor products to ensure durability, aesthetics, and also to reduce environmental impact.

The primary objective of this study is to develop products by up-cycling post-consumer waste into high-quality resin-based consumer goods and also to develop a cost-effective method for producing aesthetically pleasing resin-based consumer goods from post-consumer waste and to minimize environmental impact, and establishing a market presence through effective branding and consumer education and also to ensure proper recycling and thus completing the sustainability cycle.

Methodology:

A pre survey was carried out with 130 participants, consisting of nine closed-ended questions where respondents selected their answers from predefined options simplifying to analyze and understand the attitude toward up-cycling post - consumer waste and primary data for the survey was gathered using a Google Form. The sampling techniques employed were convenient and sno-ball sampling. Using the insights gained from the survey, the inspiration for creating the products stemmed which highlighted a growing concern for sustainability and eco-friendliness. By using post-consumer waste in shredded cut form combined with resin, to promote recycling and reduce waste. The three distinct product categories were designed to cater to various aspects of daily life: Accessories for personal use, Home Decor items for beautifying living spaces, and aesthetic Puja products to blend tradition with environmental consciousness. Development of products showcases a commitment to sustainable practices and waste reduction. The creation of three distinct product categories - Accessories, Home Decor items, and Aesthetic Puja products - demonstrates a thoughtful approach to addressing both environmental concerns and the diverse needs of consumers. It reflects an innovative way to merge eco-friendliness with everyday utility, aligning with the growing demand for responsible and conscious consumer choices.

Results and Discussion:

The preliminary questions in the survey inquired about the frequency of discarding old and used clothes. The distribution of responses across these options can shed light on participants' disposal behaviors. This data could be discussed in relation to the development of products using post-consumer waste.

1. **Frequency of discarding old clothes**

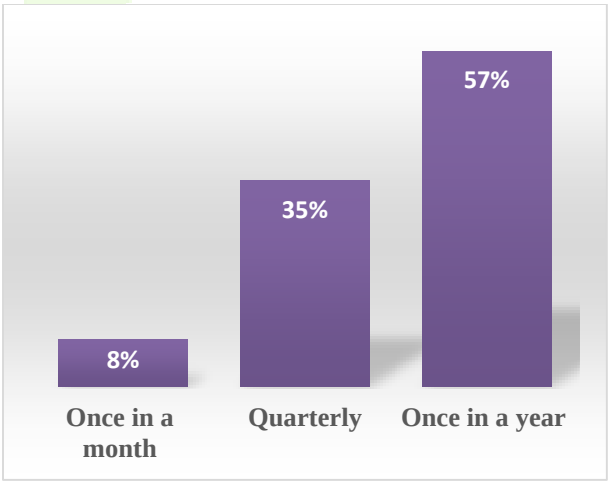


Fig. No. 1 Frequency of people discarding old clothes

The above figure indicates 57% of individuals dispose their clothing items annually, possibly due to the annual home cleaning associated with festivals. Very few participants discard their old clothes on a monthly basis.

2. Ways of discarding old clothes

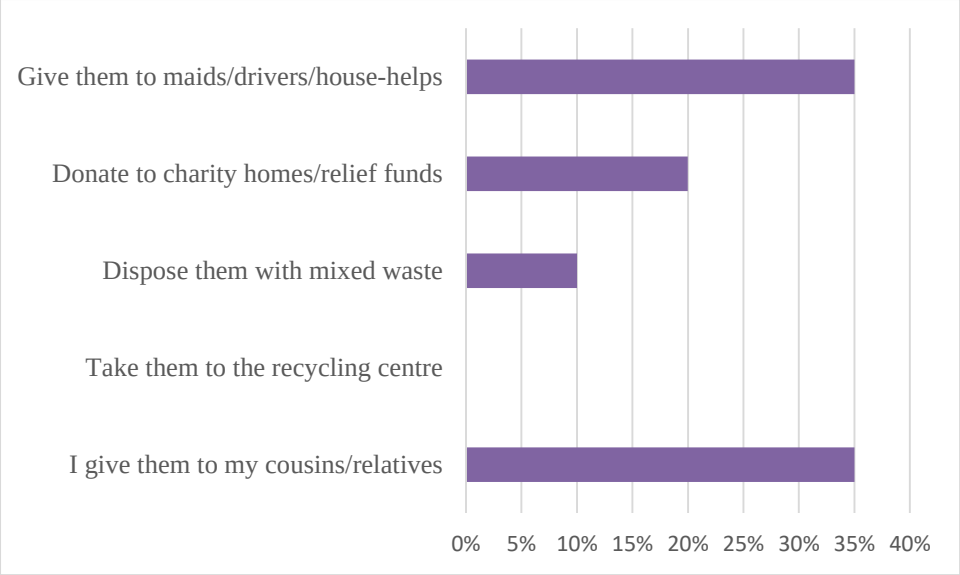


Fig. No. 2 Ways of discarding old clothes

The above figure shows that none of the respondents indicated a tendency to take their clothes to recycling centers for disposal. This insight underlines the need for greater awareness and convenience regarding proper recycling methods for clothing items and also encourage more responsible disposal practices in the future.

3. Percentage of participants up cycling old clothes

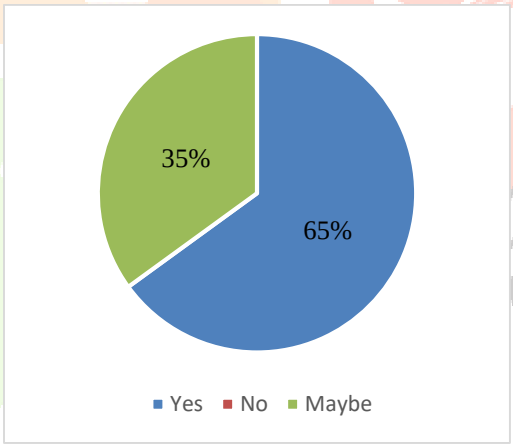


Fig. No. 3 Percentage of participants up cycling their old clothes

The above figure illustrates that 35% of people refrain from the practice of upcycling their clothing. This implies that a significant portion of the surveyed individuals do not actively participate in reusing or repurposing their old garments, which may have implications for sustainability.

4. **Availability of old clothes**

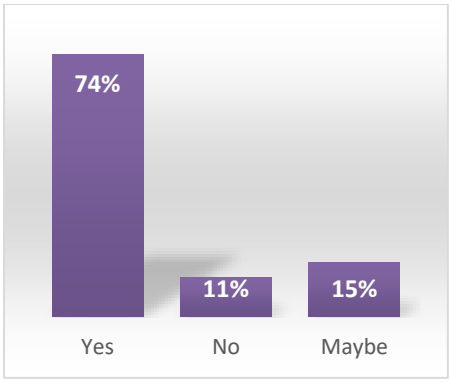


Fig. No. 4 Availability of old clothes

The above figure indicates that 74% people have old and used clothes at home. This question aimed to gauge the presence of potential post-consumer waste materials that could be utilized for the creation of products.

5. **Consent to give old clothes for up cycling**

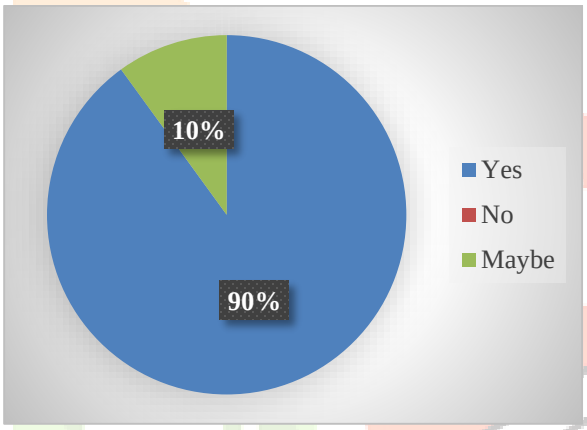


Fig. No. 5 Consent to give old clothes for creating new products out of them

The above figure shows that 90% of the surveyed individuals are willing to contribute their old and used clothing to our initiative, with the intent of repurposing their garments into new products. This willingness to participate suggests a significant interest in sustainable fashion practices and the potential for collaboration in creating innovative products from existing resources.

6. **Awareness of the impact of fashion industry**

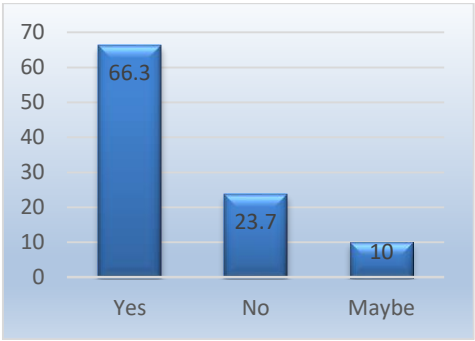


Fig. No. 6 Awareness of the impact of fashion industry on the Environment

The above figure illustrate that 23.7% of respondents are not aware of the environmental impact of the fashion industry. Additionally, 10% of respondents indicated uncertainty by saying "maybe." This suggests that there is a significant portion of the surveyed population with varying levels of awareness or uncertainty regarding the fashion industry's impact on the environment. Awareness can be created in the population.

7. **Frequency of people are ready to buy products**

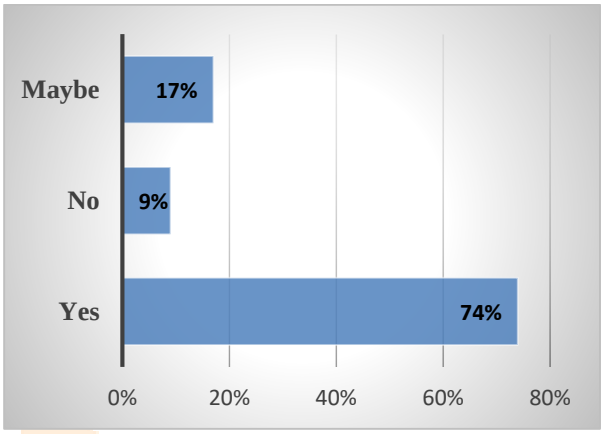


Fig. No. 7 Frequency of people ready to buy products such as Furniture, Home Décor, and Accessories made from recycling old clothes

The above figure shows that 74% of the respondents, are willing to purchase products made from recycled clothing. This suggests a strong consumer interest in sustainable fashion and a readiness to support products that promote recycling and reuse of textiles.

The results of the survey indicate a notable awareness among consumers regarding the environmental impact of fast fashion. This awareness has led to a willingness to repurpose textile waste, thereby fostering sustainability and mitigating environmental harm and also to develop innovative and distinctive designs/products that contribute to a reduction in waste generation and environmental strain. This alignment of consumer consciousness with such practices underscores the potential for positive change in the fashion industry towards more responsible approaches.

Product Development:

1. In the initial step, the researcher gathered discarded textile waste from consumers.
2. The second stage involves sanitizing and cleaning of the collected post-consumer waste.
3. Step three includes shredding or cutting the post-consumer waste material.
4. For the fourth step, the researcher utilized epoxy resin to create the products, maintaining a 2:1 ratio by measuring out two parts of resin for every one part of hardener before mixing.
5. In the fifth step, the researcher placed the shredded post-consumer textile waste into molds to craft the desired items.

Fig. No. 8 Steps involved in creating Accessories

2. ACCESSORIES

Fig. No. 9.a Accessories (Earrings)

Fig. No. 9.b Accessories (Earrings)

3. AESTHETIC PUJA PRODUCTS (PUJA THALI)

Fig. No. 10 Puja Thali

4. HOME DECOR ITEMS (CLOCK)

Fig. No. 11 Clock

Conclusion

The endeavor of creating items from post-consumer waste seamlessly aligns with various Sustainable Development Goals (SDGs). Through the use of shredded or cut waste and resin, the project actively contributes to SDG 12 (Responsible Consumption and Production) by promoting recycling and reducing waste. Furthermore, the development of a wide range of product categories, such as Accessories, Home Decor, and Aesthetic Puja items, fosters SDG 8 (Decent Work and Economic Growth) by encouraging innovation and offering potential economic prospects. Additionally, the project's emphasis on mindful consumption resonates with 17 United Nations Sustainable Development Goals (SDGs) by lessening environmental impacts and preserving natural resources. Overall, this initiative exemplifies a holistic approach to sustainability, addressing multiple SDGs, while delivering practical and attractive products and also creating entrepreneurial opportunities for individuals with a creative mindset.

References

United Nation Environment Programme report (2022) –http://https://www.unep.org/explore-topics/green-economy/what-we-do/environment-and-trade-hub/textiles Retrieved on August 9th, 2023, 3:00pm.

Wealth In Waste: India's Potential To Bring Textile Waste Back Into The Supply Chain report (2022) - https://fashionforgood.com/our_news/wealth-in-waste-indias-potential-to-lead-circular-textile-sourcing/#:~:text=Up%20to%207800%20kilotonnes%20of,that%20contributes%20a%20further%207%25. Retrieved on August 9th, 2023, 6:45pm.

Lauren Murphy, (2022), How to Recycle Textiles: Give New Life to Old Clothes - https://www.treehugger.com/textile-recycling-5203438 Retrieved on August 11th, 2023, 8:00pm.

Rachel Brown, (2021), The Environmental Crisis Caused by Textile Waste https://www.roadrunnerwm.com/blog/textile-waste-environmental-crisis?hs_amp=true Retrieved on August 12th, 2023, 6:00pm.

Apurva Nidhi, Textile Recycling: Techniques and Challenges https://www.fibre2fashion.com/industry-article/9777/textile-recycling-techniques-and-challenges Retrieved on August 12th, 2023, 6:30pm.

Article: "Recycling of waste textiles: A review" by Shailesh R. Dave and Rakshit Ameta. (2009). In "Journal of Scientific & Industrial Research," 68, 355-362.

Book: "Textile Waste Utilisation" edited by P. K. Chatterjee. (2009). Woodhead Publishing.

Report: "Closing the Loop: An EU Action Plan for the Circular Economy" by the European Commission. (2015). This report discusses strategies for textile waste management and recycling within the context of the circular economy.

Article: "Recycling of Textile Waste" by Subramanian Senthilkannan Muthu and Miguel Angel Gardetti. (2017). In "Handbook of Sustainable Luxury Textiles and Fashion: Volume 2" (pp. 197-227). Springer.

Report: "Global Fashion Agenda & The Boston Consulting Group (BCG) Circular Fashion Action Plan." (2017). This report outlines strategies for the fashion industry to transition towards circularity, including recycling textile waste.

Indian Journal of Psychology Book No.06 2024
ISSN: 0019-5553

ECO-FRIENDLY AGROTEXTILES IN AGRICULTURE

Mrs. Trupti Dhoka, Assistant Professor, Department of Textile Science and Apparel Design, SMRK-BK-AK Mahila Mahavidyalaya, Nashik
Dr. Vishaka Karnad, Associate Professor, , Department of Textile and Fashion Technology, College of Home Science Nirmala Niketan, Mumbai

Abstract:
Eco- friendly textiles are getting popular as textiles is the second largest economy generating field in India. Due to its varied applications technical textiles are getting popular.
Agrotextiles is one of the growing sectors of technical textiles and recycling of fiber, yarn and fabrics is also popularising. But due to non-degradability issues of the synthetic agrotextiles efforts are taken to produce agrotextiles by utilizing from natural fibers. Along with it many ways are found out on utilization of textile fiber waste for reduced wastage. A study was therefore undertaken to utilize the textile fiber waste into find sustainable solutions. Therefore, needle punched non-woven composites were prepared by recycling cotton waste fibers, wool waste fibers, viscose waste fibers and recycled polyester fibers with a combination of 50:50 and 100% each. It was this concluded that recycled fiber composites can be used for agrotextiles applications.
Keywords- *eco-friendly, agrotextiles, degradability*

1. Introduction:

Environment friendliness and sustainability are the key issues in the textile field currently. Researchers are thinking on eco-friendly ways of modifying textiles and making them available to consumers with minimal effects to mankind and textiles is one such field.
More than 60% people today prefer agriculture as their main occupation. Much advancement in this field too has made it possible for the farmers to increase the production rate of their crops to up to 20-30%.
Technical Textiles is one such aspect of research which contributes nearly 4 % of global growth every year when compared to home and apparel industries; which is1% per year. Technical textiles are a textile product manufactured for non- aesthetic purposes, where function is the primary criterion. It includes agro textiles. Agro textiles is one of the growing areas of technical textiles.
Along with woven fabrics nonwoven fabrics are getting popularity in the Indian market. The reason may be the cost effectiveness and also time of production is less. Also, in all the sectors of textiles now-a-days non-wovens are developed and utilised. Studies have revealed that the utilisation of non-wovens in technical and especially in agricultural field has been very beneficial for the plant as well as for the soil where the plant grows.
Every state of India has its own peculiarity in fruits and vegetables. Nashik, lying in the western part of Maharashtra is very famous for grape cultivation.[1]Other than this pomegranate, guava, spinach, amaranthus, cucumber, tomato, coriander, onion, etc. are also produced on a large scale. Fruits contribute 6% GCA (gross cropped area) under which grape contribute more than 2 % and pomegranate another 1.3% of farmers in Nashik, 73% are small or marginal and operate 40% of land.[2]

Utilizing of textile fiber waste is considered as an important issue of concern today. Pre-consumer and post-consumer wastes are utilized to find out solutions in such a way that the waste fibers and fabrics are continuously in demand for recycling. Reyling will not only reduce the textile waste but also will help in finding sustainable solution
Due to continuous efforts of Governmental and Non-governmental organizations for eco-friendly agricultural practices a study was conducted in which eco-friendly agrotextiles were developed from textile fiber wastes and then used in grapes cultivation. So the objectives of the study were-

2. Objectives-

1. To document agrotextiles used by grape fruit cultivators of Nashik city.
2. To develop agrotextiles using natural fiber wastes.
3. To analyse the developed natural agrotextiles on grape farms.

3. Methodology:

The present study is based on the primary data collected from the field visits and interviewing grape farm cultivators, experts to understand the difficulties in utilizing the existing agrotextiles. To obtain relevant literature the investigator visited several websites, journals and reviewed related articles. Purposive convenience sampling technique was used to select the grape cultivators. Field visits to grape farms were conducted by the investigator in the Nashik city. 6 non-woven fabrics were developed by using cotton fiber waste, wool fiber waste and viscose rayon fiber wastes and a combination of 50:50 was developed.

The developed fabrics were tested and analysed and results were recorded.

1. Cotton fiber waste non-woven fabric - 100 %
2. Wool fiber waste non-woven fabric - 100%
3. Viscose rayon waste non-woven fabric – 100%
4. Cotton fiber waste: wool fiber waste non-woven fabric - 50:50
5. Cotton fiber waste: viscose rayon fiber waste non-woven fabric – 50:50
6. Wool fiber waste: viscose rayon fiber waste non-woven fabric – 50:50

4. Results and discussion:

a. Documentation of agrotextiles used by farmers of grape cultivation:

Different farmers and cultivators from Nashik (including seven plant nurseries and two farms of grapes and pomegranate) were contacted through snowball and convenience sampling. Interviews were conducted using open ended questions relating to cultivation of crops, the use of fertilizers and the usage of agrotextiles during the cultivation.

Problems faced by them were noted and scope for research was ascertained. It was found that sustainable composites were required as alternative substrates to their currently used. polypropylene materials in order to relieve the cultivators from recurring cost and to prevent environment degradation.

b. Preparation of Fabric Samples:

In the present study 100% needle punched non-woven cotton waste fabric, 100 % needle punched wool waste fabric, 100% non-woven viscose rayon waste fabric, 50:50 cotton waste: wool waste needle punched non-woven fabric, 50:50 cotton waste: viscose rayon waste needle punched non-woven fabric and 50:50 wool waste: viscose rayon waste needle punched no-woven fabrics were prepared. The developed samples were tested on field for 2 months (January to March) as it is the time of ripening of the grapes.

c. Testing of developed needle punched non-woven fabrics:

The samples were tested on 3 grape vineyard farms located at different places in the city.

1. 2 farms at Panchavati, Nashik. (Mr. Sharad Gunjal and Mr. Dilip Gunjal)
2. 1 farm at Makhmalabad Naka, Nashik (Mr. Pingle)

The developed fabrics were placed in different parts of the vineyard in every farm. Some were placed on top and some of the fabrics were placed on the soil. The field trials were conducted at the time of ripening of grapes (January to March)

The samples were tested for its change in taste, anti- microbial and the ph, electrical conductivity, mineral content of the soil.

Sr. No.	Name of the Non-woven fabric	Results of the field trials when placed on top of the vineyard (UV effect on the taste of the grapes)
1.	100 % Cotton waste	The taste of the grapes was more pungent
2.	100% Wool waste	The taste of the grapes was retained
3.	100 % viscose rayon waste	The taste of the grapes was retained to some extent
4.	50:50 Cotton waste: wool waste	The taste of the grapes was retained to some extent
5.	50:50 Cotton waste: viscose rayon waste	The taste of the grapes was retained
6.	50: 50 wool waste: viscose rayon waste	The taste of the grapes was sweetened

Fig. 1. Results of the samples for UV light

From the results it can be said that 100 % wool needle punched non-woven, 50: 50 cotton waste: wool waste retained the taste of the grape fruit whereas. 50: 50 wool waste: viscose rayon waste fabrics resulted in sweetening of the grape fruit.

Sr. No.	Name of the Non-woven fabric	Microbial test result of the samples
1.	100 % Cotton waste	800 nematodes were present above the limits Appropriate treatment for management should be followed
2.	100% Wool waste	
3.	100 % viscose waste	
4.	50:50 Cotton waste: wool waste	
5.	50:50 Cotton waste: viscose rayon waste	
6.	50: 50 wool waste: viscose rayon waste	

Fig. 2. Microbial test result

From the anti-microbial test of the developed non-wovens it can be seen that there was no control of the nematodes; as its growth was increased. This can be modified by appropriate treatment like finishing of the non-woven sample with finished which have anti- microbial property.

Fig. 3. Test result for the developed sample for ph, electrical conductivity and mineral of the soil

Name of the Non-woven fabric	pH	Electrical Conductivity	Calcium Carbonate	Organic Carbon	Nitrogen	Phosphorus	Potassium
100 % Cotton waste	7.7 (Normal)	0.386 dSm (Normal)	4% (Normal)	1.521 % (Very High)	418.27 kg/ha (Normal)	34.76 kg/ha (High)	800.91 kg/ha (Very High)
100% Wool waste	7.7 (Normal)	0.386 dSm (Normal)	4% (Normal)	1.521 % (Very High)	418.27 kg/ha (Normal)	34.76 kg/ha (High)	800.91 kg/ha (Very High)
100 % viscose waste	7.7 (Normal)	0.386 dSm (Normal)	4% (Normal)	1.521 % (Very High)	418.27 kg/ha (Normal)	34.76 kg/ha (High)	800.91 kg/ha (Very High)
50:50 Cotton waste: wool waste	7.7 (Normal)	0.386 dSm (Normal)	4% (Normal)	1.521 % (Very High)	418.27 kg/ha (Normal)	34.76 kg/ha (High)	800.91 kg/ha (Very High)
50:50 Cotton waste: viscose rayon waste	7.7 (Normal)	0.386 dSm (Normal)	4% (Normal)	1.521 % (Very High)	418.27 kg/ha (Normal)	34.76 kg/ha (High)	800.91 kg/ha (Very High)
50: 50 wool waste: viscose rayon waste	7.7 (Normal)	0.386 dSm (Normal)	4% (Normal)	1.521 % (Very High)	418.27 kg/ha (Normal)	34.76 kg/ha (High)	800.91 kg/ha (Very High)

From the test results it can be seen that the all the samples showed same results. The pH, electrical conductivity, calcium carbonate levels and nitrogen are in normal range. Whereas, organic carbon, calcium, phosphorus and potassium were increased when the samples were laid on the soil.

Pictures of the samples when laid for the field trial.

Fig. 4.

Fig. 5.

Non-woven fabrics laid on the vineyard (Fig. 4 & 5)

Fig. 6.

Fig. 7.

Non-woven fabrics laid on the ripening stage of the grape fruit (Fig. 6,7,8)

Fig. 8.

Fig. 9.
Developed samples laid on soil

Conclusion:

Based on the results obtained it can be concluded that agrotextiles prepared from natural fiber waste can be utilized at various stages of cultivation of grapes. There the taste of the grape fruit was retained by 100 % wool waste and cotton viscose rayon waste fibers were laid during the stage of ripening of grapes. When other combinations were applied there was a variation observed.

For the anti-micobial property all the fabrics showed negative results which can be reduced by application of anti-microbial finish. When the samples were laid on the soil the pH, electrical conductivity, calcium carbonate and nitrogen levels of the soil remained as it is but potassium, phosphorus and organic carbon content were increased. This increase enhance plant to tolerate drought. Also, organic carbon increases potassium release and decrease potassium fixation in the soil.

This can be concluded that needle punched non-woven fabrics developed from textile fiber waste can be used for agrotextiles application.

References-

1. Debnath C.R., Roy A.N. Development of needle punched jute non-woven based bituminized water proofing material, Manmade Textiles in India, 2001 July p.290 \
2. http://hdl.handle.net/10603/172377
1. http://dieoff.org/page 57,
2. https://www.linkedin.com/pulse/textile-recycling-industry-india-2023-market-size-share-harsh-mishra-
3. https://www.sciencedirect.com/science/article/pii/S1658077X21000497
4. https://www.greenpeace.to/greenpeace/wp-content/uploads/2012/06/tirado-and-allsopp-2012-phosphorus-in-agriculture-technical-report-02-2012.pdf
5. https://www.woolmark.com/about-wool/wool-fibre/ 9 (accessed on 16/8/2020)
6. https://www.sciencedirect.com/science/article/pii/S2214993720305212?via%3Dihub (accessed on 20/11/2020)
7. https://iopscience.iop.org/article/10.1088/1755-1315/591/1/012011 (accessed on 19/12/2020)
8. https://www.sciencedirect.com/science/article/pii/S0950061820330300?via%3Dihub (accessed on 1/2/2021)
9. https://link.springer.com/article/10.1007/s10924-020-01907-4 (accessed on 7/1/2021)
10. https://www.indianjournals.com/ijor.aspx?target=ijor:ijsr&volume=26&issue=2&article=015 (accessed on 4/2/2021)
11. Mr. Sunil K. Agrawal, July 2013, Application of Textiles in Agriculture, *International Journal of Advance Research in Science and Engineering*, pp. 9-18.
12. Saiful Sabuz, 2014, Applications of Agro-Textiles Textile Learner, pp. 1-11.
13. Vijayaraaghavan N.N., Karthik T. New development in biodegradable non-wovens, The Indian Textile Journal, 2004 April, pp 13-18

Environmental Science and Engineering
Vol: 2 (3), 2023
REST Publisher; ISBN: 978-81-956353-2-0
Website: http://restpublisher.com/book- series/environmental-science-and-engineering/
DOI: https://doi.org/10.46632/ese/2/3/3

Evaluation of Potential for Textile Waste Management using the PROMETHEE Method

***Vishaka Ashish Karnad**
College of Home Science Nirmala Niketan, Mumbai, Maharashtra
*Corresponding Author Email: vishakakarnad@gmail.com

Abstract: *Textile waste management is a critical component of sustainable practices in the fashion and textile industry. It encompasses the responsible handling and disposal of discarded textiles, including clothing, fabrics, and related materials. The goal of effective waste management is to minimize the environmental impact of textile production and consumption. Several strategies are employed in textile waste management: Recycling involves transforming used textiles into new products or materials, reducing the need for virgin resources. Clothing and textiles in good condition can be donated or sold through second-hand markets, extending their lifespan. Natural fibers like cotton and wool can be composted, returning them to the natural cycle. As the fashion industry continues to grow, so does its environmental footprint through landfill decomposing. Understanding and implementing effective waste management strategies in the textile sector can lead to several crucial benefits. Developing innovative ways to manage textile waste can lead to the creation of new industries and job opportunities. This includes recycling facilities, resale markets, and companies focused on sustainable fashion. Consumer Awareness Research in textile waste management helps raise public awareness about the environmental impact of the fashion industry. This knowledge empowers consumers to make more informed and sustainable choices when purchasing clothing. Regulatory Compliance enforced by governments and regulatory bodies are increasingly focused on sustainable practices within industries, including fashion. Research in waste management provides valuable insights for developing and enforcing policies to ensure compliance. Circular Economy Promotion is required for effective textile waste management that supports the transition towards a circular economy and a sustainable life cycle, where resources are reused and recycled rather than disposed-off after a single use. By extending the life of textiles through reuse and recycling, the carbon footprint associated with the production and transportation of new clothing is reduced. Innovation and Technology Advancement through research in textile waste management drives innovation in recycling technologies, fabric design, and sustainable production methods, which can have broader applications beyond the fashion industry. Textile waste is a global issue, and effective waste management practices can have positive repercussions on a worldwide scale, contributing to broader sustainability goals. The PROMETHEE method encompasses several aspects. Firstly, it considers diverse scales for evaluating different grounds. It allows for making decisions based on the best options, as illustrated by PROMETHEE I, which involves partial ranking. This involves identifying incomparable and neglected alternatives Ginning, Spinning, Sizing, Power looms, Dyeing and printing and Cotton waste, Blow room droppings, Cotton dust, Brass bora and Iron drums as per the ranking of Textile Waste Management for using the analysis of PROMETHEE Method. Power looms were considered the first rank whereas is the Spinning was ranked the lowest in the analysis.*

Keywords: *MCDM, Cotton waste, Blow room droppings, Cotton dust, Brass bora and Iron drums.*

1. INTRODUCTION

Textile waste management is a critical facet of sustainable resource utilization and environmental conservation. It involves the systematic handling, disposal, and recycling of textiles and apparel, aiming to minimize their environmental impact. The fashion industry is one of the largest contributors to global waste, with millions of tonnes of textiles discarded annually. Recycling is a key component of textile waste management. It entails the conversion of old and worn textiles into new products, reducing the demand for virgin materials [1]. Donations and reuse are also vital strategies. Clothing in good condition can find new life through charitable donations or resale in second-hand markets. Additionally, composting is a sustainable option for natural fibers like cotton and

wool, allowing them to decompose naturally. While these methods are preferred, some textiles end up in landfills or undergo controlled incineration [2]. Landfill disposal is used for non-recyclable or non-compostable materials. Incineration, if conducted in specialized facilities, can generate energy while minimizing environmental harm. Effective textile waste management is essential in mitigating the environmental impact of the fashion industry. By implementing these strategies, the lifespan of textiles can be extended, reducing the demand for new resources, and contributing to more sustainable and circular economy [3]. The textile industry plays a crucial role in our daily lives, providing an array of clothing and fabric products, however it also generates significant waste. When a textile item reaches the end of its lifecycle, it often ends up being discarded. Natural fibers, which make up 100% of some textiles, will eventually decompose over a few years. Nevertheless, in recent years, population scientists have identified new sources of fibers, reflecting an increase in demand for clothing due to a growing global population. This has led to an estimated annual demand for 99 million tonnes of textiles, a demand that cannot be met solely through natural fibers [4]. As a result, fabrics now often consist of blends, and some combinations are impossible to achieve without the use of synthetic compounds. Most synthetic fibers are derived from petrochemicals, which were once harmful to the environment but over the years have improved with reduced toxicity limits [5].

Efforts are being made to shift towards more sustainable fiber cultivation and production methods in the textile industry. Assessments are being conducted to evaluate the environmental impact, quality, and life cycle of textile products. Certifications such as ISO are awarded to products that meet specific criteria. Unwearable textiles, once detected, are often discarded or thrown into the landfill. Some countries collect old textiles and donate them to agencies that distribute them to those in need, particularly in third-world countries. This practice exemplifies how one person's waste can be another person's treasure [6]. Textile waste is increasingly being recycled into new clothing, reflecting a growing awareness among consumers. This movement towards "green" textiles is being driven by a desire to make more environment-friendly choices. The advertising and marketing strategies of many brands have also shifted towards promoting eco-friendliness. In turn, consumers are reducing their purchases of non-recycled items. Recent studies have shown a positive correlation between environment-friendly textiles and consumerism, as well as a preference for such products among women [7]. International fashion brands are incorporating recycled fibers into their products, marking a shift towards sustainability in the industry. One notable brand, Eco-Spun by Welspun Inc., specializes in selling clothes made from recycled plastic bottles. This innovative approach diverts approximately 9 million plastic bottles from landfills each year, showcasing the remarkable potential for recycling in the textile industry. Eco-fi, made from 100% recyclable PET fibers, is another noteworthy example. It is used in various applications including home textiles, car interiors, furniture, mattresses, and even handcrafts [8]. Blending with wool has become increasingly popular in the market, offering a combination of natural and sustainable materials. Additionally, Lutradur ECO is a sustainable brand that uses fibers obtained from recycled PET bottles. One square meter of fabric produced from PET bottles helps recycle two liters of water from a single PET bottle. These initiatives contribute to a reduction in waste and a more sustainable textile production process. In 2017, a special effort was made to convert plastic into fiber, marking a significant milestone in recycling efforts [9]. Innovations continue to emerge in the textile industry, further expanding the applications of recycled materials. For instance, Safeleigh by Lay Fibres has recently launched fire-resistant menswear, bulletproof vests, and other protective clothing made from aramid fibers—a natural flame-retardant material. By leveraging organic sources, such as dandelion roots, to create rubber fibers from scratch, progress is being made in reducing the environmental footprint of textiles. These efforts collectively contribute to a more sustainable and eco-friendly textile production process [10].

The cotton-textile industry is known for its substantial water consumption during production, necessitating extensive purification efforts to manage wastewater. This wastewater carries a considerable organic load concentration, akin to municipal wastewater in terms of medium strength. Nevertheless, it stands out due to its distinctive color, which presents a notable environmental concern. This research project, conducted in collaboration with a prominent textile manufacturer, explores various treatment modalities and conducts diverse studies to identify highly cost-effective approaches [11]. These investigations encompass a combination of viewing methods. For instance, while the activated sludge process is cost-effective, it falls short of offering a comprehensive solution within an integrated wastewater management system because it cannot effectively address discoloration issues. On the other hand, coagulation/flocculation methods can tackle the discoloration of cotton-wastewater but generate significant volumes of solid waste, subsequently increasing the overall treatment costs considerably [12]. The textile industry is a significant contributor to the economy, particularly in developing countries like Pakistan. It serves as a major source of export earnings, with Faisalabad alone accounting for approximately US$3 billion per year in yarn and fabric exports. This industry also plays a pivotal role in providing employment opportunities, employing an average of 161,325 people in Faisalabad, out of which 11,860 are engaged in solid waste handling and management [13]. The textile sector generates various types of waste, including fiber, metal, plastic, and paper waste. Interestingly, no waste is immediately discarded; instead, a systematic categorization process is employed based on type and weight. Cotton waste, for instance, finds its way

to brick kilns, where it serves as an economical alternative fuel compared to wood or coal. Iron is another valuable resource retrieved from the waste stream, as it is sold in the junk market and subsequently recycled for reuse in factories [14]. Moreover, paper waste undergoes recycling processes, reducing the demand for virgin materials and contributing to the sustainability of the industry. Other materials like plastic and iron drums are sent back to factories for refilling, cutting down on costs and diminishing the need for new drum production. Despite these commendable efforts, there is room for improvement in waste management practices. Implementing a robust quality control system and enhancing monitoring mechanisms will further enhance the industry's sustainability and economic viability [15]. Cotton production in Pakistan holds a prominent position, making it a cornerstone of the nation's economy. It contributes over 60% of the total export earnings and accounts for 46% of the overall production. Furthermore, it provides employment to 38% of the workforce engaged in manufacturing (Iqbal et al., 2007). The textile industry, located mainly in Faisalabad, plays a vital role in the economic landscape. Faisalabad is the third-largest city in Pakistan, with a population estimated to be around 2,009,000 according to the 1998 census. However, current trends indicate an increase to approximately 5,000,000 (District Government Faisalabad, 2010) [16]. This district, situated in the plains of North-East Punjab, spans a total area of 5,856 square kilometers, with coordinates between longitude 73°74 east and latitude 30°31.5 north. Faisalabad is a significant industrial hub, producing vast quantities of thread and fabric that cater to a potential market of hundreds of thousands of meters. It accounts for 25% of textile exports from Pakistan and 15% of the nation's total exports. Other industries in the region have also flourished in favor of the textile industry [17]. The objective of the study was to classify waste from the textile industry, focusing on physical attributes rather than chemical composition. This includes identifying sources of waste generation and categorizing them, along with exploring economic prospects and employment opportunities within this field. Regarding solid waste, it emerges as a major waste stream, superseded only by liquid waste in the textile industry. There exist numerous options to diminish solid waste, a couple of which include 1. Implement efficient procurement procedures for raw materials to reduce excess; and 2. Opt for reusable plastic drums for chemicals rather than single-use cardboard drums [18].

2. MATERIALS AND METHOD

Ginning: Ginning is a crucial initial step in the textile industry, primarily focused on processing raw cotton. The process involves separating cotton fibers from their seeds, preparing them for further processing. During ginning, cotton undergoes cleaning and refining, ensuring it is free from impurities, making it suitable for the subsequent stages of production. This meticulous procedure ensures that the cotton fibers are of high quality, which is essential for producing fine textiles. Ginning plays a pivotal role in determining the quality and purity of the cotton fibers, ultimately influencing the overall quality of the final textile products.

Spinning: Spinning is a fundamental process in the textile industry that transforms raw fibers like that of cotton, into yarn by the insertion of twist. It involves drawing out and twisting of fibers to create a continuous thread. The goal is to produce yarns with consistent thickness, strength, and texture, ensuring its suitability for various textile applications. Modern spinning techniques use advanced machinery and technology to achieve high levels of precision and efficiency. The quality of the spun yarn greatly influences the final fabric characteristics, such as its texture, strength, and appearance. Spinning is a critical stage in the textile production chain, and advancements in this process have significantly contributed to the diversity and quality of textiles available in today's market.

Sizing: Sizing, also known as warp sizing or warp dressing, is a crucial process in the textile industry that involves applying a protective coating or sizing agent onto the warp yarns before they are woven into fabrics. This coating helps strengthen the yarns, reduce friction during the weaving process, and prevent breakage. Sizing is particularly important for high-speed weaving operations as it enhances the yarn's ability to withstand the stress and tension during the weaving process. The sizing material used can vary, including natural substances like starch or synthetic gums or resins. Properly sized warp yarns result in smoother and more efficient weaving, ultimately leading to the production of high-quality fabrics. Additionally, sizing also plays a role in determining the final appearance and characteristics of the fabric. Overall, sizing is an integral step in the textile production process that ensures the successful transformation of yarn into durable and visually appealing fabrics.

Power looms: Power looms revolutionized the textile industry by introducing automated weaving processes. These machines use power sources, such as electricity, to mechanize the process of interlacing warp and weft yarns, replacing the manual labor required in traditional hand looms. Power looms significantly increased the speed and efficiency of textile production, allowing for larger quantities of fabric to be woven in a shorter period of time. This technological advancement led to increased productivity, lowered production costs, and expanded the availability of affordable textiles in the market. Power looms have become a cornerstone of modern textile manufacturing, facilitating the production of a wide range of fabrics used in various industries, including clothing, upholstery, and home textiles. Today, they continue to play a vital role in meeting the global demand for textiles.

Dyeing and printing:

Dyeing and printing are the stages where color and design are added to the fabric. Dyeing requires immersion of the fabric in a solution containing dyes to achieve the desired color, while printing applies patterns or designs

using dyes or pigments on the surface. These processes play a pivotal role in creating a wide variety of vibrant and appealing textile products.

Cotton waste:

Cotton waste encompasses various remnants and by-products generated during the cotton processing stages. This category includes scrap, lint, and other unused portions that result from ginning, spinning, and other textile operations. Cotton waste can be repurposed for various applications, such as making paper, producing cellulose-based products, or even used as stuffing material in certain industries.

Blow room droppings:

Blow room droppings refer to the waste material produced during the initial stages of cotton processing. This includes impurities, dust, and short fibers that are removed during the cleaning and carding process. While these droppings are not suitable for further processing in the textile industry, they can find use in other industries or be recycled for alternative applications.

Cotton dust:

Cotton dust is a common byproduct of textile operations, particularly in environments where cotton fibers are handled. It consists of fine particles and fibers that become airborne during processing. Cotton dust can pose respiratory hazards for workers, making proper ventilation and safety measures crucial in cotton processing facilities.

Brass bora:

Brass bora and iron drums are types of waste generated from machinery and equipment used in textile mills. Brass bora refers to scrap metal, often from components like gears or fittings, made of brass. Similarly, iron drums are discarded containers used for various purposes within the mill. Both materials can be recycled or repurposed to minimize waste and reduce environmental impact.

Iron drums:

Iron drums refer to cylindrical containers made of iron or steel that are used in various industrial processes, including textile manufacturing. These drums serve as versatile containers for storing and transporting materials such as chemicals, dyes, solvents, and other substances used in the textile industry. They are valued for their durability, strength, and ability to withstand harsh environments.

Method: The PROMETHEE method encompasses several aspects. Firstly, it considers diverse scales for evaluating different grounds. It allows for making decisions based on the best options, as illustrated by PROMETHEE I, which involves partial ranking. This involves identifying incomparable and neglected alternatives. PROMETHEE offers a complete ranking of alternatives, which serves as a Multi-Criteria Decision Analysis (MCDA) procedure. Through the PROMETHEE technique, a step-by-step process is employed [19]. Generally, the entailing sequence is followed: Weighing the criteria and selecting Decision Makers (DMs). Evaluating the performance of alternatives against the criteria. Incorporating common values and addressing related negligence and optional values during selection [20]. The PROMETHEE methodology is widely recognized for its outreach-oriented approach. It presents a valuable way to address issues through interconnections. These connections are mutual, and PROMETHEE establishes relationships among various modes. These relationships are structured in a series of interconnected steps according to a customized configuration. PROMETHEE is a sophisticated system that proves particularly valuable in making complex decisions [21]. This utility is especially prominent in practical, real-world situations where Human Multi-Attribute Decision Making (MADM) problems require an awareness of consciousness and the expertise of individuals. These problems often involve subjective judgments. Within the PROMETHEE framework, the alternatives are comparable, and the method takes into account both positive and negative aspects [22]. Instead of merely focusing on inflows and outflows, it employs a balanced approach through the utilization of routes. Assessing performance against benchmarks addressing uncertainty appropriately however, each also connected to the measurement scale boundaries are also generally applicable criterion functions, ultimately the choice that rests with users poses significant challenges, resulting in additional uncertainty arising [23]. Hence, to overcome this hurdle, the credibility is established through reliance on the suggested approach, this is the PROMETHEE methodology derived from identifying the solution, Involves the role of the decision maker facilitates exploration [24]. THE PROMETHEE FAMILY first introduced in 1982 originating in Quebec, Canada, France emerging during a conference, a shift within this towards rankings PROMETHEE I and Section PROMETHEE, designed for addressing problems of varying nature including PROMETHEE VEO for special cases. Currently in practical use across numerous criteria, PROMETHEE methods hold utmost significance [25]. Widely applied in practical scenario, determining criteria serves to address complexities using methodologies several variations and each also in developing stages countless iterations remarks as well as one or more PROMETHEE methods conventionally employed observing the presentations. Selection of each criterion Activity Exam in PROMETHEE A function of each criterion is often nature of criteria and the decision maker is

determined predefined There are six categories' examination processes, which include the following criteria: usual criterion, quasi-criterion, criterion with linear preference, level criterion, criterion with linear preference and indifference area, and gaussian criterion [26]. The Prometheus method is for a portfolio with complexity. There are relatively few publications to apply PROMETHEE in the textile industry analysis. In the present article, with regards to PROMETHEE, more than seven outliers were identified. Sometimes data is too large to cover criteria evaluation tables. At that point, the decision will be made to use PROMETHEE to help solve problems with a black box. In this situation, if a wood-structure is adopted, it can be seen as an extension of PROMETHEE [27].

3. ANALYSIS AND DISCUSSION

TABLE 1. Textile Waste Management

Textile Operation	Cotton waste	Blow room droppings	Cotton dust	Brass bora	Iron drums
Ginning	1550	1650	75.6	57.8	63.5
Spinning	1350	1480	60.6	86.5	95.3
Sizing	1560	1950	40.5	97.8	88.6
Power looms	1750	1750	50.5	90.5	98.4
Dyeing and printing	1560	1350	67.6	50.6	69.79
Max	1750	1950	75.6	97.8	98.4
Min	1350	1350	40.5	50.6	63.5
Max-Min	400	600	35.1	47.2	34.9
	400	600	35.1	47.2	34.9

Table 1 shows Textile Waste Management in Cotton waste, Blow room droppings, Cotton dust, Brass bora and Iron drums. and Alternative Parameters Ginning, Spinning, Sizing, Power looms, Dyeing and printing in Cotton waste in 1750 Power looms is showing the Maximum Value and 1350 Spinning is showing the minimum value. Blow room droppings in 1950 Sizing is showing the Maximum Value and 1350 Dyeing and printing is showing the minimum value. Cotton dust in 75.6 Ginning is showing the Maximum Value and 40.5 Sizing is showing the minimum value. Brass bora in 97.8 Sizing is showing the Maximum Value and 50.6 Dyeing and printing is showing the minimum value. Iron drums in 98.4 Power looms is showing the Maximum Value and 63.5 Ginning is showing the minimum value.

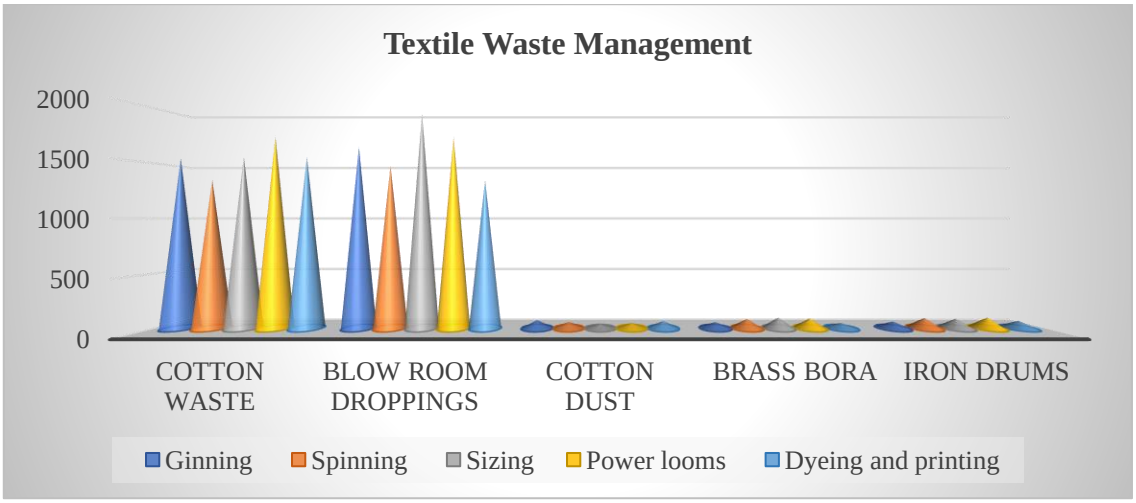


FIGURE 1. Textile Waste Management

Figure 1 shows the shows Textile Waste Management in Cotton waste, Blow room droppings, Cotton dust, Brass bora and Iron drums. and Alternative Parameters Ginning, Spinning, Sizing, Power looms, Dyeing and printing in Cotton waste in 1750 Power looms is showing the Maximum Value and 1350 Spinning is showing the minimum value. Blow room droppings in 1950 Sizing is showing the Maximum Value and 1350 Dyeing and printing is showing the minimum value. Cotton dust in 75.6 Ginning is showing the Maximum Value and 40.5 Sizing is showing the minimum value. Brass bora in 97.8 Sizing is showing the Maximum Value and 50.6 Dyeing and printing is showing the minimum value. Iron drums in 98.4 Power looms is showing the Maximum Value and 63.5 Ginning is showing the minimum value.

TABLE 2. Normalized Matrix

	Cotton waste	Blow room droppings	Cotton dust	Brass bora	Iron drums
Ginning	0.5	0.5	1	0.15254	0
Spinning	0	0.2167	0.5726	0.76059	0.9112
Sizing	0.525	1	0	1	0.7192
Power looms	1	0.6667	0.2849	0.84534	1
Dyeing and printing	0.525	0	0.7721	0	0.1802

Table 2 shows the Normalized matrix of Textile Waste Management or PROMETHEE the Normalization are shown in the above tabulation for the Textile Waste Management shown in the table above Normalized matrix Value.

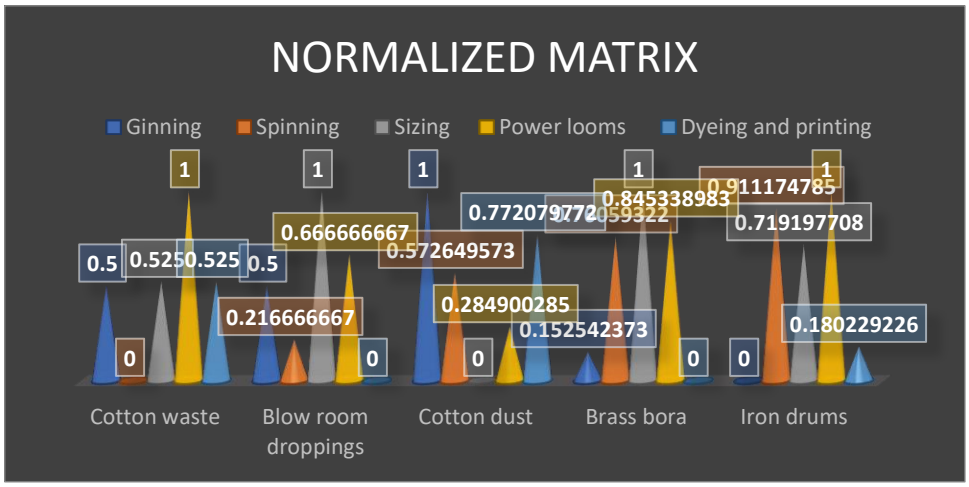


FIGURE 2. Normalized matrix

Figure 2 shows Table 2 shows the Normalized matrix of Textile Waste Management or PROMETHEE the Normalization are shown in the above tabulation for the Textile Waste Management shown in the table above Normalized matrix Value.

TABLE 3. Pair wise Comparison

Pair wise Comparison					
	Cotton waste	**Blow room droppings**	**Cotton dust**	**Brass bora**	**Iron drums**
D12	0.5	0.2833	0.4274	-0.6081	-0.911
D13	-0.025	-0.5	1	-0.8475	-0.719
D14	-0.5	-0.1667	0.7151	-0.6928	-1
D15	-0.025	0.5	0.2279	0.15254	-0.18
D21	-0.5	-0.2833	-0.427	0.60805	0.9112
D23	-0.525	-0.7833	0.5726	-0.2394	0.192
D24	-1	-0.45	0.2877	-0.0847	-0.089
D25	-0.525	0.2167	-0.199	0.76059	0.7309
D31	0.025	0.5	-1	0.84746	0.7192
D32	0.525	0.7833	-0.573	0.23941	-0.192
D34	-0.475	0.3333	-0.285	0.15466	-0.281
D35	0	1	-0.772	1	0.539
D41	0.5	0.1667	-0.715	0.6928	1
D42	1	0.45	-0.288	0.08475	0.0888
D43	0.475	-0.3333	0.2849	-0.1547	0.2808
D45	0.475	0.6667	-0.487	0.84534	0.8198
D51	0.025	-0.5	-0.228	-0.1525	0.1802
D52	0.525	-0.2167	0.1994	-0.7606	-0.731
D53	0	-1	0.7721	-1	-0.539
D54	-0.475	-0.6667	0.4872	-0.8453	-0.82

Table 3 shows the Pair Wise Comparison of table 2 the Cotton waste, Blow room droppings, Cotton dust, Brass bora and Iron drums comparing each row with other row on the tabulation.

TABLE 4. Preference Value

Preference Value						
	0.2336	**0.165**	**0.3355**	**0.102**	**0.042**	
D12	0.1168	0.047	0.1434	0	0	0.307
D13	0	0	0.3355	0	0	0.336
D14	0	0	0.2399	0	0	0.24
D15	0	0.083	0.0765	0.016	0	0.175
D21	0	0	0	0.062	0.039	0.101
D23	0	0	0.1921	0	0.008	0.2
D24	0	0	0.0965	0	0	0.097
D25	0	0.036	0	0.078	0.031	0.144
D31	0.0058	0.083	0	0.087	0.03	0.205
D32	0.1226	0.129	0	0.024	0	0.276
D34	0	0.055	0	0.016	0	0.071
D35	0	0.165	0	0.102	0.023	0.29
D41	0.1168	0.028	0	0.071	0.042	0.257
D42	0.2336	0.074	0	0.009	0.004	0.32
D43	0.111	0	0.0956	0	0.012	0.218
D45	0.111	0.11	0	0.086	0.035	0.342
D51	0.0058	0	0	0	0.008	0.013
D52	0.1226	0	0.0669	0	0	0.19
D53	0	0	0.259	0	0	0.259
D54	0	0	0.1634	0	0	0.163

Table 4 shows the Performance value of the Cotton waste, Blow room droppings, Cotton dust, Brass bora and Iron drums When compare to all others. And the last one is the sum of the same row.

TABLE 5. Sum of Performance Value

	Cotton waste	**Blow room droppings**	**Cotton dust**	**Brass bora**	**Iron drums**		
Ginning	0	0.307	0.3355	0.23992	0.1746	1.05704	0.2114
Spinning	0.10072	0	0.2003	0.09654	0.1444	0.54196	0.1084
Sizing	0.20546	0.2765	0	0.07086	0.2902	0.84296	0.1686
Power looms	0.25747	0.3204	0.2185	0	0.3422	1.13844	0.2277
Dyeing and printing	0.01348	0.1895	0.259	0.16345	0	0.62551	0.1251
	0.57712	1.0934	1.0132	0.57076	0.9514		
	0.11542	0.2187	0.2026	0.11415	0.1903		

Table 5 shows the sum of all rows and column are applied on the last row. The sum of all row of performance value is arranged above tabulation and the diagonal value is zero.

TABLE 6. positive flow, Negative Flow, Net flow

	Positive flow	**Negative Flow**	**Net flow**	**Rank**
Ginning	0.21141	0.1154	0.095983141	2
Spinning	0.10839	0.2187	-0.110283791	5
Sizing	0.16859	0.2026	-0.034057452	3
Power looms	0.22769	0.1142	0.113535054	1
Dyeing and printing	0.1251	0.1903	-0.065176952	4

Table 6 shows ranking Textile Waste Management for the positive flow, Negative Flow, Net flow. Cotton waste, Blow room droppings, Cotton dust, Brass bora and Iron drums in the above tabulation the Power looms is in the first rank and the last rank is Spinning.

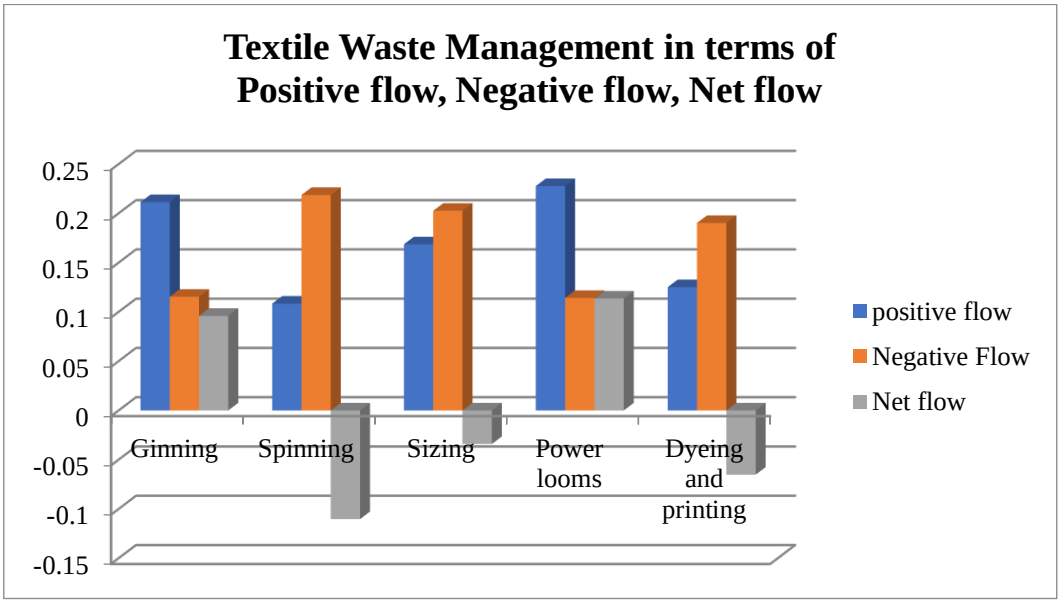


FIGURE 3. Textile Waste Management in terms of Positive flow, Negative flow, Net flow

Figure 3 depicts ranking of Textile Waste Management in terms of positive flow, negative flow, net flow for Cotton waste, Blow room droppings, Cotton dust, Brass bora and Iron drums in the above tabulation the Power looms is in the first rank and the last rank is Spinning.

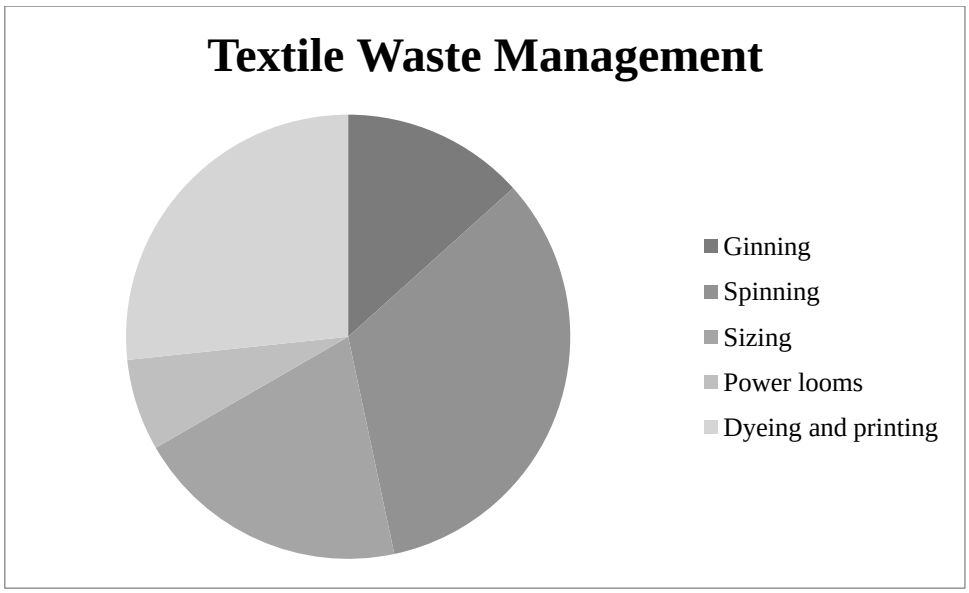


FIGURE 4. Rank

Figure 4 Ranking of Textile Waste Management for using the analysis of PROMETHEE Method. Power looms obtained the first rank whereas is the Spinning had the lowest rank.

4. CONCLUSION

Textile waste management is a critical component for adopting sustainable practices in the fashion and textile industry. It encompasses the responsible handling and disposal of discarded textiles, including clothing, fabrics, and related materials. The goal of effective waste management is to minimize the environmental impact of textile production and consumption. Several strategies are employed in textile waste management: Recycling involves transforming used textiles into new products or materials, reducing the need for virgin resources. Donation and Reuse involves clothing and textiles which are in good

condition can be donated or sold through second-hand markets, extending their lifespan. Composting refers to natural fibers like cotton and wool that can be composted, returning them to the natural cycle. Landfill Disposal, while not ideal, it is sometimes necessary for non-recyclable or non-compostable textiles. Incineration includes controlled burning of textiles that can generate energy, but it must be done in specialized facilities to prevent harmful emissions. Textile waste management research holds significant importance in today's global context. As the fashion industry continues to grow, so does its environmental footprint. Understanding and implementing effective waste management strategies in this sector can lead to several crucial benefits: Environmental Conservation: Proper management of textile waste reduces the environmental impact associated with its disposal. This includes minimizing the release of harmful chemicals and reducing the amount of textile waste sent to landfills or incineration facilities. Resource conservation implies recycling and reusing textiles, conserves valuable resources like water, energy, and raw materials. Textile waste is increasingly being recycled into new clothing, reflecting a growing awareness among consumers. This movement towards "green" textiles is being driven by a desire to make more environmentally-friendly choices. The advertising and marketing strategies of many brands have also shifted towards promoting eco-friendliness. In turn, consumers are reducing their purchases of non-recycled items. Recent studies have shown a positive correlation between environment-friendly textiles and consumers attitudes and preferences for such products especially among women. The textile manufacturing processes generates waste at various stages. Ginning is a crucial initial step in the textile industry, primarily focused on processing raw cotton. The process involves separating cotton fibers from their seeds, preparing them for further processing. During ginning, cotton undergoes cleaning and refining, ensuring it is free from impurities, making it suitable for the subsequent stages of production. Spinning is a fundamental process in the textile industry that transforms raw fibers, like cotton, into yarn. It involves the drawing out and twisting of fibers to create a continuous thread. The goal is to produce yarn with consistent thickness, strength, and texture, ensuring its suitability for various textile applications. Modern spinning techniques use advanced machinery and technology to achieve high levels of precision and efficiency. The ranking of Textile Waste Management for using the analysis PROMETHEE Method was evaluated in this paper using the presented data. Power looms was at the first rank whereas Spinning was at the lowest rank.

REFERENCES

[1]. Noman, Muhammad, Syeda Adila Batool, and Muhammad Nawaz Chaudhary. "Economic and employment potential in textile waste management of Faisalabad." Waste management & research 31, no. 5 (2013): 485-493.

[2]. Weber, Sabine, Jennifer Lynes, and Steven B. Young. "Fashion interest as a driver for consumer textile waste management: reuse, recycle or disposal." International Journal of Consumer Studies 41, no. 2 (2017): 207-215.

[3]. Wei, Fan, Munazzam Jawad Shahid, Ghalia SH Alnusairi, Muhammad Afzal, Aziz Khan, Mohamed A. El-Esawi, Zohaib Abbas et al. "Implementation of floating treatment wetlands for textile wastewater management: A review." Sustainability 12, no. 14 (2020): 5801.

[4]. Dissanayake, D. G. K., D. U. Weerasinghe, K. A. P. Wijesinghe, and K. M. D. M. P. Kalpage. "Developing a compression moulded thermal insulation panel using postindustrial textile waste." Waste Management 79 (2018): 356-361.

[5]. Sivakumar, Venkatasubramanian, and Resmi Mohan. "Sustainable Solid Waste Management in Leather and Textile Industry: Leather & Textile Waste Fibre-Polymer Composite and Nanocomposite–Overview and Review." Textile & Leather Review 3, no. 2 (2020): 54-63.

[6]. Li, Xin, Laili Wang, and Xuemei Ding. "Textile supply chain waste management in China." Journal of Cleaner Production 289 (2021): 125147.

[7]. Holkar, Chandrakant R., Ananda J. Jadhav, Dipak V. Pinjari, Naresh M. Mahamuni, and Aniruddha B. Pandit. "A critical review on textile wastewater treatments: possible approaches." Journal of environmental management 182 (2016): 351-366.

[8]. Grekova-Vasileva, M., and Y. Topalova. "Biological algorithms for textile wastewater management." Biotechnology & Biotechnological Equipment 23, no. sup1 (2009): 442-447.

[9]. Aishwariya, S. "Waste management technologies in textile industry." Innov Ener Res 7, no. 211 (2018): 2576-1463.

[10]. Georgiou, D., and A. Aivasidis. "Cotton-textile wastewater management: Investigating different treatment methods." Water environment research 84, no. 1 (2012): 54-64.

[11]. Dobilaite, Vaida, Gene Mileriene, Milda Juciene, and Virginija Saceviciene. "Investigation of current state of pre-consumer textile waste generated at Lithuanian enterprises." International Journal of Clothing Science and Technology 29, no. 4 (2017): 491-503.

[12]. Dhir, Yamini Jhanji. "Hazards of fashion and textile waste: Approaches for effective waste management." In Waste management in the fashion and textile industries, pp. 31-58. Woodhead Publishing, 2021.

[13]. Bidu, Jerome Michael, Bart Van der Bruggen, Mwemezi J. Rwiza, and Karoli N. Njau. "Current status of textile wastewater management practices and effluent characteristics in Tanzania." Water science and Technology 83, no. 10 (2021): 2363-2376.

[14]. Tripa, Simona, and Liliana Indrie. "Households textile waste management in the context of a circular economy in Romania." Environmental Engineering & Management Journal (EEMJ) 20, no. 1 (2021).

[15]. Mishra, Prince Kumar, Ansari Mohammed Dilsad Izrayeel, Bhupender Kumar Mahur, Arihant Ahuja, and Vibhore Kumar Rastogi. "A comprehensive review on textile waste valorization techniques and their applications." Environmental Science and Pollution Research 29, no. 44 (2022): 65962-65977.

[16]. Nørup, Nynne, Kaj Pihl, Anders Damgaard, and Charlotte Scheutz. "Development and testing of a sorting and quality assessment method for textile waste." Waste management 79 (2018): 8-21.
[17]. Grekova-Vasileva, M., and Y. Topalova. "Biological algorithms for textile wastewater management." Biotechnology & Biotechnological Equipment 23, no. sup1 (2009): 442-447.
[18]. dos Santos, Pedro Seolin, and Lucila MS Campos. "Practices for garment industry's post-consumer textile waste management in the circular economy context: an analysis on literature." Brazilian Journal of Operations & Production Management 18, no. 1 (2021): 1-17.
[19]. Bharathi, Pon, M. Ramachandran, Kurinjimalar Ramu, and Sathiyaraj Chinnasamy. "A study on various particle swarm optimization techniques used in current scenario." Des. Model. Fabr. Adv. Robot 1 (2022): 15-26.
[20]. Dağdeviren, Metin. "Decision making in equipment selection: an integrated approach with AHP and PROMETHEE." Journal of intelligent manufacturing 19, no. 4 (2008): 397-406.
[21]. Hyde, Kylie, Holger R. Maier, and Christopher Colby. "Incorporating uncertainty in the PROMETHEE MCDA method." Journal of Multi-Criteria Decision Analysis 12, no. 4-5 (2003): 245-259.
[22]. Feng, Feng, Zeshui Xu, Hamido Fujita, and Meiqi Liang. "Enhancing PROMETHEE method with intuitionistic fuzzy soft sets." International Journal of Intelligent Systems 35, no. 7 (2020): 1071-1104.
[23]. Lopes, Ana Paula F., María M. Muñoz, and Pilar Alarcón-Urbistondo. "Regional tourism competitiveness using the PROMETHEE approach." Annals of Tourism Research 73 (2018): 1-13.
[24]. Anand, Gapesh, and Rambabu Kodali. "Selection of lean manufacturing systems using the PROMETHEE." Journal of modelling in management (2008).
[25]. De Keyser, Wim, and Peter Peeters. "A note on the use of PROMETHEE multicriteria methods." European journal of operational research 89, no. 3 (1996): 457-461.
[26]. Albadvi, Amir, S. Kamal Chaharsooghi, and Akbar Esfahanipour. "Decision making in stock trading: An application of PROMETHEE." European journal of operational research 177, no. 2 (2007): 673-683.
[27]. Vetschera, Rudolf, and Adiel Teixeira De Almeida. "A PROMETHEE-based approach to portfolio selection problems." Computers & Operations Research 39, no. 5 (2012): 1010-1020.
[28]. Macharis, Cathy, Johan Springael, Klaas De Brucker, and Alain Verbeke. "PROMETHEE and AHP: The design of operational synergies in multicriteria analysis.: Strengthening PROMETHEE with ideas of AHP." European journal of operational research 153, no. 2 (2004): 307-317.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:8(3), August: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd August 2023
Publication Date:30th August 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.08.53
www.ijmer.in

DEVELOPMENT AND EVALUATION OF FERMENTED WATER KEFIR BEVERAGE

Vinitha Sukumar Tatipamula[1], Dr. Tasneem Ravat[2]
M.Sc. (Food Processing & Preservation) Student[1], Assistant Professor[2]
Department of Foods, Nutrition and Dietetics
College of Home Science, Nirmala Niketan, Mumbai, India

Abstract

Fermented foods and beverages have grown in popularity and there are many benefits and hence the current study was conducted to develop and standardise the recipe for preparing the fermented beverage as a healthy vegan source of probiotics. Sample A was prepared using lemon juice and mint leaves and sample B was prepared using lemon juice, mint leaves, and ginger juice. The nutritional, physiochemical, microbiological, and sensory parameters of the water kefir beverage, as well as its shelf life, were all evaluated. And, it was discovered that sample B was sensorily more acceptable than sample A. *Lactobacillus* and yeast counts when enumerated, it was found that samples A and B were within the permissible limits. This helps to distinguish the beverage as naturally probiotic, thereby promoting gut health.

Keywords: Probiotic, Product development, Sensory Evaluation, Shelf-life, Water kefir

1. Introduction

The way people perceive the importance of maintaining their health has been significantly changed by the COVID-19 pandemic. To combat illnesses, individuals have increasingly embraced natural and nourishing meals. As more people have become aware of the benefits of homemade and fermented food, these options have gained popularity. People are now actively seeking out healthy foods that offer potential advantages and positive effects when consumed. Probiotics are live bacteria that, when consumed in appropriate amounts, improve the host's health (World Gastroenterology Organisation, 2017). Consequently, various methods of consuming foods rich in probiotics are currently becoming more popular.

According to a study by Prado, *et al.* (2015), fermented products are becoming increasingly popular and accepted due to their functional advantages. Yoghurt, kefir, kombucha, sauerkraut, pickles, miso, tempeh, kimchi, sourdough bread, and various cheeses are examples of fermented foods that naturally contain or have probiotics added to them. The global trend of incorporating *lactic acid bacteria* (LAB) in food and beverages has been supported by scientific evidence showcasing the functional properties of such products. In recent times, new products, particularly non-dairy beverages made from fruits and cereals, have been introduced to the market. The inclusion of probiotic strains in beverages shows promise and presents an appealing market \opportunity. However, the advancement of this sector faces challenges, including the need for appropriate processing and storage methods to ensure the survival of these microorganisms.
Water kefir, an ancient beverage with an unknown origin, has been passed down from generation to generation and is now consumed worldwide. Incorporating kefir into one's diet, a probiotic product containing live microorganisms that promote good health, is thus an alternative for increasing the nutritional value of one's meals. The current study aimed to produce a fermented water kefir beverage and evaluate its nutritional, physiochemical, sensory, and shelf-life changes.

2. Materials & Methods

The current research was carried-out at the Laboratory of College of Home Science Nirmala Niketan, Mumbai.

Development of the water kefir beverage

Water kefir grains were purchased online through Feelgood kefir grains. Organic jaggery was purchased from White supermarket. Filtered water, lemon, mint leaves, jaggery and ginger were procured from a local market in Mumbai.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:8(3), August: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd August 2023
Publication Date:30th August 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.08.53
www.ijmer.in

The water kefir beverage was made by combining 30 g of organic jaggery with 500 ml of filtered water in a glass jar and thoroughly mixed with a plastic spoon. Because the water kefir grains were purchased and utilised for the first time, they were placed in a strainer and rinsed three times with filtered water before being strained. The rinsed grains were then added to the previously prepared jaggery water and mixed well. Later, a breathable fabric was used to cover the glass container, and a rubber band was used to secure it. The covered glass jar was left to ferment for 24 hours at 22°-25°C.
Flavouring substances were mixed into the fermented kefir water. Two beverage samples were standardised: sample A, which contained 60 ml lemon juice, 10 mint leaves, and 4 gm jaggery (Minty Lemon Kefir Delight), and sample B, which contained 60 ml lemon juice, 10 mint leaves, 4 gm jaggery, and 0.4 ml ginger juice (Lemon Mint Ginger Fizz). Both samples were left to ferment for another 24 hours at 22°-25°C. Following the second fermentation, the glass jars containing samples A and B were refrigerated.

Nutritive and Physicochemical Analysis

Carbohydrate, Protein and Sugar analysis were carried out using the methods of Association of Official Analytical Chemists (A.O.A.C.) 2000.
pH, Total titratable acidity and Total soluble solid content were performed according to the methodology proposed by the (A.O.A.C.) 2000.

Sensory Evaluation and Shelf-life study

A seven-point hedonic scale was used for sensory evaluation of semi-trained panel members to evaluate attributes such as appearance, colour, aroma, flavour, taste, and overall approval for the two samples.
The shelf life study of food was also performed which indicates the useful consumable storage life. In accordance with the Bureau of Indian Standards' (BIS) recommended protocol, the samples were examined and the counts collected were compared to the existing permissible limits. The samples were tested for Total plate count, *Coliform* count, *Lactobacillus* count, Yeast count according to the procedure described by Bureau of Indian Standards (BIS).

3. Results & Discussion

Development of the water kefir beverage

Fig. 1: Procedure to prepare flavoured water kefir beverage

The fermented kefir water was flavoured with ginger, lemon juice, mint leaves, and jaggery.

Cover Page

DOI: http://ijmer.in.doi./2023/12.08.53
www.ijmer.in

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:8(3), August: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd August 2023
Publication Date:30th August 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

Nutritive and Physicochemical Analysis

Sr. no.	Parameters	Sample A	Sample B
1	**Carbohydrate** **a. Reducing sugars** **b. Non-reducing sugars** **c. Total reducing sugars**	 0.041g 0.129g 0.17g	 0.063g 0.167g 0.23g
2	**Protein**	0.47g	0.47g
3	**Total Soluble Solids**	3.5% Brix	3% Brix
5	**Vitamin C**	0.026 mg/ml	0.026 mg/ml
6	**Total Titratable Acidity**	0.03%	0.02%
7	**pH**	2.72	3.09

Table 1: Nutritive and Physicochemical Values

Sample A had the lowest overall reducing sugar content compared to sample B (Table 1).
Protein content was found to be 0.47g in both samples. This is similar with the findings of Magalhaes-Guedes *et al.* (2010), who discovered a protein level of 0.4% in Brazilian sugary water kefir fermented for 24 hours. Because of the rise in microbial biomass and secretion, the protein content of a fermented product normally increases with fermentation time. Sample A had 3.5% more Total Soluble Solids than sample B, which had 3%. According to Dwiloka *et al*. (2020), increasing fermentation duration reduces TSS values.

According to Sepriani and Deswandi (2021), vitamin C acts as an antioxidant in the body, enhancing metabolic processes that generate energy. Mint leaves have 51.47 mg/100 g of vitamin C, ginger has 12 mg/100 g, and lemon has up to 100 mg/100 g. Both samples contained the same amount of vitamin C.

Kayath, C. A., *et al.* (2020), discovered that acidity was induced by microbial fermentation activity, which degrades cell walls by releasing organic acids into the media. Sample A had a slightly greater total titratable acidity than sample B.

Sample A had a pH of 2.72 while Sample B had a pH of 3.09. According to Dwiloka *et al.* (2020), the pH of water kefir normally ranges between 3.5 and 4, which can be attributed to the growth of bacteria that convert sugar into lactic acid and acetic acid, lowering the pH of the product. Another study, by Luca Serventi *et al.* (2020), indicates that pH declines throughout the fermentation process, from roughly 7 to a final range of 3.0 to 4.5. Similarly, Sepriani and Deswandi (2021), discovered that diets with high quantities of vitamin C have a lower pH.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:8(3), August: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd August 2023
Publication Date:30th August 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.08.53
www.ijmer.in

Sensory Evaluation and Shelf-life study

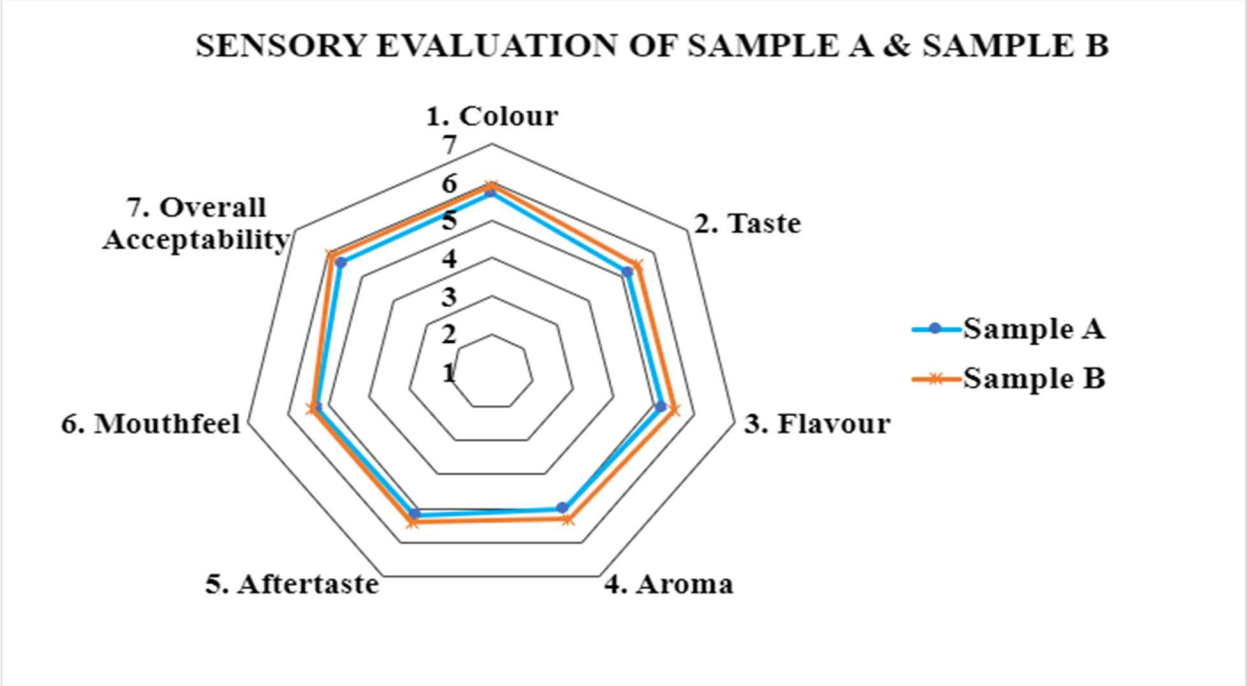


Fig. 2: Sensory evaluation of Water kefir beverage

As shown in the figure 2, sample B made of lemon juice, mint leaves and ginger juice was highly preferred over its counterpart sample B made of lemon juice and mint leaves.

Sample	Test	Day 1	Day 15	Specified limits (CFU/ml count)
Sample A	**Total Plate Count**	Absent	Absent	Not Specified
	Lactobacillus Count	4.3×10^7	4.9×10^9	Minimum 10^7
	Yeast & Mold Count	>300	1.6×10^9	Minimum 10^6
	Coliform Count	Absent	Absent	Absent
Sample B	**Total Plate Count**	Absent	Absent	Not Specified
	Lactobacillus Count	3.1×10^7	1.4×10^9	Minimum 10^7
	Yeast & Mold Count	1.0×10^7	1.9×10^9	Minimum 10^6
	Coliform Count	Absent	Absent	Absent

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:8(3), August: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd August 2023
Publication Date:30th August 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.08.53
www.ijmer.in

1st Ferment	**Total Plate Count**	Absent	Absent	Not Specified
	Lactobacillus Count	2.8×10^7	1.0×10^6	Minimum 10^7
	Yeast & Mold Count	2.0×10^7	1.0×10^7	Minimum 10^6
	Coliform Count	Absent	Absent	Absent

Table. 2: Results of Microbial Analysis

Microbiological analysis is critical since it is affected by factors such as production process, incubation, and storage conditions. According to FAO/WHO, "probiotics are live microorganisms that, when given in adequate quantities, confer a health benefit on the host."w To be labelled as "Probiotic," a product must contain at least 10^8 CFU/ml of active probiotic bacteria, according to ICMR-DBT criteria. Anything less than this amount is not considered "Probiotic" and may not have any health benefits.

According to Kazakos, S. *et al.*, in order to survive the severe conditions of the gastrointestinal tract, a product claiming to be probiotics must have probiotic effects at a concentration of between 10^6 and 10^7 CFU/ml at the end of the product's shelf life.

According to Lamba, J., Goomer, and Saxena, S. K., (2019), traditional fermentation is a food processing technique that uses microorganisms, primarily yeast and *lactic acid bacteria* (LAB). Local or household use of this centuries-old food preservation technology is still common in India. Lactic acid food fermentation converts fermentable sugars in the food substrate into lactic acid and other limited products utilising microorganisms and enzymes. The analysis also revealed that every sample produced for the study had 10^6 CFU/ml count. As a result, the product's origin could be probiotic.

Table 2 shows that no microbial growth was seen in Total Plate Count between days 1 and 15 for Sample A, sample B, and 1st Ferment, although few plates were contaminated. Water kefir contains at least 10^6-10^7 CFU/g grain of yeasts, according to Moretti *et al.* (2022). The yeast count for Samples A, B, and 1st Ferment was between 10^7-10^9 CFU/g grain. Furthermore, water kefir grains were shown to include *lactic acid bacteria* (LAB) species such as *Lactobacillus sp., Lactococcus sp., Leuconostoc sp., and Streptococcus sp.* with a minimum concentration of 10^7 -10^8 CFU/g. The *lactobacillus* counts in Samples A and B were found to be within the set limits. However, the *lactobacillus* population in the first ferment decreased from day 1 to day 15.

The Bureau of Indian Standards (BIS) specifies that the maximum allowable limit for the coliform count in water meant for human consumption is 1 colony-forming unit (CFU) per 250 millilitres. *Coliform* bacteria serve as markers for both the possible presence of faecal contamination and pathogenic species. There are no detectable coliform levels in any of the samples, making them all safe for human consumption.

4. Conclusion

The production of a vegan beverage that also supports a healthy gut was the major objective of the current study. Water kefir is a probiotic, fermented beverage that has preserved its significance over time due to its health benefits. Compared to other fermented beverages like milk kefir or kombucha, water kefir has fewer studies. According to Cufaoglu, G., & Erdinc, A. N. (2023), water kefir has emerged as a viable alternative source of probiotics for people who are lactose intolerant, allergic to dairy products, or who choose not to consume milk and dairy products. The *lactic acid bacteria*,

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:8(3), August: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd August 2023
Publication Date:30th August 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.08.53
www.ijmer.in

acetic acid bacteria, and yeast work together in a symbiotic relationship to influence the microbiota of the water kefir grain, but other factors such as temperature, oxygen content, sugar type, and concentration can also have an impact. Fortunately the yeast count and lactobacillus count indicate the presence of much-needed probiotic bacteria, proving that the flavoured varieties of water kefir beverage were in fact beneficial after consumption. There were no *coliform* counts or total plate counts observed until day 15, indicating that it was safe for consumption. Water kefir beverages were flavoured with lemon, mint leaves, jaggery and ginger. These ingredients enhanced consumer acceptance of the product. These components reduced the alcoholic aroma while also adding to the beverage's refreshing effect.

5. References

1. AOAC, M. (1990). Association of official analytical chemists. Official methods of analysis. *AOAC: Off Methods Anal*, *1*.
2. Cufaoglu, G., & Erdinc, A. N. (2023). An alternative source of probiotics: Water kefir. Food Frontiers, 4(1), 21-31.
3. Dwiloka, B., Rizqiati, H., & Setiani, B. E. (2020). Physicochemical and sensory characteristics of green coconut (Cocos nucifera L.) water kefir. International Journal of Food Studies, 9(2).
4. Kayath, C. A., Ibala Zamba, A., Mokémiabeka, S. N., Opa-Iloy, M., Elenga Wilson, P. S., Kaya-Ongoto, M. D., & Nguimbi, E. (2020). Synergic involvements of microorganisms in the biomedical increase of polyphenols and flavonoids during the fermentation of ginger juice. International Journal of Microbiology, 2020.
5. Kazakos, S., Mantzourani, I., Nouska, C., Alexopoulos, A., Bezirtzoglou, E., & Bekatorou, A. (2016). Production of low-alcohol fruit beverages through fermentation of pomegranate and orange juices with kefir grains. Current Research in Nutrition and Food Science Journal, 4(1), 19-26.
6. Lamba, J., Goomer, S., & Saxena, S. K. (2019). Study the lactic acid bacteria content in traditional fermented Indian drink: Kanji. International Journal of Gastronomy and Food Science, 16, 100143.
7. Laureys, D., & De Vuyst, L. (2014). Microbial species diversity, community dynamics, and metabolite kinetics of water kefir fermentation. *Applied and environmental microbiology*, *80*(8), 2564-2572.
8. Lindner, J. D. D., Penna, A. L. B., Demiate, I. M., Yamaguishi, C. T., Prado, M. R. M., & Parada, J. L. (2013). 11 Fermented Foods and Human Health Benefits of Fermented Functional Foods. Fermentation processes engineering in the food industry, 263.
9. Magalhaes, K. T., de M. Pereira, G. V., Dias, D. R., & Schwan, R. F. (2010). Microbial communities and chemical changes during fermentation of sugary Brazilian kefir. World Journal of Microbiology and Biotechnology, 26, 1241-1250.
10. Moretti, A. F., Moure, M. C., Quiñoy, F., Esposito, F., Simonelli, N., Medrano, M., & León-Peláez, Á. (2022). Water kefir, a fermented beverage containing probiotic microorganisms: From ancient and artisanal manufacture to industrialized and regulated commercialization. *Future Foods*, *5*, 100123.
11. Prado, F. C., Lindner, J. D. D., Inaba, J., Thomaz-Soccol, V., Brar, S. K., & Soccol, C. R. (2015). Development and evaluation of a fermented coconut water beverage with potential health benefits. Journal of functional foods, 12, 489-497.
12. Rezac, S., Kok, C. R., Heermann, M., & Hutkins, R. (2018). Fermented foods as a dietary source of live organisms. Frontiers in microbiology, 9, 1785.
13. Sepriani, R., & Deswandi, D. (2021). Biochemical analysis of ginger-infused water with a combination of lemon and mint leaves. In E3S Web of Conferences (Vol. 332, p. 06002). EDP Sciences.

International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

First-Time Grandparenting: A Cross-Sectional Study on the Benefits and Challenges Among Three Age Groups (50-70 Years And Above)

Dr. Kamini Prakash Rege[1], Lydia Samuel[2]

[1]Professor. Department of Human Development. College of Home Science, Nirmala Niketan, Affiliated to University of Mumbai, India
[2]"Master's Program Research student, Department of Human Development, College of Home Science, Nirmala Niketan, Affiliated to University of Mumbai, India

Abstract
Transitioning to grandparenthood is one the major changes in an individual's life. (Brotherson.2020) has defined grandparenting as "typically occurring when a person has reached maturity and has wisdom or experience to share with the rising generation. The study aimed to understand the opinions of first-time grandparents (50-60,60-70,71 and above years) on benefits, challenges, and coping strategies of first time grandparenting. It involved 180 first time grandparents from Mumbai. Self-constructed questionnaire was used to collect data. Findings indicated that benefits experienced by first time grandparents were majority joy and happiness by spending time with their grandchild (55%), playing and having fun, going to the park together which helps to keep them physically and mentally active. Many first time grandparents (57%) indicated that adapting to changes in cultural norms such as understanding and respecting new parenting approaches or values that may differ from those when you were raising your own children was challenging, While gathering insights on suggestions/strategies for future grandparents majority of the little less than half of the grandfathers (48.8%) responded that by being there to help, but not over taking such as offering to do homework, but allowing your grandchild to take the lead and asking for help when needed will help in grandparenting and majority of grandmothers (60%) responded that communicating openly, listening well can lead to successful grandparenting. Based on the findings, guidelines/ brochures for enhancing the role of being first time grandparents were developed. These guidelines can therefore be effective. Communicated to the future first time grandparents, the research participants and in religious places, ngos working with elderly and most importantly in hospitals.

Keywords: First time grandparents, transition, benefits of first time grandparenting, challenges of first time grandparenting

1. Introduction

Grandparents, like heroes, are necessary to a child's growth as vitamins -Allston Brotherson, & Langerud in their article The Art of Grandparenting No.1: Becoming a Grandparent' defined grandparenting typically occurs when a person has reached maturity and has wisdom or experience to share with the rising generation (Brotherson,2020). According to Chadha's (2010) paper 'Intergenerational relationships: an Indian perspective,' living with grandparents is not a duty in the Indian culture, but rather a necessity

because it allows for the general development of the children in the family. The elder lies' experience, caring, and nurturing make the children far more aware of the positives around them. It helps children comprehend that as time passes, value systems deteriorate, and that these deteriorated value systems have caused so much harm to our society. For the elderly people, it is a positive opportunity to find meaning in their lives in Indian context, one good factor is that the retired men and women have a whole new bunch of roles to play. They still have their roots in the family. Developing connections with a younger generation helps older adults to feel a greater sense of fulfilment. In fact, it is advantageous for both the groups as on one hand it helps the elderly transfer whatever they have achieved emotionally and socially in their entire life and on the other hand the kids gets multiple perspectives on reality which makes them more socially adjusted. In spite of their own health problems, the elders manage to take care of the younger ones at a good level. Indian grandparents teach their grandchildren practical abilities and provide them with information about their family and their past. They also provide them with care and support, and act as role models and sources of ideas and reflection about human life. As agents of their grandchildren's socialization, grandparents are significant and contribute to their cognitive, moral and socio-affective development. This creates a close relationship between children's development and the roles played by their grandparents within the web of family relationships. It is been seen in the Indian culture that advice, education and reflection are more frequently attributed to grandfathers while affectionate relationships and care are attributed to grandmother's. Vishnupriya (2002) says grandparents can often neglect their own health in favor of their grandchildren, particularly if money is an issue. Challenges that grandparents may face when they become involved in their grandchild's life. Some of these challenges include balancing your time between your grandchild and your other responsibilities, dealing with difficult behaviour from the child, coping with changes in the family dynamic.

Research objectives

1. To ascertain the opinion from first time grandparents in relation to benefits and challenges experienced as first time grandparents
2. To create guidelines/ brochures for enhancing the role of being first time grandparents.

2. Research Methodology

Research design used in the study was exploratory research design. Exploratory research is research conducted to gain new insights, discover new ideas, and for increasing knowledge of the phenomenon.

Sample size- 180 first time grandparents

- 60 grandparents of 50-60 years old, where 30 were female grandparents and 30 were male grandparents
- 60 grandparents of 61-70 years old, where 30 were female grandparents and 30 were male grandparents
- 60 grandparents of 70 and above years old, where 30 were female grandparents and 30 were male grandparents

Sampling techniques:

1. Snowball Sampling technique-

Rationale -Because it broadened the distribution of questionnaires to a larger group of individuals.

2. Purposive Sampling technique

Rationale- Because it helped in selecting specific individuals or cases that possess certain characteristics relevant to the research question.

Inclusion and Exclusion criteria

The key features of the target population that the investigators will use to answer their research question.

In this research it was as follows:

1. Grandparent who had his /her grandchild between the age of 3-8 years were included
2. Grandparents who lived with their own son, own daughter or independently were included
3. Grandparents from different socio-economic background were included
4. Anybody who was a second time grandparent and grandparents who resided in old age homes were excluded

Research process and development of tool: The researchers have developed a self-constructed semi structured questionnaire for the study. The proforma was based on the inclusion as well as exclusion criteria of the study. The selfconstructed questionnaire contained 6 multiple choice question and 1 open ended question.

Plan of Analysis: Data was analysed quantitatively wherein frequency and percentages were drawn and tabulated. Total 180 participants (90 first time grandfathers,90 first time grandmothers) across Mumbai and nearby distracts , were contacted and the study was conducted from the Indian population. Results obtained from the 180 participants (90 first time grandfathers,90 first time grandmothers) have been computed.

3. Result and Discussion

Objective 1. To ascertain the opinion from first time grandparents in relation to benefits and challenges experienced as first-time grandparents

Table No.1: Benefits experienced by first time grandparents (n=180)

Benefits of first time grandparenting			**Total**		**Grand total**	
		Male (n=90)	Female (n=90)		All age group (n=180)	
	f	(%)	f	(%)	f	(%)
Joy and happiness by spending time with your grandchild, seeing their smiles and hearing their laughter, brings immense joy	33	36.6	66	**73.3**	99	**55**
Sharing life lessons by teaching them things like how to tie their shoes, ride a bike	48	**53.3**	43	47.7	91	**50.5**
Playing and having fun by engaging in activities like playing games, doing puzzles, or going to the park together.	45	50	47	**52.2**	92	**51.1**
Passing down family traditions by celebrating holidays, preparing special family recipe	29	32.2	35	38.8	64	35.5
Staying mentally active by solving puzzles, reading stories, or engaging in educational activities with your grandchild.	33	36.6	25	27.7	58	32.2
Finding a new sense of purpose by being there to nurture and guide your grandchild	33	36.6	21	23.3	54	30

Note -*Multiple responses were obtained

In response to the benefits of first time grandparenting little more than half of the grandfathers (53.3%) indicated that by sharing life lessons such as teaching them things like how to tie their shoes, ride a bike benefits them and large majority of grandmothers (73.3%) indicated that there is joy and happiness by spending time with their grandchild, seeing their smiles and hearing their laughter, brings immense joy, however little more than half of the grandmothers (52.2%) stated that by playing and having fun by engaging in activities like playing games, doing puzzles, or going to the park together also is a benefit of grandparenting (Refer to table.no 1).

Table No.2: Challenges experienced as a first-time grandparent (n=180)

Challenges as a first time grandparent	**Total**				**Grand total**	
	Male (n=90)		Female (n=90)		All age group (n=180)	
	f	(%)	f	(%)	f	(%)
Neglect health in favor of grandchildren such as disturbing sleep schedule, skipping medicines	26	28.8	49	**54.4**	75	41.6
New roles and responsibilities like adjusting to being a supportive figure rather than the primary caregiver	38	42.2	45	50	83	46.1
Adapting to changes in cultural norms such as understanding and respecting new parenting approaches or values that may differ from those when you were raising your own children	51	**56.6**	51	**56.6**	102	**56.6**
Long-distance between grandchild and me which makes it difficult to spend time together	29	32.2	32	35.5	61	33.8
Family conflict if the parents disagree on how to discipline the child leading to confusion and tension	26	28.8	27	30	53	29.4
Financially not independent to satisfy grandchild's needs	25	27.7	32	35.5	57	31.6
Not able to give same energy as of grandchildren	21	23.3	29	32.2	50	27.7
Balancing time with other responsibilities such as work	25	27.7	27	30	52	28.8

Note-*Multiple responses were obtained

In response to the challenges of first time grandparenting more of the grandparents [Male (56.6%);Female (56.6%)] indicated that adapting to changes in cultural norms such as understanding and respecting new parenting approaches or values that may differ from those when you were raising your own children was challenging, however little more than half of the grandmothers (54.4%) indicated that neglecting health in favor of grandchildren such as disturbing sleep schedule, skipping medicines was also a challenge (Refer to table.no 2).

Table No.3: Strategies suggested by first time grandparents for future first time grandparents (n=180)

Suggestions/strategies for those who would be first time grandparents	**Total**			**Grand total**
	Male (n=90)		Female (n=90)	All age group (n=180)
	f	(%)	f (%)	f (%)
Communicate openly, listen well by asking your grandchild about their day at school, listening to stories	40	44.4	54	**60** 94 **52.2**
Respect parents' rules and decisions such as if the parents have set a bedtime, make sure to follow it when the grandchildren are in your care.	43	47.7	34	37.7 77 42.7
Be there to help, but don't take over such as offering to do homework, but allow your grandchild to take the lead and ask for help when needed.	44	**48.8**	35	38.8 79 43.8
Spend quality time together	44	**48.8**	40	44.4 84 46.6
Share family stories and values	38	42.2	37	41.1 75 41.6
Learn about what interests your grandchild such as ask about their favorite books, hobbies	23	25.5	19	21.1 42 23.3
Be flexible and adapt as your grandchild grows because as they get older, their interests and preferences may change, so be open to trying new activities together	29	32.2	30	33.3 59 32.7
Set a good example with kindness and respect.	32	35.5	31	34.4 63 35

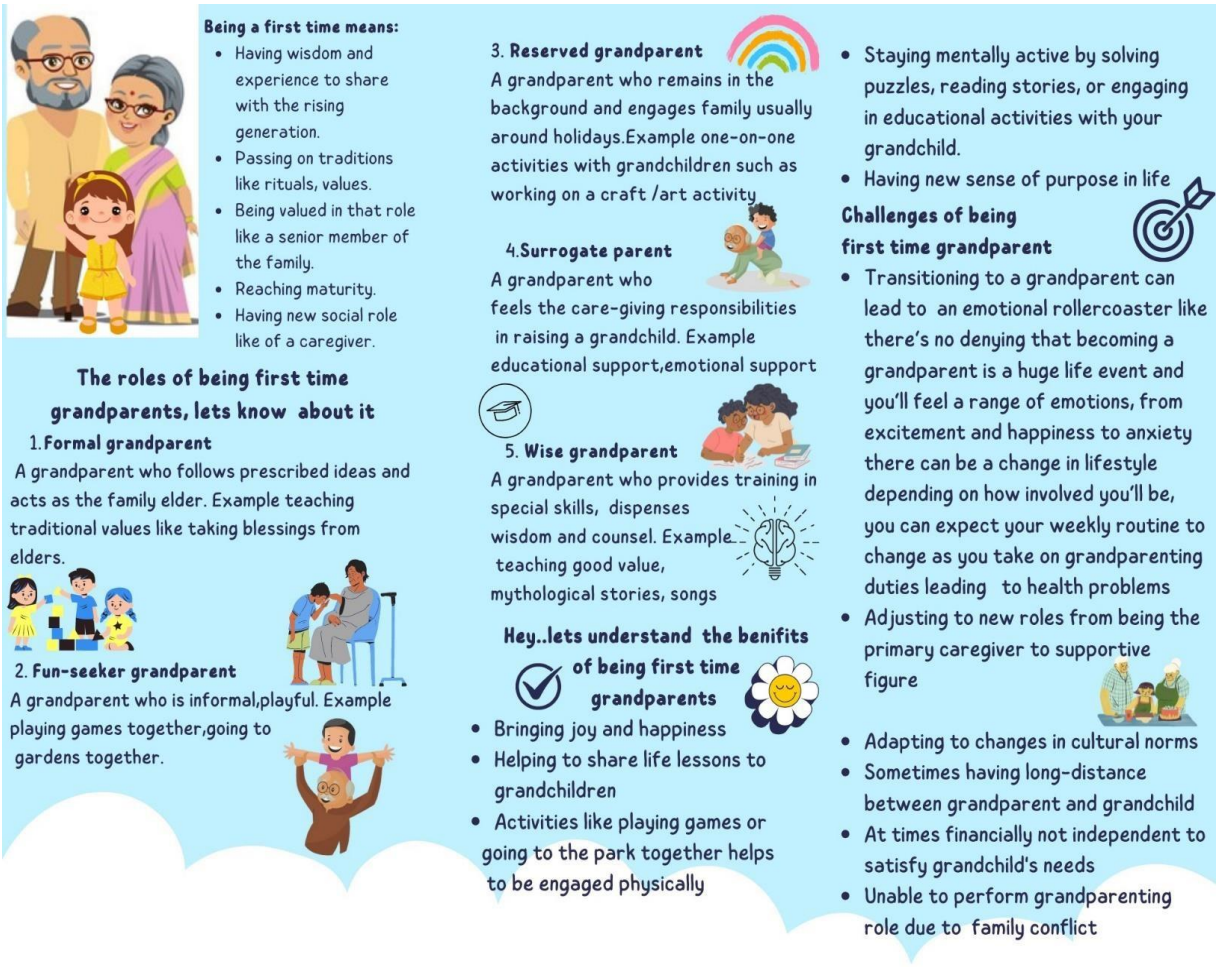
Note -*Multiple responses were obtained

While gathering insights on suggestions/strategies for future grandparents majority of the little less than half of the grandfathers (48.8%) responded that by being there to help, but not over taking such as offering to do homework, but allowing your grandchild to take the lead and asking for help when needed will help in grandparenting also they stated (48.8%) that sharing quality time together and majority of grandmothers (60%) responded that communicating openly, listening well by asking your grandchild about their day at school, listening to stories will lead to successful grandparenting (Refer to table.no 3).

Objective 2 To create guidelines/ brochures for enhancing the role of being first time grandparents (refer to figure no.1 and 2).

Figure No.1: Brochure page 1

Figure No.2: Brochure page 2



Discussion

Grandmothers stated that by playing and engaging in activities like playing games, doing puzzles, or going to the park together also was benefit physical and mental health (Suitor,2016) also says that physical impacts may be positive in that due to grandchild care often led to increase in exercise, healthier diets, and a commitment to setting a good example. Highest challenges among grandparents were adapting to changes in cultural norms such as understanding and respecting new parenting approaches or values that may differ from those when the grandparents were raising their own children furthermore in the review of literature it was mentioned that the ideology of the modern generation, their thinking, social adaptability and style quotients are widely different as compared to their pedigree (Shlomo,2013).The study indicated that grandparents neglect their health in favor of grandchildren such as disturbing sleep schedules, skipping medicines similarly (Brotherson,2020) says that grandparents can often neglect their own health in favor of their grandchildren. Also (Martin,2020) said grandparents had a range of serious health conditions, including heart disease, cancer, diabetes, impact to their chronic health conditions had on raising a grandchild. They expressed feeling exhausted, trying to balance caring for their grandchildren. Grandparents of 50-60 years old who were working had no challenges of energy as compared to60–70-year-old grandparents and 71 and above year old grandparents also Sheppard (2019) in his study 'Becoming a First-Time Grandparent and Subjective Well-Being: A Fixed Effects Approach' says said that employed men reported higher levels of expected longevity upon becoming a grandfather, whereas

those not working (retired or otherwise) reported a decrease in expected longevity after the arrival of the grandchild.

4. Contribution of the study

1. The major contribution of this study was to create guidelines/ brochures for enhancing the role of being first time grandparents. These guidelines were created on the basis of the suggestions and strategies given by the first-time grandparents. These guidelines can therefore be effectively communicated to the future first time grandparents, the research participants and in religious places, NGOs working with elderly and most importantly in hospitals.
2. The study indicates that neglecting health is one of the major challenges faced by first time grandparents. Therefore, awareness about the same can be done for future first time grandparents.
3. The study had variations of major three different cultures (Christian, Hindu, Muslim) which indicates multicultural perspective on first time grandparenting. This information can be kept in for future researches

5. Recommendation for the future research

1. The current research has focused on ascertaining the opinion of first time grandparents across the age group of 50-70 and above years in relation to benefits and challenges and coping strategies of grandparents, suggestion for enhancing grandparenting style. Further research can ascertain the perception of parents in relation to first time grandparenting and their benefits and challenges and coping strategies.
2. This research focused on the semi-structured questionnaire. Further research could include other sources to obtain information (i.e. face to face interview method where observations help to crosscheck the information obtained) as it offers data that the respondents are unable/unwilling to cooperate/reveal, approaching reality in its natural structure and studies events as they evolve.
3. The current research focused on individuals who had proficiency in English language. Further researches could develop the questionnaire in multiple languages.
4. The further research could study the perceptions and inter-relationship regarding the other variables such as, (a) type of family (b) marital status (c) education background (d) income level (e) socio-economic status of first time grandparents across the three age groups (50- 60,61-70,71 and above)
5. The current study has selected participants only from Mumbai mainly, to get a better perspective large number of participants from within state, interstate and country wide could be considered.

6. References

1. Brotherson, & Langerud. (n.d.). *The Art of Grandparenting No. 1: Becoming a Grandparent* . Publications,North Dakota State University. Retrieved August 1, 2023, from https://www.ag.ndsu.edu/publications/kids-family/the-art-of-grandparenting-no-1-in-the-series
2. Vishnupriya, R. (2002, January 1). Shodhganga@INFLIBNET: *Elderly as Grandparents Across the Life Span Perception of Two Generations*. https://shodhganga.inflibnet.ac.in/handle/10603/51079

3. Sheppard, P., & Monden, C. (2019, June 6). *Becoming a First-Time Grandparent and Subjective Well-Being: A Fixed Effects Approach.* Journal of Marriage and Family, *81*(4), 1016–1026. https://doi.org/10.1111/jomf.12584
4. Gessa, G. D., Bordone, V., & Arpino, B. (2019, October 30). *Becoming a Grandparent and Its Effect on Well-Being: The Role of Order of Transitions, Time, and Gender.* PubMed Central (PMC). https://doi.org/10.1093/geronb/gbz135
5. Danielsbacka, M., Křenková, L., & Tanskanen, A. O. (2022, January 4). *Grandparenting, health, and well-being: a systematic literature review*. European Journal of Ageing, 19(3), 341–368. https://doi.org/10.1007/s10433-021-00674-y

Conflict Resolution between School-age Friends: A Replication with Children from Mumbai, India

Article *in* North American Journal of Psychology · January 2023

CITATIONS
0

READS
29

2 authors:

Anupama Joshi
California State University, Dominguez Hills
15 PUBLICATIONS **214** CITATIONS
SEE PROFILE

Payal Maheshwari
college of home Science, Nirmala Niketan, India Mumbai
5 PUBLICATIONS **2** CITATIONS
SEE PROFILE

Conflict Resolution between School-age Friends: A Replication with Children from Mumbai, India

Anupama Joshi
California State University, Dominguez Hills

Payal Maheshwari
College of Home Science Nirmala Niketan, India

Eighty 9- to 11-year-old children provided information about a recent conflict they had had with a friend through open-ended interviews in a replication study. Of the thirteen different strategies identified from children's descriptions of their conflicts, assertion, discussion, and conventional strategies were the most frequently used strategies. Data were reduced using correspondence analysis (CA) which yielded eight strategies. There was some concordance in strategy use by the children in conflict such that children responded to reasoning with reasoning, non-action was met with conventional strategies and aggression with external intervention. Data revealed the use of strategies not found in the original study in the United States. We discuss these findings and suggest directions for future investigations.

Keywords: conflict resolution, strategies, school-age years; culture

Children's friendships are a critical context of development (Rubin et al., 2011) providing children with self-validation, emotional security, companionship, and stimulation (Rose & Asher, 2000). The occurrence of interpersonal conflict in this context both stimulates and tests children's social cognitive skills (Shantz, 1993). The ability to read interpersonal situations accurately and act in ways that strike a balance between one's own needs as well as that of the friendship is linked to positive outcomes (Selman & Demorest, 1984) such as greater acceptance by peers (McDonald & Asher, 2018) and a more favorable interpersonal climate in friendships (Laursen & Adams, 2018).

The ways in which children respond in conflict situations, typically to end the conflict, are studied as conflict resolution strategies. Different theoretical approaches anticipate an age-related change in conflict resolution strategies with a reduction in impulsive strategies focused on

Author info: Correspondence should be sent to: Anupama Joshi, 1000 E Victoria St., WH A330E, California State University, Dominguez Hills, Carson, CA 90747, USA. Email: ajoshi@csudh.edu.
North American Journal of Psychology, 2023, Vol. 25, No. 3, 551-568.

one's own perspective (e.g., aggression) and an increase in the use of strategies that require a coordination of one's perspective with the other's (e.g., compromise). However, empirical evidence reveals a complex interplay between age, relationship, and methodology in the use of conflict resolution strategies over time. Specifically, in the case of conflicts with friends, while compromise becomes the desired strategy, coercive strategies are used with greater frequency (Laursen et al., 2001).

Aligning with the social information processing model (Crick & Dodge, 1994), we view interpersonal conflict resolution as a process in which the responses of individuals in conflict are reflective of habit, of rapid reassessment of the situation, and also a function of the other person's responses in the conflict. Arguably, habitual behaviors as well as interpretation of interpersonal events are informed by one's culture. Culture constitutes aspects of the environment created by a people that are shared and endorsed by most of those people (Chen et al., 2014). As Chen and colleagues (2018) have noted, the link between cultural values and children's development may be mediated by social reasoning and self-regulation in social interactions. Cultural values related to acceptable goals, behaviors, and outcomes in social interactions contribute to shaping children's behaviors in interpersonal conflict. Social competence is culture bound and the consequences of strategies in peer relationships may vary by culture because cultures differ in what they consider as socially competent (MacDonald & Asher, 2018). Investigations of children's conflicts in different cultures show some age-related similarities and differences between children in the United States and those in Indonesia (French et al., 2005) and in Italy (Corsaro, 1994). One purpose of this study was to examine conflicts between school-age friends in India through replication of a study conducted in the United States.

India is sufficiently diverse along many facets of culture such as language, religion, and regional cultures to defy cultural categorization. Scholars have noted that not only does the Indian culture not fit neatly into the collectivist or individualist category (Sinha & Tripathi, 1994), but that there continue to be troubling lacunae in the linkages between the conceptualization and assessment of collectivism and individualism (Oyserman et al., 2002) and that the collectivist-individualist dichotomy itself may have served its heuristic purpose and be ready to be replaced with a more nuanced conceptualization of culture and cultural differences (Saraswathi et al., 2011). We, therefore, did not have specific theoretical culture-based hypothesis regarding children's strategies.

Verma and Saraswathi (2002) surmised that in India peer relationships are secondary to those in the family and that traditionally, the family itself provided a "web of peers" (p. 111). Peers become more

prominent as social class rises such that the presence of peer culture is more detectable in the upper social class. Friends, however, are a special case of peers. We assume that friendships would be characterized by companionship, mutual affection, and self-disclosure, and that these characteristics would render friendships significant enough to exert influence on developmental outcomes. Some studies of children in India have documented the importance of friends through children's and adolescents' perspectives. The studies are of specific groups of children such as street children who prefer to spend time with their friends rather than family (Mathur, 2009) or leaf-collecting girls and young women in a marginalized community in Bemni, Uttarakhand (Dyson, 2010). Nevertheless, both studies clearly indicate that from the participants' perspective, friends are significant individuals in their lives. Similarly, there is some evidence of an indirect role of friends on social outcomes as well. For example, best friends' aggression moderated the relationship between relational aggression and perceived popularity in urban Indian adolescent boys (Bowker et al., 2011).

In-depth studies of children's conflicts with peers in New Delhi provide pertinent information regarding conflicts with peers. When asked about their perspectives on conflicts with peers, younger children thought that the conflicts were short lived and more likely to be with non-friends, while older children reported that their conflicts were equally likely to be with non-friends as with friends and could last anywhere between a few minutes to a few days (Dhillon & Babu, 2013). Observation data of peer conflicts of upper-middle and middle-class children (Dhillon & Babu, 2015) showed that bilateral strategies (those that took both arguing children's perspectives into account) were common amongst first graders, while fifth graders more often resorted to verbal aggression. Many conflicts ended with either withdrawal or submission, both of which were considered as passive strategies by the researchers. We build on these findings focusing specifically on conflicts between friends and a more fine-grained analysis to capture more of what transpires between friends in conflict. In keeping with our view of conflict resolution as a process, we aimed to not use broad categorization such as prosocial or passive strategies but to identify all strategies that children use, reduce data by means of statistical analyses as needed, and identify patterns of strategies within a conflict between the children in conflict.

The goal of our study was to develop a detailed description of interpersonal conflict resolution between friends with a focus on strategies used by both the child and the friend. We attempt to identify discernable patterns, if any, in strategies used by the children in conflict. Specifically, we examine the use of strategies by a child relative to those used by the other child in the conflict. This study replicates a similar one

conducted in the United States (Joshi, 2008) to draw a comparative picture. We focus on middle childhood which is a period of significant change in social cognition and hope to add to the extant literature on peer conflicts with this description by focusing on friendships.

METHOD

Participants

A non-random snowball sample of 80 children was recruited for the study in Mumbai, India. Forty-six girls and 34 boys aged 9 to 11 years (M= 10.4, SD = .79) participated in the study. Students enrolled in a course on research methods were trained in conducting interviews. They recruited children in their neighborhoods and obtained assent following the protocol for research with children as articulated by College of Home Science Nirmala Niketan, Mumbai. Children and/or adult caregivers referred the interviewers to other 9- to 11-year-old children who could be interviewed. Each child was interviewed individually. Interviews were audio recorded and later transcribed. Children were given the option of responding in English or Hindi. Sixty-four children (80%) opted to be interviewed in English and 16 children (20%) asked to be interviewed in Hindi. Children's reports of their parents' education level (52 mothers and 80 fathers) showed that many parents had a bachelor's degree or higher (about 79% of mothers and 49% of fathers) and only one mother worked outside the home. Using Kuppuswamy's updated socioeconomic status (SES) scale (Wani, 2019), the mean SES score for the sample was 22.86 (SD = 3.09) indicating that the sample's SES would be classified as upper middle class.

Measure

Children were interviewed using a semi-structured interview of ten questions. Children were asked to recall an argument or fight they had had with a friend over the past month, what transpired during the argument, how it ended, how the child felt during and after the conflict, how the child thought the friend felt during and after the conflict, the best way to end a conflict with a friend and the causes of conflicts between friends. This paper focuses on what the conflict was about and conflict resolution strategies that children and their friends used.

Analysis

*Extraction of strategies***.** Each interview was read in its entirety. The point of initial opposition signaling the start of a conflict was identified. The strategy used by each child (both the participant child as well as the friend) was coded till the conflict ended (see Appendix A). Seven (8.8%) children reported that the conflict was ongoing and that it had not yet

ended. Intercoder reliability was established for strategies by examining percentage agreement between two coders. Overall intercoder agreement was 80% for all conflict resolution strategies; Cohen's kappa was .78. Strategies were identified based on children's descriptions of their actions during conflicts and existing knowledge of children's conflict resolution strategies. The following thirteen strategies emerged:

Submission: the individual gives in and accepts the other's position

Compromise: offering a middle ground requiring concessions from both parties (for the strategy to fall in this category, the target individual must initiate the compromise)

Conventional: apologizing, ignoring the other person or the other person's behavior (here the respondent the target child must indicate that (s)he was ignoring the other person), hugging, forgiving which may be considered conventional ways of smoothing things over

Stand-off: there is a change in activity or topic of speech generally leading to the dropping of conflict without resolution (as opposed to conventional "ignoring", the target individual is ignoring the conflict, not the other individual, e.g., pretend that it never happened)

Third-party intervention: target individual or both participants (initiated by the target individual) seek the assistance of an uninvolved individual in finding a solution

Aggression: using force through physical or verbal force or threats of force, yelling, threatening to complain to another party with the intent to inflict punishment

Assertion: insistence through repeating the viewpoint, not submitting to any other solution, no discussion, stalling, protesting.

Discussion: explaining one's viewpoint, the target individual's (the interviewed child) response reflects an intention of seeking the other person's opinion, even though there may be no intent of, or an actual event of compromise (sometimes the use of a question is an indicator of initiating discussion)

Withdrawal: individual withdraws or physically leaves the area

Restitution demand: target individual demands some form of restitution as the only way to make things right (e.g., replace a broken toy)

Nonaction: target individual does not do or say anything, but is not ignoring the conflict or the other person (e.g., step back and wait, not do anything)

Verbal disengagement: target individual stops talking with the other person with the purpose of expressing dissatisfaction or hurt

Indirect making up: target individual indirectly expresses a desire to end the fight (e.g., bringing candy for the other person) without explicitly saying so

Non-strategy events

External intervention: Adult(s)/peer(s) intervene without either child asking for help

Time lapse: time passed without any interaction between children

Most of these strategies were similar to those found by Joshi (2008). However, restitution demand, verbal disengagement, and indirect making-up, were not reported by US children.

RESULTS

Conflicts

Children were able to recall conflicts with ease. Although children chose to answer the interviewer's questions in English or in Hindi, children often used some Hindi words when answering questions in English and vice-versa. Seventy-eight (97.5%) children reported conflicts with same-sex friends. The number of interactional turns in each conflict was counted which can provide a rough estimate of the length of the conflict. For example, a conflict in which the child responded to the initial opposition with assertion, followed by a friend using discussion and then the child using conventional strategy would be considered as having three interactional turns. Conflicts ranged from having 1 to 8 interactional turns (M = 3.35, SD = 1.36). Interactional turns were correlated with the total number of unrepeated strategies used by both children in the conflict ($r(78) = .80$, $p < .001$). Paired t-test showed that mean interactional turns (M = 3.35) was higher than mean unrepeated strategies (M = 2.59) used ($t(79) = 8.53$; $p < .001$) indicating that children repeated their own or the other's strategies. Girls' (M = 3.65) and boys' (M = 3.61) conflicts did not differ in the number of interactional turns ($t(78) = 1.65$; $p = .102$).

Issues of conflict

Children disagreed and quarreled over a variety of matters. More conflicts were about sharing and use of materials such as pens and toys,

domineering or aggressive behavior, some game or sport that the children were playing at the time of the conflict, behavior that violated expectations in a friendship, or physical injury or damage to an object or person caused accidentally (see Table 1). Some investigations (e.g., French, et al. 2005) have found relational aggression as an issue of conflict. We classified what could potentially be relational aggression

Table 1
Issues of Conflicts between Friends

Issue	All Children[a]		Girls[b]		Boys[c]	
	N	%	*n*	%	*n*	%
Sharing, use/misuse of material	14	17.5	9	19.6	5	14.7
Domineering/aggressive behavior	13	16.3	8	17.4	5	14.7
Play/game related	11	13.8	4	8.7	7	20.6
Friendship violation	9	11.3	8	17.4	1	2.9
Accidental injury/ damage	8	10.0	3	6.5	5	14.7
Irritation/annoyance	6	7.5	4	8.7	2	5.9
Standard of behavior	4	5.0	3	6.5	1	2.9
Course of action	5	6.3	2	4.3	3	8.8
Interpersonal events	3	3.8	2	4.3	1	2.9
Factual information	2	2.5	0	0.0	2	5.9
Other	5	6.3	3	6.5	2	5.9

[a]$N = 80$. [b]$n = 46$. [c]$n = 34$.

either as friendship violation (child indicates that such behavior is not expected of friends, $n = 6$) or as domineering or aggressive behavior (e.g., friend telling embarrassing secrets about the child to another person, $n = 3$) depending on whether there was an indication of intent to do harm on part of the actor or not as perceived by the child reporting the conflict. While we found no age-related patterns, a fourth of the 11-year-olds ($n = 8$) argued over sharing and using materials. There were some gender-related patterns in conflict issues. Girls' conflicts were mostly over sharing and use or misuse of materials (19.6%), domineering or aggressive behavior (17.4%) or friendship violation (17.4%). A fifth (20.6%) of conflicts between boys were about the game or sport they were playing at the time, followed by sharing and use or misuse of materials, domineering or aggressive behavior and accidental injury or damage (14.7% each).

Regarding concordance between issues and strategies, in 10 of the 14 conflicts involving sharing and use of materials, and six of the nine involving friendship violation, children used discussion as the first strategy. However, there was no discernible pattern in the issue of the conflict and the first strategy, or the last strategy used.

Table 2
Frequencies of Conflict Resolution Strategies Used by Children

Strategy	All Children[a]		Girls[b]		Boys[c]	
	N	%	*n*	%	*n*	%
Submission	12	3.8	5	2.7	7	5.5
Compromise	2	0.6	0	0.0	2	1.6
Conventional	52	16.6	35	18.9	17	13.3
Stand-off	5	1.6	2	1.1	3	2.3
Third-party intervention	7	2.3	5	2.7	2	1.6
Aggression	37	11.8	16	8.6	21	16.4
Assertion	53	16.9	39	21.1	14	10.9
Discussion	48	15.3	34	18.4	14	10.9
Withdrawal	17	5.4	8	4.3	9	7.0
Restitution demand	3	1.0	1	0.5	2	1.6
Nonaction	9	2.9	6	3.2	3	2.3
Verbal disengagement	12	3.8	7	3.8	5	3.9
Indirect making up	9	2.9	2	1.1	7	5.5
Non-strategy events						
External intervention	9	2.9	2	1.1	7	5.5
Time lapse	38	12.1	20	10.8	18	14.1

[a]$N = 313$. [b]$n = 185$. [c]$n = 128$.

Conflict Resolution Strategies

When the strategies of both the target child and the friend were considered, about 55 percent of the children ($n = 89$) used more than one strategy to resolve the conflict. Specifically, 63 (39.4%) children used one strategy, 69 (43.1%) children used two strategies, and 20 (12.5%) children used three strategies. The remaining eight (5%) used no strategies. This resulted when the child's action was the initial opposition and the friend's strategy ended the conflict or an adult intervened after the friend's response to the child's initial opposition.

Frequencies of different strategies used are shown in Table 2. The most frequently used strategies were assertion (16.9%), conventional (16.6%), discussion (15.3%), and aggression (11.8%). Girls and boys differed in the strategies they used. Significantly more girls used assertion χ^2 (1, $N = 80$) = 7.76, $p = .005$, discussion χ^2 (1, $N = 80$) = 4.15, $p = .042$, and conventional χ^2 (1, $N = 80$) = 4.59, $p = .032$ strategies.

Table 3 shows the frequencies of beginning and ending strategies in conflicts between children. In about 40% ($n = 31$) of the conflicts,

children used discussion after the initial opposition. Aggression (22.5%) and assertion (21.3%) were the next two frequently used strategies at the beginning of the conflict. Mean interactional turns did not vary significantly by the first strategy used, $F(2, 71) = 2.10$, $MSE = 3.46$, $p = .054$. There were no overall sex differences in the first strategy that children used. When discussion was compared to the remaining strategies, more girls used discussion as the first strategy than boys although the difference was only marginally significant χ^2 (1, $N = 80$) = 3.76, $p = .053$.

Table 3
First and Last Strategies in Children's Conflicts

Strategy	First strategy[a]		Last strategy[b]	
	n	%	*n*	%
Submission	0	0	10	12.5
Compromise	2	2.5	1	1.3
Conventional	4	5.0	33	41.2
Stand-off	0	0	4	5.0
Third-party intervention	1	1.3	7	8.8
Aggression	18	22.5	3	3.7
Assertion	17	21.3	4	5.0
Discussion	31	38.8	1	1.3
Withdrawal	2	2.5	4	5.0
Restitution demand	0	0	0	0
Nonaction	2	2.5	1	1.3
Verbal disengagement	3	3.8	2	2.5
Indirect making up	0	0	3	3.7
Non-strategy events				
External intervention	0	0	7	8.8

[a,b] $n = 80$

Most conflicts (41.2%) ended in conventional strategies. Ten (12.5%) ended in submission and 7 (8.8%) ended in third-party intervention and external intervention each. We examined the data for any patterns in the first strategy used in conflicts with the most frequent endings (last strategy) and we found that 48.5% of the conflicts ($n = 16$) that ended with a conventional strategy, started with a discussion. Similarly, 5 (71.4%) of the conflicts that ended because an adult or peer intervened began with aggression. However, the large number of categories and zero values in some cells precluded significance testing.

Patterns of Strategies within Conflicts

To answer the question of whether the strategy that children use is related to the one used by the other child in conflict, we first broke the

sequence of strategies by the child and the friend into action and reaction pairs. For example, consider a conflict in which the friend used discussion, to which the child responded with discussion, followed by the friend using assertion and the child using standoff. This was broken into three action-reaction pairs: discussion-discussion, discussion-assertion, and assertion-standoff. This conversion yielded 227 action-reaction pairs. Since this number was not large enough to be robustly distributed over a 15 X 15 table, we first reduced the data to group strategies that would go together through analysis and would be theoretically tenable.

For this purpose, we used correspondence analysis (CA). Correspondence analysis is a data reduction technique used for categorical data that are placed in a cross-tabular form. It explores the underlying structure in the same way a principal components analysis does for continuous data. CA yields a two-dimensional graph such that the *x* axis represents the first dimension and the *y* axis the second dimension. Dimensions in CA are similar to components in principal components analysis. The first dimension is most important in explaining the similarity in the two variables (action and reaction) and the second one the next most important. Each category of action and reaction gets a dimension score which is similar to factor loading. Categories with a dimension score close to zero do not contribute to that dimension, while categories with equal or close to equal dimension scores contribute equally. In the graph, distance is used to decide which categories go together or may be merged. Thus, categories with less distance between them are similar and could be merged if the grouping can be conceptually explained. See Greenacre and Blasius (1994) for the theoretical explanation behind CA.

Data Reduction. CA revealed four different groupings that were conceptually cogent. The first grouping was of conventional (-0.22), indirect making up (-0.59), and stand-off (-0.31) which we called *conventional*. Indirect making up emerged as a distinct strategy through content analysis of the interviews. It was akin to an unspoken conventional strategy communicating that the child using the strategy was trying to make nice. We interpreted stand-off's presence in this grouping as a strategy indicating children's awareness of not belaboring the point as more socially prudent and customary. The second grouping was of compromise (-0.51), restitution demand (-0.63), and discussion (1.03). We called this grouping *reasoning* because the strategy requires articulation of thought behind an action or a solution. Third, we placed verbal disengagement (0.06) and withdrawal (0.13) in the broad category of *disengagement* as they both involved disengaging from the other person either physically or interactionally. Finally, time-lapse (-0.10) and nonaction (-0.48) were collapsed into *nonaction.* Thus, thirteen strategies

were reduced to eight – submission, reasoning, conventional, third-party intervention, aggression, assertion, disengagement and non-action.

Table 4
Dimension Scores for Action and Reaction Generated by Correspondence Analysis

	Dimension 1		Dimension 2	
Strategy	Action	Reaction	Action	Reaction
Submission	0.592	0.078	0.822	-0.675
Reasoning	0.436	0.202	-0.928[c]	-0.986[c]
Conventional	-1.041[a]	-1.193[a]	-0.004	0.210
Third-party Intervention	0.825	0.049	-2.135	-0.264
Aggression	0.981[b]	1.117	1.121	0.872
Assertion	0.329	0.505	-0.345	-1.087
Disengagement	-0.025	0.528	0.694	0.446
Nonaction	-1.268[a]	0.196	0.216	0.392
External Intervention	-0.062	0.913[b]	1.062	1.463

Note. Scores marked with the same letters go together as pairs.

Strategy Pairs. The reduced data resulting from grouped categories included the following strategies: submission, reasoning, conventional, third-party intervention, aggression, assertion, disengagement, nonaction and external. To find out if any strategies go together as action-reaction pairs, or in other words, if the use of one strategy by a child was associated with the use of a particular strategy by the other child in the conflict, we subjected the data to a second CA. This revealed that aggression was likely to evoke external intervention, the use of reasoning was associated with the use of reasoning by the other child, and nonaction was associated with conventional strategy (see Table 4).

DISCUSSION

This study provided us with a morphological description of conflicts between Indian school-age children and their friends in Mumbai. These easily recalled conflicts resulted from differences on many different issues, predominantly over use and misuse of materials and occurrences in playing of a game or sport. The frequency of disagreement between girls resulting from issues of friendship violation and standards of behavior was higher than between boys. Indeed, there was only one instance of perceived friendship violation being at the center of conflict between boys. This could indicate a greater salience of acceptable behaviors in friendships for girls than boys. Observations of friendships of US children show that there is greater intimacy and self-disclosure in

girls' friendships (Rose & Asher, 2000) and gossiping behind each other's back is considered a serious violation of friendship. Whether this is the case in friendships of Indian girls remains to be seen.

The main purpose of this study was to replicate a study of US children (Joshi, 2008). We found several similarities. Children used an array of strategies to resolve conflict with their friends. Additionally, they used more than one strategy in a conflict. More children in both studies used assertion, discussion and conventional strategies than other strategies. Children's first strategy after initial opposition in conflicts was predominantly discussion (38.8%) indicating that habitually, Indian school-age children respond to conflicts by explaining their viewpoint or by asserting it (21.3%). This was similar to the finding in the US study of assertion and discussion being the two most frequently used strategies (Joshi, 2008).

A difference emerged in the use of verbal disengagement or what would appear as the silent treatment to convey displeasure or hurt feelings by Indian children which was not found in any US samples. A similar strategy of avoiding speaking with the peer used by Indonesian children as a means of preventing overt disharmony was found by French et al. (2005). The intent behind the use of verbal disengagement in our study was not entirely clear. For example, in one conflict an 11-year-old girl was playing with her friends at a water park. Sometime during their interactions the friends left her alone and engaged in some other activity. The child confronted her friend and demanded an explanation. The friend told her "*Bas masti karni thi isliye plan banaya tha"* (We had planned this mischief to have some fun). The child told the interviewer: *I was very angry. I did not speak for four five days.*

Similarly, another case revealed verbal disengagement as a conscious strategy. A child was being completely ignored by her friends (target friend was one of them). The child cried and was consoled by two other friends. To the interviewer's question of what she did during the conflict, the child reported: *I didn't do anything. I was firm that I don't want to talk to her.* Later in the interview, the child noted that the friend began crying. The interviewer asked whether it was in response to something the child said. The child answered: *I didn't speak anything …that was very good. I just didn't talk to her almost full day.*

Children may have used verbal disengagement due to the strength of emotional arousal experienced and a recognition that an outburst could do more harm than avoiding speaking (e.g., the child noting that she thought it was a good thing that she did not say anything to make her friend cry). But children were fully aware that not speaking would clearly and assertively tell the friend that all was not right in the friendship. One could argue that this may be a form of relational aggression (Crick &

Grotpeter, 1995) because it involves withdrawing the friendship. It was not clear, however, whether children wanted to communicate their own hurt and get their friend's attention, or inflict hurt on their friend in angry retaliation. In their telling of the conflict children emphasized the intensity of their feelings as the reason behind their strategy but did not specify what they wanted to communicate to their friend through the strategy. The emphatic specification of the length of time of not speaking with the friend, it seemed, was directly reflective of the fervor of perceived wrong. There was no indication that children were interested in forgoing their friendship. A boy who had used verbal disengagement in a conflict with his friend said this of what he felt during the period of verbal disengagement – *"I was feeling alone. No friends were there in my school. He was my best friend. So I was feeling very alone there."* Of the conflicts that involved the use of verbal disengagement either by the child or the friend, seven ended with a conventional strategy (apologizing and making up), one with third-party intervention (child sought teacher's help), and two remained unresolved.

Another finding that diverged from the US study was that stand-off as a strategy clustered with conventional strategies, indicating perhaps that ignoring the conflict might be equated with being civil and socially desirable. This will need to be confirmed with further investigation, however. When patterns of action and reaction were considered, we found that aggression was met with external intervention, that reasoning from one child was likely to evoke reasoning in the other, and non-action from a child was greeted with a conventional strategy by the friend. Aggression being met with external intervention was not found in the US study. This could mean that either the likelihood of other individuals being around who are paying attention to the conflict is greater in the Indian context, or that it is more acceptable for uninvolved individuals to intervene, or both. Most of the external interventions (62%) were by children's peers or other friends. Non-action was met with conventional strategy, and reasoning with reasoning, in both US and Indian contexts.

Irrespective of the strategy used, a common thread that emerged from the interviews was that conflicts with friends were intensely emotional events. Children noted that they were "very" sad, hurt or angry during the conflict. The intensity seemed to dissipate quickly with the resolution of conflict, however. Children saw arguing and fighting as an indispensable part of friendship as revealed through their speculations about causes of conflicts such as "*if we are friends then we fight. Only best friends can fight", "zhagda kartein hein to unkee dosti badhtee hein (fighting deepens the friendship)", and "if we are best friends then fights will be there always."*

Although not with significant frequency, children used ideas from popular cinema to explain what they thought was a good way to end conflicts with friends such as giving your friend a "*jaadu ki jhappi*" which is essentially a good hug. This was not surprising considering Hindi movies are a common form of entertainment (Verma & Saraswathi, 2002).

Limitations and Future Directions

The study provided a view into the strategies that children use to resolve conflict with their friends. Some circumspection is warranted in the use of these results. This was not a random sample, and it is likely that children were similar to each other in unanticipated ways. Data on income was provided by children and that must be considered with some caution although we anticipate acceptable levels of accuracy in reports of parents' education and occupation. Additionally, only one child provided information on both children's strategies which introduces some bias in the data.

Another limitation is that we have little information on children's overall understanding of their friendships and their reasoning about people and interpersonal events that could shed light on culture-driven social cognition. That information is critical in completing the picture of interconnections between cultural philosophy, children's ideas related to that philosophy in the domain of friendships, their friendship goals, and their behaviors in friendships.

Greater incidence of other peers or friends intervening to resolve the conflict might merit a look at group processes in peer groups in the two cultures. In terms of strategies, we think that investigating stand-off clustering with conventional strategies, and the meaning and significance of verbal disengagement could be productive.

Children referred to the intensity of their emotions during conflicts with friends with one child surmising that fights between friends happen because "*we are small and cannot control ourselves.*" Self-regulation is a mediating variable both in social information processing theory (Crick & Dodge, 1994) and in the link between cultural values and children's development (Chen et al., 2018). Investigations examining the content and role of self-regulation in conflicts and its connection to the strategies used would further our understanding of conflict resolution between friends in middle childhood across cultures.

REFERENCES

Bowker, J. C., Ostrov, J. M., & Raja, R. (2011). Relational and overt aggression in urban India: Associations with peer relations and best friends' aggression. *International Journal of Behavioral Development, 36*(2), 107-116.

Chen, X., Fu, R., & Zhao, S. (2014). Culture and socialization. In J. E. Grusec & P. D. Hastings (Eds.), *Handbook of socialization* (2nd ed., pp. 287-314). Guildford.

Chen, X., Lee, J., & Chen, Li. (2018). Culture and peer relationships. In W. M. Bukowski, B. Laursen, and K. H. Rubin (Eds.), *Handbook of Peer Interaction, Relationships, and Groups (pp. 552-570).* Guilford.

Corsaro, W. A. (1994). Discussion, debate, and friendship processes: Peer discourse in U.S. and Italian nursery schools. *Sociology of Education, 67,* 1-26.

Crick, N. R., & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin, 115*(1), 74-101.

Crick, N. R., & Grotpeter, J. K. (1995). Relational aggression, gender, and social psychological adjustment. *Child Development, 66,* 710-722.

Dhillon, M., & Babu, N. (2013). A qualitative study of Indian children's perspectives on peer conflicts. *Psychology and Developing Societies, 25*(2), 367-392.

Dhillon, M., & Babu, N. (2015). Peer conflict among Indian children in school settings. *Psychological Studies, 60*(2), 154-159.

Dyson, J. (2010). Friendship in practice: Girls' work in the Indian Himalayas. *American Ethnologist, 37*(3), 482-498.

French. D. C., Pidada, S., Denoma, J., McDonald, K., & Lawton, A. (2005). Reported peer conflicts of children in the United States and Indonesia. *Social Development, 14*(3), 458-472.

Greenacre, M., & Blasius, J. (1994). *Correspondence analysis in the social sciences.* Academic Press.

Joshi, A. (2008). Conflict resolution between friends during middle childhood. *The Journal of Genetic Psychology, 169*(2), 133-148.

Laursen, B. & Adams, R. (2018). Conflict between peers. In W. M. Bukowski, B. Laursen, and K. H. Rubin (Eds.), *Handbook of Peer Interaction, Relationships, and Groups (pp. 265-283).* Guilford.

Laursen, B., Finkelstein, B. D., & Betts, N. T. (2001). A developmental meta-analysis of peer conflict resolution. *Developmental Review, 21,* 423-449.

Mathur, M. (2009). Socialisation of street children in India: A socioeconomic profile. *Psychology and Developing Societies, 21*(2), 299-325.

McDonald, K. L., & Asher, S. (2018). Peer acceptance, peer rejection, and popularity. Social cognitive and behavioral perspectives. In W. M. Bukowski, B. Laursen, and K. H. Rubin (Eds.), *Handbook of Peer Interaction, Relationships, and Groups* (pp. 429-446). Guilford.

Oyserman, D., Coon, H. M., & Kemmelmeier, M. (2002). Rethinking individualism and collectivism: Evaluation of theoretical assumptions and meta-analyses. *Psychological Bulletin, 128*(1), 3-72.

Rose, A. J. & Asher, S. R. (2000). Children's friendships. In C. Hendrick and S. S. Hendrick (Eds.), *Close relationships: A sourcebook* (pp. 46-57). Sage.

Rubin, K. H., Oh, W., Menzer, M., & Ellison, K. (2011). Dyadic relationships from a cross-cultural perspective: Parent-child relationships and friendship. In X. Chen & K. H. Rubin (Eds.), *Socioemotional development in cultural context* (pp. 208-236). Guilford.

Saraswathi, T. S., Mistry, J., & Dutta, R. (2011). Reconceptualizing lifespan development through a Hindu perspective. In L. A. Jensen (Ed.) *Bridging Cultural and Developmental Approaches to Psychology,* (pp. 276-302). Oxford University Press.

Selman, R. L., & Demorest, A. P. (1984). Observing troubled children's interpersonal negotiation strategies: Implication of and for a developmental model. *Child Development, 55,* 288-304.

Shantz, C. U. (1993). Children's conflicts: Representations and lessons learned. In R. R. Cocking and K. A. Renninger (Eds.), *The development and meaning of psychological distance (pp. 185-202)*. Lawrence Erlbaum.

Sinha, D., & Tripathi, R. C. (1994). Individualism in a collectivist culture: A case of coexistence of opposites. In U. Kim, H. C. Triandis, C. Kagitcibasi, S. Choi & G. Yoon (Eds.), *Individualism and collectivism: Theory, method, and applications* (pp. 123-136). Sage.

Verma, S., & Saraswathi, T. S. (2002). Adolescence in India: Street urchins or Silicon Valley millionaires? In B. B. Brown, R. Larson and T. S. Saraswathi (Eds.), *The World's Youth: Adolescence in Eight Regions of the Globe (pp. 105-140)*. Cambridge University Press.

Wani, R. T. (2019). Socioeconomic status scales - modified Kuppuswamy and Udai Pareekh's scale updated for 2019. *Journal of Family Medicine and Primary Care, 8,* 1846-1849.

APPENDIX A
Identifying Strategies from Children's Narratives

11-year-old boy

Today we were playing lock and key. First, I caught Dhananjay and then I also touched Ketan's shirt and told him that he is locked. Then Ketan screamed at me [Initial opposition] that he is not caught. I again started catching him [Submission (child)] but he told that we always catch him only and he went to our building's gate [Withdrawal (friend)]. I told him that he is doing cheating and I am not going to play with him and I went home [Withdrawal (child)] and started crying.

Later in the interview to the interviewer question "How did it end?" the child responded:

My mother scolded my friends that we should not cheat while playing [External intervention (mother)]. I again started playing with him.

The last strategy was coded as external intervention and not third-party intervention because there is no indication that the child requested his mother's assistance in finding a solution to the conflict.

Author Note: Some of the data described in this paper were presented at the meeting of the International Society for the Study of Behavioral Development, Wurzburg, Germany, 2008.

Intersectionality of rural community, geography, and gender in the careers of young adults.