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A STUDY ON CUSTOMER SATISFACTION IN THE INSURANCE SECTOR USING BIBLIOMETRIC ANALYSIS

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Purpose: In a conscious attempt to disseminate both quantitative and qualitative knowledge on satisfaction with the insurance industry, this bibliometric analysis has collected relevant literature. An analysis of 127 articles constitutes the basis of the study.

Design/methodology/approach: A bibliometric study of 127 research publications has been conducted using the Scopus database. The VOSviewer software was used to analyze the research articles concerning “customer satisfaction in the insurance sector research”.

Findings: The research findings revealed that customer satisfaction has grown in prominence within the context of insurance over time. The top journals, authors, countries, articles, and organizations have been found using bibliometric analysis. A presentation of the content analysis of selected publications was also included in this article.

Originality/Value: Plenty of research has been done on customer satisfaction in an array of industries, including banking, e-commerce, hospitality and tourism, insurance, etc. However, the current study aims to map the literature on "satisfaction in the insurance sector" using the Scopus database. The researchers will receive future research directions from this, which will aid in defining the key idea. This research will also help academics, decision-makers, and regulators comprehend the foundations of contentment in the insurance sector and identify the crucial areas that need further research.

Keywords: Customer satisfaction, insurance, health insurance, Customer loyalty, service quality, bibliometric analysis, scientific mapping.

LITTLE MILLET PHYTOCHEMICALS AND THEIR POTENTIAL THERAPEUTIC EFFECTS FOR THE WELFARE OF HUMAN

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Even though the green revolution altered the food system in developing nations, the majority of these nations continue to battle with malnutrition. India has an excessively high rate of malnutrition. The situation is becoming worse as non-communicable diseases including diabetes, heart disease, obesity, and digestive system are on the rise. Attention should be taken to the dietary quality of food to protect human health and fitness in general and to solve the problem of malnutrition. Millets play an important role in health benefits due to their high nutritional composition like phytochemicals, dietary fibre, complex carbohydrates, proteins, minerals, lipids and vitamins. One of the healthiest whole millets is little millet (*Panicum sumatrense*), which is important for supplying macro- and micronutrients as well as bioactive substances including phenols, tannins, and phytates. These bioactive substances and nutrients have physiological and health-promoting actions, such as preventing cancer, acting as antioxidants, treating diabetes, preventing obesity, and heart disease. Little millet is also effective in lowering the risk of chronic anti-inflammatory, antirheumatic diseases etc. as it possesses various value-added bioactive compounds such as kaempferol, luteolin and apigenin, respectively. This review emphasises the potential phytochemicals in little millet and their potential therapeutic role against disease management for the welfare of the human.

Keywords: Little millet, dietary quality, phytochemicals, antidiabetic,

PERCEIVED BENEFITS AND CHALLENGES OF VIRTUAL CLASSROOMS: INSIGHTS FROM COLLEGE STUDENTS' PERSPECTIVES

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Conceptual Background: - Global education has been severely impacted by the COVID-19 epidemic, that has afflicted many nations. When the Coronavirus pandemic occurred, the educational process underwent major alteration. Students at colleges had to switch to the online platform from the traditional classrooms and labs. An online learning method known as a virtual classroom uses the internet to deliver communication for distance learners much like it would in a traditional classroom. Due to the increasing growth of internet-dependent learning in practically all schools and institutions, this sector of education will be highly popular in the next days and will soon replace the traditional style of education.

Purpose: The study starts with a tour of conceptual framework of the virtual classrooms It helps to explore the perspective of college student for Virtual Classrooms; it means from one edge of virtual classrooms students enjoy pool of opportunities and benefits but from other edge they also faced a lot of difficulties and challenges to proceed their academic goals.

Method: - The study analyzes a sample of 88 respondents that are college students. An author 5 point Likert scale structured questionnaire is used for this study and interpretation of respondent's data done through statistical tool IBM SPSS Version 27. To analyze the data of the questionnaire descriptive statistics of demographic variables and one- way analysis of variance test is applied.

Findings: - The findings of the study that internet connectivity and home surroundings are major problems faced by students and enhancement in digital skills and career advancement opportunity are the common benefits for students. 20-30 age group happy with the benefits of flexible timing, career advancement opportunities and enhancing digital skills but they faced difficulties in maintain internet connectivity. Internet connectivity is the same problem for graduate student.

Implications: - The implementation of above findings can be used by educators and policymakers to enhance the conception and operation of virtual learning environments, hence raising the general efficacy and satisfaction of online learners. In order to better understand the changing virtual classroom scene and meet the new needs of college students, future research areas are also suggested.

Keywords: Virtual Classrooms, Students, Challenges, Opportunities, Perspective

ENHANCING SUSTAINABILITY IN BEEKEEPING: ARTIFICIAL FEEDING STRATEGIES DURING DEARTH PERIODS AND THEIR IMPACT ON HONEY QUALITY

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Beekeeping involves the rearing of honey bees in wooden hives to produce honey, facilitate crop pollination, and obtain various useful beehive products. Adequate availability of bee-friendly flora is crucial for successful beekeeping. However, during dearth periods, when nectar and pollen sources are scarce, bee colonies may experience low nutritional reserves, negatively impacting their performance and brood rearing. To address this issue, hive management during dearth periods and the concept of artificial feeding have been explored. In this study, colonies were fed with artificial diets, and the physicochemical analysis of honey samples from artificially fed colonies and control colonies was conducted. The analyzed parameters for honey samples (control and experimental) were as follows: pH (4.34 ± 0.002 and 4.31 ± 0.054), moisture content (10.1 ± 0.34 and $9.96\pm 0.27\%$), ash (0.21 ± 0.01 and $0.20\pm 0.03\%$), specific gravity (1.41 ± 0.003 and $1.43\pm 0.002\%$), electrical conductivity ($200\mu\text{s}$ and $300\mu\text{s}$), optical density (0.11 ± 0.002 and 0.12 ± 0.005), total dissolved solids (89.78 ± 0.34 and $90.01\pm 0.32\%$), reducing sugars (72.04 ± 0.841 and $72.30\pm 1.204\%$), total sugars (75.83 ± 1.026 and $74.94\pm 0.384\%$), non-reducing sugars (2.82 ± 0.535 and $2.62\pm 0.384\%$), and HMF (0.053 ± 0.004 and 0.058 ± 0.003 mg/kg). The physico-chemical testing revealed no significant differences in the quality of honey between the two groups. These findings indicate that the quality of honey remains unaffected after feeding honeybees with artificial diets, thereby meeting both national and international standards. This research dispels the myth that feeding honeybees with artificial diets leads to a decline in the quality of honey.

Keywords: Beekeeping, dearth period, bee flora, artificial diet, honey.

EFFECT OF UPPER LIMB SENSORIMOTOR TRAINING VERSUS RESISTANCE TRAINING IN MANAGEMENT OF PATIENTS WITH TYPE 2 DIABETES: A RANDOMIZED CONTROLLED TRIAL

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Background: There is a dearth of studies in the literature regarding the effect of sensorimotor exercises in patients with type 2 diabetes (T2D). Therefore, the aim of this trial was to measure the effects of upper limb sensorimotor training (SMT) and resistance training (RT) on nerve parameters and manual dexterity in patients with T2D.

Methodology: A parallel three-arm randomized controlled trial (RCT) was conducted with ninety-six patients having T2DM aged between 35 to 60 years based on eligibility criteria. They were randomly allocated into three groups: resistance training (RT) group; sensorimotor training (SMT) group; and control group. At baseline, post-intervention and follow up phases, musculocutaneous nerve latency (MCNL), musculocutaneous nerve action potential amplitude (MCNAPA), axillary nerve latency (ANL), axillary nerve action potential amplitude (ANAPA), and manual dexterity were measured using a S4-channel Neurostim EMG/NCV/EP system and box and block test.

Results: Ninety-one patients completed the trial. There was statistically non-significant difference between the baseline data. Results of within group comparison shows statistically significant improvement from pre-intervention to post-intervention level and post-intervention to follow-up level (MCNL: $p < 0.05$; MCNAPA: $p < 0.05$; ANL: $p < 0.05$; ANAPA: $p < 0.05$; manual dexterity: $p < 0.05$) in RT & SMT groups. Between group comparisons for all the groups in majority of variables were statistically significant, ($p < 0.01$) indicating a significant difference between the groups but there was statistically non-significant difference (MCNL: $p = 0.31$; ANL: $p = 0.51$; manual dexterity: $p = 0.14$) between RT and control group.

Conclusion: This study provides new data for patients with T2D that SMT can be beneficial for them by significantly increasing nerve amplitude, reducing nerve latency and enhancing manual dexterity of upper limb.

Keywords: Type 2 diabetes; upper limb; sensorimotor training; resistance training

TEMPLE FLORAL WASTE MANAGEMENT BY USING EPIGEIC EARTHWORMS

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In, India worshipping is the way of living and people offer flowers, fruits, leaves, coconuts, clothes to their deities. People offer mainly flowers of Marigold, Rose, hibiscus, Jasmine, Chrysanthemum and leaves Aeglemarmelos, Daturastramonium, Cannabisin temples. Once the ritual is concluded, these offerings are disposed of into some nearby pond, lake or river or discarded in open areas as temple waste leading to environmental pollution. Floral waste form major share in temple waste. Vermicomposting is the eco-friendly process of converting floral waste into compost with the help of microorganism and earthworms. In our work temple floral waste is collected from three temples of Barsar which was pre-composted at 30oc for 20 days, then mixed with Cow dung, leaves and used as a substrate for vermicomposting by earthworm speciesEiseniafetida for 60 days. Different physicochemical parameters like pH, Electrical Conductivity (EC), moisture content, C/N ratio, NPK, volatile organic matter and Na content were evaluated on 15, 30, 45 and 60 days.Physico-chemical analysis of worm-worked substrate showed better result in terms of pH, percentage K, N, P and organic carbon; C:N ratio; C:P ratio. Setting up of composting systems within the temples has reduced the temple's dependency on any civic body for collection or disposal of waste. The compost generated from waste is in big demand among the devotees. Vermicomposting of floral temple waste is thus economic, eco-friendly and sustainable method for the management of floral temple waste.

Keywords: Floral waste, Vermicomposting, Eco-friendly, Eiseniafetida, Physico-chemical analysis.

DOES BUSINESS STRATEGIES REDUCE PROBABILITY OF DEFAULT?

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Business strategies help a firm in improving financial performance and gaining competitive advantage. The adoption of generic strategies such as cost leadership and differentiation helps a firm in mitigating default risk. There is scant literature available in the Indian context that explores the role of business strategies in mitigating the probability of default. This paper aims to examine the impact of business strategies on default risk in Indian companies listed on National Stock Exchange. The sample size consisting of 275 companies is chosen from the industries that have incurred the highest rate of defaults over the last three decades. Porter's (1980) framework of generic strategies has been applied to measure business strategies and default risk is computed through Altman's Z-Score (2000). The study uses Panel data regression analysis to derive a relationship between default risk and business strategies for the time period 2013-2022. The results found prevalence of a significant positive relationship between Z-Score and business strategies, indicating a negative impact on default risk. The results suggest that new default forecasting models can incorporate business strategies to predict corporate defaults.

Keywords: Probability of default, Altman Z-Score, default risk prediction, business strategies

TIME SERIES MODELS FOR AREA AND PRODUCTION FORECASTING IN COTTON CROP OF INDIA

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This study aims at presenting models for the forecasting time-series data of cotton Area and Production of India by using Box-Jenkins Autoregressive Integrated Moving Average (ARIMA) models of time-series forecasting. The Time series data covering the period of 2000–2022 was used for the study. Presence of trend was checked through time series data were forecast for the starting from 2023-24 to 2029-30 the cultivated area and production of cotton in India using Autoregressive Integrated Moving Average (ARIMA) are calculated based on using this selected model. A comparison of these forecasts with observed values over this time period indicated that the model was highly accurate. The performances of the models are of ARIMA family for modeling as well as forecasting purpose.

Keywords: ARIMA, Box-Jenkins, Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD) and Mean Squared Deviation (MSD).

THE DESIGN AND ANALYSIS OF AN ON-DEMAND DATA COLLECTION SYSTEM IN WIRELESS SENSOR NETWORKS USING MOBILE SINK

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Sensor nodes (SNs) in a wireless sensor network (WSN) collect and report data in real time about the state of relevant software, hardware, and environmental factors. There are many advantages to using mobile sinks (MS) in WSNs, especially for large networks. Due to their many benefits, such as reduced energy consumption, increased network longevity, and the elimination of isolated nodes, MS have gained significant traction in recent years. When collecting information from a moving MS throughout the sensing field, SNs use a lot less power. However, the most difficult task in sensing is building the algorithm for gathering MS data and selecting the Cluster Heads (CHs). This research was conducted to find a solution to this problem and to present a fresh approach to data collection through MS. After dividing the sensor field into clusters, a certain number of CHs are located. In the proposed approach, CHs generate requests that are fulfilled by MS collecting data from CHs.

Keywords: Wireless sensor networks, on Demand Data collection, Mobile Sink, Mobile VAN.

“EECP+: AN ENHANCED ENERGY-EFFICIENT CLUSTERING PROTOCOL FOR WSN”

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Wireless sensor networks (WSNs) are composed of a large number of sensor nodes that are deployed in a specific area to collect data and transmit it to a base station. The main challenge in WSNs is energy efficiency, as the sensor nodes have limited battery power. One of the most effective ways to improve energy efficiency in WSNs is to use clustering. Clustering divides the network into smaller groups of nodes, called clusters, each of which is managed by a cluster head. This allows the nodes to conserve energy by only communicating with their cluster head and the base station. The Energy-Efficient Clustering Protocol (EECP) is a well-known clustering protocol that has been shown to be effective in improving energy efficiency in WSNs. However, EECP can be further enhanced by incorporating additional features. The integration of these features into EECP can significantly improve the energy efficiency of WSNs. In this paper, we propose an enhanced EECP (EECP+) protocol that incorporates these features. We evaluate EECP+ through simulations using the CupCarbon WSN simulator and show that it can significantly improve the energy efficiency of WSNs compared to EECP and other existing clustering protocols.

Keywords: Wireless sensor networks, clustering, energy efficiency, cooperative communication, energy-aware routing, power-aware scheduling, data aggregation, CupCarbon. Energy-Efficient Clustering Protocol (EECP)

A SYSTEMATIC LITERATURE REVIEW ON ESG:RESEARCH IMPLICATIONS AND FUTURE RESEARCH AGENDAS TOWARD A SUSTAINABLE TRANSITION

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The field of sustainable finance research has emerged as a well-established domain within the finance literature. The growing recognition of sustainability and global concerns pertaining to environmental, social, and governance (ESG) matters, especially within the investors' community, has necessitated the implementation of ESG principles and stimulated a trend towards increased scholarly research and dissemination of knowledge in this domain. This study under takes a comprehensive examination and synthesis of the existing body of literature on ESG to facilitate a comprehensive review and summary. This study incorporates a systematic literature review methodology to consider various aspects related to ESG. The researchers conducted a search in the SCOPUS database using multiple Booleans to identify the relevant literature in this specific domain and subsequently extracted a substantial corpus of literature pertaining to ESG spanning the period from 1989 to 2023. These emerging strands of literature describe the transformation occurring in the finance field. This study aims to identify the prominent theoretical foundations, empirical and methodological approaches, the interaction among ESG dimensions, the impact of ESG on financial and economic outcomes, and the function of ESG in risk prevention. This paper refines the key themes as well as drivers of interest present in the study of ESG to serve as a guide for academic research scholars and practitioners of ESG.

Keywords: ESG; Sustainability, Finance; Ethical financing; Systematic Literature Review.

DEEFAKE FORENSICS: UNVEILING SYNTHETIC MEDIA WITH ADVANCED MACHINE LEARNING

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Robust detection systems become increasingly important as the threat posed by deepfake technology to multimedia content authenticity grows. This study uses cutting-edge machine learning techniques to provide a novel method of deepfake identification. The study investigates how well recurrent neural networks (RNNs) and convolutional neural networks (CNNs) distinguish minute patterns and artifacts suggestive of synthetic media. The models that are suggested are trained and assessed using large datasets that contain a variety of deepfake scenarios. Furthermore, the study explores the incorporation of explainability mechanisms to augment the interpretability and reliability of the detection procedure. The outcomes demonstrate encouraging precision and dependability, underscoring machine learning's potential as a significant weapon in the continuous fight against misleading deepfake content. This study adds to the body of knowledge in the fields of media integrity and digital forensics by providing useful advice for creating strong defenses against the increasing number of sophisticated deepfake threats.

Keywords: Deepfake, CNN, RNN.

CAULIFLOWER FARMING IN HARYANA: TACKLING OBSTACLES FOR GROWTH AND PROSPERITY

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Cauliflower (*Brassica oleracea* var. *Botrytis*) is one of the most important remunerative vegetable crops grown on commercial scale. It is widely grown across India and is a popular vegetable among the people. It is known for its white, tender head or curd, which is used in curries, soups, and for pickling. Cauliflower is a crucial winter vegetable grown in India. A survey was conducted among a group of cauliflower growers to understand the challenges they encounter during cauliflower production, marketing, infrastructure, technical and economy in it. Panipat and Sonipat districts were purposively selected due to their significant cauliflower cultivation areas in the state. A total of 200 cauliflower farmers were conveniently chosen to gather the necessary data. In Panipat and Sonipat district, the study revealed that the major constraints in cauliflower production included the high cost of cauliflower seeds, expensive fertilizers, labour scarcity during peak periods, and other similar challenges. In terms of cauliflower marketing, respondents reported significant constraints such as high transportation costs, numerous intermediaries in the marketing process, price fluctuations, lack of awareness about the Bhavantar Bharpayee Yojana (BBY) and its complex procedures, and the higher margins of middlemen. Overall, cauliflower growers face significant technical, economic, and infrastructure challenges related to protecting plants from adverse weather, meeting fertilizer requirements, costly inputs like seeds and fertilizers, and limited access to timely credit facilities. To address these constraints, it is recommended to establish sufficient storage facilities that enable producers to distribute their sales throughout the year. Efforts should be made to ensure the availability of quality seeds, fertilizers and protect producers from experiencing low prices during peak seasons.

Keywords: Cauliflower, Production, Marketing, Constraints, Garrett Ranking.

TOPSIS-BASED FACTOR ANALYTIC MODEL FOR THE ASSESSMENT OF AGRICULTURAL DEVELOPMENT IN THE STATE OF UTTAR PRADESH, INDIA

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Uttar Pradesh is primarily an agrarian economy with more than two-thirds of its population directly or indirectly depending on agriculture for their livelihood. Uttar Pradesh undeniably requires a high-paced agricultural development not only to increase productivity to ensure food security but also to create a niche for itself among the highly developed states in India. In this paper, Factor Analytic Model based on the theory of TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) has been used to evaluate the agricultural development of Uttar Pradesh. The model is formulated regarding the cross-sectional data for the years 2019 & 2020. Also, the classification of districts based on their level of development has been made by using 'Multivariate Cluster Analysis' approach. Lastly, for the districts which are poorly developed in terms of agricultural development, the model districts and potential targets for various agricultural indicators have been estimated in order to enhance the agricultural development of the state.

Keywords: Agricultural development, Factor Analytic Model, TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), Composite Indices, Hierarchical Cluster Analysis.

STUDY OF BIOCHEMICAL CHANGES DUE TO SEWAGE FARMING IN SELECTED VEGETABLES OF DISTRICT SIRSA, HARYANA

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The current study in present paper has developed a correlative dynamics of sewage irrigation and biochemical alteration in some vegetable crops in Sirsa city, Haryana. The sewage water contains heavy metals usually comes from household, commercial and Industrial discharge. The sewage irrigated crops and vegetables accumulate the heavy metals and other non biodegradable compounds in their body, especially in harvestable part which pose the risk to human population. In present discourse of study determine the heavy metal contents particularly Fe, Pb, Mn, Cu, Zn, Cd, Cr, Ni in soil, accumulation in edible part of plants due to sewage irrigation by using heavy metal profiling methods. Study also reveals the translocation and enrichment factors long with dependent factors like physical, chemical and biological in consonance of the application of sewage irrigation.

Keywords: Sewage Farming, Heavy metals, Metal profiling.

FRICION STIR WELDING-RECENT ADVANCEMENT, PROCESS PARAMETERS, METALLURGICAL STRUCTURE, PROPERTIES, APPLICATIONS, ADVANTAGES, AND DISADVANTAGE: A REVIEW

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Friction stir welding (FSW) has become the most popular welding technique for nonferrous alloys among researchers of the concerned field in the recent decade. It is a solid-state welding process and most suitable for nonferrous alloys, especially aluminium and magnesium alloys. Aluminium and magnesium alloys are the hot material for structural applications in transport vehicles, aerospace, and marine due to their lower densities and superior mechanical properties. Furthermore, FSW is associated with low temperature, which is responsible for eliminating defects of fusion welding such as porosity, liquation cracking, solidification, and cracking. This review article briefly introduces FSW and explains the different methods employed for FSW. Furthermore, process parameters, microstructural, mechanical properties, metallurgical investigations, advantages, disadvantages, applications, contemporary challenges and drawbacks, and future hotspots of FSW are identified.

Keywords: Friction Stir Welding, Weld Properties, Metallurgical Structure,

REAL TIME IMAGE PROCESSING AND ITS APPLICATIONS

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In the fast-paced environment of the industrialized world, Real-time Image processing is on the rise to becoming an essential tool to upscale efficiency and eradicate manual errors. It continues to improve industrial standards where the cost of failure translates into capital loss. Excellent at operating when critical decision-making and time are at stake, it finds applications in the medical field and biometrics. This paper aims to sketch an overview of the applications of Real-Time Image Processing, relevant techniques, and methods developed.

BALANCING FINANCE AND GREEN: A CARBON NEUTRALITY PERSPECTIVE OF INDIAN BANKS

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In today's rapidly changing world, the need for sustainable finance and environmentally responsible practices has become increasingly paramount. Several Indian Banks are making significant strides toward carbon neutrality. The study aims to assess the impact of the carbon neutrality pledge on the financial performance and carbon footprint. It explores the reporting practices, risk management policies and initiatives & investments by HDFC and SBI banks aiming to achieving carbon neutrality. The study employed accounting and financial management techniques, a combination of qualitative and quantitative methods to analyze the impact of the carbon neutrality pledge on HDFC and SBI banks, utilizing secondary data sources such as annual reports, sustainability reports, and other relevant banking reports from 2019 to 2023. The study observed changes in interest rates and financial performance, including deposits and earnings per share. Banks implemented various initiatives such as solar and wind projects, green bonds, digital banking, and awareness campaigns to support carbon neutrality. The analysis suggests that HDFC and SBI banks have made efforts to balance finance and green considerations, reducing their carbon footprint and integrating sustainable practices. However, further improvements are needed as they are still in the early stages of implementing carbon emissions management and sustainability initiatives.

Keywords Carbon neutrality, Climate change, carbon footprint, Finance, Financial performance, Green Initiatives

FRAUD AND FORENSIC ACCOUNTING: A COMPREHENSIVE REVIEW

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Forensic accounting (FA) is a rapidly evolving area of accounting that aids in preventing and detecting financial crime. This article discusses forensic accounting as a new branch of accounting for fraud detection and prevention, as well as its three main components: litigation support, expert opinion, and fraud investigation. The research is conceptual and will aid in conceptualizing issues linked to fraud, categories of fraud supplied by the Association of Certified Examiners, in the form of a fraud tree, and motivations that encourage someone to indulge in fraudulent behavior. Finally, the fundamental and expanded abilities necessary to be a fraudulent examiner, and the challenges hindering the expansion of FA in India, have been studied. By delving into the intricacies of these concepts, future researchers will be equipped with a solid knowledge base to effectively investigate and prevent fraudulent activities, ultimately contributing to the advancement of the field.

Keywords: - Fraud, Occupational Fraud, Forensic Accounting, Fraud Triangle Theory, Fraud Dimond Theory, ACFE.

TRANSFORMATION IN PAYMENT SYSTEM: E-COMMERCE TO M-COMMERCE

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We buy and sell products and services online using computers and laptops in E-commerce, but in M-commerce, the customer utilizes a mobile phone for the same purpose. India is now experiencing an e-commerce and mobile commerce revolution. However, the introduction of m-Commerce has pushed the frontiers of the virtual commerce revolution even further. In the same way as electronic payment systems (e-payment) are an essential part of e-commerce, mobile payment systems (m-payment) are a vital component of m-commerce. The expansion of ICT (information, communication, and technology) and 5G internet has revolutionized the payment system from cash-based to electronic-based to mobile-based transactions. The Information Technology Act of 2000 also made e-commerce, online transactions, and digital signatures lawful in India. It is expected that in the near future, it will completely replace all forms of sales and services. The reason for this is that mobile payments are a recent trend as a result of collective events such as the government promoting digital India through awareness programmes, demonetization, UPI launch, telecom growth with 5G launch and affordable internet facility, economical handsets, growth of m-commerce, and new entrants in the m-payment industry. This article is based on a survey of relevant literature to acquire a better knowledge of various payment system growths ranging from e-commerce to m-commerce. The research also aimed to give a precise synthesis of past studies on the success aspects of e-payments and m-payments, as well as an overview of payment systems used in e-commerce and m-commerce.

Keywords: e-commerce, m-commerce, e-payments, m-payments, transformation

ANALYZING IMAGE QUANTIZATION USING BFO ALGORITHM

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In this research paper, color image quantization based on Bacteria Foraging Optimization (BFO) algorithm is analyzed. In the analyzed algorithm, several formats of color images (e.g. .jpg, .png, .bmp) with different size of images (256 x 256 pixels, 512 x 512 pixels) are tested and results are compared. The image analyzed is divided into three different layers of Red, Green and Blue components. The algorithm takes a block of 8x8 pixels and performs DCT. The difference in the original image and transformed image computed in terms of PSNR. The points where the difference between original and transformed pixel is minimum are then quantized. Color quantization is done by evaluating the health of the bacteria / color in terms of PSNR parameter. The BFO algorithm minimizes the number of colors present in the image keeping the PSNR as high as possible. Color image quantization is necessary if the display on which a specific image is presented works with less color than the original image. The research paper shows that images quantized with bacteria foraging optimization technique gives better results in terms of certain parameters that tells the quality of quantized images. Performance of the algorithm and quality of quantized images are evaluated by calculating the values of MSE (Mean Square Error), Peak Signal Noise Ratio (PSNR), Compression Ratio (CR) and Bits per Pixel (BPP).

Keywords: *MSE (Mean Square Error), Peak Signal Noise Ratio (PSNR), Compression Ratio (CR) and Bits per Pixel (BPP)*

ACCURACY AND PERFORMANCE ENHANCEMENT DURING SUSPICIOUS ACTIVITY DETECTION IN IOT ENVIRONMENT

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Internet of things (IOT) are becoming popular and taking an important place in our daily routine life. IOT based devices are making our life easy and comfortable. Although IoT explosion offers a wide range of opportunities for manufacturers and consumers, it also poses major risks in terms of security being a widespread network. A security mechanism is needed to protect the devices from cyber attacks. This can only be achieved by including security mechanism in the early stages of IoT based device's design to observe privacy and safe transmission of data over network. In existing system, standard protocols were used for data transmission and basic encryption techniques were being applied for ensuring the security of IoT based devices. But it failed in preventing against routing attacks and packet losses in transmission. To overcome these problems, a two tier security model has been proposed in present study. Therefore, this paper proposes a two tier security model for IoT based devices. In this approach the advanced encryption standard (AES) are used with multiplicative inverse encryption algorithm (MIE) to ensure the security of data. A comparative analysis between proposed model and existing model has been performed in the present study. The parameters packet size, transmission time and error rate has been determined in the comparison.

Keywords: IoT, Data security, AES, MIE encryption algorithm.

ANALYTICAL REVIEW OF LINEAR ALGORITHMIC APPROACH

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Analyzing performance of sorting techniques in terms of time and memory requirements and efficiency of linear-time algorithm. Two important ways to characterize the effectiveness of an algorithm are its space complexity and time complexity. Time complexity of an algorithm concerns determining an expression of the number of steps needed as a function of the problem size. We analytically review insertion sort and Merge sort Algorithms on the basis of their performance, their time complexity as well as their space complexity.

Keywords: Asymptotic Analysis, Big Oh Notation, quadratic function, Divide and Conquer paradigm.

ANALYZATION OF IOT, BIG DATA ANALYTICS AND CLOUD COMPUTING IN DEVELOPMENT OF A SMART CITY

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Nowadays, people want to employ as much automation as possible with the services they rely on and even the domestic and daily-use equipment they use. They are reluctant to spend time waiting in line. Smart gadgets are being used by more and more individuals to save time, which produces big data. Because IOT is being used its fullest potential, we can turn Big data into an asset for the present and the future, and analysts are working out how to use this asset to uncover something useful. In this work, we provide an overview of big data systems and the cloud computing architecture in order to examine the impacts of using big data and cloud computing while developing and establishing smart cities. This study also investigates how combining these two technologies may enhance the results of planning and conceiving smart cities and aid in overcoming the numerous obstacles as well as difficulties that urban designers and planners have to confront.

Keywords: Big Data Analytics, Cloud Computing, Smart City, IoT, SaaS, Paas, Iaas, MapReduce, Hadoop, ThingSpeak

EXPLORING THE UPSIDE OF HUMAN RESOURCE INFORMATION SYSTEMS: A COMPREHENSIVE ANALYSIS

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The idea of a human resource information system (HRIS) is not new, but it is evolving daily due to the changing environment. The two components that many businesses are attempting to use as competitive strategic weapons are human resources and information technology. The term "human resource information system" (HRIS) refers to information systems created specifically for managing human resources. Human Resources Information Systems (HRIS) are tools for gathering, storing, retrieving, and analyzing data on an organization's human resources. Human resource management applications include compensation administration, leave and absence tracking, skill inventories, performance reviews, training and development, HR planning, hiring, and career planning, among others. HRIS has emerged as a crucial component of successful and competitive corporate operations. This article will highlight the components and models of HRIS. This paper will also highlight challenges in the implementation of HRIS. The purpose of this paper is to explain the significance of HRIS and to provide a thorough understanding of the topic.

KEYWORDS : - Human Resource Information Systems (HRIS), Human resource management, Comprehensive, information technology.

IMPACT OF COVID-19 PANDEMIC ON SHAREHOLDER WEALTH CREATION VIA DIVESTITURES.

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The pandemic had a particularly strong financial effect on IT, wholesale and retail, education, tourism, and transport industries. Conventional literature on divestitures states that divestitures lead to positive shareholder wealth creation. Was there positive shareholder wealth creation in fifty transactions of divestitures that took place during the pandemic in these five industries that were dramatically hit by the pandemic? This paper analyzes the shareholder wealth created by the divesting company of these highly influenced industries by the pandemic. This study uses standard market-based event study methodology with an event window of twenty-one days, six days, and three days to investigate the reaction of the stock market to these divestiture announcements and an estimation period of two hundred and forty days to calculate the normal return. The study finds a significant positive 1.26% CAAR (Cumulative Average Abnormal Return) in an event window of ten days before and ten days after the divestiture announcement. Yet the immediate CAAR of the divestiture one day before and one day after the divestiture announcement was statistically significant negative 0.59%. Whereas the statistically significant CAAR in the event window of three days before and after the divestiture was 1.43%.

Keywords: Divestiture, shareholder wealth creation, COVID-19 pandemic.

INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN TEACHING-LEARNING IN POST COVID ERA

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Due to COVID-19, Information and Communication Technology (ICT) were widely used worldwide. With schools and educational institutions forced to adapt to remote or hybrid learning models, the use of ICT has become more pervasive and indispensable than ever before. One of the most notable changes has been the widespread adoption of online learning platforms, video conferencing tools, and educational apps. These technologies have enabled educators to deliver lessons remotely, facilitate interactive discussions, and provide instant feedback to students, transcending the limitations of physical classrooms. Additionally, digital resources such as e-books, multimedia presentations, and educational websites have enriched the learning experience.

ICT has also revolutionized assessment methods, with the emergence of online quizzes, exams, and automated grading systems. These tools not only streamline the assessment process but also allow for more frequent and personalized feedback, enabling educators to better track student progress and provide targeted support where needed. Beyond traditional academic subjects, ICT has also opened up new avenues for experiential and project-based learning. Virtual reality simulations, augmented reality applications, and interactive educational games offer immersive and engaging learning experiences that stimulate curiosity and critical thinking skills.

Keywords: Information and Communication Technology (ICT), COVID-19, Virtual Reality, Augmented Reality.

UNLOCKING NATURE'S TREASURE: A COMPREHENSIVE REVIEW ON THE PHYSICOCHEMICAL MARVELS OF CASSIA TORA LEAVES

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For an extremely extended period of time, the plant *Cassia tora*, which is a member of the Fabaceae family, has been lauded for the many applications it has in the fields of agriculture, medicine, and industry. The leaves of the *Cassia tora* plant are especially noteworthy among all of its parts because of the number of physicochemical substances that they contain. As a result, they are an exceptional subject for in-depth investigation. The purpose of this research is to provide an overview of the physicochemical properties of *Cassia tora* leaves, which will shed light on their composition, features, and potential applications. Anthraquinones, flavonoids, polysaccharides, proteins, and essential oils are discussed in great detail, along with their roles in providing pharmacological effects such as anti-inflammatory, antibacterial, and antioxidant qualities. *Cassia tora* leaves are a significant component of the plant itself. In addition, the investigation investigates the possibility of using these compounds in the treatment of a variety of medical conditions, including cancer, diabetes, and inflammation, among others. To highlight the relevance of *Cassia tora* leaf extracts in industrial and therapeutic contexts, its physicochemical qualities, such as solubility, stability, and formulation methods, are also investigated. This is done in order to highlight the value of these extracts. Furthermore, the sustainable and ecologically beneficial features of *Cassia tora* leaves are highlighted, attracting attention to the potential of these leaves as renewable resources that may be used for a variety of purposes. Pharmacological activities, industrial application, sustainability, physicochemical features, bioactive compounds, and the leaves of *Cassia tora* are some of the keywords that are associated with this plant.

Keywords: *Cassia tora*, Physicochemical properties, Bioactive compounds, Pharmacological activities, Medicinal properties

THE ROLE OF EMPLOYEE ENGAGEMENT IN GROWTH AND DEVELOPMENT AT NETPROPHETS CYBERWORKS PVT. LTD.

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Employee Engagement refers to the term which defines the relationship between the organization and the employees. It is the practice that helps to identify the reasons for less productivity in the organization, when the employees are either actively disengaged due to some reasons or not at all engaged. Through this practice, the organization can find who is actively engaged in the organization and being unbiased the deserving one can achieve their rewards and recognition. This practices nothing but aims to motivate the employees and create a healthy environment in the organization, as it will automatically lead to an increase in productivity. The aim behind this study is to identify the different employee engagement practices followed by different organizations, reasons behind the less productivity, disengagement of the employees, etc. The study is exploratory cum descriptive in nature, through primary survey method; data was collected from NetProphets Cyberworks Pvt. Ltd. With IBM SPSS 21 software, various statistical tools applied and significant inferences were drawn. Based on findings and recommendations study found that more attention need to be paid on various aspects like to help the employees to develop their career plans, opportunities should be there for re-skilling/ up-skilling, should be more focus on training needs of the employees, providing future opportunities, etc.

Keywords: Employee Engagement, Actively Disengaged Employees, Engaged Employees, Productivity, Skilling.

THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN MODERN SOCIETY: A COMPREHENSIVE REVIEW

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Information and Communication Technology (ICT) has become an integral part of modern society, revolutionizing various aspects of human life, including communication, education, healthcare, business, and governance. This research paper provides a comprehensive review of the role of ICT in contemporary society. It explores the evolution of ICT, its impact on different sectors, and the challenges and opportunities associated with its widespread adoption. The paper also discusses key technologies driving the ICT revolution, such as the internet, mobile devices, cloud computing, and artificial intelligence. Furthermore, it examines the social, economic, and ethical implications of ICT deployment and presents future trends and potential areas of development.

Keywords: ICT, Cloud Computing, Artificial Intelligence, Technology

EFFICIENT ROUTING PROTOCOLS FOR WIRELESS SENSOR NETWORKS IN HARSH ENVIRONMENTS

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Present-day WSNs (Wireless Sensor Networks) WSNs are extremely useful in many contexts, from healthcare to military operations. Due to their small size and inherent ability to self-organize, wireless sensor networks may be deployed with relative ease. Small, non-replaceable, and non-rechargeable batteries are built into wireless sensor nodes. It's the kind of network where resources are limited. Due to the high energy requirements, routing is the costliest part of a WSN. The purpose of this work is to provide the Position Responsive Routing Protocol (PRRP), an energy-efficient routing protocol designed to improve WSN's already impressive energy efficiency. There are a number of ways in which the position-responsive routing protocol diverges from the status quo of routing methods. To reduce energy consumption and ensure a more equitable distribution of gateways and cluster heads, a position response routing protocol is being implemented. The position-responsive steering calculation expands the battery duration of individual hubs in remote sensor organizations, which thusly broadens the organization's general lifetime by 45%. What's more, PRRP's similarly conveyed technique for entryway determination brings about critical enhancements in information throughput and offers an improved answer for the directing energy opening.

Keywords: Wireless Sensor Networks, Energy Efficient, PRRP, CELRP, Routing Protocol

A CONCEPTUAL FRAMEWORK ON INTERNET-BASED DISCLOSURE OF CORPORATE INFORMATION

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Rapid technological advancements have pushed businesses around the world to use internet-based corporate reporting to communicate and share company information either financial or non-financial throughout the world. The corporation conducts web-based corporate reporting as a means of information disclosure, and doing so will impact the value of the business. Main aim of the study is to disclose the conceptual framework of digital disclosure practices of organizations including key determinants of corporate digital reporting, important theories related to digital reporting and benefits of internet-based reporting over traditional or paper based corporate disclosure of information. This study is descriptive and exploratory in nature. Different published articles in known journals, various reports and research papers are used for achieving the aim of study. It is concluded that there are many key determinants or factors of digital reporting i.e. size of firm, age of firm, profitability, liquidity, leverage, audit quality and type of industry. Based on the agency theory, signalling theory and stakeholders theory study exhibits many benefits of online reporting over paper-based reporting including timeliness availability of information, cost economies, helps in decision making for stakeholders etc.

Keywords: Online Reporting, Corporate Disclosure, Web-based information, Digital Dissemination of Information, Internet-based disclosure.

MoS₂ NANOFLOWER SYNTHESIZED BY HYDROTHERMAL PROCESS AS ADVANCED ELECTRODE MATERIAL FOR SUPERCAPACITORS

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Herein, a hydrothermal process is used to synthesize high-quality MoS₂ nanoflowers. Characterization is carried out with electron microscopy (EM) including field emission scanning EM (FESEM), high-resolution transmission EM (HRTEM) and X-ray diffraction (XRD) with Rietveld refinement signify the 2H-MoS₂ phase with excellent flower-like morphology consisting of self-assembled 3-dimensional (3D) network of nanosheets. The diameter of flower-like morphology is observed ranging from 2.96 μm to 4.06 μm. The length and thickness of nanosheets are about 620 (±5) nm and 90 (±3) nm, respectively, with aspect ratio 6.5 (±0.3). EDX in form of elemental mapping analysis provides Mo/S ratio is 1:2.16 and confirms the uniform distribution of Mo and S elements revealing the successful formation of MoS₂. The interplanar spacing calculated from HRTEM image is found to be 0.68 nm, which corresponds to (002) plane of MoS₂. The X-ray Rietveld refinement elucidates the goodness of fit (χ^2) is 1.69. Electrochemical measurements demonstrated that MoS₂ nanoflower based supercapacitors exhibit a remarkable specific capacitance of about 71.1 Fg⁻¹ at 1 Ag⁻¹. This versatile approach for producing MoS₂ nanoflowers in high-yield suggests the as prepared materials can be used as advanced supercapacitor electrode material.

Keywords: Hydrothermal, MoS₂, Nanoflower, Supercapacitor, Electron Microscopy, Rietveld Refinement.

1. INTRODUCTION

With the ever-growing pollution, population, electronic industries and cost of fuels, the demand for economically, eco-friendly and superior energy storage devices (ESDs) such as fuel cells, solar cells, Li/Na-ion batteries and supercapacitors (SCs) is enormously increasing globally [González et al. 2016, Lee et al. 2021, Zhang et al. 2012, Bello et al. 2020, Pani et al. 2023,]. Amongst various ESDs, SCs (also known as electrochemical capacitors and ultracapacitors) have gained immense scientific and technical interests due to their green environmental protection, quick charge-discharge time, long cycle life, great energy density and high power density as compared to the conventional capacitors and batteries [Krishnamoorthy et al., 2014, Baig et al., 2020, Zhang et al., 2015, Wang et al., 2014, Huang et al., 2014, Bello et al., 2022]. Similar to graphene, layered inorganic materials like two-dimensional (2D) transition metal dichalcogenides (TMDCs) demonstrate many fascinating properties such as structural, thermal, optical, tunable band gap, transport, and polymorphism that are important in fundamental research and for a variety of technological applications like energy storage, sensors, lubricants, hydrogen evolution reaction catalysts, electrocatalysts, photocatalysts and many others [Kumar et al., 2022, Kumar et al., 2021, Ramos et al., 2017, Liang et al., 2020, Mashikhwa et al., 2017]. It has, therefore, attracted potential research interest in recent years to develop novel nanostructured 2D TMDCs as an advanced electrode material for SCs. In recent years, 2D TMDCs such as CoS₂, FeS₂, MoS₂, NbS₂, TaS₂, TiS₂, VS₂, WS₂, MoSe₂, NbSe₂, TaSe₂, WSe₂ and MoTe₂ nanomaterials have spurred enhanced research into ESDs [Pazhamalai et al., 2018, Singh et al., 2017, Gupta et al., 2019]. Among various types of 2D materials-based SCs, nanostructured MoS₂ are attaining considerable attention owing to their low cost, broad potential window, inherent chemical stability, fast redox reaction and existence in different structural phases [Lu et al., 2017, Sarkar et al., 2019].

MoS₂ can be considered as a suitable alternative to graphene and can be simply scaled-up synthesized with cost-effective hydrothermal method. However, during the hydrothermal synthesis process, this method leads to the formation of sphere-like, flower-like and sheet-like morphology of MoS₂ nanostructures but requires long time. For example, Lee et al., 2021 examined oxygen incorporated in 1T/2H hybrid MoS₂ nanoflowers prepared from molybdenum blue solution for asymmetric supercapacitor applications, Krishnamoorthy et al., 2014 investigated supercapacitive properties of hydrothermally synthesized sphere like MoS₂ nanostructures, Masikhwa et al., 2017 demonstrated high performance asymmetric supercapacitor based on molybdenum disulphide/graphene foam and activated carbon from expanded graphite, Pazhamalai et al., 2018 reported high energy symmetric

supercapacitor based on mechanically delaminated few layered MoS₂ sheets in organic electrolyt, Singh et al., 2017 studied three-dimensional graphene with MoS₂ nanohybrid as potential energy storage/transfer device and so on. These previous research works illustrate that nanostructured MoS₂ possess poor crystallinity, hybrid phase and lower specific capacitance, which is an important factor for their application as SCs. In this regard, it is yet challenging to develop MoS₂ with existing morphology via simple hydrothermal method in short duration time to overcome the shortcomings, which acts as electrode material for SCs.

2. EXPERIMENT DETAILS

2.1 Materials

Ammonium molybdate tetrahydrate ((NH₄)₆Mo₇O₂₄, 81%-83% MoO₃ basis, ACS grade) bought from Sigma Aldrich. Thiourea (H₂NCSNH₂, 99%, ACS grade) purchased from Merck. Millipore water (18 MΩ.cm) and ethyl alcohol (C₂H₅OH, 99.9%, analytical grade) were used as solvents during the synthesis endeavours. All the chemicals for this study were used without supplementary purification.

2.2 Preparation of MoS₂ Nanoflowers

MoS₂ nanoflowers were synthesized by a facile and versatile hydrothermal method. Precisely, 1.241 gm of (NH₄)₆Mo₇O₂₄ and 2.28 gm of H₂NCSNH₂ were dissolved in 40 mL of Millipore water by constant stirring for 1 hour. The final solution was then transferred into a 100 mL Teflon-lined stainless steel autoclave and reacted at 220 °C for 6 hours. After the reaction was completed, the autoclave was cooled down naturally to room temperature. The product was filtered off and washed with Millipore water and ethanol for several times to remove the inorganic and organic impurities, respectively. Finally, the obtained product was dried at 60 °C for 24 hours.

2.3 Characterization

Surface morphology and elemental analysis including mapping of as-synthesized MoS₂ nanoflowers were accomplished using field emission transmission electron microscope (FESEM, Tescan Maia3) equipped with energy dispersive X-ray (EDX, Oxford ULTI MAX65) spectroscopy. Further microstructure characterization and lattice-scale feature analysis were carried out on a transmission electron microscope (TEM) and high resolution TEM (HRTEM, JEOL 2100 +, Japan) with an accelerating voltage of 200 kV. The phase purity and structural determination was obtained by X-ray diffractometer (XRD, Pan analytical X'pert pro, Netherlands) with Cu-Kα₁ radiation having wavelength 1.5406 Å. The crystalline structure was refined by Rietveld's refinement method using FULLPROF program to find the goodness-of-fit (χ²).

2.4 Electrochemical Measurement

Electrochemical measurements were investigated by an OrigaLys electrochemical workstation in a 1M Na₂SO₄ aqueous electrolyte solution with three electrodes system. The saturated calomel electrode (SCE) connected with Pt wire referred as reference and counter electrodes, respectively. In the preparation of working electrode, the MoS₂ (active material) was mixed together with carbon black (as conducting carbon) and polyvinylidene fluoride (PVDF, acted as binder) in the ratio of 90:5:5 with sufficient droppings of N-methyl-2-pyrrolidone (NMP) in order to make a homogenous slurry. The as-prepared slurry was later drop-casted on 3D Ni foam with porosity of about 95-98% and thickness was 1.5 mm. Finally, the electrodes were dried in a hot air oven at 80 °C for overnight in order to remove the solvent.

3. RESULTS AND DISCUSSION

3.1 Morphological Studies

The surface morphology, microstructural information and atomic scale imaging of MoS₂ nanoflowers were confirmed through FESEM, TEM and HRTEM. Figure 1 represents the FESEM-EDS and TEM-HRTEM images of as-synthesized MoS₂. The typical FESEM image (Figure 1(a)) indicates agglomerated rounded flower-like morphology similar to a pink carnation flower. The size and/or diameter of the flowers were found to be ranges between 2.96 μm and 4.06 μm. Moreover the carnation flower morphology is constructed by randomly assembled regular-shaped MoS₂ nanosheets. The nanosheets are approximately 620 (±5) nm in length and

90 (± 3) nm in thickness. The aspect ratio of MoS₂ nanosheets was upto 6.5 (± 0.3). The EDX measurement was carried out in order to verify of the chemical composition of MoS₂ nanoflowers. Figure 1(b) shows the EDX analysis revealing the atomic content ratio Mo/S of 31.0/67.1, almost 1/2, which signifies the development of MoS₂ particles in a large extent, since no other element was noticed in EDX spectrum. Figure 1(c) displays a low magnification FESEM image of the area to be examined by EDX mapping. Within this area, multiple flower-like nanostructures are evidenced. The corresponding EDX maps of molybdenum (Mo; green) and sulfur (S; red) are shown in Figure 1(d) and Figure 1(e), respectively, demonstrating the homogenous distribution of Mo and S elements. The EDX analysis of as-prepared sample provides the presents of both Mo and S in the nanostructures thus verifying the composition to the nanoflowers to be MoS₂. Figure 1(f) shows a TEM image of the MoS₂ nanoflowers illustrating that they contained MoS₂ nanosheets with abundant active edge sites with thickness of about 9 nm (as marked with white solid arrows in Figure 1(f)). The HRTEM image (Figure 1(h)) depicts the regular layered structures of MoS₂ nanosheets, where the sheets are constructed by well-stacked layers and the interplanar spacing is estimated to 0.68 nm stands for the existence of (002) lattice plane in 2H-phase of MoS₂.

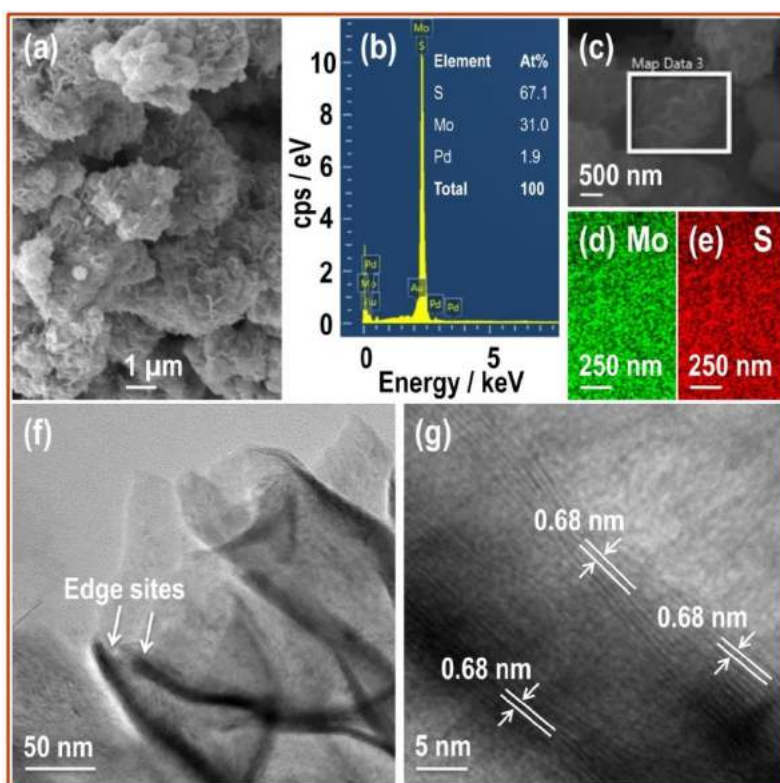


Figure 1: Electron microscopy (EM) images; (a) Field emission scanning EM (FSESEM) image, (b) energy dispersive X-ray (EDX) spectrum and (c) elemental mapping image showing homogenous distribution of (d) Mo and (e) S elements. (f) Transmission EM (TEM) and (g) high-resolution TEM (HRTEM) images.

3.2 XRD Analysis and Rietveld Refinement

The Rietveld refined XRD pattern of MoS₂ is displayed in Figure 2. The XRD analysis was performed in 2 theta (2θ) ranges between 4.02° and 79.98° with a step size of 0.017°. From Figure 2, it is observed that the as-prepared MoS₂ has two major peaks at 14.00° and 33.28° that are indexed to (002) and (100) lattice planes, respectively. Further, it is also see that there are three other minor peaks at 39.6 4° (103), 47.42° (105) and 58.83° (110). The observed diffraction peaks and relative intensities which are observed for MoS₂ are indexed using the JCPDS card number 00-037-1492 (System: hexagonal, S.G.: *P63/mmc* (194), *a*: 0.316 nm, *c*: 1.229 nm, *a/b* = 1.00, *b/c* = 0.257 and *c/a* = 3.889). The crystallite size corresponding to the high intensity peak with (002) plane was calculated using Scherrer's equation to be 9.15 nm. The Rietveld-refined XRD pattern of MoS₂ with the observed (wine dash-dots-dash), calculated (pink solid line), difference (obs.-cal., green solid line) and Bragg's position (vertical blue solid line) spectra is demonstrated in Figure 2 resulting in a χ^2 value of about 1.69, corresponding well with the reported values of MoS₂ [Kumar et al., 2021, Ramos et al., 2017]. A summary of the lattice-, atom- and statistical-parameters obtained by further refinement is displayed in Table 1.

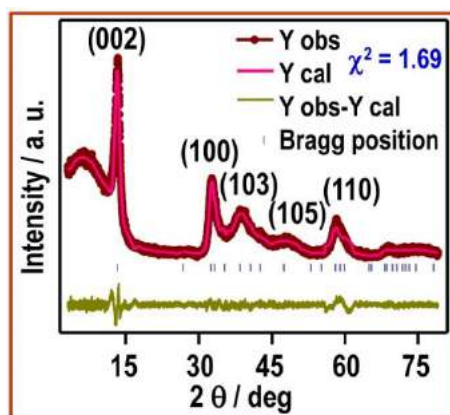


Figure 2: X-ray diffraction (XRD) with Rietveld refinement pattern of MoS₂.

Table 1: A summary of the lattice-, atom- and statistical-parameters of MoS₂ obtained by Rietveld refinement

Lattice parameters				Atom parameters						Statistical parameters			
Length (Å)		Angle (°)		Mo			S			R _p	R _{wp}	R _{exp}	χ ²
a = b	c	α = β	γ	x	y	z	x	y	z				
3.179	13.33	90°	120°	0.291	0.582	0.250	0.406	0.793	0.649	4.07	5.48	4.22	1.69

3.3 Electrochemical Analysis

Supercapacitor performances of MoS₂ nanoflowers are assessed through a series of electrochemical measurements including cyclic voltammetry (CV), galvanostatic charge/discharge (GCD) and electrochemical impedance spectroscopy (EIS). Figure 3(a) represents the cyclic voltammograms of MoS₂ nanoflowers was estimated by CV in the potential range from -200 to -900 mV at different scan rates ranging between 10-100 mV/sec in both anodic and cathodic directions against SCE. The specific capacitance (C_{sc}) value is calculated using equation (1).

$$C_{sc} = \frac{\int idv}{\Delta V \times m \times v} \quad (1)$$

where $\int idv$ is the area under the CV curve, ΔV is the potential range, m is the mass of MoS₂ (active material) and v is the scan rate, respectively.

The C_{sc} values calculated from the CV curves for MoS₂ nanoflowers are, respectively, 36.48, 27.60, 19.21, 16.75 and 14.96 F g⁻¹ at the scan rates of 10, 20, 50, 70 and 100 mV s⁻¹. Interestingly, the current density increases as the scan rate increases (as resulted in Figure 3(a)); however, the C_{sc} value decreases (as shown in Figure 3(c)), which is due to low electrolyte-electrode interaction at higher scan rate and reveals charge-resistive behavior of electrode material. Figure 3(d) illustrates the GCD curves measured in potential window of -300 mV to -850 mV at distinct current densities ranges from 1 to 5 A g⁻¹ for MoS₂ nanoflowers. All the GCD curves are close to typical triangular shapes exhibits small internal resistance drop signifying high reversibility and improved electronic conductivity of electrode reaction. The C_{sc} is also calculated from GCD curve determined from equation (2).

$$C_{sc} = \frac{I \times \Delta t}{\Delta V \times m} \quad (2)$$

where I represents the applied current, Δt is the discharging time, ΔV is the potential range during charge-discharge process and m is the mass of active material, respectively.

The calculated C_{sc} from GCD curves are found to be 71.10, 33.14, 27.19, 23.79 and 18.77 F g⁻¹ at the current density values of 1, 2, 3, 4 A g⁻¹, respectively. With increasing the current density the C_{sc} values decrease almost linearly (Figure 3(d)) which is a characteristic feature for supercapacitor. The observed GCD behavior is in quite agreement with the superior electrochemical behavior of MoS₂ nanoflowers from CV curves. A comparison of specific capacitance as a function of current density of different MoS₂ nanostructures and the present work is summarized in Table 2.

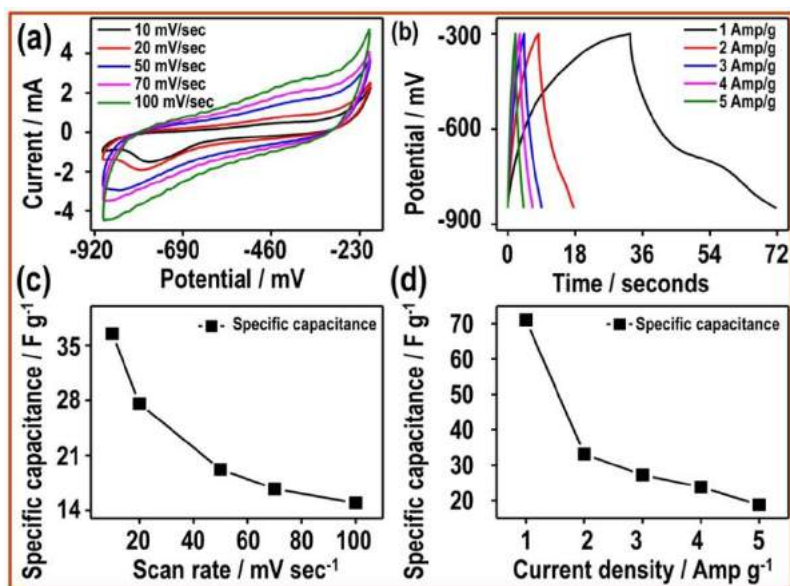


Figure 3: (a) Cyclic voltammograms at scan rates 10-100 mV/sec and (b) Galvanostatic charge/discharge curves at current densities 1-5 Amp/g. The specific capacitances as function of (c) scan rate and (d) current density.

Table 2: A summary of specific capacitance as in previously reported and present study work from electrochemical spectroscopy measurement

Electrode Materials	Electrolyte	Specific capacitance	Current density	References
MoS ₂ Nanospheres	1 M Na ₂ SO ₄	92.85 F g ⁻¹	0.5 mA/cm ²	[Krishnamoorthy et al., 2014]
Mn-MoS ₂ Nanoflowers	1 M KOH	70.73 F g ⁻¹	1 A g ⁻¹	[Bello et al., 2022]
MoS ₂ Nanowalls	6 M KOH	59.00 F g ⁻¹	1 A g ⁻¹	[Masikhwa et al., 2017]
MoS ₂ Nanosheets	0.5 M Tetraethylammonium tetrafluoroborate	14.75 F g ⁻¹	0.75 A g ⁻¹	[Pazhamalai et al., 2018]
MoS ₂ Nanoflowers	1 M Na ₂ SO ₄	71.10 F g ⁻¹	1 A g ⁻¹	This study

4. CONCLUSION

MoS₂ nanoflowers in high-quality were successfully synthesized by a facile hydrothermal process. Morphological studies observed by EM elucidate the flower-like morphology consisting of self-assembled 3D network of 2D nanosheets. The flower-like morphology of MoS₂ having the diameter in range 2.96-4.06 μm, whereas the length and thickness of about 620 (±5) nm and 90 (±3) nm, respectively for nanosheets. EDX and elemental mapping characterizations reveal the Mo and S presented in 1:2.16 ratio and homogenous distribution of Mo and S elements. The lattice spacing were calculated to be 0.68 nm attributing to the (002) plane of MoS₂. XRD and Rietveld refinement demonstrate the formation of 2H-MoS₂ phase with χ^2 value of 1.69. Electrochemical analyses provide MoS₂ nanoflowers based supercapacitors achieving a remarkable specific capacitance value of 71.1 Fg⁻¹ at 1 Ag⁻¹ current density. This simple approach indicating the prepared MoS₂ with flower-like morphology in high crystalline nature with high-yield is a very promising electrode material for advanced supercapacitors.

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AN ANALYSIS OF ASSESSMENT-BASED ADAPTIVE STEM PEDAGOGY

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Higher education faces multiple challenges in creating evidence-based pedagogical practices to improve student learning and outcomes. Fayetteville State University (FSU) piloted an Assessment-Based Adaptive Math Course, MATH 129 (Pre-Calculus) to improve college education, particularly in Science, Technology, Engineering and Mathematics (STEM) education, for the minority and disadvantaged student population. This Adaptive Math Course featured a comprehensive diagnostic assessment that pinpointed areas of academic weakness, offered immediate support, and yielded positive academic results. The process began with students taking a diagnostic test, which guided the creation of materials to supplement the existing curriculum. These materials provided students with extra opportunities for practice and engagement in enrichment sessions beyond regular class hours. Notably, students exclusively attending the conventional course, on average, passed with a grade of D. In contrast, those who participated in at least five enhancement sessions in the Adaptive Math class saw a substantial improvement, with 12% to 55% more students achieving an A grade compared to the control group. This enhancement approach effectively boosted students' pass rates, irrespective of age, gender, or ethnicity. This paper serves as a catalyst for higher education institutions, illustrating how adaptive learning curricula in STEM can alleviate deficiencies and enhance student retention.

Keywords: Assessment-Based Adaptive Pedagogy, Assessment-Based Adaptive Math Enhancement (AAME) Intervention Course, Control Classes, Univariate Analysis of Variance.

1. INTRODUCTION

In its pursuit of enhancing STEM education at Fayetteville State University (FSU) in North Carolina, the institution initiated several programs, one of which is the "Strengthening STEM Learning for Student Success (S4)" project. This project is supported by funding from the National Science Foundation through the Historically Black Colleges and Universities Undergraduate Programs (HBCU-UP) Implementation Projects. The primary goal of the S4 project is to boost the enrollment and graduation rates of students from underrepresented, underprepared, or low-income backgrounds in Science, Technology, Engineering, and Mathematics (STEM) disciplines. This objective is aligned with the "What Works" Initiative of the United States Department of Education and the National Education Council, which seeks to identify evidence-based strategies for educational success.

The S4 project encompasses a range of strategies, with a particular focus on implementing evidence-based, high-impact pedagogical practices aimed at enhancing student learning and academic outcomes. These

intervention models are meticulously designed to address issues such as attrition rates and students' performance and perceptions of STEM subjects. The overarching aim is to increase student retention and graduation rates in STEM fields.

While some of these models have already been widely adopted to engage students effectively, others have seen limited implementation at Historically Black Colleges and Universities (HBCUs), including FSU. This scarcity of implementation at HBCUs has influenced the decision to undertake these efforts, with the goal of promoting the success of minority and low-income students in STEM disciplines at FSU.

2. LITERATURE REVIEW

Adaptive learning has been defined as usage of technology or systems that monitor learning progress and use the data to continuously change the teaching content to fit the needs of the individual learner. It is a methodology to create personalized learning experiences for students, almost synonymous with personalized learning (Mirata et.al, 2020). Personalized learning is considered to encompass a range of models and approaches including tutorial models, differential instruction, and competency-based learning (Waters, 2014). Adaptive learning can be divided into two approaches: facilitator-driven and assessment-driven. Facilitator driven refers to products that deliver instructors with dashboards regarding student performance. Assessment-driven, provides almost real time adjustments to instruction, guided by learning objectives, outcomes, frameworks and allows students to move freely through the course individually or as a group without instructor interaction (Waters, 2014). Adaptive learning that provides a personalized learning experience is mostly in online or blended learning environments (Mirata et al., 2020).

Higher education faces multiple challenges in creating evidence-based pedagogical practices to improve student learning and outcomes due to cost, diversity of students, equitable access as well as providing learning opportunities to non-traditional learning groups. Adaptive learning is creating new learning environments which bring students more flexibility, adaptation, effectiveness, feedback, and motivation (Mirata et al., 2020).

From the Spring semester of 2018 to the Fall semester of 2022, Fayetteville State University (FSU) introduced the Assessment-Based Adaptive Instruction in a Pre-Calculus course. This intervention course was designed to offer support to students facing challenges in Pre-Calculus, identify their specific learning deficiencies, and promptly provide tailored solutions to facilitate their success and swift progress in the course. To assess the effectiveness of this implementation, the study formulated four research questions:

1. Is there a variance in the academic performance between students who received the intervention and those who did not?
2. Do students who attended five or more Assessment-Based Adaptive Math Enhancement (AAME) sessions exhibit a higher likelihood of successfully completing the course?
3. Are there gender disparities among students who participated in the AAME and those who did not?
4. Are there differences in ethnicity among students who engaged in the AAME and those who did not?

3. RESEARCH METHODOLOGY

3.1 Theoretical Framework

To investigate the research questions, the Adaptive Math Course involved a comprehensive diagnostic assessment. This assessment was designed to identify areas where students had deficiencies and promptly offer solutions to support them, ultimately leading to positive academic results.

Although the concept of “Adaptive Math” is identified with computerized adaptive testing, the idea of adjusting math problems and concepts to the level of the learner is what prompted the idea of the conceptual framework that was employed. Computer-adaptive tests are designed to adjust their level of difficulty—based on the responses provided—to match the knowledge and ability of a test taker. Therefore, computer-adaptive scoring is based on both the number of correct answers provided and the difficulty of the items completed. Adaptive testing, officially known as Computerized Adaptive Testing (or CAT for short) is the latest development in test administration (Eggen and Straetmans, 2000; Green, 2000; Kingsbury and Weiss, 1984; Lawrence). In adaptive tests, the test's difficulty adapts to the performance of the candidate, getting harder or easier following a correct or incorrect answer respectively. From the examinee's perspective, the difficulty of the exam seems to tailor itself to their level of ability. For example, if an examinee performs well on an item of intermediate difficulty, he will then be presented with a more difficult question. Or, if the examinee performed poorly, he would be presented with a simpler question. The CAT concept was modified to be used as a tool to help expand on concepts presented and fortify students' understanding and thus master the concepts covered in the course. The basic computer-adaptive testing method is an iterative algorithm with the following steps:

1. The pool of available items is searched for the optimal item, based on the current estimate of the examinee's ability.
2. The chosen item is presented to the examinee, who then answers it correctly or incorrectly.
3. The ability to estimate is updated, based upon all prior answers.
4. Steps 1–3 are repeated until a termination criterion is met.

Our implementation commences with students undergoing a diagnostic assessment, which includes problems related to fundamental concepts and the mastery of key principles that students are expected to grasp before the course commences. Based on the results of this diagnostic test, supplemental materials are created to complement the existing course, offering students additional opportunities for practice, and engaging them in enrichment learning sessions that go beyond regular class hours.

Initially, students are assigned to participate in support sessions that extend beyond their regular class schedule. Following the initial diagnostic test, students are given the option to take part in 4-week long enrichment learning sessions, which are led by faculty members and upper-class students. During these sessions, students receive worksheets and other course materials tailored to their incremental performance. Upon completion of the enhancement sessions, students undergo a reevaluation to assess the impact of these supplementary learning opportunities.

Following the initial achievements of the Pre-Calculus course intervention, the department has made the decision to enhance the course by increasing its credit hours from 3 to 4. This modification enables the integration of a support lab into the course, a change that the department believes will be beneficial for students.

3.2 Results

The descriptive statistics associated with the number of students who participated in this study based upon course taken, gender, and ethnicity are reported in Table 1. The control course had a higher number of students

($n = 196$) and the AAME course had a lower number of students ($n = 169$). During the academic year 2020 and 2021, the university had to adjust the restrictions incurred by the COVID-19 global pandemic. As a result, students who received untraditional grades FC, failed due to COVID; PD, passed with a grade of D; CW, withdrawal from course due to COVID; and WU, withdrawal from the university were removed and not included in the analysis. As a result, the number of students analyzed was $n = 166$ for the control course, and $n = 160$ for the AAME course (see Table 2).

Q1: Is there a variance in the academic performance between students who received the intervention and those who did not?

There is a difference in the academic performance of students who took the AAME classes and the control classes. Over half of the students, 51%, passed with a grade of “A”; and more than 14% passed with a grade of “C” or better in the AAME course versus the control group. (see Table 4). The AAME students’ average final grade increased between 0.51 and 0.98 points and attending seven enhancement sessions had the largest effect on final grade (see Table 4). AAME male students’ final grade increased between 0.68 and 1.2 points and attending six enhancement sessions had the largest effect on final grade. AAME female students’ final grade increased between 0.18 and 1.09 points and attending seven enhancement sessions had the largest effect on final grade.

A one-way analysis of variance was conducted to analyze by analyzing the null hypothesis that there is no difference in academic performance of students based on who received the intervention and those who didn’t ($N = 326$) (see Table 2). The independent variables are the type of courses, including two groups: AAME ($M = 2.92$, $SD = 1.45$, $n = 160$), and control course ($M = 2.30$, $SD = 1.40$, $n = 166$). The average grades for the AAME 2.92 and the control course 2.30 indicate that a student in AAME course has higher final grade. (see Table 5).

The assumption of homogeneity of variances was tested and found tenable using Levene’s Test with $F(1, 324) = .011$ and $p = .92$. The ANOVA was significant with $F(1, 324) = 15.68$ and $p = <.001$. Thus, there is significant evidence to reject the null hypothesis, and therefore conclude that there is a significant difference in academic performance of students who received the intervention and those who did not.

Q2: Do students who attended five or more Assessment-Based Adaptive Math Enhancement (AAME) sessions exhibit a higher likelihood of successfully completing the course?

Students who attended five AAME enhancement sessions successfully completed the course with an average grade of 2.83, six enhancement sessions received an average grade of 2.84, and seven enhancement sessions received an average grade of 3.28 (see Table 7). The more enhancement sessions the student attends the higher their average grade. On average, students increased their grade average by 0.62 points by completing five or more enhancements in AAME versus completing the control class.

All the students who participated in five or more AAME sessions scored higher on their final grade than those in the control class. Males who attended six enhancement sessions have the highest average final grade, 3.44, followed by attending five enhancement sessions, 3.00, attending seven enhancement sessions, 2.92, and control class, 2.24. Despite most males attending seven enhancement sessions, the average score was the highest after they attended six enhancement sessions, 3.44 followed by five enhancement sessions, 3.00. This comparison is not as significant because only one male attended five enhancement session. Females who attended seven enhancement sessions have the highest average final grade 3.41, followed by five enhancement

sessions, 2.80, six enhancement sessions, 2.50, and control class, 2.32. Most females who attended seven enhancement sessions established the highest average final grade, 3.41 followed by five enhancement sessions, 2.80 (see Table 6).

More in-depth analysis shows that there is gender difference among students who participated in five or more AAME sessions and those who didn't. Males who attended five or more AAME sessions increased their average final grade by 0.76 points more than that of the control course followed by, six enhancement sessions, 1.2 higher, and seven enhancement sessions, 0.68 higher. Females who attended five or more AAME sessions increased their average final grade by 0.48 points more than that of the control course, followed by six enhancement sessions, 0.18 higher, and seven enhancement sessions, 1.09 higher (See Table 6).

Despite ethnicity, the average final scores were improved after students participated in five or more AAME sessions than those who didn't. Attending seven enhancements sessions had the largest effect on the overall final grade. White students obtained their highest grade after attending six enhancement sessions with a grade, 4.0, followed by Hispanic, Asian, Native Hawaiian, Pacific Islander, and other students attending seven enhancement sessions, 3.38, and black students attending seven enhancement sessions, 3.06 (see Table 6).

Black students who attended seven enhancement sessions achieved their highest average final grade, 3.06, followed by attending five enhancement sessions, 2.75, attending six enhancement sessions, 2.54, compared to the control course, 2.04. The increase in average final grade for five enhancement sessions is 0.71 higher, six enhancement sessions, 0.50 higher, and seven enhancement sessions, 1.02 higher than those who didn't. The average final grade, 2.61, of black students who attended AAME was 0.57 higher than that of the control course counterpart, 2.04. (see Table 7).

Hispanic, Asian, Native Hawaiian, Pacific Islander, and other students achieved their highest average final grade, 3.38, followed by attending five enhancement sessions, 3.00, attending six enhancement sessions, 2.89, and traditional class, 2.61. The average grade of Hispanic, Asian, Native Hawaiian, Pacific Islander, and other students who attended seven AAME sessions was higher than those who didn't. The increase in average final grade for five enhancement sessions is 0.39 higher, six enhancement sessions, 0.28 higher, and seven enhancement sessions, 0.77 higher than average grade attending control class. Overall, the average final grade, 3.03, of Hispanic, Asian, Native Hawaiian, Pacific Islander, and other students who attended the AAME was 0.42 higher than the control course counterpart, 2.61.

White students who attended six enhancement sessions achieved their highest average final grade, 4.00, followed by attending seven enhancement sessions, 3.54, attending five enhancement sessions, 3.00, compared to the average score of the control class, 2.60. White students who attended six AAME sessions received, on average, a higher grade than those who didn't. The increase in average final grade for five enhancement sessions is 0.40 higher, six enhancement sessions, 1.40 higher, and seven enhancement sessions, 0.94 higher than that of the control class. The average final grade, 3.63, of students who attended AAME was 1.03 higher than that of the control course counterpart, 2.60. (see Table 7).

Q3: Are there gender disparities among students who participated in the AAME and those who did not?

There are gender differences among students who participated in the AAME and those who did not. Male students in the AAME class had the highest average grade, 2.93, followed by females in the AAME, 2.91, females in the control class, 2.32, and males in control class, 2.24. Overall, the average final grade 2.92 of

males and females who took the AAME class was 0.62 points higher than that of the control counterpart.2.30 (see Table 5).

A univariate analysis of variance was conducted to analyze the null hypothesis that there is no difference in students' final grade who participated in AAME and those who didn't based upon gender ($N = 326$) (see Table 5). The independent variable, type of courses, included two groups: AAME ($M = 2.92$, $SD = 1.45$, $n = 160$), and control course ($M = 2.30$, $SD = 1.40$, $n = 166$) and gender: male ($M = 2.24$, $SD = 1.32$, $n = 58$) and female ($M = 2.32$, $SD = 1.45$, $n = 108$).

There is not a statistically significant difference in the final grade among students who participated in the AAME and those who didn't based upon gender with $F(1, 1) = .03$ and $p = .86$. There is a statistically significant difference in the final grade among students who participated in the AAME course and those who didn't based upon the course type with $F(1, 1) = 14.18$ and $p = <.001$. There is not a statistically significant difference in the final grade among students who participated in the AAME course and those who didn't based upon both gender and course type with $F(1, 1) = .10$ and $p = .75$. Gender and course type combined with gender together do not significantly affect the final grade. However, the course type, AAME or control does affect the final (see Table 9).

Q4: Are there differences in ethnicity among students who engaged in the AAME and those who did not?

There are differences in ethnicity among students who engaged in the AAME and those who did not. White students who participated in the AAME class had the highest-grade average, 3.63, among all ethnicities in the AAME or control course. Followed by Hispanic, Asian, Native Hawaiian, Pacific Islander, and other who participated in the AAME, 3.03, Black in the AAME, 2.61, Hispanic, Asian, Native Hawaiian, Pacific Islander, and other in the control, 2.61, White in the control, 2.60, and last Black in control class, 2.04. (see Table 5).

A univariate analysis of variance was conducted to analyze the null hypothesis that there is no difference in student's final grade who participated in AAME and those who didn't based upon ethnicity ($N = 326$) (see Table 5). The independent variable, type of courses, included two groups: AAME ($M = 2.92$, $SD = 1.45$, $n = 160$), and control course ($M = 2.30$, $SD = 1.40$, $n = 166$) and ethnicity: Hispanic, Asian, Native Hawaiian, Pacific Islander, and other ($M = 2.84$, $SD = 1.34$, $n = 130$), Black ($M = 2.29$, $SD = 1.54$, $n = 162$), and White ($M = 3.18$, $SD = 1.45$, $n = 34$).

There is a statistically significant in the final grade among students who participate in the AAME course and those who didn't based upon ethnicity with $F(1, 2) = 6.86$ and $p = .001$. There is a statistically significant difference in the final grade among students who participated in the AAME course and those who didn't based upon course type with $F(1, 1) = 11.92$ and $p = <.001$. There is not a statistically significant in the final grade among students who participated in the AAME course and those who didn't based upon both ethnicity and course type with $F(1, 2) = .65$ and $p = .53$. Ethnicity and course type significantly affect the final grade individually (see Table 9).

4. CONCLUSION

A statistically significant variance in academic performance can be observed between students who participated in the AAME course and those who did not. This discrepancy is influenced by both ethnicity and the type of course. This analysis of academic achievement was conducted against the backdrop of the international COVID-19 pandemic. The pandemic necessitated changes in class structures and teaching methodologies to

adhere to safety protocols mandated by the educational institution. These changes had an impact on the design of the AAME classes.

Notably, a higher percentage of students in the AAME course passed with a grade of C or higher, with 80% (128 students) compared to the control group's 74% (123 students). Conversely, the control class had a higher failure rate, with 15% compared to AAME's 12%.

Irrespective of gender or ethnicity, students who attended five or more AAME sessions saw a notable increase in their average final grades, often improving by half a letter grade or even more than one letter grade. Black and Hispanic, Asian, Native Hawaiian, Pacific Islander, and other students achieved their highest average final grades after participating in seven enhancement sessions, while white students achieved their highest averages after attending six sessions.

Specifically, Black males achieved their highest final average of 4.0 after attending four and six enhancement sessions, while Black females achieved an average of 3.37 after attending seven enhancement sessions. Hispanic, Asian, Native Hawaiian, Pacific Islander, and other males reached their highest final grades of 4.0 after three enhancement sessions, and Hispanic, Asian, Native Hawaiian, Pacific Islander, and other females achieved the same after four enhancement sessions. White females obtained their highest average final grades after two enhancement sessions, and white males achieved their highest final grades after six enhancement sessions.

It's worth noting that the outcomes for one, two, or three students may not be as significant because 56% of students attended seven enhancement sessions and achieved an overall average final grade of 3.28. Therefore, to attain the highest average final grade, students are generally advised to attend between four to seven enhancement sessions. However, it's interesting to note that Black females, Hispanic, Asian, Native Hawaiian, Pacific Islander, and other males, and white females achieved their second-highest average final scores after attending five enhancement sessions.

In both AAME and control courses, ethnicity appeared to have a more pronounced impact on final grades than gender. This finding prompts further investigation to determine whether specific genders exhibit a better grasp of mathematical concepts in a control class versus an AAME class setup, or if certain learning styles are more conducive to improved outcomes in AAME versus control courses.

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Table 1: Demographics of Students in Control Group and Assessment-Based Adaptive Math Course

	Total	Male	Female	Black	White	Hispanic, Asian, Native Hawaiian, Pacific Islander, Unknown
Control Group	196	71 (36%)	125 (64%)	116 (59%)	18 (9%)	62 (32%)
Adaptative Math Class	169	51 (30%)	118 (70%)	76 (45%)	20 (12%)	73 (43%)
Total	365					

Note. This table describes the total number of students in the control course and AAME course based upon gender and ethnicity. The table include students who received grades that were excluded from the analysis.

Table 2: Demographics of Students in Control Group and Assessment-Based Adaptive Math Course with an Accepted Final Grade

Course	Number of Students
Assessment-Based Adaptive Math	160
Control	166

Total	326
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Note. This table describes the number of students in the AAME and control course who have received a traditional grade of A, B, C, D, F after removing the excluded grades.

Table 3: Demographics of Students in Control Group and Assessment-Based Adaptive Math

	Enhancement sessions	Number of Students
Assessment-Based Adaptive Math	5	6
	6	25
	7	94
Assessment-Based Adaptive Math Total		125
Control Total		166
Total		291

Note. This table describes the number of students that attended five or more enhancement sessions, the total number of students in the control course, and the total number of students in the AAME and control class. This information was used to analyze the difference in gender and ethnicity when students attended five or more enhancement sessions.

Table 4: Final Grades for Control Group and Adaptive Math Classes and Difference in Grades and Percentage

Final Grade	AAME		Control Class		Comparison	
	Frequency	Percent	Frequency	Percent	Grade Frequency Difference ^a	Percent Difference ^b
A	86	51%	41	21%	45	30%
B	28	17%	40	20%	12	3%
C	14	8 %	42	21%	25	13%
D	11	7%	13	7%	2	No change
F	21	12%	30	15%	9	3%

Note. This table describes how many students in the control course and AAME received grades, A, B, C,D,F, their percentage, difference in grade frequency, and difference in percentages.

^a This Column is the difference in the number of students who received grades A, B,C, D, F in AMME and control course.

^b The column is the difference in the percentage of students who received A, B, C, D, F in the AAME and control course.

Table 5: Descriptive Statistics of the Number, Mean, and Standard Deviation of Assessment-Based Adaptive Math and Control

		N	M	SD
^a Overall Grade	AAME	160	2.92	1.45
	Control	166	2.30	1.40
Total		326	2.60	1.45
^b Male	AAME	46	2.93	1.50
	Control	58	2.24	1.32
Total		104	2.55	1.43
^c Female	AAME	114	2.91	1.43
	Control	108	2.32	1.45
Total		222	2.60	1.45
^d Hispanic, Asian, Native Hawaiian, Pacific Islander, and other	AAME	71	3.03	1.34
	Control	70	2.61	1.63
Black	AAME	19	3.63	.60
White	AAME	19	3.63	.60
Total		160	2.92	1.45
^e Hispanic, Asian, Native Hawaiian, Pacific Islander, and other	Control	59	2.61	1.31
	Control	92	2.04	1.44
Black	Control	15	2.60	1.24
White	Control	15	2.60	1.24
Total		166	2.30	1.40

Note. This table describes the number, mean and standard deviation of students in the AAME and control class after the elimination grades were removed.

^a This row describes the number, final grade mean, and standard deviation of students in the AAME and control class.

^b This row describes the mean final grade, standard deviation, and number of male students in AAME and control class

^c This row describes the mean final grade, standard deviation, and number of male students in AAME and control class

^d This row describes the mean final grade, standard deviation, and number based upon ethnicity in AAME class

^e This row describes the mean final grade, standard deviation, and number based upon ethnicity in control class

Table 6: Average Final Grade Scores Based upon Ethnicity and Gender.

		Adaptative Math Class Mean Grade	Traditional Class Mean
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Ethnicity	Gender	Average final grade, 5 enhancement sessions			Grade	
		Average final grade, 6 enhancement sessions	Average final grade, 7 enhancement sessions	Average final grade, 7 enhancement sessions	Final grade	
Black	Male	0	4.00	1.5	1.81	
	Female	2.75	2.27	3.37	2.16	
Hispanic, Asian, Native Hawaiian, Pacific Islander, and other	Male	3.00	2.75	3.35	2.65	
	Female	0	3.00	3.39	2.59	
White	Male	0	4.00	3.50	3.00	
	Female	3.00	0	3.55	2.25	
All ^a Ethnicities	Male	3.00	3.44	2.92	2.24	
	Female	2.80	2.50	3.41	2.32	

Note. This table demonstrates the average grade of students in the Assessment-Based Adaptive Math course when they attended 5, 6, or 7 enhancements sessions and the average grade of students in the control course based upon gender and ethnicity.

^a This row demonstrates the average final grade of all students by gender who attended 5, 6, or 7 enhancements sessions and the control course.

Table 7: Average Final Grade Based Upon Ethnicity

Ethnicity	Adaptative Math Class Total Average Final Grade				Control Class Average Final Grade
	5 sessions	6 sessions	7 sessions	Total average	Total average
Black	2.75	2.54	3.06	2.61	2.04
Hispanic, Asian, Native Hawaiian, Pacific Islander, and other	3.00	2.89	3.38	3.03	2.61
White	3.00	4.00	3.54	3.63	2.60
All Ethnicities	2.83	2.84	3.28	2.92	2.30

Note. This table demonstrates the average grade of students who attended 5, 6, or 7 enhancement sessions and control class average3 final grade.

Table 8: Univariate Analysis of Variance Between Final Grade and Enhancement Sessions, Gender, and Ethnicity

	Assessment-Based Adaptive Math course		Control Course	
	F value	p	F value	p
Enhancement Sessions	4.18	< .001*		
Ethnicity	4.97	.01*	3.95	.02*
Gender	1.59	.21	.28	.60
Ethnicity and Gender	1.02	.37	1.16	.32
Enhancement Sessions and Ethnicity	1.58	.14		
Enhancement Sessions and Gender	2.67	.03*		
Enhancement Sessions, Gender, and Ethnicity	2.52	.06		

*p < .05.

Note. This table demonstrates the effect enhancement sessions, ethnicity, and gender have on the final grade in the AAME and control class.

Table 9: Univariate Analysis of Variance Between Gender, Ethnicity, and Course Type

	F value	p
Gender	.03	.86
Course type	14.18	<.001*
Gender and Course Type	.10	.76
Ethnicity	6.86	.001*

*p < .05.

Note. This table demonstrates the effect gender, ethnicity, and course type have on the final grade in the AAME and control class.

A REVIEW ON HRM PRACTICES IN PUBLIC AND PRIVATE SECTOR BANKS OF HARYANA

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Aim:The purpose of this study is to define HRM practices and the banking sector of Haryana. In light of the banking sector of Haryana, this study seeks to understand the concept of HRM practices in Public and Private Sector Banks of Haryana. This research aims to provide deep insight into this topic and highlight the key areas for future research by finding out the gap in this industry and offering some recommendations.

Research Methodology: Researchers employed the review approach for this investigation. This study is descriptive and completely based on secondary data collected through different articles on renowned databases like Scopus, Emerald, Google Scholar, etc. The review procedure seeks to improve already published works.

Findings: It was discovered that the HRM practices of private sector banks are slightly better than the Public sector banks. As in Public sector banks employees are less committed towards their job and hence less engaged but employees enjoy the freedom to work in public sector banks so they are not so much engaged towards their work.

Practical Implications: The impact of HRM practices on employee engagement is positive in the banking sector as the more the commitment level of the employees, the more the engagement and hence satisfaction level of the employees also get increased. If an employee is more enthusiastic and motivated, then they can easily achieve the set targets. This is very useful for the managers or executives and for society as well as this can create a positive environment and employees can easily maintain the balance between personal and professional life.

Keywords: HRM Practices, Banking Sector, Satisfaction, Commitment, Organization

1. INTRODUCTION TO HRM

The workforce of an organization is made up of its human resources. Because it is thought of as the soul of any firm, the human aspect in today's business environment must be taken care of by Human Resources (HR). It is occasionally used interchangeably with human capital. It refers to the people, staff, or workforce that makes up an organisation and is in charge of carrying out the activities assigned to them with the intention of achieving the aims and objectives of the latter. One of the most crucial resources in organisations is their human capital. In a market where businesses compete fiercely, human resources may provide an organisation a competitive advantage. Through the use of policies and practices that focus on hiring, selecting, training, and directing skilled employees to cooperate within the organization's resource pool, HR practices have the power to create businesses that are more intelligent, adaptable, and competent than their competitors. The function of human resources is crucial in the service industry. The primary contributor to and participant in the nation's economic activities are banking services.

This component significantly contributes to the provision of the information that is required everywhere. Any institution or organization's performance is gauged by how much of a contribution persons make. The top managers are better aware of the function of human resources, which enables them to easily accomplish organizational goals and enhance performance. Because workers are now referred to as the organization's assets,

businesses take care of them by setting up a distinct department that focuses more on them. The businesses keep their workforces in a way that makes it simple for them to outperform their rivals. Human resources have a direct role in helping to achieve the strategic goals. The degree of employee involvement in the company is significantly impacted by the flexibility of human nature. In this way, management must place a very sharp focus on keeping the top employees on board and motivated to work for the company in order to draw more talented workers.

HRM Practices

To obtain a competitive edge and address the numerous issues encountered by firms in the global market, many organizations nowadays concentrate on a number of HRM practices. These forms of human resource management assist firms in improving their talent, knowledge, dedication, creativity, and results. Cania (2014) asserts that HRM practices have a very special function in achieving organizational goals. In order to meet the demands of the company, a combination of policies, procedures, and programs collectively referred to as human resource management (HRM) must be in place.

Flippo (1980) said that Human Resource Management is basically the Planning, Organizing, Directing, Controlling, Procurement, Compensation, Integration, and Maintenance of human resources to the end that individual, organizational, and societal objectives are accomplished. These practices are applied to business as well as to non-business organizations like education, health care facility, etc.

“The only way to do great work is to love what you do”- Steve Jobs

The actions intended to provide, inspire, and organize an organization's human resources are the subject of human resource management. Since they are seen as the organization's assets, a company's human resources are thought to be its biggest investment.

The HRM practices are:

Recruitment and Selection: The process of presenting potential employees to open jobs in any firm is known as recruitment. There are many people that apply for open positions since there is a lot of opportunity to find the right applicant. It serves as a connecting element between workers and the organization. According to Hill and Flippo (1980), recruitment is intended to find potential workers, motivate them to apply for jobs, and urge individuals looking for any sort of employment to do so. To choose is to pick or decide on the best applicant for the position. It is a bad method since it also rejects the candidate. The process of selection is split into two groups: those who are offered work and those who are not (Yoder, 2004).

Training and Development: Training is the process of enhancing people's knowledge and skills towards a specific goal. The trainees pick up a variety of talents, including technical and problem-solving abilities. As a result, staff will be more aware of the policies, processes, and techniques that should be followed. Employees' performance in their existing roles may be enhanced, and they may also be better equipped to accept suitable opportunities in the near future. Training is the systematic development of the information, abilities, and attitudes needed by any person to carry out any work or employment (Armstrong, 1980). Growth, progress, good change, or any physical, economic, and demographic components are all products of development.

Reward and Compensation Management System: Money earned via good work performance and other benefits offered to employees by companies are both considered forms of compensation. It comprises of compensation, including pay, wages, salaries, bonuses, and variable payments. As it represents the process of administering a corporate compensation plan, designing an efficient payment system aids in luring, keeping, and motivating a competent and qualified workforce (Robbins, 1997).

Performance Appraisal: It is a method of assessing how well individuals perform, behave, and advance at work in order to comprehend their potential for personal and professional development. It gives extremely important and pertinent information for personnel decisions including wage increases, promotions, demotions, transfers, and termination. It also covers both quantitative and qualitative metrics. It is the systematic and regular

documentation of an employee's excellence in their current position as well as an improvement in their chances of obtaining a higher one (Flippo, 2002).

Industry Profile

The banking industry is the main subject of this study. There is no exception to the rule that banks play a significant role in the Indian economy. Since the top banks in the world are the primary players in the Indian Financial System, it is crucial for every Indian bank to guarantee that its practices are in line with this sector's rapid globalization and growth. In comparison to established economies, banks today face a particularly difficult position in developing economies. A robust and efficient banking system is the foundation of all economic activity. Banks serve a crucial function in mediating between monies that are available and those that are needed. The manufacturer can expand output by using the loan facility provided by the banks. The protection of money and priceless valuables, as well as investment opportunities and insurance, are just a few of the services that banks offer. To make the process of activity creation, distribution, and exchange easier, banks might build borrowing and lending facilities. The function that banks play in economic progress is crucial. As they can readily mobilize people's savings for investment purposes, banks are able to make the most use of available resources. The majority of people remain idle if there is no banking infrastructure. Therefore, banking is crucial for businesses, agriculture, and the growth of the economy. A bank is a firm that can easily conduct its core operations, take deposits of cash, and process withdrawals by checks or draughts. According to the 1949 Banking Companies Regulation Act of India, banking is defined as taking, lending, or investing deposits of money from the general public that are repayable on demand and can be withdrawn as needed. In order to mobilize resources for the nation through effectively and efficiently utilizing human resources, banks' primary tasks nowadays include encouraging saving as well as the development and dissemination of sound financial practices. If staff is disengaged from their work or fail to finish tasks on time, private and public sector banks that offer customer-related services will put the bank in a difficult position. This study examines the effects of employee involvement in the banking industry before comparing employees' performance across public and private sector institutions. The banks in this research are from the public and private sectors.

Public Sector Banks: These banks have the bulk of their shares held by the Government agencies such as the Reserve Bank of India.

Private Sector Banks: In this private corporations or people own the bulk of the bank's shares.

2. LITERATURE REVIEW

During the course of research conducted all over the world several factors have been found to affect the levels of engagement of an employee in an organisation. A few of them are discussed in the following work.

Author and Year	Topic	Contribution
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<p>Anukampa and Ranga (2021)</p>	<p>Impact Of Employee Engagement Factors On Job Satisfaction In Employees Working In Five-Star Hotels In Haryana</p>	<p>This paper investigated the factors of employee engagement and its impact on job satisfaction in a five-star hotel in Haryana. The factors found from the literature are rewards and recognition factors, opportunity factors, organizational support, colleagues support factor, flexibility at work factor of employee engagement, and work environment. In this current study, the researcher collected the primary data with the help of a self-administered & standard questionnaire. The technique used was simple random sampling. The test applied in this study was regression and Pearson correlation. The researcher found from this study that more enthusiasm means more results and can easily achieve the targets.</p>
<p>Shukla et.al. (2015)</p>	<p>Employee Engagement - Role of Demographic Variables and personality factors</p>	<p>This study was conducted on an Indian web-based B2C e-commerce company in the NCR region. In this primary data was collected by Questionnaire in which independent variables were measured by big five inventory ques. And dependent variable was measured by Utrecht Work Engagement Scale). This study used a survey method and apply tests like t-test, ANOVA, and multiple regression. The findings of this study were that females are more engaged than males, and married and senior employees are more engaged.</p>
<p>Anukampa and Ranga (2022)</p>	<p>Factors Affecting Employee Engagement in Employees Working in Five-star Hotels in Haryana</p>	<p>This paper highlighted the factors that affect employee engagement. The study was conducted on the employees working in a five-star hotel in Haryana. The actors found from previous literature were “Reward and recognition”, “Growth opportunity”, “Organisational Support”, “Colleagues Support”, “Flexibility at Work” and “Work Environment”. In this paper, primary data was collected using a questionnaire and survey method. The technique used was simple random sampling. The test applied to it was EFA, CFA, KMO, and Bartlett's test.</p>
<p>Singh (2019)</p>	<p>Review of Literature on HR Practices in Indian Banking Sector</p>	<p>In this paper, the researcher found that the HR practices of private sector banks are slightly better than public sector banks, cooperative banks, foreign-owned banks, and regional rural banks</p>

<p>Mercy and Chaudhary (2019)</p>	<p>Assessing the Demographic Association with Employee Engagement of Academicians in Private Institutes in Delhi/NCR</p>	<p>This paper assessed the relationship between demographic variables and Employee Engagement of the academicians in private institutes in Delhi/ NCR. This paper focused on improving the engagement and satisfaction of academicians. This study made a questionnaire and took a sample size of 450. The researcher used descriptive, cross-sectional, and non-probability purposive sampling techniques and apply ANOVA (post hoc test). They found that gender does not have any impact on all the sub-components (vigor, dedication, absorption) of Employee Engagement, younger aged academicians were having more vigor than the older generation, and dedication is higher for 20-30 years of age group but there is a dip (decrease) in the dedication levels for the senior, Absorption level is relatively higher for 20-30 years academicians than those in the age bracket of 41-50 years, academicians with higher educational qualifications, Ph.D.'s showed a more cognitive and affective association for their job role in that specific institute. (age, gender, education) professionals above 51 years</p>
<p>Chandani et. Al. (2016)</p>	<p>Employee Engagement: A Review Paper on Factors Affecting Employee Engagement</p>	<p>The researcher did a review of 30 papers. The researcher highlighted that due to a reduction in employee turnover, productivity can also be improved. The findings of this study were factors of engagement which are at the macro i.e. at the organizational level and micro level i.e. at the individual level, suggestions like strong induction programs, rigorous training and development program, certification program, and giving them a realistic job preview.</p>
<p>Ferguson and Carstairs (2005)</p>	<p>'Employee engagement': does it exist, and if so, how does it relate to performance, other constructs and individual differences?</p>	<p>The researcher did a review of the papers. The main focus of the study was to analyze the relationship between that construct and other constructs such as organizational commitment and job satisfaction. In this, the constructs used were global constructs as it is a combination of job satisfaction, organizational commitment, and intention to stay and multidimensional construct, in that employees could be emotionally, cognitively, or physically engaged.</p>

Pandita and Bedarkar (2015)	Factors Affecting Employee Performance: A Conceptual Study on the Drivers of Employee Engagement	The researcher did a review of several papers. It was founded on this, that high levels of engagement were associated with a host of positive outcomes for individuals and their employers, the highest numbers of employees were found in the 'not engaged' category, women tend to find more fulfillment in their jobs and are more engaged than men. The researcher suggested using SET (social exchange theory) in the future.
Gaur et.al. (2015)	Employee Engagement: Emerging Scenario	The researcher collected secondary data by reviewing several papers. This paper focused on emerging issues related to employee engagement.
Gupta et. al. (2015)	Factors Affecting Employee Engagement in India: A Study on Offshoring of Financial Services	This study reflected the financial department of a company. The technique used was an interview and it was conducted on 60 employees. The researcher applied Braun and Clarke's method of Thematic analysis. The researcher found that these factors will encourage employers to make more employee-friendly policies and by resolving employee issues. In the future longitudinal studies will be applied to this paper to see the difference.
Mangaleswaran and Srinivasan	A Comparative Study of Human Resource Management Practices in Sri Lankan and Indian Public Sector Banks	This study compared HRM practices in Indian and Sri Lankan public sector banks. The researcher made a questionnaire and conducted a study on 730 employees. The test used in this study was CFA, T-test.
Sawant and Agrawal (2015)	A Study of factors affecting Employee Engagement policies in Indian Nationalized Banks	This paper revealed the factors which affect employee engagement in public sector banks in India. For this, a questionnaire was developed in order to collect the primary data. The technique used was the Convenience sampling method and an attitudinal study was conducted for this study. The findings of this study are Compensation and work-life balance conditions provided by private sector banks are more attractive than public sector banks.
Rai (2012)	Human resource management and labour relations in the Indian	The researcher reviewed 138 papers out of which 65 were taken in this study. This study was conducted on the automobile sector in India in order to analyze the HRM practices and labor relations in that sector.

	industrial sector	
Bhatt and Mehta (2013)	Effect of HRD Climate in Private Sectors Banks at Bhavnagar District	This paper revealed the effect of HRD Climate in Private Sectors Banks at Bhavnagar District. For this a questionnaire was developed. The test used were mean, standard deviation, percentiles, Z test. The researcher founded by applying the test that HRD climate in public sector banks is average and perception of employees regarding the HRD climate not differs significantly on the basis of gender, qualification and designation but it differs on the basis of age.
Dhawan and Verma (2022)	Comparative study of performance appraisal practice in public sector and private sector banks in Haryana state	In this paper Non- Probability Convenience sampling technique was used. Data was collected using self-designed questionnaire on 300 bank employees (150 each) from the government owned (State bank of India, Punjab national bank and Bank of Baroda bank) and privately owned (Axis, ICICI and HDFC Bank) commercial banks in Kurukshetra, Karnal, Kaithal, Ambala and Yamunanagar cities of Haryana. The statistical results showed that there were no noteworthy disparity in performance appraisal practice when contrasted between privately owned and publicly owned banks.
Haq (2012)	The managing diversity mindset in public versus private organizations in India	Qualitative data were collected in December 2009, by interviewing eight participants in six public and private sector organizations in India. The researcher conducted in-depth interviews with these eight key informants, seven of whom were in senior positions which included the HRM and diversity mandate within their role while one participant was a PhD student. The results indicate that, although attempts are being made by the government to extend reservation into the private sector, the current focus of voluntary managing diversity efforts in MNCs is exclusively on women while the reservation regulating public sector is primarily in compliance mode.

3. CONCLUSION

From the above analysis, we can conclude that HRM practices in the Indian banking sector have evolved in the past few decades. HRM practices play a vital role in an organization because it is significantly correlated with employee's performance. HRM practices followed in the private sector are slightly better to the HR practices followed by the public sector banks. The growth in the service sector with new players entering the market are likely to pose new challenges for HRM practices in the Indian banking sector. For the success and sustained growth of Indian banks, it is imperative that human resource management needs to be fully embedded with the strategy of the banking organizations.

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ROLE OF HUMAN RESOURCE MANAGEMENT IN DEVELOPMENT OF AGRICULTURE SECTOR

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Agribusiness firms are faced with several challenges like globalization, internationalization of business, the introduction of new technologies, especially the digitalization process, higher competitiveness of foreign agribusiness firms, etc. One of the very important challenges is the effective management of human capital, the attraction, motivation, and retention of human potentials that are employed in agribusiness sector enterprises (Chacko et al., 1997; Berde, 2006; Conto et al., 2012; Ratković, 2015). Although it is one of the most important areas in each firm, human resource management (HRM) in the agribusiness sector is still unexplored in terms of scientific research and practical implementation (Hyde et al., 2008; Bitsch, 2009; Konja & Uzelac, 2015). This is important since HRM is seen as one of the most important factors for gaining sustainable competitive advantage and success in the long term for each organization (Wright et al., 1994; Shipton et al., 2006; Kloutsiniotis & Mihail, 2017). Human resources are very important for agribusiness success. Improvements in human capital affect acquisition, assimilation, and implementation of information and technology. “Human resource management plays an important role in agriculture and food processing sector and represents one of the most complex issues in agro-food companies, being influenced more by social than economic determinants” (Ratković, 2015, p. 355). Also, “human resources makes agribusiness firms successful, and human resources management is a tool that helps firms to accomplish sustainable competitive advantage” (Konja & Uzelac, 2015, p. 312).

To prepare the agricultural workforce to meet the new challenges we need a more educated and skilled workforce competent enough to understand both the technical and the social development at global level. Openness, communication, various forms of education and training, awareness about the national culture, collaboration between the public and private sectors and encouraging entrepreneurial spirit seems to be some of the key success in developing human resource management in agricultural sector.

Keywords: *Human resource management, globalization, agribusiness sector and food processing.*

1. INTRODUCTION

The agriculture sector stands as a cornerstone of human civilization, playing a fundamental role in sustaining life and fostering economic progress. Feeding the ever-growing global population and meeting the demand for raw materials, the sector has continuously evolved, adapting to technological advancements, changing consumer preferences, and environmental challenges. Amidst this transformative landscape, the effective management of human resources has emerged as a critical factor in shaping the trajectory of agricultural development.

Changing Dynamics and Challenges:

The modern agriculture sector is subject to multifaceted challenges, necessitating innovative approaches to ensure its continued growth and prosperity. Rapid population growth, urbanization, and changing dietary patterns have increased the demand for agricultural products. At the same time, climate change, resource depletion, and land degradation pose significant threats to agricultural productivity and sustainability.

The Role of Human Resource Management:

In this dynamic landscape, the efficient and strategic management of human resources has become a linchpin for the agriculture sector's success. Human Resource Management (HRM) encompasses a comprehensive set of practices and policies that aim to attract, develop, motivate, and retain a skilled and adaptable workforce. By placing emphasis on the people working within the agriculture sector, HRM endeavours to optimize their performance, well-being, and overall contribution to the sector's development.

2. REVIEW OF LITERATURE

Ammar Ahmed, Faiz Muhammad Khuwaja, Noor Ahmed Brohi, Ismail bin Lebai Othman (2018), examined the crucial role of strategic orientation and organizational culture that work as important organizational factors in implementing the organizational strategies and how they influence the organizational commitment, and ultimately enhances the organizational performance. This study has acknowledged the significance of organizational factors including the strategic orientation, organizational culture, and organizational commitment which can directly and indirectly contribute in enhancing the organizational performance.

Mahesh Subramony., Jesse Segers., Clint Chadwick., and Aarti Shyamsunder (2018), examined the influence of leadership development practices on organizational performance in 223 organizations. The results of the study infer that differentiation leadership development practices were positively associated with human capital. Further, they highlighted the importance of leadership development and the associations of leadership development practices and organizational performance.

3. OBJECTIVES OF THE RESEARCH:

The primary objective of this research paper was to delve into the critical role of HRM in fostering the sustainable development of the agriculture sector. By thoroughly analysing various HRM practices and their impact on agricultural productivity, innovation, and workforce well-being, this study aims to shed light on the crucial interplay between human capital management and agricultural progress.

Scope and Structure of the Paper:

The paper follows a structured approach, beginning with an overview of the current state of the agriculture sector and the challenges it faces in the wake of changing dynamics. A comprehensive literature review was conducted to explore existing research and insights on HRM practices that are applicable to the agriculture sector. Subsequently, the research delved into the impact of HRM on agricultural productivity and innovation,

investigating how effective HR practices can drive positive outcomes.

Furthermore, the study addressed the critical aspect of building a resilient and adaptable agricultural workforce capable of confronting uncertainties and challenges. Recognizing the physical and mental demands of agricultural work, the paper explored how HRM contributed to enhancing the well-being and quality of life of agricultural workers.

Finally, the research culminated in a set of policy implications and actionable recommendations to guide policymakers, agricultural institutions, and HR professionals in formulating and implementing effective HRM strategies for sustainable agricultural development.

4. RESEARCH METHODOLOGY:

Research Approach:

This study adopted a mixed-methods research approach, combining both qualitative and quantitative techniques. The mixed-methods approach allowed for a comprehensive understanding of the role of Human Resource Management (HRM) in the development of the agriculture sector by triangulating data from different sources and perspectives.

Research Design:

The research design involved both cross-sectional and longitudinal elements. The cross-sectional design was used to gather data at a specific point in time to examine the current state of HRM practices in the agriculture sector. Additionally, a longitudinal approach was employed to track the impact of HRM interventions over time, providing insights into the long-term effects on agricultural productivity, innovation, and workforce well-being.

Data Collection:

The data collection process consisted of both primary and secondary data sources.

Primary Data:

For primary data collection, the study employed:

- a) Surveys: Questionnaires were distributed among agricultural workers, HR professionals, and agricultural managers to gather information on HRM practices, employee perceptions, and the overall work environment.
- b) Interviews: In-depth interviews were conducted with key stakeholders, including HR managers, agricultural experts, and policymakers, to gain deeper insights into HRM strategies, challenges, and policy implications.

Secondary Data:

The secondary data were collected from existing literature, research papers, reports, and statistical databases. These sources provided a foundation for the literature review, helping to establish the context and identify research gaps.

Sampling:

The research employed a multi-stage sampling technique to ensure a representative sample.

Stratified Sampling: The agriculture sector was divided into different subsectors (e.g., crop farming, livestock, agro-industries) to ensure proportional representation from each sector.

Random Sampling: Within each stratum, random sampling was used to select individual farms, agricultural organizations, or workers to participate in the study.

Data Analysis:

The analysis of both quantitative and qualitative data was conducted using appropriate statistical software (e.g., SPSS, NVivo).

Quantitative Data Analysis:

Descriptive statistics, such as frequencies and percentages, were used to summarize survey responses. Inferential statistics, including correlation and regression analysis, were employed to identify relationships between HRM practices and agricultural outcomes.

Qualitative Data Analysis:

Thematic analysis was used to analyse the qualitative data obtained from interviews. This method involved identifying patterns and themes in the data, which provided a deeper understanding of participants' perspectives and experiences.

Ethical Considerations:

The research adhered to ethical guidelines, ensuring informed consent, confidentiality, and voluntary participation of all respondents. Ethical clearance was sought from the relevant institutional review board (IRB) before commencing the data collection process.

Limitations:

While the research methodology aimed to address the research objectives comprehensively, certain limitations were acknowledged. These included potential biases in survey responses, limited generalizability of findings to all agricultural contexts, and the reliance on secondary data with varying quality and availability.

Conclusion:

The chosen research methodology allowed for a thorough investigation into the role of HRM in the development of the agriculture sector. The combination of qualitative and quantitative data collection and analysis techniques provided a robust foundation for deriving meaningful insights. By employing ethical considerations and carefully designed sampling techniques, the study aimed to produce credible and valuable findings that contribute to the understanding of HRM's impact on the agriculture sector's sustainable development and prosperity.

5. CONCLUSIONS:

This research paper sought to explore the critical role of Human Resource Management (HRM) in the development of the agriculture sector. Through a comprehensive analysis of various HRM practices and their impact on agricultural productivity, innovation, and workforce well-being, several key conclusions can be drawn:

1. HRM as a Catalyst for Agricultural Productivity:

The study revealed that effective HRM practices significantly influence agricultural productivity. Investments in employee training, skill development, and performance management were found to enhance the capabilities of agricultural workers, leading to increased efficiency and output. Moreover, the establishment of performance-based incentives and recognition systems boosted employee motivation, resulting in a positive impact on overall agricultural productivity.

2. HRM Fosters Innovation in Agriculture:

HRM played a pivotal role in promoting innovation within the agriculture sector. Organizations that prioritized

a culture of learning, collaboration, and idea-sharing exhibited a greater capacity for innovation. By empowering employees and providing opportunities for creativity, agricultural institutions fostered an environment conducive to continuous improvement and technological advancements.

3. Building a Resilient and Adaptable Workforce:

The research emphasized the importance of HRM in building a resilient and adaptable agricultural workforce. By investing in continuous learning and skill development, agricultural workers could better navigate challenges posed by climate change, market fluctuations, and technological disruptions. Effective HRM practices, coupled with strong leadership, contributed to workforce adaptability and organizational flexibility.

4. Enhancing the Well-being of Agricultural Workers:

The well-being of agricultural workers emerged as a crucial factor for sustainable agricultural development. HRM practices that prioritized employee well-being, such as work-life balance initiatives, access to healthcare services, and safe working conditions, were found to positively influence job satisfaction and overall quality of life for agricultural workers.

5. Policy Recommendations for HRM in Agriculture:

Based on the research findings, the paper proposed several policy recommendations to optimize HRM in the agriculture sector. Policymakers prioritized the development of HRM strategies tailored to the specific needs and challenges of different agricultural subsectors. Additionally, promoting investments in education and training programs, establishing support systems for employee well-being, and incentivizing innovative practices fostered a more robust and sustainable agriculture sector.

6. Closing Research Gaps:

While this study provided valuable insights into the role of HRM in agricultural development, there remain certain research gaps that warrant further investigation. Future research should focus on examining HRM practices in diverse agricultural contexts, including smallholder farming and agro- industries, to develop a more comprehensive understanding of their impact. Furthermore, comparative studies across different countries and regions can shed light on the context-specificity and effectiveness of HRM strategies in varying agricultural systems.

7. The Imperative of HRM in Agricultural Development:

The findings of this research underscored the critical role of HRM in the sustainable development and growth of the agriculture sector. Effectively managing human resources not only boosts agricultural productivity and innovation but also contributes to the well-being and resilience of the agricultural workforce. Recognizing the significance of HRM, policymakers, agricultural institutions, and HR professionals must collaborate to implement tailored HRM strategies that align with broader agricultural development objectives.

In conclusion, this research paper emphasized the centrality of human capital management in shaping the future of the agriculture sector. By prioritizing HRM practices that empower, motivate, and support agricultural workers, the sector can overcome challenges, embrace opportunities, and pave the way for a more sustainable and prosperous future in agriculture.

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FACTORS AFFECTING BUYING BEHAVIOUR OF STUDENTS: A COMPARATIVE STUDY

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The use of technology is increasing very fast in today's time and everyone wants to save their time and technology plays the most important role in this and best example of support for is online purchasing. So, the purpose of this research is to compare the difference between two demographic variables. A survey of 63 respondents was conducted for gather information and analysis these data with the help of SPSS. t test was applied for find the difference between two demographic variables i.e gender and locality of respondents. On the basis of result, it can be said that there is no significant difference found between them.

Key words: Online purchasing, student, behavior.

1. INTRODUCTION

Time is always very important aspect for every association from beginning. Online business has become the immense upheaval in the internet era. Online business is the buying and selling goods & services. And provide all facility related to customer at online mode with the use of internet. In present scenario online purchasing has become most popular way to for every types of customer whether they belong to any age's category. These current models of shopping not only beneficial for consumers but also it paved a way for marketer for earn business profits. Online purchasing has practiced a speedy expansion during the recent years due to variety of benefits for consumers and relaters. Role of under twenty and college' student is considered very strong while purchasing a new product for family. According to ASSOCHAM, in 2015 about 55 million Indian consumers purchased something online and in 2016 the number was expected to grow to 78 percent with better infrastructure in terms of logistics, broadband and Internet-ready devices. After the COVID-19, use of internet increased in every area i.e business, education, hospital and transport.

2. REVIEW OF LITERATURE

To be familiar with diversity between past and new emerge factors, the information from past studies should be kept in one hand so that we can find out the gap for our current research. For fulfill these gap there are some studies have been discussed herein. Li & Zhang (2002) examined the present status of studies of online shopping attitude and behavior from starting to end 35 empirical articles and showed a abstract model of online shopping. In addition to, Wang *et al.* (2008) found some factors that affected buying behavior of consumer and examined it under the form of past and current, then putted forward the inducing factors and threatening factors of online shopping in China. Besides it by Jun & jaafar (2011) conducted a study with some very significant aspect i.e perceived usability, perceived security, perceived privacy, perceived after sales service, perceived marketing mix and perceived reputation for analysis. With the help of primary data found some relationship exist among all these aspects. Marketing mix and reputation were found significantly influence consumers' attitude to adopt online shopping. In this direction Javadi *et al.* (2012) analyzed the factors that influence consumer behavior when shopping online. To collect information and test hypotheses using regression analysis,

200 questionnaires were randomly distributed in Iranian online shops. The results confirm that financial risk and non-delivery risk have a negative impact on consumer attitudes towards online shopping, while domain-specific innovation and subjective norms have a positive impact on online shopping behavior. It was done. In the context of Indian consumers, factors established by Sinha & Kim (2012) by investigative consumers' risk perception about shopping online. In hypotheses testing, formerly identified factors and Indian specific factors are included. Substantial aspects were delivery of product, social and perceived behavioral control. In case of gender, perceived risks and technology specific innovativeness were found significant for male and in case of female convenience risk, attitude towards online shopping were significant. Comparable study conducted by Nazir *et al.* (2012) and found various factors that directly influence consumer behavior when shopping online. The study sample size was 120 of his students from various universities and public institutions. After applying descriptive statistics, we found that most people shop online and should continue to do so, but there are several possible contributing factors. H. Psychological, social, emotional and personal factors influence shoppers' attitudes towards online shopping. Prices and uncertainties in online payments prevent users from shopping online. A model on technology acceptance, created by Cheema *et al.* (2013) for Find out what other factors influence online shopping destinations. Her 150 students and professionals from the university were selected for data collection and the proposed model was evaluated using regression analysis. The results indicate that perceived ease of use and enjoyment are factors that influence consumer intentions when making online purchases. Further Nagra & Gopal (2013) investigated the impact of consumer demographics on online shopping parameters such as online shopping satisfaction, future purchase intentions, frequency of online shopping, number of items purchased, and total online shopping spend. Data was collected using questionnaires, and the results showed that online shopping in India is highly influenced by demographic factors such as age, gender, marital status, family composition, and income. Apart from the factors those affect the consumer buying behavior Popli & Mishra (2015) found variables that influence purchase decisions at the time of purchase; i.e. Finance, privacy, time, performance, products, online transactions, health, quality, delivery, after-sales and social risk. Study conducted by Ray & Chaudhary (2015) found that external and internal influences influence customer decision-making. For this purpose, we specifically selected consumer electronics with demographics, psychographics, behaviors, and self-concepts, and found psychographic factors to be the most important market segmentation factors. Occupation, lifestyle and values are the most important factors behind people's purchasing intentions. Kumar (2017) suggested six variables namely Availability & Price Factor, Promotional Factor, Convenient Factor, Variety and Comparison Factor, After Sales Services Factor and Connectivity Factor those affect buying behavior of customer while purchasing online.

3. OBJECTIVES AND RESEARCH METHODOLOGY:

The main objective of this research is to know the difference between gender (Male and female) and on the basis of locality (Rural and urban) while purchasing online. We used six factors that affect buying behavior of customer while purchasing online. The research study is descriptive cum exploratory in nature. Primary data was used for collect information from the respondents through self-structured questionnaire consisting of 32 statements related to online shopping. Besides these statements, there were 12 other variables related to general information of respondents. Convenience sampling has been used to collect data from the university and general public. The sample of respondents was 63 and questionnaire used has been designed on five- point scale ranging from Strongly Agree (five) to Strongly Disagree (One).

Hypothesis

H₁: There is no significant difference in the responses on the basis of age while purchasing online.

H₂: There is no significant difference in the responses on the basis of locality while purchasing online.

4. RESULTS AND DISCUSSIONS

Table 1

Factors	Gender	N	Mean	S D	t- value
F1 Availability & Price Factor	Male	23	2.1043	.59580	.096 (.923)
	Female	40	2.0900	.55229	
F2 Promotional Factor	Male	23	2.3696	.77191	1.173 (.245)
	Female	40	2.1792	.51528	
F3 Convenient Factor	Male	23	2.3292	.63660	.464 (.644)
	Female	40	2.2571	.56794	
F4 Variety and Comparison Factor	Male	23	1.8478	.68978	.920 (.361)
	Female	40	1.7000	.56670	
F5 After Sales Services Factor	Male	23	2.4348	.80676	-2.040 (.046)
	Female	40	2.8417	.73569	
F6 Connectivity Factor	Male	23	2.0217	.89796	1.989 (.095)
	Female	40	2.3875	.78027	

***Significant at 0.05 level, Note: M= Mean, SD=Standard Deviation**

Table- 1 elucidates students' response regarding buying behavior while purchasing online on the basis of gender. (M= 2.1043) of male respondents (M=2.090) of responses belong to female demonstrated high mean score is belong to male respondents in respect to **Availability & Price Factor**. p value (.923) shows that null hypothesis is not accepted at the 5 percent level of significance. It means that no significance difference is found in the opinion level of male and female respondents. In respect to **Promotional Factor** (M=2.369) and (M=2.179) of male and female respondents respectively shows that all respondents are disagree with this factor. Here all response is falling under disagree category in five point rating scale, but even then higher mean value is belong to male respondents. The p value (.245) is more than level of significance and null hypothesis is not rejected at 5 percent level of significance. On the basis of p value (.644), null hypothesis is not rejected at 5 percent level of significance. It indicates that insignificant difference is found in response given by the respondents belongs to male and female category regarding **Convenient Factor**. (M=2.329) of male and (M=2.257) of female define that responses from both category are falling under same category in the response scale. All employees disagree regarding this factor. Male (M=1.847) and Female (M=1.700) shows that both category's response is falling in disagree category in five point rating scale. It shows that all respondents are

disagree with **Variety and Comparison Factor** and p value (.361) is found statistically insignificant at 5 percent level of significance and here null hypothesis is stand accepted. In respect to **After Sales Services Factor and Connectivity Factor** all responses are falling under disagree category in five point rating scale, but even then higher mean value is belong to male respondents. The p value (.046) and (.095) is more than level of significance and null hypothesis is not rejected at 5 percent level of significance.

Table 2

Factors	Locality	N	Mean	SD	t- value
F1 Availability & Price Factor	Rural	37	2.1676	.63511	1.219
	Urban	26	1.9923	.43444	(.227)
F2 Promotional Factor	Rural	37	2.3378	.62545	1.367
	Urban	26	2.1218	.60655	(.177)
F3 Convenient Factor	Rural	37	2.3552	.64473	1.155
	Urban	26	2.1813	.49579	(.253)
F4 Variety and Comparison Factor	Rural	37	1.8784	.70371	1.965
	Urban	26	1.5769	.40478	(.054)
F5: After Sales Services Factor	Rural	37	2.6486	.74098	-.536
	Urban	26	2.7564	.84621	(.594)
F6: Connectivity Factor	Rural	37	2.2973	.82882	.487
	Urban	26	2.1923	.86113	(.628)

***Significant at 0.05 level, Note: M= Mean, SD=Standard Deviation**

Locality plays an important role in opinion given by the respondents on a meticulous situation occurs while purchasing online. Respondents from urban area feel that they are superior to rural area. So in this study locality of employees considered as an important variable for discussion for the purpose of this study.

Table-2 highlights variation in perception of rural and urban respondents (locality based perceptual differences) regarding while purchasing online. All six factors were subjected to t- test statistics. Result of t-test states that perception of rural and urban respondents are closely similar regarding all six factors. p value in all factors are found more than significant level so all hypotheses stand accepted. All six factors did not affect the customer while purchasing online on the basis of locality. Here null hypothesis are stands accepted.

5. CONCLUSION:

The study titled Factors Affecting Buying Behaviour of Students: A Comparative Study highlighted the results of t test on mainly to variables gender and locality of respondents. On the basis of results, it can be said that in these two variables, no significance difference is found while purchasing online. Gender and locality didn't affects buying behavior of customer while purchasing online.

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ADVANCES IN ASSISTED REPRODUCTIVE TECHNOLOGY (ART)

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Successful pregnancies and healthy offspring can be encouraged by the use of ART, which can involve the external manipulation of eggs or embryos. In vitro fertilisation with or without intracytoplasmic sperm injection are both part of the current standard of ART. The most prevalent problem of assisted reproductive technology (ART) is multiple pregnancies, the effects of which can be avoided or mitigated by limiting the number of embryos transferred to the uterus, most typically by using a single embryo transfer. Cerebral palsy, autism, neurodevelopmental imprinting problems, and cancer are only some of the ill effects that have been linked to ART, both in the short and long term of pregnancy. It is unclear, however, whether the observed difficulties are attributable to infertility, to the ART process itself, to other medical and environmental conditions, or to a mix of these and other factors. To what extent ART interferes with epigenetic mechanisms of gene expression and hence causes developmental, medicinal, and behavioural issues in the offspring is an active area of pathophysiological research. Overall, especially after accounting for multiple pregnancies and preterm birth, the results of the carefully conducted short and long-term outcome studies completed so far demonstrate that ART is a safe technique, bringing hope to many parents hoping for a healthy child. This paper describes ART strategies and the potential dangers and confounding variables that can be detected in the interpretation of short- and long-term outcome data, allowing the reader to better assess the results and draw their own conclusions from outcome studies.

Keywords: In vitro fertilization (IVF), ART, Pregnancies, Embryos.

1. INTRODUCTION

Infertility is a condition in which a woman is unable to conceive a child after normal sexual intercourse without the use of birth control pills. In assisted reproductive technology, the egg is removed from the donor women and it is mixed with sperm in the laboratory and an embryo is formed under suitable conditions, then it is transferred to the recipient women's uterus. There are several techniques for example- IVI, IVF, ZIFT, GIFT, ICSI used to address infertility. Procedures that examine only semen, such as intrauterine insemination, are excluded from this definition. Ovarian surgery without oocyte retrieval is also excluded from the definition. In vitro fertilization (IVF) was performed in England in 1978 for immunocompromised women.

Doctors used a laparoscope to remove oocytes from the ovaries. It is fertilized in vitro and sent to the uterus as an embryo. Since then, IVF has continued to grow and gain popularity worldwide. This overview describes the current state of assisted reproduction, indicators and associated risks. IVF, such as cryopreservation and intracytoplasmic sperm injection (ICSI), is by far the most common ART procedure and the most studied method. These techniques are used to reduce the risk factors of miscarriage.

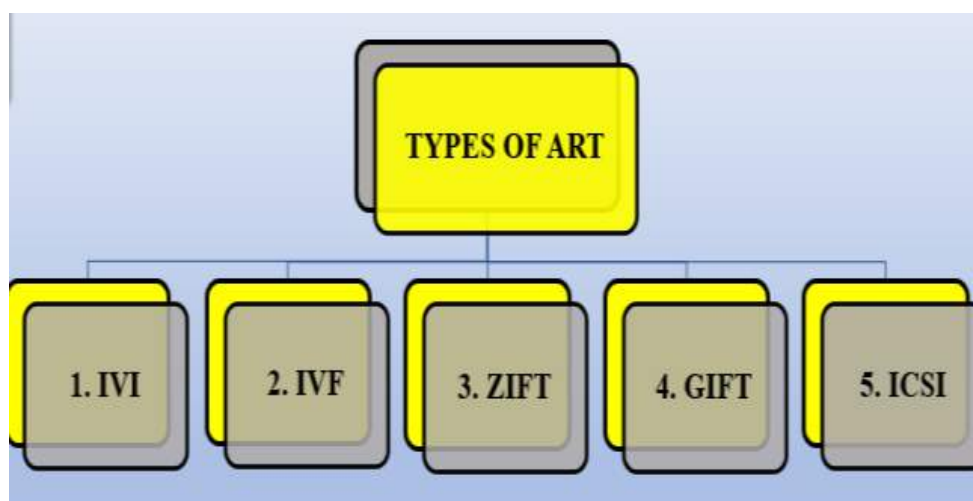
PROCEDURE:

In IVF, the eggs are removed after stimulation of the ovaries. Ovarian stimulation is used to facilitate the

retrieval of multiple oocytes in a single IVF cycle. A semen sample is also taken. After ovarian stimulation and egg retrieval, the eggs are fertilized in a Petri dish to form embryos. Most women can transfer more than one embryo, and the transferred embryos can be frozen for use in future pregnancies, eliminating the need to recollect the ovaries and oocytes. There are several ways to select sperm. In ICSI, a single sperm is injected into the cytoplasm of an oocyte. Fertilize mature oocytes with a special pipette. It uses a thin, sharp, hollow needle to grab and collect individual sperm. Carefully insert the needle into the membrane and cytoplasm of the oocyte. Sperm are injected into the cytoplasm and the needle is removed. The next day, oocytes are examined for signs of fertility. Immediately after fertilization, embryos can be returned to the uterus (fresh) or frozen for future implantation. Frozen embryos may be used if the patient wants another baby or if a previous cycle was not successful and the patient has embryos from a previous cycle. ICSI is often recommended for male infertility related to sperm count or function problems. Whether ICSI should be used for male infertility is controversial. Patients who want embryo genetic testing freeze the embryos while waiting for test results. In general, the choice of fresh or frozen embryos must be determined on an individual basis. When transferring new embryos, the embryos are transferred 3-5 days after collection. In this case, estrogen in the follicle helps prepare the endometrium for implantation. In frozen embryo transfer, embryos can be transferred months or years later. In this case, estrogen, tablets, or injections can be used to prepare the uterus. There is much debate about the optimal media for embryo culture. Despite the importance of an optimal environment for embryonic development and the subsequent success of IVF or ICSI, there is insufficient evidence to support or refute the use of any particular medium.

2. ART AND OUTCOME OVERVIEW:

Overall, there is substantial variation in the availability, use, and use of ART worldwide. Recognizing this, international registries have been developed that provide regular information on short-term and long-term results to monitor trends and results. This follow-up period is important because results change over time, reflecting changes in pregnancy risk and methods used.



Overall, one of the most prominent risks of ART is multiple embryo transfer, which is associated with injuries caused by preterm birth and an increased risk of multiple births and preterm births compared to singletons. Although there are international differences, the general direction is embryo transfer. This is associated with a reduced risk of developing neurodevelopmental disorders such as cerebral palsy later in life. One of the most important etiological questions is "Which came first, the chicken or the egg?" Are factors specifically related to infertility related to outcome? Does the ART process itself contribute, or is it a combination of the two, perhaps with other genes? Another important aspect to consider is laboratory changes, including changes in media use. An important study factor in considering the risk outcome is the nature of the comparison group used. A control group was usually selected on the basis of pregnancy, but pregnancy was not considered an outcome. An appropriate group would be pregnancies of infertile parents, but this is difficult to determine. However, even in this case, the difference in the mother's gestation period is important. From a mechanistic point of view, the mechanism may be multifactorial, but gene regulation may play an important role in the placenta, gametes, and embryonic epigenome, leading to congenital and chromosomal abnormalities in childhood. in models of health and disease. The results can be divided into two dimensions.

- (1) body composition -mother/foetus/infant, child and adult;
- (2) Medicine- Maternal/Deformity, Developmental Disorders, Mental Health and General Medicine.

MATERNAL AND PERINATAL OUTCOME:

Regarding maternal / child outcomes, immunosuppression has health implications for both mother and foetus / infant. From the mother's perspective, ART can increase the risk of miscarriage, placental complications (such as abortion and late pregnancy bleeding), preterm delivery, and cesarean section. There is an increase in preterm births, low birth weight, small gestational age, stillbirth and perinatal death for singleton pregnancies. As noted earlier, it is important to be aware that other factors may also increase the risk, including pregnancy and other biological diseases, supraphysiological estradiol levels, and ovarian induction and ART procedures. For individuals, ART appears to be associated with a modest risk for certain diseases, including diseases of the heart, blood vessels, palate, gastrointestinal and genitourinary tract, but there is conflicting evidence here. Proposed mechanisms include underlying infertility, ovulation-inducing drugs, and micromanipulation of embryos outside the uterus. Multiple pregnancies also increase the risk of birth defects, but there is no clear strategy for this. However, given the differences in birth background and ART methods, it is difficult to draw firm conclusions. In addition to postpartum growth, concerns have been raised about increased singleton preterm births and low birth rates due to ART. Emerging literature supports growth-promoting early adult development.

CHILDHOOD OUTCOME:

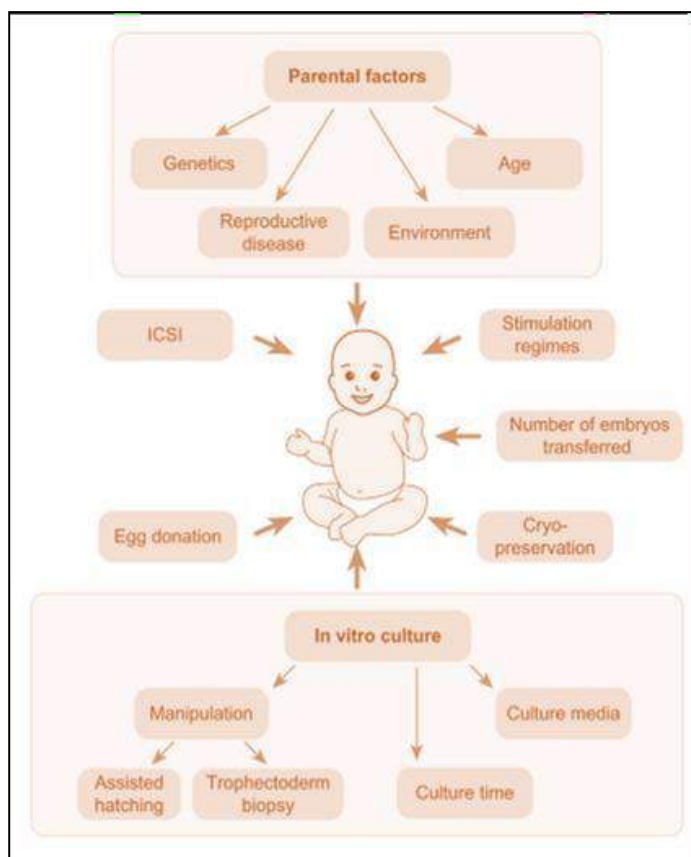


Figure. 1: A wide range of factors can adversely affect the offspring born after assisted reproductive technology.

With regard to intellectual disability, the results also show differences between studies, between populations, and in follow-up time. While a recent meta-analysis showed similar results, several studies have shown an increased incidence of intellectual disability. Current evidence suggests that ICSI may be associated with an increased incidence of intellectual disability compared to IVF, but there are differences. In the past, research results on the development of cerebral palsy have shown that ART increases the risk of cerebral palsy. A recent study using successful registration data in Western Australia showed that several embryo transfers doubled the incidence of brain damage. Although these studies and other results show an increased risk of cerebral palsy, the increase in the risk of stillbirth and preterm birth is negligible. A recent meta-analysis reported that the incidence of cerebral palsy increased more than twice, but this risk was mainly due to multiple births and preterm births. The decrease in brain death incidence, increase in single embryo transfer and decrease in multiple births in Scandinavian countries between 1990 and 2014 support the continuation of single embryo transfer. Although the incidence of autism spectrum disorders and ART use increased over the same period, it remains unclear whether there is an association. According to the risks associated with other benefits, pregnancy-related problems include old age of the father, sperm quality and fertility of the mother. In a long-term study conducted in conjunction with early participation data in the literature, there was no increase in mental health among women with IVF, ICSI, or without children. Conversely, exposure to progesterone during a given period of fetal development increased the risk of autism spectrum disorder in a national registry cohort, with a causal effect on putative levels of secondary epigenetic changes. A recent meta-analysis found an

increased overall risk of autism spectrum disorder but no single births, suggesting an increased risk associated with multiple pregnancies. Some groups provide data suggesting a higher risk of autism spectrum disorder with ICSI than with IVF, but evidence has not been established.

OUTCOME IN ADULTHOOD:

With increasing knowledge of the origin of health and disease (Barker's hypothesis), concerns have arisen about the long-term risks of cardiometabolic diseases. Since surgical ART was not performed until 1978, little data is available on adolescents and young adults. Regarding long-term cardiovascular health, studies in human and animal models have shown an increased risk of early vascular disease in adolescents and young adults who take ART during pregnancy. These findings increase with age in arterial hypertension. From a theoretical point of view, it is predicted that epigenetic changes may be involved. More research is needed to track the lives of older people, as other studies reduce this risk. When considering outcomes in older adults, it should be recognized that many postnatal factors, including genetics and environment, may play a role in pathogenesis given the potential for measurements over many years. Given that children conceived with ART are middle-aged, the long-term effects of ART will become clear in the future.

COVID-19 VACCINES AND ASSISTED REPRODUCTIVE TECHNIQUES:

The global health crisis has raised many questions and uncertainties about the long-term effects and side effects of the disease. Additionally, the rapid growth of that response has led to public mistrust. Patients undergoing infertility treatment are not exempt. It is well known that managing fertility and reproductive health is stressful for most patients with fertility problems. Many infertility treatments were withheld early in the pandemic and later had psychological effects on women and their partners, causing stress and anxiety. Despite recommendations from international organizations, it remains a problem for doctors and patients to refuse vaccinations during and before pregnancy.

3. CONCLUSION

Overall, ART has the potential to be life-changing for those who cannot conceive; however, parents should be aware of the risks and benefits. As with any medical technology, the benefits of ART are associated with risks. Special births, imprinting disorders, premature births, small births, small for gestational age births, still births and perinatal deaths, while the risks associated with many births are significant, they increase even in single ton pregnancies. Neurodevelopmental outcomes are generally reliable and risk is eliminated when various birth conditions are adjusted. Also, when there is risk, it is usually for specific groups such as IVF versus ICSI or fresh embryo transfer versus cryopreservation. Finally, we concluded that ART is a safe method and implantation alone produces the best results. However, understanding the full benefits of ART requires consensus (including risks and benefits) and ongoing research.

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LITHIUM MINING INDUSTRY AND IT'S SOCIO- ENVIRONMENTAL IMPACT

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Lithium-ion technology is vital for its advancement and wider applications across various industries, notably in energy density, charging speed, and lifespan improvements. Lithium is also determined as “White gold”. The increasing demand for battery systems is driven by the growing role of electricity as an energy carrier in decarbonization efforts. Electric vehicles and stationary systems of energy storage are major contributors to this increasing demand. India has recently discovered 5.9 million tonnes of lithium. Not only governmental activities are boosting the distribution of electric vehicles, but the private players are also adopting electric vehicles which is a significant part of the sustainability transition’s goal; thus, the knowledge about environmental and social effects of increased lithium demand is essential. However, numerous industries and societal groups have expressed interest in the extraction and mining of lithium. The "Lithium Triangle" in the Andes of Chile is affected by the changes in climate. which disturbs the availability of primary productivity, surface water, and the prosperity of economically also threatening the significant species of flamingo. Flamingo abundance could be soon dramatically impacted by continuous raises in lithium mining and decrease in surface water across their habitat. While the need for lithium is growing exponentially with the expansion of clean mobility trends, there are both positive economic opportunities and negative social, environmental, and health effects associated with lithium mining.

Keywords: Lithium triangle, White gold, Sustainability transitions, Environmental impacts, Decarbonizing.

1. INTRODUCTION

In the age of technology, the world is moving towards using more sustainable energy for transportation. This means finding better ways to produce and use energy that won't harm the environment. But we need to be careful about any negative impacts it might have on the environment (Agusdinata et al., 2018). One important part of this energy change is using lithium-ion batteries. These batteries are good at storing lots of energy in a tiny space (Jaskula, 2017). As the demand for lithium batteries grows, so does the need for lithium production. In 2016, global lithium production increased by 12%, and it's expected to keep growing quickly (Eller and Gauntlett, 2017). The need for lithium-ion batteries has increased a lot from 2015 to 2020. By 2030, it is expected to rise by more than 500% and reach 2.2 million tons. To meet the rising demand around the world, China, for instance, produced 1.34 billion lithium-ion batteries by the end of August 2019. Around 1.3 million metric tonnes of lithium carbonate equivalent (LCE) are anticipated to be needed to meet the world's lithium demand by 2025 (Kaunda, 2020).

2. LITERATURE REVIEW

Lithium element has atomic number 3 and is symbolized by Li. Lithium is a silvery white and soft alkali metal. Lithium is preferred because it is lightweight and can store a lot of energy. The rising demand for lithium is an outcome of highly efficient batteries in gadgets and electric cars. The expected demand for lithium-ion batteries

is to reach 2.2 million tonnes by 2030. As a result, there is significant interest in mining and exploiting lithium from various industries and societies. Which affect the environment drastically (Kaunda, 2020). Even with recycling, the production data revealed that demand will outpace the world's lithium supplies before 2025. As lithium becomes scarcer, its price will rise, leading to mining in environmentally sensitive areas like Bolivia, which is rich in lithium. Lithium extraction can cause water pollution and harm native biodiversity, impacting human health due to cyanobacteria. The environmental, biodiversity, and health impacts of lithium extraction from ponds and mining should be considered when talking about how to recycle and safeguard resources. While sensible lithium recycling strategies are effective now, there is a need for alternative technologies soon to ensure resource and environmental protection (Wanger, 2011). Including a decline in vegetation, in national reserve regions, there have been more severe drought conditions, higher daytime temperatures, and less soil moisture. focus on the consequences of lithium mining on the ecosystem in the Atacama Salt Flat, the world's prime lithium extraction region. Using satellite imagery, the constant growth of lithium mining negatively correlates with vegetation and soil moisture while positively correlates with higher daytime temperatures. This indicates that lithium mining is a major factor contributing to environmental degradation in the region (Liu, 2019).

3. LITHIUM: MINERAL RESOURCES DISTRIBUTION

Lithium (Li) is also mentioned as "white gold" due to its extreme global demand for replenishable lithium-ion batteries used in the manufacturing of electric vehicles. According to the U.S. Geological Survey, worldwide, there are 98 million metric tonnes of lithium resources, out of which 26 million tonnes are considered reserves (ready for use).

Lithium reserves in the world: According to a US Geological Survey report published in January 2023, Chile has the largest lithium deposit in the world, with approximately 9.3 million tonnes. Australia came at second with 6.2 million tonnes. The third and fourth place was taken by Argentina and China, with 2.7 million tonnes and 2.0 million tonnes respectively. Most of the world's lithium output was produced by Australia's six mineral operations, Brazil's one mineral tailings project, Argentina and Chile's has two brine operations each and three mineral and two brine operation in China. The global lithium reserve is huge and may be sufficient to satisfy all the demands of the International Energy Agency (IEA) sustainable development. The production of lithium was further increased by smaller enterprises in Portugal, Zimbabwe, Brazil, Canada, the United States, and China. In 2022, established lithium enterprises around the world increased or were in the midst of boosting production capacity due to the swift rise in demand and prices for lithium (USGC, 2023).

3.1 Resources worldwide:

The total lithium resources are huge and may be sufficient to satisfy all the demands of the IEA's (International Energy Agency) sustainable development. (Graham et al., 2021). Exploration activity has led to a massive increase in the number of recognized lithium deposits, which today total about 98 million tons. The United States is home to 12 million tonnes of lithium resources, which are found in pegmatites, hectorite, oilfield brines, geothermal brines, and claystone. There are now 86 million tonnes of lithium deposits thought to exist in other countries. The recognized lithium resources are dispersed as follows: There are 21 million tonnes in Bolivia, 20 million tonnes in Argentina, 11 million tonnes in Chile, 7.9 million tonnes in Australia, 6.8 million tonnes in China, 3.2 million tonnes in Germany, 2.9 million tonnes in Canada, 1.7 million tonnes in Mexico, 1.3 million tonnes in Czechia, 1.2 million tonnes in Serbia, and 1 million tonnes in Russia. There are 880,000

tonnes in Peru, 840,000 tonnes in Mali, 730,000 in Brazil, 690,000 tonnes in Zimbabwe, 320,000 tonnes in Spain, and 270,000 tonnes in Portugal (USGC, 2023).

3.2 Lithium reserve in India: The Geological Survey of India released a significant statement that 5.9 million tonnes of lithium, has been discovered in Jammu and Kashmir. Precious metal is used in the batteries of electric cars and other clean energy devices. India would rank among the top nations with considerable lithium deposits if the findings were validated. The adoption of electric vehicles in India attempts to save the environment, and achieving energy independence could all be significantly impacted by this discovery (Ellison, 2023).

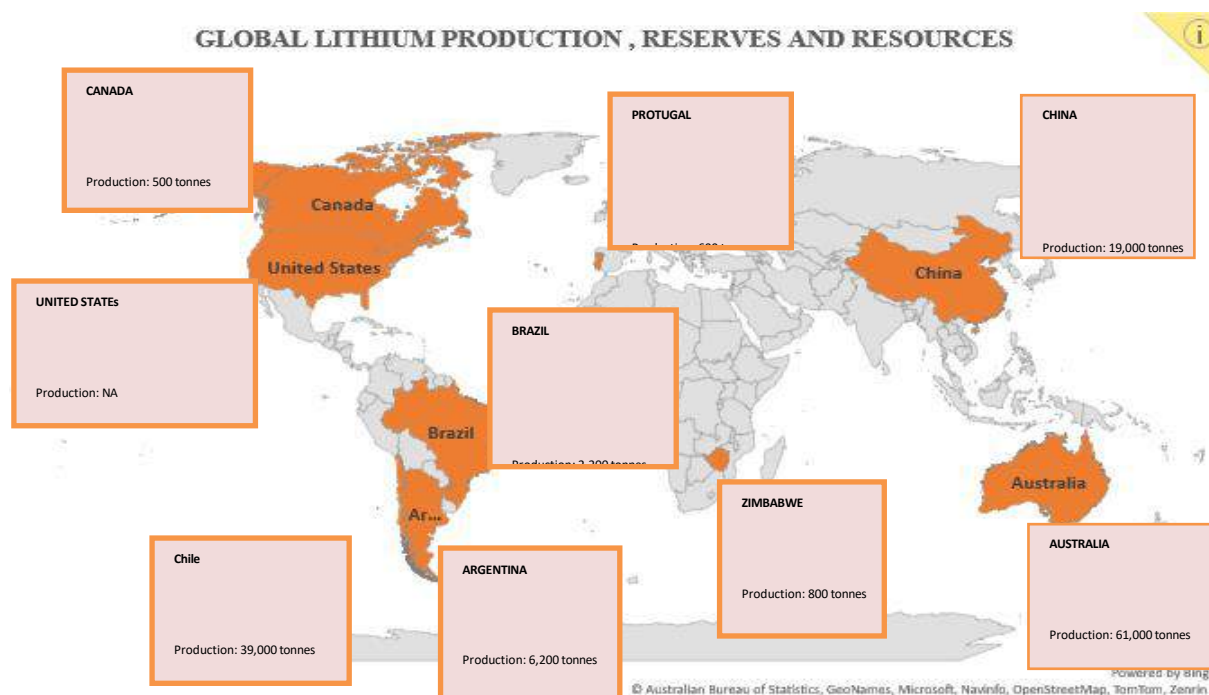


Figure 1: Global lithium production, reserves, and resources. Source: U.S. Geological Survey, Mineral Commodity Summaries, January 2023.

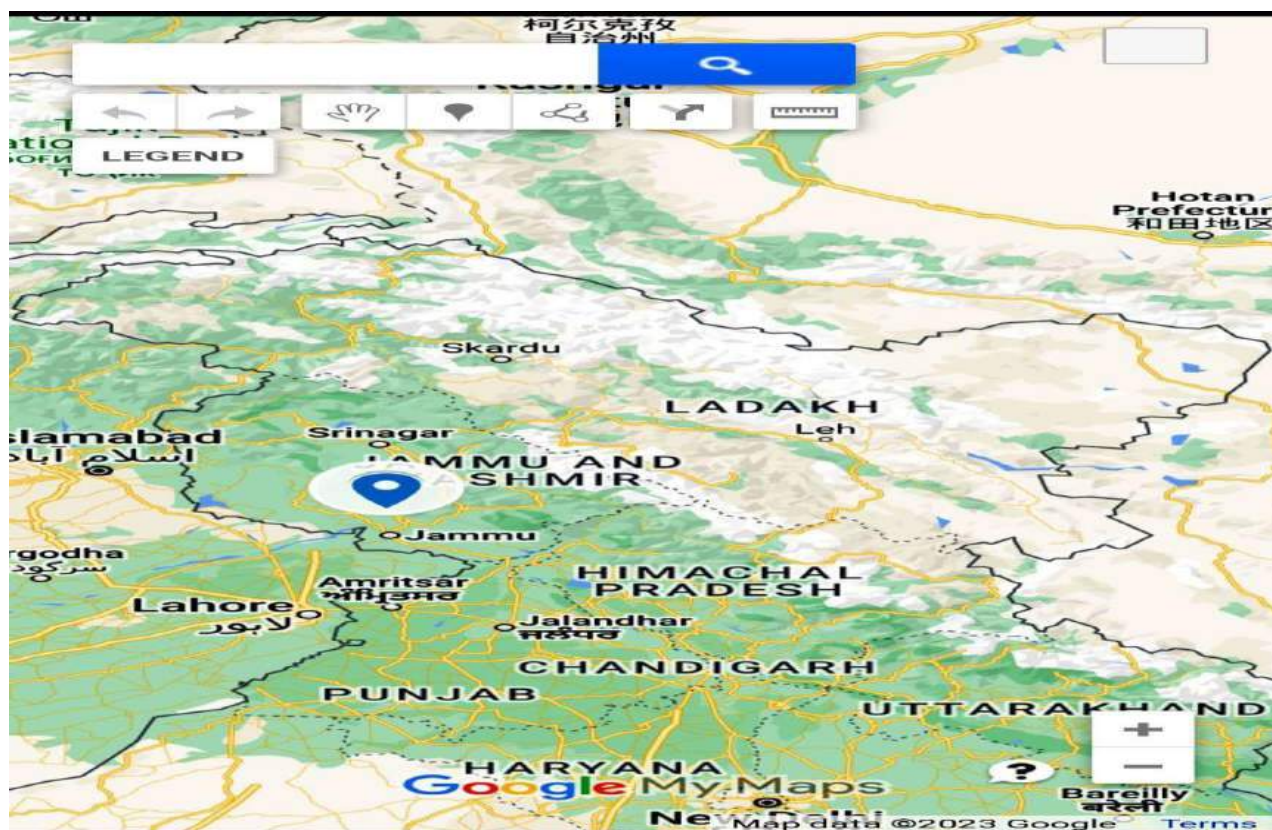


Figure 2: India's Lithium Resources in Kashmir (Salal). Sources: Armed Conflict Location and Event Data Project (ACLED), Government of India, ESRI India, UNESCO, CIA World Factbook.

4. Sources of lithium in the environment

Lithium is found throughout the earth in different amounts. In the above part of the Earth's crust, there are about 24 parts per million (ppm) of lithium. In the middle part of the crust, it's about 12 ppm, and in the lower part, it's about 13 ppm. The mantle, which is deeper inside the Earth, contains about 1.5 ppm of lithium (Jagoutz, 1979; Rudnick, 2014; Gao, 2014; Liu, 2018). Lithium concentration in seawater is about 0.18 milligrams per litre (Riley and Tongudai, 1964). In primary rocks, lithium is mainly found in silicate minerals, especially those rich in magnesium (Misra and Froelich, 2012). The three primary categories of lithium resources are surface and near-surface brine, hard-rock deposits, and unconventional resources such as deep geothermal brines or seawater. Natural processes within the Earth's crust result in the formation of hard-rock deposits, which can include rocks produced by volcanic eruptions or sedimentation. (Kesler et al., 2012). These deposits contain various lithium-carrying minerals such as lepidolite, jadarite, spodumene, hectorite, and petalite. Extracting lithium from these minerals requires different methods. Surface brines are found in dry or semi-dry regions where there are salt pans and temporary salt lakes.

These areas are often located in geologically active basins, and they are known as "salars," particularly found in South America (Sanjuan et al., 2022). In certain areas called "salars," lithium concentrations are up to 6400 milligrams per litre (Lopez Steinmetz, 2018). Other prominent areas with surface brines rich in lithium exist, including the Tibetan Plateau in China and the basin of Qaidam (Li, 2018).

5. Uses of Lithium

Lithium compounds are extensively used in various industries. Over 60% of the domestic consumption of lithium is for ceramics, glass, and primary aluminium production. Other significant uses include rechargeable

batteries for electric vehicles, computers, digital cameras, and making lubricants, greases, and synthetic rubber.

Metallurgy: Lithium can combine with many metals to form alloys. In Germany, they made an alloy called *Bahnmetall* (containing 0.04% lithium) for railroad cars. In the United States, an alloy called X-2020 (consisting of 4.5% copper, 1.1% lithium, 0.5% manganese, 0.2% cadmium, and the rest aluminum) was introduced in 1957 for structural components in naval aircraft. During World War II, lithium-magnesium alloys were created and have since been used in aerospace applications.

Electrochemical Applications: Numerous consumer, medicinal, industrial, and military applications all make use of lithium batteries. They have several benefits, including low self-discharge rates, high energy density, rapid voltage responsiveness, and being lightweight. Electronic devices, including watches, cameras, calculators, and CMOS-RAM memory backups, are all powered by lithium batteries in consumer goods. Lithium batteries are also used in medical devices like cardiac pacemakers etc. In industry, remote sensing devices, like oil-well logging tools, Moreover, lithium batteries have several military uses, including powering communications equipment and giving missile systems standby power (Kamienski, 2000).

6. Impacts of Lithium

Lithium elements occur naturally; however, it is not necessary for life. The rising demand for lithium in several sectors is negatively affecting plants, animals, human beings, and the environment, but the lithium reserves will have a positive impact on the economy. It will lower the country's import bill and trade deficit.

Plants

Lithium affects the growth of plants which depends on the amount of lithium in the medium of growth. Lithium negatively affects plant growth by interfering with various physiological processes and changing the metabolism of the plant. The lithium pollution is becoming a major problem in soil, which could pose a risk to the production of crops in the near future. Lithium negatively affects plant growth by interfering with various physiological processes and changing the metabolism of the plant (Shahzad, 2016).

Effects on development and growth: Lithium-rich soil, damage to the root tips, and the appearance of yellow and brown patches on leaves have been recorded in corn plants. These brown patches are typical of situations where the plant and pathogen are incompatible (not a good match), and it appears that the presence of lithium in the plants triggers this response through a chemical called ethylene. Researchers have also found that when oats were exposed to 25 mg of lithium per kilogram of soil, there was a significant decrease in their yield. Similarly, spinach and maize exposed to 40 mg of lithium per kilogram of soil also showed reduced yields (Kabata and Mukherjee, 2007).

Effects on carbon assimilation and photosynthetic pigments: Maize plants, when exposed to a high amount of 50 mg of lithium per decimeter cubed of soil, it led to a reduction of about 45% in chlorophyll a and b contents and a 67% reduction in carotenoid contents. Additionally, it caused the occurrence of brown patches on the leaves, indicating damage (Hawrylak and Nowak et al., 2012).

Animals

The major effects of lithium on animal motor behavior are most consistently seen in three areas: rhythmic activity regulated by endogenous biological clocks, hyperactivity and stereotypy brought on by medicines that

modify monoaminergic neurotransmission, and exploratory behavior. The motor activities in animals are found in hyperactivity, stereotypy, and exploratory activity, stimulated by drugs that change monoaminergic neurotransmission, as well as rhythmic activities carried out by endogenous biological clocks (Smith, 1980).

Domestic animals

The impact of lithium on domestic animals through the food chain, lithium can build up in animals, and large quantities can be extremely harmful (Tanveer, 2019). For example, an amount of 500–700 mg kg⁻¹ in hybrid beef cattle (*Bos taurus*) resulted in severe depression and ataxia along with residual Li in the tissues of the heart (79.15 mg L⁻¹), kidneys (66.97 mg L⁻¹), muscles (86.64 mg L⁻¹), and brain (51.7 mg L⁻¹) (Johnson, 1980). The antiviral activities of LiCl against enterovirus A71, pseudorabies herpesvirus, infectious bronchitis virus, and transmissible gastroenteritis virus were also found at the same time (Harrison, 2007). LiCl LC50 values for rats varied from 526 to 840 mg kg⁻¹. Continuous exposure to high Li concentrations has been associated with numerous adverse effects, including oxidative stress on the liver, weight polydipsia, damage to the reproductive system of males, and a noteworthy decline in the testosterone level (Nciri, 2009).

Aquatic animals

Lithium naturally occurs in surface waters at a concentration of 0.04 mg L⁻¹ (Sposito, 2016). Mineral water normally contains 0.05–1.0 mg Li per liter, while it can infrequently reach 100 mg L⁻¹ (Schrauzer, 2002). Li affects aquatic life negatively at higher concentrations but not negatively at lower ones (Hou et al., 2014). For instance, treatment of zebrafish to 5–10 mg L⁻¹. Adenosine diphosphate was reduced by LiCl, although ecto-5-nucleotidase and acetylcholinesterase activities were only reduced at 10 mg L⁻¹ LiCl (Oliveira et al., 2011). LiCl was found to have negative effects on zebrafish at higher concentrations (235.9 mM), including delayed growth, skeletal abnormalities, curvature of the dorsal, diminished swimming, reduced heart rate, and declined velocity (Pruvot, 2012). Domoic acid is emitted in significant amounts by aquatic species, which interferes with the development of the embryo and causes microcephaly. It is also caused by lithium poisoning.

Human beings

Lithium is a mood-stabilizing medication used to treat certain mental illnesses, for example, bipolar disorder. Lithium carbonate is the active component in lithium medicine. Short-term side effects can include muscular weakness, nausea, diarrhea, or a dazed feeling.

Low levels of lithium (Li) have been linked to increased rates of chronic pain, anxiety, sensitivity to stress, depression, and insomnia, as well as a reduction in memory function, learning ability, and the body's ability to heal itself (Naeem et al., 2021). Manic-depressive disorders are treated with lithium salts such as Li₂CO₃ and LiCH₃COO. However, off-label therapeutic use of Li₂CO₃ can be hazardous to the human neurological, gastrointestinal, cardiovascular, muscular, and urinary systems and even fatal (Watson et al., 2004). Nephrogenic diabetic insipidus, which manifests as dehydration, polydipsia, polyuria, and deficiency in urine concentration, can be brought on by temporary exposure to Li (months to years). End-stage renal disease may be six to eight times more likely to develop in patients receiving long-term treatment with greater doses of Li (Aiff et al., 2015).

Moreover, drugs that lower the glomerular filtration rate may also have a long-term harmful effect (Maddu and Raghavendra, 2015). Additionally, the WHO and various health regulatory authorities should establish daily intake guidelines along with common safe and dangerous limits of Lithium. Short-term side effects can include muscular weakness, nausea, diarrhea, or a dazed feeling. Finally, it's important to keep an eye on the amount of Li in food, particularly in regions where mining for metal is a major industry (Shakoor et al., 2023).

Environment

The impact of lithium mining on the environment is one of the major concerns. The activities for extraction of lithium require lots of energy and water, and it can also pollute the water and air with heavy metals and chemicals, which disrupt the habitats of wildlife and cause erosion of soil, further leading to continuing ecological damage.

The demand for lithium-based goods and electric batteries is increasing worldwide which has raised concern about the environmental effect of mining industries of lithium which include both processing and extraction of lithium. The environmental worries are notably related to soil, water, and air pollution, along with the loss of water resources, which are essential to local people in these lithium mining localities (Kaunda, 2020).

The impact of lithium on the environment primarily arises from its extraction, production, use, and disposal processes. During the process of extracting lithium from the Atacama Salt Flat (ASF), Chile evaporates roughly 95% of its saline water, and the remaining 5% is used to draw freshwater from the region's adjacent mountains on its eastern border (Marazuela, 2019). Hydrodynamics show that saline water still has an impact on the nearby water system, even though it is not appropriate for human or agricultural use. In a place where the climate is already dry, this water-intensive mining method can have negative effects on ecosystems, aquifers, and water balance. This has caused residents, environmentalists, and government officials to express alarm (Babidge and Bolados, 2018).

However, this expanded mining can bring changes to the landscape and microclimate of the area, leading to conflicts between mining companies and the local communities living there. (Ellison, 2023).

Social

Social consequences of lithium mining can be observed along with its environmental impact. In most cases, mining can relocate the native population or negatively impact their health. Most of the global lithium deposits are present in developing nations, where environmental regulations and labor standards are repeatedly degraded.

There are several problems and conflicts that may have a significant impact on how lithium mining in the area develops in the future. From the perspective of society, supply security, decarbonization, and environmental effects are the main issues. The difficulties are:

- The view of environmental harm from lithium extraction by society may result in opposition to the expansion of the mine, delays, and a halt to mining operations.
- The public's perception that mining for lithium damages the environment could result in opposition to mine construction, delays, and a halt to mining operations.
- The inability of local communities to comprehend mining regulations and associated disclosure documentation due to a lack of technical knowledge may affect their social licence to operate.
- Lithium mining initiatives fall short of the expectations of the local community in terms of growth and employment creation, which may cause social unrest.
- Social tensions and a negative view of mining are caused by an inadequate distribution of mining remittances to the local community (Petavratzi et al., 2022).

Economy

Rapidly boosting the market for electric vehicles and other green technologies. The raw material can be provided through lithium mining for producing lithium-ion batteries, which can be used in electric cars as well

as other appliances. It would boost economic growth, create jobs, and encourage innovation. Lithium (16%), as lithium carbonate equivalent (LCE), graphite (10%), cobalt (39%), copper (12%), nickel (9%), aluminum (5%), and manganese (2%), the seven primary components, account for >90% of the commercial value of a consumed lithium-ion battery, according to a recent patent. The necessity for Li-ion batteries now outweighs the allocation due to the significant economic (and environmental) benefits of EVs, notwithstanding the fast-increasing output from new, massive plants in China. This is particularly true for countries and regions like Europe, where only a tiny amount of Lithium-ion battery manufacturing occurs (Pagliaro and Meneguzzo 2019). According to recent Chinese legislation, it is now the duty of EV producers to recover batteries. These requirements require them to build recycling roads and service facilities where used batteries can be assembled, stored and relocated to recycling firms. 393 manufacturers, 44 discarded car disassembling companies, 37 cascade utilisation companies, and 42 recycling companies had all signed up for the new tracking platform by the end of February 2019 (Hongyu, 2019). Other companies operate Lithium-Ion Batteries (LIB) recycling facilities all over the world, including Australia (Envirostream Australia), Belgium (Umicore), Great Britain (Belmont Trading), the United States and Canada (Retriev Technologies), Singapore (TES-AMM), and South Korea (SungEel).

Lithium is consumed in different sectors such as batteries, ceramics and glass, thermoplastics, lubricating greases, air treatment, rubber, etc., but the share of battery production could significantly double in 10 years (2010–2020). Aluminum, lubricating greases, glass, and ceramics were the first things to be made with lithium. Due to its extensive use in lithium-ion batteries for electrified vehicles (EVs) or electronic devices, this chemical element is currently attracting attention. From 23% in 2010 to 65% in 2019, battery use as a percentage of total lithium consumption has climbed dramatically.

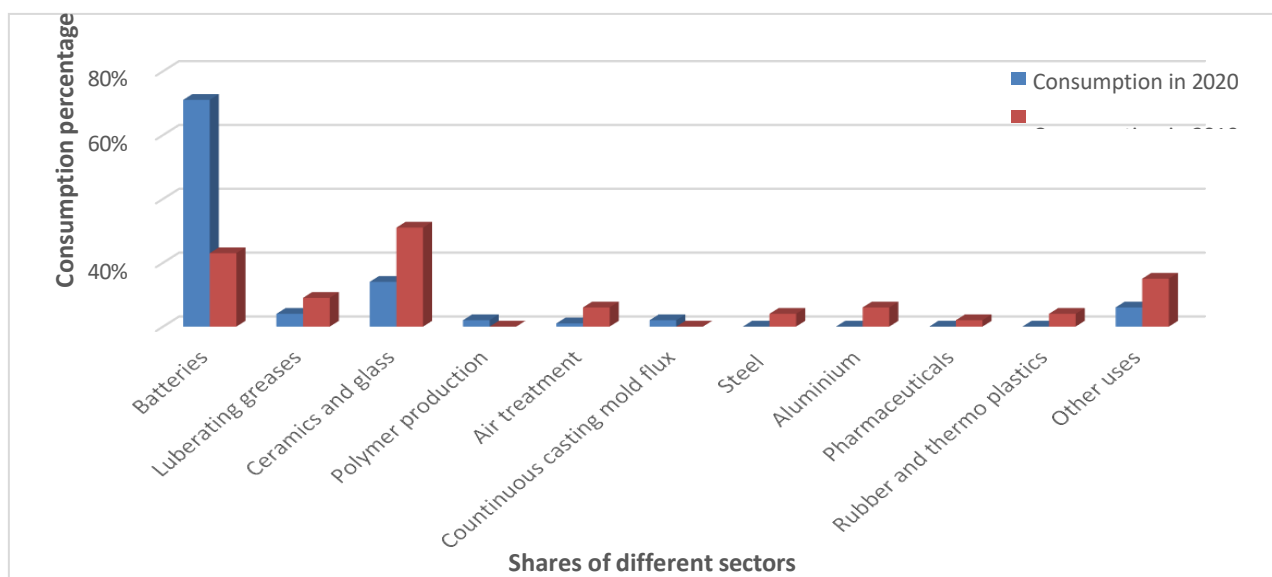


Figure 3. Different sectors in lithium consumption in 2020 and 2010.

Source: USGS, 2010, 2021

7. Conclusion

People's desire to minimize their carbon footprint and contribute to the fight against climate change has resulted

in a significant enhance in the demand for better electric batteries recently. Due to their widespread use in electric vehicles, laptops, energy storage systems, cell phones, and other devices, lithium-ion batteries are a suitable solution for this. There is a problem, though. Even though we know a little bit about how completed lithium batteries harm the environment, mining lithium directly impacts the ecosystem. Lithium mining may pose problems such as depleting and contaminating water supplies, endangering plants and animals with hazardous chemicals, producing and discarding waste, and even cause the land degradation. All these things have an impact on native flora and animals, as well as human health, the environment, and water supplies. Steps like waste minimization, recycling, and water treatment, more effective processing of lithium brines, and the adoption of unconventional technologies can all help to lessen the adverse effects of lithium processing and extraction on the environment.

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A SYSTEMATIC REVIEW AND META-ANALYSIS ON THE EFFECT OF MCKENZIE EXERCISE ON FORWARD HEAD POSTURE

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Background: The McKenzie exercise supports self-care treatment through frequent exercise and focuses on extension, including ROM exercise, manipulation, and patient education. An anterior weight bearing of the cervical spine results from FHP, which is characterized by an increase in the upper cervical convexity and a decrease in the lower cervical convexity.

Aim and Objectives: To find out the effect of McKenzie exercise on forward head posture.

Methods: The following worldwide databases were searched for this systematic review: PubMed (MEDLINE), Cochrane Library (CENTRAL), PEDro, and Google Scholar. The following keywords were used “FHP”, “Forward head posture”, “McKenzie exercises” (all in title and/or abstract) in advanced search options were used to search relevant articles.

Results: Nine articles with 289 participants that met the inclusion criteria were included in the study and assessed out of a total of 95 works on the topic that were analyzed. A total of six studies were included in the meta-analysis. Result of craniovertebral angle (MD=-1.48; 95% CI: -2.23 to -0.73; heterogeneity $I^2=59%$; $p=0.06$). Result of neck disability index (mean difference=- 3.36; 95% CI: 0.77 to 5.94; $I^2=92%$; $p<0.00001$). Result of respiratory parameters (FVC) MD=-0.72, CI: -1.61 to -0.16; $I^2=61%$; $p=0.11$), (FEV1) MD=-0.82, CI: -1.86 to 0.22; $I^2=71%$; $p=0.07$.

Conclusion: This study found that the McKenzie exercises were useful for improving posture in FHP patients.

Keywords: “FHP”, “Forward head posture”, “McKenzie exercises”

1. INTRODUCTION

FHP is a severe condition that has risen in frequency recently. The head moves forward, shifting the centre of gravity. The head is placed in front of the trunk as the upper body recedes and the shoulders drop forward in order to make up for the change in the centre of gravity (Wah *et al.*, 2022). Normal balance depends on posture, and adolescents frequently have poor posture (Lee *et al.*, 2013). Reduced physical activity and improper everyday postural habits might cause skeletal and muscular structures to reorganise incorrectly (Lee *et al.*, 2017). A number of musculoskeletal disorders, particularly those affecting the neck, such as Forward Head Posture (FHP), rounded shoulders, upper cross syndrome, mechanical neck pain, etc., have been linked to prolonged use of mobile devices and computers in the modern era (Ahmed *et al.*, 2022, Kim *et al.*, 2015). According to Kim *et al.*, 2018, forward head posture (FHP) is defined as an elevated flexion of the upper chest and inferior cervical spine and an excessive extension of the atlanto-occipital joint and superior cervical spine. FHP refers to the posture that results from excessive forward bending of the lower cervical vertebrae and excessive extension of the upper cervical vertebrae (Lee *et al.*, 2017; Joshi *et al.*, 2019). It is defined as extreme anterior positioning of the head in relation to a vertical reference line. (Kage *et al.*, 2016). A forward neck posture is one in which the head is positioned anteriorly, the normal anterior cervical convexity is elevated, and

the apex of the lordotic cervical curve is at a significant distance from the line of gravity (LOG) in compared to the ideal posture. According to Kage *et al.*, 2016 and Deshpande *et al.*, 2019, forward neck posture is also known as forward head posture, scholar's neck, reading neck, or wearsie neck.

FHP is the most prevalent postural issue, estimated to affect 66% to 90% of the population, and its impact on health is becoming more and more clear (Patel *et al.*, 2016). A weakening of the deep cervical flexors, tightening of the suboccipital muscles, aberrant function of the sternocleidomastoid (SCM), and scalene muscles are all factors that contribute to this posture. Muscle length and change in strength are also strongly linked to it (Kang *et al.*, 2016).

According to some studies, hyper-kyphosis is the aetiology of FHP for both ascending and descending components. FHP is more common these days as a result of lengthy periods of time spent sitting still while using a phone or laptop in improper posture. (Ahmed *et al.*, 2022).

The frequency of FHP among university students was reported to be 63.96%, including both genders. According to a study, FHP is prevalent in 85.5% of cases, and gender is significantly correlated with FHP. Another study on heroin addicts revealed that 20% had severe FH10 and 20% had mild FH10 (Ahmed *et al.*, 2022). Patients with neck pain were found to have a prevalence of 37% for FHP utilising anterior head translation on plain radiographs, with 58% of the individuals being female and 42% being male overall (Deshpande *et al.*, 2019).

When the head is positioned anteriorly and the craniovertebral angle is less than 50 degrees, this is known as a forward head posture. Assessment of forward head posture involves measuring the craniovertebral angle (CVA). For calculating CVA, one marker was placed on C7, while the other was placed on the tragus. A line from C7 and a vertical line were both measured and photographed to determine the angle between them (Tamilarasan *et al.*, 2022). The average craniovertebral angle is between 49.9 and 50 degrees. The craniovertebral angle (CVA) is generally 48.8 degrees or less in males with FHP, with a mean age group of 22–44 years, and 47.6 degrees or less in females with FHP, with a mean age range of 23–66 years. On the basis of their measured values, pulmonary function and chest expansion were negatively impacted by the decreased craniovertebral angle (Ahmed *et al.*, 2022).

The head is positioned anterior to the body's centre of gravity in the forward head posture, increasing lordosis in the upper cervical region and decreasing it in the lower cervical region. This results in a decrease in the cervical spine's total curvature and exerts stress on the cervical area and the entire posterior spinal muscle system (Kim *et al.*, 2019). Neck extensors and nearby connective tissues experience extreme tension as a result of FHP's dominant external flexion torque on the cervical spine. Due to the increased stress on the spinal tissue, this resulted in permanent spinal deformity. Additionally, FHP decreases proprioception in the cervical spine (Ahmed *et al.*, 2022). According to earlier research, persistent FHP increases thoracic spine retroversion while decreasing cervical spinal area range of motion (Kim *et al.*, 2018). Persons with persistent FHP also demonstrated higher neck muscular fatigue when compared to healthy persons. Alterations in respiratory function might result from aberrant alterations in the anatomical structure of the cervical and thoracic regions of the spine caused by forward head posture. Additionally, changes in the cervical region's range of motion, poor posture, and the dysfunction of the global and local muscular systems cause muscle imbalance and instability of the various spinal segments. Inefficient abdominal muscular contractions and a forward head posture reduce lung capacity by limiting the diaphragm's mobility and ability to function (Kim *et al.*, 2019). Because of the imbalance and weakening of the related respiratory muscles, a forward head posture has a detrimental effect on pulmonary volumes (Ahmed *et al.*, 2022).

FHP can be improved with a variety of conservative treatments, including McKenzie's posture correction

exercises, muscular stretching and strengthening exercises, electrical stimulation therapy, and traction procedures (Ahmed *et al.*, 2022). In New Zealand in the 1960s, Robin McKenzie created the McKenzie approach (Arshad *et al.*, 2020). Patients perform the McKenzie exercise, a type of self-therapy that combines patient education, mobilisation, and manipulation through repetitive motions (Kim *et al.*, 2015; Kim *et al.*, 2018; Kim *et al.*, 2019; Joshi *et al.*, 2019). Its main emphasis is on stretching exercises, which are recognised to be successful in correcting neck posture (Lee *et al.*, 2017). Deep neck flexors helps to keep the head and neck in proper alignment in the cervical area as well as the back and waist in the lower half of the body. McKenzie exercises are frequently used to treat spinal discomfort that is located around the spine (Kim *et al.*, 2015). The McKenzie approach, which involves managing patients with an appropriate repeated loading strategy that is progressed according to patient response and postural correction, is one of the most widely used treatments for the management of spinal conditions, including dysfunctions like FHP (Deshpande *et al.*, 2019). This programme should improve neck posture and speed up return to work. Additionally, it can enhance patient functionality and lessen stress-related pain recurrence. In therapeutic practise, the McKenzie exercise is a popular technique for treating musculoskeletal issues (Kim *et al.*, 2019).

2. METHODOLOGY

This meta-analysis and systematic review were carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher *et al.*, 2009), and the protocol for these studies was registered in the "International Prospective Register of Systematic Reviews" (PROSPERO) under the identification number CRD42023447554.

Data Sources and Search Strategy

The information was gathered using four electronic databases: Google Scholar, Cochrane Library, PEDro, and PubMed (MEDLINE). The PICO [Participant Intervention Comparison outcome] search methodology confined the search to human subjects and the English language. In every pertinent research investigation, the impact of McKenzie exercises on forward head position has been examined. The keywords "forward head posture," "FHP," and "McKenzie exercises" are utilized. Title abstract phrases, related keywords, and Boolean operators ('OR' and 'AND') were all used in conjunction with the 'Advanced' search choices. Duplicate records were eliminated from computerized systems using Mendeley Desktop software. Editorials, case studies, meta-analyses, systematic reviews, and reviews were not included.

Table 1. Search Strategy

Database	Keywords	Results
Google scholar	("Forward head posture") OR ("FHP") AND ("McKenzie exercises")	83
Cochrane Library	("Forward head posture"): ti, ab, kw AND ("McKenzie exercises")	5
PubMed	("Forward head posture" [Title/Abstract] OR "FHP" [Title/Abstract] AND "McKenzie exercises" [Title/Abstract])	4
Pedro	Forward head posture* McKenzie exercises*	3

Study selection

The complete text was examined following the title and abstract screening. Studies can be included if they satisfy the following criteria: they must include a full text that is available in English. Studies were rejected if (a) none of the groups were original articles, or (b) no exercise training was given.

Data Extraction

To fulfil the study's objectives, data from the included research was gathered. First author, year, location, sample size, outcome measures, intervention, and results of each study were all noted. The intervention, results, and research ID (first author) for each study were also noted. To integrate the data that had been retrieved, the authors then assessed inconsistencies, such as data presentation that was unclear or deficient.

Risk of Bias Assessment

The "Cochrane Collaboration tool" was used to assess bias risk. The seven main sources of bias in this evaluation tool are "random sequence generation, allocation concealment, selective reporting, blinding of participants and staff, blinding of outcome assessment, incomplete outcome data, and other sources of bias." These were independently evaluated by the authors, who then classified the bias risk as "high risk," "low risk," or "unclear risk" (Higgins *et al.*, 2008).

Data Analysis

The major objective used to assess the efficacy of treatment was the mean difference between baseline and study's end in the Craniovertebral angle (CVA), Neck Disability Index (NDI), and Respiratory Parameters (FVC and FEV1). We generated and evaluated the mean differences with standard deviations for the outcome variables as continuous variables using the weighted mean difference and 95% confidence interval (CI) for the effects of exercise. The missing values were imputed using the correlation coefficient as the standard deviation

for change from the baseline. The degree of heterogeneity of the studies was assessed using the Chi (X²) test and the I² statistic. The I² test classified heterogeneity of 0–25% as low, 2–75% as moderate, and 76–100% as considerable. Sensitivity analysis for the outcome variables was also performed where the heterogeneity was moderate or significant. The meta-analysis was carried out using the "Review manager (version 5.3) software" (Manager, 2004).

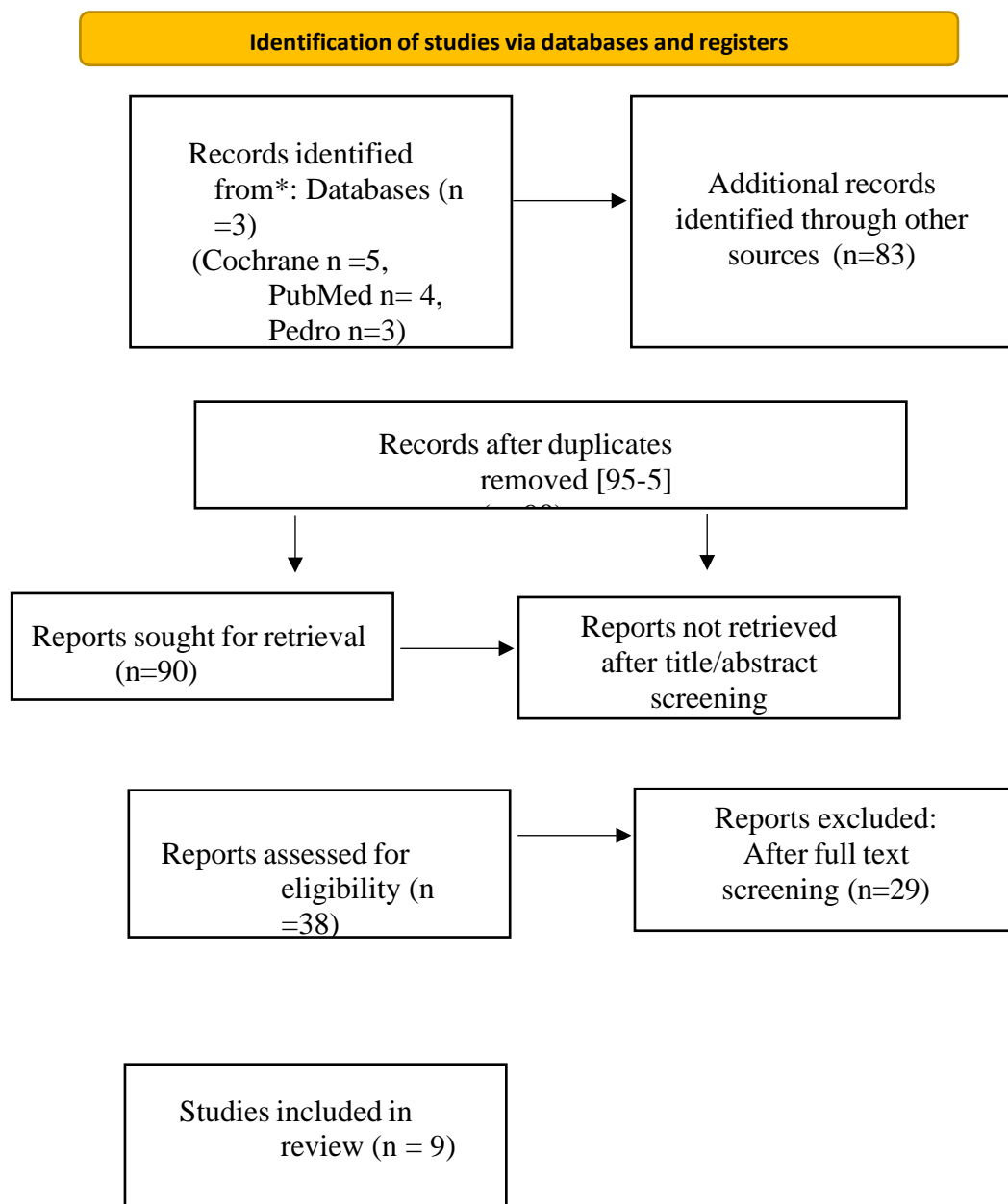


Figure 1 : - Flow diagram of study as per PRISMA guidelines

Table 2. Major characteristics of included studies

Sr. No.	Author	No. of Participants	Study Location	Study Duration	Treatment	Outcome Measures	Results
1	Ahmed M. <i>et al.</i> , 2022	N=42, McKenzie group (MG) (n=21) and Postural Correction band group (PCB) (n=21)	Lahore	2 weeks	MG: McKenzie exercise for 2 weeks PCB: Postural correction band for 2 hours	Chest expansion measurements First- at axillary level chest, Second- at 4 th intercostal space and Third- at xiphisternum level	There are significant effects of wearing PCB on chest expansion with mean clinical difference and statistical significance.
2	Tamilarasan A. <i>et al.</i> (2022)	N=20, McKenzie group (MG) (n=10) and Suboccipital release group (SG) (n=10)	Coimbatore, Tamil Nādu	4 weeks	MG: McKenzie exercises for 20 min/day in 3 times a week/ 4 weeks SG: Suboccipital release for 4 minutes before McKenzie exercise	Craniovertebral angle (CVA) Neck disability index (NDI)	There was significant difference in both groups. McKenzie exercise helps us to improve CVA and reduce disability in FHP than suboccipital release.
3	Deshpande V. <i>et al.</i> , 2019	N=30, McKenzie group (MG), Neck Exercise group (NEG) And Combination group (CG)	Maharashtra, India	4 weeks	MG: McKenzie exercise repeated 10 times, 3 times/week for 4weeks NCG: Neck exercises; deep cervical flexors strengthening (10 times),	Craniovertebral angle (CVA) Cranial rotation angle (CRA) Cervical ROM Craniocervical flexion test Neck disability index (NDI)	Both McKenzie approach and Neck exercises were effective in treating Forward Head Posture but statistically significant difference was found between groups MG & NCG, NCG & CG but there

					Sub-occipitals stretching (4 times) and self-stretching CG: combination of both exercises		was no significant difference found between groups MG & CG.
4	Kage V. <i>et al.</i> , 2016	N=30, McKenzie group (MG), Deep neck flexor Strengthening exercises group (NEG) Pectoralis minor stretching group (PSG)	Karnataka, India	6 sessions	MG: 4 McKenzie exercises was given NEG: 4 stretches for 30 sec holds with 30 sec rest was given PSG: was given to both groups for 6 sessions	Cervical ROM Pectoralis minor length Postural analysis through plumb line	Both the McKenzie neck exercises and deep neck flexor strengthening exercises showed no statistically significant differences. (p<0.05) but showed statistically significant differences within the groups.

Sr. No.	Author	No. of Participants	Study Location	Study Duration	Treatment	Outcome Measures	Results
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5	Kim EY. et al., (2015)	N=25 McKenzie group (MG) (n=13) Deep cervical flexor strengthening exercise group (DCG) (n=12)	Korea	4 weeks	MG: McKenzie exercises performed 3 times/week for 4 weeks DCG: Exercise performed using Pressure biofeedback unit (PBU)	Neck disability index (NDI) Breath testing unit (FVC, FEV1) Pressure biofeedback unit (PBU)	In comparison of FVC and degree of breathing in expiratory volume showed no statistically significant, NDI shows statistically significant changes and static muscular strength of deep cervical flexors revealed statistically significant in both groups.
6	Kim J. et al., (2018)	N=28 Group A (MG+MFR) Group B (MG +Kinesio taping) Group C (MG+MFR+ Kinesio taping)	Korea	4 weeks	MG: maintained peak isometric force for 7 sec/ 15 reps. MFR: performed for each muscle by using a lacrosse ball. 3 sets/15 reps. Kinesio taping: 2 elastic tape was used in V shape around C7-T1 junction	Acromian-tragus (A-T length) Craniovertebral angle (CVA) Cranial rotation angle (CRA) Neck disability index (NDI)	A-T length change in all three groups, CVA only significantly change in group C and CRA changes in all three groups, However, these increases were not statistically significant.
7	Kim S. et al., (2019)	N=30 McKenzie group (MG) (n=15), Control group (CG) (n=15)	Korea	4 weeks	MG: McKenzie exercise consist 7 exercises performed with 15-20 reps/20min/day/3 times/week/	Craniovertebral angle (CVA) Respiratory parameters (FVC, FVC % Predicted, FEV1 and FEV1 %	In McKenzie group CVA increases and respiratory parameter were significantly improved. There was no significant improvement in control group.

					.4weeks CG: didn't receive any intervention.	Prediction)	
8	Lee DY. et al., (2017)	N=28 McKenzie group (MG) (n=9) Self- stretch group (SG) (n=10) Kendall exercise group (KG) (n=9)	Korea	8 weeks	MG: 7 exercises repeated 20 times SG: Each movement performed 10 sets KG: all exercises 25/day/3 times/ week/ 8weeks	Craniovertebral angle (CVA) Rounded shoulder by scapular index	Changes in the CVA and the scapular index results had no significant differences statistically (p>0.05). The post-test results using the LSD did have a significant difference between SG and KG statistically (p<0.05).

Sr. No.	Author	No. of Participants	Study Location	Study Duration	Treatment	Outcome Measures	Results
9	Wah YC. et al., (2022)	N= 30 McKenzie exercise (MG) (n=15) Postural correction group (PC) (n=15)	Malaysia	6 weeks	MG: consist 7 exercises performed 3 days/week/6 weeks PC: Performed 3days/week/6w eeks	Visual analog scale (VAS) Range of motion (ROM) Neck disability index (NDI) Copenhagen neck disability scale (CDS) Neck Bournemouth Questionnaire (NBQ)	There was statistically significant improvement in both group after intervention (p<0.01).

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Ahmed M. et al. 2022	?	-	-	-	-	+	+
Anthoni T. et al. 2022	-	-	-	+	+	+	?
Deshpande V. et al. 2019	?	-	-	-	?	+	+
Kage V. et al. 2016	+	+	-	-	+	?	+
Kim EY. et al. 2015	?	-	-	-	+	+	?
Kim J. et al. 2018	?	-	-	-	+	+	+
Kim S. et al. 2019	?	-	-	-	+	+	+
Lee DY. et al. 2017	?	-	-	-	+	?	+
Wah YC. et al. 2022	?	-	-	-	+	+	+

Fig. (2) Risk of bias summary. Studies in green or + are at low risk of bias. Studies in red or - are at high risk of bias. Studies in blank are at unclear risk of bias

3. RESULTS

Search Results

After doing a preliminary search in four databases—Google Scholar, Cochrane Library, PubMed, and Pedro—a total of 95 studies were found. Using the Mendeley Desktop programme, 5 records were removed because of duplication. Based on the eligibility requirements, the titles and abstracts of the remaining 90 studies were examined. 52 records were left out after the initial scanning because they didn't meet the criteria for inclusion. 29 articles from the remaining 38 full-text papers were eliminated for the reasons shown in Figure 1 after they had been examined. Excluded studies were also checked for any potential omissions. The flow diagram for the investigation was shown in Figure 1. Six articles were chosen for the quantitative analysis (meta-analysis) out

of the nine total studies that were included in the qualitative analysis (systematic review)

Characteristics of Included Studies

Table 1 provides characteristics of the included studies. All of them were randomized controlled trials. These studies were conducted in Lahore, Tamil Nadu, Maharashtra, Karnataka, Malaysia and Korea (4).

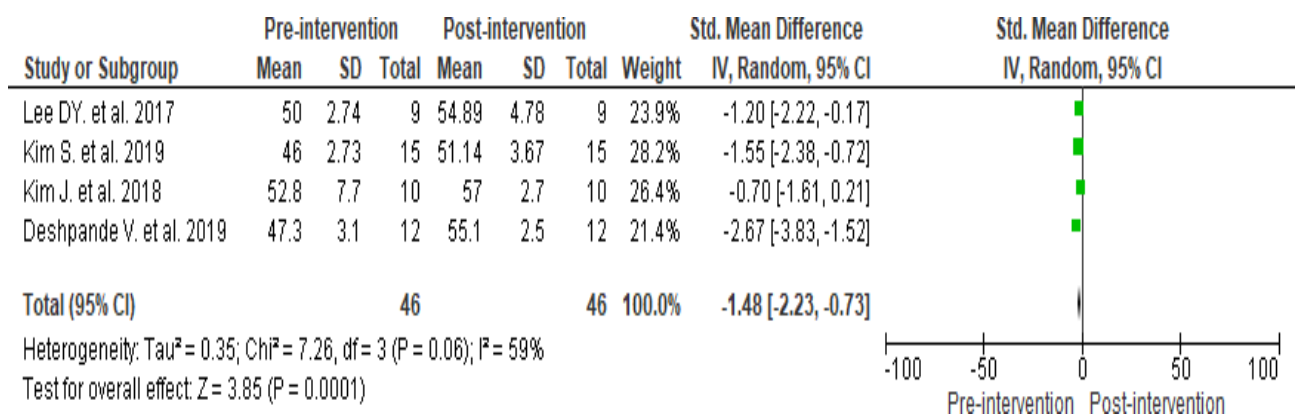
Subject in these studies underwent McKenzie exercises with Postural Correction band, Suboccipital release, Neck Exercise, Deep neck flexor Strengthening exercises plus Pectoralis minor stretching, MFR plus kinesio tapping, Self- stretch group plus Kendall exercise group and postural correction were also incorporated. Study protocol ranged from 6 sessions to 4 weeks.

Risk of Bias Assessment

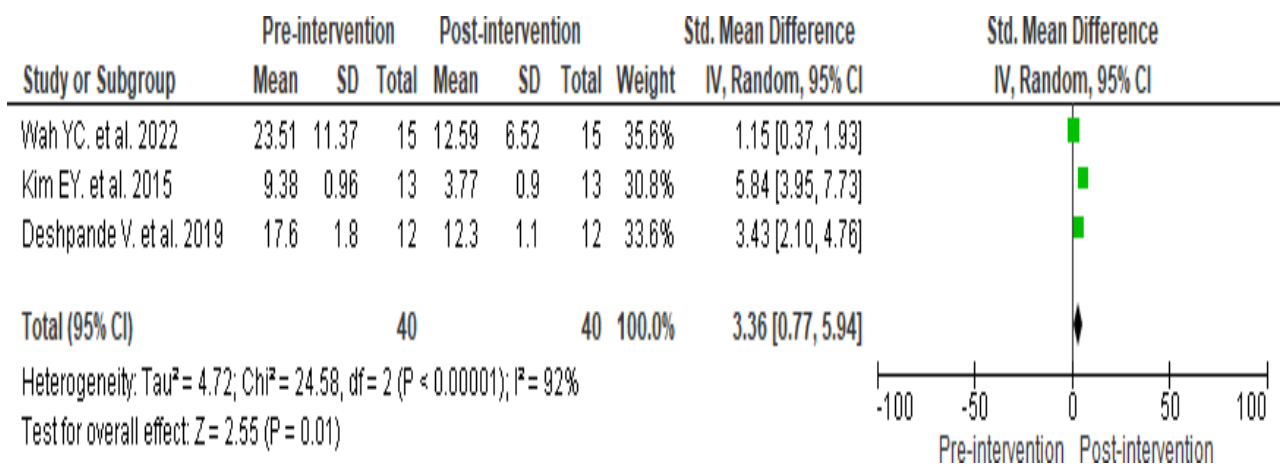
The Cochrane tool was used to conduct the risk of bias assessment, which is shown in fig. (2) (Higgins *et al.*,2008). Overall quality of the included study was low, one two studies were considered moderate risk of bias and the remainder were considered at high risk.

Meta-analysis

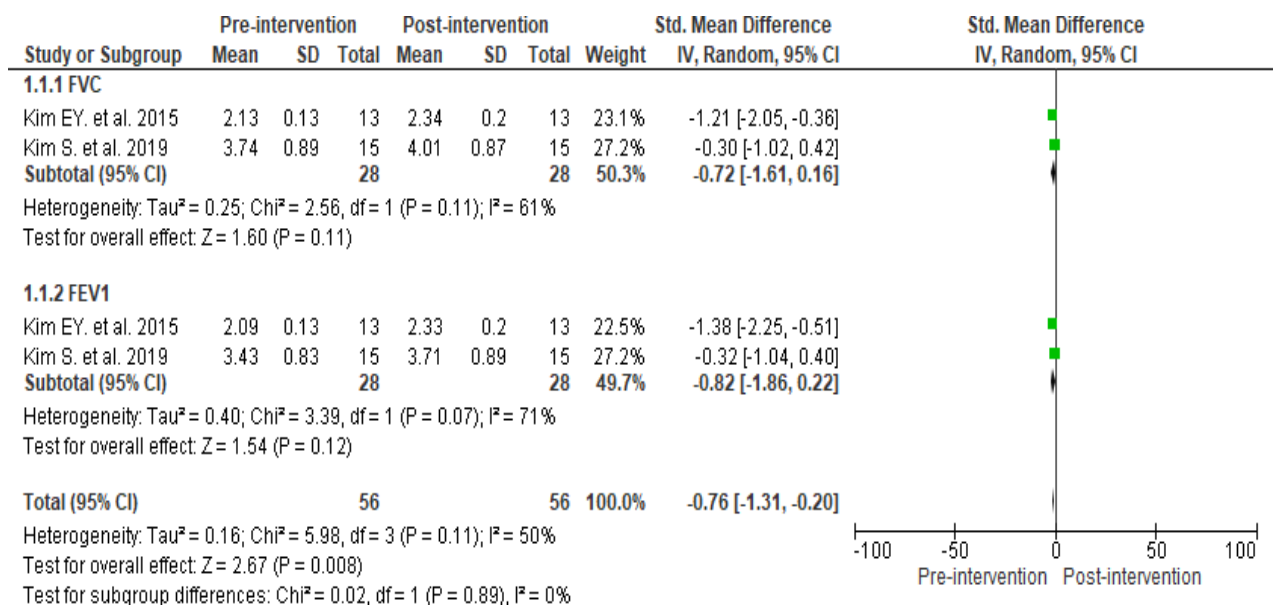
For the meta-analysis six articles were included with outcome measures as Craniovertebral angle (CVA), Neck disability index (NDI) and respiratory parameters (FVC & FEV1) to find out the effect of McKenzie exercise in patients of forward head posture. Primary outcome measure as craniovertebral angle (CVA) contributes the data (mean difference=-1.48; 95% CI: -2.23 to -0.73; heterogeneity $I^2=59\%$; $p=0.06$) from three studies. From the four studies contributes the data of secondary outcome measures as neck disability index (Mean Difference=- 3.36; 95% CI: 0.77 to 5.94; $I^2=92\%$; $p<0.00001$). Result of tertiary outcome measures as respiratory parameters from two studies: (FVC) MD=-0.72, CI: -1.61 to -0.16; $I^2=61\%$; $p=0.11$), (FEV1) MD=-0.82, CI: -1.86 to 0.22; $I^2=71\%$; $p=0.07$.



Mean difference between pre and post intervention of CVA



Mean difference between pre and post intervention of NDI



Mean difference between pre and post intervention of respirator parameter

Sensitivity analysis

On the meta-analysis with strong heterogeneity, sensitivity analysis was also carried out. Exclusion of two studies from the meta-analysis because of no single outcome measure match with other outcome measures for analysis. One study is also excluded because no standard deviation value is given in the article only mean value are given.

4. DISCUSSION

Using a systematic review and meta-analysis, this study can determine how the McKenzie exercise affects the forward head posture. The findings of a meta-analysis demonstrate that the end measures for this study were

changes in respiratory parameters as well as improvements in the neck disability index and craniovertebral angle.

The posture that results from excessive extension of the upper cervical vertebrae and forward bending of the lower cervical vertebrae is referred to as forward head posture. The activities and lifestyle of modern people are some of the causes of this posture. The habit of using electronic devices such computers and smartphones has a significant impact on most instances, with the exception of those where the occupational component is present. Long-term usage of visual display devices like smartphones can lead to incorrect postures such forward head posture, which causes round shoulders, increased cervical lordosis, and decreased vital capacity and thoracic cavity (Kim *et al.*, 2015).

Physical therapy can be utilised in a variety of ways to improve FHP. The McKenzie exercise involves mobilisation and manipulation and is performed by patients as a kind of self-therapy. It focuses mostly on stretching exercises and is well known for improving neck posture (Lee *et al.*, 2017). The McKenzie technique is one of the most popular treatments for treating spinal problems, including dysfunctions like FHP. Patients are treated using a suitable repeated loading strategy that is progressed in accordance with patient response, as well as postural correction (Deshpande *et al.*, 2019).

The review's outcome variables included the craniovertebral angle, the neck disability score, and respiratory parameters. Assessment of forward head posture involves measuring the craniovertebral angle. The angle was created by drawing a line across C7 that was level and perpendicular to the ground, as well as a line through C7 and the tragus of the ear (Deshpande *et al.*, 2019). It is measured by the Kinovea programme (Deshpande *et al.*, 2019) and the "ON PROTRACTOR" application (Tamilarasan *et al.*, 2022). Studies that showed improvements in CVA with McKenzie exercise with suboccipital release, neck exercise group, McKenzie, MFR and Kinesio taping, self-stretching with Kendall exercises were included.

The Neck Disability Index is rated on a 0 to 5 rating scale, with zero denoting "No pain" and five denoting "worst imaginable pain." The raw value can be reported as a percentage or can be doubled. (Wah *et al.*, 2022). When the NDI was compared in Kim's study before and after training, the McKenzie exercises and deep neck flexor strengthening exercise both showed statistically significant improvements. The neck disability score before McKenzie exercises and posture correction in Wah *et al.*, 2022 study had a mean of 12.59, which was better than the mean after those interventions (mean=23.51). Following suboccipital release and McKenzie exercises, there was a significant improvement in the neck disability index and craniovertebral angle (Anthoni *et al.*, 2022).

A breathing test unit is a tool used to assess pulmonary volumes and ventilation. Cardio Touch 3000S was used to measure Forced Vital Capacity (FVC) and Forced Expiratory Volume for One Second (FEV1) (Kim *et al.*, 2015), as well as spirometer measurements. Following the intervention for four weeks, the McKenzie group's FVC and FVC% pred significantly increased (p 0.05). Also, substantially higher (p 0.05) were FEV1 and FEV1%pred. According to this study's findings (Kim *et al.*, 2019), McKenzie exercise can help with breathing and forward head position. This meta- analysis and systematic review validate that McKenzie exercises are effective in improving craniovertebral angle, neck disability index and respiratory parameters in patients with forward head posture. The meta-analysis revealed that there is a moderate amount of heterogeneity. Sensitivity analysis was performed to see the various sources of heterogeneity.

The systematic review and meta-analysis had a number of significant effects. First of all, to the best of our knowledge, it is the first review study to evaluate the impact of McKenzie exercise on forward head posture. Second, it followed the PRSIMA guidelines for reporting systematic reviews. Thirdly, review is registered in advance on a prospective register like PROSPERO. This study had certain shortcomings despite its advantages. This study's main flaw is that the studies are not connected to one another. Significant clinical implications

result from this systematic review and meta-analysis. The craniovertebral angle, the neck disability score, and respiratory parameters can all be improved with McKenzie exercises.

CONCLUSION

Based on the results of this meta-analysis, the study's conclusion is that the McKenzie exercises programmed can considerably improve the craniovertebral angle, neck disability index, and respiratory parameters in patients with a forward head posture. As a result, it is possible to propose that structured exercise programmes be recommended for the treatment of forward head posture.

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ANALYTICAL REVIEW OF LINEAR ALGORITHMIC APPROACH

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Analyzing performance of sorting techniques in terms of time and memory requirements and efficiency of linear-time algorithm. Two important ways to characterize the effectiveness of an algorithm are its space complexity and time complexity. Time complexity of an algorithm concerns determining an expression of the number of steps needed as a function of the problem size. We analytically review insertion sort and Merge sort Algorithms on the basis of their performance, their time complexity as well as their space complexity.

Keywords: Asymptotic Analysis, Big Oh Notation, quadratic function, Divide and Conquer paradigm.

1. INTRODUCTION

An algorithm, named after the ninth century scholar Abu Jafar Muhammad Ibn Musu Al-Khowarizmi, is defined as follows:

- An algorithm is a set of rules for carrying out calculation either by hand or on a machine.
- An algorithm is a finite step-by-step procedure to achieve a required result.
- An algorithm is a sequence of computational steps that transform the input into the output.
- An algorithm is a sequence of operations performed on data that have to be organized in data structures.
- An algorithm is an abstraction of a program to be executed on a physical machine (model of Computation).

Finiteness of a computational method is the property that the number of steps in any execution of the method must be finite. The finiteness property is also called termination, and the method is said to be terminating. Algorithm is a synonym for finite computational method, a computational method with the additional property of finiteness. Every abstraction that belongs to an algorithm concept must have the termination property. Note that among the abstractions belonging to a computational method concept, some might be terminating while others are non terminating.

Refinements: An Algorithm can be refined by two ways.

- Algorithm Specialized by Input.
- Algorithm Specialized by Strategy.
- Strategy: The strategy depends on two characteristics of the problem to be solved, optimal substructure and overlapping sub problems.
- Optimal substructure: A problem is said to have optimal substructure if the optimal solution to the problem contains within it optimal solutions to the contained sub problems.
- Overlapping sub problems: A problem exhibits overlapping sub problems if the total number of sub problems required to assemble and solve the complete problem is "small," generally polynomial in the input size. In other words, a naive recursive (top down) approach to the problem would re compute the

solution to the sub problems many times. Taking advantage of the above properties, a dynamic programming algorithm functions in a bottom up fashion.

The overall strategy can be described as:

- Compute and store the solutions to all of the simplest sub problems.
- Repeat until the full problem has been solved.

There are enough hard problems to worry about without having to face up to the exact limitations on arithmetic that real hardware tends to impose. The so called “procedural” programming languages provide for vectors or arrays of these primitive types, where an integer index can be used to select out a particular element of the array, with the access taking unit time. For the moment it is only necessary to consider one-dimensional arrays. It will also be supposed that one can declare record data types, and that some mechanism is provided for allocating new instances of records and (where appropriate) getting rid of unwanted ones. The introduction of record types naturally introduces the use of pointers. Note that languages like ML provide these facility but not (in the core language) arrays, so sometimes it will be worth being aware when the fast indexing of arrays is essential for the proper implementation of an algorithm. Another issue made visible by ML is that of updatability: in ML the special constructor `ref` is needed to make a cell that can have its contents changed. Again it can be worthwhile to observe when algorithms are making essential use of update-in-place operations and when that is only an incidental part of some particular encoding.

Category: One important and exclusive distinction one can make is, whether the algorithm is deterministic or randomized.

Deterministic algorithms produce on a given input the same results following the same computation steps.

Randomized algorithms throw coins during execution. Hence either the order of execution or the result of the algorithm might be different for each run on the same input.

There are subclasses for randomized algorithms. Monte Carlo type algorithms and Las Vegas type algorithms.

- Las Vegas algorithms: A Las Vegas algorithm will always produce the same result on a given input. Randomization will only affect the order of the internal executions.
- Monte Carlo algorithms: The case of Monte Carlo algorithms, the result may might change, even be wrong. However, a Monte Carlo algorithm will produce the correct result with a certain probability.

2. LITERATURE REVIEW

Gupta Pooja (2008), In computer programming, the sorting problem is one that commonly occurs. To make sorting quick, several sorting algorithms have been created and enhanced. Performance has mostly been assessed and compared based on the average number of operations or average execution times of various algorithms. There isn't a single sorting technique that works well in every circumstance. The size of the list to be sorted, the programming effort, the amount of main memory words available, the size of the disk or tape units, the degree to which the list is already organized, and the distribution of values are some of the aspects to be taken into account when choosing a sorting method.

Paira et al. [12]: Timsort (2002), and Library sort (2006), One of the oldest computer science issues is the

sorting problem. Since the dawn of computers, several scholars have developed and examined techniques for sorting problems. Bubble sort was the initial sorting algorithm developed in 1956. Numerous helpful sorting algorithms, such as Merge sort, Tim sort (2002), and Library sort (2006), are constantly being developed. The literature contains a sizable number of sorting algorithms and their improvements. It would be nice to know that these sorting algorithm improvements are indeed superior to the traditional sorting algorithms. The authors used the cases of the traditional merge sort and the improved merge sort method put out by Paira et al. [12] for this purpose.

Using various random number distributions, writers have evaluated the performance of both approaches. In several applied areas of computer science, database applications, networks, and artificial intelligence, there are numerous well-known issues. The sorting problem has drawn a lot of study attention. It is one of these fundamental procedures and challenges. To improve the performance in terms of computing complexity, many sorting methods have been created. There are a number of things to consider, including memory space, stability, and temporal complexity. Our world's increasing information expansion encourages the development of more sort algorithms. Records with equal keys are kept in the relative order desired by a stable sorting algorithm. This study compares the performance of the Grouping Comparison Sort (GCS) algorithm with that of common algorithms such as Selection sort, Quick sort, Insertion sort, Merge sort, and Bubble sort.

It is possible to compare the two methods using both machine-dependent and machine-independent criteria. Factors that depend on certain machine setups can be measured and compared. The time it takes for each algorithm to complete a sorting operation is quantified as a measure of computational complexity, which is regarded as a machine-dependent factor. The elements that may be examined and compared from a general standpoint using mathematical constructs or depending on each algorithm's behavior are known as machine independent factors. Machine independent aspects include things like memory utilization, stability, memory usage metrics like worst case, average case, and best case, internal/external sorting, system complexity, and so on.

These are the definitions of the variables this study took into account:

- Internal Sorting looks at how the main memory sorts information. This could be immediate or indirect. External Sorting examines the mode of sorting carried out in the auxiliary memory.
- The worst, medium, and best case scenarios can be used to categorize system complexity.
- Computing complexity be assessed by counting the swaps the algorithm does while sorting the data.
- Memory Usage is the amount of memory used depends on the algorithm.
- Stability evaluates the condition of the input and output records as indicated by the arrangement of its components before to and following sorting..
- To test the software where the two techniques are implemented, several array sizes are employed.

Algorithm's Performance

Two important ways to characterize the effectiveness of an algorithm are its space complexity and time complexity. Time complexity of an algorithm concerns determining an expression of the number of steps

needed as a function of the problem size. Since the step count measure is somewhat coarse, one does not aim at obtaining an exact step count. Instead, one attempts only to get asymptotic bounds on the step count. Asymptotic analysis makes use of the O (Big Oh) notation. Two other notational constructs used by computer scientists in the analysis of algorithms are Θ (Big Theta) notation and Ω (Big Omega) notation.

The performance evaluation of an algorithm is obtained by totaling the number of occurrences of each operation when running the algorithm. The performance of an algorithm is evaluated as a function of the input size n and is to be considered modulo a multiplicative constant.

Notations

The following notations are commonly use notations in performance analysis and used to characterize the complexity of an algorithm.

Θ -Notation (Same order)

This notation bounds a function to within constant factors. We say $f(n) = \Theta(g(n))$ if there exist positive constants n_0 , c_1 and c_2 such that to the right of n_0 the value of $f(n)$ always lies between $c_1 g(n)$ and $c_2 g(n)$ inclusive.

O -Notation (Upper Bound)

This notation gives an upper bound for a function to within a constant factor. We write $f(n) = O(g(n))$ if there are positive constants n_0 and c such that to the right of n_0 , the value of $f(n)$ always lies on or below $c g(n)$.

Ω -Notation (Lower Bound)

This notation gives a lower bound for a function to within a constant factor. We write $f(n) = \Omega(g(n))$ if there are positive constants n_0 and c such that to the right of n_0 , the value of $f(n)$ always lies on or above $c g(n)$.

3. ALGORITHM ANALYSIS

An algorithm can be analyzed on the basis of some criteria like run time, cost and performance. We will discuss in following sections.

Performance Analysis

Probably the most important special case of a table is when the keys are known to be drawn from the set of integers in the range $0, \dots, n$ for some modest n . In that case the table can be modeled directly by a simple vector, and both **set** and **get** operations have unit cost. If the key values come from some other integer range (say a, \dots, b) then subtracting a from key values gives a suitable index for use with a vector. If the number of keys that are actually used is much smaller than the range $(b - a)$ that they lie in this vector representation becomes inefficient in space, even though its time performance is good.

Run time Analysis

The exposition is based on the following sources, which are all required reading: Corman, Leiserson, Rivest: Introduction to algorithms, we recall the basic notations for run time analyses and then describe the different

concepts of worst-case run time, average case run time, expected run time, amortized run time, and the analysis of competitiveness. Let's start by recalling the definitions of the Landau symbols:

- $O(f) := \{g : \mathbb{N} \rightarrow \mathbb{R}^+ : \exists c \in \mathbb{R}^+, n_0 \in \mathbb{N} : \forall n \geq n_0 : g(n) \leq c \cdot f(n)\}$
- $\Omega(f) := \{g : \mathbb{N} \rightarrow \mathbb{R}^+ : \exists c \in \mathbb{R}^+, n_0 \in \mathbb{N} : \forall n \geq n_0 : g(n) \geq c \cdot f(n)\}$
- $\Theta(f) := \{g : \mathbb{N} \rightarrow \mathbb{R}^+ : \exists c_1, c_2 \in \mathbb{R}^+, n_0 \in \mathbb{N} : \forall n \geq n_0 : c_1 \cdot f(n) \leq g(n) \leq c_2 \cdot f(n)\}$
- $o(f) := \{g : \mathbb{N} \rightarrow \mathbb{R}^+ : \lim_{n \rightarrow \infty} \frac{g(n)}{f(n)} = 0\}$
- $\omega(f) := \{g : \mathbb{N} \rightarrow \mathbb{R}^+ : \lim_{n \rightarrow \infty} \frac{g(n)}{f(n)} = \infty\}$

In the following we list some commonly used adjectives describing classes of functions. We say a function f :

- is constant, if $f(n) = c$
- grows logarithmically, if $f(n) = O(\log n)$
- grows polylogarithmically, if $f(n) = O(\log^k n)$ for a $k \in \mathbb{N}$.
- grows linearly, if $f(n) = O(n)$
- grows quadratic, if $f(n) = O(n^2)$
- grows polynomially, if $f(n) = O(n^k)$, for a $k \in \mathbb{N}$.
- grows superpolynomially, if $f(n) = O(n^k)$, $k \in \mathbb{N}$.
- grows sub exponentially, if $f(n) = o(2^{cn})$, $0 < c \in \mathbb{R}$.
- grows exponentially, if $f(n) = O(2^{cn})$ for a $0 < c \in \mathbb{R}$.

Run time definitions:

Worst case analysis:

We assume for both, the input and the execution of the algorithm the worst case. The latter is of course only applicable for non-deterministic algorithms.

Best case analysis:

We assume for both, the input and the execution of the algorithm the best case. The latter is of course only applicable for non-deterministic algorithms.

Average case analysis:

We average over all possible input the run time of our (deterministic) algorithm.

Expected run time analysis:

Our algorithm runs depending on the value of some random variables for which we know their distributions. Hence we try to estimate the expected run time of the algorithm.

Amortized analysis:

Sometimes, an algorithm (usually an operation on a data structure) needs a long time to run, but changes the data structure such that subsequent operations are not costly. A worst case run time analysis would be inappropriate. An amortized analysis averages over a series of operations (not over the input).

Competitiveness analysis:

For online algorithms we need a new concept of run time analysis. The main concept is to compare the run time an algorithm needs in the worst case (i.e. for all possible inputs) not knowing the input, with the runtime of an

optimal offline algorithm (which knows the input). The well-known (deterministic) quick sort algorithm for sorting an array chooses a fixed element as its pivot element, lets say w.l.o.g. the first one. It arranges all smaller elements on the left of the pivot, all larger ones on the right and recurses on the two halves.

Worst case analysis:

In the worst case, the left (or the right) half are always empty. Hence the worst case run time is the solution to the recurrence.

Complexity Analysis:

The complexity of an algorithm is a function $g(n)$ that gives the upper bound of the number of operation (or running time) performed by an algorithm when the input size is n .

There are two interpretations of upper bound.

- **Worst-case Complexity:**

The running time for any given size input will be lower than the upper bound except possibly for some values of the input where the maximum is reached.

- **Average-case Complexity**

The running time for any given size input will be the average number of operations over all problem instances for a given size.

Cost Analysis

Usually the simplest way of analyzing an algorithm is to find the worst case performance. It may help to imagine that somebody else is proposing the algorithm, and you have been challenged to find the very nastiest data that can be fed to it to make it perform really badly. In doing so you are quite entitled to invent data that looks very unusual or odd, provided it comes within the stated range of applicability of the algorithm. For many algorithms the “worst case” is approached often enough that this form of analysis is useful for realists as well as pessimists. Average case analysis ought by rights to be of more interest to most people (worst case costs may be really important to the designers of systems that have real-time constraints, especially if there are safety implications in failure). But before useful average cost analysis can be performed one needs a model for the probabilities of all possible inputs. If in some particular application the distribution of inputs is significantly skewed that could invalidate analysis based on uniform probabilities. For worst case analysis it is only necessary to study one limiting case; for average analysis the time taken for every case of an algorithm must be accounted for and this makes the mathematics a lot harder (usually). Amortised analysis is applicable in cases where a data structure supports a number of operations and these will be performed in sequence. Quite often the cost of any particular operation will depend on the history of what has been done before, and sometimes a plausible overall design makes most operations cheap at the cost of occasional expensive internal re-organization of the data. Amortised analysis treats the cost of this re-organization as the joint responsibility of all the operations previously performed on the data structure and provide a firm basis for determining if it was worth-while. Again it is typically more technically demanding than just single-operation worst-case analysis.

A good example of where amortised analysis is helpful is garbage collection where it allows the cost of a single large expensive storage reorganization to be attributed to each of the elementary allocation transactions that made it necessary. Note that (even more than is the case for average cost analysis) amortized analysis is not appropriate for use where real-time constraints apply.

Estimation of cost via recurrence formulae

Consider particularly the case of divide and conquer. Suppose that for a problem of size n the division and combining steps involve $O(n)$ basic operations. Suppose furthermore that the division stage splits an original problem of size n into two sub-problems each of size $n/2$. Then the cost for the whole solution process is bounded by $f(n)$, a function that satisfies $f(n) = 2f(n/2) + kn$ where k is a constant ($k > 0$) that relates to the real cost of the division and combination steps.

This recurrence can be solved to get $f(n) = \Theta(n \log(n))$. More elaborate divide and conquer algorithms may lead to either more than two sub-problems to solve, or sub-problems that are not just half the size of the original, or division/combination costs that are not linear in n .

The one is the recurrence that corresponds to algorithms that at linear cost (constant of proportionality k) can reduce a problem to one smaller by a fixed factor α : $g(n) = g(\alpha n) + kn$ where $\alpha < 1$ and again $k > 0$. This has the solution $g(n) = \Theta(n)$. If α is close to 1 the constant of proportionality hidden by the Θ notation may be quite high and the method might be correspondingly less attractive than might have been hoped. A slight variation on the above is $g(n) = pg(n/q) + kn$ with p and q integers. This arises when a problem of size n can be split into p sub-problems each of size n/q .

If $p = q$ the solution grows like $n \log(n)$, while for $p > q$ the growth function is n^β with $\beta = \log(p)/\log(q)$. A different variant on the same general pattern is $g(n) = g(\alpha n) + k$, $\alpha < 1$, $k > 0$ where now a fixed amount of work reduces the size of the problem by a factor α . This leads to a growth function $\log(n)$.

4. SORTING

Algorithms are bound to discuss a number of sorting methods. The volume 3 of Knuth is dedicated to sorting and the closely related subject of searching; it is a big or complex topic with much number of techniques.

Minimum cost of sorting

If I have n items in an array, and I need to end up with them in ascending order, there are two low-level operations that I can expect to use in the process. The first takes two items and compares them to see which should come first. To start with this course will concentrate on sorting algorithms where the only information about where items should end up will be that deduced by making pair wise comparisons. The second critical operation is that of rearranging data in the array, and it will prove convenient to express that in terms of "interchanges" which swap the contents of two nominated array locations. In extreme cases either comparisons or interchanges may be hugely expensive, leading to the need to design methods that optimize one regardless of other costs. It is useful to have a limit on how good a sorting method could possibly be measured in terms of these two operations. Assertion: If there are n items in an array then $\Theta(n)$ exchanges suffice to put the items in order. In the worst case $\Theta(n)$ exchanges are needed. Proof: identify the smallest item present, then if it is not already in the right place one exchange moves it to the start of the array. A second exchange moves the next smallest item to place, and so on. After at worst $n-1$ exchanges the items are all in order. The bound is $n-1$ not n because at the very last stage the biggest item has to be in its right place without need for a swap, but that level of detail is unimportant to Θ notation. Conversely consider the case where the original arrangement of the data is such that the item that will need to end up at position i is stored at position $i+1$ (with the natural wrap-around at the end of the array). Since every item is in the wrong position I must perform exchanges that touch each position in the array, and that certainly means I need $n/2$ exchanges, which is good enough to establish the $\Theta(n)$ growth rate. Tighter analysis should show that a full $n-1$ exchanges are in fact needed in the worst case. Assertion: Sorting by pair wise comparison, assuming that all possible arrangements of the data are equally likely as input, necessarily costs at least $\Theta(n \log(n))$ comparisons. Proof: there are $n!$ Permutations of n items,

and in sorting we in effect identify one of these. To discriminate between that many cases we need at least $\log_2(n!)$ binary tests. Sterling's formula tells us that $n!$ is roughly nn , and hence that $\log(n!)$ is about $n \log(n)$. Note that this analysis is applicable to any sorting method that uses any form of binary choice to order items, that it provides a lower bound on costs but does not guarantee that it can be attained, and that it is talking about worst case costs and average costs when all possible input orders are equally probable. For those who can't remember Stirling's name or his formula, the following argument is sufficient to prove the $\log(n!) = \Theta(n \log(n))$.

$$\log(n!) = \log(n) + \log(n-1) + \dots + \log(1)$$

Often if interchanges seem costly it can be useful to sort a vector of pointers to objects rather than a vector of the objects themselves — exchanges in the pointer array will be cheap.

All n terms on the right are less than or equal to $\log(n)$ and so $\log(n!) \leq n \log(n)$. The first $n/2$ terms are all greater than or equal to $\log(n/2) = \log(n) - 1$, so $\log(n!) \geq n/2(\log(n) - 1)$

Thus for large enough n , $\log(n!) \geq kn \log(n)$ where $k = 1/3$, say.

Stability of sorting methods

Often data to be sorted consists of records containing a key value that the ordering is based upon plus some additional data that is just carried around in the rearranging process. In some applications one can have keys that should be considered equal, and then a simple specification of sorting might not indicate what order the corresponding records should end up in the output list. "Stable" sorting demands that in such cases the order of items in the input is preserved in the output. Some otherwise desirable sorting algorithms are not stable, and this can weigh against them. If the records to be sorted are extended to hold an extra field that stores their original position, and if the ordering predicate used while sorting is extended to use comparisons on this field to break ties then an arbitrary sorting method will rearrange the data in a stable way. This clearly increases overheads a little.

Simple sorting

We saw earlier that an array with n items in it could be sorted by performing $n-1$ exchanges. This provides the basis for what is perhaps the simplest sorting algorithm — at each step it finds the smallest item in the remaining part of the array and swaps it to its correct position. This has as a sub-algorithm: the problem of identifying the smallest item in an array. The sub-problem is easily solved by scanning linearly through the array comparing each successive item with the smallest one found earlier. If there are m items to scan then the minimum finding clearly costs $m-1$ comparisons. The whole insertion sort process does this on sub-arrays of size $n, n-1, \dots, 1$. Calculating the total number of comparisons involved requires summing an arithmetic progression: after lower order terms and constants have been discarded we find that the total cost is $\Theta(n^2)$. This very simple method has the advantage (in terms of how easy it is to analyze) that the number of comparisons performed does not depend at all on the initial organization of the data. Now suppose that data movement is very cheap, but comparisons are very expensive. Suppose that part way through the sorting process the first k items in our array are neatly in ascending order, and now it is time to consider item $k+1$. A binary search in the initial part of the array can identify where the new item should go, and this search can be done in $\log_2(k)$ comparisons. Then some number of exchange operations (at most k) put the item in place. The complete sorting process performs this process for k from 1 to n , and hence the total number of comparisons performed will be $\log_2(1) + \log_2(2) + \dots + \log_2(n-1)$ which is bounded by $\log_2((n-1)!) + n$.

This effectively attains the lower bound for general sorting by comparisons that we set up earlier. But remember that it has high (typically quadratic) data movement costs. One final simple sort method is worth mentioning. Insertion sort is perhaps a combination of the worst features of the above two schemes. When the first k items of the array have been sorted the next is inserted in place by letting it sink to its rightful place: it is compared against item k , and if less a swap moves it down. If such a swap is necessary it is compared against position $k - 1$, and so on. This clearly has worst case costs $\Theta(n^2)$ in both comparisons and data movement. It does however compensate a little: if the data was originally already in the right order then insertion sort does no data movement at all and only does $n - 1$ comparisons, and is optimal. Insertion sort is the method of practical choice when most items in the input data are expected to be close to the place that they need to end up.

The objective of the sorting algorithm is to rearrange the records so that their keys are ordered according to some well-defined ordering rule. There are two classes of sorting algorithms namely, $O(n^2)$ -algorithms and $O(n \log n)$ -algorithms. $O(n^2)$ class includes bubble sort, insertion sort, selection sort and shell sort. $O(n \log n)$ -class includes heap sort, merge sort and quick sort.

Types of Sorts: Basic types of sorting methods are discussed here

Internal Sort

If the file to be sorted will fit into memory or equivalently if it will fit into an array, then the sorting method is called internal. In this method, any record can be accessed easily.

External Sort

Sorting files from tape or disk. In this method, an external sort algorithm must access records sequentially or at least in the block.

The cost model used for memory access is adjusted to take account of reality. It will be assumed that we still have a reasonable sized conventional main memory on our computer and those accesses to that have unit cost. But it will be supposed that the bulk of the data to be handled does not fit into main memory and so resides on tape or disc, and that it is necessary to pay attention to the access costs that this implies.

- Major part of any external sorting method is liable to be breaking the data up into store-sized chunks and sorting each of those.
- The second point is that variants on merge-sort fit in very well with the sequential access patterns that work well with disc drives.
- The final point is that with truly large amounts of data it will almost certainly be the case that the raw data has well known statistical properties including the possibility that it is known that it is almost in order already, being just a modification of previous data that had itself been sorted earlier, and these should be exploited fully

Cost assumptions for External Sort

When Knuth's series of books were written magnetic tapes formed the main stay of large-scale computer storage. Since then discs have become larger, cheaper and more reliable, and tape-like devices are really only used for archival storage. Thus the discussions here will ignore the large and entertaining but archaic body of knowledge about how best to sort data using two, three or four tape drives that can or cannot read and write data backwards as well as forwards. The main assumption to be made about external storage will be that it is slow so slow that using it well becomes almost the only important issue for an algorithm. The next characteristic will be that sequential access and reading/writing fairly large blocks of data at once will be the best way to maximize data transfer. Seeking from one place on a disc to another will be deemed expensive. There will probably be an underlying expectation in this discussion that the amount of data to be handled is roughly between 10 Mbytes

and 10 Giga bytes. Much less data than that does not justify thinking about external processing, while much larger amounts may raise additional problems.

Memory Requirement

Sort in place and use no extra memory except perhaps for a small stack or table.

Algorithm that use a linked-list representation and so use N extra words of memory for list pointers. Algorithms that need enough extra memory space to hold another copy of the array to be sorted.

Stability

A sorting algorithm is called stable if it preserves the relative order of equal keys in the file. Most of the simple algorithm is stable, but most of the well-known sophisticated algorithms are not.

Execution Time

The comparison-based sorting algorithm has an $\Omega(n \log n)$ worst-case lower bound on its running time operation in sorting, then this is the best we can do. Note that in a comparison sort, we use only comparisons between elements to gain information about an input sequence $\langle a_1, a_2, \dots, a_n \rangle$. That is, given two elements a_i and a_j we perform one of the tests, $a_i < a_j$, $a_i \leq a_j$, $a_i = a_j$ and $a_i \geq a_j$ to determine their relative order

A Lower Bound for the Worst Case

The length of the longest path from the root to any of its leaves in decision tree represents the worst-case number of comparisons the sorting algorithms perform. Consequently, the worst-case number of comparisons corresponds to the height of its tree. A lower bound on the height of the tree is therefore a lower bound on the running time of any comparison sort algorithm.

The running time of any comparison-based algorithm for sorting an n -element sequence is $\Omega(n \lg n)$ in the worst case.

Insertion Sort

The insertion sort works on idea is that first take one element; iterate it through the sorted array. Its similar to the sorting of playing cards. Its Adaptive in nature means it is appropriate for data sets that are already substantially sorted.

If the first few objects are already sorted, an unsorted object can be inserted in the sorted set in proper place. This is called insertion sort. An algorithm consider the elements one at a time, inserting each in its suitable place among those already considered (keeping them sorted). Insertion sort is an example of an incremental algorithm; it builds the sorted sequence one number at a time. This is perhaps the simplest example of the incremental insertion technique, where we build up a complicated structure on n items by first building it on $n - 1$ items and then making the necessary changes to fix things in adding the last item. The given sequences are typically stored in arrays.

Algorithm

Step 1 : Assume first element as already sorted. Step2 : Store the next element in a separate key.

Step3 : Compare the key with all elements in the sorted array.

Step 4 : If the element in the sorted array is smaller than the current element, then move to the next element.

Else, shift greater elements in the array towards the right.

Step 5 : Insert the value.

Step 6 : Repeat until the array is sorted.

Pseudo code

We use a procedure INSERTION_SORT. It takes as parameters an array A [1.. n] and the length n of the array. The array A is sorted in place: the numbers are rearranged within the array, with at most a constant number outside the array at any time.

INSERTION_SORT (A)

1. FOR j ← 2 TO length[A]
2. DO key ← A[j]
Put A[j] into the sorted sequence A[1 .. j - 1]
4. i ← j - 1
5. WHILE i > 0 and A[i] > key
6. DO A[i + 1] ← A[i]
7. i ← i - 1
8. A[i + 1] ← key

Following figure shows the operation of INSERTION-SORT on the array A= (5, 2, 4, 6, 1, 3). Each part shows what happens for a particular iteration with the value of j indicated. j indexes the current number being inserted.

Examples of Insertion sort

Example with Alphabetic List: The following example illustrates insertion sort on alphabetic list.

```

B|E W I L D E R M E N T all to left of | are sorted
# #
B E|W I L D E R M E N T # #
B E W|I L D E R M E N T
# * *

B E I W|L D E R M E N T
# * * # = read, * = read-write B E
I L W|D E R M E N T
# * * * * *

B D E I L W|E R M E N T
# * * * *

B D E E I L W|R M E N T
# * *

B D E E I L R W|M E N T
# * * *
    
```

Figure 1: Alphabetical Insertion Sorting

Example with Numeric List: The following example illustrates insertion sort on numeric list.

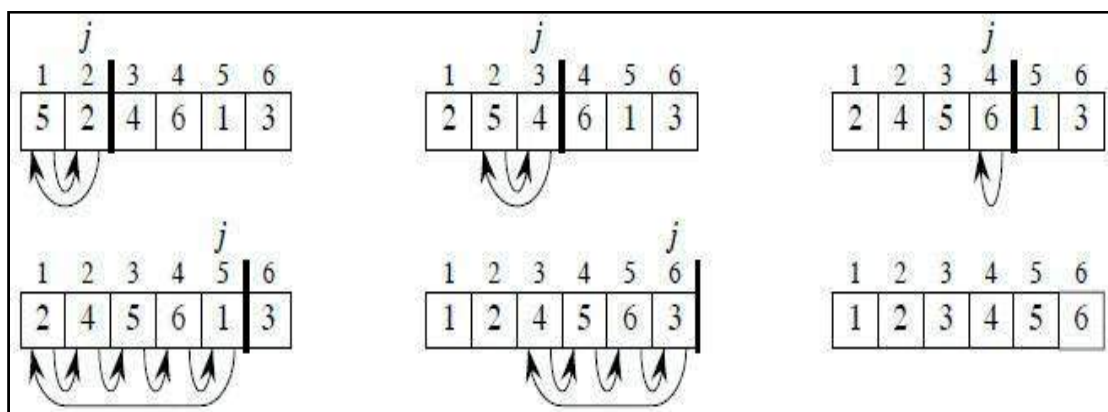


Figure 2: Numerical Insertion Sorting

Read Figure 2 row by row. Elements to the left of $A[j]$ that are greater than $A[j]$ move one position to the right, and $A[j]$ moves into the evacuated position.

Analysis

This analysis shows time complexity as well as space complexity of insertion sort

Execution Time

The following Graph shows the execution time of insertion sort. The Execution time of insertion sort is $O(n^2)$ which is diagrammatically shown below.

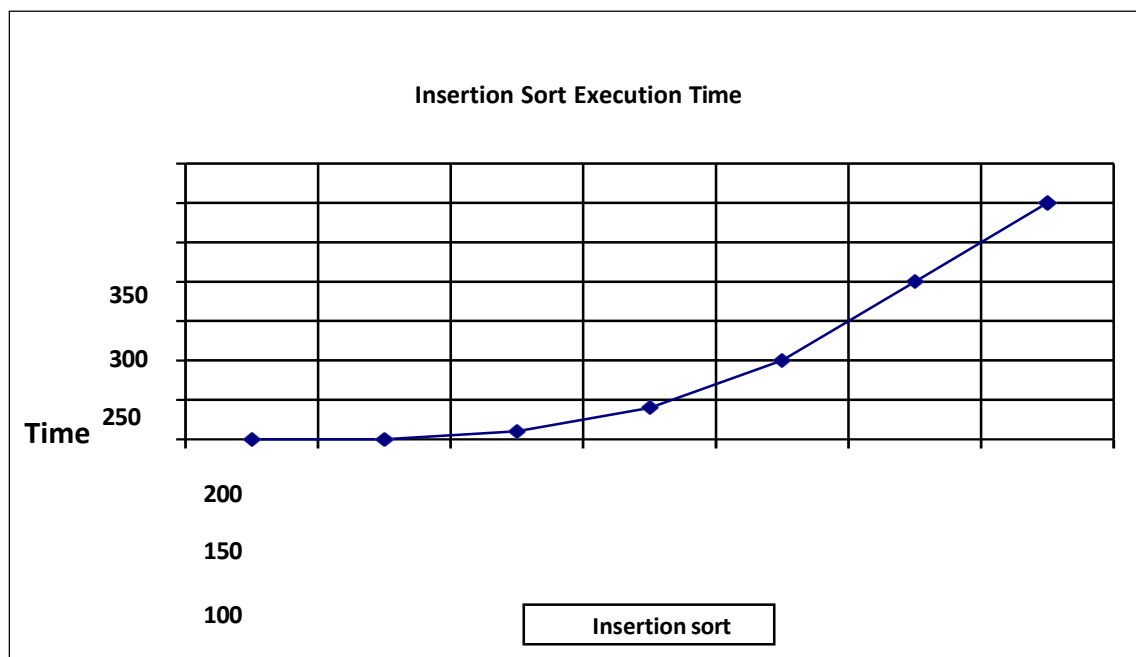


Figure 3: Execution Time Insertion Sort Algorithm ($O(n^2)$)

Insertion Sort Time complexity

- **Best Case Complexity $O(n)$** When there is no sorting required, i.e. the array is already sorted.
- **Average Case Complexity $O(n^2)$** It occurs when the array elements are in jumbled order that is not properly ascending and not properly descending.
- **Worst Case Complexity $O(n^2)$** when the array elements are required to be sorted in reverse order. Given array is in descending order & sorting will be done in ascending order,

Since the running time of an algorithm on a particular input is the number of steps executed, we must define "step" independent of machine. We say that a statement that takes c_i steps to execute and executed n times contributes $c_i n$ to the total running time of the algorithm. To compute the running time, $T(n)$, we sum the products of the cost and times column. That is, the running time of the algorithm is the sum of running times for each statement executed. So, we have

$$T(n) = c_1 n + c_2 (n - 1) + c_3 (n - 1) + c_4 (n - 1) + c_5 \sum_{2 \leq j \leq n} (t_j) + c_6 \sum_{2 \leq j \leq n} (t_j - 1) + c_7 \sum_{2 \leq j \leq n} (t_j - 1) + c_8 (n - 1).$$

In the above equation we supposed that t_j be the number of times the while-loop is executed for that value of j . Note that the value of j runs from 2 to $(n - 1)$. We have

$$T(n) = c_1 n + c_2 (n - 1) + c_4 (n - 1) + c_5 \sum_{2 \leq j \leq n} (t_j) + c_6 \sum_{2 \leq j \leq n} (t_j - 1) + c_7 \sum_{2 \leq j \leq n} (t_j - 1) + c_8 (n - 1)$$

The best case occurs if the array is already sorted. For each $j = 2, 3, \dots, n$, we find that $A[i]$ less than or equal to the key when i has its initial value of $(j - 1)$. In other words, when $i = j - 1$, always find the key $A[i]$ upon the first time the WHILE loop is run.

Therefore, $t_j = 1$ for $j = 2, 3, \dots, n$ and the best-case running time can be computed using follows:

$$T(n) = c_1 n + c_2 (n - 1) + c_4 (n - 1) + c_5 \sum_{2 \leq j \leq n} (1) + c_6 \sum_{2 \leq j \leq n} (1 - 1) + c_7 \sum_{2 \leq j \leq n} (1 - 1) + c_8 (n - 1)$$

$$T(n) = c_1 n + c_2 (n - 1) + c_4 (n - 1) + c_5 (n - 1) + c_8 (n - 1)$$

$$T(n) = (c_1 + c_2 + c_4 + c_5 + c_8) n + (c_2 + c_4 + c_5 + c_8)$$

This running time can be expressed as $an + b$ for constants a and b that depend on the statement costs c_i . Therefore, $T(n)$ it is a linear function of n .

Here, the while-loop in line 5 executed only once for each j . This happens if given array A is already sorted.

$T(n) = an + b = O(n)$. It is a linear function of n .

The worst-case occurs if the array is sorted in reverse order i.e., in decreasing order. In the reverse order, we always find that $A[i]$ is greater than the key in the while-loop test. So, we must compare each element $A[j]$ with each element in the entire sorted sub array $A[1 .. j - 1]$ and so $t_j = j$ for $j = 2, 3, \dots, n$. Equivalently, we can say that since the while-loop exits because i reaches to 0, there is one additional test after $(j - 1)$ tests.

Therefore, $t_j = j$ for $j = 2, 3, \dots, n$ and the worst-case running time can be computed using follows:

$$T(n) = c_1n + c_2(n - 1) + c_4(n - 1) + c_5 \sum_{2 \leq j \leq n} (j) + c_6 \sum_{2 \leq j \leq n} (j - 1) + c_7 \sum_{2 \leq j \leq n} (j - 1) + c_8(n - 1)$$

Here the worst-case occurs, when line 5 executed j times for each j . This can happens if array A starts out in reverse order

$T(n) = an^2 + bn + c = O(n^2)$. It is a quadratic function of n .

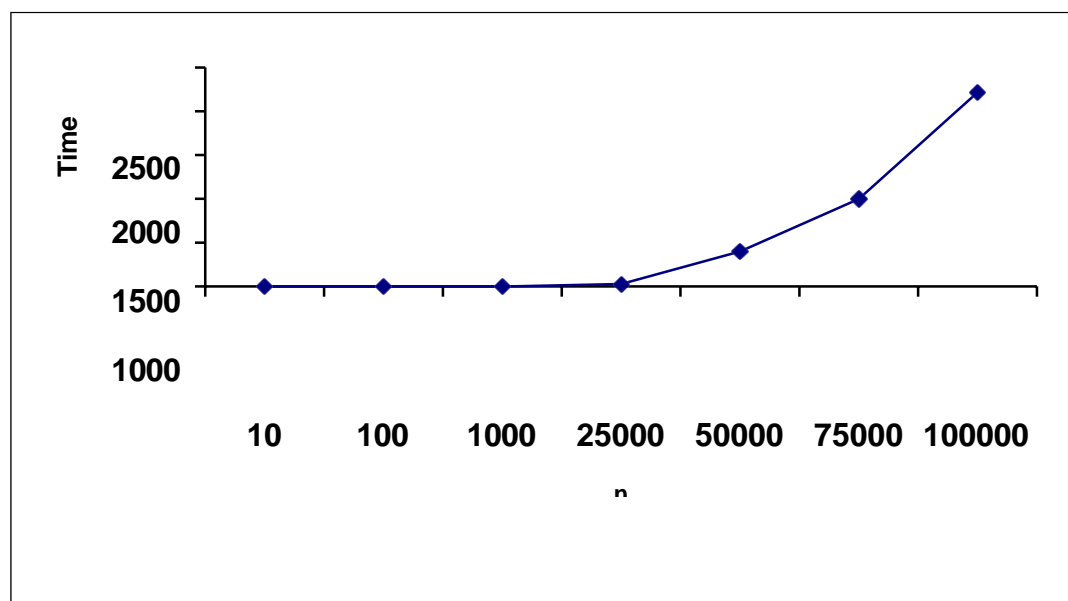


Figure 4: The graph shows the n^2 complexity of the insertion sort.

We usually concentrate on finding the worst-case running time: the longest running time for any input size n .

The reasons for this choice are as follows:

The worst-case running time gives a guaranteed upper bound on the running time for any input. That is, upper bound gives us a guarantee that the algorithm will never take any longer. For some algorithms, the worst case occurs often. For example, when searching, the worst case often occurs when the item being searched for is not present, and searches for absent items may be frequent.

Suppose that we randomly choose n numbers as the input to insertion sort.

On average, the key in $A[j]$ is less than half the elements in $A[1 .. j - 1]$ and it is greater than the other half. It implies that on average, the while loop has to look halfway through the sorted subarray $A[1 .. j - 1]$ to decide where to drop key. This means that $t_j = j/2$.

Although the average-case running time is approximately half of the worst-case running time, it is still a quadratic function of n .

Since multiple keys with the same value are placed in the sorted array in the same order that they appear in the input array, Insertion sort is stable.

This algorithm does not require extra memory. For Insertion sort we say the worst-case running time is $\theta(n^2)$, and the best-case running time is $\theta(n)$. Insertion sort use no extra memory it sort in place. The time of Insertion sort is depends on the original order of a input. It takes a time in $\Omega(n^2)$ in the worst-case, despite the fact that a time in order of n is sufficient to solve large instances in which the items are already sorted.

6.4.3 Insertion Sort Space complexity

The space complexity of insertion sort is $O(n)$. It is because; n extra variable is required for the purpose of swapping.

2. Merge Sort

Merge sort is based on the divide-and-conquer paradigm. It divides the given list into two equal halves, calls itself for the two halves and then merges the two sorted halves. The sub-lists are divided again and again into halves until the list cannot be divided further. Combine the pair of one element lists into two-element lists, sorting them in the process. Sorted two-element pairs are merged into the four-element lists, and so on until we get the sorted list.

Its worst-case running time has a lower order of growth than insertion sort. Since we are dealing with sub problems, we state each sub problem as sorting a sub array $A[p .. r]$. Initially, $p = 1$ and $r = n$, but these values change as we recurs through sub problems.

To sort $A[p .. r]$:

1. Divide Step:

If a given array A has zero or one element, simply return; it is already sorted. Otherwise, split $A[p .. r]$ into two sub arrays $A[p .. q]$ and $A[q + 1 .. r]$, each containing about half of the elements of $A[p .. r]$. That is, q is the halfway point of $A[p .. r]$.

2. Conquer Step:

Conquer by recursively sorting the two sub arrays $A[p .. q]$ and $A[q + 1 .. r]$.

3. Combine Step:

Combine the elements back in $A[p .. r]$ by merging the two sorted sub arrays $A[p .. q]$ and $A[q + 1 .. r]$ into a sorted sequence. To accomplish this step, we will define a procedure MERGE (A, p, q, r). To sort the entire sequence $A[1 .. n]$, make the initial call to the procedure MERGE-SORT ($A, 1, n$).

```
1. IF  $p < r$  // Check for base case
```

2. THEN $q = \text{FLOOR}[(p + r)/2]$ // Divide step
3. MERGE (A, p, q) // Conquer step.
4. MERGE (A, q + 1, r) // Conquer step.
5. MERGE (A, p, q, r) // Conquer step.

Bottom-up view of the above procedure for $n = 8$.

Algorithm

MERGE_SORT(arr, beg, end) Step 1: If $beg < end$

Step 2: Set $mid = (beg + end)/2$

Step 3: MERGE_SORT(arr, beg, mid) Step 4: MERGE_SORT(arr, mid + 1, end) Step 5: MERGE (arr, beg, mid, end)

Step 6: End of If

Step 7: END MERGE_SORT

arr is the given array, beg is the starting element, and end is the last element of the array. This algorithm performs the merging of two sorted sub-arrays that are $A[beg...mid]$ and $A[mid+1...end]$, to build one sorted array $A[beg...end]$. So, the inputs of the MERGE function are $A[], beg, mid, end$.

Pseudo code

MERGE (A, p, q, r)

1. $n1 \leftarrow q - p + 1$
2. $n2 \leftarrow r - q$
3. Create arrays $L[1 \dots n1 + 1]$ and $R[1 \dots n2 + 1]$
4. FOR $i \leftarrow 1$ TO $n1$
 5. DO $L[i] \leftarrow A[p + i - 1]$
6. FOR $j \leftarrow 1$ TO $n2$
 7. DO $R[j] \leftarrow A[q + j]$
8. $L[n1 + 1] \leftarrow \infty$
9. $R[n2 + 1] \leftarrow \infty$
10. $i \leftarrow 1$
11. $j \leftarrow 1$
12. FOR $k \leftarrow p$ TO r
13. DO IF $L[i] \leq R[j]$
14. THEN $A[k] \leftarrow L[i]$
 15. $i \leftarrow i + 1$
16. ELSE $A[k] \leftarrow R[j]$
 17. $j \leftarrow j + 1$

The first part shows the arrays at the start of the "for $k \leftarrow p$ to r " loop, where $A[p \dots q]$ is copied into $L[1 \dots n1]$ and $A[q + 1 \dots r]$ is copied into $R[1 \dots n2]$. Succeeding parts show the situation at the start of successive

iterations.

Entries in A with slashes have had their values copied to either L or R and have not had a value copied back in yet. Entries in L and R with slashes have been copied back into A. The last part shows that the subarrays are merged back into A[p . . r], which is now sorted, and that only the sentinels (∞) are exposed in the arrays L and R.]

The first two for loops (that is, the loop in line 4 and the loop in line 6) take $\Theta(n_1 + n_2) = \Theta(n)$ time. The last for loop (that is, the loop in line 12) makes n iterations, each taking constant time, for $\Theta(n)$ time. Therefore, the total running time is $\Theta(n)$.

Example of Merge sort

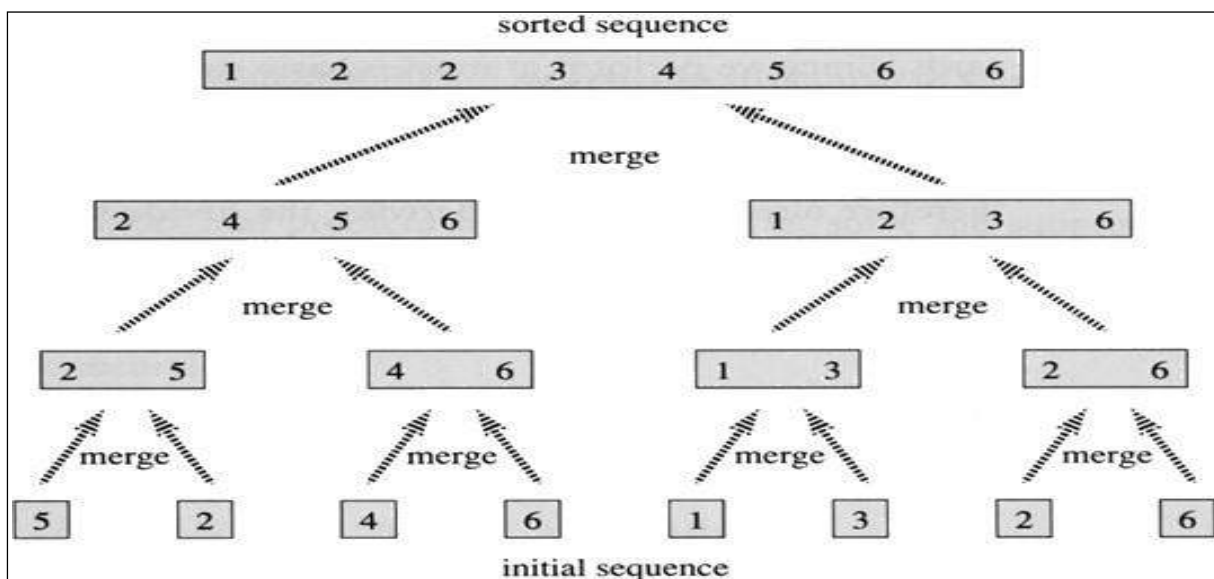


Figure 5: Merging Process

We implement it so that it takes $\Theta(n)$ time, where $n = r - p + 1$, which is the number of elements being merged.

Analysis

For simplicity, assume that n is a power of 2 so that each divide step yields two sub problems, both of size exactly $n/2$.

The base case occurs when $n = 1$. When $n \geq 2$, time for merge sort steps:

Divide: Just compute q as the average of p and r, which takes constant time i.e. $\Theta(1)$.

Conquer: Recursively solve 2 sub problems, each of size $n/2$, which is $2T(n/2)$.

Combine: MERGE on an n-element sub array takes $\Theta(n)$ time.

Summed together they give a function that is linear in n, which is $\Theta(n)$. Therefore, the recurrence for merge sort running time is $T(n) = \Theta(n \lg n)$.

Execution Time

The following Graph shows the execution time of Merge sort. The Execution time of Merge sort is $O(n \log n)$ which is diagrammatically shown below.

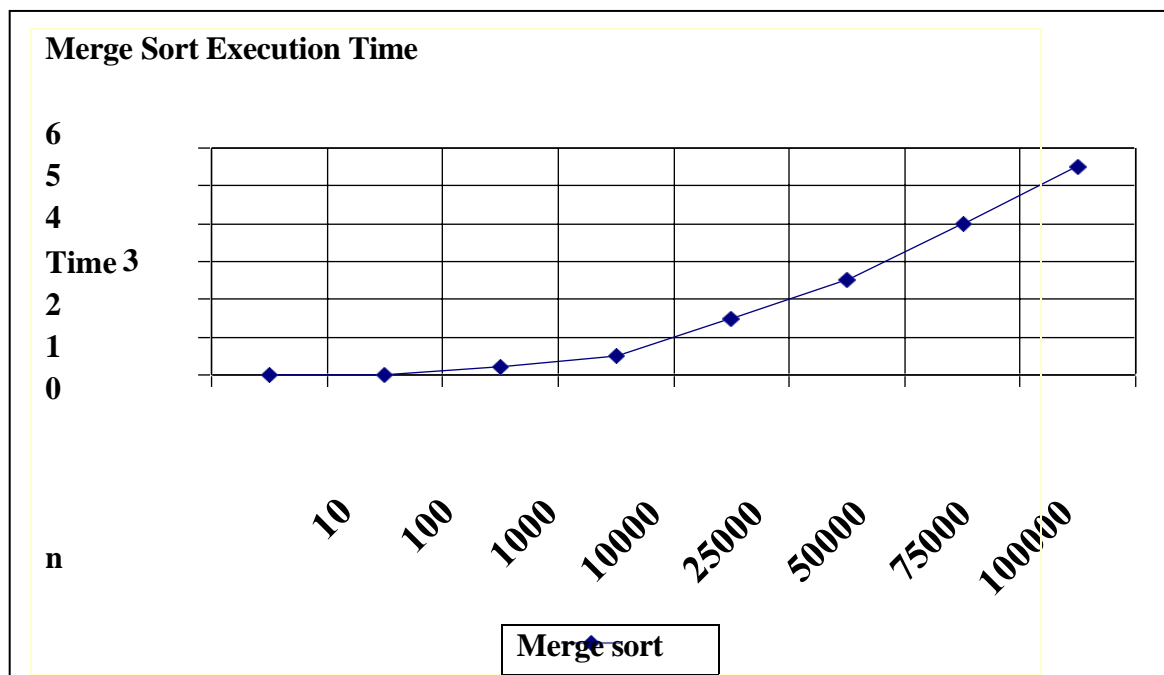


Figure 6: Execution Time Merge Sort Algorithm ($O(n \log n)$)

Merge sort Time complexity

Average Case $O(n \cdot \log n)$

It occurs when the array elements are in jumbled order that is not properly ascending and not properly descending.

Worst Case $O(n \cdot \log n)$

It occurs when the array elements are required to be sorted in reverse order. That means suppose you have to sort the array elements in ascending order, but its elements are in descending order.

Best Case $O(n \cdot \log n)$

It occurs when there is no sorting required, i.e. the array is already sorted.

Merge sort Space complexity

The space complexity of merge sort is $O(n)$ It is because, an extra variable is required for the purpose of swapping.

8. Comparative Analysis based on performance and space

Performance & Space Complexity

- Merge sort takes up $O(n)$ space complexity being recursive hence it cannot be preferred with limited memory Space.

Worst case performance	$O(n^2)$
Best case performance	$O(n)$
Average case performance	$O(n^2)$
Worst case Space complexity	$O(n)$

Table 1: Merge Sort

- Insertion sort only takes up $O(n)$ space complexity. It sorts the entire array by using one extra variable.

Worst case performance	$O(n \log n)$
Best case performance	$O(n \log n)$
Average case performance	$O(n \log n)$
Worst case Space complexity	$O(n)$

Table 2: Insertion Sort

Time Complexity

Sort	Average	Best	Worst	Space	Stability	Remarks
Insertion Sort	$O(n^2)$	$O(n)$	$O(n^2)$	Constant	Stable	In the best case every insert requires constant time
Merge Sort	$O(n \log(n))$	$O(n \log(n))$	$O(n \log(n))$	Depends	Stable	On arrays, merge sort requires $O(n)$ space; on linked lists, merge sort requires constant space

Table 3: Time Complexity

5. CONCLUDING REMARKS

In comparison of the insertion sort [$\Theta(n^2)$ worst-case time], merge sort is faster based on time complexity. Trading a factor of n for a factor of $\log n$ is a good deal.

- On small inputs, insertion sort may be faster. But for large enough inputs, merge sort will always be faster, because its running time grows more slowly than insertion sorts.
- The efficiency of linear-time algorithms depend on the keys randomly ordered. If this condition is not satisfied, the result is the degrading in performance.
- These algorithms require extra space proportional to the size of the array being sorted, so if we are dealing with large file, extra array becomes a real liability.
- The "inner-loop" of these algorithms contains quite a few instructions, so even though they are linear, they would not be as faster than Nonlinear-time algorithms.

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PARAMETER IDENTIFICATION OF MANET THROUGH DIFFERENT TECHNIQUES AND ITS PERFORMANCE EVALUATION

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Abstract - MANET stands for Mobile Adhoc Network also called a wireless Adhoc network or Adhoc wireless network that usually has a routable networking environment on top of a Link Layer ad hoc network.. They consist of a set of mobile nodes connected wirelessly in a self-configured, self-healing network without having a fixed infrastructure. MANET nodes are free to move randomly as the network topology changes frequently. Each node behaves as a router as they forward traffic to other specified nodes in the network. Sharing data and services and communication facilities to set up a necessary performance and other deceives can observe the presence of mobile ad hoc network device. It may change rapidly and unpredicted over some time through the topology network due to the mobility model. 5 The topology fluctuates with the environmental decentralization with the problem with the routing message. The power source, the constrained by the network static with a network of high dynamic, large-scale range. Miscellaneous In the application set of the MANET. Personal Area Network: among different mobile devices the inter-connection was simple in the short range in the MANET system. The connection was wireless that has been replaced with cable wires. By mechanism, the other network can be accessed to the extent of the ad hoc network.

Keywords : - MANET, OLSR, DSDV, NIS Routing, Algorithm, Packet Drop Rate

1. INTRODUCTION

MANET become one of the important resources since it can deal with the protocols of network communication. The technology used in the MANET newly emerges so that the infrastructure of the communication is without the enabled user regarding the location of the user. The conservation of the energy and the stabilization of the network was a priority of the investigation of the mobile network. techniques help in the communication of energy. Each not causes a traffic situation for the quality of hop for a time and by this investigation the range of the energy level residue and node traffic to minimize the energy consumption of the communication. The energy level is similar to each node in the technique of the communication that compared maximum to finding the path occurrences in the entire network traffic. The MANET protects the group in the wrong characteristic node. The environment network has difficulties with the production in the individual. The request level remains the node with the characteristic concerning the fake clarification of the premeditated broadcast, in losing the network. In collaborating the deficient choice made with the characteristics of a node with aiming the intrusion energy at sedation and DoS attack of overhead routing. The mobile network communication follows a separate scheme for the environmental network. Positive communication schemes me and the automated communication scheme. The mobile network presents the routing of energy sources demanding the AODV protocol. The

mobility is promoted with highly topology architecture of dynamic in the MANET system. In MANET the routing protocols are the important features in it. From the destination node to the source node the route was recognized by the routing protocol. The routing protocol has been classified into proactive protocol, reactive protocol, and hybrid protocol.

2. RESEARCH METHODOLOGY

The methodology carried out in this research paper is based on the objective which was achieved based on the schemes and algorithms used in the MANET.

- To control the energy consumption and the time count has been achieved by the TCSSR (Timer Count Scheduling with Spectator Routing) techniques and stifles restricted algorithm.
- The connection ratio and the packet loss rate in the packet data node have been improved by using ETPA (Enhanced Twisting Path Allocation) Technique and Connection divination-based neighbor selection algorithm.
- The storage space in the packet data node and to connect a direct path of the node have been achieved by using MDS (Maximum Data Storage Space allocation) techniques and Position Middle storage space allocation algorithm.
- A new path has been discovered for the packet data transmission and also control of the data packet. This has been achieved by EAPD (Enhanced data Accuracy based Path Discovery) techniques and Backing Route Algorithm.

PARAMETERS OF MANET

The following are the parameters that are used in the analysis of the performance in the MANET.

End-to-End Delay

The End-to-end delay connects the stable required application in the MANET to guarantee the quality of services and the frequency of the connective topology in the mobile node complex. the performance of End-to-end delay depends on the stability of the routing, which includes the number of paths in the link and the stability link. It depends on the path along with the number of links the number of nodes, the range of transmission, and the fixed receiver from the sender distances.

$$D = \frac{1}{n} \sum_{t=1}^n (Tr - Ts) * 1000 \quad \text{----- (i)}$$

Communication Overhead

The transferor transmission of a total number of packet data from one node to another node is termed communication overhead. The process involves in the communication overhead is the routing table, preparation of packets, and routing process. Productive work is done by getting the term instead of the communication speed with the time proposed with it. they approach overhead communication in a very 14 rate case. It works on its data structure. The size of the communication message is fixed with the bytes that are excepted such as sequences of patterns and search tree parts.

$$\text{Communication Overhead} = (\text{Number of Packet Losses/ Received}) * 100 \quad \text{---(ii)}$$

Packet Delivery Ratio

In any network, the performance of protocol routing is to measure the important factor of packet delivery ratio. it depends on a various parameter that depends on the performances of the protocol selected for the simulation process. at the destination received the packet delivery ratio is the number of a packet to packets sent by the source. When the packet delivery ratio is high the performance will be better. = total packet received by all the destination nodes total packets sent by all the source nodes.

$$\text{Packet Delivery ratio} = \frac{\text{total packet received by all the destination nodes}}{\text{total packets sent by all the source nodes}}$$

Network Lifetime

The network lifetime is defined as the network duration that can be performed with the functionality that is desired. It can be defined in various ways that depend on the application like approaches to the cluster.

$$T = \min T_k \dots\dots(iii)$$

Energy Consumption

Energy consumption is an important issue in the MANET system with the battery resources that operate the mobile node with the most the important issues the reception power that transmits energy was included in the cost of related energy that composed in various mobile ad hoc network which was evaluation the energy consumption of the existing model. The consumption of energy in the MANET can be calculated by

$$\text{Energy Consumption} = \frac{\text{Total energy consumed by the nodes}}{\text{Total energy that received by the nodes}}$$

$$\dots\dots(iv)$$

Packet Drop Rate

The destination of the computer network fails when the data packet travels with one or more packet losses. In the allocation of time and then in each cluster with the traffic load that can be found with the packet drop rate.

$$\text{Packet Drop Rate} = [\text{Number of packet (dropped/sent)}] * 100$$

Multi-Packed transmitted by Clustering Nodes

The transmission activities were used for the coordinates that help in secluding the time of the transmission. By clustering nodes, they broadcasted the multi-packet, and the position of the mobile node was depending on the four reasonable clusters that separate the area more to analyze. The base station is inaccessible that placed next to a mobile node which non-grouped area from a single cluster. The base station nodes transmitted the straight packet with those mobile nodes because of the node’s distance and small base station. Considering, the mobile nodes that have many ungroup areas, the base station is rechargeable with the next place value.

$$C_n = \frac{\{M_p + S_p\}}{T_C} \dots\dots\dots(v)$$

Where,

M_p = Multi Packet

S_p = Single Packet

T_C = Timer Count

The data packet that organizes from the base station has to exchange the perfect packet with those mobile nodes, and the packet were carried to the sink nodes. The cluster nodes were taken out and placed away with some of the mobile nodes. Moreover, the header node was connected to the broadcast packet with the multihop area of the grouping in the mobile node

$$M_p = n\sqrt{P}$$

As the cluster is known for the region of monitoring separated from the starting stage of the base station, all the groups that choose the arbitrary by a cluster head. A cluster head is possibly similar to the nodes of the group. As a cycle of operation, all the communication tasks were restructured in the cluster head.

Stifle Restriction Algorithm

For the control packets, with the mobile node, the outer scheme was rewarded guarantee with the stifle restriction. The available nodes were ensured with those packets and the environment across the mobile network can achieve the exchange of packets. On the performance of the identification route, in the network that collects all the nodes with the multi-packet data from the base station. To the mobile data, the packet acknowledgment was broadcast with the single cast of the subsequent node.

$$C_n = \frac{\{limP_n * limP_1\}}{TC} \quad \text{-----}(vi)$$

$$C_n = \frac{\{limP_n * limP_1\}}{\int \int \int_n^{Slot} T/s} \quad \text{-----}(vii)$$

The nodes were classified was performed with the method of aggregation packet. At the base station, the nodes were packet aggregated with the packet of broadcasting which is trustworthy to guarantee the area of the sender that cover under the base station that we guarantee.

Performance Matrices

Among all the nodes a randomly chosen part is known as CBR, the destination and the traffic sources wee potential with every node in the network. Every node was covered with a CBR connection with n/2 among each node. The data and control packets were the two important packets that we consider. At the routing level, the connectivity was maintained to provide support for the control packet. The value of the overhead was provided with the value and summed for each node which is counted and receives several packets. Through the broadcasting, the delivery of the message has been controlled with the overhead, in the network, the received pack can cause a collision.

The destination of the source from the data packet was delivered to the protocol that was efficient with the representation of the CBR drop rate.

$$CBR_{rate} = \frac{\#CBR_{drop}}{\#CBR_{Sent}} \quad \text{-----}(viii)$$

Where,

CBR_{drop} = number of dropped packet

CBR_{sent} = number of sent packet

3. CONCLUSION

The unstable position nodes are known as the mobile nodes, in any place of the network they can update their location from one end to another end. The nodes were not joined to the cluster when they reach their outer coverage range in certain situations. The interruption was caused by some unwanted nodes, broadcasting a single data packet takes more time, so the lifetime of the network has been minimizing the network. In the proposed TCSSR scheme to measure the duration of the time of each transmission packet they contain a time counter, from the sender to node neighbor in the path routing. From the routing path, the node that interrupted were separated to construct the stifle restricted algorithm, the packet latency was reduced. The lifetime of the network has been improved by this, and the ratio of the packet delivery. In future connection of missed work based on the method of re-clustering to a parameter that analyses

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DEVELOPMENT OF SMART TOURISM RESEARCH: A GLOBAL SCENARIO

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Technology development encourages the use of smart technology in the tourism industry. Smart technologies enable the tourism industry to facilitate smart services and smart infrastructure at the destination. In the last ten years, the academic community has shifted its focus on smart tourism. The concept of systematic review and bibliometric analysis has been used in some studies of smart tourism. The goal of this study is to investigate the growth of smart tourism development through bibliometric analysis. The study's findings demonstrate the trending topics, prevalent themes, and co-citation patterns of the last ten years in the field of smart tourism. The findings of this study may be beneficial for the effective research of smart tourism in the future.

Keywords: Smart Tourism, Bibliometric analysis, Systematic Review, Co-citation Analysis.

1. Introduction

Individuals moving from one region to another for specific reasons that are either professional or personal is known as tourism, which is a service activity (Brittonf, 1991). In terms of industry and marketing, it contributes significantly to the culture, society, and financial expansion of most nation (Hamid et al., 2021). In the execution of cutting-edge technologies, it is one of the pioneering sectors (Buhalis& Law, 2008). The tourism sector has been significantly impacted by the recent developments in internet information and communication (ICT) technology (Xu et al., 2017). For the travel industry, the contemporary ICT era has unlocked a variety of new instruments (Dorcic et al., 2019). There is no denying that tourism-related encounters and expenditures have become more technologically sophisticated. Smart devices, such as phablets, tablets, smartwatches, and smartphones among a growing array of cutting-edge ICTT technology, are increasingly used to mediate them. (Dickinson et al., 2014; Neuhofer et al., 2014; Wang et al., 2012, Wang et al., 2016).

Even if the term "smart" has received greater interest in the literature, there is still a pressing need for theoretical explanation as well as empirical evaluation and characterization (Gelter et al., 2021; Werthner et al., 2015). In business and education, the word "smart" has become prominent (X. Wang et al., 2016). The popularity of intelligence (smartness) has increased recently as a result of a few noteworthy incidents (Mehraliyev et al., 2019). The notion of smart tourism was established using literature on the application of mobile and smart technologies (Dorcic et al., 2019; Femenia-Serra et al., 2019; D. Wang et al., 2014) and their effects on tourism (Dorcic et al., 2019; Kirillova & Wang, 2016; Yu et al., 2018). The essence of smart tourism was primarily (Mehraliyev et al., 2019) the effect of smart technologies on encounters that were enriched and customized (Neuhofer et al., 2015).

Beyond smart tourism, the term "smart" has been used to characterize several fields, including smart cities, smart tourism destinations, and smart tourism ecosystems (Mehraliyev et al., 2019). In addition to smart tourism, Smart Tourism Destination (STD) and smart tourism cities were also introduced (Ghorbani et al., 2020). Despite the fact that these phrases naturally relate to one another, they each have a unique meaning and purpose (Del Chiappa & Baggio, 2015). Utilizing technology (such as the internet, mobile devices, and augmented reality) to gather immense quantities of data and offer real-time assistance to all stakeholders in the destination is known as smart tourism (Gretzel, Sigala, et al., 2015; Hunter et al., 2015). Additionally, smart tourism is defined as the gathering and compilation of data from individuals, infrastructures, and tour providers related to a specific place (Gelter et al., 2022). Um & Chung, (2021) stated that smart tourism not only

enhances the quality of resources available for tourism but also facilitates tourism management, improves standard of life, and boosts communication. According to Lee, (2021) ICTs support the promotion and supply of tourist goods and services at destinations in the context of smart tourism. Technology is a structure used in "smart tourism" which incorporates software, hardware, and network technologies to deliver instantaneous information so that all stakeholders may make more informed decisions (Gretzel, Sigala, et al., 2015).

Researchers and decision-makers have wholeheartedly accepted the idea of smart tourism in anticipation that "suddenly everything is smart" (Gretzel, Sigala, et al., 2015). Initially, in their seminal publications, smart tourism was presented to academia (Buhalis&Amaranggana, 2013, 2015). By examining its foundations, difficulties, and development potential, (Gretzel, Sigala, et al., 2015), (Gretzel, Werthner, et al., 2015) advanced this field of study. The task of examining and assessing the progress of smart tourism research is timely and important in light of the subject's rapidly rising number of publications (Mehraliyev et al., 2019). Johnson &Samakovlis, (2019) examined the development of smart tourism with the help of collaborative network. Mehraliyev et al., (2020)recognised thematic research trends and knowledge categories in smart tourism research. Mehraliyev et al., (2019) conducted a systematic review to identified the research life cycle and social structure of smart tourism research. Borges-Tiago et al., (2022)tracked the development and intellectual framework of smart tourism research. Ye et al., (2020) investigated the development trends and categories of smart tourism. In this row, this study also discovers the smart tourism development in last ten years with the help of trending topics, thematic map and co-citation analysis. So, this study aims to investigate the growth of smart tourism development through bibliometric analysis.

2. Methodology

A bibliometric analysis conducted in this study to review the research structure and trend of smart tourism in last 10 years. This study followed the qualitative method to understand the thematic map and co-citation network in the field of smart tourism. A procedure was followed for research methodology in this research.



Figure 1: Scheme of Methodology

2.1 Data Collection

At first database was selected to search and collect relevant data. Scopus was used to search all suitable documents. The search criteria were applied to collect the data from Scopus. The term “smart tourism” was searched in article title only on 4th July, 2023. Other criteria were related to year and documents types. So, articles, conference papers, book chapters and review paper were included from 2003 to 2023. All language were included in terms of language criteria.

2.2 Data Selection

507 documents were resulted after initial search in Scopus. After applied all above criteria these documents were limited to 490. Finally, 490 smart tourism documents were selected for further analysis and to get significant results.

2.3 Data Analysis

Numerous types of analysis were conducted for the recent research in the field of smart tourism. R software was used to identify conceptual structure, intellectual structure and co-citation analysis. Thematic map, trending topics, most cited references, most cited documents and co-citation network were got after analysing these aspects.

3. Findings

The collected data from Scopus is analysed with the help of R software. Numerous results are found in this way like topics trends, documents citation, citation network and thematic of smart tourism research in last ten years.

3.1 Trend Topics

Figure 2 shows the trending topics of smart tourism during this period. All given topics are presented with a particular term frequency. Almost, all terms are resulted with 50 term frequency. Tourism and smart tourism terms are with the highest frequency of 150 and 100 respectively between the year of 2020 and 2022. Rest of the terms are appeared with only 50 term frequency in the research.

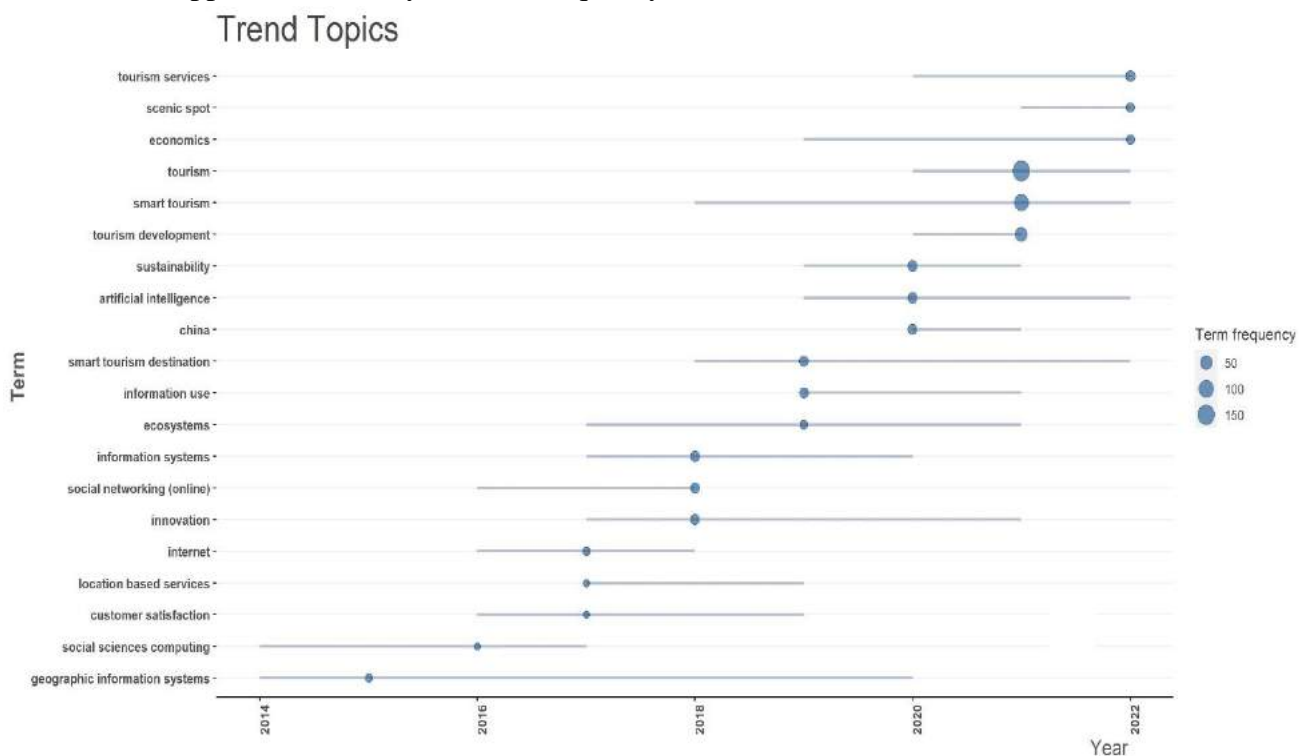


Figure 2: Trends Topics

3.2 Average Citations Per Year

Figure 3 shows the average citation per year in the field of smart tourism research. It was only 5 in the year of 2013. It was extended in the further years. It was huge hike in the year of 2015 due the increment of research in the field of smart tourism. Then it was getting down after 2015 till present.

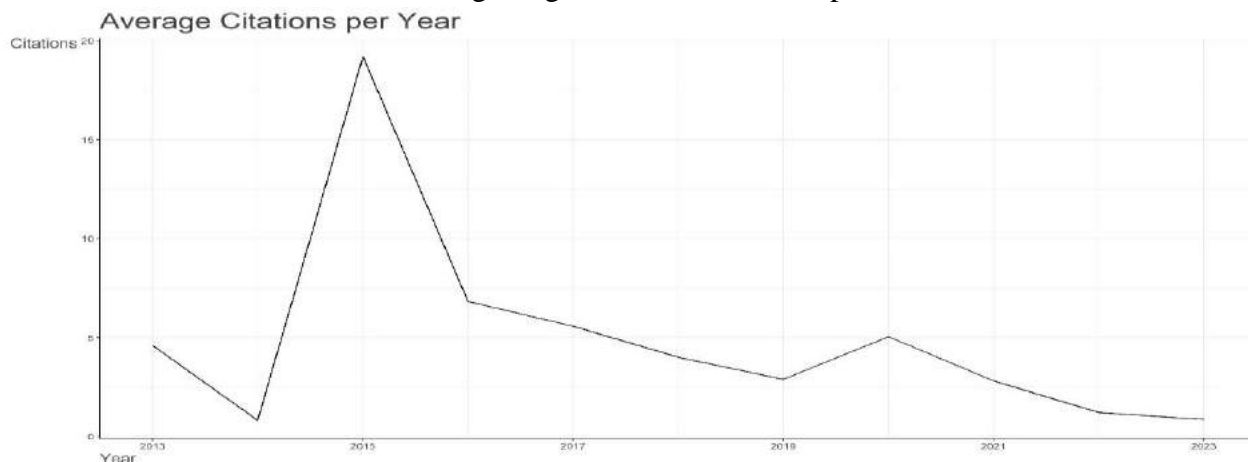


Figure 3:

Average Citations Per Year

3.3. Most Local Cited Documents

This figure 4 presents the most cited documents of different authors. This list includes top 10 most cited documents. Gretzel U. (2015), electron mark, is most citation number i.e., 209. It is the only which has got citation above 200. Second rank was also achieved by Gretzel U (2015), comput behave. There is not any other author who got citation above 100. There is showing both local and global citation number and percentage for top 10 documents in the table 1.

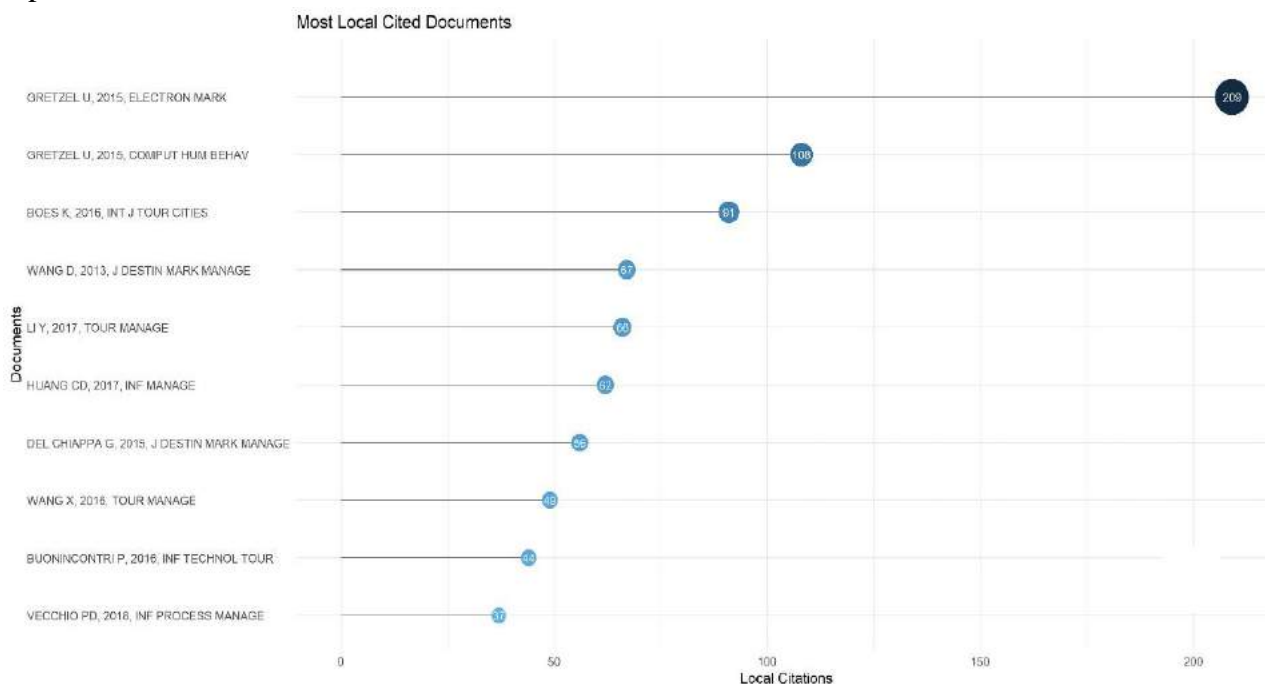


Figure 4: Most Local Cited Documents

Table 1: Most Local Cited Documents

Document	DOI	Year	Local Citations	Global Citations	LC/GC Ratio (%)	Normalized Local Citations
Gretzel U, 2015, Electron Mark		2015	209			
Gretzel U, 2015, Comput Hum Behav		2015	108			
Boes K, 2016, Int J Tour Cities		2016	81			
Wang D, 2013, J Destin Mark Manage		2013	67			
Li Y, 2017, Tour Manage		2017	66			
Huang CD, 2017, Inf Manage		2017	57			
Del Chiappa G, 2015, J Destin Mark Manage		2015	55			
Wang X, 2016, Tour Manage		2016	50			
Buonincontri P, 2016, Inf Technol Tour		2016	40			
Vecchio PD, 2016, Inf Process Manage		2016	37			

GRETZEL U, 2015, ELECTRON MARK	10.1007/s12525-015- 0196-8	2015	209	895	23.35	4.94
GRETZEL U, 2015, COMPUT HUM BEHAV	10.1016/j.chb.2015.03.04 3	2015	108	387	27.91	2.55
BOES K, 2016, INT J TOUR CITIES	10.1108/IJTC-12-2015- 0032	2016	91	309	29.45	6.56
WANG D, 2013, J DESTIN MARK MANAGE	10.1016/j.jdmm.2013.05. 004	2013	67	206	32.52	4.29
LI Y, 2017, TOUR MANAGE	10.1016/j.tourman.2016.0 3.014	2017	66	252	26.19	7.50
HUANG CD, 2017, INF MANAGE	10.1016/j.im.2016.11.010	2017	62	236	26.27	7.05
DEL CHIAPPA G, 2015, J DESTIN MARK MANAGE	10.1016/j.jdmm.2015.02. 001	2015	56	227	24.67	1.32
WANG X, 2016, TOUR MANAGE	10.1016/j.tourman.2015.1 2.003	2016	49	207	23.67	3.53
BUONINCONTRI P, 2016, INF TECHNOL TOUR	10.1007/s40558-016- 0060-5	2016	44	136	32.35	3.17
VECCHIO PD, 2018, INF PROCESS MANAGE	10.1016/j.ipm.2017.10.00 6	2018	37	191	19.37	8.04

3.4 Thematic Map

Figure 5 shows a thematic map which includes relevance degree or centrality (X-axis) and development degree or density (Y-axis) to examine the development of major research themes in smart tourism and divided these in four different sections. All the emerging or declining themes are showing in the lower left part of map. It means these themes either gain high research attention or can be sideline or decline from the research. It includes only one theme i.e.; industrial economics management is continuous development. Basic themes are located on the lower right part of the map which shows the low density and higher centrality in research area and need to more attention from the authors. The terms or themes include in this section are tourism, smart city, big data, tourism development, tourist destination and tourism management which are use in present. In the upper left part niche themes are located with low centrality and higher density in which geographic information systems, computer

simulation, complex network, smart tourism enterprise and corporate themes are included. These themes are developed recently but not in trends so much yet. The highly developed and needful themes are located in the upper right part of the map which are known as motor themes. These themes are with higher density and centrality in research publications. But such type of themes is very few according to this thematic map.

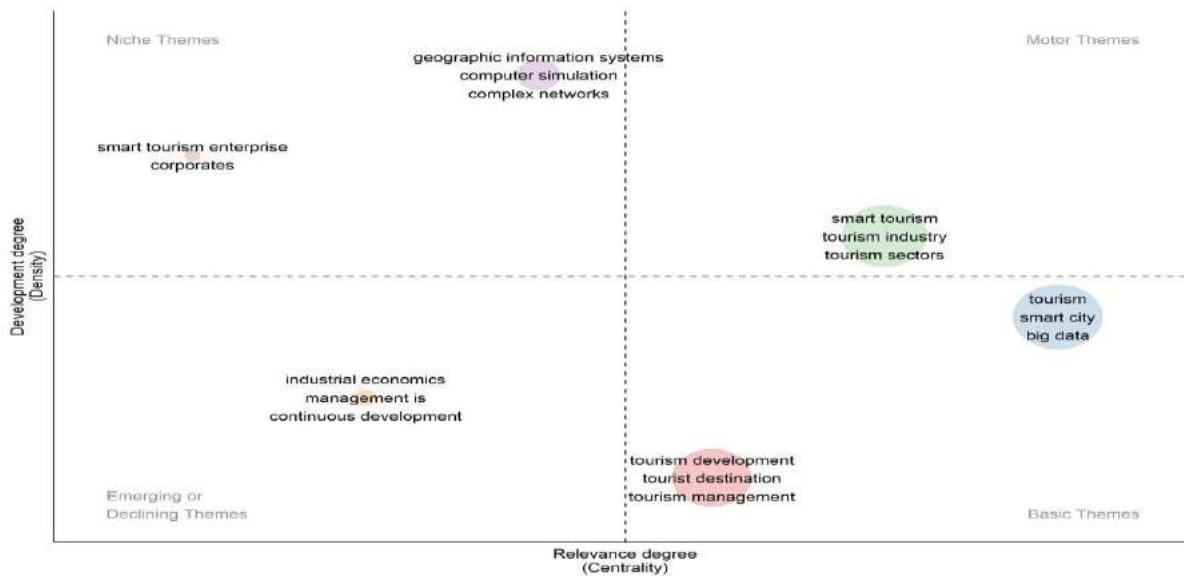


Figure 5: Thematic Map

3.5 Co-citation Network

The co-citation analysis in this is represented in Figure 6. This picture has shown the three colours of co-citation. These three colours show the three clusters i.e., red cluster (1), blue cluster (2) and green cluster (3). These clusters present a network among the cited authors and their documents in the last ten years. Ulrike Gretzel located in cluster 3 (green) has a strong connection with all nodes among three clusters in last ten years. The documents of Ulrike Gretzel were mostly cited together with others as it has a foundational and development concept of smart tourism which has an influence on the other studies. Rest of the nodes approximately has similar scenario of cited together with other nodes. Other's documents were less centred in comparison of Ulrike Gretzel.

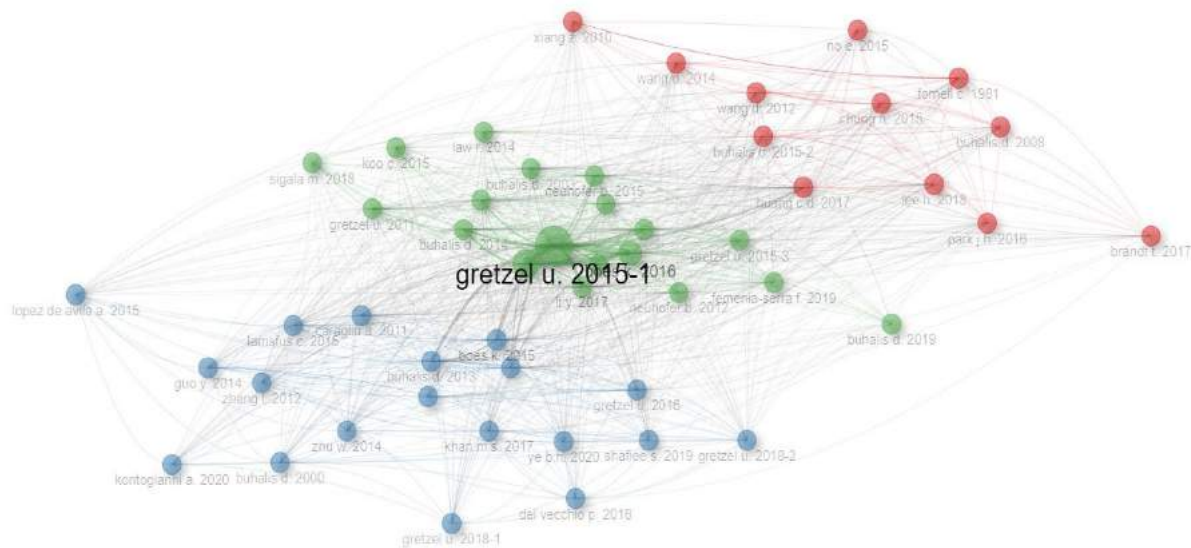


Figure 6: Co-citation Network Analysis

4. Discussion

This study conducted a bibliometric analysis with the help of collected data published from 2013 to 2023. Smart tourism is a trending concept in the research from last decade. It has not gained much development in literature; it is in progress with the efforts of numerous authors. This study presented the trending topics, local cited documents, average citation per year, thematic map and co-citation network in the field of smart tourism. A number of trending topics has been observed from 2013 to 2023. Major topics were tourism, smart and tourism development with higher frequency. Rest of the topics like tourism services, scenic spot, economics, sustainability, artificial intelligence and information system with lower frequency. Apart from these some others components are being added in the research. Average citation per year is observed that in the year of 2015 more documents were cited when smart concept was in the initial stage in tourism research. In rest of the years maximum number of cited documents was only 5.

The document of Ulrike Gretzel with the title of smart tourism foundation and development was most cited document with the number of 209. This document includes the basic concepts, definition and foundations for smart tourism which were used in further research. Other documents also got the citation number of above 50. Thematic map showed the relevance and development degree of different themes of smart tourism research. There are very less themes like tourism sector, smart tourism and tourism industry with higher density and centrality. Some other's themes like geographic information systems, computer simulation, complex network, smart tourism enterprise and corporate were also with higher centrality and low density as these are at developing stage and not promoted well in the research area.

5. Conclusion, Limitation and Future Recommendation

This study explored the themes and status of smart tourism research in last ten years with the help of bibliometric analysis. Some review research of smart tourism conducted in previous years to highlight the review trends and various qualitative analysis. Smart tourism has been becoming an emerging concept for the academicians and practitioners for last one decade. Smart advancement in technological way provides smartness to develop tourism destination, activities and infrastructure at global level. This study provides trending topics, cited documents, different themes and co-citation network of smart tourism research. Tourism and smart tourism topics have become trending topics. A number of authors have done their research related to smartness and smart tourism in recent years. There is need of consistent research in this area. There is much requirement

of quality research in smart tourism as average citation per year declined every year after 2015. There is not many more documents or authors which have appropriate cited number till yet. It is required to enhance research work in the area of smart tourism. Some themes are developed but have isolated. There is a need to provide a progress all the dimensions of smart tourism in research area. Co-citation network has shown the low citation of most documents. There is need of more efficient and influential documents to increase the co-citation network significantly. Limitation of this study is to include the documents from Scopus database only. Future studies may involve more databases with the expansion of years. Another limitation is related to search criteria that was only with article title. So, further studies may include the other criteria also like abstract, keywords and other aspects. It may provide an efficiency in the research of smart tourism.

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THE AWARENESS AND ADOPTION OF DIGITAL PAYMENT SYSTEM: A STUDY OF KAPURTHALA DISTRICT OF PUNJAB

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The last decade has seen a tremendous growth in use of internet and mobile phone in India. Increasing use of internet, mobile penetration and government initiative such as “Digital India” are acting as catalyst which leads to exponential growth in use of digital payment. Electronics Consumer transactions made at point of sale (POS) for services and products either through internet banking or mobile banking using smart phones or card payment are called as Digital payment. The structured questionnaire was used as research tool for understanding the Digital Payment System in Punjab State especially in Kapurthala Districts. Primary data was collected from 150 respondents in Punjab especially who engaged in Public and Private sector Jobs.

Keywords: Digital Payment System, Awareness and adoption level of DPS and Demographical Factors

1. INTRODUCTION

Today world is moving toward the digitalisation whether it is digitalisation of Documents (Digi Locker), Transfer of direct government benefits to individual bank account (DBT) or Keeping money in mobile wallet instead of possession of Physical Currency. When we call bank then first thing comes in our mind is about Money. Traditional banking believes more in physical currency and when we see at Modern or Digital Banking then everything is digitalisation. Customer can exchange money through just one click via internet. The real boost to the digitalisation starts when our Honourable PM Shri Narendra Modi launch ‘Digital India’ campaign in the month of July’2015. Digital India is the one of the initiative of the government through which government is promoting for cash less society and encouraging the people to opt digital mode of payments for all kind of transactions. Paperless and Cashless, these are the pillar of Digital India and without Digital Payment it can’t be success. The meaning of digital payment is within its word, Payment which has been done through digital way both the parties i.e sender and receiver uses the electronic mode of payment transaction. The real boost for the digital payment received when government banned Rs 500 and Rs 1000 physical currency notes on 8th November’2016 and another reason is due to revolution in mobile payment and its development in technology. Demonetization has helped digitization to grow. Factors like mobile connectivity, infrastructure, electronic delivery, technology, information technology etc have helped digitization to grow in India. Advantages are ease of use, faster transactions, reduced pollution of environment, more satisfied customers, and social upheaval. Lack of education, adaptation of technology, less support from government, costs of implementation, safety issues, infrastructure problems and lack of training are challenges for digitization. Better systems, security, and collaboration from all concerned can hasten the process of digitization {Shallu *et al* (2019).

Demonetization has set off the far-reaching utilization of advanced exchanges; nonetheless, it concentrates on showing that UPI has built up momentum over the long haul by promoting computerized installment techniques. It has been seen that UPI surpassed all the advanced monetary exchange instruments by expanding the volume of exchanges by 450% toward the finish of the monetary year 2018-2019. As per industry specialists, the moderateness of cell phones and web information has sped up the inescapable adequacy among clients from

various layers of society. The data and Communication Technology area is likewise assuming a critical part in the improvement of society and digitization of the economy. The economy is likewise called a computerized economy or web economy.

The traditional system is replacing by the digital system. The traditional payment systems are Cheques , withdrawals, drafts, money orders, letters of credits, travel cheques etc. why Payment systems also turning into electronic payment system using computer and internet there are several reasons of adaption . The most common reason is that the traditional system has some leakages and inefficiency and that's overcome by the digital payment system. But in India digital system is in emerging trend and not so popular and generalized. Today India is using most common electronic payment systems include Debit Cards, Credit Cards, but the use of Electronic Fund Transfer, Internet Banking, Unified Payment System (UPI), e-commerce payment system, internet banking, and *99# USSD based payment system etc are not in popular use. Therefore it is important to know the problems of digital payment system and its progress in India

Digitalization is found everywhere from manufacturing, purchase to payments. With the advancement of the internet, online banking facilities and other mobile applications have made consumers more convenient to do their transactions anywhere and at any time. Adoption of cashless/ digital transaction comes with its own benefits. A customer who use digital payment can pay directly from his bank account, track and maintain his transactions, receive cash back offers and rewards and collect any kind of payments remotely. The same holds good for a merchant as well. There are various methods of online payments that are being used by the customers like credit or debit cards, Unified payment interface, mobile wallets etc to name a few. But acceptance of these digital payments methods depends on consumer perception. Although with the developments in technology in the form of big data, internet of things, etc. are getting its momentum, cashless economy has its drawback too. The identity theft and other cybercrimes, technologically unprepared population, poor internet connectivity, lack of exposure on digital payments, unwillingness to adopt digital medium for economic transactions etc create a major hinderance for the country to go for a cashless economy. The numbers of new entrant in market are increasing which enabling digital payment.

National Payments Corporation of India (NPCI) is the umbrella of all digital payment transaction which is set up in the initiative of RBI and IBA under Payment and Settlement Act 2007. It is looking digital payments and settlement in India. NPCI is the real transformation of Digital Payment in Indian banking industry.

Important Methods of Digital Payment are:

Banking Cards: Banking cards offer customers greater security, accommodation, and control than some other installment techniques. The wide assortment of cards accessible - including credit, charge, and paid ahead of time - offers huge adaptability, also. These cards give 2 component verification to get installments e.g secure PIN and OTP. RuPay, Visa, and MasterCard are a portion of the case of card installment frameworks. Installment cards empower individuals to buy things in stores, on the Internet, through mail-request lists, and via phone. They save the two clients and traders' time and cash, and in this way empower them for simplicity of exchange.

USSD: The creative installment administration *99# chips away at Unstructured Supplementary Service Data (USSD) channel. This assistance permits portable financial exchanges utilizing an essential component cell phone, there is a compelling reason to need to have a versatile web information office for utilizing USSD-based portable banking. It is imagined to give monetary development and consideration to underbanked society in the standard financial administrations.

AEPS: AADHAAR ENABLED PAYMENT SYSTEM (AEPS) is a bank-driven model which permits online interoperable monetary exchange at PoS (Point of Sale/Micro ATM) through the Business Correspondent

(BC)/Bank Mitra of any bank utilizing the Aadhaar verification. The Rise of Artificial Intelligence in Marketing: The Next Frontier

UPI: Unified Payments Interface (UPI) is a framework that controls various ledgers into a solitary portable utilization (of any taking part bank), blending a few financial highlights, consistent asset directing, and dealer installments into one hood. It likewise takes care of the "Distributed" gathered demand which can be booked and paid according to necessity and comfort. Each Bank gives its own UPI App to Android, Windows, and iOS portable platform(s).

Versatile Wallets: A portable wallet is a method for conveying cash in a computerized design. You can connect your Mastercard or charge card data on the cell phone to a versatile wallet application or you can move cash online to the portable wallet. Rather than utilizing your actual plastic card to make buys, you can pay with your cell phone, tablet, or savvy. A singular record is expected to be connected to the advanced wallet to stack cash in it. Most banks have their e-wallets and a few privately owned businesses. for example Paytm, Freecharge, Mobikwik, Oxigen, mRuppee, Airtel Money, Jio Money, SBI Buddy, Itz Cash, Citrus Pay, Vodafone M-Pesa, Axis Bank Lime, ICICI Pockets, SpeedPay and so forth.

Banks Pre-paid Cards: Spending money are loaded onto the prepaid card in advance with a bank account debit card if you have "opted in" to your bank's overdraft program. This means that your bank may charge you a fee for covering the cost of a purchase or ATM withdrawal that exceeds what you have in your account.

Point of Sale: A point of sale (PoS) is the place where sales are made. On a macro level, a PoS may be a mall, a market or a city. On a micro level, retailers consider a PoS to be the area where a customer completes a transaction, such as a checkout counter. It is also known as a point of purchase.

Internet Banking: Internet banking, also known as online banking, e-banking or virtual banking, is an electronic payment system that enables customers of a bank or other financial institution to conduct a range of financial transactions through the financial institution's website. It includes National Electronic Fund Transfer (NEFT), Real Time Gross Settlement (RTGS), Electronic Clearing System (ECS) and Immediate Payment Service (IMPS).

Mobile Banking: Mobile banking is a service provided by a bank or other financial institution that allows its customers to conduct different types of financial transactions remotely using a mobile device such as a mobile phone or tablet. It uses software, usually called an app, provided by the banks or financial institution for the purpose. Each Bank provides its own mobile banking App for Android, Windows and iOS mobile platform(s).

Micro ATMs: Micro ATM meant to be a device that is used by a million Business Correspondents (BC) to deliver basic banking services. The platform enable Business Correspondents (who could be a local kirana shop owner and will act as 'micro ATM') to conduct instant transactions.

List of Top 14 Digital Wallet Apps in India

1. PayTM

PayTM, the most common and popular apps among the current millennial generation in India offers you the option to transfer money into a digital wallet and use it to make payments. It was launched in 2010 and followed a semi-closed model, which takes advantage of the enormous mobile and smartphone market. Any user can use the app to make payments in stores that have tie-ups with the company. Other uses of PayTM include making bill payments, transferring cash, and avail the services of travel and entertainment websites. Currently, it is also utilized to make cashless fee payments in educational institutes.

2. Amazon Pay

The next entry on our list is Amazon Pay, yet another of the best digital wallet app in India that is, as the name suggests, owned by none other than the com giant Amazon. It was launched internationally in 2007 and widely used by Amazon's massive customer base. Secure and extremely efficient, you can use it to easily make payments

while using the balance in your Amazon account. It can be used in external merchant websites.

3. Google Pay

Currently, you can see Google Pay is a payment option in almost all brick and mortar as well as online stores. It has a massive user base; it can be used to quickly send money to friends, pay bills, buy anything online, order food, recharge your phone, or shop at stores. It links your existing bank account to the app and does not require you to load wallets or verify KYC since it is directly connected to your bank.

4. PhonePe

Yet another digital wallet app in India that launched in 2015, PhonePe has been downloaded by more than 100 million users to date. It can be used to conduct UPI payments, do recharges, and ensure secure money transfers as well as online bill payments. Since it comes with a very easy-to-use user interface, it is one of the most common apps in India.

5. Mobikwik

MobiKwik is a widely used digital wallet app in online retail stores. You can add money using your debit, credit card, and net banking account into the mobile wallet and then utilize this money to recharge or pay bills and shop at online sites. Several grocery stores, as well as food establishments, use MobikWik, especially for its feature called expense tracker, which offers the unique option of monitoring spends and maintaining a budget.

6. Yono by SBI

Surprisingly, when SBI launched the Yono application, it turned out to be one of the best digital wallet apps in India. You can use this software to transfer money to other users and bank accounts. You can also use Yono to pay your bills, do recharges, make movie bookings, hotel reservations, and online shopping. It is a type of semi-closed prepaid wallet that is available in multiple languages and can even be used if you do not have an SBI account.

7. HDFC PayZapp

PayZapp by HDFC is very famous as it has the choice of making all installments in only a single tick. You can utilize it to re-energize your telephone, DTH association, and information card, make service bill installments, book flight tickets (in the wake of contrasting costs), reserve a spot for transport and lodgings, and shop, buy film tickets, and shop at music and supermarkets. You can likewise utilize it to move money to anybody on your contact list.

8. BHIM Axis Pay

Gathering together the rundown of the most dependable and best-computerized wallet applications in India is BHIM Axis Pay, which chips away at UPI banking and permits you to move cash quickly to anybody through your cell phone. You can utilize it to do portable and DTH re-energizes also.

9. ICICI Pockets

The ICICI Pockets e-wallet application isn't simply restricted to those keeping money with ICICI. You can add cash to the computerized wallet utilizing any ledger. You can utilize the VISA-fueled e-wallet application to move assets to any telephone number, ledger number, Facebook client, or email ID. It likewise permits you to shop on the web, do re-energizes, split costs with companions, buy tickets, and send presents. ICICI likewise gives you the choice to change it over completely to a zero-offset bank account with the bank. Dependent upon an expense, you can likewise get an actual charge card for your computerized wallet that can be utilized in disconnected stores and furthermore for online buys. The application gives you selective limits, arrangements, refunds, and bundles from driving brands. The ICICI Pockets application is a magnificent illustration of an advanced versatile application.

10. JioMoney

Jio SIM clients will find the JioMoney application introduced consequently on their cell phones. In the event that you are not a Jio client, you can download it from the application store on your gadget and use it. You won't be guaranteed to require a financial balance to re-energize JioMoney. You likewise have the choice to pay money to a Jio vendor, who will stack the sum in your computerized wallet. This component is particularly huge since Jio cell phones are broadly utilized in country India. You can appreciate restrictive limits and offers from select shippers and furthermore procure different cashback benefits on different exchanges when you utilize this e-wallet application.

11. Airtel Payments Bank

You can download the Airtel Thanks application on your gadget to deal with your Airtel versatile records and utilize the Airtel Payments Bank and the Airtel Money Wallet. Cash added to the Airtel Money Wallet goes into the Airtel Payments Bank account. It likewise procures an ostensible measure of interest. You can utilize the cash to shop on the web, re-energize your prepaid record, take care of your postpaid bills, and send cash to others. It additionally allows you to appreciate limits, cashback and offers on lodging, transport, flight, and film ticket appointments. The application additionally gives you free admittance to stages, for example, Amazon Prime, Wynk Music, HOOQ, Airtel TV, and so on. All installments are secure and require a 4-digit mPIN.

2. REVIEW OF LITERATURE

During the writing search, it had been seen that the numerous previous sorts of exploration were significantly founded on different models like TAM, TAM2, and UTAUT to investigate factors influencing reception and fulfillment of advanced installment techniques. Albeit the majority of the investigated arranged socioeconomics profile of respondents, further investigation of various aspects of computerized installment techniques has not yet drawn in the analysts. The audit of the writing included broadly and universally presumed diaries crossed from 2003 to 2018. The audit was centered around the segment factors versus fulfillment with arising computerized installment strategies.

The exploration done by Chang (2003) zeroed in on the parts of social construction concerning training and innovation in Korea. The outcomes suggested that the reception of web banking was essentially affected by socioeconomics and the level of openness to web banking, and the elements of the banks.

Hogarth et al (2008) led a study basically founded on an assessment of the shopper installment conduct. Utilizing bunch investigation various customer gatherings (technophile and technophobe) were made in view of their use example of fluctuated e-installments and financial, segment, and attitudinal qualities. It was figured out more youthful, exceptionally qualified, big-time salary levels were bound to embrace computerized installment decisions than others.

Kumbhar (2014) featured the vital elements of elective financial administrations given by open and confidential area that influences consumer loyalty in Satara City, Maharashtra State. The outcomes laid out that there was a critical connection between age, instruction, and calling with consumer loyalty with the exception of orientation and pay.

Amin et al (2014) inspected the Technology Acceptance of Model (TAM) factor apparent helpfulness (PU) and saw usability (PEOU) alongside an extra variable trust on portable sites client's fulfillment in Malaysia. The consequences of primary condition displaying (SEM) demonstrated a critical relationship of consumer loyalty with accurately adjusted PU, PEOU, and trust.

Ling et al (2015) recognized five factors to be specific help quality, website composition and content, security and protection, accommodation, and speed of web banking which influence consumer loyalty. The discoveries indicated that website architecture and content, comfort, and speed were the deciding variables of consumer loyalty toward Internet banking.

Singh et al. (2016) added another variable gratification alongside factors of a model in the coordinated UTAUT. The outcomes portrayed a critical connection between customers' insight, inclination, utilization and fulfillment, and security, trust, and gratification are not many of the most affecting factors joined by segment factors, for example, orientation an age likewise influence buyer fulfillment and use rate.

Woraku et al. (2016) research was explicitly found because of segment factors on consumer loyalty to electronic banking in Gondar City, Ethiopia. The creators likewise pondered extra factors, for example, branch visits, and the degree of client understanding of e-banking. The overview result showed that there was a critical connection between segment factors like age, orientation, training, occupation, and conjugal status with consumer loyalty.

Yaokumah et al. (2017) analyzed the effect of segment factors (age, orientation, and the degree of instruction) regarding clients' inclinations toward e-installment administrations in Accra, the capital of Ghana. The outcomes recommended that there were no tremendous contrasts between the sexual orientations of the clients utilizing e-installment administrations. On the opposite side, the assessment uncovered intriguing bits of proof that male clients with higher ICT abilities and a more significant level of schooling thought about e-installment as less protected.

Siddiqui and Khan's (2017) work set out the significance of dissecting the segment factors on accommodation, e-fulfillment, and marketing saw esteem and monetary exchanges in E-retailing.

Singh and Rana (2017) zeroed in their work on researching client discernment towards advanced installments. The discoveries uncovered that only one segment factor for example schooling impacted the reception of the computerized installment in Delhi NCR rest of different factors, for example, orientation, age, calling, and pay was viewed as not huge. The creators guaranteed that a client who had concentrated on registration and was well informed would bound to like to utilize the computerized installment mode.

2.1 RESEARCH GAP

Various studies have covered different aspects of the Digital Payment System In India. Owing to the volatile nature of the title of this report, there is a gap established that not any one of the author or researcher have studied the digital payment system on Punjab state as a individual.

As this is a much newer topic of discussion, no literature as such has been published on the Punjab state about the concerned topic. Hence, this study is a foot forward in the direction of fulfilling this gap for further fellow enthusiasts to take forth.

2.2 OBJECTIVES OF THE STUDY

To study the awareness level of digital payment among individuals.

To study the relationship between Individuals' demographic factors with awareness level of Digital Payment.

3. RESEARCH METHODOLOGY

3.1 Research Design

A Research design is a framework or blueprint for conducting the marketing research project. It details the

procedures necessary for obtaining the information needed to structure or solve marketing research problems. This study based on descriptive in nature.

3.2 Sample Design

- ❖ Area of Research: In this study Kapurthala Districts of Punjab is selected for research.
- ❖ Sample Size: A sample of minimum respondents has been selected from Kapurthala Districts of Punjab. The survey was carried out on 150 respondents.
- ❖ Sample Unit: It indicates who is to be surveyed. In this project sampling unit is the individuals of Kapurthala districts of Punjab.
- ❖ Sampling Technique: For the purpose of this Research, Convenience Sampling technique is used.

3.3 Data Collection and Analysis

Primary data is used for the achievement of the objectives of the study. Well structured questionnaire is used. By face-to-face interview method, data is collected. The secondary data is used for the introduction and review of literature of the study.

Statistical Tools: Chi-Square test is used to check the association of demographical factors with Digital Payment System awareness level.

4. DATA ANALYSIS AND INTERPRETATION

Table number 1.1 shows that the education of the respondents with uses of digital payment methods. Table shows that most of the respondents who's have post graduate degree holders i.e. 32.66% and only the 14.67% respondents used digital payment methods whose education less than 10th standard.

Sr. No	Education	Number	%age
1	>10 th	22	14.67
2	+2	33	22
3	UG	46	30.67
4	PG	49	32.66
	Total	150	100

Table number 1.2 shows that the gender of the respondents with uses of digital payment methods. Table shows that most of the respondents are males i.e. 65.33% and only the 34.67% respondents used digital payment methods that are female.

Sr. No	Gender	Number	%age
1	Male	98	65.33
2	Female	52	34.67
	Total	150	100

Table number 1.3 shows that the Income of the respondents with uses of digital payment methods. Table shows that majority of the respondents belongs to above 30,000/- income i.e. 38% and only the 10.67% respondents used digital payment methods whose Income less than 10,000/-.

Sr. No	Income	Number	%age
1	>10,000	16	10.67
2	10,001-20,000	28	18.67
3	20,001-30,000	49	32.66
4	Above 30,000	57	38

	Total	150	100
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Table number 1.4 shows that the area of the respondents with uses of digital payment methods. Table shows that majority of the respondents belongs to urban area i.e. 61.33% and only the 38.67% respondents used digital payment methods whose belongs to rural area.

Sr. No	Area	Number	%age
1	Urban	92	61.33
2	Rural	58	38.67
	Total	150	100

Table number 1.5 shows that the Occupation of the respondents with uses of digital payment methods. Table shows that most of the respondents are students i.e. 44.67% and only the 3.33% are businessman who's used digital payment methods.

Sr. No	Occupation	Number	%age
1	Job	78	52
2	Business	5	3.33
3	Student	67	44.67
4	Household	00	00
	Total	150	100

Table number 1.6 shows that the Job types of the respondents with uses of digital payment methods. Table shows that most of the respondents are doing private jobs i.e. 59.33% and only the 40.67% are belongs to public sector.

Sr. No	Job Type	Number	%age
1	Private	89	59.33
2	Public	61	40.67
	Total	150	100

Table number 1.7 shows that the frequency of digital payment's used by the respondents. Table shows that most of the respondents are used digital payment method once a month or lesser i.e. 60% and only the 1.33% are respondents are used daily digital payment methods.

Frequency	Daily	More than once a week	Once a week	Once a Month or Lesser
Number	2	21	37	90
%age	1.33	14	24.67	60

Table number 1.8 shows that the frequency of digital payment's used by the respondents. Table shows that most of the respondents are used digital payment method once a month or lesser i.e. 60% and only the 1.33% are respondents are used daily digital payment methods.

Amount	Small transactions	Big transactions	All transactions
Number	99	13	38
%age	66	8.67	25.33

Table number 1.9 shows that the mode of digital payment's used by the respondents. Table shows that majority of the respondents are used smart phones for digital payment i.e. 74% and only the 5.33% are respondents are used PC/Laptop for digital payment methods.

Mode	Smart Phone	PC/Laptop	Both
Number	111	8	31
%age	74	5.33	20.67

Table number 1.10 shows that the method of digital payment's used by the respondents. Table shows that majority of the respondents are used card for digital payment i.e. 52% and only the 4% are respondents are used all and wallet for digital payment methods.

Methods	Card	Wallet	Net Banking	Mobile Banking	All
Number	78	7	48	11	6
%age	52	4.67	32	7.33	4
Purpose	Shopping	Bill Payment	Transferring Money between A/c	B2B Transactions	Ticket Booking
Number	96	27	18	2	7
%age	64	18	12	1.33	4.67

Hypotheses for the data shown in Table 4.40 for chi-square test are as under:

H0: There is no significant association between individuals' demographic factors and the digital payment.

H1: There is a significant association between individuals' demographic factors and the digital payment.

Chi-Square Tests

	Value	Df	p-value
Pearson Chi-Square	35.198	8	0.001
Likelihood Ratio	36.901	8	0.000
Linear-by-Linear Association	27.889	1	0.000
Number of Valid Cases	500		

The test was performed at 5% level of significance. The output of Chi-square test is as presented in Table 4.41. The Pearson Chi-square significance value is 0.001 with degree of freedom 4. Therefore, null hypothesis is rejected and hence, it is found that there is a significant association between individuals' demographic factors and the digital payment

5. CONCLUSION

The findings of this study also hold important practical implications for banks and firms that are currently offering digital payments solutions and others that are planning to offer such services. Issues such as fears of privacy and

security risks together with comparative usefulness or relative advantages of using digital payments should be highlighted to educate potential customers. The Majority of respondents are aware about Digital Payment in Kapurthala. Male are used more digital payment than female. More educated people used more Digital Payment. Mostly Mobile phones are used for digital payment rather than Laptop or other devices. Shopping is major reason for the growth of Digital Payment.

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A STUDY ON ONLINE CONSUMER BEHAVIOUR TOWARDS DIGITAL ADVERTISING

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Digital Advertisers use the internet to send out promotional messages to both present and future clients in an effort to grow their clientele and relationships with the ones they already have. Compared to earlier, businesses are investing more on internet advertising. Online marketing, also known as online advertising, internet marketing, or web marketing, is a type of marketing and advertising that uses the internet to communicate marketing messages to consumers. Due to its widespread use and accessibility, digital advertising on smart phones, tablets, computers, televisions, game consoles, digital billboards, social media, SEO (search engine optimization), videos, content, and e-mail is crucial for promoting goods and services. Online advertising has risen fast during the past ten years, attracting businesses' attention. People are connecting and logging on to the internet more frequently and in greater numbers every day. Various review articles from various publications have been examined in order to successfully complete this study. This study establishes a strong correlation between online advertising and consumer purchasing habits. The present study examined the adoption factor of digital advertising and its impact on online consumer behaviour. The goal of this study is how consumers' buying decisions are influenced by various forms of online advertising.

Keywords: Consumer Behaviour, Online Advertising, Buying Habits, Social Media Marketing, advantages, disadvantages

1. INTRODUCTION

"Digital advertising" is a category of marketing that makes use of digital media to spread advertising messages in an effort to attract and keep customers. Due to the increase in consumer access to the internet, marketers are spending money on online advertising (Shiju, 2022). The 4Ps of the marketing mix, along with Product, Price, Place, and Promotion, are all components of the promotional mix, which also includes advertising. Today's advertising is a fantastic tool for distributing information about the business throughout the market

1.1 Types of Digital advertisement

Digital advertisements come in a variety of forms, according to an article on India Free Notes dated February 6, 2020. These include

1.1.1 Direct Mails

It takes skill to choose the target demographic and then send them mail or sales letters. Offers for the product are included in these emails. Estimating responses helps businesses understand what kind of customers are responding to this configuration, so they can use much more precision in their future mailshots.

1.1.2 Social Media Marketing

Advertising on social media platforms like Facebook, Instagram, and Pinterest is generally affordable. These are sponsored promotions. Businesses can post about their operations on social networking sites. The organisation can create its own page, much like on Facebook. People will comment on the merchandise and like the page.

Additionally, they tag their friends, which builds a network. This will enable customers to learn about new products.

1.1.2 Video Ads

Small videos that are posted online aid in the organisation's product promotion. These videos are directed towards a certain consumer group that may be interested in buying based on their search. In between various videos of films, television episodes, etc., these ones advertise on the well-known website YouTube. Owners of the pages are paid by advertisers for the placement of their ads. Video promotion can be created by professionals working from a desk or even by an internal team of the advertiser.

1.1.3 Banners Ads on a Web page

Companies display their banners on some well-known websites they have chosen as their target audience. It's possible that these banners correspond to the audience's interests or not.

1.1.4 Search Engine Optimization (SEO)

Digital marketing's core component is SEO. Enhancing visibility for relevant searches (search engine results) is one benefit. The best example of a search engine is Google, which is followed by numerous others.

1.1.5 Social Media Marketing

Social media is the channel used for interacting with others, producing, and disseminating material. Facebook, Instagram, Telegram, Twitter, Pinterest, and other social media platforms are examples. Today, social media has become quite popular for product promotion, and the majority of businesses use it to target their customers (Jogi and Vashisth ,2021).

1.2 ADVANTAGES OF DIGITAL ADVERTISING

1.2.1 Cost related

Cost-related factors are the main benefit of social media marketing. Social media marketing has relatively minimal price barriers when compared to traditional forms of advertising. Creating a profile, posting content, and using most social networking platforms are all free. While conventional advertising efforts might cost millions of dollars, Despite being used for corporate purposes, many social media tools are free. Even with a small marketing budget, businesses can execute extremely effective social media campaigns.

1.2.2 Measurable Results

Online advertising also has the advantage of allowing for real-time campaign evaluation of its effectiveness. Businesses may monitor the efficacy of their advertisements and make the required adjustments with the use of analytics software.

1.2.3 Increased Brand Awareness

By reaching a larger audience, digital advertising also contributes to boosting brand awareness. Businesses can connect with potential clients who may not have known about their goods or services through social media platforms and search engines. This promotes brand recognition and customer loyalty, which can improve sales and revenue.

1.2.4 Flexibility

When compared to conventional advertising strategies, digital advertising offers a significant degree of flexibility. Businesses are able to adapt quickly and efficiently to shifting market conditions and customer demands by rapidly creating and distributing advertisements. In conclusion, there are a number of benefits to digital advertising that help firms sell their goods and services online effectively and affordably. Digital advertising has evolved into a crucial instrument in the contemporary corporate scene due to its focused promotion, cost-effectiveness, measurable results, and enhanced brand awareness (Olley and Akpor ,2023).

1.3 DISADVANTAGES OF DIGITAL ADVERTISING

Digital advertising has some benefits, but it also has some drawbacks.

1.3.1 High Competition:

Given the recent increase in competition, the digital marketing strategy needs to be well-planned, distinctive, compelling, and have an influence on the target demographic. Any repetitive or monotonous strategy will quickly eliminate the brand from the competition. Digital marketing initiatives are now extremely competitive. Because of this, brands must be responsive to the requirements of their customers.

1.3.2 Dependability on Technology

Digital advertising depends completely on technology, and the internet is highly susceptible to errors. There are instances when the links may not function, web pages may not load, and page buttons may not simply carry out their functions. This prompts potential buyers to turn to other brands. Therefore, a website test is required to prevent this.

1.3.3 Time Consuming

The time-consuming nature of digital advertising efforts is one of their main drawbacks. It can be tough to devote the necessary amount of time to the campaign due to chaotic techniques and strategies that may take a lot of time.

1.3.4 Security and Privacy Issues

For any brand, security is the most important necessity. Therefore, as a digital marketer, you should take website protection seriously. It is usually advised to use firewalls and encryption solutions like VPNs to secure and protect network connections.

1.4 CONSUMER BUYING BEHAVIOUR

Consumer buying behaviour is the study of how people acquire and discard products, services, ideas, or experiences to fulfil their needs and desires (Kotler and Keller, 2011) This covers what they buy, how they buy it, why they buy it, where they buy it, how frequently they buy it, how frequently they use it, how to evaluate it after the purchase and the effects of such an evaluation in the future, and how they dispose of it.

1.5 TYPES OF CONSUMER BEHAVIOR

There are four different forms of consumer conduct (Ihinmoyan ,2022).

1.5.1 COMPLICATED BUYING BEHAVIOUR: Consumers often exhibit complex purchasing behaviour while purchasing expensive goods. For instance, when a consumer purchases a car for the first time, it is a significant decision because it carries a high level of financial risk.

1.5.2 HABITUAL BUYING BEHAVIOUR: Customers do not give much care to the things they purchase while they are making daily purchases. They either purchase their preferred brand, the one they frequently use, the one that is readily accessible at the store, or the least expensive option.

1.5.3 VARIETY-SEEKING BEHAVIOUR: In this area, brand switching by consumers is common. Due to the low cost of switching items, customers may do so out of pure curiosity or boredom. In this country, consumers typically purchase a range of goods because of a desire for variety rather than discontent.

1.5.4 DISSONANCE-REDUCING BUYING BEHAVIOUR: Consumer involvement is extremely strong in purchasing behaviour that reduces dissonance. The high costs and infrequent purchases could be to blame for this. Additionally, there are few options available and there aren't many notable brand differences. A buyer purchases a readily accessible goods in this category.

2. REVIEW OF LITERATURE

A literature review examines the most recent research on a subject, including findings as well as methodological and theoretical contributions. The literature study cites secondary sources rather than the most recent or novel experimental work, which is not reported.

Nadaraja and Yazdanifard (2013) examined that the main benefits and drawbacks that digital marketing has as a result of the advancement of Internet technology. Social media is the go-to tool of today for marketers who use every available channel to reach their target audiences. Many businesses are still having trouble figuring out how to use the medium effectively because it offers a variety of benefits and drawbacks, depending on the firm. The typical business owner or marketer does not completely comprehend the risks and difficulties involved. The area is still so new that it is challenging to assess the credentials of social media "experts" who advertise their services online.

Singh et al. (2014) examined that the study of how people, groups, and organisations acquire and dispose of products, services, ideas, or experiences to fulfil their needs and desires is known as consumer buying behaviour. The author stated that the businesses stand to gain significantly over the long term by having a better grasp of consumer purchasing behaviour through research and identification. It is highly challenging to pinpoint the precise factors that influence a consumer's decision to buy one product or service over another, despite the considerable efforts made to learn about and understand their purchasing behaviour.

Afzal and Khan (2015) investigated that Online advertisements are only effective when they include high-quality content, graphics, and production. One of the key elements that affects and has a direct and considerable impact on consumers' online purchasing behaviour is their loyalty to a brand (one of the factors of attitude). **Sivasankaran (2017)** exclaimed that the economy in general and marketing in particular have been revolutionised by digital marketing, which presents various threats and challenges to the marketer in the cutthroat marketplace. The market needs to move away from the traditional customer-oriented marketing approach and towards a technological customer-oriented marketing approach soon, which requires marketers to better understand young people in order to develop marketing strategies that will retain the present and capture the potential market.

Dhore and Godbole (2018) investigated that Consumer purchasing behaviour is the result of a consumer's attitudes, interests, intentions, and choices around how they will act in the marketplace while making a purchase of a good or service. The degree of familiarity with the available advertising platforms affected the reach and awareness-raising abilities of digital advertising. As seen by their diverse perspectives regarding the usage of advertising, the majority of the respondents had a positive attitude towards advertising. This demonstrates a definite favourable attitude towards advertising, which is encouraging for marketers. The results confirm that marketing is seen by internet users as a significant source of knowledge about the products that are currently on the market, as evidenced by their positive attitudes around the globe. Because the ads are attractive and enticing and vary frequently, internet advertising is a successful medium for marketing.

Pal and Shukla (2020) exclaimed that Consumer behaviour favour the digital market. Both the customer and the supplier benefit from it. People who want to sell their goods internationally and provide him with products and services can do so easily. In the shortest amount of time, the online market penetrated a wide territory. It generates a large number of customers at once. In digital marketing, we have access to a variety of product information in one location and through a variety of means. Based on a recent survey, we can predict the potential of digital marketing and how consumers will behave while making purchases through online channels. It's improved and given them more power.

Jogi and Vashisth (2021) investigated that Online advertising and purchasing behaviour are significantly related. Online advertisements have a significant impact on how customers perceive products. Customers are being encouraged to buy the product as a result. Additionally, it aids people in remembering why they require the goods.

Online advertisements are also assisting businesses in forging a brand identity for their goods. The experience that customers have while making an online purchase after clicking on internet advertisements must also be taken into account. Understanding consumer problems can be aided by research on post-purchase behaviours.

Alamsyah et al. (2021) examined that consumer demands can be supported through digital advertising, which may influence consumer preferences. to ensure that the content of digital advertising meets consumer expectations. There is a side that is digital. Consumer preference for advertising has a favourable effect on consumer brand awareness of goods from businesses. In this study, it was discovered that consumer requirements couldn't be used to gauge consumer brand awareness. As a result, the desire for digital advertising is identified as a mediator between consumer requirements and consumer brand recognition.

Ihinmoyan (2022) observed that the printing press, radio, television, and social media are just a few of the variables that have revolutionised how businesses and organisations interact with their target audiences through advertisements. Because of communication's growth, corporations don't think twice about spending money on advertisements to accomplish their objectives. Today's advertising is more adaptable than ever. The author found that there is a strong correlation between consumer purchasing habits and digital advertising, and as a result, people tend to purchase more products for which they have been made aware of the advantages through digital information. Target consumers are made aware of information, enabling them to make quick decisions on the purchase of the products.

Sule et al. (2023) attempted to investigate the digital advertising platforms have a big influence on consumer behaviour, and how well they can serve their target market will determine how effective they are. To have a beneficial impact on consumer behaviour as consumers become more discerning, digital advertising platforms must concentrate on delivering relevant, personalised, and engaging advertising.

3. RESEARCH METHODOLOGY

This study is based on earlier research. The internet was used to compile several published research papers. The secondary data was gathered by searching Google, Google Scholar, reports, websites, research scholar, and journals etc.

4. RESEARCH OBJECTIVES

- To study the factors responsible for adoption of digital advertising
- To study the impact of digital advertising on online consumer behaviour
- To examine the challenges/obstacles /problems faced by online consumer of digital advertising.

4.1 FACTORS RESPONSIBLE FOR ADOPTION OF DIGITAL ADVERTISING

4.1.1 People Are Spending a Lot of Time Online

Everyone appears to be online all the time. Everywhere we go, there is access to technology, and we are making the most of it. People clearly appreciate being linked, which, in my opinion, explains why there is so much connectedness. Everyone aspires to maintain as much contact as they can with their friends, family, jobs, and interests. Our intentions are even honourable, so it makes sense. Since we spend so much time online, it's beneficial for businesses to know how that time is used. People from all generations are eager to use the internet. It seems like everyone wants to have access to friends, information, and entertainment.

4.1.2 People Are Increasingly Mobile

People are always hooked to their phones when you glance around a restaurant, park, or baseball event. Everywhere people travel, they have access to the internet and use mobile devices to get information. We can see from the data that one of the main factors in our increased online activity is our access's portability.

4.1.3 People use search engines for all kinds of things

One of the most popular tools for helping individuals easily find the information they need is search engines. They frequently use search engines as the starting point for their access to and consumption of information in order to find what they are looking for.

4.1.4 Availability Information Has Empowered Consumers

The game has changed for businesses competing for the attention of customers eager to make purchases thanks to the availability of information at any time and from any location. The days of prospective buyers heavily relying on salespeople are long gone. Car "shopping" is done online rather than at the dealership.

4.2 IMPACT OF DIGITAL ADVERTISING ON ONLINE CONSUMER BEHAVIOUR

4.2.1 Ability to Research and Experiment

They are exposed to a huge amount of content as businesses promote their goods online. As a result, consumers can now conduct online product comparisons and studies before deciding what to buy, which has made the purchasing process easier for them. Even experimenting with various brands to reach a decision has been made possible by the huge amount of information available online. The same technology that has greatly facilitated their ability to be influenced by marketers has also greatly increased their power.

4.2.2 Accessible Word-of-Mouth

Advertising via word-of-mouth is nothing new. Both consumers and brands use it to facilitate commerce. The main factor influencing consumer behaviour is, obviously, word of mouth. The opinions of others regarding a brand are something that consumers frequently look out for. This is especially true for a product they are considering buying. When a customer tells their network about a brand, it matters a lot to the company.

4.2.3 Enhancement of Customer Engagement

Customers have always desired to participate in something bigger. They don't pass up an opportunity to engage with their preferred brand. Social media, search engines, and other review websites all offer customers the chance to interact with their companies. They are now able to communicate their opinions to their brands immediately. Rapid responses to customer feedback will result in increased engagement and increased revenue for the companies.

4.2.4 Less Patience, High Expectations

As their expectations for quick, efficient service have doubled, consumers have become notably more impatient thanks to technology. As a result of exposure to online forums and user reviews, they get genuine, emotional feedback on goods and services. Their purchase behaviour is significantly impacted by the wealth of information consumers receive from digital marketing. Consumer expectations are gradually rising worldwide because of services like hassle-free swaps and next-day delivery.

4.2.5 Personalised Shopping Experience

Consumers are now accustomed to a customised purchasing experience because of digital advertising. These days, they don't want to take a lot of time to study and buy the things they want. Because of this shift in consumer behaviour, brands have adapted their online marketing and branding strategies to give every customer a customised experience through the curation of individualised information. The entire purchasing experience is thus customised to meet the demands of each unique website user.

4.3 OBSTACLES FACED BY ONLINE CONSUMER OF DIGITAL ADVERTISING

4.3.1 Ad Fraud

According to some estimates, up to 20% of all digital ad impressions may be fake, which is a significant issue for the digital marketing sector. Click fraud, bot traffic, and ad stacking are just a few examples of the various types of ad fraud.

4.3.2 Fake News and Misinformation

The growth of social media has provided a forum for the dissemination of false information. Digital marketers must exercise caution to avoid promoting incorrect content and to make sure that their advertising does not appear next to stories that are not true.

4.3.3 Ad Blockers

According to some estimates, up to 30% of internet users may have ad blockers installed, which shows how common they are and how they are growing in popularity. Reaching their target demographic is, therefore, more challenging for digital marketers.

4.3.4 Competition

The competition is getting more intense as the digital marketing sector expands. Small and medium-sized enterprises may find it challenging to compete with larger firms that have larger budgets as a result.

4.3.5 Complexity

With numerous tools, platforms, and channels to manage, digital advertising is becoming more and more complicated. This can make it challenging for marketers to stay up and may result in errors or missed opportunities.

4.3.6 Lack of Trust

Trust in the digital marketing sector is declining. Consumers are becoming more critical of the messages they receive and more aware of the strategies employed by marketers. This means that in order to gain the audience's trust, marketers must be open and genuine.

5. CONCLUSION

Digital advertising and purchasing behaviour are significantly related. Digital advertisements have a significant impact on how customers observe products. Customers are being encouraged to buy the product as a result. Additionally, it aids people in remembering why they require the goods. The study's findings show how consumers feel about digital advertising and its influence on consumer purchasing behaviour. The most widely used and cost-effective form of marketing is digital advertising. Digital advertising offers advantages that outweigh its costs. Consumers are introduced to new products supplied by various businesses through digital advertising, thereby expanding their product base. There is no doubt that they run a lot of risks when they advertise things online. Businesses that wish to increase their customer base and revenue should invest more resources in digital advertising and research consumer patterns in various states to better target their campaigns.

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WEB-LINKS

- <https://www.chainreaction.ae/blog/the-impact-of-digital-marketing-on-consumer-behaviour/>
- <https://www.linkedin.com/pulse/top-16-challenges-problems-facing-digital-marketing-industry-kubode>
- <https://www.revenueriver.co/thecuttingedge/digital-marketing-factors-of-consumer-behavior>
- <https://digitalcatalyst.in/blog/what-are-the-main-advantages-and-disadvantages-of-digital-marketing/>
- https://www.clootrack.com/knowledge_base/types-of-consumer-behavior

BITCOIN CLOSING PRICE PREDICTION USING AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) MODEL

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This paper investigates the application of the Autoregressive Integrated Moving Average (ARIMA) model for predicting the price of Bitcoin. With the rapid growth and volatility of the cryptocurrency market, accurate price forecasting has become a vital aspect for investors and market participants. The ARIMA model, a popular time series analysis technique, is employed to analyse historical Bitcoin closing prices and predict future values. The data has been collected from July 2010 till June 2023. It is then pre-processed and analysed to identify trends and then stationarity is checked using Augmented-Dickey Fuller (ADF) test. By leveraging this time series, the ARIMA model is utilized to forecast the future price of Bitcoin. The findings of this research contribute to cryptocurrency analysis and provide valuable insights for investors and researchers interested in Bitcoin price forecasting. By understanding the trends and patterns in Bitcoin prices, stakeholders can make informed decisions regarding investments, risk management, and portfolio diversification in the cryptocurrency market.

Keywords: ARIMA, Bitcoin, Closing Price, Cryptocurrency, forecasting, price prediction

1. INTRODUCTION

Nowadays, the combination of traditional investment and alternative assets has become a hot spot. With the development of block-chain technology, virtual currency gradually enters the vision of asset allocation (Yao et al., 2022). The rapid and unchecked growth of cryptocurrencies in the recent decade has gained the attention of investors, researchers, and financial institutions worldwide. Among all the digital currencies available, Bitcoin has emerged as a widely recognized and is known as the gold in the virtual currency. Bitcoin is the foremost distributed cryptocurrency, while other digital currencies are created either by cloning or adjusting the mechanism of Bitcoin (Nakamoto, 2008). Its huge volatility has attracted countless people to invest (Fang et al., 2018; Hattori & Ishida, 2021; Kim et al., 2020). However, its volatility can not only bring huge profits to investors but also bring the possibility of losses (Hattori & Ishida, 2021). Since the advent of bitcoin, the academic community has never stopped predicting its price. However, no one or organization has ever been able to accurately predict the price of bitcoin (Guo et al., 2022).

The objective of this research paper is to explore the application of the Autoregressive Integrated Moving Average (ARIMA) model in predicting Bitcoin prices. To accomplish this, we have collected and pre-processed historical Bitcoin price data available in public domain. We then conducted a thorough analysis of the data, including descriptive statistics, visualization, and identifying any underlying patterns or trends. Subsequently, ARIMA model has been applied to generate forecasts.

The findings of this research will contribute to the growing body of knowledge on cryptocurrency price prediction and provide practical implications for investors, financial institutions, and policymakers.

2. LITERATURE REVIEW

After getting through the literature review in the relevant domain, it was found that various techniques, models have been used over the period to forecast the future values of the time series. Variety of papers have tried predicting the prices of cryptocurrencies with different methodologies.

To understand the dynamics of Bitcoin, various studies have been conducted over the period. Arutunyan et al. (2018) applied descriptive statistics on the dynamics of Bitcoin cryptocurrency and thereby developed descriptive models based on 5 variables i.e., daily return, volatility, trading volume, transaction volume and search for the Bitcoin term in Google to explain price change in Bitcoin. Kim et al. (2020) investigates the effects of the launch of Bitcoin futures on the intraday volatility of Bitcoin and reported that although the Bitcoin market became more volatile immediately after the introduction of Bitcoin futures, over time it has become more stable than it was before the introduction. Social Media messages influence on the value of cryptocurrency have been studied by Tandon et al. (2021) and their study resulted into the conclusion that no one person can control the utter volatile world of cryptocurrencies and the decentralized system ledger of cryptocurrency remains unharmed.

The Machine Learning and Deep Learning models have been used widely to forecast time series with varied degree of accuracies. The techniques like Monte Carlo Simulations, Cycle Prediction Method, Neural Network Autoregressive Model (NNAR), Linear, Ridge, LASSO regression, LSTM, GRU, Bayesian method, Support Vector Machine (SVM) and Random Forest (RF) have also been experimented to forecast the time series accurately (Guo et al., 2022; Gupta & Nain, 2021; Khedmati et al., 2020; Malhotra et al., 2022). Yamak et al. (2019) compared three different machine models to forecast Bitcoin prices.

Neural networks using ARIMA have been used by Poongodi et. al. (2019) for prediction while Adaboost-Based Ensemble Learning Techniques used by Machanda et. al. (2021). ARIMA performance have been compared with other techniques like Long-Short-Term Memory (LSTM) model by Latif et al. (2023), Artificial Neural Network (ANN) by Khedmati et al. (2020), Multistage Dynamic Trading Model Based on Gray Model by Latif et al. (2023), Facebook prophet by Devi et al. (2022). Hybrid methods between ARIMA and machine learning presented by Nguyen and Le (2019) to improve prediction of Bitcoin price and they showed that hybrid methods have improved accuracy of predicting through RMSE and MAPE. A primary MLP neural network structure was provided in order to predict the best window size for Bitcoin price prediction and to detect the influence of noise-type behaviors (Rajabi et al., 2022).

Guo et al. (2022) used diluted prediction method and puts forward an investment strategy which realizes a very safe profit with a final return rate of 6.2 times under the condition of making full use of the prediction risk coefficient. Yao et al. (2022) proposed Objective Empowerment Multi-Objective Programming Investment strategy based on ARIMA, which can increase the income obtained on the premise of minimizing investment risk. A new method entitled Learnable Window Size (LWS) is presented by Rajabi et al. (2022) for smartening the number of days intended to predict the price of Bitcoin the next day. A study by Bakar and Rosbi (2017) used ARIMA to forecast Bitcoin's prices considering volatility and relevant volatile environment during 2013-2017 while Yiqing Hua (2020) compared the accuracy of bitcoin price in USD prediction based on two different model, LSTM network and ARIMA model. Jing et al. (2021) predicted the prices using Broad Learning System and

Genetic Algorithm whereas Fractional and Fractal processes have been applied by David et al. (2021) on the cryptocurrency prices.

These prediction models and techniques have been used in other applications like Trading strategies based on ARIMA shown by Tang et al. (2022), Cryptocurrency Portfolio Construction Using Machine Learning Models done by Ramkumar (2021).

3. RESEARCH METHODOLOGY

The data used in this study is Bitcoin daily closing prices which is a time series. The data of Bitcoin prices have been obtained from Kaggle website. The prices of Bitcoin ranges from 17 July 2010 till 02 June 2023 with total of 4704 observations.

The ARIMA model is used to predict the Bitcoin prices. The Autoregressive Integrated Moving Average (ARIMA) is a method developed by George Box and Gwilyn Jenkins in 1970 and is commonly referred to as the Box-Jenkins method (Dagum, 2005). The forecasting approach using autoregressive integrated moving average (ARIMA) method produce a reliable forecasting model (Bakar & Rosbi, 2017).

To apply the ARIMA model and forecasting the future prices of Bitcoin, the entire study includes a series of Steps which are shown in Figure 1.

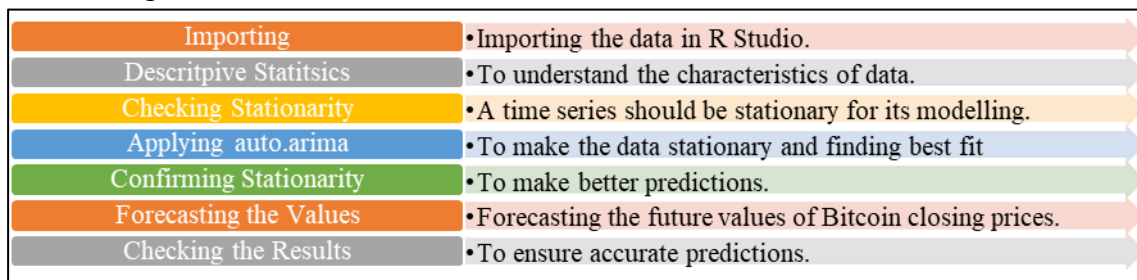


Figure 1: Steps Involved in ARIMA Modelling

Descriptive Statistics

The descriptive statistics of Bitcoin daily closing prices have been obtained in Table 1 to understand the characteristics of data.

Statistic	Value
Mean	9,137.34
Standard Error	212.45
Median	938.85
Mode	17.51
Standard Deviation	14,571.07
Kurtosis	3.02
Skewness	1.95
Range	67,305.05
Minimum	0.05
Maximum	67,305.10
Count	4,704

As Table 1 shows, the Average Bitcoin closing price is \$9,137.34. The Standard Deviation of \$14,571.07 suggesting a wide range of Bitcoin closing prices. The Kurtosis value of 3.02 suggests a distribution that is moderately peaked and has tails that are less extreme than a normal distribution while a positive skewness value of 1.95 indicates that the distribution is skewed to the right, meaning it has a longer tail on the right side. The range of Bitcoin closing prices is \$67,305.05 which represents huge volatility in the prices. The minimum value represents the lowest Bitcoin closing price in the dataset, which is \$0.05 and the maximum value represents the highest Bitcoin closing price in the dataset, which is \$67,305.10.

Stationarity of Data

Before modelling any time series, it is important to ensure that time series stationarity. For that, stationary test can be done in two ways, first by looking at the graphic plot of the original data or viewing the graphic plot of the ACF data.

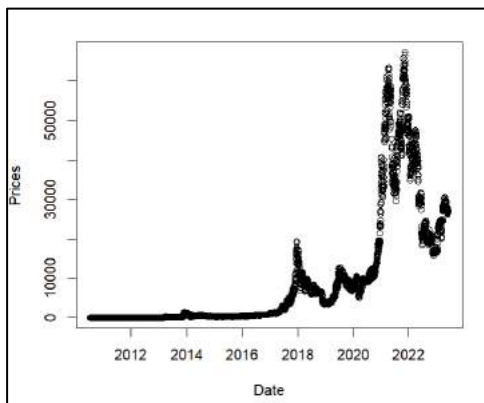


Figure 2: Trend of Bitcoin Closing Price

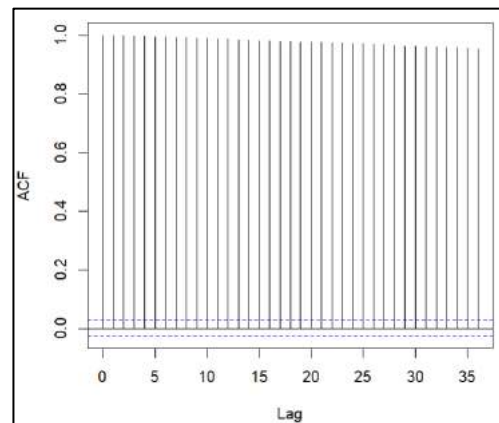


Figure 3: ACF Plot

The Figure 2 is clearly showing that the time series is not having constant mean and variance and the ACF chart Plot in Figure 3 shows a significant value in the initial lag and then shrinking very gradually. From both tests it can be ensured that the data is non-stationary.

Further to confirm about the stationarity, the Augmented-Dickey Fuller (ADF) test is used. The ADF test is a statistical test which is used to determine whether a time series is stationary or not. The output of the test can be seen in Figure 4.

```

Augmented Dickey-Fuller Test
data: ts
Dickey-Fuller = -2.2958, Lag order = 16, p-value = 0.4531
alternative hypothesis: stationary
    
```

Figure 4: ADF Test Output

As shown in Figure 4, p-value is 0.4531 which is higher than the significance level of 0.05, thus the null hypothesis is accepted and thus the time series is non-stationary.

ARIMA Modelling

Before the time series modelling, it is essential to make this time series stationary. For this, auto.arima function is used in R Studio. This function automatically conducts a differencing test to determine the order of differencing

required to make the series stationary and then search for the best-fitting ARIMA model based on the selected differencing orders and other model parameters. The Figure 5 shows the output of auto.arima function and the best fit is ARIMA(0,1,0).

```
> ARIMA=auto.arima(ts,ic="aic",trace = TRUE)
Fitting models using approximations to speed things up...
ARIMA(2,1,2) with drift      : Inf
ARIMA(0,1,0) with drift     : 73941.73
ARIMA(1,1,0) with drift     : 73942.72
ARIMA(0,1,1) with drift     : 73941.69
ARIMA(0,1,0)                : 73940.13
ARIMA(1,1,1) with drift     : 73944.7
Now re-fitting the best model(s) without approximations...
ARIMA(0,1,0)                : 73953.01
Best model: ARIMA(0,1,0)
```

Figure 5: Fitting the Best ARIMA Order

Here, the best fit for the Bitcoin closing prices time series is ARIMA(0,1,0) model which is also known as a random walk model. It assumes that the differenced series is a white noise process, which implies that the current values in the time series is a random walk from the previous values.

The ACF of residuals in Figure 6 indicates that the time series is stationary as the lines are under control of Blue dotted line.

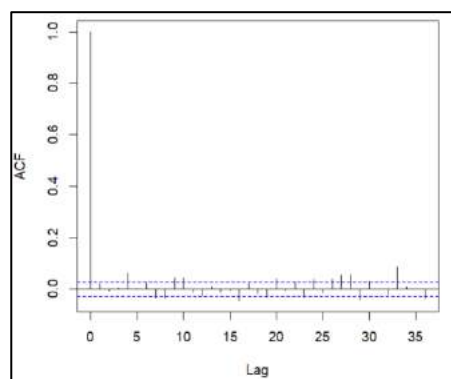


Figure 6: ACF Plot for Residuals

Forecasting

Now the forecasting is done using forecast function in R Studio. The Figure 7 is showing the forecasted values after 4704 observations. So, the price on 03 June 2023 will be USD 27214.70. The forecasted values are plotted in Figure 8.

```
> BTCforecast=forecast(ARIMA,level = c(95),h=5)
> BTCforecast
Point Forecast    Lo 95    Hi 95
4705             27214.7 25983.06 28446.34
```

Figure 7: Forecasted Values of Bitcoin Closing Prices

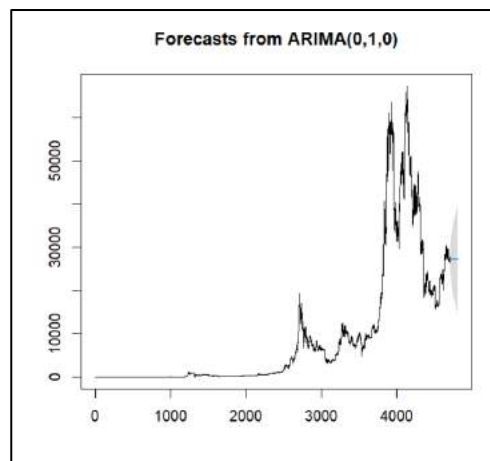


Figure 8: Plot of Forecasted Values

This forecasted data is confirmed by using Box-Ljung test. The Box-Ljung test is a statistical test which is used to assess the presence of auto-correlation in a time series. If p-value is greater than 0.05 with different lags, that indicates that the time series does not have the problem of auto-correlation.

```
> Box.test(BTCforecast$residuals, lag=10, type = "Ljung-Box")
Box-Ljung test
data: BTCforecast$residuals
X-squared = 52.912, df = 10, p-value = 7.732e-08
> Box.test(BTCforecast$residuals, lag=15, type = "Ljung-Box")
Box-Ljung test
data: BTCforecast$residuals
X-squared = 58.071, df = 15, p-value = 5.396e-07
> Box.test(BTCforecast$residuals, lag=20, type = "Ljung-Box")
Box-Ljung test
data: BTCforecast$residuals
X-squared = 84.226, df = 20, p-value = 7.442e-10
```

Figure 9: Box-Ljung Test Output

As shown in Figure 9, the p-value is greater than the significance level of 0.05. Hence, the forecasted values are free from the problem of auto-correlation.

4. CONCLUSION

In this paper, an econometric model i.e., Autoregressive Integrated Moving Average (ARIMA) model is applied on the Bitcoin closing prices. The best fit ARIMA model is used to predict subsequent bitcoin prices. The investors can use this model in the smart investing and can judge the best buy and sell. The same modelling can also be done on the other cryptocurrencies with a fair level of accuracy.

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CORPORATE SOCIAL RESPONSIBILITY ADVERTISEMENTS THROUGH SOCIAL MEDIA A NEW TACTIC FOR BRAND PROMOTION

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Today social media has created a virtual world in which the whole world lives and interacts. In the era of new media and branding the corporate sector has found a new way to promote their brand through social media with wield of CSR. There is a sturdy need of promotions to keep a brand as well as products alive. Promotion and branding through social media is easy, simple and economical. Many CSR (Corporate social responsibility) campaigns has tremendously performed well but somewhere campaigns has made a way for branding and promotions. In current paper the focus is on corporate social responsibility and how it is a tactic of brand promotion on social media The brands are using CSR as a tactic for brand promotion. Advertisements related to awareness campaigns on social media have performed well and have been received well by the target audiences of the brands, which has resulted in the promotion of the brands and has created a positive image of the brand among the external publics. The current paper will discuss how CSR advertisements on social media have become a tactic for brand promotion in India through content analysis of five different advertisements.

Keywords: CSR, Social Media, Consumer behavior, New media, Brand promotion

1. Introduction:

Corporate Social Responsibility(CSR) has come an essential part of the branding strategy for numerous companies. It refers to the consumers taken by brands to address social, humanitarian, and environmental issues. CSR isn't only important for a company's branding and image but also helps in building trust with consumers, workers, and stakeholders. One of the tactics for promoting CSR is through social media advertisements.

Social media has revolutionized the way companies interact with their consumers. It has handed businesses a platform to engage with their potential consumers, promote their products or services, and showcase their CSR initiative. CSR advertisements through social media are a new tactic that has gained significant fashionability in recent times. Then are some reasons why CSR advertisements through social media are an effective brand creation tactic.

Increase Awareness about the Brand

CSR advertisements through social media platforms like Facebook, Twitter, and Instagram can help companies to increase brand awareness. Social media platforms have a vast followership base, meaning companies can reach a wider audience through these channels. By promoting their CSR interest through social media advertisements, companies can increase their visibility and have a positive brand image

Connect with consumers

By promoting their CSR enterprise through social media advertisements, companies can connect with their consumers and show them that they watch about the same issues. This can help companies to make a pious client

base and enhance their brand character. As consumers are more aware today about environmental and other issues which may affect them directly or indirectly.

Show Social Responsibility

CSR advertisements through social media are an excellent way for companies to show their social responsibility. Companies can use social media platforms to show their initiatives to reduce their carbon footprint, promote sustainable practices, or support social causes. This can help companies to highlight themselves as different from their competitors and place themselves as socially responsible brands.

Enhance Corporate Image

CSR advertisements through social media can help companies to enhance their corporate image. Social media provides a platform for companies to communicate their CSR initiatives and highlight the impact of their efforts. This can help companies to make a positive brand image, which can enhance their corporate character.

Social media platforms have handed companies with an excellent thing to connect with their consumers, showcase their CSR interest, and enhance their brand character. By using social media channels, companies can produce a positive impact on society while promoting their products and services. Therefore, companies must embrace this new tactic and use it effectively to make a sustainable and socially responsible brand.

CSR, a concept in the business world, focuses on sustainable outcomes through good business practices and standards. It has evolved from being perceived as charity and donations to an integrated part of corporate strategy, balancing economic, environmental, and social imperatives while addressing shareholder and stakeholder expectations.

2. Literature Review:

CSR, a concept introduced by Clarence C Walton in 1967, emphasizes a company's social obligation and responsibilities. The concept gained popularity in the 1990s, with Howard R. Bowen's book promoting business considering social implications. Consumers increasingly buy products based on a firm's role in society. (Forte and Lamont, 1998) A survey by Confederation of Indian Industry (2002), UNDP, British Council, and PwC revealed that corporate citizenship and improved brand image are the main drivers of CSR among companies in India. CSR is crucial for consumers, as 52% of them recommend brands supporting good causes. In a recession, 55% of consumers will buy from brands supporting good causes, even if not necessarily the cheapest. Companies that prioritize CSR can improve brand image, reduce liabilities, and reduce insurance costs. (Saunders, 2006). CSR, as Scott Beaudoin (2009) suggests, has the same effects as advertisements, as it positively impacts a brand or product. Social responsible campaigns increase brand awareness and recognition, as consumers increasingly seek companies that share their values.

CSR initiatives are increasingly being undertaken by organizations to build their brands in a competitive era. In India, certain organizations are required to spend 2% of their net profits on CSR initiatives. CSR helps build an organization's image in the minds of people, making them big names in the industry. CSR activities directly connect organizations with stakeholders, enhancing their brand building efforts (Chhabra, P., & Guliani, S. 2022).

Customers' emotional connections to brands and their CSR initiatives can be sparked by the nature of CSR, which strengthens the bond between the brand and its audience. This aids in both raising brand recognition and cultivating a favourable perception of the company in the eyes of potential customers. Many businesses are focused on establishing their identities in this cutthroat economy, and CSR has emerged as one of the most powerful methods for doing so. Regardless of whether they conduct business in India or elsewhere, both Indian and foreign businesses have started to implement numerous CSR programmes. Additionally, some businesses in

India are compelled to devote 2% of their net revenues to CSR initiatives. As a result, CSR has grown in significance and scope, and by interacting directly with stakeholders, it may be used to strengthen the brand. In 2022, (Chhabra, P., & Guliani, S.)

Utilising CSR in advertising is mostly done to satisfy customer demand for information on how businesses handle social and environmental issues, which is on the rise. However, it has been difficult to discuss CSR in an effective manner. The premise behind the concept is that corporations should uphold social and ethical ideals for the benefit of society as well as profits. CSR has become a new business strategy that enables organisations to give back to society and cultivate public perceptions that are socially acceptable. CSR is now a crucial component of any organisation because consumers demand businesses to act responsibly not just towards their stakeholders but also towards the larger society in which they operate Das, S., and Mishra, P. (2020) Advertising is regarded as one of the most effective means of spreading CSR messages. As pointed out by Yoon et al. (2006), Morsing and Schultz (2006), and Pomeroy and Johnson (2009), utilising advertising to spread social information is more likely to arouse negative responses and consumer mistrust than other forms of communication sources.

In Dawkins' survey on corporate ethics from 2004, a sizable portion of respondents (74%) claimed that the company's social and ethical behaviour would influence their purchasing decisions, and an even larger portion (86%) thought that CSR initiatives would improve their perception of the corporate brand.

Objectives:

- To find out the use of social media as a platform for CSR advertisements.
- To analyze the role of CSR advertisements through social media in increasing brand awareness.
- To determine the factors that influence consumer attitudes and behavior towards CSR advertisements on social media.
- To understand the concept of Corporate Social Responsibility (CSR) and its role in brand promotion.

3. Research methodology:

Content analysis and case study methods are used to conduct this study and five successful social media advertisement campaigns were selected which were also successful. The sample was randomly selected for this study and the samples were selected according to the convenience of the researcher.

Findings and Discussions

Dove - #RealBeauty Sketches

Today, users spend more time browsing the web than watching TV or reading magazines, making the Internet a popular place for marketing and advertising. Companies like Dove have used social media to make connect with their consumers and launched this campaign it quickly became popular. It was declared the most viewed commercial video of the year. The campaign aimed to address issues such as social pressures on women, poor body image and low self-esteem, artificially set beauty standards and self-esteem. The ad was published on 33 Dove YouTube channels and was also available in 25 other languages.

The "Real Beauty Sketches" marketing campaign for Unilever's personal care brand Dove drew women based on their own and the perceptions of strangers with the help of an FBI-trained sketch artist. Images of the alien were often stereotypically gorgeous, emphasizing how unattractive women were seen on the outside and their lack of true beauty. The goal of the campaign was to encourage women to see their true beauty and establish Dove as a premium brand that understands what women need and want.

The Economic Times reports that Dove's sales in India increased by 20% after the launch of the #RealBeauty Sketches campaign. The campaign was well-received by Indian consumers, promoting self-esteem and body

positivity. Edelman Berland's report found that 71% of Indian women felt the campaign positively impacted their perception of beauty, and 82% would recommend Dove products to friends. Overall, the campaign was successful in India, promoting inclusivity and self-acceptance, receiving significant media coverage and positive feedback from consumers.

Coca-Cola - #ShareACoke

The 'Share a Coke' campaign, launched in Australia in 2011, changed the traditional wrapping of Coca-Cola bottles to read 'Share a Coke with...' and a popular name. The campaign aimed to create a more personal relationship with consumers and inspire shared moments of happiness. Other countries worldwide adopted the campaign, with Israel turning billboards into interactive signs and China using nicknames instead of first names. In 2016, a new variation, 'Share a Coke and a Song', featured popular song lyrics on Coke bottles, earning the most-liked photo on Instagram. The 'Share a Coke' campaign, a global success with 7 awards at the Cannes Lion festival, should have been allowed to run its full course. The campaign created a strong bond between the brand and consumers, allowing them to connect with loved ones by sharing their names on bottles or cans of Coke. This triggered massive buzz and increased consumption, boosting the brand's revenue by 2.5%.

Airbnb - #WeAccept

In November 2016, Airbnb publicly acknowledged widespread discrimination on its platform and called for its elimination "through community engagement." According to the initiative, users must treat all members of the Airbnb community with respect and without judgment or prejudice, regardless of race, creed, ethnicity, nationality, disability, gender, sexual orientation, sexual orientation or age. The campaign took place between the 1st and 2nd quarter of the Super Bowl 2017, and the hashtag #WeAccept was adopted to unite the global conversation against the travel ban and on behalf of refugees in need.

After the Super Bowl ad aired, Airbnb used paid media on Facebook, YouTube and Twitter to drive engagement. The campaign also included a letter from Airbnb's founders and announced Airbnb's pledge to provide housing to 100,000 people in need over the next 5 years and \$4 million to the International Red Cross (IRC) over the next 4 years. The #WeAccept campaign was Airbnb's third highest earner of all time with 87 million earned impressions. On Twitter, #weaccept was the most popular advertising hashtag used during the Super Bowl, generating more than 33,000 tweets during the first half of the game. In the month following the great event, website traffic increased by 13% (US and Canada) and 7.2% (US and Canada). Bowl. The 30-second #WeAccept video on Facebook received 19 million views and 100,901 shares with 18,600 shares from conservative audience segmentation.

Nike - #YouCantStopUs

This paper presents a case study of Nike's social media marketing strategy, focusing on the #YouCantStopUs campaign launched in July 2020. The campaign aimed to keep the audience engaged with the brand and convey the company's message about equality. Launched on various social media platforms, the campaign featured visually appealing images and videos, including a 90-second split-screen featuring Asian, Black, Muslim, and White athletes in various sports. The narrator, soccer player Megan Rapinoe, called the audience not to give up during this difficult time. Nike also used other images and videos, such as a tweet on Twitter promoting the Nike app and emotional videos featuring athletes. The campaign was intended for the American sports enthusiast audience and gained millions of views on Twitter and YouTube. By October 2020, the campaign's videos received over 90.5 million views on Twitter and 184 million views on YouTube.

The success of Nike's social media tactic can be attributed to three main reasons: addressing topical issues, using high-quality visuals, and utilizing connections with celebrities to reinforce its brand image. Experts believe that Nike's campaign was inspiring due to its ability to lift people's spirit and reinforce its brand image as a sports company. Additionally, the campaign was praised for its extensive research, editing, and visual effects, and its large media impact value due to its support from influencers like Cristiano Ronaldo and Naomi Osaka. Overall, Nike's social media marketing strategy proved successful due to its relevance, high-quality visuals, and celebrity support.

Patagonia - #TheSolutionIsLess

In 2019, Patagonia launched the #TheSolutionIsLess campaign to promote sustainability and encourage consumers to buy less. During the campaign, a video depicting the environmental impact of fast fashion was presented and consumers were encouraged to choose sustainable alternatives. The campaign received positive feedback from consumers, industry experts and environmental organizations. India's growing concern for environmental issues has made the campaign successful in India as it appeals to Indian consumers interested in a sustainable lifestyle. The campaign's focus on responsible consumption also resonated with India's growing middle class, which is increasingly interested in ethical and sustainable products. The message of the campaign to reduce consumption and a simpler lifestyle is consistent with these values and attracts new consumers to the Patagonia brand.

In 2011, Patagonia ran a bold full-page ad in The New York Times warning viewers not to buy their jackets because of the environmental impact of fast fashion. Although the advertisement did not achieve its goal, it raised awareness about environmental consumption. Patagonia has stayed true to its mission since it was founded in 1973, despite the rise of fast fashion brands like Zara and H&M. Patagonia's 2016 Black Friday campaign pledged to donate all proceeds to environmental groups, up to \$10 million, quadrupling the company's valuations. This marketing contribution encourages customers to live more in motion, emphasizing the company's environmental priority and the importance of good business practices.

4. Theoretical Framework

Uses and gratification theory

The Uses and Gratifications Theory highlights the importance of individuals seeking media for specific purposes, such as information, entertainment, or social connection. This theory is relevant to the research article, which focuses on the motivations behind using social media for corporate social responsibility (CSR) advertisements. CSR advertisements on social media attract consumers interested in ethical and sustainable products, aligning with the Uses and Gratifications Theory. Social media also allows companies to engage with consumers and build relationships based on shared values, aligning with the social connection aspect of the theory. By understanding the reasons consumers seek out and engage with CSR content on social media, companies can better target their advertisements and build stronger relationships with their consumers.

Social learning theory

The Social Learning Theory highlights the importance of social learning in promoting corporate social responsibility advertisements through social media. This theory suggests that people learn by observing and imitating others, and this learning occurs within a social context. Companies can use social media to create platforms for sharing CSR initiatives and encourage social learning among their target audience. The theory suggests that people are more likely to engage in behaviors that are reinforced or rewarded. By providing positive support to consumers participating in CSR initiatives, companies can develop effective CSR campaigns that resonate with their target audience and promote positive social change.

5. Conclusion

A new strategy for brand promotion, corporate social responsibility (CSR) promotion in social media was the focus of this research paper's investigation. Nike's "You Can't Stop Us," Coca-Cola's "Share A Coke," Airbnb's "We Accept," Dove's "Real Beauty Sketches," and Patagonia's "The Solution Is Less" Case studies demonstrated how these businesses successfully marketed their brands on social media by integrating CSR programmes into their advertising. These businesses have been able to connect with customers on a more personal level and reach a larger audience thanks to the use of social media. The findings imply that social media advertising that includes CSR initiatives can boost brand loyalty, favourable brand perceptions, and positive brand attitudes. This demonstrates that social media CSR advertising may be a helpful strategy for businesses looking to enhance their brand image and achieve a competitive edge. It should be emphasised that the target demographic, the legitimacy of the CSR project, and the message in the campaign are only a few of the variables that affect how well CSR advertisements perform on social media. To ensure that their CSR initiatives are in line with their brand values and appeal to their target audience, businesses must carefully plan and carry out these initiatives. In conclusion, this study emphasises the potential of CSR promotion via social media as a fresh strategy for brand promotion. The long-term consequences of such commercials on brand image and consumer behaviour could be investigated in further research.

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AN INVESTIGATION OF GENDER DIFFERENCES IN ATTITUDE TOWARDS SOCIAL MEDIA POLITICAL ADVERTISING

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Informativeness, entertainment and irritation are key factors in determining people's attitudes toward social media political advertising (SMPA). The more informative, entertaining, and less irritating an advertisement is, the more likely it is to positively influence people's attitudes toward it. Even though there are studies which have been conducted in the past on the role of gender in advertising evaluation, but the picture is still not clear in the context of political advertising. In order to address this issue, the present research is conducted to investigate the impact of these belief factors on attitude towards SMPA among different genders. According to the results of this study, females can lead to a more favourable attitude towards SMPA in the context of informativeness than for males, and entertainment can help form a more favourable attitude towards SMPA for males than for females. However, females are more likely to be irritated by SMPA than males. Findings, Conclusion, and limitations are discussed followed by suggestions for future research.

Keywords: Informativeness, Entertainment, Irritation, Attitude, Social Media Political Advertising (SMPA)

1. INTRODUCTION

Political campaigns are increasingly relying on social media advertising which is valuable because it is informative and entertaining while also irritating. Advertisements are considered informative when they provide viewers with information about the political message they are trying to convey. The degree to which viewers find an advertisement enjoyable determines its entertainment value whereas irritation is the degree to which it provokes negative emotions. According to previous research, attitude towards social media advertising is strongly influenced by these three factors. Gaber & Wright (2014) also pointed that, improvement in attitude towards social media advertising, can be done with the advertisement which is informative, entertaining, and not irritating. However, advertising is generally processed differently by men and women (Darley & Smith, 1995). The concept of gender is not simply a biological construct, but a psychological one as well (Bem, 1981). It has been suggested in previous studies (e.g., Venkatesh & Morris, 2000; Shao et al. 2019) that men and women show different decision-making because they have different types of socially constructed cognitive structures. In addition, males and females have different motivations for using the Internet, resulting in different attitude and behaviour (Wolin & Korgaonkar, 2003). Ducoffe, 1996 model, explains that an individual's attitude towards advertisement is determined by how informative, entertaining, and irritating he or she finds it. Studies have repeatedly shown the direct impact of these factors on attitude, but potential moderators like gender affecting their relationship with SMPA have not been examined yet. Therefore, in order to fill this research gap, gender is considered in this study. The study aims to find out that who among the males and females have more impact of these factors on attitude towards SMPA and whether there is any difference in attitudes toward SMPA among different genders.

2. LITERATURE REVIEW

Political leaders around the world recognize the power of social media and include it into their communication strategies during election campaigns, making it an essential part of modern election campaigns. In addition to

reaching voters easily and quickly, social media allows you to transmit the correct information immediately, stop rumours, and provide one-to-one communication (Mengü et al. 2015). Different people have different attitudes toward these advertisements. Various studies have revealed that both the genders have different levels of general advertising effectiveness and this ability to recognize gender differences in advertising effectiveness offers advertisers the opportunity to spend advertising money more effectively (Wolin & Kargaonkar, 2003).

2.1 Informativeness

Informativeness is the advertisement's ability to communicate effectively and pass information to its target audience (Ducoffe, 1996). According to advertising attitude research, informativeness plays a crucial role in advertising evaluation. Brown & Stayman (1992) found that an important determinant of brand attitude is informativeness. One of the main reasons people use social media is to search for information (Muntinga et al. 2011). Men and women process information differently, which explains their cognitive differences. According to Bamoriya & Singh, (2011) men tend to seek out more information than women do. There is a contradiction that who has more impact of informativeness on attitude among different genders. A study by (Logan et al. (2012) concluded that females find social media advertising more informative and entertaining than males. On the contrary, Wolin & Kargaonkar, 2003 proved that relative to females, males have more impact of informativeness on attitude. Based on the results of these studies, following hypothesis is suggested:

H1: Informativeness has a greater influence on SMPA attitudes for males than for females.

2.2 Entertainment

A major factor affecting advertisement value and attitude is the level of entertainment offered by an advertisement. Entertainment is a key component of an advertisement that help people to satisfy some basic needs for enjoyment, diversion, escapism, or emotional release (McQuail, 1987). In order to increase the effectiveness of the advertisements, advertisers strive to provide entertaining advertising. In particular, it is believed by advertisers that entertaining advertisements generate more favourable attitude towards advertising (MacKenzie & Lutz, 1989). According to (Weiser, 2000) Internet usage is more common among males for entertainment, leisure, and functional purposes, while it is more common among females for communication and socializing. This suggests, in the context of attitude towards advertising on social media, that men's attitudes are more affected by the entertainment value of advertising than women's (Taylor et al. 2011). As a result of the preceding discussion, the following hypothesis has been proposed:

H2: Entertainment has a greater influence on SMPA attitudes for males than for females.

2.3 Irritation

An individual's irritation from advertisements increases when they feel uncomfortable watching those advertisements. The reasons can be personal or social, for example, people are distracted while trying to focus on an online task because of these advertisements (Saxena & Khanna, 2013). In some cases, people may perceive the advertisements as confusing or distracting, resulting in a decrease in productivity. Furthermore, some messages may be misleading or even offensive to them (Ducoffe, 1986). So, there is a feeling of irritability among people due to the high number of advertising messages they receive online every day. There is also a difference in irritation level of males and females due to these advertisements. The study of Wolin & Korgaonkar (2003) proved that most females find internet advertising irritating and annoying as compared to males and female's perceptions of intrusiveness play a crucial role in deciding their attitude towards social media advertising. Following is the hypothesis derived from the preceding discussion:

H3: Irritation has a greater influence on SMPA attitudes for males than for females.

2.4 Attitude

It appears that males and females have different levels of privacy concerns, attitudes, and behaviours when it comes to online privacy (Sheehan, 1999). In spite of earlier studies showing that men dominate internet usage, recent studies have shown that the gender gap is rapidly shrinking (Youn et al. 2003; Weiser 2000). Finding of Lewis & Nichols (2010) indicate that gender does influence attitude towards social media advertising, but they are relatively weak.

Due to the differences in responses between males and females to advertising, gender issues are important for advertisers. There are many evidences by previous studies (Kempf et al. 1997; Shavitt et al., 1998; Wolin & Korgaonkar, 2003; Liaw & Huang (2011) that males exhibit a more positive attitude towards advertising than females do. Therefore, based on these results, following hypothesis is formulated:

H4: Males have stronger influence on attitude towards SMPA than females have.

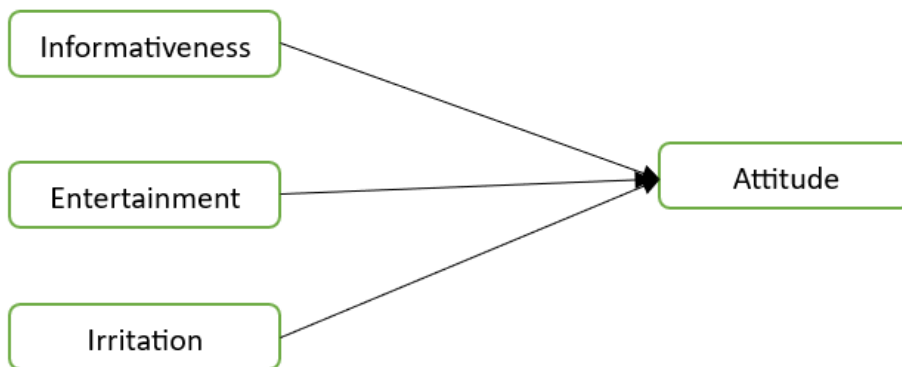


Fig 1. Proposed Conceptual Model of attitude towards SMPA moderated by gender.

3. RESEARCH METHODOLOGY

The measurement scales used in this study are adapted from previous research Yuanxin & Noichangkid (2011); Cheng et al. (2009); Mir (2012); Barriopedro et al. (2020); Nevarez, & Torres (2015). 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree was used. In order to collect the data, non-probability sampling was used through Google forms, and received a sample of 107 respondents. Out of these, 71% of the respondents are males and 29% are females. 42% are from the age group of 18–24 years, whereas, 53% are from 25-44 years and the rest are 45 years and above. 63% (more than half) respondents are employed followed by 32% students.

4. FINDINGS AND RESULTS

The study is quantitative, therefore descriptive statistics are provided. Reliability for the constructs is tested using Cronbach's alpha. The model is also tested using structural equation modelling. Moreover, to ensure the quality of the data, convergent and discriminant validity tests are conducted before testing hypotheses. 0.70 is the minimum recommended value for Cronbach's alpha and the acceptable reliability coefficient should be between 0.70 and 0.95 (Tavakol & Dennick, 2011). In Table 1, Cronbach's alpha for all factors is exceeding 0.8, indicating high reliability.

Table 1: Reliability test using Cronbach’s Alpha

Scales	Items	Cronbach's Alpha
Informativeness	6	0.918
Entertainment	5	0.931
Irritation	5	0.867
Attitude	4	0.952

Source: The authors (using SPSS 26.0)

All the constructs have AVE values greater than 0.5, and CR values more than 0.70, confirming their convergent validity. Additionally, the regression weights of all the items are greater than 0.50 (Hair et al. 2010) and to establish discriminant validity, the square root of the AVE should exceed the correlation values among all the constructs (Fornell & Larcker, 1981). So, in this study, all these conditions have been fulfilled (refer Table 2).

Table 2: Convergent and Discriminant Validity

	CR	AVE	MSV	MaxR(H)	INF	ATT	ENT	IRR
INF	0.919	0.654	0.484	0.922	0.808			
ATT	0.953	0.835	0.526	0.956	0.684***	0.914		
ENT	0.933	0.738	0.526	0.946	0.696***	0.725***	0.859	
IRR	0.865	0.567	0.466	0.888	-0.575***	-	-0.601***	0.753
						0.683***		

Source: The authors (using AMOS 23.0)

Notes: The bold numbers on the diagonal are the square roots of the AVE.

***Correlation is significant at $p < 0.001$ (two-tailed).

The CFI and IFI of the model are greater than 0.90, indicating a good fit (Husin et al. 2016). As shown in Table 3, CFI = 0.949, IFI = 0.950, RMR = 0.068 (<0.08), SRMR = 0.073 (<0.08) and RMSEA = 0.079 (<0.08), which represent good fit of the model (Hair et al. 2006).

Table 3: Fit Indices

Measure	Estimate	Threshold	Interpretation	Source: The authors (using AMOS 23.0)
CMIN/DF	1.56	Between 1 and 3	Excellent	
CFI	0.949	>0.90	Excellent	According to
IFI	0.950	>0.90	Excellent	the findings
RMR	0.068	<0.08	Acceptable	(refer Table 4)
SRMR	0.073	<0.08	Acceptable	females have
RMSEA	0.073	<0.08	Acceptable	stronger
				impact of

informativeness on attitude towards SMPA ($\beta = 0.428, p < 0.01$) than for males ($\beta = 0.262, p < 0.05$), hence H1 is not supported. However, males have stronger impact on attitude towards SMPA ($\beta = 0.418, p < 0.001$) than for females ($\beta = 0.328, p < 0.05$) supporting H2. Irritation has negative impact on attitude towards SMPA and this negative attitude from irritation is stronger in females ($\beta = 0.569, p < 0.01$), than for males ($\beta = 0.324, p < 0.01$), supporting H3. This study shows that both the genders have positive impact on attitude towards SMPA, and that overall difference between the attitudes of males and females is very little. Even if that impact is little, difference

between the attitudes is still there, which is females ($\beta = 0.929$, $p < 0.01$) have stronger impact on attitude towards SMPA, than for males ($\beta = 0.890$, $p < 0.01$) and these results do not support H4.

Table 4: Hypothesis testing results

	Std. RW	C.R.	p-value
(Informativeness)			
Males	0.262	3.113	0.002
Females	0.428	3.707	***
(Entertainment)			
Males	0.418	4.983	***
Females	0.328	2.843	0.004
(Irritation)			
Males	-0.324	-4.309	***
Females	-0.569	-4.935	***
(Attitude)			
Males	0.890	17.023	***
Females	0.929	13.539	***

Source: The authors (using AMOS 23.0)

Note: ***Significant at $p < 0.001$.

5. DISCUSSION AND CONCLUSION

This study aims to develop a model for investigating how gender differences can moderate the relationship among the belief factors (informativeness, entertainment, irritation) and attitude towards SMPA. Overall, males and females think and behave differently due to their biological differences. The results of current study indicate that women have stronger impact on attitude towards SMPA than for men which proves the results of Wang & Sun (2010) who also found that online advertising is more likely to be favoured by those who perceive it informative. Tschla et al., 2014 stressed towards the need to understand the differences in attitudes between genders. The results of present study also indicate that males and females form attitudes toward SMPA differently. Furthermore, the current study also suggests that it is important for advertisers to take gender differences into account when producing political advertisements for men and women.

6. LIMITATIONS AND FUTURE RESEARCH

The data for this study have been collected using the non-probability sampling technique, therefore the results can vary if the sample is collected by using random sampling technique. Second, the sample collected is very small ($N=107$), hence the results cannot be generalised. Future research might expand this study by taking large number of samples to find out the clearer image of attitude difference between males and females. Lastly, the factors used here in this study are informativeness, entertainment, and irritation to find out the impact on attitude and these factors cannot explain the attitude towards SMPA entirely. There are other factors also (e.g., trustworthiness or credibility). Future research can expand this study by including other factors thereby getting a more comprehensive result.

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CUSTOMER BEHAVIOR TOWARDS USE OF CREDIT CARDS WITH SPECIAL REFERENCE TO ONLINE SHOPPING

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The present study is of descriptive nature which describes the Customers Perception towards Credit Cards with Special reference to Online Shopping. In present scenario along with online shopping the growth of credit cards user is increasing day by day. Due to competition the credit card providers are providing cash-back offers and no cost EMI facility in collaboration with the online retailers. The present study is conducted with the objective to study what are the various motives behind acquiring credit cards and their use in online shopping. The study is based on primary data collected with the help of a structured questionnaire. A sample of 100 customers were drawn by adopting judgmental sampling who are having credit card as well as doing online shopping. The results of the study show that a direct relationship exists between the growth of Credit Cards and Online Shopping. Most of the customers even after having surplus funds are using credit cards to earn cash-back and rewards point. Even banks have launched specific cards for online retail website which provides round the year specific cash-back to the Specific cards users.

1. INTRODUCTION

Since the 1980s, credit card usage has spread all around the Globe. The convenience and safety of not carrying cash, option of EMI, instant cashback offers, reward points, shopping milestone coupons and quick and easy access to credit are among the factors that contributed toward the growth of credit card users. In India, there has been a significant growth of credit card users. The current trend depicts that the coming years will witness a large growth of credit cards users which will lead us to a cashless society. Credit has become an important promotional vehicle of business promotion. Credit cards provide convenience and ensure safety of the buying process. One of the crucial factors for the adoption of credit cards is the sea change witnessed in consumer behavior. Credit cards enable the users to purchase products or services without paying immediately. The buyer only needs to swipe the credit cards or by entering card details and OTP in online shopping. Therefore, Credit cards are considered as a good substitute for cash or cheques. Most of the retail firms accept credit cards and all online shopping websites accepts credit cards without any extra charges. The credit card issuing banks establishes the card's terms and conditions, including the interest rate, annual fees, penalties, the grace period, reward points value and other benefits. Credit card utilization provides a number of benefits and drawbacks subject to user behavior. Sensible and appropriate use of credit cards increases the liquidity and offers additional funds. Conversely, credit card transactions done in excess of the financial limits of the card holder results in unnecessary debt. The increased spending due to credit cards results in excessive credit card debts. Debt due to a credit card has risen more rapidly than the disposable income; this has alarmed policymakers and governments. Though the increase in consumption is encouraging for the economy high levels of debt may create financial difficulties or lead to bankruptcy, hence in the long-term, it will result in slower economic growth. Apart from misuse by consumers, sometimes the credit card companies exploit the customers through high-interest rates and hidden fees (Tidwell, Bexley & Maniam 2010). The credit card issuers have also penetrated quickly into the emerging markets in order to exploit the opportunities that are provided by the emerging markets. Credit card usage pattern of emerging markets also differs from those of well-developed markets in important ways. The factors that affect credit card usage pattern of consumers in emerging markets and the implications of these factors for developing marketing strategies may not be the same as those for well-developed markets. Understanding the factors that explain

consumer behavior of credit card users in emerging markets could provide essential insights to marketing strategists of financial services, retailers, and businesses in promoting use of credit cards. The consumer credit card market is reaching the saturation point, that's why the credit card issuers are implementing new strategies and launching co-branding cards, zero annual fees cards and so on. For online and offline merchants, a credit card transaction is often more secure than other forms of payment, such as cheques/cash on delivery. In most cases, cards are even more secure than cash, because they discourage theft by the merchant's employees and reduce the amount of cash on the premises. Prior to credit cards, every merchant had to evaluate each customer's credit history before extending credit. That task is now performed by the credit card issuers who assume the credit risk. The increasing profitability of credit cards has encouraged card issuers to issue cards to users who do not have stable incomes and to people who were once believed not to be credit worthy or had bad credit histories. Consequently, more people will have a chance to get involved in credit card debts. Co-branding cards like Flipkart Axis and Amazon ICICI cards are being issued to their regular shoppers and these cards provide 5 percent cashback on their respective website and 1-2 percent cashback on other merchant, utility bill payments and on offline merchant swipe. Almost every credit card issuer has made co-branding with petroleum companies and provides extra reward points on refueling. Now credit card issuer banks also provide personal loan on credit cards to the users who pay their dues on time. Every credit card issuer bank provides mobile app and website portal where they can login using their credentials and see their statements, current outstanding, reward points detail, EMI details, apply for new cards, manage the credit card limit, credit card bill payment and so on. Because online shoppers apply for more and more cards according to upcoming sales on that specific cards, online shopping websites put the apply link for that credit cards and earn commission from the bank for the same. However, credit cards also have disadvantage for users in many ways. For example, sometimes cardholders are charged high annual fees and high APRs when they borrow money from credit card companies. Consequently, these extra costs put extra financial burden to cardholder. The increasing profitability and competition of credit cards has encouraged card issuers to issue cards to consumers who do not have stable incomes and to people who were once believed not to be credit worthy or had bad credit histories. This results in more defaults by card user towards credit card issuer.

2. LITERATURE REVIEW:

Elroy Monis and Ramesh Pai (2023) said that Visas give the opportunity to buy even without having cash, the gamble of inability to make ideal installments of charge cards levy can lead an individual into an obligation trap. The high interest rate on credit card debt must be taken into consideration. If not managed properly, credit cards can result in debt and damage to a person's credit history. Maintaining a budget may be difficult if purchases are not tracked. The terms and conditions may not be available in regional languages, making them even more difficult to understand. The National Payments Corporation of India claims that at least 641 customers at 90 ATMs lost 1.3 crores in fraudulent transactions. As a result, it is critical that NBFCs and banks establish regulations to prevent fraud control and enforcement procedures and implement internal control mechanisms to combat fraud. Banks must urgently examine network security in order to regain and maintain customers' trust in the banking system. **Banerji and Rashi, (2020)** stated that a variety of policy measures, including Aadhar-enabled payments, UPI-based payments, financial inclusion, demonetization, and enhanced digital infrastructure, among others, the RBI and the Indian government have collaborated to move the Indian economy closer to cashless payment systems. One of the most widely used cashless payment options is credit card. Credit cards are cutting-edge financial tools that give customers access to unique reward programs, lounges, and memberships, cashless payment options, short-term borrowing, and more. Through structured equation modeling, the purpose of this study is to empirically test the credit card selection scale and credit card usage preferences of Indian consumers. **Mohammad (2020)** found that credit limit, the minimum payment amount, late payments, and credit card advances all show gender differences. Males have been found to engage in riskier behavior on some parameters, while females have also been found to engage in riskier behavior. Age matters because people in

higher age groups are more likely to make their payments on time. Also, people between the ages of 41 and 50 and older are less likely to take out a credit card advance. Lastly, salaried individuals are less likely to take out a cash advance, pay only the minimum, and pay on time. **Sumit Agarwal, (2015)** Even though automatic screening technology and a credit score system have made it easier for card issuers to assess borrowers' creditworthiness, studies still show that switching costs exist. In terms of rejection costs, this is especially expensive for customers with high balances because they are more likely to be turned down when applying for new credit. However, it has been discovered that high balance customers actively seek out favorable interest rates. At the same time, research has shown that banks, not credit unions, are taking advantage of financially strapped customers by charging them higher interest rates for switching **Simon and Saravanan (2012)** stated that credit card's insurance coverage attract a large number of credit card users. It has been discovered that cardholders' insurance payments have been delayed. As a result, this term might be something to think about if you want to keep cardholders from being negative. It has been discovered that the State Bank of India's Additional Card attracted a large number of customers. This is a significant one. Nevertheless, the card fee of Rs.250 or Rs.500 prevents many cardholders from applying for an additional card. The card fee should be reduced to attract more cardholders to the bank. **Alamelu (2020)** When compared to public sector banks, private sector banks and foreign banks had significantly higher credit card transactions than public sector banks. POS transactions were significantly higher than ATM transactions. In contrast, all bank groups, with the exception of the public sector bank group, favored POS transactions over ATM transactions when it came to using credit cards. **Agarwal et al. (2010)** analysed unique data from multiple large-scale randomized marketing trials of preapproved credit card solicitations by a large financial institution, and found out that consumers responding to the lender's inferior solicitation offers have poorer credit quality attributes. This finding supports the argument that riskier type borrowers are liquidity or credit constrained and, thus, have higher reservation loan interest rates. We also find a more severe deterioration ex post in the credit quality of the booked accounts of inferior offer types relative to superior offers. After controlling for a cardholder's observable risk attributes, demographic characteristics, and adverse economic shocks, we find that cardholders who responded to the inferior credit card offers are significantly more likely to default ex post. Our results provide evidence on the importance of adverse selection effects in the credit card market. **Geanakoplos and Dubey (2010)** propounded widespread use of credit cards increases trading efficiency but, by also increasing the velocity of money, it causes inflation, in the absence of monetary intervention. If the monetary authority attempts to restore pre-credit card price levels by reducing the money supply, it might have to sacrifice the efficiency gains. When there is default on credit cards, there is even more inflation, and less efficiency gains. The monetary authority might then have to accept less than pre-credit card efficiency in order to restore pre-credit card price levels, or else it will have to accept inflation if it is unwilling to cut efficiency below pre-credit card levels.

Chung and Suh (2009) were of the view that Excessive issue of credit cards has contributed to increased credit card delinquencies, which have become a burden for credit card companies. In such a negative situation, companies should build and use models to estimate maximum profits from credit card delinquents. However, traditional classification models used to classify customers into good or bad groups are not useful in estimating profits from credit card delinquents. **Ekici and Dunn (2009)** investigated the relationship between credit card debt and consumption using household level data. This is a departure from the previous studies which have used aggregate measures of consumption and general debt such as the Debt Service Ratio or total revolving credit . We use a detailed monthly 13 survey of credit card use to impute credit card debt to respondents from the Consumer Expenditure Survey sample. Investigations are also made into effects of debt within different age categories and into the impact of expected income growth on the debt– consumption relationship. **Kerr and Dunn (2008)** investigated whether search costs inhibit consumers from searching for lower credit card interest rates. The results provide evidence that the credit card search environment has changed since the mid-1990s. Using the 2001 Survey of Consumer Finances, we model consumers' propensity to search and their probability of being denied credit simultaneously and find that larger credit card balances induce cardholders to search for more even though they face a higher probability of rejection. This result may be related to the high volume of

direct solicitation, combined with disclosure requirements, which has lowered the cost of search to find lower interest rates. **Lopes (2008)** solved an empirically parameterized model of life cycle consumption, which allows for uncollateralised borrowing and the possibility of default. The simulation results show that: (i) "social stigma" and credit limit have a very large impact on default rates; (ii) education level also has a significant effect on the probability of default, namely, through differences in the shape of lifetime labor income profiles; and (iii) the response of simulated default rates to labor income shocks is determined by the nature of labor income uncertainty (temporary versus permanent). Additionally, the model generates simultaneous consumer holdings of credit card debt and liquid assets.

3. RESEARCH OBJECTIVES

- To examine the consumer behavior towards use of credit cards with special reference to online shopping.
- To study the impact of credit cards on online shopping
- To study the impact of online/offline credit card offers and on the sale of credit cards.

4. Research Methodology

The present study is of descriptive nature. Primary data is collected through well-structured questionnaires. The secondary is collected from internet websites, journals and reports. A sample size of 100 respondents has been taken from Haryana state. Data analysis has been made using Percentage.

5. DATA ANALYSIS

Table 1 below depicts the demographic profile of credit card users. It can be observed that respondents of age group of 21-30 is having highest credit card followed by age group 31-40 and majority of respondents are male. As far as the Educational Qualification of the respondents is concerned majority respondents are Graduate followed by postgraduates and in case of occupation the highest number of respondents are businessman followed by service class. The majority of respondents fall in 25k-35k per month income group followed by below 25k per month group.

Table 1: Demographical profile of the respondents

Profile	Frequency	Percentage
Age Groups (Years)		
Up to 20	11	11
21-30	40	40
31-40	37	37
Above 40	12	12
Total	100	100
Gender		
Male	67	67
Female	33	33
Total	100	100
Educational Qualification		
Graduation	53	53
Post-graduation	41	41
Doctorate	03	03
Other	03	03
Total	100	100
Occupation		
Student	10	10

Service	22	22
Business	40	40
Agriculture	17	17
Any other	11	11
Total	100	100
Monthly Income		
Below 25	30	30
25to 35	38	38
35to 45	24	19
Above 45	08	08
Total	100	100

Source: Primary Data

Table 2 below depicts the summarize form of the collected data along with percentage which is sub-divided into eight sections. Section 2.1 of the table shows number of credit cards owned by respondents. It can be observed that 52 percent respondents are having one credit card, 27 percent respondents are having 2 credit cards, 12 percent respondents are having three credit cards, 6 percent respondents are having 4 credit cards and 3 percent respondents are having 5 or more than 5 credit cards. Section 2.2 of the table shows the utilization of credit card by respondents. It can be observed that 60 percent respondents utilize credit card for online shopping and 25 percent for offline shopping and 15 percent respondents for both online and

Table 2:

Response	Frequency	Percentage
2.1 Number of Credit Cards		
1	52	52
2	27	27
3	12	12
4	6	6
5 and above	3	3
Total	100	100
2.2 Utilize Credit Card for		
Online Shopping	60	60
Offline Shopping	25	25
Both	15	15
Total	100	100
2.3 Situation of Using Credit Card		
In case of surplus fund	71	71
In case of shortage of funds only	29	29
Total	100	100.0
2.4 Reason for using Credit Card even after having Surplus funds by above 71 respondents		
For Instant discount and/or Reward	30	42.25
For no Cost EMI	25	35.21
Both	16	22.53
Total	71	100
2.5 Instant discount/rewards point on online payments for shopping stimulates to apply new cards		
Yes	62	62
No	38	38
Total	100	100
2.6 Credit Card Offers and there promotion Increased Online Shopping Transactions		
Yes	60	60

No	40	40
Total	100	100
2.7 Wait for credit card offer for buying Mobile, Laptop and other appliances (if not required)		
Yes	62	62
No	38	38
Total	100	100
2.8 Flipkart Axis, Amazon ICICI Cards and other co-branding credit cards switches to Online shopping even for Small amount Transaction.		
Yes	62	62
No	38	38
Total	100	100

Source: Primary Data

offline shopping. Section 2.3 of the table shows the result of the situation in which credit card are used. It can be observed that 71 percent respondents use credit card even after having Surplus funds and 29 percent use credit card in funds shortage situation. Section 2.4 of the table depicts the reasons for using the Credit Card even after having Surplus funds by 71 respondents who use credit cards even in the situation of surplus funds. It can be observed that 42.25 percent respondents use credit card for Instant discount and/or Reward Points provided by credit card, 35.21 percent respondents use credit card for no cost EMI provided by credit card and 22.53 percent for both the reasons discussed above. Section 2.5 of the table depicts the impact of Instant discount/rewards point on online payments for shopping on applying new credit card. 62 percent respondents agree that instant discount/rewards points provided by credit cards company on online payments for shopping stimulates to apply new cards. Section 2.6 of the table depicts the impact of credit card offers and there promotion on online Shopping transactions. It can be observed that 60 percent respondents agree that credit card Offers and there promotion Increased their online shopping transactions. Section 2.7 of the table shows that 62 percent respondents wait for credit card offer for buying Mobile, Laptop and other appliances (if not required urgent) to save their money. Section 2.8 of the table shows the impact of Flipkart Axis, Amazon ICICI and other co-branding credit cards on Switching to Online shopping even for Small amount Transaction. Sixty two percent respondents agree that they switched to online shopping even for small amount transaction because of fixed discount provided by the Flipkart Axis, Amazon ICICI and other co-branding credit cards.

6. CONCLUSION:

From the above data analysis we can conclude that credit card acceptance is increasing day by day and a direct relationship exists between online shopping and credit cards because online shopping stimulates to acquire more and more credit cards and credit cards stimulate towards increased online shopping. Majority of users are using their credits for online shopping transactions, a majority of credit card holders use their credit card even when they have surplus funds to earn card discount, rewards points and EMI, majority of credit card holders agree that Online shopping offer, cashback etc. increased their shopping transactions and also stimulates to apply for another bank credit card. Even credit card holders wait for the online sales offered by online retailers to buy mobile, laptop, and other appliances (if not required urgently), majority of customers agree that Flipkart Axis, Amazon ICICI and other co branding cards are switching them toward online shopping due to discount offered by them on respective website without any specific sales.

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PROGRESSION AND PERFORMANCE OF INDIAN WOMEN ATHLETES IN SUMMER OLYMPICS

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Sports are essential to a nation's development. In India, women's sports have seen quite a transformation. Despite numerous challenges, Indian women performed at different levels in a variety of sports and games. This article's major objective is to investigate the development, and performance in the Olympic games of Indian women athletes. The analysis is built on a descriptive mode with documental analysis, referencing a variety of sources and bibliographies, including reports and informational pamphlets from the Indian Olympic Association and by different writers. The study shows that the role of Indian women athletes in Olympic games is unforgettable. Weightlifter Karnam Malleshwari creates history in Sydney Olympic 2000 to clinch a bronze medal for India and became the first Indian weightlifter to do so in both men and women category, and it is also the single medal win by India in Sydney Olympic 2000. Tokyo 2020 Olympics is the most successive Olympic of all time in Indian history, India win total 7 medals, in this 3 medals are winning by women athletes.

Keywords : Women, Olympic, Athlete, Sports

1. INTRODUCTION

The first modern Olympic, held for the first time in Athens, Greece, in 1896. It is also known as the “Games of Olympiad”. The Olympic Games take place once every four years. At the first modern Olympics, 241 athletes from 14 different nations, all of whom were male, competed. The modern Olympic Games were established by “Sir Baron Pierre de Coubertin”.

History of women participation in Modern Olympic

Women first competed in the Olympic Events at the 1900 Paris Games, the second version of the games. “Helene de Pourtales” of Switzerland, was the first female athlete to participate in the Olympic and also win a gold medal as a member of the winning team in the first 1 to 2 ton Sailing event. After winning the women's singles tennis competition, Charlotte Cooper became the first female individual champion. Women could only compete in tennis and golf as individuals. In Paris Olympic 1900, 22 women competed, accounting for 2.2% of all competitors. The 1900 Games had 997 male and female participants.

Indian women competing in the Olympics

India participated in the Helsinki, Finland, Summer Olympics in 1952. In 42 competitions in 11 sports, 64 participants—60 men and 4 women—took part. First time Indian women participated in 1952 Helsinki Olympic Games. Four women athletes Nilima Ghos, Mary D’Souza Sequeira, Dolly Nazir and Arati Saha participated first time in 1952 Olympic Games.

2. LITERATURE REVIEW

Nunes, R.A. (2018) steered a study on “Women athletes in the Olympic Games”. This essay's main goal is to examine how women's involvement in the modern Olympics has changed through time. The findings demonstrate an evolution that has been known to exist since the turn of the 20th century, as there were no women competing in the first Olympic Games. This essay reveals that female Olympians have served as genuine social change agents, both in terms of their participation in and success in sports as well as their representation of women in modern society. Female Olympic athletes have captured the world's attention with their strength, tenacity, and beauty since their first appearance in the 1900 Olympic Games.

Anushree Mahurkar & Anil Walke (2018) The objective of this article is to analyse the global and national trends in women's participation in sports and physical activity. The Olympic Games offer the best representation of all sporting events at all levels. "Sports: A Strong Approach to Promote Women's Rights." Nevertheless, things are getting better and time is changing very quickly. Many sportswomen have been beating the odds, or the psychological and social barriers that prevent women from participating in sports, but there is still much to be done. There is no denying that the number of women participating in sports is rising year, but their participation is still lower than that of men.

Sandip Shankar Ghosh & Jharen Debsarma (2018) The study will be important for determining how parents and guardians of female athletes feel about encouraging or discouraging their participation in sports and activities. The government, sports groups, clubs, and other social organisations and organisations might benefit from this study's advice on how to grab girls' and women's interest and motivate them to participate in games and sports in big numbers. We need to enable women and support them in strengthening their resolve as they go into the next Olympics. More girls need to participate in sports starting in early childhood and at the grassroots level. Let's then watch in delight as the Wonder women take home the awards.

Basu I. (2017) Despite the fact that gender bias against women is still typical in the workplace, the world of sports does not now have modern gender equality. Female Players endure discrimination at work from teammates and occasionally from complete strangers. Considering the fact that many have said they love their jobs, these barriers make it very difficult for women to grow in their careers. Girls who possess self-assurance, leadership, and collaborative skills are better able to confront social conventions that continue to marginalise and oppress women. At that time, many female athletes competed in the Olympics, making the country proud.

3. METHODOLOGY

This research involves study of various papers, books, websites and government reports to analyse the progression and performance of Indian women athletes in summer Olympics. This research paper employs a qualitative and quantitative research approach to analyse the progression and performance of Indian women athletes in summer Olympics. The analysis involves study of various women players who participated in Olympic Games. This study conducts quantitative studies for analysis of the year-wise medals of Indian women in Olympic Games. This study also conducts qualitative studies for analysis of the achievement of Indian women athletes in Olympic Games.

4. RESULT AND DISCUSSION

4.1. First time Indian Women Athletes Make History at the 1952 Olympics

The first Indian woman to compete in the Olympics was Nilima Ghose, who participated in the 1952 Summer Olympics held in Helsinki, Finland. She competed in the 100-meter sprint and 80-meter hurdles events. However, Indian women had participated in various other sports in earlier editions of the Olympics. For example, Mary D'Souza Sequeira represented India in the 1952 Olympics as part of the women's 4x100 meter relay team.

4.1.1. Nilima Ghos:

When she was just 17 years old, Nilima Ghos became the first Indian woman ever participate in an Olympic event. At the 1952 Olympics in Helsinki, she competed in the 100-meter sprint and the 80-meter hurdles. The Indian female track athlete had pursued history even if her time of 13.8 seconds in the 100m couldn't advance her to the next round. She competed in the 80-meter hurdles two days later as the youngest competitor in the competition, placing seventh in her heat with a timing of 13.07 seconds.

4.1.2. Mary D'Souza Sequeira:

Another sportsperson that participated in the women's 100-meter and 200-meter races at the 1952 Olympics was Mary D'Souza Sequeira. She too failed to advance to the next round, though.

Swimmers Dolly Nazir and Arati Saha also competed at the 1952 Olympic Games in Helsinki alongside the two runners.

4.1.3. Arati Saha:Youngest Indian to compete at the Olympics –

Swimmer Arati Saha was just 11 years and 10 months old when she took part at the 1952 Olympics. When Arati Saha jumped in the pool on July 26, 1952 for the women's 200m breaststroke heats it made her the youngest Indian Olympian. Arati Saha swam in the third heat of the women's 200m. The Indian swimmer finished sixth in the heats, clocking 3:40.8 seconds and was unable to qualify for the semifinals. She later crossed the English Channel at 19.

4.1.4. Dolly Nazir:

Arati Saha's main competitor in India was Dolly Nazir, who is five years elder to Arati Saha also took part in 1952 Olympics in Swimming. She competed in 100m freestyle and 200m breaststroke. In 100m freestyle she is clocking 1:24.8 sec, and in 200m breaststroke she is clocking 3:37.9 but could qualify for the next round.

4.2. Indian female medallist at the Olympics:

4.2.1. Sydney Olympics 2000:

4.2.1.1. Karnam Malleshwari:

Karnam Malleshwari went on to make history at the Sydney Olympic Games in 2000. She became the first female athlete from India to earn an Olympic bronze medal in weightlifting 69 kg category . The women's weightlifting event makes its Olympic debut at the Sydney 2000 Games. She is the only Indian to have won an Olympic medal

in Sydney 2000. She lifts 110 kg snatch, 130 kg clean and jerk and a total 240 kg to win a bronze medal in 2000 Olympic. 65 competitors, 44 men and 21 women represented India in 2000 Sydney Olympic.

4.2.2. London 2012 Olympics, after 12 years later:

4.2.2.1. Mary Kom:

In 2012 London Olympic, women's Boxing included for the first time. Only one Indian qualified for the competition, and she was Mary Kom, a five-time world champion. She was defeated by UK competitor Nicola Adams in the semi-finals. But she managed to clinch a bronze medal in the Olympics, making history as the first woman boxer to do it.

4.2.2.2. Saina Nehwal:

By earning the bronze medal in Badminton at the London Olympics 2012, Saina Nehwal became the first Indian to achieve so. Saina Nehwal's Olympic medal at the London 2012 Games was truly a significant milestone for Indian Badminton. In the bronze medal match she had a tough fight with Chinese player Xin Wang. Saina Nehwal's performance in the match was poor as she dropped the opening game 21-18. When Chinese twisted her right knee, she were up 1-0 in the second game. Wang was forced to leave the field while injured and in extreme discomfort. Saina Nehwal was so given the bronze medal.

4.2.3. Rio Olympic 2016:

In Rio Olympic 2016, a total number of 117 Indian competitors participated. Out of 117 participants there are 63 men and 54 women, among 15 different sports.

4.2.3.1. Sakshi Malik:

Sakshi Malik bagged the first medal for India in Rio 2016 Olympics. She creates to to become the first Indian female wrestlers to take home a medal. She defeated Aisuluu Tynybekova of Kyrgistan 8-5 in the play-off match to win the bronze medal in the 58 kg freestyle wrestling division.

4.2.3.2. P.V Sindhu:

P.V Sindhu's full name is Pusarla Venkat Sindhu. At the Rio 2016 Olympic, "P.V. Sindhu" has become the first Indian woman athlete to win a silver medal in the Olympics. In the "women's singles badminton" final, she was defeated by Carolina Marin of Spain. P.V. Sindhu defeated Carolina Marin in the first game 21-19, but she was unable to hold onto that lead as the world number one rallied to win the following two games 21-12 and 21-15. Even yet, Sindhu gained admiration for her heroic efforts and silver medal, the best result for a shuttler at the Olympics. She also became the nation's youngest Olympic medalist.

4.2.4. Tokyo Olympics 2020:

Tokyo 2020 Olympic games, most successful Olympic of all time for India, On July 23 2021, the year-delayed, begins in Japan, and India will have a record-breaking 121 athletes in their official delegation. The largest

contingent record held by India, which was established at the Olympics in Rio, has now been surpassed. Rio 2016 had 117 participants in all, and India brought home two medals.

There are 121 athletes registered for the Tokyo 2020 Olympics, 68 of whom are male and 53 of them are female. By earning medals at the Tokyo 2020 Olympics, “P.V. Sindhu”, “Saikhom Mirabai Chanu”, and “Lovlina Borgohain” brought honour to their country, India.

4.2.4.1. Mirabai Chanu:

On the starting day of the Tokyo 2020 Olympics, the Indian woman “Saikhom Mirabai Chanu” clinches the silver medal in weightlifting. After adding together totals for Snatch, Clean and Jerk, she came in second. She was able to lift overall 202 kg weight, in this 87 kg at Snatch, and 115 kg at Clean and Jerk. Her weight category is 49kg.

4.2.4.2. P.V Sindhu:

P.V Sindhu creates history as she became the second Indian player after Wrestler “Sushil Kumar”, first Indian woman to win two medals in the Olympic games. She took home two medals: In Rio 2016 she won a silver, and in Tokyo 2020, she win a bronze medal. In the third-place play-off, P.V. Sindhu win against China's “He Bing Jiao” by 21-13, 21-15 . By winning two medals in the different Olympics Sindhu became the first Indian female athlete to do so. "I'm on cloud nine. Worked hard for so many years. I think I've done really well. I had a lot of emotions going through me - should I be happy that I won bronze or sad that I lost the opportunity to play in the final?" a statement given by Sindhu.

4.2.4.3. Lovlina Borgohain:

In the women's welterweight 69 kg boxing event in Tokyo 2020, Lovlina Borgohain won her maiden Olympic medal after defeating Chan Nien-Chin of Taiwan in the quarterfinals. She was defeated by Turkish player Busenaz Surmeneli in the semifinals, though. The bronze medal was won by her. After Vijender Singh and M C Marykom's bronze medal, Lovlina Borgohain is the only other Indian Pugilist to have won an Olympic bronze medal.

4.3. Some other greatest moment and achievement by Indian women in Olympics:

P.T Usha :

“Pilavullakandi Thekkeparambil Usha” is P.T Usha’s full name. She is one of India’s greatest athlete often called the country’s “ Queen of Track and Field”. Also called “ Payyoli Express” and “ Golden Girl” . P.T Usha made her Olympics debut at the age of 16 the youngest Indian sprinter in 1980 Moscow Olympics contingent. She finished 6th in 100m, 200m heats. “ My first flight from Delhi to Moscow, wearing synthetic spikes for the first time, seeing how big everyone was made to me nervous and I felt like a student in primary school,” she admitted. In the 1984 Los Angeles Olympics, P.T Usha competed in 400m Hurdles event and finished 4th in the final and missed a Bronze medal by mere 1/100th seconds. She becomes the first Indian women to reach an Olympic final. She participated in three consecutive Olympics: “Moscow (1980), Los Angeles (1984), Seoul (1988)”. She is the first nominated MP in history to become the Vice Chairperson of Rajyasabha. P.T Usha appointed to the panel of Rajyasabha vice chairman to controls the proceedings of upper house during the absence of both Currently

she is the 1st woman in Indian history and also the first Olympian to become the 16th President of Indian Olympic Association. She inspires the whole generation by her achievement.

Shiny Abraham:

Shiny Abraham was the first Indian Track athlete to reach in the semi-final at the 1984 Los Angeles Olympic games. She competed in the 800m event and finished 4th in her heats with the timing of 2:04:69. Overall she represented India in four consecutive Olympics: “Los Angeles (1984), Seoul (1988), Barcelona (1992), Atlanta (1996)”.

4.3.1. Athens 2004 Olympics:

4.3.1.1. Anju Bobby George:

One of the greatest Indian woman athlete Anju Bobby George, in her debut Olympics 2004 Athens, in the qualifying round she covered 6.69m Long Jump in her first attempt and made the cut for 12 women finals field in 9th position. In the final round Anju Bobby George registered a 6.83m jump in her first attempt. However she couldn't better her distance in next five attempts but had to settle for a respectable 5th position in the final. She set a new national record in Athens 2004 Olympics with the distance 6.83m, her personal best still stands as national record of India. Anju Bobby George creates history in the 2003 “World Athletics Championship” held at Paris, she clinched a bronze medal with the distance of 6.70m. At that time she is the only Indian to win a medal in “World Championship” in Athletics. Currently she is the “Senior Vice President” of “Athletics Federation of India”. She is two times Olympian: Athens (2004), Beijing (2008).

4.3.2. London Olympics 2012:

4.3.2.1. Geeta Phogat:

Geeta Phogat creates Olympic history when she becomes the first Indian female wrestler to qualify for the 2012 Games in London. In freestyle wrestling, she achieved qualification in the 55 kg weight class. Geeta made headlines after she captured the first women's wrestling gold medal in 55 kg freestyle at the “Commonwealth Games 2010 Delhi”.

4.3.3. Rio Olympics 2016:

4.3.3.1. Dipa Karmakar:

The first woman gymnast from India to make it to the Olympics is Dipa Karmakar. Despite not taking home a medal, she placed an outstanding fourth in the women's vault final at Rio 2016. Just 0.15 points separated her from an Olympic medal. She gained recognition as a gymnast in India as a result of her historic performance in the Olympics in Rio.

4.3.4. Tokyo Olympics 2020:

4.3.4.1. Aditi Ashok: India's Golf Star

In the 2016 Rio Olympics, she finished 41st and this time in Tokyo 2020, she finished 4th – it simply doesn't get any better than this, as Aditi Ashok was barely two shots behind first position winner, World champion Nelly Korda of the United States of America. It was heartbreaking for Aditi to finish 4th, after she had maintained second position, thereby staying in silver medal position over much of the three of the four rounds played. She finished 4th with a three under 68 in the final round that left her 15 – under 269 overall at the Kasumigaseki Country Club.

4.3.4.2. Kamalpreet Kaur: Discus Throw

At the Olympic stadium in Tokyo 2020 Olympics, Kamalpreet Kaur and Valarie Allman of the USA were the only two athletes to cross the 64m automatic qualification barrier in the qualifying round. While Valarie Allman topped the qualifying round with a throw of 66.42m, Kamalpreet was 2nd with her effort of 64m. After placing second in the qualification round with a best throw of 64 metres, Kamalpreet had sparked hopes that India will win the ultimate Athletics medal. She was unable to win any medals in the Tokyo 2020 Olympics final; in her debut Olympics, she placed sixth with a best throw of 63.70 metres during a rain-interrupted competition. Her personal best throw 66.59m getting her a bronze medal in Tokyo Olympics if she secured this throw in the final.

4.3.4.3. Pranati Nayak:

The only female gymnast from India competing in the Olympics in Tokyo was Pranati, who also qualified as the nation's second Olympic gymnast after Deepa Karmakar. She participated in artistic gymnastics competitions, which feature floor exercises, uneven bars, vault, and uneven bars. She wasn't able to advance to the event's finals.

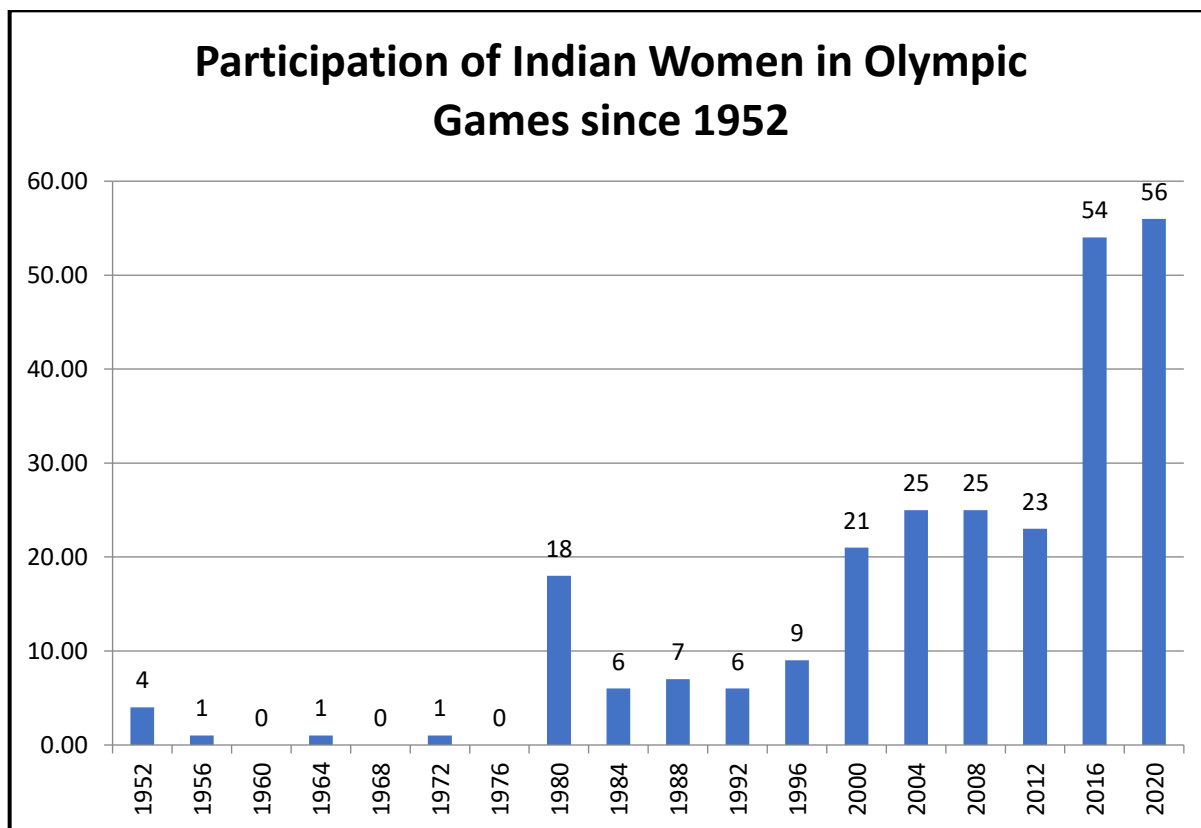
4.3.5. Women's National Hockey team:

Indian women's Hockey first introduced in 1980 Moscow Olympics. There is only 6 team participated in the Moscow Olympic. Indian women hockey team also competed in the first edition of women hockey in the Moscow Olympic. They finished 4th spot in their maiden Olympic in Moscow. Rupa Saini was the captain of Indian Hockey team in Moscow Olympic. After 36 years in 2016 Rio Olympic Indian women hockey team qualified again after a long gap but at that time the performance was not good as they finished 12th in Rio Olympic. Sushila Chanu Pukhrambam was the captain in Rio Olympic.

4.3.6. Rio Olympic 2016 and Tokyo 2020:

In Rio Olympic 2016 Indian women Hockey team scripted history as they qualified for the semi-final, first time. With a great effort at the Tokyo Olympics, Indian women have done themselves and make India proud. Indian hockey team lost the bronze medal match by 3-4 to the Rio Olympic champion at the Oi Hockey Stadium in Tokyo. But the fight that has highlighted their stunning campaign was on display and also in hearts of every Indian. Despite almost missing out on a historic bronze medal, they won everyone's heart. The Indian women's hockey squad was participating for just the third time in the games' history. For the first time ever, they advanced to the semi-finals, but they were heartbrokenly denied of what would have been a historic medal for Indian women's hockey due to two painful losses (against Argentina and Great Britain). However, despite the fact that a medal was dropped, India's women's hockey programme as a whole may look back on the Tokyo Games campaign as a turning point.

4.4. Participation of Indian women in the Olympic Games



From 1952 to 2020, the participation of Indian women in the Olympic Games has shown both variations and notable increases. In 1952, there were 4 Indian women participants. The number decreased to 1 in 1956 and further declined to 0 in 1960 and 1968. In 1964 and 1972, there were 1 Indian woman participant each. The participation remained at 0 in 1976. The year 1980 witnessed a significant increase in Indian women's participation with 18 athletes representing their country. In 1984, 6 Indian women took part, followed by 7 in 1988. The numbers slightly decreased to 6 in 1992, but then increased to 9 in 1996. The year 2000 saw a significant jump with 21 Indian women participating, and it continued to rise in subsequent years. In 2004, the number further increased to 25, and it remained the same in 2008 and 2012. The year 2016 marked a notable increase with 54 Indian women participating in the Olympic Games. The trend continued in 2020, where the highest number to date, 56 Indian women, represented their nation.

5. CONCLUSION

Indian women played a greatest role to make India proud in the Olympic games. In the past so many Indian female competed in the Olympic Games. Total number of medal winning by Indian women in Olympic games till now is 8. . Their names are as follows: “Karnam Malleswari”, “Mary Kom”, “Saina Nehwal”, “Sakshi Malik”, “P.V Sindhu”, “Mirabai Chanu”, “Lovlina Borgohain”, “P.V Sindhu”. In the two Olympic only Indian women athlete win medal in 2000 Sydney Olympic and 2016 Rio Olympic, no male athlete win any medal. Thats the power of Indian women athlete who makes us proud. As you know that “Karnam Malleshwari” creates history as she is the first Indian women athlete to win a medal in Olympic games, in the 69kg weight category in weightlifting. MC Mary Kom also creates history as she became the first Indian woman Boxer to win Olympic medal in 2012 London Olympic. And also in this Olympic Saina Nehwal also win a bronze medal in badminton.

She is the first Indian shuttler to win Olympic medal. In the Rio Olympic, Sakshi Malik win a bronze medal in Wrestling, as she became the first Indian female wrestler to do so. P.V Sindhu also creates history as she won two medal a silver in Rio and a bronze medal in Tokyo. Second after the wrestler Sushil Kumar. Tokyo 2020 is the most successive Olympic in the Indian history as India win total 7 medal and in this women win 3 medals. Aditi Ashok, Indian Hockey team lost the medal with a little margin. If we are talking about all over the world regarding the performance of female athletes in Olympics, For several of the best performing nations, female athletes took home more medals than their male counterparts. For instance, up to 23 of the USA's 39 gold medals were won by female athletes. The female athletes also won more medals than their male counterparts in China and Japan. . The efforts of Indian women athlete makes India proud with their performance in different Olympics. Their hard work and performance motivate the young generation and the parents, families to participate their children in Sports.

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GREEN BANKING IN INDIA: A STUDY ON PUBLIC AND PRIVATE BANKS

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Green banking refers to the promotion of environmentally friendly practices that are managed in such a way that carbon footprints are reduced, as well as the development of internal banking processes. It has prompted environmentalists, governments, and organizations from throughout the world to discuss a crucial subject of environmental protection. The importance of environmental sustainability and sustainable development has increased as a result of green banking. The current study aims to comprehend the use of green banking products in the banking sector and to investigate the green banking initiatives of India's top two public and private sector banks. According to the findings of the study, both banks have successfully launched green banking initiatives.

Keywords: Green Banking, Climate Change, Sustainability, Green Initiatives, Public Bank, Private Bank

1. INTRODUCTION:

One of the most significant economic and social concerns that all nations are currently dealing with is environmental change. Environmental degradation is a global problem that has major implications for economies and communities everywhere. The disastrous consequences of recent storms, floods, droughts, and high heat, which have been felt by many people worldwide, motivate us to seriously consider solutions to these problems. Businesses are obliged to act in a way that is environmentally friendly due to the notion of "protection of the environment" receiving more attention and relevance. Despite the fact that the effects of climate change are becoming a greater threat to the nation's health, economy, and environment, economists are beginning to see financial benefits from preventing climate change and fostering a low-carbon economy (Naidu, 2015). As an accountable part of society, we must reduce carbon footprints and preserve the environment through our processes, operations, personnel, facilities, and people. Green banking is rapidly becoming an accepted standard for conducting business in a socially and environmentally responsible manner. In order to preserve the environment and improve habitation, this banking is ecologically friendly. The Bank is recognized as the foundation of an economy and affects environmental sustainability directly and indirectly. Though the banking sector has historically been seen as environmentally beneficial, banks' carbon footprint has significantly expanded in recent years due to their extensive energy use (lighting, air conditioning, computers), limited space, haphazard construction, and disregard for internal sustainability. Therefore, banks are encouraged to employ eco-friendly technology, green products, new processes, and strategies in order to reduce carbon footprints and ensure a sustainable environment (Bhardwaj & Malhotra, 2013).

CONCEPT OF GREEN BANKING

Green banking has been a buzzword in the sustainable banking industry during the past few decades. Green banking is actually known a sustainable banking, which contributes to preventing adverse environmental impacts with the aim of ensuring long-term economic growth (Islam *et al.*, 2020), it is also known as an ethical bank. Ethical banks were founded with the goal of safeguarding the environment. These banks function similarly

to normal banks in terms of environmental protection, and they are governed by the same authorities. A notion known as "green banking" first appeared in Western nations. In 2009, Mt. Dora, Florida, in the United States, hosted its initial introduction to the state of Florida. To conserve the environment and natural resources, the idea first surfaced in 2003. In order to create a green bank that is owned by the US government, Congressman Chris Van Hollen of the US proposed the Green Bank Act in March 2009 (Mir & Bhat, 2022). There are two approaches to practicing green banking. One type of green banking is internal, and the other is green banking as it is applied by bankers in their individual business sectors. Online banking, environmentally friendly construction, reforestation, the installation of solar panels on the bank's roof, the use of webcams for video conferencing rather than in-person meetings, the usage of emailing documents and online statements, and other practices are all part of in-house green banking. The major practices of bankers in their respective business areas include working on specialized green projects, volunteering, and funding green projects including solar and renewable energy plants, biogas plants, bio-fertilizer plants, projects with ETP, and effluent treatment plants (ETP), among others. While supporting and effectively utilizing renewable, non-renewable, human, and natural resources, green banking takes proactive measures to protect the environment and solve climate change concerns.

2. REVIEW OF LITERATURE

(Vadrle & Katti, 2016) examined the green banking initiatives of India's major three public and private sector banks. According to the findings of the study, both banks have successfully launched green banking initiatives. In terms of green banking initiatives, public sector banks have performed better than the private sector's. ((Zhixia et al., 2018) highlighted the current state of green banking practice, advancements, and various green initiatives adopted by Bangladeshi banks. The study discovered that Bangladeshi banks were done well in practicing sustainable banking while maintaining the specific guidelines of Bangladesh Bank (the Central Bank of Bangladesh). (Fakhira *et al.*, 2023) demonstrated the link between the variables and factors that affect the adoption of green banking, conducted a SWOT analysis of the strategy, and developed managerial recommendations for boosting green banking adoption. Data were gathered through an online survey. The Structural Equation Model (SEM)-PLS is the statistical analysis employed. The findings demonstrated a substantial correlation between all variables and the factors affecting the adoption of green banking. (Mir & Bhat, 2022) examined the green banking methods used by a few Indian banks in order to determine the difficulties in implementing this environmentally beneficial trend. For the purpose of this study, secondary data have been employed. The result showed that, first and foremost, customer awareness must be raised. Green banking encompasses not just sustainable resource consumption but also green lending strategies. Effective training and instructional programs for banks' green initiatives will be vital to the success of Green Banking. (Mia *et al.*, 2022) presented evidence on green banking efforts implemented by commercial banks in Bangladesh during the last decade. To investigate green banking practices in Bangladesh, quantitative data was gathered from several secondary sources. The study found that, commercial banks in Bangladesh had launched a number of green banking initiatives in recent years. Commercial banks' green banking practices eventually help to strengthen the banking sector's brand image at both the national and international levels. (Sangiseti & Kumari, 2023) investigated the most recent improvements in sustainability in Indian banks through proper green banking practices and strategies, as well as the implementation issues they encounter.

OBJECTIVE OF THE STUDY

➤ To analyse the application of green banking products in banking sector.

3. RESEARCH METHODOLOGY

The study is based on secondary data that was gathered from the individual banks' annual reports and Web sites of the banks. Only two public sector banks (State Bank of India and Punjab National Bank) and two private sector banks (Housing Development Finance Corporation Bank (HDFC) and Industrial Credit and Investment Corporation Bank of India (ICICI)) are included in the study. These are the top two banks in both the public and private sectors in terms of net profit. For the purpose of gathering data regarding the green banking initiatives carried out by the banks, which is based mostly on the annual reports, Banks Business Responsibility Reports, environmental, social, and governance report and official websites of the selected respective banks from 2015 to 2020.

GREEN BANKING PRODUCTS ARE USED IN THE BANKING SECTOR

❖ Go Green:

Internet banking, mobile banking, tab banking, phone banking, RTGS, and NEFT transactions, among other forms of online banking, are all included. Online bill payment, online deposits, fund transfers, account statements, etc. are among the functions involved. Banks ultimately use less paper, use less energy, and spend less on natural resources thanks to these financial activities.

❖ Green Finance:

In addition to offering some processing fee and interest rate concessions, banks should finance environmentally friendly projects and products, such as solar equipment, recycled furniture, vehicle financing for low-emission vehicles, home financing for green buildings, etc.

❖ Power saving equipment's:

The installation of solar-powered ATMs, the use of solar-powered UPSs, GSL/LED lighting, rainwater harvesting by banks, etc.

❖ Card based transactions

Banks have launched green channel counters (GCC) to introduce a range of card-based transactions. GCC encourages card-based transactions among its clients in order to save time for the clients as well as resources like paper and electricity. Customers can choose from a range of cards, including ATM, Credit and Debit, Green Remit, Foreign Travel, eZ Pay, Gift, and Smart Payout cards.

GREEN INITIATIVES TAKEN BY INDIAN BANKS:

I. Public sector banks

A.) State Bank of India

1. The Green Chanel Counter was introduced by SBI on July 1st, 2010 as an innovative initiative in the field of green banking. The Green Channel Counter (GCC) promotes "Green Banking," or paperless deposit, withdrawal, and cash transfers within the Bank. All retail branches now offer GCC facilities. Cash withdrawal, cash deposit, fund transfers inside SBI, registration of mobile numbers for mobile banking services, and demand draft (DD) issuing are among the services provided through the GCC.

2. The Bank has contributed significantly in a number of ways, including through financial backing for and activities in the field of renewable energy, as well as by the adoption of various measures that reflect the significance attached to environmental issues and energy saving. In this regard, the Bank's branches and offices in Maharashtra, Gujarat, and Tamil Nadu installed 15 MW of windmill capacity for captive use of clean power, among other internal energy efficiency initiatives like switching to LED lighting, installing star-rated air conditioners, and installing solar-powered water heaters.

3. In 2015, The bank released GREEN PIN. With this service, a customer can generate an ATM pin by INB, SMS, and the bank's contact centre without visiting the branch to obtain a hard copy of the ATM pin.

4. India's first comprehensive digital service platform, entitled YONO-"You Only Need One," was introduced by SBI on 24th November 2017. The largest Business to Customer (B2C) marketplace in India is accessible through YONO, an integrated omni-channel, digital platform that provides access to banking and other financial goods. Customers can apply for personal loans and maintain their accounts without having to visit a branch. Aside from banking, YONO provides consumers with the convenience of managing various financial products such as life and general insurance, credit cards, and mutual funds.

5. SBI's initiative to modernize its digital infrastructure has been astounding. With the establishment of SBI touch centers, e-corners, mobile wallets, alternative banking channels, and a single digital service platform, as well as the creation of AI "chatbots" for resolving client issues and the use of algorithms for data analytics, the Bank is making great efforts to lessen the operational work required across branches. Additionally, "digitization" has been recognized by SBI as one of the fundamental ideas that it used to construct its financial inclusion initiatives.

6. The Bank's SBI Pay program is another effort to stay on the forefront of innovation. The unified payment interface-based program offers users the ease of transferring money across different bank accounts through a variety of mechanisms, making it an incredibly useful option. SBI and Google India have joined to provide UPI services to Google Pay users under the UPI Multi-Bank Integration Model.

7. SBI Patna Circle has implemented the practice of recharging ground water aquifers from rooftop run-off across five different locations as part of its sustainability efforts. In order to use this approach, the building's roof outlet had to be connected in order to direct the rainwater to already-existing wells, tube wells, bore wells, or filtering tanks. Rainwater is soft in nature and comparatively free of germs and organic debris. The necessary structures are straightforward, affordable, and incredibly eco-friendly.

8. SBI has developed a carbon neutrality policy with the intention of being a carbon neutral organization by 2030 in response to worries about climate change. To do this, the Bank has started installing solar power systems at its branches and offices across the nation in place of generators. Remote monitoring of the solar system will be possible, enabling efficient use.

9. SBI has focused on providing goods and services, launching new projects responsibly to reduce its environmental impact, and encouraging individuals to choose electric cars to lessen their carbon impact by offering Green Car Loans with lower interest rates and longer loan terms.

10. SBI has increased its efforts to raise awareness among its staff about the need to consume less water. Additionally, the Bank has taken tiny precautions to protect the resource, such shutting off faucets when they are not in use. As of March 31, 2020, the Bank had installed 248 rainwater harvesting systems across its branches, offices, and other enterprises.

Among the public sector banks, SBI is the first to create a sustainability roadmap for its operations across India. The Bank has made a commitment to reducing both the direct and indirect effects of its operations on the environment. The Bank's main environmental obligations are to: Reduce SBI's environmental impact; Use less water; Manage the amount of waste produced, particularly plastic and e-waste; Invest in renewable energy; and Raise awareness of the value of environmental sustainability.

B.) Punjab National Bank

1. The bank has put in place certain easy-to-implement "Green practices" to conserve resources such as power, water, paper, and so on. It has made attempts to collect rainwater in existing structures and in new, ecologically friendly ones. In rural areas, the bank has encouraged wind energy and promoted the use of solar energy.
2. The bank has successfully implemented SMS notifications Services for both retail and business customers, and SMS notifications are now issued for specific transactions (credit/debit) made at branches, ATMs, IBS, Mobile Banking, and POS terminals.
3. UPI, a mobile-based banking program, was created, allowing clients to access their bank accounts opened with different banks through a single app.
4. The Bank also introduced a first Proof of Concept Model of its Digital Branch, known as PNB DIGIHUT, at its Dwarka headquarters.
5. A unified mobile application called "PNB One" was released by the bank to provide numerous functionalities on a single platform.
6. The Bank is moving toward installing solar water heating systems and solar PV cell-based energy sources in its new structures. The Bank also supports projects that demonstrate solar energy, vermicomposting, tree protection, and other ecologically sound practices.
7. To prevent physical pin printing for debit cards other than PMJDY accounts, the bank introduced the Green Pin feature.
8. The Bank is implementing "Green PNB" measures to assist decrease resource and energy waste, such as cutting down on paper usage by printing on both sides and electricity usage by using CFL lights, etc.
9. The Bank considers that environmental protection is a necessary component of sustainable growth. With a focus on clean energy projects including solar, wind, and renewable energy, the Bank has been involved in programs that support green financing, clean energy, and environmental protection.
10. To ease digital transactions, the bank released a number of innovative mobile applications, including PNB Mobiease, PNB Rewards, PNB Fin Literacy, PNB Yuva, PNB ATM Assist, PNB m-Banking, PNB Kitty, etc. Additionally, PNB M-Passbook was made available to consumers in FY'18 so they could check their account statements on their smartphones.

II.Private sector banks

A.) Housing development finance corporation bank

1. The Bank has made use of the digital banking platform as part of its 'Go Digital' programs, which aim to increase consumer convenience while reducing the environmental impact of its operations.
2. The Bank has introduced the 10-second personal loan, the fastest loan disbursement offered by any bank. A pre-approved loan amount is always available to a select group of consumers. Users can access this loan by simply login into their bank account using Net-Banking or Mobile Banking. The entire loan disbursal process is fully paperless. They can also use the ATM to access the same services.
3. HDFC Bank is a major facilitator of tax payments for the Union and State Governments. Jodhpur has launched the first-of-its-kind payment gateway for online payment of urban development tax. This approach will cut the amount of time spent commuting and queuing to make tax payments.

4. Mobile banking services like Pay-Zapp, Chillr, Zip-Ride, Zip-Drive, and Mobile Banking Lite are introduced by the bank. Pay-Zapp is a one-click mobile payment solution that guarantees paperless and digital transactions for all purposes. When users are connected to the Chillr app through a bank account, they can instantly send money to any contact in their phonebook. The Sustainable Livelihood Initiative (SLI) has also utilized the app. Customers can apply for auto loans using the Bank's services in the comfort of their own homes. Two apps that offer fast and pre-approved loans are Zip-Ride and Zip-Drive. The Bank has released Mobile Financial Lite software for consumers in rural areas, enabling financial services without even utilizing the Internet.

5. The Bank recognizes its role in enhancing energy efficiency, lowering greenhouse gas emissions, and mitigating climate change despite the fact that its energy usage is modest for a corporation in the financial industry. Electricity, DG sets, and fuel for company-owned vehicles make up the bulk of energy use. Along with internal energy-saving activities, it has placed 51 ATMs that are supported by a solar-powered UPS in areas with erratic electricity, greatly reducing their need for the grid. Rechargeable Lithium-Ion batteries were initially used as the pilot technology for the solar ATM project.

6. As part of its holistic commitment to rural development, HDFC Bank has installed water wheels in rural villages to facilitate easy access to clean water. The Bank has planted trees with the dual goals of promoting horticulture and maintaining the soil's top retention for improved agricultural productivity.

7. HDFC Bank is the first bank in the country to offer a digital loan against shares (LAS). In the automobile industry, customers continued to acquire vehicles and two-wheelers through online services such as Zip Drive and Quick Money.

8. Reduced paper use is an important component of the Bank's sustainability strategy. The bank has implemented mechanisms to reduce paper consumption in all of its offices, with a centralized stationary desk handling the majority of the needs. Email printing has been avoided unless absolutely necessary. Several more initiatives were additionally carried out at the individual and group levels.

9. In the banking industry, the use of recycled materials as processed inputs is limited. Even so, the Bank is continually on the lookout for ways to recycle garbage. E-waste is the primary component of waste generated by the bank, and it includes computers, monitors, modems, switches, laptops, scanners, routers, printers, and UPS systems.

10. The Bank has adopted solar ATMs in an effort to reduce its environmental impact. These make use of solar-powered rechargeable lithium-ion batteries, which cut down on the need for traditional electricity, and the bank has achieved this by supplying ATMs in places with erratic power supplies with renewable energy.

B.) Industrial Credit and Investment Corporation Bank

1. ICICI Bank has been working to adopt green, sustainable goods, processes, policies, and practices as an environmentally conscious business. An organization-wide program called "Go Green" encourages the use of automated, cost-effective methods that are favourable to the environment as well as raising staff knowledge of environmental issues.

2. One of the main initiatives performed by the Bank has been energy-saving measures, including the installation of energy-efficient equipment, Variable Refrigerant Flow (VRF) technology in HVAC, polarized refrigerant additives for improving compressor efficiency of HVAC systems, and electronically commutated blowers in Air Handling Units (AHU). These measures have been implemented throughout the offices and branches. According to the annual report for 2016–2017, 85 ATMs have been switched to solar-powered models.

3. The adoption of alternative banking channels, such as internet banking, mobile banking, phone banking, insta-banking, ATMs, fully electronic branches, and tab banking, is encouraged by ICICI Bank in order to reduce paper usage. ICICI Bank switched from paper-intensive processing to electronic processing based on images. The Bank has made an effort to get in touch with its clients and ask for their support in the "Go Green" campaign. To this end, it has encouraged online bill payment, online funds transfer, and subscription to e-statements in order to move customers to "paperless" and "commute-free" ways of carrying out banking activities.

4. The bank presumes that behavioural change is the key to obtaining long-term and sustainable environmental benefits. As a result, the bank has launched a number of programs to raise awareness among its personnel. This includes hosting "Environmental Week" on World Environment Day and launching the 'Save Trees, Save Earth' project, which focuses on tree planting.

5. To minimize the overall number of visits, the bank introduced an automated end-to-end travel procedure using the online booking tool and expanded the use of audio and video conferencing for meetings, which has reduced traffic and pollution. The use of digital conferencing has resulted in a 31% decrease in the number of journeys (flight and train) in FY2020, to 3,678. The bank has partnered with an electric car operator, which will help us reduce our reliance on fossil fuels even more.

4. CONCLUSION

The significance of environmental preservation and protection is becoming increasingly clear. Green banking is a novel concept in India. By fusing banking activity with environmental management, it aims to minimize carbon footprints. In addition to being corporate citizens, banks have obligations to the communities in which they do business. An important concern for the development of the country is green banking. According to the findings of this study, both public and private sector banks are actively engaged in a variety of green banking activities. Specifically, banks are raising awareness about environmental issues among bank employees, customers, and the general public through green banking. The focus of banks' green banking initiatives has gradually evolved from promoting and implementing virtual banking to recycling garbage, building green buildings, using solar-powered equipment, harvesting rainwater, etc., more successfully.

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SON PREFERENCE AND CONTRACEPTIVE PREVALENCE IN HARYANA: AN EMPIRICAL ANALYSIS

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This research investigates the relationship between contraceptive prevalence and son preference in Haryana, one of India's most affluent states. Son preference refers to the prevalent cultural inclination towards granting priority to sons over daughters. Using data from the National Family Health Survey (NFHS-IV) conducted during 2015-2016, the study employs Arnold's index to gauge the impact of son preference on contraceptive adoption among women in Haryana. The analysis focuses on women of different parities, namely 1, 2, 3, 4, 5, and above, to comprehend the extent of son preference's influence on contraceptive practices. Our findings reveal a notable trend: women with one or more living sons are more inclined towards adopting contraception, whereas couples without sons or with a majority of daughters display lower contraceptive usage. Moreover, the study identifies a monotonic increase in contraceptive acceptance with an escalating number of living sons in a family. Importantly, the desire for additional children among women is significantly influenced by their current count of living sons; women with a higher number of sons exhibit maximum contraceptive usage. Additionally, our results highlight a strong manifestation of son preference in the Haryana region.

Keywords: Contraceptive prevalence, Parity, Arnold's index, Son preference, Sex composition

1. INTRODUCTION

Son preference, denoting the inclination to prioritize sons over daughters, has been extensively documented in traditional and male-dominated patriarchal societies, such as China (Arnold and Zhaoxiang, 1986) and Korea (Park, 1983). The manifestation and intensity of this preference are heavily influenced by economic, social, cultural, and psychological factors. In communities where sons traditionally assume the role of providing income for old-age maintenance and where the family structure follows a patriarchal framework (Cain, 1981), there tends to be a pronounced favoring of sons by couples (Ahmed, 1981; Bairagi and Langston, 1986; Mason and Bennet, 1977). In the Indian context, where the custom of dowry persists, parental preference for sons over daughters remains common. The complex interplay of societal norms and economic considerations plays a pivotal role in shaping this preference. The phenomenon of son preference represents an intriguing cross-cultural subject worthy of further exploration, as it provides valuable insights into the dynamics of gender roles and societal expectations across diverse cultural landscapes.

The preference for sons over daughters has deep-rooted implications in many societies, particularly in regions with patriarchal family structures. Sons are often sought as valuable assets, capable of providing family labour for farming or family businesses, and crucial support during their parents' old age. Additionally, son's marriage brings domestic assistance through daughters-in-law and financial contributions in the form of dowry payments. Moreover, within a patriarchal framework, having at least one son is deemed essential for upholding the family

line, while possessing multiple sons elevates the family's stature in the community. This preference for children of a specific sex significantly influences fertility planning and regulation, particularly in developing countries. In India, various states, including Haryana, exhibit marked preferences for sons due to traditional beliefs that ascribe economic and social significance to male offspring. This preference is deeply intertwined with complex cultural and social factors, contributing to a society-wide emphasis on the hope for a male child, especially as the firstborn or in families with only daughters. A common motivation shared across different regions and religions in India, particularly Haryana, is the desire for sons to ensure the continuity of the family name and inheritance of property, thereby garnering prestige for the family. Moreover, in agrarian societies, the possession of one or more sons offers access to social insurance programs, representing one of the few available sources of support for the elderly. These strong desires for sons exert a compelling influence on family size and ultimately impact population growth in these societies. Understanding the multifaceted factors driving son preference is crucial for comprehending the intricate dynamics of fertility patterns and social structures in regions where such preferences persist.

Haryana, one of India's most affluent state, have a population of approximately 2.53 crores. Within this demographic, males constitute nearly 53% (1.34 crore), while females account for approximately 47% (1.18 crore), as recorded in 2011 census. Notably, Haryana's decadal population growth stands at 19.90%, surpassing India's overall growth rate of 17.7% during the same period. The sex ratio in Haryana is a concerning 879 females per 1000 males, representing the lowest among all states in India. This figure significantly lags behind the national average of 943 women per 1000 males. Furthermore, approximately 65.9% of females in Haryana are literate, according to the latest census data of 2011. Given the decentralized nature of decision-making and program implementation in India, it becomes imperative to conduct state-specific research, particularly when examining contraceptive behavior. Notably, the degree of son preference, socioeconomic conditions, and fertility rates exhibit considerable variation across the nation. As such, understanding the unique dynamics at the state level is crucial for formulating effective and tailored interventions to address prevailing challenges in contraceptive usage and family planning.

There are a number of studies conducted in various parts of India which explain the relationship between fertility behavior, contraceptive use and son preference (Bairagi, 2001; Bhat and Zavier, 2001; Malhi,1999; Mutharayappa,1997; Rajaretnam,1995; Reretto,1972; Sinha,2006)

Despite the critical significance of understanding fertility behavior and contraceptive practices in Haryana, there remains a dearth of comprehensive studies on this subject. In light of this gap, the current investigation endeavors to explore the interplay between son preference and contraceptive adoption in the region. By assessing the prevalence of son preference, the study focuses on evaluating the impact of sex composition of surviving children on the utilization of modern contraceptive methods in Haryana. Through this nuanced examination, we aim to shed light on the complex relationship between son preference and family planning choices in the state. The findings of this study are poised to contribute valuable insights to the field of reproductive health and inform targeted interventions to address pertinent issues in the domain of fertility and contraceptive behavior in Haryana.

2. LITERATURE REVIEW

There are a number of studies conducted in various parts of India which explain the relationship between fertility behavior, contraceptive use and son preference (Bairagi, 2001; Bhat and Zavier, 2001; Malhi,1999; Mutharayappa,1997; Rajaretnam,1995; Reretto,1972; Sinha,2006)

Sons traditionally assume the role of providing income for old-age maintenance and where the family structure follows a patriarchal framework (Cain, 1981), there tends to be a pronounced favoring of sons by couples (Ahmed, 1981; Bairagi and Langston, 1986; Mason and Bennet, 1977).

3. RESEARCH METHODOLOGY

3.1 Data set

The data for the present study has been taken from National Family Health Survey NFHS-IV (2015-16). NFHS-IV has been conducted under the ministry of Health and Family Welfare (MoHFW), Government of India. MoHFW designated the International Institute for Population Sciences (IIPS), Mumbai, as the nodal agency for this survey. NFHS-IV survey was conducted in all 21 districts of Haryana. NFHS-IV survey extensively collected data on a wide array of parameters, encompassing fertility, infant and child mortality, maternal and child health, family planning, contraceptive usage among couples as well as the number of children ever born to women aged 15-49, and many other vital indicators. An index has been created utilizing data on the sex composition of the desired number of children along with contraceptive usage in order to comprehend the level of son preference. Women are assumed to prefer sons if they state that the desired number of sons is greater than the ideal number of girls for women.

3.2 Methodology

Arnold's index has been calculated to assess the impact of a son's preference on the usage of contraceptives by the women. According to Arnold, it can handle any type of sex preference (boy preference, girl preference, balance preference or any combination of these), it can be used with a number of behavioural and attitudinal measures related to fertility and family planning and this method requires data only on the number of living children by sex along with any fertility related dependent variables such as contraceptive use etc.

Arnold (1985) proposed this method and the measure is defined as

$$I_P = \frac{\sum_i C_i * P_i}{\sum_i P_i} \dots\dots\dots (1)$$

Where, C_i = maximum contraceptive use rate at each parity 'i'

P_i = number of women at each parity 'i'

In order to assess the presence of son preference, we shall analyse in NFHS-IV data the pattern of modern contraceptive use by sex composition of the surviving children considering residence and other socio-economic backgrounds of eligible/ever married women from whom data has been collected.

In NFHS IV, in Haryana, in the sample of 21654 eligible/ever married women, 70.9% (15355) has at least one child and 69.9% (15355) of them are using modern method of contraceptives, giving prevalence rate of 69.9%. The distribution in rural and urban areas of Haryana are 65.1% (14092) and 34.9% (7562) respectively. The figures using modern contraceptive out of these women are 47.6% (6706) and 46.9% (3544) providing contraceptive prevalence rate of 32.8% and 42.3% respectively in rural and urban areas. In Haryana, people who are literate is 66.8% and illiterate is 33.2%. People belong to Hindu community is 88.7%, Muslim is 6.9% and in other religious community majority of them are Sikh whose population constitute 4.3% of the total population of Haryana. O.B.C. constitute about 45.5%, S.C. constitute nearly 27.3%, S.T. constitute 0.2% and General constitute 26.6% of the total population. When we talk about rich person then they constitute 75.6% of the total population.

Table 1 provides the rural and urban distribution of contraceptives use by sex composition of surviving children born to women. In all categories in all the tables, the first column shows the number of eligible/ever married women, the second column shows the percentage of women who are actually using modern methods of contraceptives in each parity along with specified sex composition of children. The third column shows the percentage of women who would use contraception in the absence of sex preference of the children. For example, from the Table 1 in rural areas, 73.2% of women with one boy and one girl are using modern contraceptives as compared to 44.3% of those with two daughters. It is assumed that if sex of the child is no longer make any difference then women with two girls would be equally satisfied as women with one boy and one girl and hence, they would have the same rate of contraceptive use. With this assumption, the figures of the third column in each

parity is obtained for all categories in all the tables and at the end of the table Arnold index is calculated to see sex preference of the child.

3.3 Results

Table 1: Contraceptive use by sex composition and residence in Haryana						
Sex composition of living children	Urban			Rural		
	Nos. of women	Percentage using contraceptives	In the absence of sex preference (percentage)	Nos. of women	Percentage using contraceptives	In the absence of sex preference (percentage)
One Child						
One Boy	790	54.8% (433)	54.8	1283	45.7% (586)	45.7
One Girl	394	37.8% (149)	54.8	663	32.1% (213)	45.7
Two Children						
Two Boys	743	75.5% (561)	75.5	1382	79.1% (1093)	79.1
One Boy & One Girl	1312	73.2% (961)	75.5	2134	73.8% (1574)	79.1
Two Girls	174	44.3% (77)	75.5	321	35.8% (115)	79.1
Three Children						
Three Boys	142	70.4% (100)	84.9	263	81.4% (214)	82.5
Two Boys & One Girl	592	84.9% (503)	84.9	1155	82.5% (953)	82.5
One Boy & Two Girls	435	67.8% (295)	84.9	925	64.9% (601)	82.5
Three Girls	45	48.9% (22)	84.9	99	24.2% (24)	82.5
Four Children						
Four Boys	16	75% (12)	75	47	78.7% (37)	78.7
Three Boys & One Girl	98	68.4% (67)	75	189	68.7% (130)	78.7
Two Boys & Two Girls	196	70.4% (138)	75	473	69.9% (331)	78.7
One Boys & Three Girls	107	70.1% (75)	75	333	62.7% (209)	78.7
Four Girls	16	31.2% (5)	75	21	28.6% (6)	78.7
Five Children						

All Boys	1	0% (0)	74	7	71.4% (5)	71.4
Most Boys	19	52.6% (10)	74	41	48.8% (20)	71.4
More Boys	45	68.2% (30)	74	96	50% (48)	71.4
More Girls	50	74% (37)	74	171	63.5% (108)	71.4
Most Girls	26	73.1% (19)	74	93	61.2% (57)	71.4
All Girls	5	40% (2)	74	18	38.9% (7)	71.4
Total	5206	69.70%	$I_p=74.44$ %	9714	69.27%	$I_p=75.50%$

Overall it is seen from the Table 1 that sex preference has more effect on contraceptive use in both urban and rural areas since the contraceptive use rate would increase from 69.70% to 74.44% in the urban areas and 69.27% to 75.5% in rural areas in the absence of sex preference.

The results of table 1 reveal high preference for sons in both urban and rural areas. It is seen that among the women residing in urban areas with one child, those with one boy i.e. 54.8% of them reported using modern method of contraceptives as compared to 37.8% of women with one girl in the urban areas. Further, we observe that two patterns of modern contraceptive use are emerging when the parity increases. First, a higher percentage of women use contraception once they have more boys than girls, indicating that they are most satisfied with the sex composition of their children, demonstrating a clear preference for male child. The next larger percentage of women using contraceptives is visible when there is balance in the sex composition of the children. For women with two children, those who have both sons, among them 75.5% are using contraceptives as compared to 73.2% of women who have one male child and one female child. This shows that there is decrease in contraceptive use from two male children to one male and one female children. But the contraceptive use among the women is reduced more when compared to two male children to two female children to women i.e. from 75.5% to 44.3%. This shows that there is preference for male child in second parity. This means that the preference of one son is most acceptable sex combination of children and 75.5% women are using contraceptives in this combination. Again, when we observe for third parity, we find that 70.4% women are using contraceptives when they have only boys i.e. three boys but when they have two boys and one girl combination then contraceptive use has been increased to 84.94%. If a woman has one boy and two girls combination then they go for lower percentage of contraceptives use i.e. 67.8% and if they have only girls children i.e. all three girls then contraceptive use rate is decreased to much lower side i.e. 48.9% from 89.9% when women has two boys along with one girl. Again, in case of four children, the most preferred sex composition is all four boys for the women with contraceptive prevalence rate of 75.1%. In order of preference, this is followed by two boys and two girls to the women having contraceptive prevalence rate of 70.4% This shows that in higher parity also they prefer son. But when women go for five and above five parity, there is large number of children and as a result the preference for certain sex composition of children is gradually diminishing.

Similar pattern of preference for sex composition of children among rural women is also evident from table 1. It is seen that among the women residing in rural areas with one child, those with one boy i.e. 45.7% of them reported using modern method of contraceptives as compared to 32.1% of women with one girl in the rural areas. Further, we observe that two patterns of modern contraceptive use are emerging when the parity increases. First, a higher percentage of women use contraception once they have more boys than girls, indicating that they are most satisfied with the sex composition of their children, demonstrating a clear preference for male child. The next larger percentage of women using contraceptives is visible when there is balance in the sex composition of the offspring. For women with two children, those who have both sons, among them 79.1% are using

contraceptives as compared to 73.8% of women who have one male child and one female child. This shows that there is decrease in in contraceptive use from two male children to one male and one female children. But the contraceptive use among the women is reduced more when compared to two male children to two female children to women i.e. from 79.1% to 35.8%. This shows that there is preference for male child in second parity. This means that the preference of one son is most acceptable sex combination of children and 79.1% women are using contraceptives in this combination. Again, when we observe for third parity, we find that 81.4% women are using contraceptives when they have only boys i.e. three boys but when they have two boys and one girl combination then contraceptive use has been increased to 82.5%. If a woman has one boy and two girls combination then they go for lower percentage of contraceptives use i.e. 64.9% and if they have only girls children i.e. all three girls then contraceptive use rate is decreased to much lower side i.e. 24.2% from 82.5% when women has two boys along with one girl. Again, in case of four children, the most preferred sex composition is all four boys for the women with contraceptive prevalence rate of 78.7%. In order of preference, this is followed by two boys and two girls to the women having contraceptive prevalence rate of 69.9%. This shows that in higher parity also they prefer son. But when women go for five and above five parity, there is large number of children and as a result the preference for certain sex composition of children is gradually diminishing.

Table 2: Contraceptive use by sex composition and literacy in Haryana

Sex composition of living children	Illiterate			Literate		
	Nos. of women	Percentage using contraceptives	In the absence of sex preference (percentage)	Nos. of women	Percentage using contraceptives	In the absence of sex preference (percentage)
One Child						
One Boy	468	38.2% (179)	38.2	1605	52.3% (840)	52.3
One Girl	223	23.8% (53)	38.2	834	37.1% (309)	52.3
Two Children						
Two Boys	831	75.6% (628)	75.6	1294	79.3% (1026)	79.3
One Boy & one girl	861	67.5% (581)	75.6	2585	75.6% (1954)	79.3
Two Girls	152	30.3% (46)	75.6	343	42.6% (146)	79.3
Three Children						
Three Boys	263	78.3% (206)	79.9	142	76.1% (108)	81.5
Two Boys & One Girl	1021	79.9% (816)	79.9	726	81.5% (592)	81.5

One boy & Two Girls	640	68.9% (441)	79.9	720	70.8% (510)	81.5
Three Girls	71	35.2% (25)	79.9	73	37% (27)	81.5
Four Children						
Four Boys	54	79.6% (43)	79.6	9	77.8 % (7)	80.9
Three Boys & One Girl	224	70.1% (157)	79.6	63	73% (46)	80.9
Two Boys & Two Girls	517	74.9% (387)	79.6	152	80.9% (123)	80.9
One Boy & Three Girls	288	68.4% (197)	79.6	152	69.1% (105)	80.9
Four Girls	19	26.3% (5)	79.6	18	33.3% (6)	80.9
Five Children						
All Boys	8	62.5% (5)	74.7	0	0% (0)	100
Most Boys	57	49.1% (28)	74.7	3	66.7% (2)	100
More Boys	124	50% (62)	74.7	16	100% (16)	100
More Girls	189	66.7% (126)	74.7	32	78.1% (25)	100
Most Girls	99	74.7% (74)	74.7	20	60% (12)	100
All Girls	17	41.2% (7)	74.7	6	33.3% (2)	100
Total	6126	70%	$I_p= 75.80\%$	8793	70.02%	$I_p= 74.74\%$

Overall it is seen from the Table 2 that sex preference has effect on contraceptive use in both illiterate and literate section, since the contraceptive use rate would increase from 70% to 75.80% in illiterate and from 70.02% to 74.74% in the literate section in the absence of sex preference.

Among women with one child, those with one boy i.e. 38.2% of them reported using modern method of contraceptives as compared to 23.8% of women with one girl in the illiterate section whereas in literate section, among women with one child, those with one boy i.e. 52.3% of them reported using modern method of contraceptives as compared to 37.1% of women with one girl. As it is seen that contraceptives use in both cases, whether it is a boy or a girl, is less, this means that women want to go for next child birth. Further, we observe that two patterns of modern contraceptive use are emerging when the parity increases. First, a higher percentage of women use contraception once they have more boys than girls, indicating that they are most satisfied with the sex composition of their children, demonstrating a clear preference for male child. The next larger percentage of women using contraceptives is visible when there is balance in the sex composition of the children. In case of two children, the most preferred sex composition is two boys in both illiterate and literate women with contraceptive prevalence rates of 75.6% and 79.3% respectively. In order of the preference, this is followed by a son and a daughter with contraceptive prevalence rates of 67.5% and 75.6% in illiterate and literate women respectively. For three children, most popular combination is two boys and one girl for illiterate women with contraceptive prevalence rate of 79.9% and two boys and one girl for literate women also with contraceptive prevalence rate 81.5%. In order of preference, this is followed by all three boy children to illiterate women with

contraceptive prevalence rate of 78.3% and all three boys in literate women having contraceptive prevalence rate of 76.1%. In case of four children, the most preferred sex composition is all four boys for illiterate women with contraceptive prevalence rate of 79.6% and three boys and one girl children for literate women with contraceptive prevalence rate of 80.9%. In order of preference, this is followed by three boys and one girl in illiterate section of the women having contraceptive prevalence rate of 74.9% and all four boys in literate section of the women having contraceptive prevalence rate of 77.8%. But when women go for five and above five parity, there is large number of children and as a result the preference for certain sex composition of children is gradually diminishing.

Table 3: Contraceptive use by sex composition and religion in Haryana

Sex composition of living children	Hindu			Muslim			Others		
	Nos. of women	Percent age using contraceptives	In the absence of sex preference (percentage)	Nos. of women	Percent age using contraceptives	In the absence of sex preference (percentage)	Nos. of women	Percent age using contraceptives	In the absence of sex preference (percentage)
One child									
One Boy	1851	50.4% (933)	50.4	100	14% (14)	14	122	59% (72)	59
One Girl	933	35.2% (328)	50.4	65	10.8% (7)	14	59	45.8% (27)	59
Two Children									
Two Boys	1973	79.6% (1570)	79.6	71	31% (22)	44.8	81	76.5% (62)	87.3
One Boy & One Girl	3196	73.7% (2356)	79.6	85	44.8% (38)	44.8	165	87.3% (144)	87.3
Two Girls	436	41.3% (180)	79.6	40	15% (6)	44.8	19	31.6% (6)	87.3
Three Children									
Three Boys	363	79.9% (290)	81.5	25	36% (9)	47.6	17	88.2% (15)	89.1
Two Boys & one Girl	1597	81.5% (1302)	81.5	86	47.6% (41)	47.6	64	89.1% (57)	89.1
One Boy & Two Girls	1257	71.6% (900)	81.5	48	22.9% (11)	47.6	55	72.7% (40)	89.1
Three Girls	125	40% (50)	81.5	16	6.2% (1)	47.6	3	33.3% (1)	89.1
Four Children									
Four Boys	53	86.8% (46)	86.8	9	33.3% (3)	43.7	1	100% (1)	100

Three Boys & One Girl	234	80.3% (188)	86.8	46	19.6% (9)	43.7	7	85.7% (6)	100
Two Boys & Two Girls	577	79.7% (460)	86.8	64	43.7% (28)	43.7	23	85.7% (24)	100
One Boy & Three Girls	400	71% (284)	86.8	28	32.1% (9)	43.7	12	75% (9)	100
Four Girls	35	28.6% (10)	86.8	1	0% (0)	43.7	1	100% (1)	100
Five Children									
All Boys	6	83.3% (5)	83.3	2	0% (0)	38.8	0	0% (0)	100
Most Boys	40	57.5% (23)	83.3	18	38.8% (7)	38.8	2	100% (2)	100
More Boys	93	71% (66)	83.3	43	18.6% (8)	38.8	4	100% (4)	100
More Girls	181	79.6% (144)	83.3	35	8.6% (3)	38.8	5	80% (4)	100
Most Girls	102	75.5% (77)	83.3	16	6.2% (1)	38.8	1	100% (1)	100
All Girls	19	47.4% (9)	83.3	3	0% (0)	38.8	1	0% (0)	100
Total									
Total	13471	71.64%	$I_P=$ 77.03%	801	34.66%	$I_P=$ 41.86%	642	77.30%	$I_P=$ 83.23%

Overall it is seen from the Table 3 that sex preference has more effect on contraceptive use on Hindu, Muslim and others community women since the contraceptive use rate would increase from 71.64% to 77.03%, 34.66% to 41.86% and 77.30% to 83.23% respectively in the absence of sex preference.

Among Hindus women with one child, those with one boy i.e. 50.4% of them reported using modern method of contraceptives as compared to 35.2% of women with one girl. Similarly, we found that among Muslims women with one child, those with one boy i.e. 14% of them reported using modern method of contraceptives as compared to 10.8% of women with one girl but in others community in which Sikh, Christians, Jains, Buddhist/Neo-Buddhist and all other religion women are there, it is seen that women with one child, those with one boy i.e. 59% of them reported using modern method of contraceptives as compared to 45.8% of women with one girl. In case of two children, the most preferred sex composition is two boys to the women with contraceptive prevalence rates of 79.6% for the Hindus, one boy and one girl for Muslims and others community women with contraceptive prevalence rates of 44.8% and 87.3% respectively. In order of preference, this is followed by one son and one daughter in Hindus women with contraceptive prevalence rates of 73.7% whereas two sons for Muslims and Others community women with contraceptive prevalence rates of 31% and 76.5% respectively. For three children, most popular combination is two boys and one girl children for Hindus, Muslims and others community women with contraceptive prevalence rate of 81.5%, 47.6% and 89.1% respectively. In order of preference, this is followed by three sons in Hindu, Muslims and others community women with prevalence rate of 79.9%, 36% and 88.2% respectively. In case of four children, the most preferred sex composition is all four boys to Hindu

women and to others community women with contraceptive prevalence rates of 86.8% and 100% respectively, two boys and two girls combination among Muslim women with contraceptive prevalence rates of 43.7%. In order of preference, this is followed by three sons and one daughter among Hindu and Others community women with contraceptive prevalence rates of 80.3% and 85.7% respectively and all four boys among Muslim women with contraceptive prevalence rates of 33.3%. But when women go for five and above five parity, there is large number of children and as a result the preference for certain sex composition of children is gradually diminishing.

Table 4: Contraceptive use by sex composition and community wise in Haryana

Sex composition of living children	Scheduled Caste (S.C.)			Scheduled Tribe (S.T.)			Other Backward Caste (O.B.C.)			General		
	Nos. of women	Percentage using contraceptives	In the absence of sex preference (percentage)	Nos. of women	Percentage using contraceptives	In the absence of sex preference (percentage)	Nos of women	Percentage using contraceptives	In the absence of sex preference (percentage)	Nos of women	Percentage using contraceptives	In the absence of sex preference (percentage)
One Child												
One Boy	429	39.2% (168)	39.2	5	20% (1)	20	1017	52.1% (530)	52.1	619	51.4% (318)	51.4
One Girl	253	33.2% (84)	39.2	3	0% (0)	20	495	32.3% (160)	52.1	305	38.4% (117)	51.4
Two Children												
Two Boys	506	77.5% (392)	77.5	8	37.5% (3)	37.5	1007	78.9% (795)	78.9	602	76.9% (463)	76.9
One Boy & One Girl	706	70% (494)	77.5	10	30% (3)	37.5	1666	75% (1249)	78.9	1061	74.4% (789)	76.9
Two Girls	108	45.4% (49)	77.5	10	0% (0)	37.5	229	37.6% (86)	78.9	147	38.8% (57)	76.9
Three Children												

Three Boys	167	83.8 % (140)	84.7	1	100% (1)	100	164	76.2% (125)	78.3	73	65.8% (48)	78.7
Two Boys & One Girl	555	84.7 % (470)	84.7	6	83.3% (5)	100	771	78.3% (604)	78.3	414	78.7% (326)	78.7
One Boy & Two Girls	369	71.3 % (263)	84.7	6	33.3% (2)	100	604	71.4% (431)	78.3	380	67.1% (255)	78.7
Three girls	55	32.7 % (18)	84.7	1	0% (0)	100	55	41.8% (23)	78.3	32	34.4% (11)	78.7
Four Children												
Four Boys	27	88.9 % (24)	88.9	0	0% (0)	50	30	76.7% (23)	76.7	6	50% (3)	73.8
Three Boys & One Girl	99	79.8 % (79)	88.9	0	0% (0)	50	132	69.7% (92)	76.7	56	57.1% (32)	73.8
Two Boys & Two Girls	259	82.2 % (213)	88.9	4	50% (2)	50	284	71.1% (202)	76.7	122	73.8% (90)	73.8
One Boy & Three Girls	148	66.2 % (98)	88.9	3	0% (0)	50	195	72.3% (141)	76.7	94	67% (63)	73.8
Four Girls	15	26.7 % (4)	88.9	0	0% (0)	50	10	40% (4)	76.7	12	25% (3)	73.8
Five Children												
All Boys	3	66.7 % (2)	81.3	0	0 % (0)	100	4	50% (2)	64.2	1	100% (1)	100
Most Boys	29	65.5 % (19)	81.3	1	0% (0)	100	22	36.4% (8)	64.2	7	42.9% (3)	100
More Boys	63	69.8 % (44)	81.3	1	100% (1)	100	56	37.5 % (21)	64.2	20	60% (12)	100

More Girls	91	81.3 % (74)	81.3	0	0% (0)	100	95	62.1% (59)	64.2	35	51.4% (18)	100
Most Girls	47	68.1 % (32)	81.3	0	0% (0)	100	53	64.2% (34)	64.2	19	68.4% (13)	100
All Girls	10	70% (7)	81.3	0	0% (0)	100	11	18.2% (2)	64.2	2	0% (0)	100
Total	3939	72.21 %	$I_P=$ 78.3 2%	59	55.86 %	$I_P=$ 69.17 %	6900	69.90 %	$I_P=$ 74.09 %	4007	68.40 %	$I_P=$ 73.29 %

Overall it is seen from the Table 4 that sex preference has much effect on contraceptive use in either S.C. or S.T or O.B.C. or General community since the contraceptive use rate would increase from 72.21% to 78.32%, 55.86% to 69.17%, 69.90% to 74.09% and 68.40% to 73.29% respectively in the absence of sex preference.

In the first parity it is seen that among women with one child, those with one boy i.e. 39.2%, 20% 52.1% and 51.4% of them reported using modern method of contraceptives in S.C., S.T., O.B.C. and General respectively as compared to 33.2%, 0%, 32.3% and 38.4% women with one girl in S.C., S.T., O.B.C. and General community respectively. It is also seen that contraceptives use in both cases whether it is a boy or a girl is less, this means that women want to go for next child birth or next parity. Further, we observe that two patterns of modern contraceptive use are emerging when the parity increases. First, a higher percentage of women use contraception once they have more boys than girls, indicating that they are most satisfied with the sex composition of their children, demonstrating a clear preference for male child. The next larger percentage of women using contraceptives is visible when there is balance in the sex composition of the children. In case of two children, the most preferred sex composition is two boys among the S.C., S.T., O.B.C., and the General community women with contraceptive prevalence rates of 77.5%, 37.5%, 78.9% and 76.9% respectively. In order of preference, this is followed by one boy and one girl among the S.C., S.T., O.B.C., and the General community women with contraceptive prevalence rates of 70%, 30%, 75% and 74.4% respectively. For three children, most popular combination is two boys and one girl children for S.C., O.B.C. and General community women with contraceptive prevalence rate of 84.7%, 78.3% and 78.7% respectively whereas in S.T. women, most popular combination is all three boys with contraceptive prevalence rate of 100%. In order of preference, this is followed by all three boys in S.C. and O.B.C. women with contraceptive prevalence rate of 83.8% and 76.2% respectively. Whereas in S.T. and General community women, this is followed by one boy and two girl children with contraceptive prevalence rate of 33.3% and 67.1% respectively. In case of four children, the most preferred sex composition is all four boys in S.C and O.B.C. community women with contraceptive prevalence rate of 88.9% and 76.7% respectively whereas two boys and two girl children in S.T. and General community women with contraceptive prevalence rate of 50% and 73.8% respectively. In order of preference, this is followed by two boys and two girls children in S.C., one boy and three girls in O.B.C. and General community women with contraceptive prevalence rate of 82.2%, 72.3% and 67%. But when women go for five and above five parity, there is large number of children and as a result the preference for certain sex composition of children is gradually diminishing.

Table 5: Contraceptive use by sex composition and wealth wise in Haryana

	Poorest	Middle		Richest
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Sex composition of living children	Nos of women	Percentage using contraceptives	In the absence of sex preference (percentage)	Nos of women	Percentage using contraceptives	In the absence of sex preference (percentage)	nos. of women	percentage using contraceptives	In the absence of sex preference (percentage)
One Child									
One Boy	21	0% (0)	8.3	232	33.2% (77)	33.2	1272	56.8% (723)	56.8
One Girl	12	8.3% (1)	8.3	136	28.7% (39)	33.2	605	40.5% (245)	56.8
Two Children									
Two Boys	13	53.85 (7)	53.8	279	74.2% (207)	74.2	1181	81.3% (960)	81.3
One Boy & One Girl	9	11.1% (1)	53.8	350	58% (203)	74.2	2145	78.6% (1687)	81.3
Two girls	8	12.5% (1)	53.8	76	30.3% (23)	74.2	243	46.9% (114)	81.3
Three Children									
Three Boys	7	14.3% (1)	41.7	92	77.2% (71)	80.7	151	77.5% (117)	80.7
Two Boys & One Girl	25	40% (10)	41.7	347	80.7% (280)	80.7	763	80.7% (616)	80.7
One Boy & Two Girls	12	41.7% (5)	41.7	255	69.8% (178)	80.7	628	73.7% (463)	80.7
Three Girls	2	50% (1)	41.7	30	36.7% (11)	80.7	51	43.1% (22)	80.7
Four Children									
Four Boys	1	0% (0)	60	20	90 % (18)	90	13	76.9% (10)	77.2
Three Boys & One Girl	10	60% (6)	60	66	81.8% (54)	90	83	75.9% (63)	77.2
Two Boys & Two Girls	21	28.6% (6)	60	174	78.7% (137)	90	197	77.2% (152)	77.2
One Boy & Three Girls	6	33.3% (2)	60	111	70.3% (78)	90	142	74.6% (106)	77.2
Four Girls	2	0 "0	60	7	42.9% (3)	90	15	46.7% (7)	77.2
Five Children									

All Boys	0	0% (0)	21.4	3	100% (3)	100	1	100% (1)	100
Most Boys	4	0% (0)	21.4	12	33.3% (4)	100	13	76.9% (10)	100
More Boys	15	20% (3)	21.4	43	60.5% (26)	100	24	79.2% (19)	100
More Girls	14	21.4% (3)	21.4	61	67.2% (41)	100	51	76.5% (39)	100
Most Girls	3	0% (0)	21.4	43	65.1% (28)	100	18	72.2% (13)	100
All Girls	1	0% (0)	21.4	9	55.6% (5)	100	8	37.5% (3)	100
Total	186	38.37%	$I_P=$ 46.16%	2346	68.44%	$I_P=$ 78.30%	7604	73.13%	$I_P=$ 76.76%

The results of the Table 5 reveal preference for sons in all classes of society/ people whether they are Poorest, Middle or Richest person.

Overall it is seen from the Table 5 that sex preference has much effect on contraceptive use in poorest, middle and richest class since the contraceptive use rate would increase from 38.37% to 46.16%, 68.44% to 78.30% and 73.13% to 76.76% respectively. In the middle class or richest class, pattern is same as in all above table. In the first parity, it is seen that among women with one child, those with one boy i.e. 33.2% and 56.8% of them reported using modern method of contraceptives in middle and richest class women respectively as compared to 28.7% and 40.5% women with one girl in middle and richest class respectively whereas in poorest class those with one girl, 8.3% of women are using modern method of contraceptives. It is also seen that contraceptives use in poorest and middle class whether it is a boy or a girl is less, this means that women want to go for next child birth or next parity. In case of two children, the most preferred sex composition is two boys for the poorest, middle and the richest class women with contraceptive prevalence rate of 53.8%, 74.2% and 81.3% respectively. In order of preference, this is followed by one boy and one girl in middle and in richest class women with contraceptive prevalence rates of 58% and 78.6% respectively whereas in poorest class, two girls children are in second preference. For three children, most popular combination is two boys and one girl children for middle and the richest class women with contraceptive prevalence rate of 80.7% and 80.7% respectively whereas two girls children is most popular combination in poorest class women with contraceptive prevalence rates of 50%. In order of preference, this is followed by all three boys for middle and richest class women with contraceptive prevalence rates of 77.2% and 77.5% respectively and one boy and two girls for poorest class women with contraceptive prevalence rates of 41.7%. In case of four children, the most preferred sex composition is all four boys in middle, two boys and two girls in richest class and three boys along with one girl in poorest class women with contraceptive prevalence rates of 90%, 77.2% and 60% respectively. In order of preference, this is followed by three boys and one girl in middle class women and all four boys for richest class women with contraceptive prevalence rate of 81.8% and 76.9% respectively. But when women go for five and above five parity, there is large number of children and as a result the preference for certain sex composition of children is gradually diminishing.

Table 6: Effect of sex preference on contraceptive prevalence in Haryana

Socio-Economic/Residence background	Contraceptive prevalence Rate		Difference (Percentage)
	Actual (Percentage)	In the absence of sex preference (Percentage)	
Rural	69.27	75.5	6.23
Urban	69.7	74.44	4.74
Illiterate	70	75.8	5.8
Literate	70.02	74.74	4.72
Hindu	71.64	77.03	5.39
Muslim	34.66	41.86	7.2
Others	77.3	83.23	5.93
Scheduled caste (S.C.)	72.21	78.32	6.11
Scheduled tribe (S.T.)	55.86	69.17	13.31
Other backward caste (O.B.C.)	69.9	74.09	4.19
General	68.4	73.29	4.89
Poorest	38.37	46.16	7.79
Middle	68.44	78.3	9.86
Richest	73.13	76.76	3.63
Total	64.93	71.34	6.43

In the table 6, we have analysed the enhancement in the contraceptive prevalence rate of women belonging to different socio-economic and residence background under the assumption that if women are satisfied with their present sex composition of children. In this table, the first column represents the actual contraceptive prevalence while second column depicts the enhancement in the contraceptive use in the absence of sex preference. This table tells that in all socio-economic /residence background of the women there is gain in contraceptive prevalence rate of more than 4.19% except in richest class where gain is 3.63%. From the present analysis based on the index proposed by Arnold (1985), a strong son preference is found among women/couples in India's most affluent state Haryana.

4. CONCLUSION

For any traditional male dominated patriarchal society like Haryana, preference for son is expected particularly for family lineage. Another element that may intensify the preference for sons in the state of Haryana, is the persistence of the agrarian economy with its limited social security system. At the same time presence of evil social elements like dowry for marrying daughters is another factor for the preference of male child in the society. Considering all factors along with background characteristics, it is interesting to see that at which level of sex preference of children is prevailing in the traditional and one of the most affluent state of India i.e. Haryana. For this purpose, a simple but powerful index i.e. Arnold's index based on modern contraceptive status of eligible/ever married women by sex composition of children is adopted. The analysis tells/reveals that there is a strong son preference across residence and socio-economic background of the women/couples in Haryana. Son preference is stronger in every field of the society. Most of the people strongly prefer sons over daughters in Haryana.

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EFFECTS OF KAATSU TRAINING ON STRENGTH IN FOOTBALL PLAYERS: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Background: Football is a fast-paced, 90-minute game that requires participants to make a range of rapid motions, including kicking, tackling, jumping, turning, and sprinting. KAATSU is an exercise technique that is used in conjunction with low-intensity resistance training.

Objective: To assess the effect of KAATSU training on strength in Football players.

Methods: The databases were searched in Cochrane, PubMed, and Google Scholar databases up to June 2023. Keywords used “Hypertrophy” and “KAATSU” or “BFRT” and “Strength” and “Endurance” and “Football players”. Standardized mean differences (SMDs) with 95% CI were calculated to compare outcome measures.

Results: A total of ten studies were included in this meta-analysis, with very low to moderate risk of bias. The pooled results showed no significant difference between KAATSU and conventional resistance training for jump height (SMD 0.11 [95% CI -0.29 to -0.52; $I^2=61\%$], $P = 0.59$) and sprint 60m (SMD -0.48 [95% CI -0.91 to -0.04; $I^2=80\%$], $P = 0.03$). The results also showed significant difference between KAATSU and traditional resistance training for 1RM (SMD 1.14 [95% CI 0.64 to 1.65; $I^2=95\%$], $P < 0.00001$) in football players.

Conclusion: The literature appears to support that BFR can lead to improvements in strength, hypertrophy and sports performance in football players.

Keywords: Hypertrophy, KAATSU, BFRT, Strength, Endurance, Football players

1. INTRODUCTION

Football is a fast-paced, 90-minute game that requires participants to make a range of rapid motions, including kicking, tackling, jumping, turning, and sprinting (Bangsbo *et al.*, 2006). Therefore, in order to change direction, accelerate, and jump during a football game, skeletal muscular strength, power, and contraction speed are essential (Reilly *et al.*, 2000). These physical attributes include the capacity for both aerobic and anaerobic exercise, the ability to run as hard as possible repeatedly, as well as the capacity for muscular endurance, strength, and power (Stolen *et al.*, 2005). The level of development of such muscular endurance determines the qualified football players' capacity to sustain maximum motor efforts for the duration of the playing run, making strength endurance a crucial component of their physical conditioning regimen (Godik *et al.*, 2006 and Stolen *et al.*, 2005).

The development of muscular endurance in football players currently involves a range of resistance workouts carried out utilizing the repeated effort approach, with repeated instances of overcoming non-limiting resistance until significant tiredness, or the muscular failure method (Monakov *et al.*, 2007). Exercises are performed at 70% of one-repetition maximum (1RM) during high intensity resistance training, which may result in significant physiological changes (Liguori *et al.*, 2021). A high-intensity resistance training program has the drawback that, like sport training, it has the potential to be improperly managed, leading to muscular overuse or damage, and that some populations might not be able to participate due to risk concerns (Spada *et al.*, 2018).

On the other hand, low-intensity resistance training, a lower-risk training method, does not result in the same rate of muscle growth and strength gains as high-intensity resistance training without substantially increasing the

number of repetitions or contraction time (*Ikezoe et al., 2020*). Innovative techniques have started to be incorporated into sports practices recently in addition to more traditional ones for the development of physical skills. KAATSU Training is one of these techniques.

Dr. Yoshiaki Sato created and received a patent for the KAATSU Training system in Japan in the 1960s. In KAATSU training, the upper portion of the limb is encircled by a pneumatic cuff that is attached to an electric pressure regulation and control system, partially restricting blood flow to the implicated muscles (*Takarada et al., 2006*). This method is usually recognized as blood flow restriction training (BFRT) in Europe and is known as occlusion training or blood flow restriction (BFR). A group of athletes who performed workouts based on KAATSU Training showed increased local muscle endurance during knee extensions when compared to a control group who did the same training without the system (*Takarada et al., 2002*).

BFRT is a more recent exercise technique that has primarily been used in conjunction with low-intensity resistance training. It has been demonstrated in the past that it can produce similar muscle hypertrophy and strength improvements as high-intensity resistance training (*Abe et al., 2005*). Additionally, it has been noted that BFRT increases bone mineral density and reduces muscular atrophy during situations of immobility (*Beekley et al., 2005*). BFR inhibits venous return while lowering arterial blood flow to active muscles. This results in a somewhat ischemic state for working muscles, which increases metabolic stress without the requirement for heavy loads (*Burgomaster et al., 2005 and Loenneke et al., 2011*). The effects of BFRT on muscular hypertrophy and strength improvements in healthy male and female athletes when added as a supplemental portion of a high-intensity resistance training program have not been well explored, despite BFRT's vast research.

Coaches frequently look for innovative methods of training that can enhance performance in a variety of athletic employment opportunities without requiring significantly higher training demands because training for such a wide range of various attributes is time-consuming and taxing on players. Training with blood flow restriction (BFR) to the working muscles is one such approach that has attracted growing study interest in recent years.

The indicators of maximal oxygen consumption and maximum heart rate have shown a considerable improvement in correlation with the development of the muscular system when combined with aerobic activity and KAATSU Training. Additionally, it has been demonstrated that training with blood flow restriction improves parameters related to maximum oxygen uptake, which helps the body adapt to aerobic activities and muscular endurance development exercises (*Park et al., 2010*).

2. METHODOLOGY

This systematic review and meta-analysis were carried out in accordance with the the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (*David et al., 2006*) and Cochrane Handbook for Systematic Reviews were followed in this systematic review (*Higgins et al., 2022*) with a pre-defined registered protocol in “International Prospective Register of Systematic Reviews” (PROSPERO), (Identification no. CRD42023448269).

2.1 Eligibility criteria

The primary eligibility criteria were formulated based on the Population, Intervention, Comparison, Outcome, and Study design (PICOS) framework and were predefined as follows:

1. Population: Football players (15-21 years of age).
2. Intervention: performance of BFRT of the lower limb

3. Comparison: a comparator group performing low, medium, or high load exercise of the lower limb.
4. Outcomes: pre- and post-training measures of jump height, 1RM and sprint 60m
5. Study design: experimental and a pilot study designs written in the English language.

2.3 Search Strategy

The search was conducted from database inception to June 2023 using the following database PubMed, Cochrane, Pedro and Google scholar. The search strategy consisted of MeSH terms and keywords were KAATSU training, Strength, Hypertrophy, BFRT, Football players.

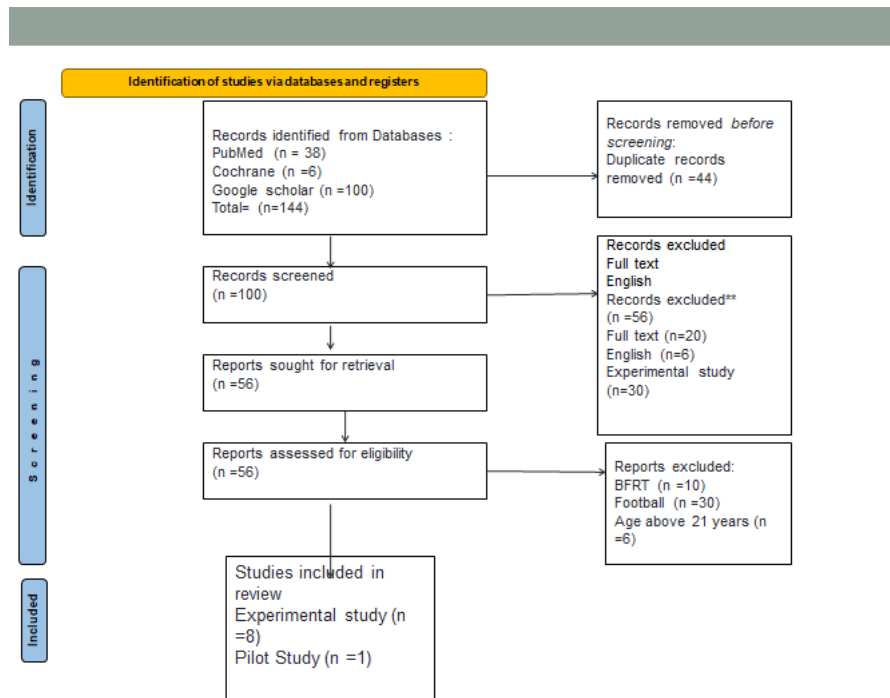


Figure 1: Prisma table for systematic reviews and meta-analyses flowchart of study selection process

Table 1. Major characteristics of included studies

Sr. No	Title	Author's Name	Type of study	No of participants	Intervention	Outcome measures	Results
1	Semi-squat exercises with varying levels of arterial occlusion pressure during blood flow restriction	Depeng S. et al.,2023	Experimental Study	12	Group A= non-BFRT, Group B= 50% arterial occlusion pressure (AOP), Group C= 60% AOP, or Group	Jump height, peak power output (PPO), vertical ground reaction forces (vGRF),	Low-intensity BFRT can increase lower limb muscle activation, induce PAPE, and improve

	training induce a post-activation performance enhancement and improve vertical height jump in female football players				D=70% AOP		vertical height jump in female footballers.
2	The Effects of combining BFR and plyometric exercise on quadriceps muscle strength, functional ability & balance capacity- A pilot study amongst amateur soccer players	<i>Krekoukias O G et al., 2023</i>	Pilot Study	10	Group A=Plyometric exercise Group B= Plyometric exercise with BFRT	Y Balance test, Horizontal countermovement jump, Vertical countermovement jump, Single leg triple hop test	Plyometric exercise with BFRT enhance strength, Balance and functional ability in young amateur soccer players
3	Effect of blood flow restriction training program on strength of lower limb in young football players	<i>Paul J et al., 2023</i>	Experimental Study	15	Group A= Hamstring curl exercise, Quadriceps curl exercise, Nordic exercise Group B= All exercises with BFR Cuff	speed and strength using 60m sprint test and 1RM	BFRT program improve the strength and speed of the young football players.
4	The effects of supplementar	<i>Scott R B et al., 2016</i>	Experimental Study	21	Group A=BFRT	Muscle architecture	No improvements were

	y low-load blood flow restriction training on morphological and performance-based adaptations in team sport athletes				Group B= Control	CMJ performance Sprint performance	observed for sprinting, acceleration, or jumping abilities after the training period in either group.
5	Performing soccer-specific training with blood flow restriction enhances physical capacities in youth soccer players	<i>Khakhak H A S et al., 2020</i>	Experimental Study	19	Group A=soccer-specific drills, small-sided games, plyometrics, and continuous running with BFRT Group B= soccer-specific drills, small-sided games, plyometric, and continuous running without BFRT	leg extension strength and endurance, countermovement jump performance, 40-yd sprint time, change-of-direction (COD) ability, aerobic endurance, and soccer-specific endurance	BFR enhance lower-body muscular endurance and improve performance in tests of COD ability, and aerobic and soccer-specific fitness.
6	Influence of the KAATSU Training on the strength endurance of the muscles of the lower extremities in qualified football players	<i>Alexander G et al., 2020</i>	Experimental Study	18	Group A= barbell squats, seated leg extensions, and lying leg curls using KAATSU Training Group B= barbell squats,	Strength, Endurance, Acute Pain and DOMS	Significant changes in strength endurance occurred within seven days after the termination of KAATSU Training,

					seated leg extensions, and lying leg curls without KAATSU training		
7	The effects of supplementary low-load blood flow restriction training on morphological and performance-based adaptations in team sport athletes	<i>Requena B et al., 2016</i>	Experimental Study	22	Group A=low-load squats with BFR (LLBFR) Group B= low-load squats without (LL) BFR	3-repetition maximum (3RM) and muscular endurance in the back squat, vastus lateralis muscle architecture, and performance in sprint and vertical jump tasks	Low-load BFR training has been repeatedly demonstrated to enhance muscular development even in well-trained athletes
8	The effects of a 7-week practical blood flow restriction program on well-trained collegiate athlete	<i>Lubberes E P et al., 2014</i>	Experimental Study	62	Group A= Traditional High-Intensity Training Program(H) Group B= Modified Training Program(M) Group C= Supplemental 20% 1 Repetition Maximum Lifting Protocol(S) Group D=H+M+S with BFR	Body Mass and Girths, 1 Repetition Maximum Tests	BFR program in conjunction with a traditional high-intensity off-season training program was effective in increasing 1RM squat performance in well-trained collegiate athletes.
9	Occlusion training increases muscular	<i>Yamanaka T et al., 2012</i>	Experimental Study	32	Group A=Bench press and squat with	Resting blood pressure, bench press and squat 1RM, upper and	Occlusion training provide additional

	strength in division ia football players				BFRT , Group B= Bench press and squat without occlusion	lower arm girths, thigh girth, height, and body mass.	benefits to traditional strength training to improve muscular hypertrophy and muscular strength in collegiate athletes.
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	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Alexander G et al., 2020	-	-	-	-	?	+	+
Depeng S et al., 2023	-	+	-	?	-	+	+
Khakhak H A S et al., 2020	-	-	-	+	+	-	+
Krekoukias O G et al., 2023	-	-	-	-	+	+	?
Lubberes E P et al., 2014	-	-	-	+	+	+	?
Paul J et al., 2023	?	-	-	-	+	+	?
Requena B et al., 2011	-	-	-	-	+	+	+
Scott R B et al., 2016	-	-	-	-	+	?	+
Yamanaka T et al., 2012	?	-	-	-	+	+	+

Figure 2: Risk of bias summary. Studies in green or + are at low risk of bias and in – are at high risk of bias. Studies in blank are at unclear risk of bias.

2.4 Data extraction

Authors extracted the data, using MeSH terms and keywords. Collected information was cross-checked for any discrepancy. To evaluate treatment efficacy, mean change in 1 RM, Jump height and sprint 60m were included in meta-analysis. Information extracted from included studies was first author, number of participants, interventions, outcome measures and finding. Biasing of publication was examined by visual scrutiny of funnel plot for outcomes. Forest plots were made using “Review manager (Software, version 5.3).”

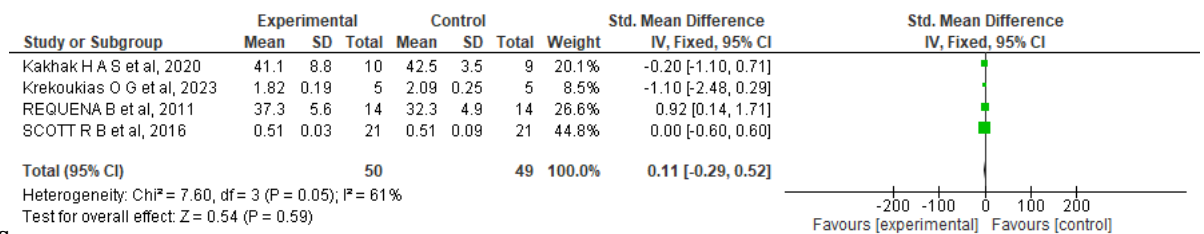
Study selection

A total of 144 researches were collected from database searches, of which 10 fulfilled the selection criteria. Three researches were excluded from the meta-analysis as required data could not be retrieved. The remaining 4 out of 7 studies comprising 104 participants in study group and 97 subjects in control/placebo group were included in meta analyses of jump height. Three out of seven studies comprising 96 subjects in the study group and 85 subjects in the control/ placebo group were included in meta-analysis of 1RM. Three out of seven studies comprising 70 subjects in the study group and 62 subjects in the control/placebo group were included for meta-analysis of Sprint 60m.

2. RESULT

3.1 Risk of Bias Assessment

The Cochrane tool was used to conduct the risk of bias assessment, which is shown in fig. (2) (Higgins et al., 2022). Overall quality of the included studies was low, one or two studies were considered moderate risk of bias and the remainder were considered at high risk



3.1 Meta-analysis

Figure 3: Forest plot showing effect of KAATSU training on jump height in football players

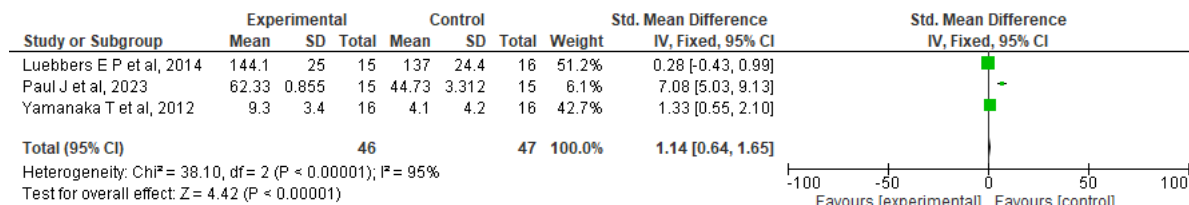


Figure 4: Forest

plot showing effect of KAATSU training on 1RM in football players

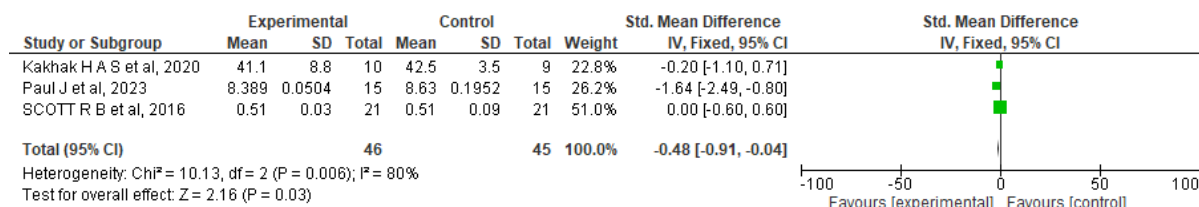


Figure 5: Forest

plot showing effect of KAATSU training on sprint 60m in football players

In primary outcome analysis of the studies, four studies were considered for meta-analysis of Jump height while three studies were considered in meta-analysis of 1RM. KAATSU training interventions pooled results showed non-significant difference (SMD 0.11 [95% CI -0.29 to -0.52; I²=61%], P = 0.59). Similarly, experimental group significantly increased strength than control group (SMD 1.14 [95% CI 0.64 to 1.65; I²=95%], P < 0.00001) with moderate heterogeneity. There was a non-significant pre-post strength increased in experimental group as measured by Sprint 60m (SMD -0.48 [95% CI -0.91 to -0.04; I²=80%], P = 0.03). Baseline characteristics of included studies in meta-analysis were compared.

3.2 Discussion

The purpose of this study was to investigate the effect of KAATSU training on strength in football players. To evaluate treatment efficacy, mean change in 1 RM, Jump height and sprint 60m were included in meta-analysis. Information extracted from included studies was first author, number of participants, interventions, outcome measures and finding. So, this study shows that jump height and sprint 60m has non-significant difference between KAATSU training and strength but 1 RM has significant difference between KAATSU and strength.

Through BFRT, low-intensity resistance training can be used to build muscle and improve strength. When compared to an HIRT regimen, a low-intensity resistance training program combined with BFR can produce comparable gains in muscle growth and strength (Yasuda *et al.*, 2012 and Beekley *et al.*, 2005). This study observed non-significant differences between the control group (HIRT) and BFRT group. Even though we did see increases in 1RM, prior research has shown that muscle cross-sectional area and strength can increase even after 2-4 weeks. However, neuromuscular changes may be more important in explaining the changes in strength, and edema may affect such early increases in measures of muscle size (Hughes *et al.*, 2018).

According to Moore *et al.* (2004), it is also possible that adding blood flow restriction to low intensity resistance training produces enough stimuli to cause metabolic stress, attracting Type II muscle fibers and starting the myogenic cascade, which leads to gains in strength and muscular hypertrophy. When using BFR to increase bench press strength, Luebbbers *et al.*, 2014 found no effect. They hypothesized that the high-load training done prior to supplemental bench press likely already provided the maximum stimulus for increased strength, negating the additive stimulus from the BFR.

The current study's findings might be explained by the individuals' high overall training demands. In team sports, jumping and sprinting are known to be susceptible to neuromuscular and sport-specific fatigue (Twist *et al.*, 2013).

Limitations

It is important to recognize this study's limitations. The generalizability of our findings is constrained by the small number of pertinent research and the absence of defined protocols, methodologies, and measurement techniques, both of which prevented extended quantitative synthesis.

Future scope

Both in earlier research and in the present study, blood flow restriction training led to gains in muscle growth and strength when combined with a low intensity resistance training program. However, this training method has not been widely adopted into clinical practice due to health professionals' inadequate understanding of how to use it correctly. Additionally, there are inconsistent data about the effects of BFRT versus HIRT on muscle power output. Future studies may want to evaluate the effects of this training modality on power output and the rate of force growth as well as muscular strength and hypertrophy after prolonged periods of BFRT.

4. CONCLUSION

The literature appears to support that KAATSU training can lead to improvements in strength, hypertrophy and sports performance in football players. KAATSU training with low intensity resistance training shows similar

muscular response to high intensity resistance training. Therefore, it is possible to indicate that KAATSU training with other high intensity or spots specific trainings should be recommended.

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LITHIUM MINING INDUSTRY AND IT'S SOCIO- ENVIRONMENTAL IMPACT

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Lithium-ion technology is vital for its advancement and wider applications across various industries, notably in energy density, charging speed, and lifespan improvements. Lithium is also determined as “White gold”. The increasing demand for battery systems is driven by the growing role of electricity as an energy carrier in decarbonization efforts. Electric vehicles and stationary systems of energy storage are major contributors to this increasing demand. India has recently discovered 5.9 million tonnes of lithium. Not only governmental activities are boosting the distribution of electric vehicles, but the private players are also adopting electric vehicles which is a significant part of the sustainability transition’s goal; thus, the knowledge about environmental and social effects of increased lithium demand is essential. However, numerous industries and societal groups have expressed interest in the extraction and mining of lithium. The "Lithium Triangle" in the Andes of Chile is affected by the changes in climate. which disturbs the availability of primary productivity, surface water, and the prosperity of economically also threatening the significant species of flamingo. Flamingo abundance could be soon dramatically impacted by continuous raises in lithium mining and decrease in surface water across their habitat. While the need for lithium is growing exponentially with the expansion of clean mobility trends, there are both positive economic opportunities and negative social, environmental, and health effects associated with lithium mining.

Keywords: Lithium triangle, White gold, Sustainability transitions, Environmental impacts, Decarbonizing.

1. Introduction

In the age of technology, the world is moving towards using more sustainable energy for transportation. This means finding better ways to produce and use energy that won't harm the environment. But we need to be careful about any negative impacts it might have on the environment (Agusdinata et al., 2018). One important part of this energy change is using lithium-ion batteries. These batteries are good at storing lots of energy in a tiny space (Jaskula, 2017). As the demand for lithium batteries grows, so does the need for lithium production. In 2016, global lithium production increased by 12%, and it's expected to keep growing quickly (Eller and Gauntlett, 2017). The need for lithium-ion batteries has increased a lot from 2015 to 2020. By 2030, it is expected to rise by more than 500% and reach 2.2 million tons. To meet the rising demand around the world, China, for instance, produced 1.34 billion lithium-ion batteries by the end of August 2019. Around 1.3 million metric tonnes of lithium carbonate equivalent (LCE) are anticipated to be needed to meet the world's lithium demand by 2025 (Kaunda, 2020).

2. Literature Review

Lithium element has atomic number 3 and is symbolized by Li. Lithium is a silvery white and soft alkali metal. Lithium is preferred because it is lightweight and can store a lot of energy. The rising demand for lithium is an outcome of highly efficient batteries in gadgets and electric cars. The expected demand for lithium-ion batteries is to reach 2.2 million tonnes by 2030. As a result, there is significant interest in mining and exploiting lithium from various industries and societies. Which affect the environment drastically (Kaunda, 2020). Even with recycling, the production data revealed that demand will outpace the world's lithium supplies before 2025. As lithium becomes scarcer, its price will rise, leading to mining in environmentally sensitive areas like Bolivia, which is rich in lithium. Lithium extraction can cause water pollution and harm native biodiversity, impacting human health due to cyanobacteria. The environmental, biodiversity, and health impacts of lithium extraction from ponds and mining should be considered when talking about how to recycle and safeguard resources. While sensible lithium recycling strategies are effective now, there is a need for alternative technologies soon to ensure resource and environmental protection (Wanger, 2011). Including a decline in vegetation, in national reserve regions, there have been more severe drought conditions, higher daytime temperatures, and less soil moisture. In the Salt Flat of Atacama, world's most prominent site for extraction, focus on the consequences of lithium mining on the ecosystem. Using satellite imagery, the constant growth of lithium mining negatively correlates with vegetation and soil moisture while positively correlates with higher daytime temperatures. This indicates that lithium mining is a major factor contributing to environmental degradation in the region (Liu, 2019).

3. Lithium: Mineral Resources Distribution

Lithium (Li) is also mentioned as "white gold" due to its extreme global demand for replenishable lithium-ion batteries used in the manufacturing of electric vehicles. According to the U.S. Geological Survey, worldwide, the lithium resources are nearly 98 million metric tonnes, out of which considered reserves are 26 million tonnes (ready for use).

a. **Lithium reserves in the world:** According to a US Geological Survey report published in January 2023, Chile has the largest lithium deposit in the world, with approximately 9.3 million tonnes. Australia came at second with 6.2 million tonnes. The third and fourth place was taken by Argentina and China, with 2.7 million tonnes and 2.0 million tonnes respectively. Most of the world's lithium output was produced by Australia's six mineral operations, Brazil's one mineral tailings project, Argentina and Chile's has two brine operations each and three mineral and two brine operation in China. The global lithium reserve is huge and may be sufficient to satisfy all the demands of the International Energy Agency (IEA) sustainable development. The production of lithium was further increased by smaller enterprises in Portugal, Zimbabwe, Brazil, Canada, the United States, and China. In 2022, established lithium enterprises around the world increased or were in the midst of boosting production capacity due to the swift rise in demand and prices for lithium (USGC, 2023).

3.1.2 Resources worldwide:

The total lithium resources are huge and may be sufficient to satisfy all the demands of the IEA's (International Energy Agency) sustainable development. (Graham et al., 2021). Exploration activity has led to a massive increase in the number of recognized lithium deposits, which today total about 98 million tons. The United States is home to 12 million tonnes of lithium resources, which are found in pegmatites, hectorite, oilfield brines, geothermal brines, and claystone. There are now 86 million tonnes of lithium deposits thought to exist in other countries. The recognized lithium resources are dispersed as follows: There are 21 million tonnes in Bolivia, 20 million tonnes in Argentina, 11 million tonnes in Chile, 7.9 million tonnes in Australia, 6.8 million tonnes in China, 3.2 million tonnes in Germany, 2.9 million tonnes in Canada, 1.7 million tonnes in Mexico, 1.3 million

tonnes in Czechia, 1.2 million tonnes in Serbia, and 1 million tonnes in Russia. There are 880,000 tonnes in Peru, 840,000 tonnes in Mali, 730,000 in Brazil, 690,000 tonnes in Zimbabwe, 320,000 tonnes in Spain, and 270,000 tonnes in Portugal (USGC, 2023).

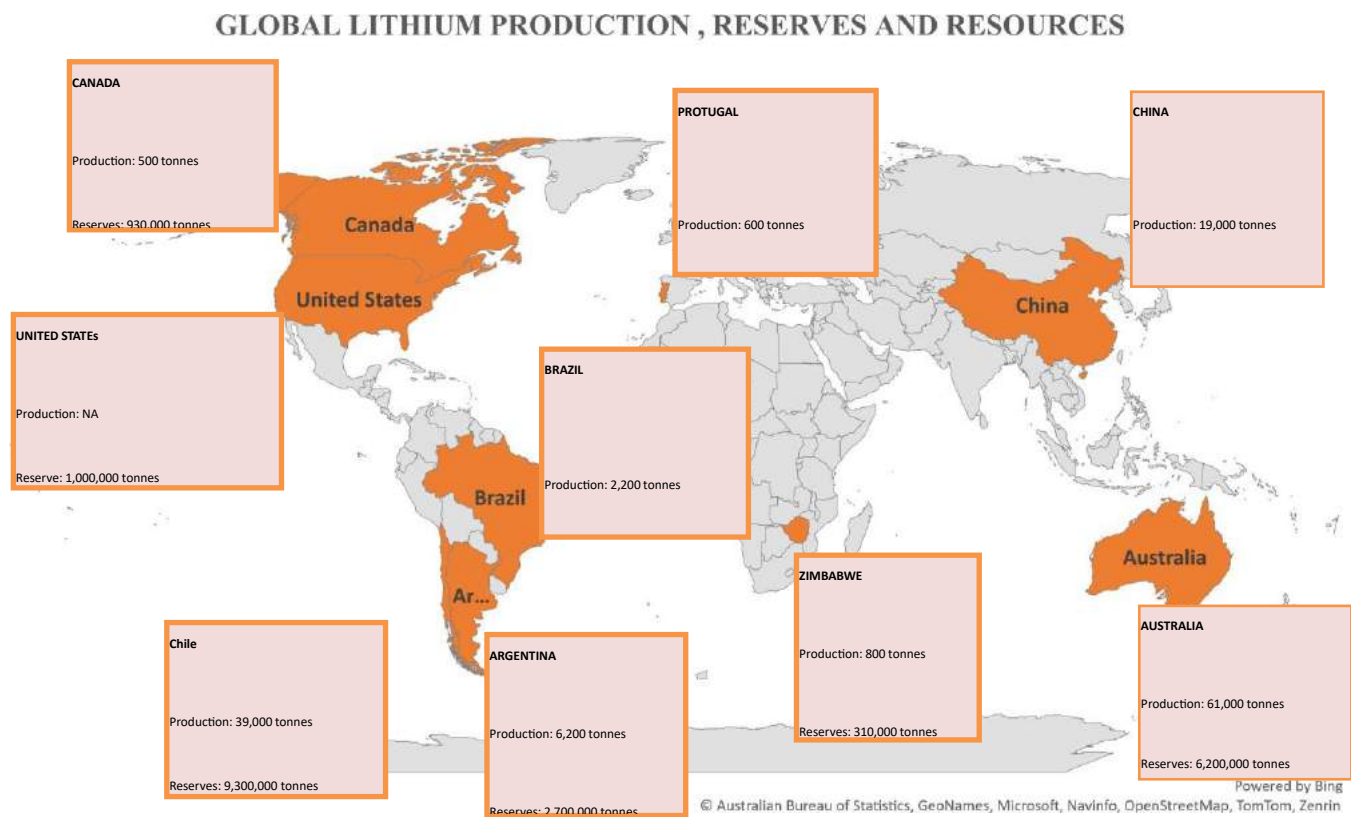


Figure 1: Global lithium production, reserves, and resources. Source: U.S. Geological Survey, Mineral Commodity Summaries, January 2023.

3.2 Lithium reserve in India: The Geological Survey of India released a significant statement that 5.9 million tonnes of lithium, has been discovered in Jammu and Kashmir. Precious metal is used in the batteries of electric cars and other clean energy devices. India would rank among the top nations with considerable lithium deposits if the findings were validated. The adoption of electric vehicles in India attempts to save the environment, and achieving energy independence could all be significantly impacted by this discovery (Ellison, 2023).

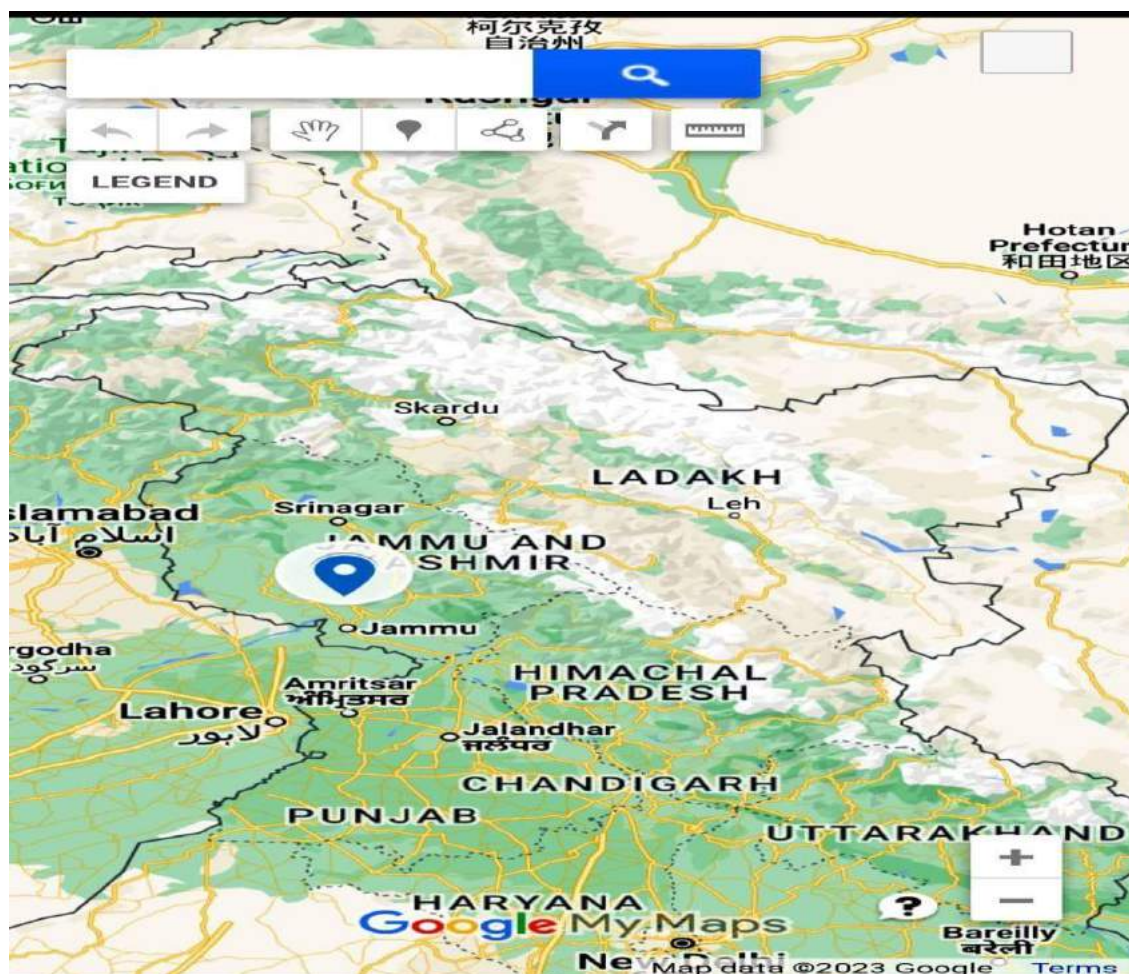


Figure 2: India's Lithium Resources in Kashmir (Salal). Sources: Armed Conflict Location and Event Data Project(ACLED), Government of India, ESRI India, UNESCO, CIA World Factbook.

4. Sources of lithium in the environment

Lithium is found throughout the earth in different amounts. In the above part of the Earth's crust, there are about 24 parts per million (ppm) of lithium. In the middle part of the crust, it's about 12 ppm, and in the lower part, it's about 13 ppm. The mantle, which is deeper inside the Earth, contains about 1.5 ppm of lithium (Jagoutz, 1979; Rudnick, 2014; Gao, 2014; Liu, 2018). Lithium concentration in seawater is about 0.18 milligrams per litre (Riley and Tongudai, 1964). In primary rocks, lithium is mainly found in silicate minerals, especially those rich in magnesium (Misra and Froelich, 2012). The three primary categories of lithium resources are surface and near-surface brine, hard-rock deposits, and unconventional resources such as deep geothermal brines or seawater. Natural processes within the Earth's crust result in the formation of hard-rock deposits, which can include rocks produced by volcanic eruptions or sedimentation. (Kesler et al., 2012). These deposits contain various lithium-carrying minerals such as lepidolite, jadarite, spodumene, hectorite, and petalite. Extracting lithium from these minerals requires different methods. Surface brines are found in dry or semi-dry regions where there are salt pans and temporary salt lakes.

These areas are often located in geologically active basins, and they are known as "salars," particularly found in South America (Sanjuan et al., 2022). In certain areas called "salars," lithium concentrations are up to 6400 milligrams per litre (Lopez Steinmetz, 2018). Other prominent areas with surface brines rich in lithium exist, including the Tibetan Plateau in China and the basin of Qaidam (Li, 2018).

5. Uses of Lithium

Lithium compounds are extensively used in various industries. Over 60% of the domestic consumption of lithium is for ceramics, glass, and primary aluminium production. Other significant uses include rechargeable batteries for electric vehicles, computers, digital cameras, and making lubricants, greases, and synthetic rubber.

a. **Metallurgy:** Lithium can combine with many metals to form alloys. In Germany, they made an alloy called *Bahnmetall* (containing 0.04% lithium) for railroad cars. In the United States, an alloy called X-2020 (consisting of 4.5% copper, 1.1% lithium, 0.5% manganese, 0.2% cadmium, and the rest aluminum) was introduced in 1957 for structural components in naval aircraft. During World War II, lithium-magnesium alloys were created and have since been used in aerospace applications.

b. **Electrochemical Applications:** Numerous consumer, medicinal, industrial, and military applications all make use of lithium batteries. They have several benefits, including low self-discharge rates, high energy density, rapid voltage responsiveness, and being lightweight. Electronic devices, including watches, cameras, calculators, and CMOS-RAM memory backups, are all powered by lithium batteries in consumer goods. Lithium batteries are also used in medical devices like cardiac pacemakers etc. In industry, remote sensing devices, like oil-well logging tools, Moreover, lithium batteries have several military uses, including powering communications equipment and giving missile systems standby power (Kamienski, 2000).

6. Impacts of Lithium

Lithium elements occur naturally; however, it is not necessary for life. The rising demand for lithium in several sectors is negatively affecting plants, animals, human beings, and the environment, but the lithium reserves will have a positive impact on the economy. It will lower the country's import bill and trade deficit.

a. Plants

Lithium affects the growth of plants which depends on the amount of lithium in the medium of growth. Lithium negatively affects plant growth by interfering with various physiological processes and changing the metabolism of the plant. The lithium pollution is becoming a major problem in soil, which could pose a risk to the production of crops in the near future. Lithium negatively affects plant growth by interfering with various physiological processes and changing the metabolism of the plant (Shahzad, 2016).

6.1.1 Effects on development and growth: Lithium-rich soil, damage to the root tips, and the appearance of yellow and brown patches on leaves have been recorded in corn plants. These brown patches are typical of situations where the plant and pathogen are incompatible (not a good match), and it appears that the presence of lithium in the plants triggers this response through a chemical called ethylene. Researchers have also found that when oats were exposed to 25 mg of lithium per kilogram of soil, there was a significant decrease in their yield. Similarly, spinach and maize exposed to 40 mg of lithium per kilogram of soil also showed reduced yields (Kabata and Mukherjee, 2007).

6.1.2 Effects on carbon assimilation and photosynthetic pigments: Maize plants, when exposed to a high amount of 50 mg of lithium per decimeter cubed of soil, it led to a reduction of about 45% in chlorophyll a and b contents and a 67% reduction in carotenoid contents. Additionally, it caused the occurrence of brown patches on the leaves, indicating damage (Hawrylak and Nowak et al., 2012).

b. Animals

The major effects of lithium on animal motor behavior are most consistently seen in three areas: rhythmic activity regulated by endogenous biological clocks, hyperactivity and stereotypy brought on by medicines that modify monoaminergic neurotransmission, and exploratory behavior. The motor activities in animals are found in hyperactivity, stereotypy, and exploratory activity, stimulated by drugs that change monoaminergic neurotransmission, as well as rhythmic activities carried out by endogenous biological clocks (Smith, 1980).

i. Domestic animals

The impact of lithium on domestic animals through the food chain, lithium can build up in animals, and large quantities can be extremely harmful (Tanveer, 2019). For example, an amount of 500–700 mg kg⁻¹ in hybrid beef cattle (*Bos taurus*) resulted in severe depression and ataxia along with residual Li in the tissues of the heart (79.15 mg L⁻¹), kidneys (66.97 mg L⁻¹), muscles (86.64 mg L⁻¹), and brain (51.7 mg L⁻¹) (Johnson, 1980). The antiviral activities of LiCl against enterovirus A71, pseudorabies herpesvirus, infectious bronchitis virus, and transmissible gastroenteritis virus were also found at the same time (Harrison, 2007). LiCl LC50 values for rats varied from 526 to 840 mg kg⁻¹. Continuous exposure to high Li concentrations has been associated with numerous adverse effects, including oxidative stress on the liver, weight polydipsia, damage to the reproductive system of males, and a noteworthy decline in the testosterone level (Nciri, 2009).

ii. Aquatic animals

Lithium naturally occurs in surface waters at a concentration of 0.04 mg L⁻¹ (Sposito, 2016). Mineral water normally contains 0.05–1.0 mg Li per liter, while it can infrequently reach 100 mg L⁻¹ (Schrauzer, 2002). Li affects aquatic life negatively at higher concentrations but not negatively at lower ones (Hou et al., 2014). For instance, treatment of zebrafish to 5–10 mg L⁻¹. Adenosine diphosphate was reduced by LiCl, although ecto-5-nucleotidase and acetylcholinesterase activities were only reduced at 10 mg L⁻¹ LiCl (Oliveira et al., 2011). LiCl was found to have negative effects on zebrafish at higher concentrations (235.9 mM), including delayed growth, skeletal abnormalities, curvature of the dorsal, diminished swimming, reduced heart rate, and declined velocity (Pruvot, 2012). Domoic acid is emitted in significant amounts by aquatic species, which interferes with the development of the embryo and causes microcephaly. It is also caused by lithium poisoning.

c. Human beings

Lithium is a mood-stabilizing medication used to treat certain mental illnesses, for example, bipolar disorder. Lithium carbonate is the active component in lithium medicine. Short-term side effects can include muscular weakness, nausea, diarrhea, or a dazed feeling.

Low levels of lithium (Li) have been linked to increased rates of chronic pain, anxiety, sensitivity to stress, depression, and insomnia, as well as a reduction in memory function, learning ability, and the body's ability to heal itself (Naeem et al., 2021). Manic-depressive disorders are treated with lithium salts such as Li₂CO₃ and LiCH₃COO. However, off-label therapeutic use of Li₂CO₃ can be hazardous to the human neurological, gastrointestinal, cardiovascular, muscular, and urinary systems and even fatal (Watson et al., 2004). Nephrogenic

diabetic insipidus, which manifests as dehydration, polydipsia, polyuria, and deficiency in urine concentration, can be brought on by temporary exposure to Li (months to years). End-stage renal disease may be six to eight times more likely to develop in patients receiving long-term treatment with greater doses of Li (Aiff et al., 2015). Moreover, drugs that lower the glomerular filtration rate may also have a long-term harmful effect (Maddu and Raghavendra, 2015). Additionally, the WHO and various health regulatory authorities should establish daily intake guidelines along with common safe and dangerous limits of Lithium. Short-term side effects can include muscular weakness, nausea, diarrhea, or a dazed feeling. Finally, it's important to keep an eye on the amount of Li in food, particularly in regions where mining for metal is a major industry (Shakoor et al., 2023).

d. Environment

The impact of lithium mining on the environment is one of the major concerns. The activities for extraction of lithium require lots of energy and water, and it can also pollute the water and air with heavy metals and chemicals, which disrupt the habitats of wildlife and cause erosion of soil, further leading to continuing ecological damage.

The demand for lithium-based goods and electric batteries is increasing worldwide which has raised concern about the environmental effect of mining industries of lithium which include both processing and extraction of lithium. The environmental worries are notably related to soil, water, and air pollution, along with the loss of water resources, which are essential to local people in these lithium mining localities (Kaunda, 2020).

The impact of lithium on the environment primarily arises from its extraction, production, use, and disposal processes. During the process of extracting lithium from the Atacama Salt Flat (ASF), Chile evaporates roughly 95% of its saline water, and the remaining 5% is used to draw freshwater from the region's adjacent mountains on its eastern border (Marazuela, 2019). Hydrodynamics show that saline water still has an impact on the nearby water system, even though it is not appropriate for human or agricultural use. In a place where the climate is already dry, this water-intensive mining method can have negative effects on ecosystems, aquifers, and water balance. This has caused residents, environmentalists, and government officials to express alarm (Babidge and Bolados, 2018).

However, this expanded mining can bring changes to the landscape and microclimate of the area, leading to conflicts between mining companies and the local communities living there. (Ellison, 2023).

e. Social

Social consequences of lithium mining can be observed along with its environmental impact. In most cases, mining can relocate the native population or negatively impact their health. Most of the global lithium deposits are present in developing nations, where environmental regulations and labor standards are repeatedly degraded.

There are several problems and conflicts that may have a significant impact on how lithium mining in the area develops in the future. From the perspective of society, supply security, decarbonization, and environmental effects are the main issues. The difficulties are:

- The view of environmental harm from lithium extraction by society may result in opposition to the expansion of the mine, delays, and a halt to mining operations.

- The public's perception that mining for lithium damages the environment could result in opposition to mine construction, delays, and a halt to mining operations.
- The inability of local communities to comprehend mining regulations and associated disclosure documentation due to a lack of technical knowledge may affect their social licence to operate.
- Lithium mining initiatives fall short of the expectations of the local community in terms of growth and employment creation, which may cause social unrest.
- Social tensions and a negative view of mining are caused by an inadequate distribution of mining remittances to the local community (Petavratzi et al., 2022).

f. Economy

Rapidly boosting the market for electric vehicles and other green technologies. The raw material can be provided through lithium mining for producing lithium-ion batteries, which can be used in electric cars as well as other appliances. It would boost economic growth, create jobs, and encourage innovation. Lithium (16%), as lithium carbonate equivalent (LCE), graphite (10%), cobalt (39%), copper (12%), nickel (9%), aluminum (5%), and manganese (2%), the seven primary components, account for >90% of the commercial value of a consumed lithium-ion battery, according to a recent patent. The necessity for Li-ion batteries now outweighs the allocation due to the significant economic (and environmental) benefits of EVs, notwithstanding the fast-increasing output from new, massive plants in China. This is particularly true for countries and regions like Europe, where only a tiny amount of Lithium-ion battery manufacturing occurs (Pagliaro and Meneguzzo 2019). According to recent Chinese legislation, it is now the duty of EV producers to recover batteries. These requirements require them to build recycling roads and service facilities where used batteries can be assembled, stored and relocated to recycling firms. 393 manufacturers, 44 discarded car disassembling companies, 37 cascade utilisation companies, and 42 recycling companies had all signed up for the new tracking platform by the end of February 2019 (Hongyu, 2019). Other companies operate Lithium-Ion Batteries (LIB) recycling facilities all over the world, including Australia (Envirostream Australia), Belgium (Umicore), Great Britain (Belmont Trading), the United States and Canada (Retriev Technologies), Singapore (TES-AMM), and South Korea (SungEel).

Lithium is consumed in different sectors such as batteries, ceramics and glass, thermoplastics, lubricating greases, air treatment, rubber, etc., but the share of battery production could significantly double in 10 years (2010–2020). Aluminum, lubricating greases, glass, and ceramics were the first things to be made with lithium. Due to its extensive use in lithium-ion batteries for electrified vehicles (EVs) or electronic devices, this chemical element is currently attracting attention. From 23% in 2010 to 65% in 2019, battery use as a percentage of total lithium consumption has climbed dramatically.

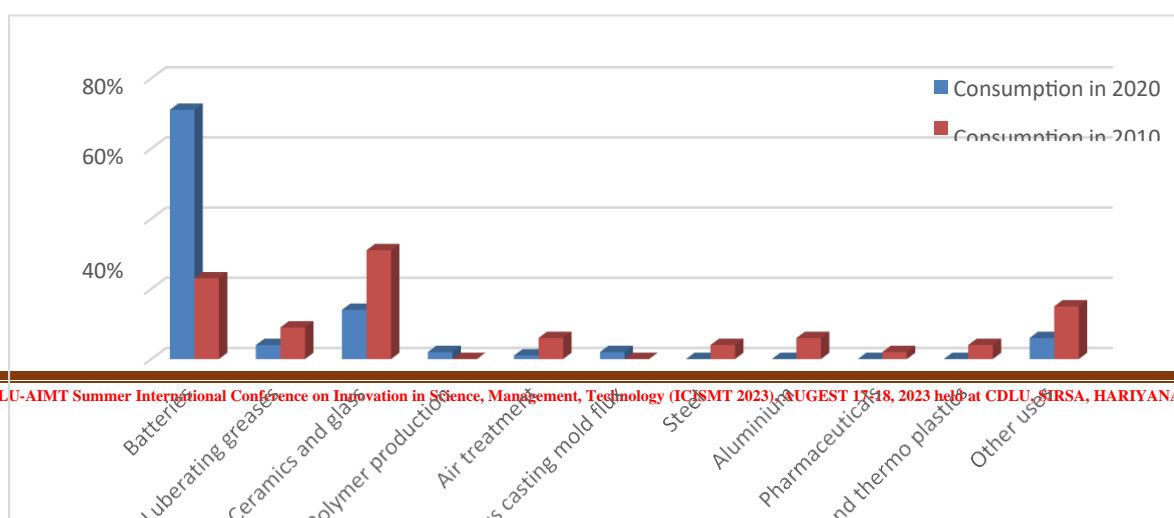


Figure 3. Different sectors in lithium consumption in 2020 and 2010. Source: USGS, 2010, 2021

7. Conclusion

People's desire to minimize their carbon footprint and contribute to the fight against climate change has resulted in a significant increase in the demand for better electric batteries recently. Due to their widespread use in electric vehicles, laptops, energy storage systems, cell phones, and other devices, lithium-ion batteries are a suitable solution for this. There is a problem, though. Even though we know a little bit about how completed lithium batteries harm the environment, mining lithium directly impacts the ecosystem. Lithium mining may pose problems such as depleting and contaminating water supplies, endangering plants and animals with hazardous chemicals, producing and discarding waste, and even cause the land degradation. All these things have an impact on native flora and animals, as well as human health, the environment, and water supplies. Steps like waste minimization, recycling, and water treatment, more effective processing of lithium brines, and the adoption of unconventional technologies can all help to lessen the adverse effects of lithium processing and extraction on the environment.

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MAJOR PROBLEMS FACED BY FARMERS IN MARKETING OF TOMATO IN HARYANA

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Tomatoes are one of the most widely grown vegetables in Haryana and are an important commercial crop for farmers in state. The demand for tomatoes has increased significantly due to growing popularity for processed and ready to eat food. Perishability of tomatoes demands great attention of farmers in marketing of tomatoes to ensure availability of tomatoes in optimum conditions to ultimate consumers. By considering these facts, the study was conducted with the objective to study problems faced by farmers in marketing of tomato in Haryana. The analysis of data was done with the Garrett ranking technique. The results concluded that the major problems faced by farmers at marketing level were unstable prices during peak harvesting period, high transportation cost due to distant markets, lack of refrigerated vehicles, high spoilage and losses during transportation, presence of large number of intermediaries and non-availability of Minimum Support Price. It was suggested to build processing units in major tomato producing belts and also to develop small centers facilitated with facilities of grading, sorting, packaging and storage at village or block level. Government and private sector should take consideration to provide transportation facilities facilitated with refrigeration facilities to avoid spoilage and losses during long distance travel of tomatoes.

KEYWORDS- Tomato, Marketing, Problems, Farmers, Vegetables

1. INTRODUCTION

Tomato (*Lycopersicon esculentum*) is a ubiquitous vegetable, and because of its significant nutritional content, it is also one of the most important "protective foods." Tomatoes are in high demand all year since they are utilized in almost all Indian recipes. Because of the perishability, seasonality, and bulkiness of vegetables and fruits, marketing them can be difficult. Marketing of extremely perishable items poses difficulties due to customers' diverse consumption patterns and inadequate supply chain infrastructure. The presence of a large number of stakeholders, insufficient cold chain capacity, high packaging costs, high transportation costs and a lack of temperature-controlled transportation facilities, high post-harvest losses, poor marketing efficiency, and a low producer's share in consumer's price, as well as high price bearing by consumers, are the major obstacles in existing supply chains of fresh vegetables in India (Negi and Anand, 2015). Growers often sell vegetables to middlemen, who gather produce from numerous small farmers and sell it to commission agents or dealers. fee agents are middlemen that locate buyers for the local middleman and receive a fee on the transactions they make. They usually discover the bigger players or dealers that buy a lot of veggies. The dealers then gather all little quantities, aggregate them into huge types, and sell them to the wholesaler. Keeping the aforementioned factors in mind, the study was carried out to investigate significant marketing challenges experienced by farmers in marketing and to solicit solutions from farmers to address these problems and improve efficiency.

2. METHODOLOGY

The present study was carried out in Kurukshetra, Karnal and Yamuna Nagar districts of Haryana as these districts have great share under area and production of tomato in state and a total of 70 farmers from each district were interviewed to collect the data. Thus, in total 210 tomato growers were interviewed to collect the required information. The data were collected to study major problems faced by farmers in marketing of tomato, during 2021-22. Besides simple averages and percentages, Garrett's ranking technique and 5-point Likert scale were used to realize the objectives of the study. Major problems were also divided in 4 categories i.e., extremely serious, very serious, serious and not so serious based on the overall mean score criteria that problems with mean score of above 75 are extremely serious, very serious (50-75 mean score), serious (25-50 mean score) and not so serious (below 25).

3. RESULT AND DISCUSSION

Major problems faced by the farmers in marketing of tomato are presented in Table 1. The perusal of data presented in Table 1 revealed that unstable prices during harvesting period was identified as the most prominent problem faced by farmers with mean score of 82.90 and ranked first and extremely serious problem on severity scale followed by high transportation cost due to distant markets and ranked second with mean score of 76.29 as majority of the farmers sell their produce in distant markets like Azadpur Mandi of Delhi and markets of Gurgaon, Saharanpur, Dehradun and Chandigarh to avail good prices, which ultimately demands very high transportation charges. Lack of refrigerated vehicles and cold chain facilities with mean score of 63.90 (ranked 3rd), high spoilage and losses during transportation with mean score of 62.83 (ranked 4th), presence of large number of intermediaries in marketing process with mean score of 60.40 (ranked 5th), non-availability of MSP with mean score of 55.59 (ranked 6th) and lack of processing units near production point with mean score of 52.82 (ranked 7th) were categorized as very serious problems on risk severity scale. Cumbersome process of registration and getting J form under BBY (Bhawantar Bharpayi Yojana) with mean score 47.69 (ranked 8th) followed by poor marketing facilities with mean score of 43.39 (ranked 9th), high cost of packing material with mean score of 42.41 (ranked 10th), lack of information about government schemes and subsidies taking procedure for farmers with mean score of 38.48 (ranked 11th) and lack of availability of market information with mean score 27.62 (ranked 12th) respectively, were found serious on risk severity scale. Lengthy procedure for getting credit from government institutions for marketing purpose with mean score 24.69 (ranked 13th) and lack of knowledge about grading and packaging with mean score of 19.69 (ranked 14th) were categorized as not so serious risk severity scale.

The results are in line with Baskaur (2011), Kumar (2019) and Rashmi *et al.* (2020). Baskaur (2011) investigated problems in vegetable farming in Sonapat, Gurgaon, Kurukshetra, and Hisar districts of Haryana and results of study reported that shortage of labour during peak season, high labour costs and financial difficulties were major production problems whereas major marketing challenges were inadequate and overpriced transportation and lack of information about prospective markets in large cities. Kumar (2019) observed similar marketing constraint faced by tomato growers of Nuh district of Haryana. He reported that the lengthy procedure for obtaining credit from government institutions for marketing purposes, the expensive nature of transportation, exorbitant price fluctuation, no provision of minimum support prices, inadequacy of appropriate credit facilities, inclusion of a large number of intermediaries in the marketing process, lack of market information, and the considerable distance from the point of production to the market were major problems faced by farmers in marketing. Rashmi *et al.* (2020) stated that tomato producers face difficulties due to unexpected shifts in market prices, commission agent charges are high, high transportation costs and distant markets were major constraints in marketing of tomato in Karnataka.

Table: 1: Major problems faced by farmers in marketing of tomato

Sr. No.	Particulars	D1	D2	D3	Overall Mean Score	Rank	Risk Severity
1	Unstable prices during harvesting period	81.26	83.43	84.00	82.90	1	Extremely Serious
2	High transportation cost due to distant markets	77.20	76.37	75.30	76.29	2	
3	Lack of refrigerated vehicles/chilled vans and cold chain facility	65.04	64.64	62.03	63.90	3	Very Serious
4	High spoilage and losses during transportation	61.60	61.81	65.07	62.83	4	
5	Presence of large number of intermediaries in marketing process	60.71	59.81	60.69	60.40	5	
6	Non availability of Minimum Support Price	49.86	58.93	57.99	55.59	6	
7	Lack of processing units near production point	58.13	49.80	50.54	52.82	7	
8	Cumbersome process of registration and getting J-form under Bhawantar Bharpayi Yojana	47.69	47.43	47.94	47.69	8	Serious
9	Poor market facilities	41.51	44.03	44.64	43.39	9	
10	High cost of packing material	44.17	41.51	41.55	42.41	10	
11	Lack of information about government schemes and subsidies taking procedure for farmers	39.01	39.11	37.31	38.48	11	
12	Lack of availability of market information	28.03	24.23	30.61	27.62	12	
13	Lengthy procedure for getting credit from government institutions for marketing purpose	21.09	28.71	24.27	24.69	13	Not So Serious
14	Lack of knowledge about grading and packaging	22.89	19.06	17.11	19.69	14	

Note: D1 represents district Kurukshetra, D2 represents Karnal and D3 represents Yamuna Nagar, respectively

4. CONCLUSION

Marketing of tomatoes due to its high perishability and bulkiness nature needs careful attention at each and every stage of marketing so that farmers could avail high prices and consumers can get quality products. It is recognized that if improvement in income of tomato producers is to be made, they must be modernized in terms of knowledge, adoption, and other personal, social, and economic aspects. Government and other agencies should focus on development of well-planned logistics system to ensure better income to producers and quality tomatoes to consumers. It is required that FPOs should operationalized more actively to provide platform to farmers to market and sell their produce in more organized form. Farmers should be encouraged to use product differentiation strategies like quality certification which also help them to tap opportunity of premium markets with better price realization. Training should be provided to farmers to enhance their marketing skills by making them understand market dynamics, grading and packaging requirements, negotiation techniques and branding strategies.

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NBFCS BANKING IN INDIA: A COMPARATIVE ANALYSIS OF VARIOUS NBFCS

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NBFC banks have expanded rapidly in emerging countries in recent decades, despite their origins dating back to the 1970s. In India, NBFC banks have also seen similar expansion. In all economies, NBFC banking has taken place and is present. All actions carried out outside of the conventional banking system are included in NBFC banking, which is operated as a financial intermediary. In the previous 20 to 30 years, the financial industry has seen several changes and faced increased competition. Many of the banking subsidiaries of NBFCs belong to regular banks as their parent firm. In this paper, researcher compare the performance of three NBFCs (Bajaj Holding & Investment Ltd., L&T Finance holding Ltd., and Mahindra and Mahindra Financial Service Ltd.). This Paper's objectives are to test the hypothesis that there is no significance difference between return on equity share and return on capital employed of the NBFCs.

Key words: - NBFCs, Return on Equity share, and Return on capital employed.

1. INTRODUCTION

Non-Banking Financial Companies (NBFCs) play a crucial role in the Indian financial sector. They are financial institutions that offer banking services similar to traditional banks but are not licensed to accept deposits from the general public. NBFCs are regulated by the Reserve Bank of India (RBI) under the provisions of the Reserve Bank of India Act, 1934.

NBFCs in India provide a wide range of financial services, including loans, investments, asset financing, infrastructure financing, wealth management, and more. They cater to various sectors of the economy, including retail, agriculture, real estate, microfinance, and small and medium-sized enterprises (SMEs). NBFCs have been instrumental in promoting financial inclusion by extending credit to underserved segments of the population.

Key Features of NBFCs in India:

- **No Deposit Acceptance:** Unlike traditional banks, NBFCs cannot accept demand deposits from the public. They raise funds through other means like issuing debentures, bonds, and accepting public deposits with a minimum maturity period of one year.
- **Registration and Regulation:** NBFCs need to register with the RBI to operate and are subject to regulations and guidelines issued by the RBI. They are required to maintain a minimum net owned fund (NOF) as specified by the RBI.
- **Credit Activities:** NBFCs primarily engage in credit activities, such as lending and investment. They provide loans and advances to individuals, businesses, and other entities. NBFCs can also provide leasing, hire-purchase, and other asset-based financing options.
- **Risk Management:** NBFCs are required to maintain prudent risk management practices and follow guidelines related to capital adequacy, asset classification, provisioning, and liquidity management. The RBI sets regulatory norms to ensure the stability and soundness of the NBFC sector.
- **Financial Inclusion:** NBFCs have played a vital role in promoting financial inclusion by extending credit to individuals and businesses in rural and underserved areas. Microfinance NBFCs, in particular, focus on providing small-ticket loans to low-income households and small businesses.

➤ Customer Base: NBFCs serve a diverse customer base, including retail borrowers, SMEs, corporate clients, and individuals seeking specialized financial services. They often cater to customers who may not meet the stringent requirements of traditional banks.

It's important to note that while NBFCs offer banking services, they are not considered full-fledged banks and operate under a different regulatory framework. The RBI regulates and supervises NBFCs to ensure financial stability and protect the interests of depositors and borrowers.

Top NBFCs in India

Here are some of the top Non-Banking Financial Companies (NBFCs) in India:

- i. Bajaj Finance Limited: Bajaj Finance is one of the largest NBFCs in India. It offers a wide range of financial products and services, including consumer finance, SME loans, mortgage loans, commercial lending, and wealth management. Bajaj Finance has a strong presence across the country and caters to diverse customer segments.
 - ii. Housing Development Finance Corporation Limited (HDFC): HDFC is a leading NBFC primarily focused on housing finance. It provides home loans, loan against property, and other related services. HDFC has a significant market share in the housing finance sector and has been instrumental in promoting homeownership in India.
 - iii. Shriram Transport Finance Company Limited (STFC): STFC is a prominent NBFC specializing in commercial vehicle finance. It offers loans for the purchase of new and used commercial vehicles, as well as ancillary services like tire finance and working capital loans for truck operators. STFC has an extensive network across the country, catering to the transportation sector.
 - iv. Mahindra & Mahindra Financial Services Limited (MMFSL): MMFSL is a subsidiary of Mahindra & Mahindra Group and operates in the rural and semi-urban areas of India. It provides a range of financial services, including vehicle loans, SME loans, insurance, and mutual funds. MMFSL primarily focuses on financing agricultural vehicles and equipment.
 - v. L&T Finance Holdings Limited: L&T Finance is part of Larsen & Toubro Group and offers a diverse range of financial products and services. It provides rural finance, housing finance, infrastructure finance, wholesale finance, and investment management services. L&T Finance has a strong presence in rural and semi-urban areas.
 - vi. Power Finance Corporation Limited (PFC): PFC is a leading NBFC in the power sector. It provides financial assistance for various power-related projects, including thermal, hydro, and renewable energy projects. PFC plays a crucial role in funding the growth and development of the power sector in India.
 - vii. Cholamandalam Investment and Finance Company Limited: Cholamandalam Finance is a well-known NBFC that offers a range of financial services, including vehicle finance, home loans, SME loans, and investment advisory services. It caters to both retail and corporate customers and has a strong presence in South India.
- These are just a few examples of the top NBFCs in India. The NBFC sector is quite diverse, with several other companies also making significant contributions to the Indian financial landscape.

2. OBJECTIVE OF THE STUDY

To examine the return on equity and return on capital employed in NBFCs (Bajaj Holding & Investment Ltd., L&T Finance holding ltd., and Mahindra & Mahindra Financial Service Ltd.).

3. RESEARCH METHODOLOGY

- Research Design: This research used both descriptive and exploratory research design.
- Sample Design: Secondary data sources will use to collect the data. The used sample size in this research paper is 3 top NBFCs of India.
- Sampling Technique: In this research, judgement sampling technique used.
- Data Collection: The source of data would be secondary in nature and it collected using company annual reports, financial database from Prowess.
- Statistical Analysis: To analyze the collected data ANOVA used.

4. DATA ANALYSIS

The **Return on Equity (ROE)** ratio is a financial metric that measures the profitability of a company by assessing its ability to generate a return for shareholders on their invested equity. It is commonly used by investors and analysts to evaluate the performance and efficiency of a company.

The formula for calculating Return on Equity (ROE) is:

$$\text{ROE} = \text{Net Income} / \text{Average Shareholders' Equity}$$

Where:

- Net Income refers to the company's profit after deducting all expenses, taxes, and interest.
- Average Shareholders' Equity represents the average value of shareholders' equity over a specific period, typically a year.

ROE is expressed as a percentage and indicates the amount of profit a company generates for each dollar of shareholders' equity. A higher ROE is generally considered favorable, as it suggests that the company is effectively utilizing its shareholders' investments to generate profits.

It is important to note that ROE can vary significantly across industries due to differences in capital structure and business models. It's often more meaningful to compare the ROE of a company with others in the same industry to gain insights into relative performance.

Table 1: Return on Equity Ratio of Selected NBFCs

(Ratio in Percentage)

(Value in Rs Crore)

Company Name	Basis of Ratio	Financial year				Mean
		2018-19	2019-20	2020-21	2021-22	
Bajaj Holding & Investment ltd	Net Profit	2654.75	3048.38	3080.19	3654.15	3109.37
	Net worth	25201.2	26952.3	27763.5	37167	29271
	Ratio	10.53	11.31	11.09	9.83	10.69
L&T Finance holding ltd	Net Profit	1277.52	2232.03	1700.26	738.23	1487.01
	Net worth	11406.7	13448.6	14692.4	18773.2	14580.2
	Ratio	11.2	16.6	11.57	3.93	10.83
M & M Financial Service ltd	Net Profit	1185.6	1820.35	1039.92	740.74	1196.65
	Net worth	9855	11269	11969	15776.4	12217.4
	Ratio	12.03	16.15	8.69	4.7	10.39

Source: - Annual Report & Account of NBFC's Company

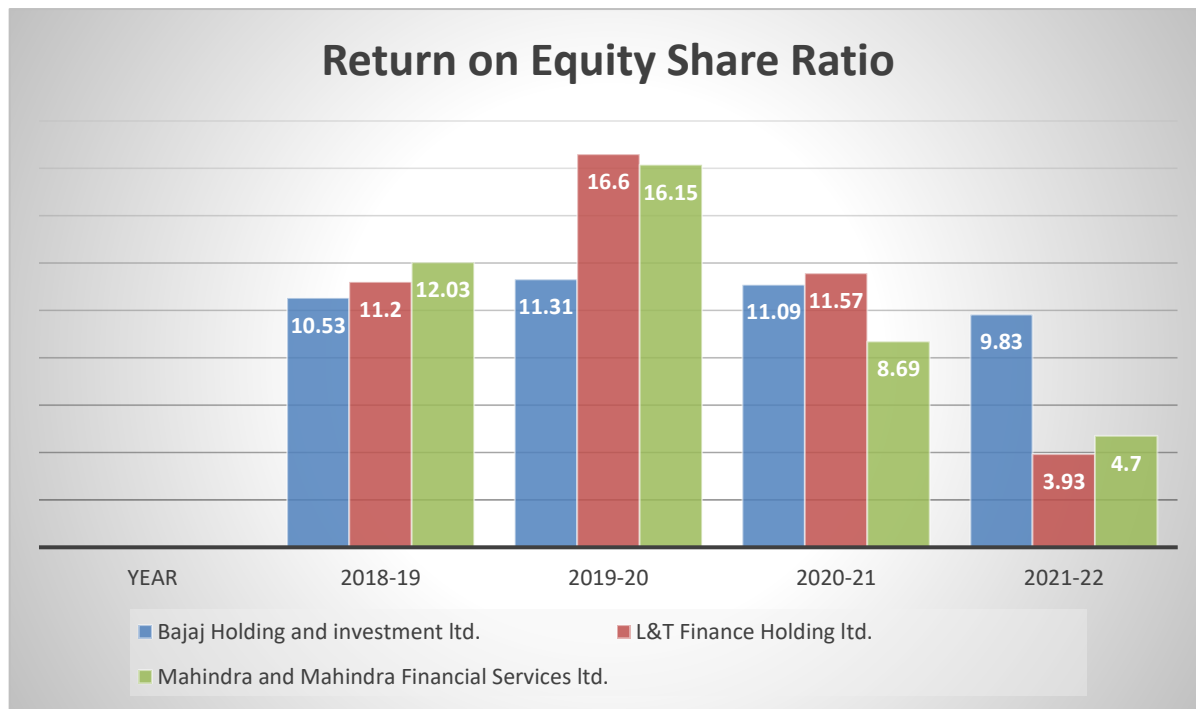


Figure 1: Return on Equity Ratio of Selected NBFCs

The above table 1 and figure 1 analyzed the return on equity ratio of top three NBFC's of India.

Hypothesis Testing

➤ **Null Hypothesis H₁:** There is no significant difference in Financial Performance Based on return on equity ratio of Selected NBFC's in India during study period.

Table 2: ANOVA Table

	df	SS	MS	F-Stat	P-Value
Between Groups	3	0.4044	0.1348	0.010475	0.49
Within Groups	12	154.4221	12.8685		
Total	15	154.8265			

It is clear from table 2 that the calculated value of 'F' is 0.010475, which is less than table value of 'F' 3.49 and P value is 0.49 which is higher than 0.05 at 5% level of significance. So, null hypothesis is accepted and alternative hypothesis is rejected. So, it can be concluded that there is no significant difference in Financial Performance Based on return on equity ratio of Selected NBFC's in India during study period.

The **Return on Capital Employed (ROCE)** is a financial ratio that measures the profitability and efficiency of a company's capital investments. It provides insights into how effectively a company utilizes its capital to generate profits.

The formula for calculating Return on Capital Employed (ROCE) is:

$$\text{ROCE} = \text{Earnings Before Interest and Taxes (EBIT)} / \text{Capital Employed}$$

Where:

- Earnings Before Interest and Taxes (EBIT) refers to the company's operating profit before deducting interest and taxes.
- Capital Employed represents the total capital invested in the company, including both equity and debt. It is calculated by subtracting current liabilities from total assets.

ROCE is expressed as a percentage and indicates the return a company generates on the total capital employed in its operations. It helps assess the efficiency of a company's investments and capital allocation decisions. A

higher ROCE generally suggests that a company is generating higher profits relative to the capital it has employed.

Like ROE, ROCE can vary across industries due to differences in capital requirements and business models. It is often useful to compare the ROCE of a company with others in the same industry to evaluate relative performance. Similar to other financial ratios, ROCE should be considered in conjunction with other metrics and factors to gain a comprehensive understanding of a company's financial performance and to make informed investment decisions.

Table 3: Return on Capital Employed Ratio of Selected NBFCs

(Ratio in Percentage)

(Value in Rs Crore)

Company Name	Basis of Ratio	Financial year				Mean
		2018-19	2019-20	2020-21	2021-22	
Bajaj Holding & Investment ltd	PBIT	2739.45	3170.02	3326.21	3769.54	3251.31
	Capital Empl.	25035.2	26818.7	32485	45292.4	32407.8
	Ratio	10.94	11.82	10.24	8.32	10.33
L&T Finance holding ltd	PBIT	6922	9950.36	10253.5	8499.08	8906.22
	Capital Empl.	59093.9	71187.9	82663.2	80853.1	73449.5
	Ratio	11.71	13.98	12.4	10.51	12.15
M & M Financial Service ltd	PBIT	5310.3	7226.11	6946.69	6202.17	6421.32
	Capital Empl.	49538.3	65510.2	76848.4	78772.9	67667.4
	Ratio	10.72	11.03	9.04	7.87	9.67

Source: - Annual Report & Account of NBFC's Company

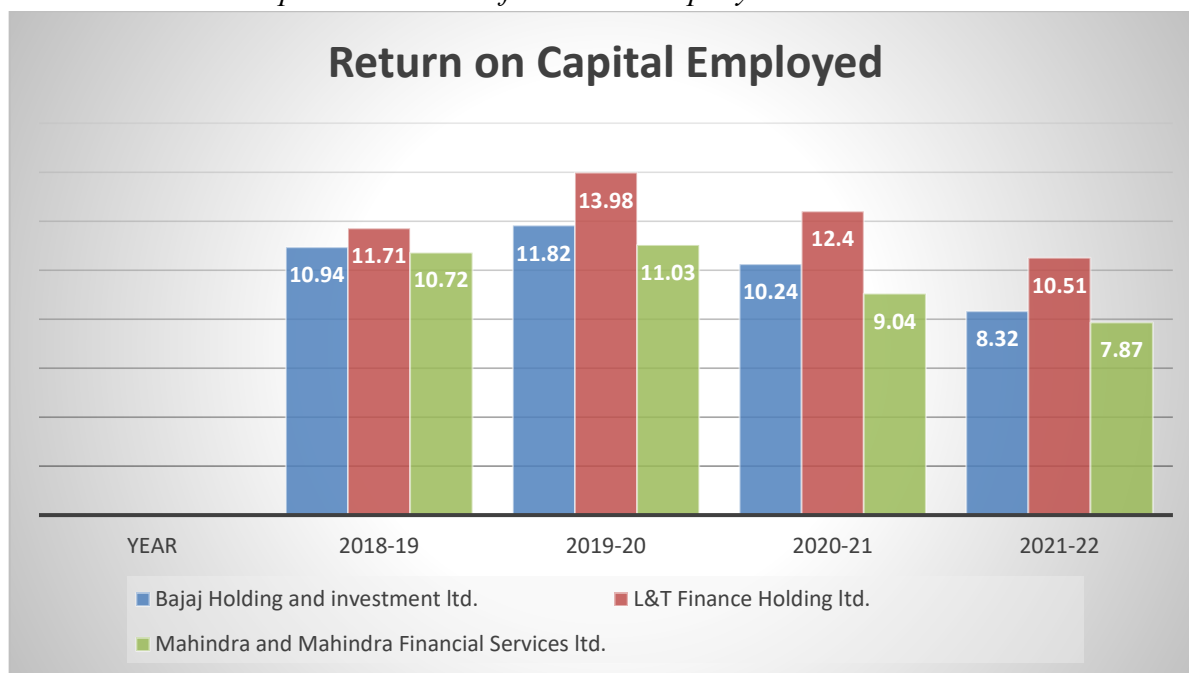


Figure 1: Return on Capital Employed Ratio of Selected NBFCs

The above table 3 and figure 2 analyzed the return on capital employed ratio of top three NBFC's of India.

Hypothesis Testing

➤ **Null Hypothesis H₂:** There is no significant difference in Financial Performance Based on return on capital employed ratio of Selected NBFC's in India during study period.

Table 4: ANOVA Table

	df	SS	MS	F-Stat	P-Value
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Between Groups	3	13.198	4.399	1.611	0.41
Within Groups	12	32.764	2.730		
Total	15	45.962			

It is clear from table 4 that the calculated value of 'F' is 1.611, which is less than table value of 'F' 3.49 and P value is 0.41 which is higher than 0.05 at 5% level of significance. So, null hypothesis is accepted and alternative hypothesis is rejected. So, it can be concluded that there is no significant difference in Financial Performance Based on return on capital employed ratio of Selected NBFC's in India during study period.

5. CONCLUSION

Our analysis reveals that the growth of the NBFCs sector is reduced after covid period. As compare to the before covid period NBFCs banking perform well and rapidly grow year to year. But during the covid period and after covid period the trend is downward. In our analysis we analysis the two parameters Return on equity, return on capital employed. The analysis shows that there is no Significant difference between on these parameters between different NBFC's companies.

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FABRICATION AND MORPHOLOGICAL INVESTIGATION OF COBALT OXIDE NANOPARTICLES SUITABLE FOR ELECTROCHEMICAL APPLICATIONS

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Cobalt oxide nanoparticles are synthesized by using an enhanced sol-gel technique. The organized samples are characterized in order to connect their structural and chemical properties in the synthesized state by using XRD, FTIR and SEM-TEM spectroscopy, etc. The Powder XRD crystallographic analysis was used to follow the crystalline behavior, homogeneity, and phase purity of the sample. The cubic structure of Co_3O_4 was observed from the XRD pattern and crystallite size using the Debye Scherer equation. The presence of the constituent functional groups in the synthesized nanoparticles of silica-mixed cobalt oxide is endorsed by FTIR spectroscopy. SEM-TEM micrograph certifies the crystallization of well-developed nanoparticles of silica mixed cobalt oxide in nanosize. Cobalt having a high valence state could also be achieved without any calcination condition which is enchanting for catalytic applications for its strong oxidation ability. Particularly as electrodes, cobalt oxide exhibits good electrochemical performance in alkaline solutions, and redox processes occurring at the surface.

Keywords: Sol-gel, Co_3O_4 , XRD, SEM, TEM, etc.

1. INTRODUCTION

Transition metal oxide nanoparticles distributed in an inorganic matrix have been engrossed for their structural, magnetic, optical, and catalytic properties. Such metal oxide nanostructures dispersed in silica matrix are freshly projected as gas sensors, electrodes, and catalysts (Jozwiak, 2004). The binary formation of silica-mixed cobalt oxide exhibits additional properties in the field of electro-optic, magneto-optical, sensing, and energy conversion (Thota, 2009). Cobalt oxide (Co_3O_4) has an approximate lattice constant of 8.02 \AA and reveals a normal spinel structure with a cubic closed packing structure. Cobalt oxide having a valency of more than three is unstable in the ordinary environment because of its distinctive features. The color of cobalt oxide (Co_3O_4) changes to yellow when Li^+ ions have been inserted, so it is also used as an active optical material (Barreca, 2001). Numerous fascinating properties of cobalt oxide are reported due to its ability to change the particle shape in a controlled manner (Zhang, 2008). Therefore, many efforts have been made to synthesize silica-mixed cobalt oxide binaries to obtain spherical nanoparticles with the perfect size for practical purposes (Makhlouf, 2013). Silica matrix has captivated much interest due to its low cost, less toxicity, and small pollution effects as compared to other polymer matrices (Meng, 2015). In literature, several forms of Co_3O_4 like nanoparticles, nanofilms, nanoflowers, and nanowires are attained using different physical and chemical methods (Niu, 2009, Pal, 2010). To explore more, we have used the enhanced sol-gel technique for cobalt oxide nanoparticles dispersed in the silica matrix and investigated its structural and morphological features (Khoza, 2012, Tonya, 2017).

2. USED CHEMICALS & METHODOLOGY

The chemical supplies used in the synthesis of silica mixed cobalt oxide binaries were tetraethyl orthosilicate (TEOS, transparency > 98%), spectroscopical score ethyl alcohol (C_2H_5OH 99.8%), analytical grade $[Co(NO_3)_2 \cdot 6H_2O]$, double distilled water catalyzed by hydrochloric acid (HCl). The preparation of the ready sample was supported by the sol-gel process labeled in Fig.1. The gels were then matured at room temperature for one week and to end dehydrated in steps from $30^\circ C$ to $110^\circ C$ for five days to generate the as-groomed sample 'K1'. Some as-groomed powder was shifted into another crucible and then placed in the furnace at $900^\circ C$ for 3h termed as 'K2'. Both the prepared samples were characterized by well-known techniques like XRD, FTIR, SEM, and TEM to explore their structural outcomes.

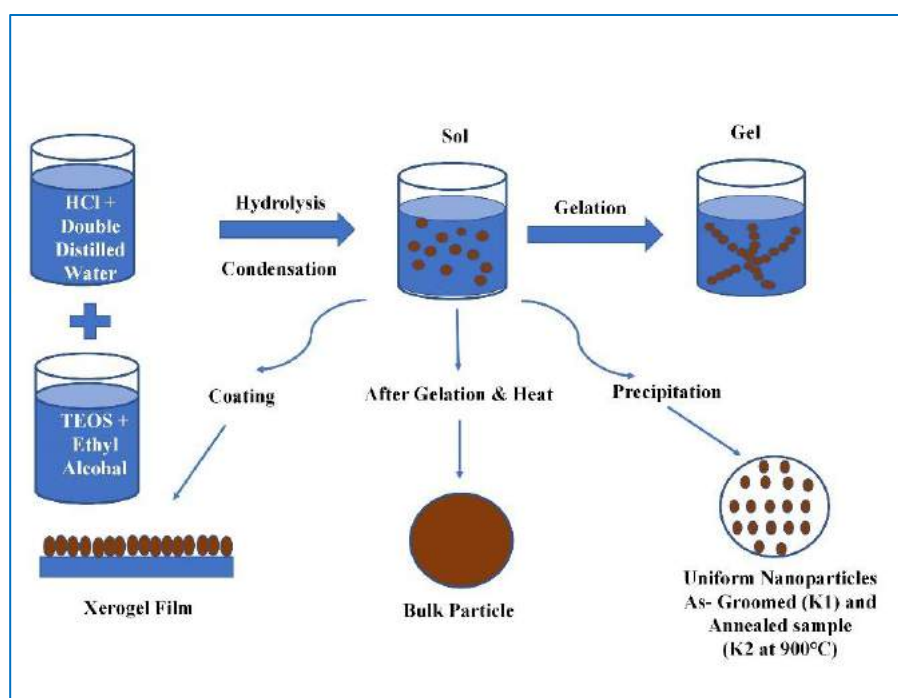


Figure 1. Synthesis 'sol-gel' route synthesized silica-mixed cobalt oxide nanoparticles.

3. RESULTS & DISCUSSION

3.1 XRD ANALYSIS

In Fig. 2(a), the XRD pattern is shown to study the phase and crystalline features of the prepared oxide nanoparticles. Sample K1 expresses some asymmetrical peaks at the angle 25.38° and 35.30° which resemble metal-ethanol (C_2H_5OH) peaks [Rani, 2019]. Minor peaks with fluctuating intensity also exist in as-groomed sample K1 at $2\theta \sim 31.28^\circ$, 36.79° , and 51.86° designated for crystalline silica (Ahlawat, 2013). The small hump at $2\theta \sim 22.13^\circ$ displays the amorphous nature of silica corresponding to JCPDS card no. 29-0085 (Goswami, 2018). When the temperature has increased in the K2 sample, sharp peaks are extensively attained with boosted intensity. The intensified peaks illustrate the growth of Co_3O_4 nanoparticles with cubic phase.

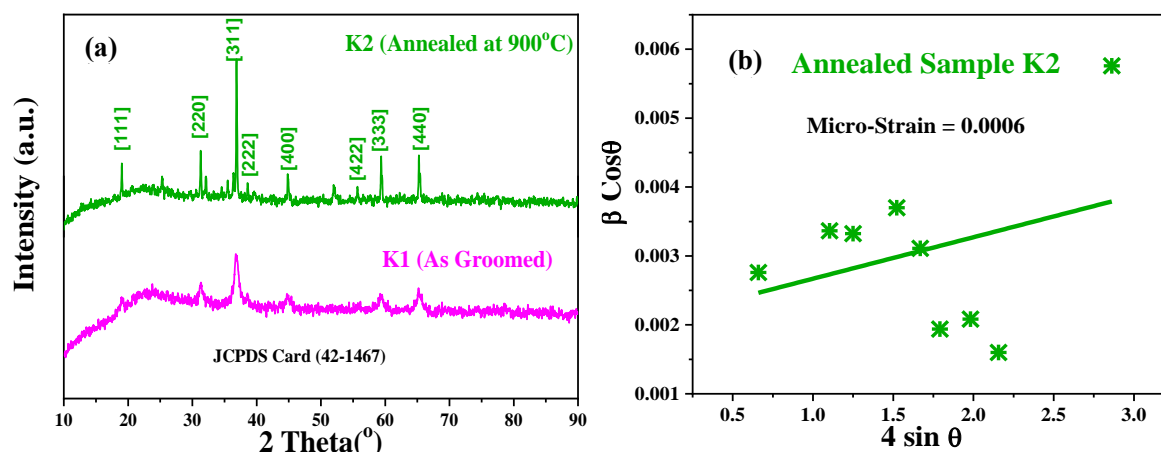


Figure 2. (a) XRD spectra (b) W-H Plot synthesized silica-mixed cobalt oxide nanoparticles.

The diffractogram is well matched with JCPDS files (PDF # 00-042-1467) having 2θ values $\sim 19.12^\circ$, 32.03° , 36.43° , 38.67° , 44.92° , 55.69° , 59.40° , and 65.30° referred to (111), (220), (311), (222), (400), (422), (333) and (440) planes. Moreover, the lattice parameter for annealed sample K2 has value 'a' = 8.065 Å, and unit cell volume 'VK2' is considered as 524.58 Å³ (Niu, 2009). The average nanocrystallite size is evaluated as 30 and 40 nm respectively for both K1 and K2 samples using the following equation: $D = k\lambda/\beta\cos\theta$, where D is an average crystallite size, K is 0.9 considered as the shape factor, the wavelength of X-ray is λ , and θ is the diffraction angle. It is to be apparent that the micro-strain and nanocrystallite size, both are the origin of peak broadening in the XRD patterns. The effect of the micro-strain could be evaluated by the Williamson-Hall plot for annealed samples as shown in Fig. 2(b). In the annealed sample K2 micro strain have values i.e., 0.0006 corresponding to extensional strain respectively.

3.2 FTIR ANALYSIS

Fourier transform infrared spectroscopy collects all high-resolution data over the wide spectral range of 4000-400 cm^{-1} . FTIR is a more efficient way to obtain information regarding compounds/elements stability as depicted in Fig. 3. The K1 sample contains a large amount of water due to stretching and -H-O-H- bending at the surface. In the K2 sample, the water absorption band becomes wide to some extent between 3400-3000 cm^{-1} (Jozwiak, 2004, Thota, 2009).

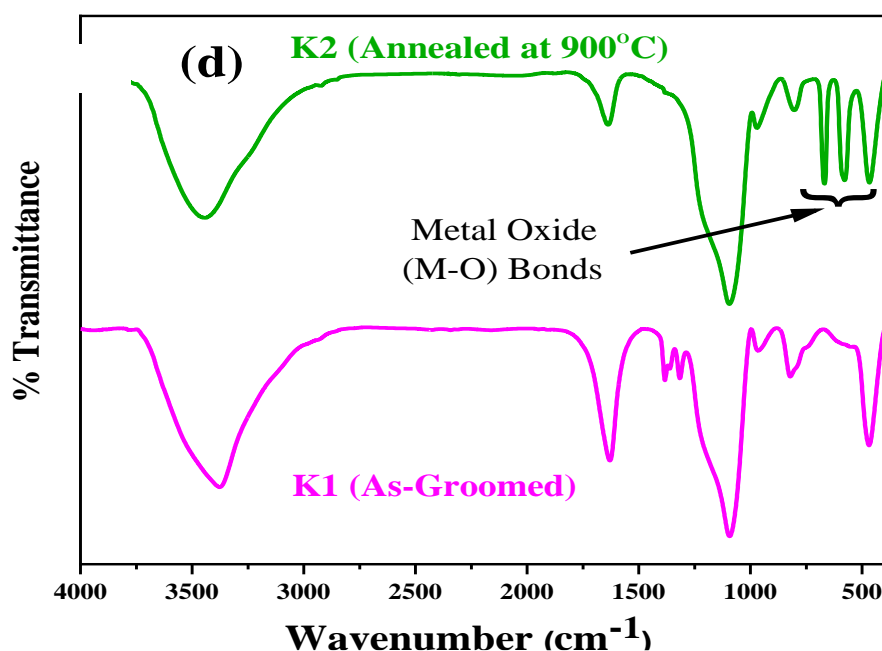
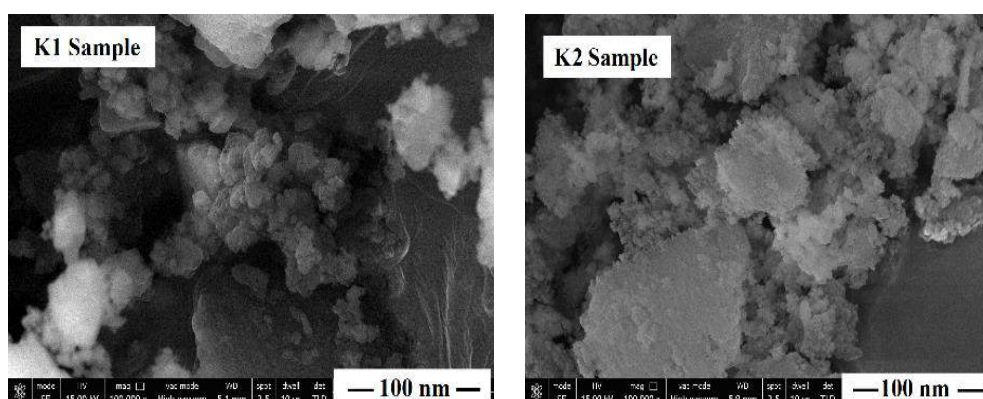


Figure 3. Vibrational FTIR Spectra of synthesized silica-mixed cobalt oxide nanoparticles.

The asymmetric and symmetric stretching vibration of the -Si-O-Si- bond is obtained at ~ 1100 and 800 cm^{-1} in both the prepared samples corresponding to the silica gel network (Barreca, 2001, Zhang, 2008). One may notice near the lower wavenumber side; the fingerprint region includes the characteristic metal-oxygen (Co-O) bonds. The spectra present significant peaks at 567 and 663 cm^{-1} corresponding to stretching vibrations of the Co-O bond in Co_3O_4 oxide nanoparticles (Tonya, 2017). The sharpness of the peak with high absorption intensity proved that cobalt is successfully embedded in silica.

3.3 SURFACE TEXTURE ANALYSIS BY SEM AND EDX

SEM micrograph of the prepared sample displays the surface morphology with identical shapes as shown in Fig. 4. The as-groomed samples show the amorphous nature of the prepared sample with the presence of silica. However, the annealed sample represents an agglomeration of nanoparticles due to thermal treatment (Khoza, 2012). This type of surface topography illustrates the homogenous dispersion of Co_3O_4 nanoparticles in the silica matrix. EDX spectra give the elemental composition percentage for the prepared sample K1. The topmost intensify peaks of oxygen and silica have $57.84\text{ wt } \%$ and $19.43\text{ wt } \%$ respectively. The medium or average intensified peak of cobalt is due to the controlled amount present at starting level of the prepared sample with $22.72\text{ wt } \%$.



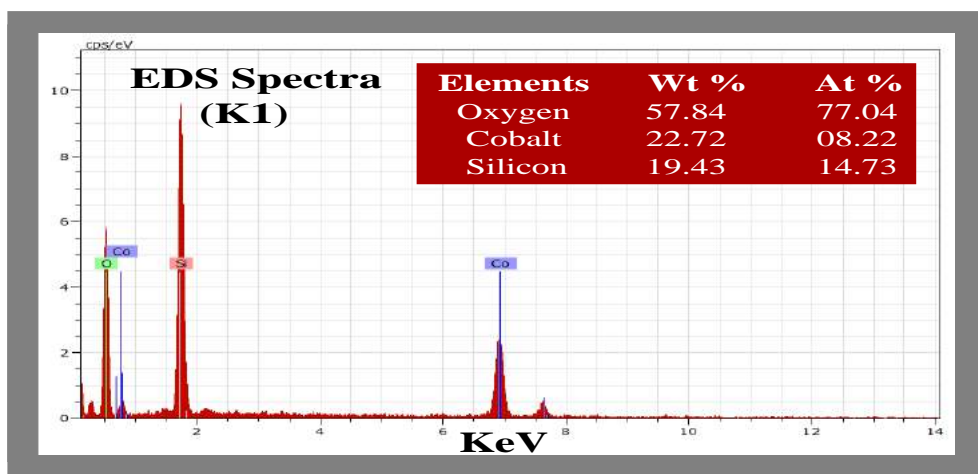


Figure 4. SEM images and EDX spectrum of silica mixed cobalt oxide nanoparticles.

3.4 TRANSMISSION ELECTRON MICROSCOPE (TEM)

Transmission electron microscopic images disclose the nanocrystallinity of the prepared samples. Fig. 5 represents the characteristic micrographs attained from cobalt oxide at nanoscale dimensions. The indefinite shapes have appeared with comparable agglomerations that can be accompanied by the high surface energy of the nanometric particles (Goswami, 2018). One may notice the size of particles and their agglomerates are similar, around 20 and 30 nm as depicted in respective micrographs. Controlled agglomeration is helpful to overcome the challenges related to sample integrity, dusting, flowability, and density, etc. The selected area electron diffraction (SAED) pattern and HR-TEM image for the K2 sample are also depicted in Fig. 5.

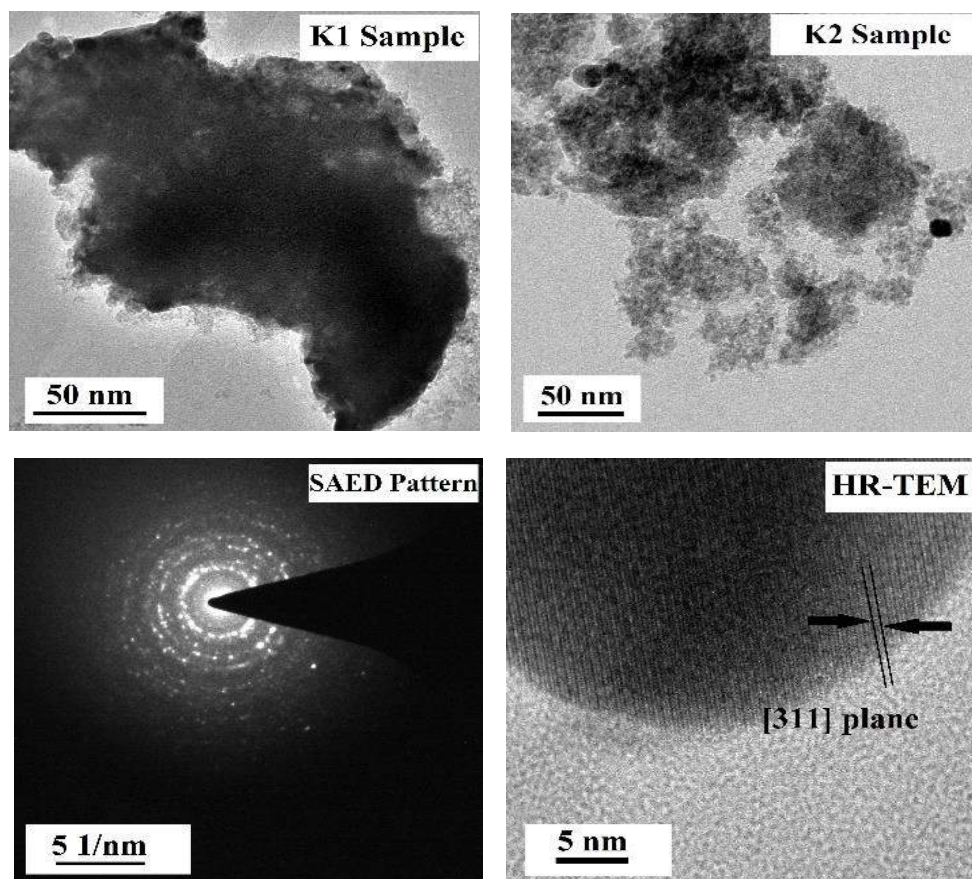


Figure 5. TEM micrograph of as-groomed (K1) and annealed sample (K2) of silica-mixed cobalt nanoparticles.

4. CONCLUSIONS

We have successfully synthesized silica-mixed cobalt oxide nanoparticles by using an enhanced sol-gel technique. Average nanocrystallite size was obtained as 30 and 40 nm for K1 and K2 samples respectively using the Debye-Scherrer formula. The lattice constant corresponding to the cubic structure of Co_3O_4 is determined as 8.065 Å. The sharp and intensified peaks are evident in the XRD pattern of Co_3O_4 . FTIR notified the characteristic band at 567 cm^{-1} owing to Co^{3+} -O vibration in octahedral form while the band at 663 cm^{-1} is attributed to Co^{2+} -O vibration in the tetrahedral site of the lattice. SEM micrograph shows the powdered surface of the particles with their specific elemental composition. TEM micrograph represents the average particle size ~ 20 -30 nm that tends to increase with temperature. In summary, the synthesized silica mixed cobalt oxide nanoparticles possess suitable applications in the form of sensors and electrochemical electrodes.

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INVESTIGATION OF STRUCTURAL AND OPTICAL PROPERTIES OF STRONTIUM SILICATE

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Pure Phase Sr_2SiO_4 nano ceramic was synthesized by citric acid-assisted sol-gel technique and further analyzed by XRD, SEM, TEM, FTIR, and PL techniques. The XRD analysis confirms the sample's crystalline nature, homogeneity, and phase purity. The presence of the constituents in the synthesized ceramic has been evaluated by FTIR spectroscopy. TEM was used to certify the crystallization of well-developed orthorhombic Sr_2SiO_4 particles in nano size. SEM images emphasize the texture and shape of the prepared nanopowder. The most prominent emission peak appears at 465 nm using the excitation wavelength of the NUV region i.e., 295 nm. Also, the excitation spectrum is depicted after holding the emission at 465 nm. Therefore, the structural, and optical investigations convey that Sr_2SiO_4 ceramic is a better host material for the advanced study of silicate-based ceramic nanopowder. The presently prepared silicate could be a definitive choice for practical applications, especially in photonic devices.

Keywords: Sr_2SiO_4 ceramic, XRD, FTIR, Excitation, Emission spectra, etc.

1. INTRODUCTION

Recent research and development in material science have attracted the attention of researchers toward the eminent luminescent materials which have numerous photonic applications in display technology and lightening materials like fluorescent lamps, light emitting diodes (LEDs), scintillators and plasma display panels, sensors, television tubes, radar screens, and compact fluorescent lamps, etc (Verma, 2019). The inorganic nanostructured phosphors have taken an important role in the new exploration of the optoelectronic device. At the nanoscale dimensions, there is a drastic change in all the physical and chemical properties such as the large fraction of surface atoms, high surface energy, spatial confinement and reduced imperfections, etc. Due to these properties, they are frequently used in different areas of photonics such as light-emitting diodes, optical memory, solid-state lighting, traffic signals, and luminous paint, etc (Singh, 2020).

The glass-ceramics exhibit high thermal and chemical stability at high temperatures. Also, ceramic nanomaterials are relatively inexpensive and can be easily formed by thermal annealing without affecting their external geometry. The glass-ceramics made up of silicates have been regarded as appropriate material for the research exploration (Trusovaa, 2018). Silicates have some essential properties such as easy synthesis using inexpensive raw material, low sintering temperature, better formability, multicolor phosphorescence, resistance for alkali and oxygen, transparency to visible light, better durability, and flexibility of different color emission with rare earth ions as dopant (Hameeda, 2019). The selection of silicates as a host material is a better choice as they have a low dimensional structure so it is easy to impart other ions for the exploration of new luminescent materials.

Significant research work has been done in the field of silicate-based nano phosphors at national and international platforms. In this direction, **Panith et al. (2019)** have prepared magnesium silicate hydrate by hydrothermal

crystalline and investigated the dye degradation properties of synthesized hydrated and non-hydrated MgSiO_3 . **Masli et al. (2019)** synthesized calcium silicate nanopowder and examined the crystal structure and chemical composition of the nanopowder by necessary characterization techniques. The focus of their study was on the effect of the mixing ratio of CaOSiO_2 on the properties of calcium silicate. **Joseff et al. (2021)** synthesize MSiO_3 (M= Ba, Ca, Mg) by combustion method. In their report, the silicates were evaluated by irradiation of UV light and studied Hydrogen Evolution Reaction (HER) by the photocatalysts. **Quan et al. (2012)** prepared SrSiO_3 powder by chemical deposition method and studied the effect of sintering temperature on phase composition, and microstructure and concluded that this method of synthesis is superior to the solid-state reaction method. **Jia Xu et al. (2016)** have prepared BaSiO_3 doped with Eu by solid state and precipitation reaction method. They have worked on the luminescent properties of synthesized phosphor. **Ernawati et al. (2021)** synthesized CaSiO_3 by solid-state reaction method and reported that the prepared CaSiO_3 composite is promising for dye removal in contaminated aqueous solution. It is pertinent that the deep examination of structural parameters like crystallite size, lattice parameters, the volume of the unit cell, microstrain, and dislocation density is still lacking in aforesaid reports of metal silicates. Some researchers have studied strontium silicate ceramics but have not explored the optical outcomes at the level of commercial relevance. Therefore, by taking into consideration these observations, we have synthesized (Sr_2SiO_4) strontium silicate and investigated its structural and optical properties. The method of synthesis adopted here is the citric acid-assisted sol-gel technique which has advantages such as easy setup, high chemical homogeneity, less undesirable content, time-saving and low cost. Due to chemical and thermal stability, the stoichiometry of the reacting precursors does not change in citrate mediated sol-gel method and defect-free crystallites are induced in this chemical route. Furthermore, we have used different tools and characterization techniques for the morphological, structural, and optical investigations of the sample.

2. MATERIALS AND METHODS

The ceramic with the general formula Sr_2SiO_4 was synthesized by the citric acid-assisted sol-gel technique. The chemicals used as a precursor for the formation of the required phosphor are high-purity strontium nitrate $\text{Sr}(\text{NO}_3)_2$ (99%), tetraethylorthosilicate (TEOS)($\text{C}_2\text{H}_5\text{O}$)₄Si (99%), ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) (99%) and citric acid ($\text{C}_6\text{H}_8\text{O}_7$) (99.5-102%) supplied by Sigma Aldrich. The whole process of synthesis is shown pictorially in Fig. 1(a). All the precursors are mixed in the proper stoichiometric ratio. Firstly, $\text{Sr}(\text{NO}_3)_2$ and TEOS were dissolved in distilled water with continuous stirring on a magnetic stirrer at temperature $\sim 60^\circ\text{C}$. A few drops of ethylene glycol were added to the mixture. Citric acid was added dropwise to the prepared solution to perform the chelation process. For the formation of gel, the mixture was allowed to stir for 2h at the same temperature of 60°C . Thus, we obtained a colorless, viscous, and consistent gel which was placed in an oven for 3h at 225°C for the dehydration process. To avoid moisture, the sample was placed in a desiccator while cooling down to room temperature (RT). By using an agate mortar and pestle, the dried sample was ground into a fine powder and annealed at 850°C for 3h in a muffle furnace. Finally, the nanopowder of required strontium silicate (Sr_2SiO_4) was obtained by further grinding the annealed sample. Different characterization tools and techniques were used to analyze the structural and optical properties of ceramic nanopowder.

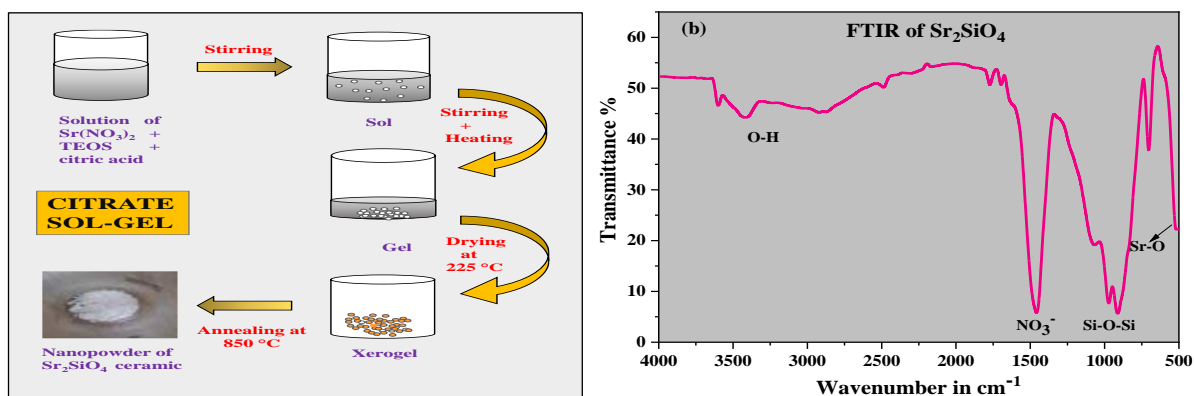


Figure 1(a): Pictorial representation of the complete synthesis route adopted. (b) FTIR spectra of Sr_2SiO_4 ceramic nanopowder.

3. RESULTS AND DISCUSSION

3.1 IDENTIFICATION OF FUNCTIONAL GROUPS BY FTIR

Fourier transform infrared spectroscopy (FTIR) characterization technique was used for identifying the certain functional group existing in the synthesized nanopowder by a Bruker Tensor-27 FTIR analyzer in the wavenumber range of $500\text{-}4000\text{ cm}^{-1}$. The FTIR spectra as shown in Fig. 1(b) show the absorption peaks at 515, 694.02, 909.862, 976.794, 1455, 1692.73, 1767.189, 2474, 3420, 3594.64 in cm^{-1} wavenumbers. The absorption band around $2500\text{-}3600\text{ cm}^{-1}$ shows the symmetric stretching vibration of a hydroxyl group (OH) which is due to the moisture present in the environment. The peak around 1448 cm^{-1} corresponds to NO_3^- group which reveals that NO_3^- is not completely diminished during the synthesis (Singh, 2020). Strontium silicate peaks have been reported at 729, 817, 1352, 1318, 1774 and 2410 cm^{-1} and some missing peaks at these wavenumbers the absence of nitrate precursor in the sample. The peaks at 1407.28 and 1596.04 cm^{-1} could be ascribed to vibrations of the Si-O bond or SrO available at octahedral and tetrahedral site (Zahedi, 2018). In the present sample, the peaks in the region of $800\text{-}900\text{ cm}^{-1}$ are due to stretching vibrations of the Si-O-Si and SiO_4^- groups (Tandel, 2018). The band in the region of $500\text{-}700\text{ cm}^{-1}$ is attributed to the bending of SiO_4^- , SrO_4^- , and Si-O-Si groups (Sahu, 2016). Thus, the overall FTIR spectroscopic analysis under IR irradiation confirms the pure crystalline form of nanopowder which has a wide range of applications in the field of material science.

3.2 CRYSTALLOGRAPHIC ANALYSIS

An X-ray diffraction study was carried out to determine the crystal structure and to emphasize the nature of the lattice phase available in the synthesized nanopowder. The data was obtained by using an XPERT PRO x-ray diffractometer at a step difference of 0.02°s^{-1} employing an X-ray beam with wavelength 1.54056 \AA . Fig. 2 depicts the XRD pattern of the sample in three sections with distinct 2θ angles.

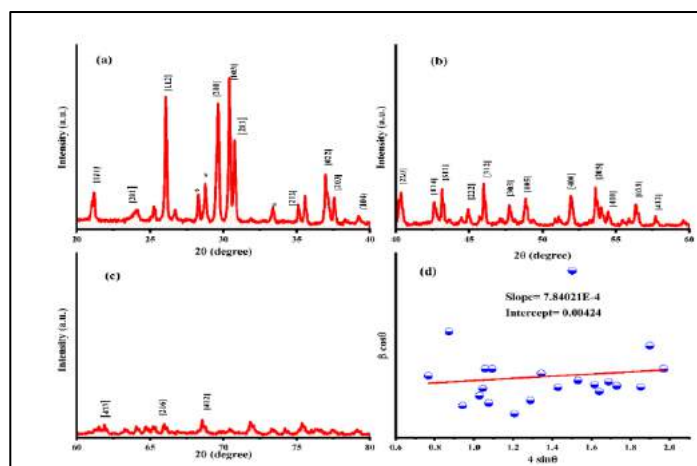


Figure 2: XRD pattern of Sr_2SiO_4 nanopowder having distinct 2θ range (a) from 20° to 40° . (b) from 40° to 60° . (c) from 60° to 80° . (d) W-H plot of Sr_2SiO_4 ceramic nanopowder.

It is clear from graph that Sr_2SiO_4 ceramic has a fair agreement with the JCPDS card no. 39-1256 which suggests that the method of synthesis is flavorful to produce a highly crystalline dense and pure form of the required ceramic nanopowder (Pan, 2016). Some peaks of the secondary phase are also observed corresponding to the β - Sr_2SiO_4 phase. The structure of the sample is orthorhombic with space group P_{nma} . Standard unit cell parameters for this structure have values $a = 5.683\text{\AA}$, $b = 7.142\text{\AA}$, $c = 9.94\text{\AA}$, volume = 403.583\AA^3 and $\alpha = \beta = \gamma = 90^\circ$ (Yesilkaynak, 2021). The most famous Debye-Scherrer's formula is used to calculate the average crystallite size of Sr_2SiO_4 ceramic whose equation is given as

$$D = \frac{k\lambda}{\beta \cos\theta} \quad (1)$$

Here, D is the average crystallite size in nm, λ is the wavelength of the X-Ray (1.54056\AA), k is the Scherrer's constant whose value is considered nearly equal to 1 for spherical particles, θ is the diffraction angle and β is the full width at half maxima (FWHM) of the peaks in the XRD pattern. Thus, by using XRD data the average crystallite size of Sr_2SiO_4 was found to be 29 nm corresponding to the most prominent diffraction peak. Williamson Hall (W-H) plot is used for a better understanding of the strain effect. The plot is also useful for calculating the crystallite size which confirms the nanoparticle formation of Sr_2SiO_4 powder. The W-H equation is given as

$$\beta_{hkl} \cos(\theta)_{hkl} = \frac{k\lambda}{D} + 4\epsilon \sin(\theta)_{hkl} \quad (2)$$

The sample has a 7.84021×10^{-4} microstrain and a corresponding crystallite size of 32 nm was calculated by extrapolating the graph between $\beta_{hkl} \cos(\theta)_{hkl}$ along the y-axis and $4\sin\theta$ along the x-axis portrayed in Fig. 2(d). Due to annealing at high temperatures, many defects and imperfections are generated. Keeping this in view, the dislocation density of the prepared crystalline material is also estimated which gives the number of dislocations per unit volume. The theoretical formula of calculation for dislocation density (δ) is given by the following equation

$$\delta = \frac{1}{D^2} \quad (3)$$

Using the XRD data dislocation density is found to be $1.697 \times 10^{-3} \text{ nm}^{-2}$ which indicates that the synthesized nanopowder is highly dislocated due to formation at nanoscale dimensions.

3.3 TEXTURE ANALYSIS BY SEM

The surface morphology of Sr_2SiO_4 is inspected by scanning electron microscope (SEM) Hitachi Japan SU8010 series and the obtained image is shown in Fig. 3 (a). The shape of the particles is spherical but irregularly arranged also these nanoparticles are tightly agglomerated. However, a highly dense surface texture can be observed in Fig. 3(a) which predicts the small and large grains of Sr_2SiO_4 . To confirm the elementary composition on the surface of the strontium orthosilicate phosphor Energy-Dispersive X-ray analyzer was used. The spectrum of EDAX is shown in Fig. 3(b). The exact atomic and weight percentages of the elements Sr (strontium), Si (silicon), O (oxygen) are mentioned in the inset of EDAX spectrum of the Sr_2SiO_4 ceramic nanopowder.

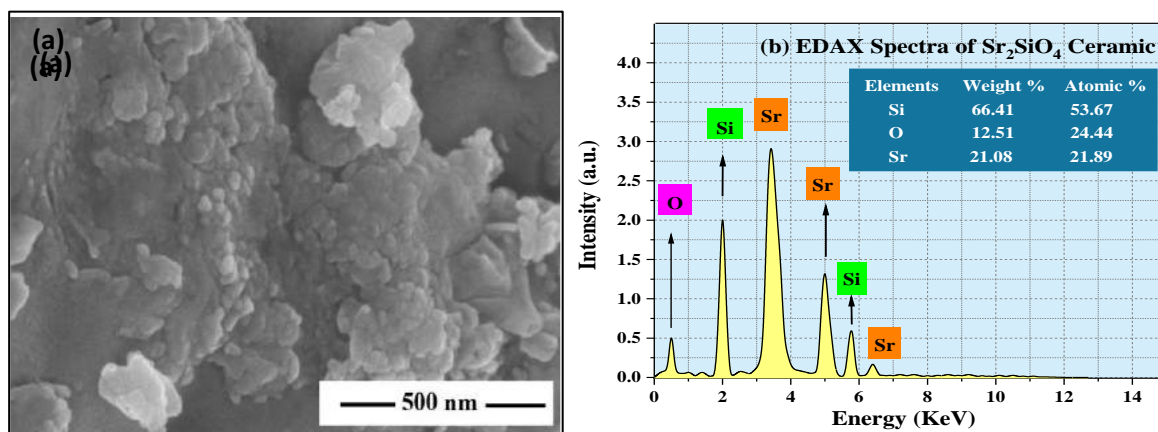


Figure 3(a): SEM

image and (b) EDAX spectrum of Sr_2SiO_4 ceramics.

3.4 TRANSMISSION ELECTRON MICROSCOPE (TEM)

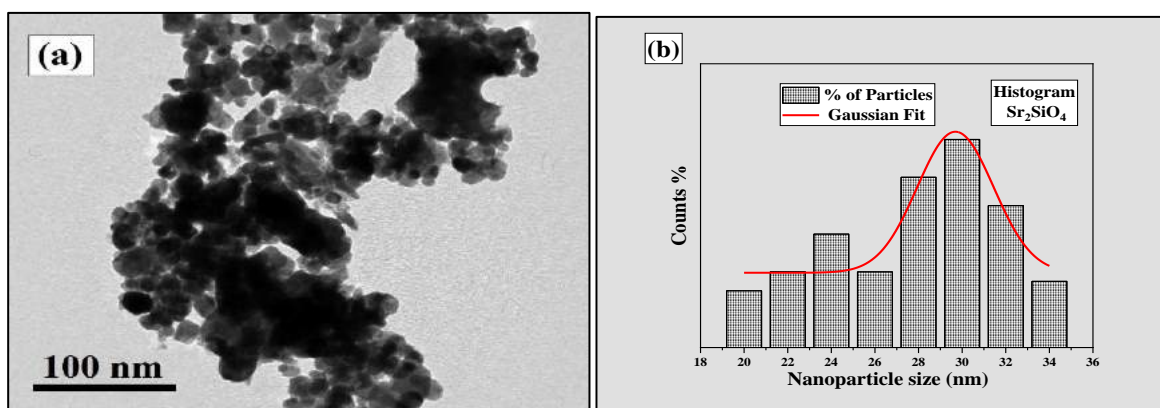


Figure 4(a): TEM micrograph and (b) histogram for the particle size distribution of Sr_2SiO_4 ceramic nanopowder.

To analyze the internal structure and nanocrystallinity of the sample, a high-energy electron beam was passed through the sample known under the technique of Transmission Electron Microscopy (TEM). The micrograph obtained from TEM JEOL JEM2100 plus is displayed in Fig. 4(a). It is clear from the micrograph that the particles are spherical in shape with distinct grain boundaries. By using Image J software, the average particle size was calculated from the micrograph and plotted in a bar graph known as a histogram. It is noticed that the particles are in the nano range but have uneven size distribution. The histogram provided the percentage of particle size distribution in the nano range which is exhibited in Fig. 4(b). Further, the peaks with the mathematical Gaussian function were employed to find the average size of the prepared Sr_2SiO_4 ceramic nanopowder which is found to be ~30 nm.

3.5 PHOTOLUMINESCENCE (EMISSION & EXCITATION SPECTRA)

The practical applicability of the prepared Sr_2SiO_4 ceramic nanopowder was executed by photoluminescence analyzer Perkin Elmer LS 55. The Spectrophotometer of the PL analyzer has an excitation wavelength range of about 200-800 nm and the Xenon lamp is the source of excitation. The data of excitation and emission spectra were recorded using the process in which UV-visible light from a Xenon lamp was allowed to pass through a monochromator and then incident on the sample.

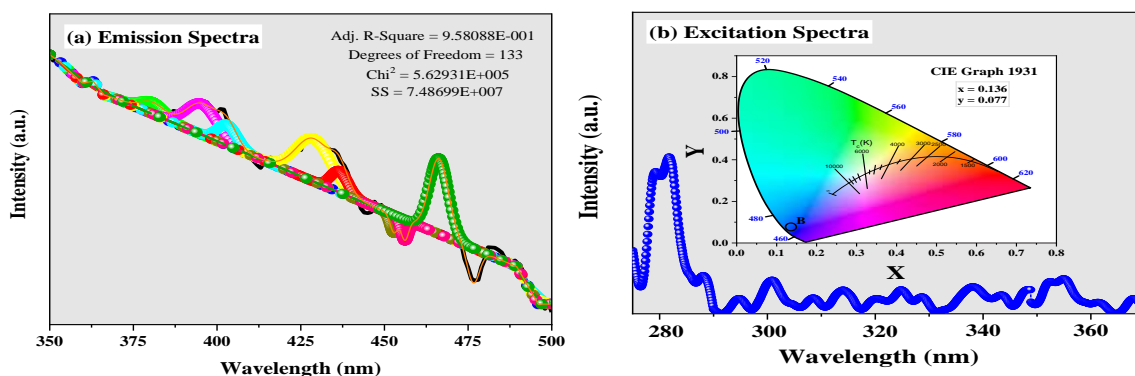


Figure 5(a): Emission spectrum (b) Excitation spectrum and its inset depicts the CIE chromaticity graph of Sr_2SiO_4 ceramic nanopowder.

Emission Spectrum: Fig. 5(a) shows the emission spectrum in the wavelength range of 350-500 nm. The broader asymmetric band was fitted by Gaussian Curve fitting and the details of peaks obtained after Gaussian Fitting of the observed data of emission spectra are given in Table 2. The emission spectrum of the Sr_2SiO_4 sample is shown in Fig. 5 with the excitation wavelength of 295 nm. The spectrum exhibits many peaks in which a strong sharp peak at 465 nm was prominently noticed which lies in the blue region of the electromagnetic spectrum (Singh, 2015). In Fig. 5(a), the other important peaks are found at 381, 395, 403, 429, and 437 nm wavelengths. The peaks are devoted to various defect centers induced in the prepared sample due to annealing at 850°C (Alemi, 2015). The maximum height of the peaks, full width at half maxima (FWHM) and area under each peak are also evaluated. The detailed features of various peaks are given in Table 2 obtained from the Gaussian fitting data analyzer.

Excitation Spectrum: The excitation spectrum of Sr_2SiO_4 nanopowder was investigated by using the same device Perkin Elmer LS 55 as depicted in Fig. 5(b). For recording the excitation spectrum, the emission of the sample was held at 465 nm. Basically, UV-visible light is allowed to fall on the sample, and the intensity of scattered light with respect to wavelength in nm gives information about the excitation spectrum of the sample. The excitation spectrum was recorded within the spectral range of 200-900 nm but displayed only within the range 270-370 nm wavelength. It is noticed that 295 nm is a prominent excitation peak while many small peaks are also visible in the prescribed range owing to the defect/imperfection states present in the host material. The excitation peak at 295 nm is devoted to the charge transfer states of $\text{Sr}^+-\text{O}^-/\text{Si}^{4+}-\text{O}^-$ available in the Sr_2SiO_4 ceramic nanopowder (Wang, 2022).

Table 2. Details of peak's position, area, FWHM, and height of the observed emission Spectra.

Peak	Position	Area	FWHM	Max Height
1	381	21137.71	8.73004	2274.622
2	395	69262.68	10.9979	5916.399
3	403	29319.86	7.07739	3891.853
4	429	109723.4	12.4776	8261.066
5	437	26313.07	6.0875	4060.694
6	465	104201.4	6.72476	14556.75

One may also notice that the CIE chromaticity graph has been recorded in the inset of Fig. 5(b). The blue emission color of the sample is significantly observed. The x and y coordinates are calculated as 0.136 and 0.077 for the prepared Sr_2SiO_4 ceramic nanopowder. It is suggested that the emission wavelength lying in the visible region

can be easily tuned further by doping with any rare earth or transition metal ions. Hence, Sr₂SiO₄ alkaline earth metal silicate nanopowder is a better host material for the advancement of silicate ceramics and is a prominent host material for rare earth ions with many brilliant features such as high thermal stability, long life, and easy synthesis using inexpensive raw materials.

4. CONCLUSION

We have successfully synthesized Sr₂SiO₄ ceramic by citric acid-assisted sol-gel technique. The XRD pattern revealed the orthorhombic phase and an average crystallite size of about 29 nm. The FTIR analysis confirmed the existence of constituent elements having vibrations in the IR region. The surface morphology of the sample is examined by SEM and TEM micrographs and EDS confirms the elemental composition. PL results suggest the presence of defects like F/F⁺ centers generated due to applied heat treatment. Highly dense and crystalline Sr₂SiO₄ ceramic powder is a potential candidate to be used as a host matrix as well as a refractory structural material. The blue luminescence emphasized the utilization of prepared powder in the lamp and in display devices.

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THE INTERNET OF THINGS (IOT) IN HEALTHCARE MARKET

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The Internet of Things (IoT) refers to a network of physical objects, devices, and other "things" that are embedded with sensors, software, and connectivity, allowing them to collect and exchange data over the Internet. The IoT promises many benefits to streamline and enhance healthcare delivery to proactively predict health issues and diagnose, treat, and monitor patients both in and out of the hospital. Worldwide, government leaders and decision-makers are implementing policies to deliver healthcare services using technology & services to respond to chronic diseases & the novel COVID-19 pandemic.

The aim of this viewpoint paper is to identify the factors responsible for growth of IOT market in healthcare and provide an overview after the discussion and analysis of growth & trends for market segmentation in healthcare through IOT. Further, the discussion will also cover the market, key players, and challenges in the development of the healthcare industry by adopting IOT. In this paper we also analyzed the various technological innovations and service adaptation by hospitals & patients in application, product, connectivity & component insights. Further we also analyzed marketing trends & growth that have been seen within the past, are being in the present and will be in the future. Finally study will conclude the findings of complete analysis of healthcare market.

Keywords: Internet of Things, healthcare, medical environments, segmentation, insights.

1. INTRODUCTION

The term "Internet of Things" was disseminated by the research work of the Auto-ID Center at the Massachusetts Institute of Technology (MIT) in 1999, IoT includes two concepts: "Internet" and "Thing", where "Internet" refers to "The world-wide network of interconnected computer networks", based on a standard communication protocol, while "Thing" refers to "an object not precisely identifiable" Therefore, semantically, Internet of Things means a world-wide network of interconnected objects uniquely addressable, based on standard communication protocols[8]. Cisco Systems estimates that IoT will consist of 70.8 billion devices connected to the Internet by 2024.[6] and it is predictable that many physical objects, like computers, and sensor actuators, will be distributed with unique addresses and the ability to transfer data, from the common daily activities to restricted medical records, in a secure way.

According to Gartner, the Internet of Things (IoT), "provides an integrated approach for all these physical objects that contain embedded technologies to be coherently connected and enables them to communicate and sense or interact with the physical world, and also among themselves"[5]. One of the most attractive applications fields for IoT is Healthcare, giving us the possibility of many medical applications such as remote health monitoring, fitness programs, chronic diseases, and elderly care[7]. Figure 1 shows the dimensions of IoT.

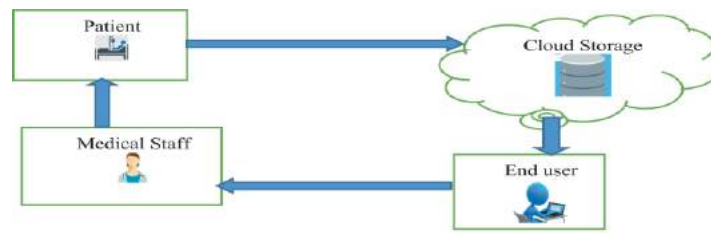


Figure-1: IOT and Health Care

In the healthcare industry, IoT has the potential to revolutionize patient care by providing real-time monitoring of patient health data, improving the accuracy and efficiency of medical devices, and facilitating communication and collaboration among healthcare providers.

2. IOT IN HEALTHCARE MARKET GROWTH & TRENDS

The Internet of Things (IoT) has been rapidly growing and expanding its presence in various industries, including healthcare. IoT in healthcare market basically includes sensors, software's, information processing systems and many more. The increase of the IoT in healthcare have shown maximum growth due to increased demands of medical devices in health care center and increasing number of active patients day by day and increased focus on medical devices with high efficiency and good results in a short period of time. According to a new report by Precedence Research, the global healthcare IoT market size tabulated as:

Table-1: IOT in health care market Size (2021-20230) (Source: Precedence Research)		
Year	Growth in USD (Billion)	Compound Annual Growth Rate (CAGR)
2021	180.20	Expected compound annual growth rate (CAGR) of 20.41% during the forecast period 2022 - 2030.
2022	217.34	
2023	289.20	
2024	315.09	
2025	379.40	
2026	456.82	
2027	550.05	
2028	666.30	
2029	797.46	
2030	960.20	

The table show valued at USD 180.20 billion in 2021 and IOT in healthcare market size is expected to reach USD 960.20 billion by 2030 and is expected to expand at 20.41 % Compound Annual Growth Rate from 2023 to 2030.

2.1 FACTORS RESPONSIBLE FOR RAPID GROWTH OF IOT BASED HEALTHCARE SYSTEM

High penetration of smartphones is one of the significant factors boosting the growth of the market. As per the statistics published in Global system for mobile communication (GSM) Association’s report are represented in below table:

Table-2 GSM report for Mobile Communication & Expected forecast			
Characteristics	2021	2025	
Mobile Subscriptions/Technology	Till end of 2021, 5.3 billion people subscribed to mobile services, representing 67% of the global population.	The total number of subscribers to 5.7 billion (70% of the global population).	
Mobile Internet Subscribers	Till end of 2021, 4.2 billion people subscribed to mobile internet services, representing 53 % of the global population	Till end of 2025, 5.00 billion people subscribed to mobile internet services, representing 60 % of the global population	
Smart Phones	Till end of 2021, 75% globally population has smart phone	84% globally population has smart phone	
Internet of Things	15.1 Billion connected devices	23.3 billion connected devices	
Employment	12 Million Directly job	14 Million Directly job	
5G adoption (percentage of connections)	Region	% people have 5G till 2025	% people have 5 G till 2030
	Australia, Japan, Singapore & Japan	64	93
	North America	63	91
	Greater China	52	88
	Arab States	49	95
	Europe	44	87
	Latin America	11	57
	Rest of Asia Pacific	8	32
	Saharan Africa	4	16
		Global Average growth is 25%	Global Average growth is 55%

The Rise in the number of mobile subscriptions in emerging economies such as India, China, Indonesia, Bangladesh, and some African & Latin American countries is expected to further drive the market growth. In addition, continuous improvements in network infrastructure and growing network coverage are also creating opportunities for the key players to grow in the market.

The outbreak of COVID-19 had a positive impact on the IoT in the healthcare market. During the pandemic, the risk of getting infected with novel corona virus while treatments and patient visits to the hospital was rising. This has led hospitals and healthcare systems adopt IoT in healthcare diagnosis to avoid the spread of viral infection.

The Government of India in February 22 has launch open platform including digital registries for doctors, other healthcare providers; novel healthcare identities; global access to digital healthcare facilities.

Technological advancements in healthcare IT infrastructure, including the use of IoT, AI, and big data are one of the key factors boosting the market growth. Increasing applications of smart devices and wearable's in healthcare, such as glucometer, tablets, smartphones, smart watches and headphones, heart rate cuff, bands and others, is expanding the scope of internet of things, especially in healthcare as they give special attention to access the patients remotely. The tracker system in these devices enables to access patients in emergency by sending emergency alerts to seek medical help.

Growing affordability and reduction in hardware costs are driving the demand for smartphones in the market, which in turn is expected to drive the growth of the market. In December 2022, Palo Alto Networks, announced medical IoT security a Zero Trust Security for medical devices. This will enable the healthcare providers to manage the connected devices securely and quickly. It is a type of cyber security that provides security to the data of the organization by verifying every individual user and device.

The advanced developed technologies of medical devices in IoT with wide utilization of medical devices in healthcare center due to increased number of active patients with chronic disorders which involves respiratory disease, COPD, genetic disorders and many more have helped to boost the market growth rate. Due to increased self-medical devices available in the market for example, glucose monitor, blood pressure monitoring devices, self-injecting, sleep monitor device, stress monitors, inhalers installed in the smart phone or the smart watches over wireless connectivity which enhanced the market growth of IoT in healthcare.

Decreased ratio of doctor to patient in various countries. The many new health policies imposed by the government such as reimbursement.

Rise in healthcare spending across the globe is driving the demand for the implementation of IoT solutions in the healthcare sector. According to estimates published by WHO in 2020, global spending on healthcare witnessed a significant surge, accounting for 11% of the global GDP or USD 9 trillion. The healthcare industry is evolving from fee-for-service model to value-based model, wherein treatment outcomes are reimbursed. The pressure of reducing healthcare costs is escalating globally as its cost is increasing faster than the growth of economies.

Furthermore, IoT solutions-enabled clinical trials also offer an opportunity for cost reduction as IoT simplifies the overall process and captures sophisticated endpoints. Remote patient monitoring solutions help in handling of noncritical patients at home, which eventually reduces hospital admissions and improves workflow efficiency. In addition, IoT solutions also enhance clinical operations through asset tracking and improvement in data capturing helping in significant cost savings. Thus, the demand for the development of the internet of things in healthcare is rising globally.

Increased research and development of the medical devices in IoT with improved technologies and facilities with new infrastructures of health care center developed. The key market players involved in introducing the new medical devices contributes to enhance the market growth of IoT.

3. IOT MARKET SEGMENTATION

The Market segmentation is used by companies across industries to group their customers into diverse groups based on their similarities and to analyze each group separately for identifying key factors affecting their behavior. Healthcare market segmentation is a relatively new concept. It provides insights into the behavior of healthcare consumers in an environment where healthcare is moving rapidly towards patient-centered care which is premised

on individuals becoming more active participants in managing their healthcare plans following are the market Insights of IOT in healthcare

Product Insights

Segmentation of IoT in healthcare on the basis of product advanced developed technologies with improved electronic health records for monitoring the health. Advanced developed technology of medical devices using wireless connections in health care center has increased widely to monitor the health of the active patient, management of disorders, and many more which boost the market high.

Connectivity Technology Insights

By connectivity technology, the cellular segment held the largest share of 22.3% in 2022. Cellular technology enables us to send a huge amount of data over a long distance. In healthcare, they are used for remote patient monitoring as it allows data from devices to be collected and made available to healthcare professionals in real-time.

The LPWANs segment is expected to witness rapid growth over the forecast period. LPWAN is well suited in telemedicine applications for providing data in case of poor weather conditions It adapts modulation schemes to the appropriate band for enhanced performance during poor weather conditions. Hence, advantages associated with LPWANs in healthcare industry are likely to boost the segment during the review period.

Component Insights

By component, the medical devices segment held the largest share of 37.8% in 2022. Several key players and universities are launching novel medical devices for self-monitoring of health indicators. For instance, in January 2022, Abbott introduced bio wearable's for self-monitoring of major nutritional health indicators. Such, initiatives are driving the medical devices segment. In September 2021, McKesson launched a rapid return solution for health systems, which helps health systems and hospitals increase the amount of credit received for returned pharmaceuticals & OTC products, simplify the returns process and expedite credit processing.

The system & software segment is anticipated to exhibit a rapid CAGR during the forecast years. This growth is attributed to the technological advancements and growing investments by operating players for the development of novel connected solutions for the life science industry. The need for managing medical records is rising in developed economies such as the U.S., which is positively influencing the demand for software solutions.

Type Insights

Segmentation of internet of things in healthcare based on the type basically involves stationary medical devices, implantable medical devices, wearable medical devices and other medical devices with enhanced development and features of medical devices in health care center. Based on connectivity technology Wi-Fi, Bluetooth, signee and other embedded systems which carry out the work flow smoothly without any disruption. System and software involved re analytics layer, database layer, network layer.

Application Insights

By application, the telemedicine segment held the largest share of 31.7% in 2022. The key players in internet of things in healthcare are focused on the development of innovative telemedicine solutions or devices for improving the healthcare system. For instance, CareClix offers a broad range of tele health and telemedicine services through high-definition video examinations and remote consultations. The patient monitoring segment is anticipated to

witness rapid growth over the forecast period. The growing prevalence of chronic diseases such as diabetes, cancer, and congestive heart failure is significantly contributing to the adoption of patient monitoring services, which in turn is expected to boost the demand for IoT solutions in healthcare. According to International Diabetes Federation, in 2021, about 537 million adults were living with diabetes globally and the number is estimated to increase to 643 million by 2030 and 783 million by 2045. Moreover, the growing demand for home healthcare services, the rising cost of advanced hospital equipment, and the increasing geriatric population are some of the factors driving the demand for patient monitoring and are thus, expected to boost segment growth during the study period.

End-use Insights

The hospitals and clinics segment captured the highest revenue share of 55.4% in 2022. IoT solutions allow enhanced treatment outcomes, disease management, and patient experience leading to improved care delivery. Moreover, increasing investments by hospitals for accelerating the adoption of digital technology is another factor contributing to the segment share. The clinical research organizations (CROs) segment is anticipated to expand at a significant pace with a CAGR of 17.0%. The rising implementation of IoT solutions for enhancing the accuracy of clinical research is a major factor fuelling the segment. CROs have augmented the widespread use of these solutions for improving patient retention and recruitment process, which are potential issues in clinical research. Hence, these capabilities are estimated to drive the segment during the forecast period.

Regional Insights

In 2022, North America dominated the internet of things in healthcare market with a share of 43.2%. The increased usages of telehealth, e-prescribing, mHealth, and other HC IT technologies as a response to COVID-19, as well as increased government requirements & support for IoT solutions in healthcare, are the primary growth factors driving the market. Furthermore, rise in the number of hospitals, advanced research organizations, universities, and medical device manufacturers has a positive impact on market growth. Increase in adoption of electronic health records is increasing significantly in the U.S. As per the Health IT reports until 2021, nearly 9 out of 10 U.S.-based physicians have adopted EHR. Asia Pacific is anticipated to witness the fastest growth over the forecast period. This is due to the improvement in healthcare infrastructure & increase in healthcare expenditure in developing Asian countries, owing to the growth in the adoption of advanced technology to cut down medical costs & streamline hospital workflow, are the key drivers of demand for IoT in healthcare in the region.

4. KEY COMPANIES & MARKET SHARE INSIGHTS

Various strategies such as product development, partnerships, funding, investments, etc. adopted by key players is driving the internet of things in the healthcare market. For instance, in June 2022, the company launched Allia platform, which was designed for minimally invasive image-guided surgery. It was designed with the purpose of improving workflow efficiency, enhancing user experience, and increasing the adoption of image guidance in daily practice. Some prominent players in the global internet of things in the healthcare market include:

- Medtronic
- Cisco Systems, Inc.
- IBM Corporation
- GE Healthcare
- Microsoft Corporation
- SAP SE
- Infosys Limited
- Cerner Corporation

- QUALCOMM Incorporated
- Amazon
- Intel corporation
- Wipro ltd

Table -3 Summaries of Various Insights in Market Segmentation

IOT Market Insights	Insight Description	Examples/Remarks
Product Insights	Product advanced developed technologies with improved electronic health records for monitoring the health	Monitoring devices involves blood glucose monitors, blood pressure monitors, multipara meter monitors, Heart rate monitors. Imaging systems, respiratory devices, patient monitoring, infusion pump, hearing devices, anesthesia machines, ventilators, neurological devices, fetal monitoring devices, implantable cardiac devices includes pacemakers, implantable cardiac monitors, cardio verter defibrillators

<p>Connectivity Technology Insights</p>	<p>Cellular technology enables us to send a huge amount of data over a long distance. Cellular networks have wide range of applications. In healthcare, they are used for remote patient monitoring as it allows data from devices to be collected and made available to healthcare professionals in real-time.</p>	<p>LPWANs (Low-power WAN) is a wireless wide area network technology that interconnects low-bandwidth, battery-powered devices with low bit rates over long ranges) Transmit data over the air from sensors with low transmission range, for about tens of kilometers. Those sensors are not expected to be powered by electricity, and they are powered by batteries.</p>
<p>Component Insights</p>	<p>Hardware: (Portable diagnostic device and Non-portable diagnostic device. Software: used to supervise the health of patient and expected largest share of market Services: expected grow rapidly due to integration of IOT services</p>	<p>This is attributed to the large scale-adoption of medical devices owing to the increasing need for efficient and cost-effective solutions for delivering healthcare services. For instance, medical devices are connected with IoT sensors to offer healthcare professionals a continuous stream of real-time health data such as glucose monitoring, heart rate, and blood pressure, self-monitoring devices such as wearable devices is expected to surge the demand for connected medical devices in the healthcare sector.</p>
<p>Type Insights</p>	<p>based on the type basically such as : Stationary medical devices Implantable medical devices, wearable medical devices</p>	
<p>Application Insights</p>	<p>The increasing prevalence of chronic diseases and the rising demand for patient monitoring are the major factors contributing to the segment's share.</p>	<p>The telemedicine segment held the largest share of 31.7% in 2022. Telehealth/Telemedicine, Hospital Operations & Workflow Management, In patient Monitoring, Imaging</p>

End User Insights	Improved operational and functional efficiency gained by hospitals due to IoT is a key factor propelling the growth of the market.	The hospitals and clinics segment captured the highest revenue share of 55.4% in 2022 Hospitals & Clinics Home Care & Long-Term Care Centers Health Insurance Companies Personal Users
Regional Insights	A competitive landscape based on an extensive assessment of the product portfolio offerings, geographic presences, and key strategic developments adopted by leading market players in this market in the last three to four years.	North America: U.S., Canada Europe: U.K, Germany, France, Spain, Italy Rest of Europe Asia-Pacific: Japan, China, India Rest of Asia-Pacific Latin America Middle East & Africa
Key Companies & Market Share Insights	The global healthcare analytics market size was valued at USD 11.59 billion in 2018 and is projected to reach USD 80.21 billion by 2026, exhibiting a CAGR of 27.5% during the forecast period.	

4.1 Internet of Things in Healthcare Market Report Segmentation

This report forecasts revenue growth at the global, regional, and country levels and provides an analysis of the latest industry trends and opportunities in each of the sub-segments from 2018 to 2030. For this study, Grand View Research has segmented the global IoT in the healthcare market report based on component, connectivity technology, application, end-use, and region:

Table-4: Segment description with various prospects

Segment Name	Segment Description		Remarks
Component/Product Perspective	• Medical Devices	Wearable External Devices, Implanted Medical Devices, Stationary Medical Devices	The medical devices segment is expected to account for the largest share of the IoT in healthcare market (2023-2030). Factors such as increased demand for wearable devices and the need for real-time patient data for better diagnosis support the largest share of the market.
	• System & Software	Remote Device Management, Network Bandwidth Management, Data Analytics, Application Security Network Security	

	<ul style="list-style-type: none"> • Services 	System Integration Services, Consulting, Training, and Education, Support and Maintenance Services	
Connectivity Technology Perspective	<ul style="list-style-type: none"> • Cellular • Wi-Fi • Bluetooth • LPWANs • Zigbee • RFID 		
Application Perspective	<ul style="list-style-type: none"> • Telemedicine • Patient Monitoring • Connected Imaging • Clinical Operations • Medical Management • Others 		The Telemedicine segment is expected to hold highest market share during 2023-2030
End-use Perspective	<ul style="list-style-type: none"> • Hospitals and Clinics • Clinical Research Organizations • Research and Diagnostic Laboratories • Others 		Hospitals & clinics segment is expected to account for the largest share(2023-20230) of the IoT in healthcare market.
Region Perspective	<ul style="list-style-type: none"> • North America 	U.S., Canada	Based on geography, North America is expected to account for the largest share of the market in 2023-2030. High adoption of IoT technology, improved healthcare infrastructure, and the presence of key players contribute to the largest market share.
	<ul style="list-style-type: none"> • Europe 	U.K., Germany, France, Italy, Spain, Sweden, Norway, Denmark	
	<ul style="list-style-type: none"> • Asia Pacific 	Japan, China, India, South Korea, Australia Thailand	
	<ul style="list-style-type: none"> • Latin America 	Brazil, Mexico, Argentina	
	<ul style="list-style-type: none"> • Middle East Asia 	South Africa, Saudi Arabia, UAE, Kuwait	

4.2Key Market Challenges

Increased usage of the IoT in healthcare in health care center due to increased number of patients and developed technologies in medical devices over wireless connections, embedded systems and other. Transmitting of data

from one machine to another machine over wireless connectivity, developed software's and updating of the software's is utmost important for continue chain of the process.

Increased online processed with more data security issues and the data hack or release of the data is the challenging task to challenge the expansion of the growth of the market rate. Increased costing of the medical devices in health sector with developed technologies is the challenging task for the growth. Many citizens cannot afford the cost of the medical devices.

5. CONCLUSION

The study has covered multiple aspects related with growth of IOT in healthcare, trends & market segmentations, the identified facts has been summarized in following titles:

Market Size & Trends

- The global healthcare IoT market size till end of the 2022 is valued at USD 217.34 billion, it is growing very fast and is expected to reach USD 960.20 billion till end of the 20230, at 20.41 % Compound Annual Growth Rate (2022 to 2030).
- IoT will consist of 70.8 billion devices connected to the Internet till end of the 2024.
- Till the end of the 2021, 5.3 billion people subscribed to mobile services, representing 67% of the global population, there will be an additional 400 million new mobile subscribers, (most of them from Asia Pacific and Sub-Saharan Africa), taking the total number of subscribers to 5.7 billion till end of the 2025 (70% of the global population).
- Till the end of 2021, 4.2 billion people subscribed to mobile internet services, representing 53 % of the global population, it is expected till end of 2025 5.00 billion people subscribed to mobile internet services, representing 60 % of the global population.
- Till the end of 2021, 75% globally population has smart phone, till end of the 2025 it is expected 84% globally population will have smart phone.
- Till the end of 2021 Internet of Things 15.1 billion connected devices, till end of the 2025 23.3 billion connected devices are expected
- For Employment point of view till end of 2021 12 million Directly job is available in mobile industry, till the end of 2025 it is expected 14 million directly jobs will be available in market. In 5 G technology adaptations present (till end of 2022) growth rate is 25% across the globe till end of 2030, global average growth is expected 55% (Maximum in 64% in Australia, Japan, and Singapore).

Influential factors in fast growth of IOT in healthcare market:

- High riding of smartphones.
- Technological advancements in healthcare IT infrastructure, including the use of IoT, AI, & big data
- Growing affordability and reduction in hardware costs.
- Outbreak of COVID-19
- Decreased ratio of doctor to patient in various countries.
- Rise in healthcare spending across the globe.
- A lot of imposed health policies.
- More attention on research and development of the medical devices in IoT with improved technologies and facilities and infrastructures.

- prominent players in in the healthcare market like Medtronic, Cisco Systems, Inc., IBM Corporation, GE Healthcare, Microsoft Corporation, SAP SE, Infosys Limited, Cerner Corporation, QUALCOMM Incorporated, Amazon, Intel corporation, Wipro ltd.

Market Segments

- By connectivity technology, the cellular segment held the largest share of 22.3% in 2022.
- By component, the medical devices segment held the largest share of 37.8% in 2022
- By application, the telemedicine segment held the largest share of 31.7% in 2022
- About 537 million adults were living with diabetes globally and the number is estimated to increase to 643 million by 2030 and 783 million by 2045.
- The hospitals and clinics segment captured the highest revenue share of 55.4% in 2022.
- In 2022, North America dominated the internet of things in healthcare market with a share of 43.2%

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STRUCTURAL, THERMAL, OPTICAL AND MAGNETIC PROPERTIES OF CrFe_2O_4 AND ZnFe_2O_4 SPINEL FERRITES

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CrFe_2O_4 and ZnFe_2O_4 spinel ferrite nanoparticles are prepared by auto combustion method and subsequently annealed at 800°C for 1 hr. Structural, morphological, thermal, optical and magnetic properties of ferrites get changed when different transition metal ions are taken at tetrahedral site of the spinel structure. The prepared samples are characterized by using XRD, SEM, UV-VIS, TG, DTA and VSM. The X-Ray diffraction analysis confirmed the formation of cubic phase with $\text{Fd}3\text{m}$ space group for the prepared nanoparticles.

Keywords: Spinel ferrites, Auto combustion method, Morphology, Optical properties, Magnetic measurements

1. Introduction

Spinel ferrites are most encouraging due to their simple structure, multifaceted cation distribution, easy preparation and stable structure. These have the general formula AB_2O_4 , in this A represent the tetrahedral site while B represent the octahedral site, which are respectively occupied by divalent and trivalent ions. One unit cell consists of 96 total inner sites, from them 64 A sites are tetrahedral and 32 B sites are octahedral (Yousaf et al., 2021). Various techniques like, different substitution of cations, temperature, synthesis methods, method of sintering and nature of metal elements, can change the properties of spinel ferrites. It is therefore necessary to use such a method that yield good homogeneity, less particle and crystallite size, which can be provided by methods like sol gel method, solid state reaction, hydrothermal, co precipitation, and sol gel auto combustion (Majid Niaz Akhtar et al., 2020). Out of these methods, sol gel auto combustion method is considered promising and facile due to good homogeneity, better controlled reaction, self purification, fine grain size and this technique use less equipment. It is due to their distinctive and tuneable electrical, optical and magnetic properties, spinel ferrites are used in various applications like cancer treatment, microwave absorption, sensing, biomedical, target drug delivery, pharmaceutical (Akhtar et al., 2021), catalyst, magnetic memory devices, and notebook computers (Jadhav et al., 2015). In the present work, a comparative study is carried out by taking two different transition metals at A site in AB_2O_4 spinel structure.

2. Literature Review

Due to the tuneable structural, magnetic and optical properties of spinel ferrites, various researchers have studied the impact of sintering temperature, pH and composition on the cubic spinel structure. One of the potential applications of ZnFe_2O_4 spinel ferrites is used as a catalyst in the reaction of organic compounds. High stability of material makes it reusable catalyst (Liandi et al., 2023). Zahid et al., (2023) studied copper substituted spinel ferrites which were prepared by sol-gel auto combustion. Dielectric and magnetic properties of these ferrites get improved with the doping of copper cation which is play an important role in different electronic components and energy storage devices. Parveez et al. (2018) studied the structural, magnetic, dielectric and a.c. conductivity of $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$ ($x=0, 0.1, 0.15, 0.2, 1$) samples prepared by auto combustion method. Hussain et al. (2023) studied dielectrically modified Nd^{3+} doped (Ni-Mn) based spinel ferrite nanoparticles. Kamran et al.

(2023) prepared rare earth co-substituted cobalt ferrites by co-precipitation method and studied their structural and electrical properties.

3. Experimental Details

3.1 Sample Preparation & Characterization

The highly analytical grade $\text{Cr}(\text{NO}_3)_2 \cdot 9\text{H}_2\text{O}$, $\text{Fe}(\text{NO}_3)_2 \cdot 9\text{H}_2\text{O}$ and Citric Acid (from Sigma Aldrich 99.99%) are separately mixed in stoichiometric ratio in 30ml deionized water with continuous stirring for 20 minutes at room temperature. All the three solutions are then mixed in 50ml distilled water sequentially. And pH is maintained to 7 by adding ammonia solution drop wise. Now, the temperature of solution is increased upto 70° till the sol formation. After that temperature is raised to 90° for the gel formation. On raising the temperature to 130°C , the solution suddenly combust itself and grey color ash is formed. This raw powder is named as C1 and it is annealed in two ways. Firstly, furnace is kept at 800°C the rate 5° per minute without sample. Then sample is kept in it and after 1 hr sample is taken out from furnace and allowed to cool down, the prepared sample is named as C2 (CrFe_2O_4). Secondly, some amount of raw powder (C1) is taken and kept into the furnace and temperature of sample is raised upto 800°C at the rate 5° per minute and it is maintained for 1 hr. After that furnace is switched off and sample is allowed to cool slowly inside the furnace, the prepared sample is named as C3 (CrFe_2O_4). Similar procedure is adopted for the synthesis of ZnFe_2O_4 . Similarly, raw powder of ZnFe_2O_4 is called as Z1. Whereas, two annealed samples of ZnFe_2O_4 formed are called as Z2 and Z3.

The powder XRD patterns were recorded at ambient temperature using Multipurpose Versatile XRD System, Model – SmartLab 3kW, Make – Rigaku with wavelength 1.54 \AA . Thermal measurements of the as prepared powders were recorded in temperature range from 0 to 800°C with the heating rate of $5^\circ\text{C}/\text{min}$ in a thermogravimetric (TG) and differential thermal analyzer (DTA) using Extar SII 6300. The morphological properties were studied using a Gemini 500 Carl Zeiss scanning electron microscope (SEM) along with an Energy Dispersive X-ray Spectrometer (EDS) Bruker QUANTAX 200. Optical spectra were recorded using Thermo scientific Evolution One Plus UV-Vis spectrometer. Finally, Magnetic properties were determined using VSM (Lakeshore 7410S) at room temperature.

3.3 Results and Discussion

XRD interpretation

Fig.1 shows the XRD pattern of CrFe_2O_4 and ZnFe_2O_4 nanoferrites (samples, C2 and Z2) annealed at 800°C at 1hr with different techniques. The diffraction peaks (111), (220), (311), (222), (400), (422), (440), (533) correspond to the planes of CrFe_2O_4 spinel structure (Parveez et al., 2018). The diffraction peaks (220), (311), (222), (400), (422), (511), (440), (533) (JCPDS data 82-1042) correspond to the ZnFe_2O_4 spinel structure. Both samples of CrFe_2O_4 and ZnFe_2O_4 possess single phase cubic structure with space group $\text{Fd}\bar{3}\text{m}$ (Gao et al., 2018). The structural parameters are calculated and tabulated as

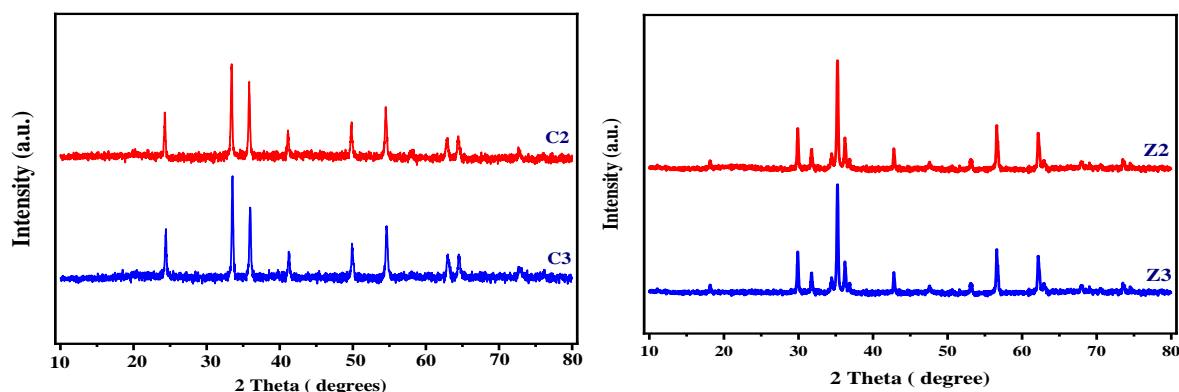


Fig. 1: XRD pattern of samples of (i) CrFe_2O_4 and (ii) ZnFe_2O_4 annealed differently

Table 1: Structural parameters of C2 and Z2 at 800°C		
Microstructural Parameters	C2	Z2
Samples	CrFe_2O_4	ZnFe_2O_4
FWHM (°)	0.2409	0.2326
Crystallite size By DS-formula (nm)	35.98	37.44
Particle size By SEM (nm)	92.88	89.42
Lattice constant a (Å)	8.8943	8.4518
Lattice Volume (Å ³)	703.6154	603.7368
X-Ray Density (g/cm ³)	4.2981	5.3036
Dislocation Density δ (nm ⁻²)	0.7724	0.7130
Lattice strain $\times 10^{-3}$	3.502	3.200

Thermogravimetric analysis and differential thermal analysis

Heat treatment of as prepared samples of CrFe_2O_4 (C1) and ZnFe_2O_4 (Z1) was carried out in temperature range 0°C to 800°C as shown in Fig 2. In sample C1, weight loss of 1.03% is observed from 15°C to 80°C and a cubic phase formation is seen from 638°C to 743°C and in DTA curve a small endothermic peak observed at 720 °C represents the dehydration of water. In the second sample Z1, a weight loss is 3.08% is observed from 28°C to 124°C, and cubic phase formation is seen from 571°C to 611°C and in DTA curve three endothermic peaks are observed at 390 °C, 600 °C and 780 °C. The peak at 390 °C represents the dehydration of water, the peak at 600 °C represents the formation of spinel ferrite and peak at 780 °C represents formation of crystalline phase.

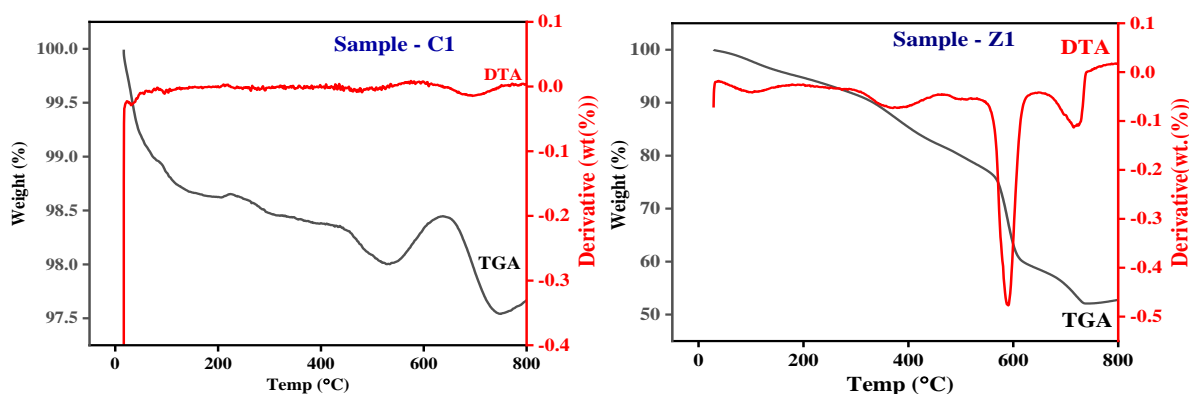


Fig. 2: Thermogravimetric and Differential Thermal Analysis of C1 (CrFe_2O_4) and Z1 (ZnFe_2O_4).

SEM and EDS Analysis:

The structural morphology of the prepared spinel ferrite samples CrFe_2O_4 and ZnFe_2O_4 are shown in SEM micrographs (Fig.3) which reveals that grains of the developed samples are almost homogenous. The clusters formed are due to magnetic interactions among the particles. Agglomeration is also due to increase in surface to volume ratio (Kumar et al., 2020). Using ImageJ software, the particle size calculated from SEM micrographs for samples C2 and Z2 are 92.88 ± 1.3 and 89.42 ± 1.2 nm respectively

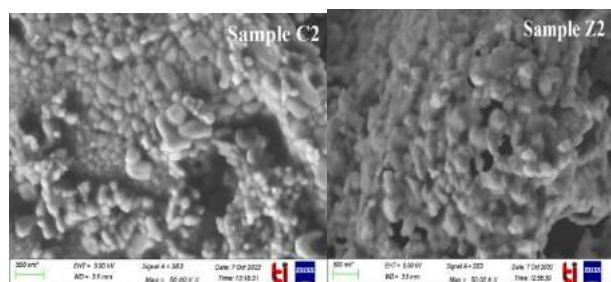


Fig. 3: SEM micrographs of C2 and Z2 samples.

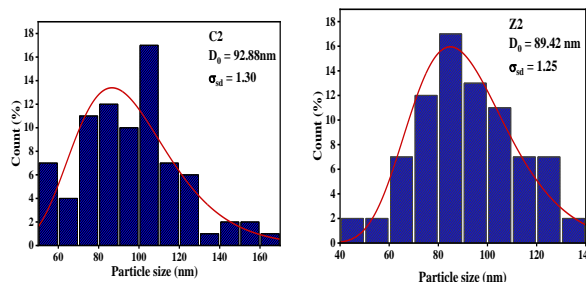


Fig. 4: Particle size histograms for C2 and Z2

The elemental analysis of the prepared samples (CrFe_2O_4 and ZnFe_2O_4) is carried out by using Energy Dispersive X-Ray Spectroscopy (EDS) along with elemental composition as shown in Fig.5 (Lemziouka et al. 2020). The EDX plot indicates that the nanoparticles of C2 are composed of Cr, Fe, and O and for Z2, these are Zn, Fe and O. The weak peak for C and Cu are attributed to the carbon-copper tape supporter used for FESEM imaging purpose.

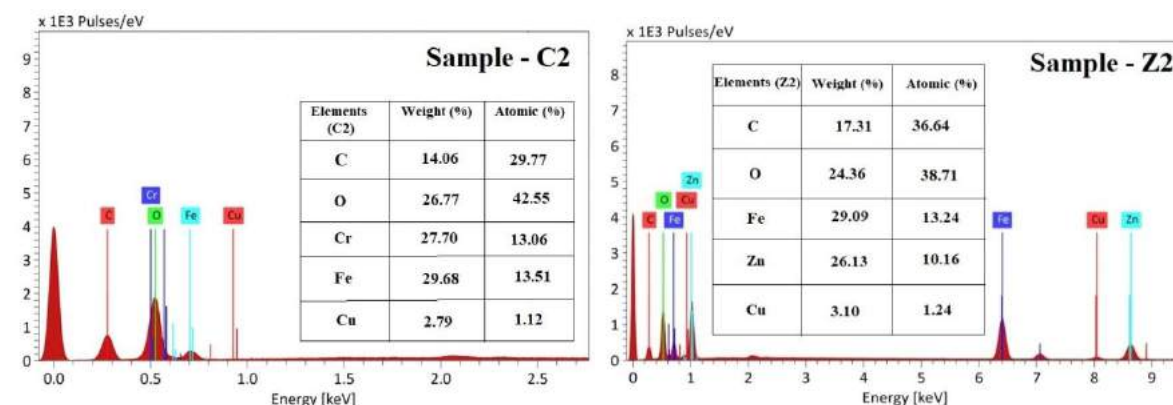


Fig. 5: EDS mapping and elemental composition of C2 and Z2

UV-Visible Spectroscopy

Fig.6 shows, absorption spectra of both samples. For both samples, optical band gap is calculated using Tauc's plot (Tauc et al., 2012). After the extrapolation of linear region in plot, the intercept gives the value of band gap. For C2 and Z2 samples, it comes out to be 3.63eV and 3.65eV respectively. The refractive index (n_0) of ferrites can be calculated by using Moss empirical relation (Massoudi et al., 2020) - $E_g n_0^4 = 104\text{eV}$ Where, E_g the band gap of the sample. The values of calculated refractive index are 2.3136 and 2.3104 for C2 and Z2 samples.

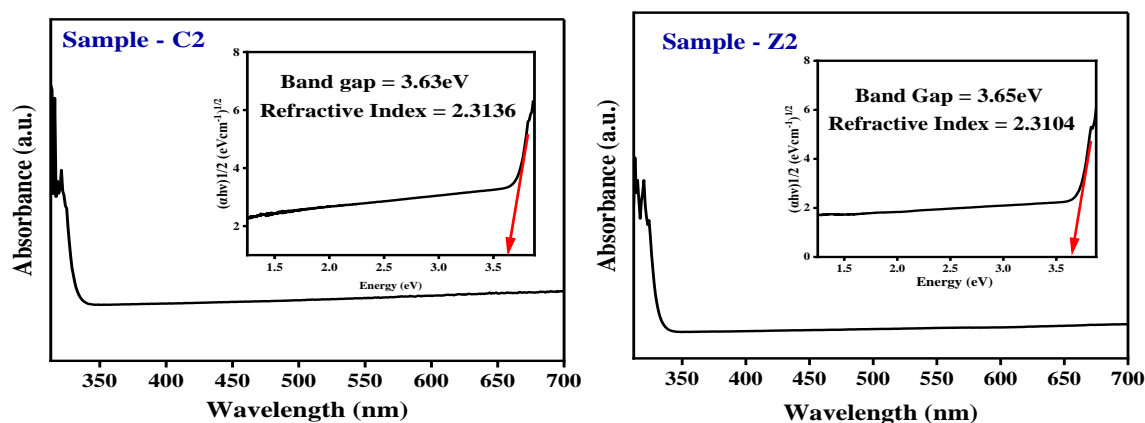


Fig.6: UV–Visible absorption spectra and Tauc's plot for C2 and Z2 samples

Vibrating Sample Magnetometer (VSM) Analysis:

The magnetization curves of the prepared samples C2 and Z2 (CrFe_2O_4 and ZnFe_2O_4) obtained from the VSM measurements at 300K are shown in Fig.7. Coercivity of sample C2 is calculated as 131.8354 Oe, whereas lower value (0.2348 Oe) of coercivity for Z2 indicates that prepared sample can be demagnetized easily. Due to low coercivity, the larger grain size of the sample makes the motion of the domain walls easily (Kombahaiah et al., 2017). The squareness ratio ($S = M_R/M_S$) is less than 0.5 indicate that the materials have multi-domain structure (Assar et al., 2015). The magnetic parameters calculated for both samples are shown in Table 2.

S.No	Magnetic Parameters	C2	Z2
1	Saturation Magnetization (emu/g)	0.2549	1.4538
2	Coercivity (Oe)	131.8354	0.2348
3	Retentivity (emu/g)	0.002398	0.000052
4	Squareness Ratio	0.0094076	0.0000358

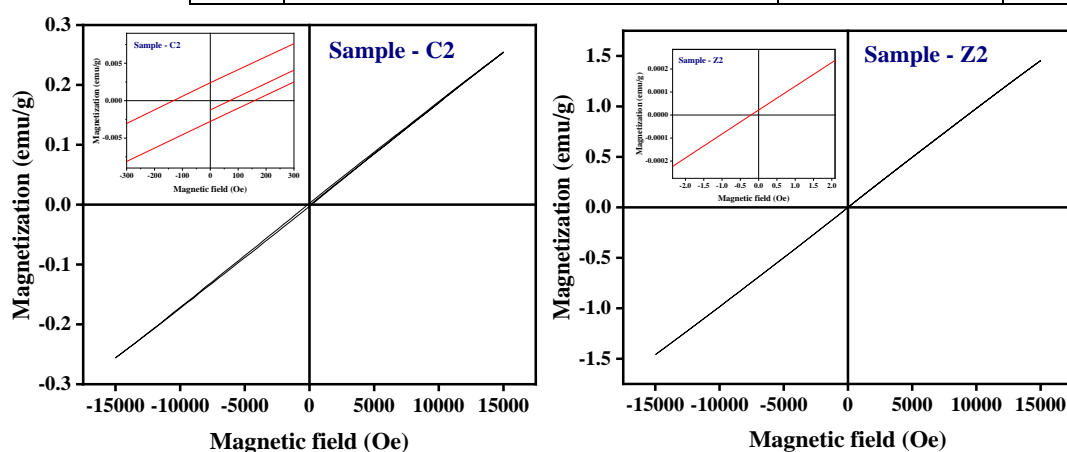


Fig. 7: M-H curve of C2 and Z2 samples respectively.

4. Conclusions

The crystallite size of the samples C2 (CrFe_2O_4) and Z2 (ZnFe_2O_4) calculated using Debye Scherrer formula are 35.98 and 37.44 nm respectively. Difference in other structural parameters is detected when different transition metal is taken at A site of AB_2O_4 spinel structure. Due to heat treatment, crystals agglomerate to form particles which can be seen from SEM micrographs. Therefore, the particle size calculated from SEM images, using

ImageJ software is bigger than crystallite size that comes out to be 92.88 and 89.42 nm for CrFe_2O_4 and ZnFe_2O_4 which is due to agglomeration. From UV-Vis spectroscopy, it is confirmed that there is very little difference in band gap and refractive index of the two samples. M-H graphs from magnetic measurements show the large difference in the magnetic parameters of both samples and squareness ratio less than 0.5; indicate the multi domain structure of both samples.

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SOCIO-ECONOMIC IMPLICATIONS OF QUAD COUNTRIES IN THE GLOBAL ECONOMY

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QUAD continues to uphold and advocate rules-based order. Quad's commitment to delivering essential services is a way of enabling choices, promoting resilient region with sovereignty. Quad countries have multiple justifications to enhance economic involvement. Of course, each nation has an individual variant in economic growth standing. Together, they hold an estimated GDP of \$34.8 trillion with a quarter of the global population, 1.9 billion. It is necessary that Trade, and Foreign Investment be made possible to build resilient Supply Chains. Additionally, they are capable of overcoming one another's socio-economic shortcomings and the world at large. As they complement each other well with culture, infrastructure, technology, alongside natural and human resources. The study sums up; nations must develop a collective will in order to gradually push the globe away from the apparent old colonization era to Security and Growth for All. This is precisely what Quad Nation signifies.

Keywords: QUAD, Trade, Foreign Direct Investment, Supply Chains.

1. Introduction

Extreme events often compel mankind to reinvent the wheel. Likewise, COVID-19 has pushed for worldwide solidarity under investigation. Added to this, Russia-China against a US-led West heightened antagonism, probably the most lethal subject of the century. Now is the time to make choices that will have overarching implications. Therefore approach to multilateralism needs to be adjusted as the outbreak offers a conduit to interconnect multiple societies. But identifying a purpose for consensus across heavyweights is perhaps as hard as it was during the Soviet era. A suitable strategy can treat the underlying issues. So, one must renounce the differentials in international governance paradigms. This is also an effort that must reorient development funding and private-sector incentives. Additionally, advanced economies must now honor their promises to provide official demographic assistance.

The Quadrilateral Security Dialogue – the "Quad" member states have already sensed that in order to contend competently with an eddying global power, they must pool their capabilities and competencies. Collectively bargain out political, institutional, technical, but also economic strands. All nations underlined their determination Indo-Pacific mandates to join the alliance as a central aspect. With 1.9 billion people, the four countries jointly account for USD 34.8 trillion in GDP. Furthermore, these account for 30% of global FDI stock along with 18% of two-way trade (both goods and services) (*Quad Leaders' Summit, 2023*). Re-evaluating QUAD's profile as a full-fledged organisation is necessary in light of its significant worldwide role in *Socio-Economic* engagement.

The study at hand is a small attempt to examine QUAD's present functioning in order to see potential future outcomes.

2. Quad Chipping in Trade, and Foreign Investment Foundation

Quad - fraternization of three advanced, producer-trading nations in Pacific Ocean with one developing consumer market in an Indian Ocean. This features scalable solutions across critical sectors e.g. technology, medicine, or financing for continuing socio-economic growth. Consequently, encourages innovative thinking, information sharing to improvisation that can serve the foundation for a post-pandemic geo-strategic era. Although, too soon to decide on the Quad's codification (Chari, 2021).

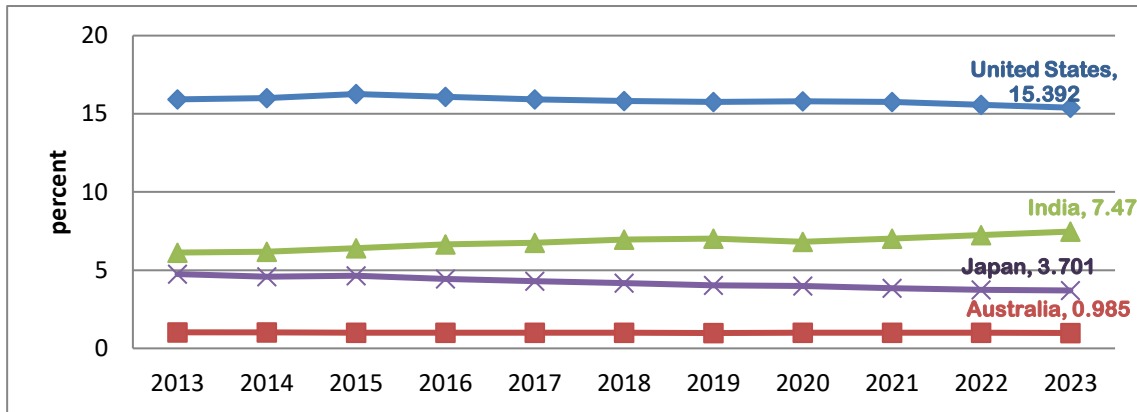


Figure 1: Share of Quad in world's GDP based on PPP, Author's calculation on the basis of details provided by IMF based on DataMapper estimates

There is a noticeable disparity between their economic growth standings, but they complement each other well with lifestyle and culture, infrastructure, technology, and natural and human resources. They can overcome each other's weaknesses and the world, of course, by working together.

COVID has reminded people that they need sovereign capabilities. Unfortunately, the battle of wills continues barring allies, and as a result, the world is witnessing disturbing circumstances. Commanding production of all items locally is barely attainable or not even ideal every time. Such is now the scenario in the U.S. that requires the ingenuity, expertise, and industrial resources necessary for specialised lithium-ion batteries (Building Resilient Supply Chains, 2021). Likewise, Australia and New Zealand are both gourmandizing oil over and above available offshore services. Regardless of the fact both natural gas and oil deposits are in short supply throughout Australia and Oceania (Australia and Oceania, 2012). Imports of the same by Australia increased at the fastest rate in two decades, reaching a record A \$ 41.3 billion (\$30.9 billion) (Zhang, 2022). Even Japan imports 87.9% of its energy needs. The administration is always striving to build a sustainable energy demand-supply arrangement geared to reducing current bills (Statistics Bureau, 2021).

Table 1 Share of Quad in world's Trade and FDI										
<i>(in billions of US\$)</i>	JAPAN		AUSTRALI A		INDIA		UNITED STATES OF AMERICA		WORLD	
	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021
Trade balance										

Merchandise	-23.1	-12.9	-20.8	83.6	-126.1	-177.4	-812.7	-1181.0	-182.9	276.3
Services	-15.9	-39.4 (e)	-8.8	6.0 (e)	32.7 (e)	44.7 (e)	271.0	245.2	109	-448.2
FDI										
Inflows	2.9	24.6	29.5	25.0	44.0	44.7	467.6	367.3	2063.6	1582.3
Outflows	136.2	146.7	-9.3	9.2	7.5	15.5	264.3	403.1	1722.7	1707.5
Source: Author’s calculation on the basis of details provided by UNCTAD, based on UNCTADstat estimates, World Investment Report 2022										

Considering the world’s adjustment to a low-carbon atmosphere, a couple of biases come into play. One is an increase in desire for magnets, specifically neodymium-iron-boron magnets, and the other is China's rare earths industrial predominance (China extracted 110,000 tonnes of rare earths during 2020, accounting for over 55 percent of the estimated worldwide mine yield).

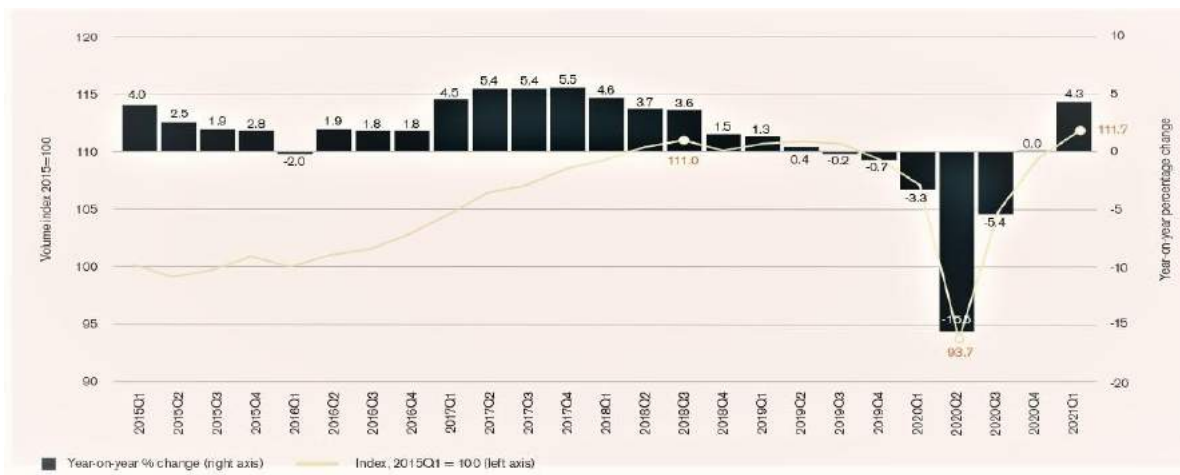


Figure 2: Global merchandise trade volumes, WTO Secretariat and UNCTAD. World Trade Statistical Review 2021, pg23

The current underlying scourge will continue to cast doubt on corporate policies, the trade system, and even the investment surface. Organizations confront difficulties in absorbing this volatility into their management (*Our Global Condition*, 2021). It indeed reached the stage wherein demand shook off supply. Such vulnerabilities were exacerbated by transitory restrictions on trade. A robust supply chain should adapt swiftly to an unusual incident and involves speedy solutions backed by line expertise, direction, and commitment. However both industrial production and distribution have been affected by supply chain failures. The same factors contribute to grey market behavior and deceptive solutions (Narcisi, 2022). All of this forged worldwide manufacturers to reduce their reliance on riskier suppliers along with reconsidering lean manufacturing practices that include decreasing the amount of inventory retained in their global supply chains (Shih, 2020).

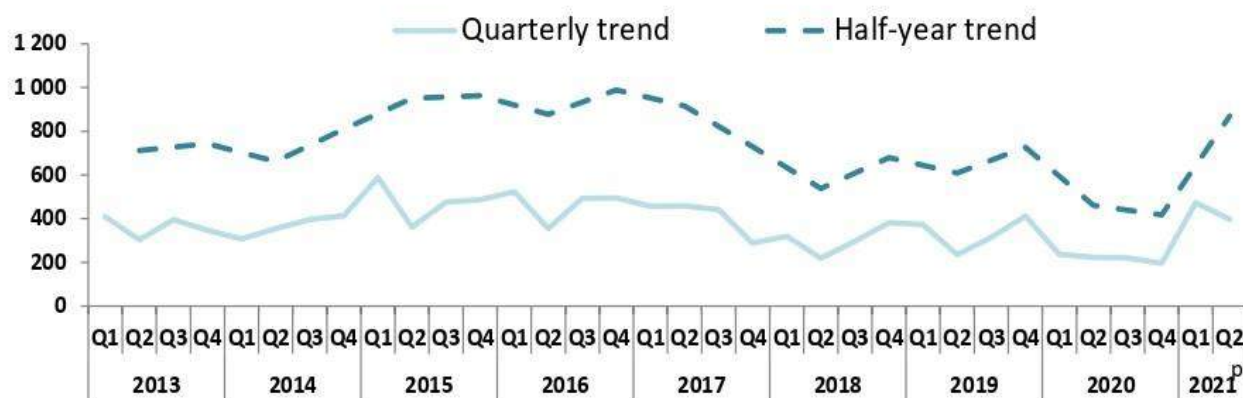


Figure 3:

Global FDI Flows, OECD International Direct Investment Statistics database.

To maintain consistent availability of vital minerals and metals, leading economies such as the United States, Japan, and Russia are all looking for rare earths from sources other than China (Williams, 2021). The University of South Australia has already made significant efforts to create game-changing methods for extracting important minerals from downstream ore processing, tailings reprocessing, or wastewater treatment. This proposal will benefit India as it is sponsored by the Australia-India Strategic Research Fund. This would also provide Indians with the means to explore eco-technologies towards the extraction process. This further suggests that Australia will supply mineral wealth to India as a substitute for China (Researchers Look into Extracting Critical Metals, 2022). In addition, India intends to launch its first lithium ion (li-ion) battery to achieve self-sufficiency in the defense industry and limit imports, particularly from China. This should massively boost clean energy and the National Electric Mobility Mission (Pioneer, 2018).

3. Quad towards modern challenges

Quad is currently pursued in the form of six Leader-level Working groups, including:

Climate, health security, critical and emerging technology, cyberspace, infrastructure, and space
 To begin with an event that showcase current instability. Even though this collaboration was initially put forward in 2004, the public only became fervently informed about it after the fatal corona interruption. For that reason, the reference to COVID will certainly be in the task descriptions. Nonetheless, it does not imply that there will not be a future, yet it was an excellent inspiration for it to speed up its slow endeavours.

Table 2. Solutions to Cut Socioeconomic Concerns

Structural Fiscal Indicators (Percent of GDP, except when indicated otherwise)	United States	Japan	Australia	India
Pension Spending Change, 2021–30	0.7	-0.9	-0.1	0.6
Net Present Value of Pension Spending Change, 2021–50	17.2	4.9	-3.6	28.7
Health Care Spending Change, 2021–30	3.5	1.6	1.0	0.2

Net Present Value of Health Care Spending Change, 2021–50	130.7	52.0	38.4	7.4
Projected Interest Rate–Growth Differential, 2022–27 (percent)	-2.5	-1.1	-1.8	-4.2
Nonresident Holding of General Government Debt, 2021 (percent of total)	25.0	12.8	33.7	4.8

Source: Author's compilation on the basis of details provided by International Monetary Fund (IMF). 2022. Fiscal Monitor: Helping People Bounce Back. Washington, DC: IMF, p. 99.

Quad Pan Assistances from high-rise structures to cold chain mechanisms to training healthcare professionals, guarantee immunization coverage in far-off regions (Joint Statement on Quad Cooperation in the Indo-Pacific, 2022). In tandem with increasing commitment to the Indo-Pacific community; For example, ASEAN is well-known for its staunch support of international doctrine. Particularly on maritime rule-based issues in the South and East China Seas, as enshrined in the United Nations Convention on the Law of the Sea (UNCLOS) (Brajesh, 2022). Accordingly group endorses ASEAN's effective application of the regional agenda. Then, reiterating their readiness to achieve North Korean denuclearization in accordance with the UN Security Council provisions. Whilst settling the challenge of Japanese abductees and nurturing Myanmar's democratic resiliency (Quad Leaders' Joint Statement, 2021).

At the same time, rising digital revolution of numerous processes or behaviors emphasizes the call for rigorous project work. Because anti-corruption initiatives struggling to form substantial cross-national doctrine (Holovkin et al., 2021). As shown by Accenture's Cyber Investigations, Forensics & Response (CIFR), the United States has been victimized most, making up 36 percent, trailed by the United Kingdom (24 percent), and Australia (11 percent). Indeed, the Australian authorities announced an investment of \$1.67 billion over a decade to create a highly safe online environment for businesses' services (Cyber Security Strategy, 2020). In the first half of 2021, the frequency of large-scale cyber infiltration increased by 125 percent when compared to the same period the previous year (Geib & Berard, 2021).

China, Russia, Iran, and even North Korea have all intensified the world's present cyber security problems (Committee on Homeland Security, 2013). Indeed, Taiwan currently has the largest semiconductor manufacturing industry in the world. With global hostilities and reliance on Taipei, Quad is determinate to uphold hi-tech supply networks. It plans to reconfigure the system to ensure supply management operations (Krishnan et al., 2021). The Quad Tech Network (QTN) seems to have the power to create one such forum for academics as well as think-tank specialists to address such concerns with their peers in related democracies (Takahashi et al., 2021).

As a result, Japan has chosen Indians and Australians for projects in the data, IT, medical, and cold chain domains. India has been covered for six out of the eight project activities. Wherein one of attempts is to create a master repository of manufacturing elements, facilitating accessibility over production iterations in favor of digitizing drone manufacturing (Nandi, 2022). Other initiatives would use spatial information as well as artificial intelligence to help limit the utilization of chemical fertilization; eventually cutting carbon emissions from fields. This action came after the Supply Chain Resilience Initiative (SCRI) agreement to supply chain resilience and to

also consider potential source nations that may join the action. It also intends to create chances for stakeholders to enhance capacity and promote local production. Further, Japan's Ministry of Defense seeks to advance its cyberspace manpower by employing private player (Kobera, 2021). Likewise Indian Computer Emergency Response Team (CERT-In) directed public as well as private organizations to disclose cyber incidents within six hours of the incident. It mandates companies to keep records of ICT systems for 180 days within India (Bhardwaj, 2022). As such, deeply committed democratic countries must also try to coordinate impactful multilateral retorts against disruption techniques. Lastly, "medical diplomacy" can make or break a country, as acknowledged by Peter Bourne, in 1978, he believed that the United States had not adequately pursued the potential of medical science as a tool for foreign policy (Khodayari – Zarnaq et al., 2019).

4. Way Forward

Humanity is presently grappling with an interplay of struggles—wars, the global pandemic, and extreme weather events. They run the danger of rolling back the notable progress gained in the last several decades. Covid has dragged societies into unanticipated harsher positions comprising starvation, involuntary migration, debt swamping, food-fuel emergencies, etc.

Besides, the Russia-Ukraine confrontation, Chinese surveillance of Taiwan, continual strikes on Syria, assaults on Afghanistan, North-South Korean missile competition, and so on. Additionally, as evident in Pakistan and Myanmar, a few nations are indeed undergoing domestic emergencies. This is all concerning the murky end, with superior economies daring to seize impoverished societies. Eventually, the new world will return to its historic merciless penchant for warfare to control another land.

Here, the Quad, priority is to keep the Indo-Pacific "free and open." It's an informal pact of democracies sharing joint socioeconomic and geopolitical ambitions, brings together the United States, Japan, India, and Australia. There is a noticeable disparity between their economic growth standings, but they complement each other well with lifestyle and culture, infrastructure, technology, and natural and human resources. They can overcome each other's weaknesses and the world, of course, by working together.

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MEDICAL TOURISM IN INDIA

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Medical tourism is a rapidly expanding global industry, with patients travelling across borders to access healthcare services in various countries. India has appeared as one of the leading destinations for medical tourism, offering world-class healthcare facilities at affordable prices. This research paper aspires to provide an in-depth analysis of the medical tourism industry in India, investigating its growth drivers, challenges, and prospects. By exploring various factors such as healthcare infrastructure, quality of medical services, cost-effectiveness, government initiatives, and marketing strategies, this study presents a comprehensive overview of India's position in the global medical tourism market.

Key Words: Medical, Tourism, Growth, Healthcare.

1. Introduction

Medical tourism is a global phenomenon where individuals travel to different countries to seek medical treatment, surgery, or healthcare services. It is a combination of healthcare, travel, and tourism, and it has evolved an increasingly prevalent alternative for patients seeking specialized, cost-effective, or timely medical care that may not be readily obtainable or affordable in their home countries. The rise of medical tourism can be attributed to factors such as refinements in transportation, globalization, rising healthcare costs in developed countries, and the availability of high-quality medical services in certain destinations. India has long been renowned for its extensive history of "wellness" customs and has a lot to offer anyone seeking such things. One of the travel and leisure sector's fastest-growing subsectors in India is the wellness sector. Medical Tourism in India, in mid-2020, was estimated to be worth around USD 9 billion which makes India stand at 10th in the Global Medical Tourism Index. Approximately 2 million patients come to India annually from 78 different countries for medical, wellness, and IVF treatments. This generates \$6 billion for the business, which is supported by the government's Heal in India initiative and is predicted to reach \$13 billion by 2026. Modern facilities and highly skilled staff found especially in the private institutions are adding feature of Indian healthcare industry. Further, low cost of medical care has encouraged foreign tourists to visit the country eventually enabling tourism at other locations across the nation. In terms of infrastructure, technology, specialized doctors, and nurses, the Indian healthcare business competes with the best in the world. The nation possesses one of the best and largest pools of physicians and paramedics in all of South Asia, many of whom are well-known internationally. India is quickly becoming a popular destination for medical tourism because of its proficiency in highly specialized fields like oncology, cardiology, and organ transplantation, among others. Ayurveda, Yoga, Unani, Siddha, and homoeopathy (AYUSH), which have repeatedly demonstrated their effectiveness for patients and are now widely accepted as alternative treatment procedures in many geographies, are just a few of the ancient and age-old traditional treatment methods that represent India's unmatched heritage. More and more patients are traveling to India in recent years to receive a combination of the tried-and-true and health-restoring AYUSH treatments. In addition to creating jobs, financial gain, and foreign exchange for hospitals, medical tourism also enhances India's soft power and positions it as the global center of healing. Additionally, it increases demand for expensive equipment, which drives constant improvement in Indian healthcare. In addition to medical facilities, India provides excellent travel and tourism opportunities. Patients can combine their medical treatments with visits to historical

landmarks, cultural experiences, and natural wonders. The country's rich heritage, diverse cuisine, and warm hospitality contribute to a holistic experience for medical tourists.

Significance of Medical Tourism: The significance of medical tourism lies in its potential to address healthcare requirements and priorities across borders. For patients from developed countries, it suggests an opportunity to access high-quality remedies at a fraction of the cost they would incur at home. On the other hand, for patients from developing countries, medical tourism provides credentials to advanced medical facilities and treatments that may not be public in their home countries. Beyond the economic benefits, medical tourism also promotes international cooperation, exchange of medical knowledge, and cultural understanding.

2. Review of Literature:

Singh (2016) examined the growth of medical tourism in India with an objective to review the state, growth reasons and future prospects. It was found that medical tourism is one of the fastest growing services in India and World. India's competitive advantage in medical facilities made it favorable. It was suggested that steps need to be taken for the development of medical industry.

Malhotra and Dave (2022) assessed the competitiveness of medical tourism in India through a case study of Delhi NCR. The aim of study was to analyse the key driving factors for the medical tourism industry in India and the issues that Indian stakeholders should address in crafting a winning strategy. A qualitative research design was adopted, and data were collected through semi structured in-depth interviews with practitioners and senior representatives of the hospital management. It was found that the growth was driven by five major factors such as cost competitiveness, medical expertise, quality of healthcare services, robust private sector and cultural adaptability. It was also found that there were paucity of an amenable policy framework, inadequate tourism and logistic infrastructure, unstandardized service quality standards, and India's poor perception on macroeconomic factors such as corruption, environment quality, safety. It was suggested that India must place a premium on a collaborative effort from all the stakeholders, to address these issues; a commitment to innovation and sustained inclusive growth.

Jindal and Yashika (2019) analysed medical tourism in India with the objective to study situations and future prospects of Indian medical tourism industry. It also studied the growth drivers, mechanism and challenges faced by medical tourism industry. It was found that medical tourism industry was a continuously developing and growing industry in India. The arrival of tourist was increased during the month of October, November and December due to weather. Kerala was one of the famous states for ayurvedic treatment in India. The study found competition, infrastructure, brain drain, follow-up problems as major challenges faced by the industry.

Manjula, Sharma and Kumar (2022) studied medical tourism in India with the purpose to find out factors impacting India's appeal as a health tourism destination and to examine the current situation of medical tourism in India. The analysis was based on secondary data such as Ph. D. theses, government agency websites, publications, and research papers. It was found that some form of public-private collaboration between hospitals for medical treatment would be extremely beneficial.

3. Objective and Scope of the Research Paper:

The objective of this research paper is to analyse medical tourism in India. The study aims to explore the growth drivers, challenges, and prospects of medical tourism in India. This study will contribute to a better understanding

of the dynamics of medical tourism in India and provide valuable insights for stakeholders in the healthcare and tourism industries.

Growth Drivers of Medical Tourism in India: One of the primary attractions of medical tourism is the potential for cost savings. Medical treatments in the country is significantly less expensive compared to developed countries, making it an appealing option for individuals seeking affordable healthcare. However, the quality of care is also a crucial consideration. India has internationally accredited hospitals and clinics, highly skilled doctors, and state-of-the-art medical facilities to ensure high-quality medical services.

Quality of healthcare infrastructure and Technological advancements: India has invested much in creating world-class healthcare facilities, including hospitals, specialty clinics, and destinations for medical tourism. Modern amenities, progressive medical technology, and infrastructure are all available in Indian hospitals and establishments. International accreditations for some Indian hospitals guarantee high standards of treatment and patient security. The availability of such high-quality infrastructure increases India's appeal as a destination for medical tourism. Modern technologies and practices are being used by hospitals and healthcare organizations in India. Such as Renowned cardiac care facilities include cutting-edge cardiac catheterization labs, hybrid operating rooms, and resources for difficult cardiac operations and interventions. Modern organ transplant facilities, including those for liver, kidney, heart, and bone marrow transplants, are available in Indian hospitals. These facilities are backed by advanced infrastructure and qualified medical staff. Using advanced implant technology, India provides modern orthopedic treatments such as joint replacements, minimally invasive operations, and robotic-assisted procedures. Medical oncology, surgical oncology, medical oncology, and precision medicine techniques like targeted treatments and immunotherapies are all available in Indian hospitals for the treatment of cancer. India is renowned for its proficiency in fertility treatments, including modern facilities and specialist procedures like surrogacy and in vitro fertilization (IVF).

1. **Highly skilled healthcare professionals and specialists:** The nation's robust medical school system annually turns forth a sizable number of physicians, nurses, and specialists. India has a large and talented doctor population that excels in many different medical areas. They receive intensive education and training in reputable medical schools and hospitals. For their proficiency in specialties like cardiology, oncology, neurology, orthopedics, and many more, Indian physicians are renowned throughout the world.

2. **Cost-effectiveness and competitive pricing:** Cost effectiveness is a key component of Indian healthcare because of the diverse population, economic inequalities, and requirement to offer healthcare to all inhabitants in India. Generic medication is widely available, and its use lowers overall healthcare costs for people and the healthcare system. In order to offer the people services at reasonable costs, Indian government has worked to develop a public healthcare infrastructure that includes district hospitals and primary healthcare facilities. These clinics provide basic healthcare treatments at reduced costs or without charge. People with insurance can obtain high-quality healthcare without having to worry about significant out-of-pocket costs. Due to the expansion of the private sector and the entrance of corporate hospitals, pricing rivalry in the healthcare industry has risen. Regulations have been put in place by the Indian government to monitor and manage healthcare costs, particularly for necessary medications and medical treatments. To ensure equitable pricing in healthcare, regulatory organizations like the National Pharmaceutical Pricing Authority (NPPA) are important.

3. **Diverse treatment options and specialized services:** India provides tailored services to meet the unique requirements of patients from other countries. Many hospitals have departments specifically for international patients that offer individualized help and support throughout the therapeutic process. These divisions support patients with appointment scheduling, visa arrangements, airport transportation, lodging, language interpretation, and even travel-related activities. India is a desirable location for medical tourism due to its rich heritage and cultural variety. Alternative and complementary therapies are receiving more attention than conventional medical

procedures. Acupuncture, chiropractic treatment, herbal remedies, and mindfulness-based techniques are a few examples of these. While obtaining medical attention, patients can see the nation's historical sites, immerse themselves in its rich culture, and savor its delectable food. Patients benefit from a satisfying and comfortable healing process thanks to the kind hospitality and sympathetic care given by medical specialists.

4. **Favorable government policies and initiatives:** India has been a well-liked destination for medical tourists as a result of the introduction of the e-Medical Visa, the creation of healthcare zones, international collaborations, accreditation programs, and a focus on cost-effectiveness. These initiatives have improved not only India's healthcare industry but also the country's general tourism industry as a whole. In order to encourage foreign partnerships and collaborations in the healthcare industry, the government has also taken numerous actions. This includes promoting collaborations between Indian hospitals and foreign medical organizations and facilitating the transfer of medical knowledge and technology.

5. **Geographical proximity and ease of travel:** India, which is located in South Asia, borders a number of nations, including Bangladesh, Nepal, Bhutan, and Myanmar. Patients from these nearby countries can easily access healthcare services in India without taking long flights or making difficult travel arrangements due to this close proximity. India also boasts a sophisticated transportation network that includes a sizable network of airports and domestic carriers. This connectivity makes it simple to go to other cities and healthcare institutions across the nation.

4. **Challenges for Medical Tourism in India:** While medical tourism provides benefits, it also comes with challenges and risks. Language barriers, cultural differences, varying medical standards, complications during travel or recovery, and limited legal recourse in case of malpractice are some of the challenges that patients may encounter.

- The quality of healthcare services might vary, notwithstanding India's tremendous improvements in healthcare infrastructure and knowledge. India's healthcare facilities don't all adhere to international norms, and there are not enough uniform quality control procedures applied across. The variability can make it difficult for medical tourists to get the standard of care they expect.
- For foreign patients seeking medical care in India, language problems is a major obstacle. Despite the fact that many Indian healthcare workers are fluent in English, still there are times when something is misunderstood. This may affect how well follow-up care, treatment regimens, and consultations with doctors work.
- Medical tourism poses ethical issues, notably that involving organ transplantation, surrogacy, and the exploitation of weaker groups of people. There have been instances of unethical behavior, despite the fact that India has legislation in place to address these issues. Medical tourists must exercise caution and make sure they receive treatments that are morally and legally acceptable.
- There may be issues with infection control and hygiene standards in some healthcare institutions, especially those that cater to lower-cost medical tourism. To maintain patient safety, proper cleanliness, sterilization of medical equipment, and adherence to infection control policies are crucial. To reduce this risk, medical travelers should do their research and pick reputed hospitals and clinics.
- Medical tourists frequently need follow-up care after treatment or surgery, which can be difficult to arrange from a distance. It can be difficult logistically to arrange follow-up care with healthcare providers in the patient's native country and maintain continuity of care.
- Patient experiences for medical tourists might be impacted by cultural expectations and disparities. Misunderstandings and discontent may result from differences in healthcare procedures, communication methods, and patient-provider interactions. Healthcare professionals must be aware of these cultural variances and offer the proper treatment and support.

- Medical tourists must understand India's laws as well as the laws and regulations of their own nation. It can be complicated and difficult to understand legal rights, obligations, and available remedies.

- Medical tourists may find it difficult to arrange travel logistics, such as visas, lodging, transportation, and insurance. The coordination of these factors while addressing health-related issues adds another level of complexity.

5. **Future prospects for medical tourism in India:** Due to a number of variables, India has a promising future in the field of medical tourism. The following are some of India's top medical tourism prospects:

- India has invested heavily in creating top-notch healthcare infrastructure. India has a large number of hospitals and medical institutions with latest equipment and staff who have received international accreditation.

- One of the main factors contributing to the growth of medical tourism in India is the cost savings it provides. While still maintaining good standards of care, medical procedures in India can be much less expensive than in wealthy nations. Patients from all over the world who want high-quality care at a fraction of the price they would pay in their native countries are drawn to this cost-effectiveness.

- There is a sizable pool of highly qualified and experienced physicians, surgeons, and other medical specialists in India. Numerous Indian doctors have studied abroad and are regarded as experts in a variety of medical areas. This promotes confidence and trust among foreign patients seeking medical treatment in India.

- Country offers a wide range of medical procedures and treatments, including advanced cardiac surgery, organ transplants, orthopedic procedures, fertility treatments, cosmetic surgeries, and more. India is a popular destination for medical tourism because there are many different treatment options available.

- Ayurveda is a traditional medical system practiced in India. Tourists seeking holistic health and rejuvenation are increasingly turning to ayurvedic therapies and wellness retreats. Indian traditional medicine has a long history, and it combines with contemporary wellness centers to offer medical tourists something special.

- The Indian government has been actively encouraging medical tourism and has put rules into place to make it easier for patients and the people they are traveling with to obtain visas. With these initiatives, India will be easier to reach and more convenient for foreign people seeking medical care.

- India is a popular destination for medical tourists due to its rich cultural history, historical sites, and tourist attractions. Patients and their families can enhance their overall experience by combining their medical vacation with an exploration of India's rich cultural heritage.

6. **Conclusion:** Medical travel to India has grown into a booming business that benefits patients from all over the world in a variety of ways. India's healthcare system has advanced significantly in recent years, boasting top-notch facilities, highly qualified medical staff, and latest technology. Indian healthcare is far more affordable than that of other nations, which attracts foreign patients looking for high-quality care at competitive costs. In addition, India's rich cultural diversity, welcoming people, and well-known tourist attractions make it a desirable location for medical travelers who want to combine their treatment with an unforgettable travel adventure. India continues to be a top choice for anyone looking for top-quality medical care and a life-changing healthcare experience because of its remarkable medical infrastructure, affordability, and holistic patient care.

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MULTIMODALITY IN BIOMETRICS.....SAFE, SEAMLESS AND SECURE

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In recent years combining several biometric technologies together has proved very useful to identify or authenticate a person with the best reliability. This is called multimodal biometrics. Sometimes it is too difficult to rely on one of the two or three. Multimodal authentication offers a higher level of security compared to unimodal biometrics, which relies on a single biometric data point like fingerprint, face, palm print, or iris. One of the benefits of combining several biometric solutions is security. Indeed, by layering new and additional modalities together, biometrics can contribute to creating a safer, more seamless, and secure environment. A multimodal biometric system expands the range and diversity of input data collected from users during the authentication process. Biometrics system applies pattern recognition, signal processing and image processing operations based on various human traits to provide security that makes the more robust system.

Keywords: Biometrics, Sensory Organs, unimodal biometrics, multimodal biometrics

1. INTRODUCTION

The topic "Multimodality in Biometrics: Ensuring Safety, Seamlessness, and Security" discusses the application of various biometric modalities or traits in authentication and identification systems. Utilising distinctive physical or behavioural traits of people, such as fingerprints, facial features, voice, iris patterns, or EEG signals, for identity verification is known as biometrics. In order to improve the precision, dependability, and security of the identification process, multimodality in biometrics entails integrating two or more of these biometric properties.

Safety: Incorporating multiple biometric traits provides an added layer of safety to the authentication process. By relying on multiple traits, the system becomes more robust against spoofing attacks or attempts to deceive the system using fake or stolen biometric data. Multimodal biometric systems are less susceptible to false positives and false negatives, improving overall safety and minimizing security breaches.

Seamlessness: Multimodal biometric systems offer a seamless and user-friendly experience. Users can be authenticated using different modalities without the need for explicit input, such as entering a password or PIN. This seamless process enhances user convenience and reduces the likelihood of forgetting or sharing credentials, making it more user-friendly and efficient.

Security: Multimodal biometrics significantly enhance the security of identification systems. Traditional single-modal biometric systems shown in figure 1 may have limitations in terms of accuracy or susceptibility to certain types of attacks. By combining multiple modalities, the system can benefit from the strengths of each individual modality while compensating for their weaknesses. This increases the level of security and makes it more challenging for malicious attackers to bypass or circumvent the system.

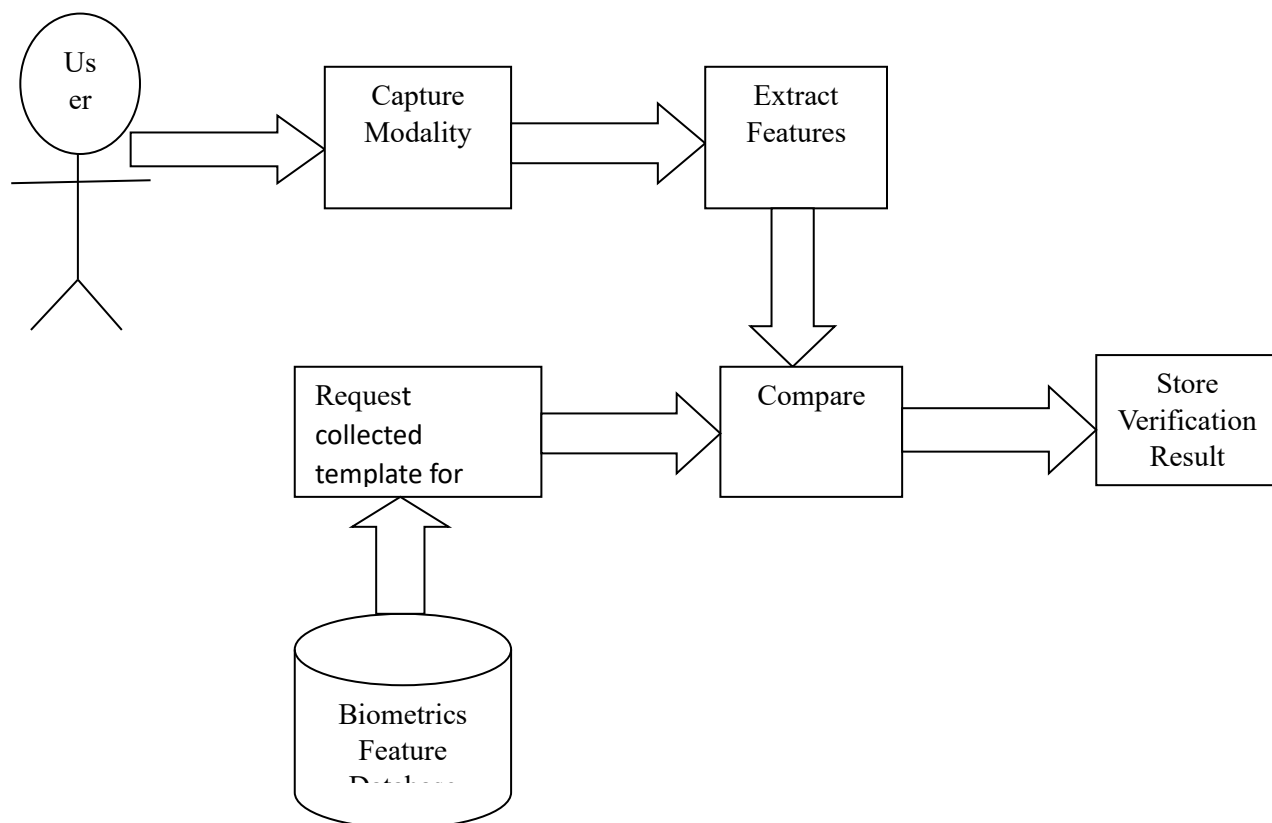


Figure 1: General steps for Biometric verification of single modality.

Implementing multimodality in biometrics requires sophisticated algorithms for data fusion, matching, and decision-making. The system must effectively integrate and compare biometric data from different modalities to determine the authenticity of the user. Additionally, privacy considerations must be addressed to ensure the safe handling and storage of sensitive biometric information. Overall, multimodality in biometrics represents a promising approach for creating robust and reliable identification systems that prioritize safety, provide seamless user experiences, and enhance security in various applications, including access control, financial transactions, healthcare, and more (Al Abdulwahid et al., 2016)

In the modern world, biometrics is crucial to many parts of our everyday lives and is now an essential component of security and identity systems. Here are some significant fields where biometrics are employed frequently:

Mobile Phones: In order to unlock the device and secure sensitive data, many smartphones now have biometric authentication techniques like fingerprint scanners or face recognition.

Airport Security: Biometric technology is used at airports for passenger screening and border control. Facial recognition and iris scans are employed to verify travellers identities, streamline the immigration process, and enhance security.

Financial Services: Biometric authentication is increasingly utilized in the financial sector for secure transactions and identity verification in mobile banking apps and digital payment systems.

Healthcare: Biometrics is used in healthcare for patient identification, access control to electronic health records, and secure medication dispensing.

Time and Attendance Tracking: To reliably record employee attendance, several organisations utilise biometric solutions in place of time cards to cut down on time fraud.

Law enforcement: To identify criminals, solve crimes, and preserve public safety, law enforcement agencies rely on biometric techniques like fingerprint and facial recognition.

Access manage: To manage access and guarantee that only authorised personnel can enter, biometric systems are used in offices, government buildings, and protected facilities.

Education: To manage student attendance and streamline administrative procedures, certain colleges and universities adopt biometric attendance tracking systems.

Healthcare Wearable: Health and fitness trackers with biometric sensors, such as heart rate monitors and fingerprint recognition, provide personalized health data and secure access to the user's health information.

Immigration and border control: At international borders, biometrics are used to confirm travellers' identities and stop identity fraud.

Personal Devices: To offer secure access and safeguard user data, biometrics are implemented into personal devices such as laptops and tablets.

These instances highlight the many and broad uses of biometrics in all facets of our daily lives, highlighting their importance in boosting security, enhancing ease, and safeguarding sensitive information. Biometrics is anticipated to play an increasingly bigger role in future applications as technology develops.

2. LITERATURE SURVEY

This section discussed the existing work on multimodal biometrics that are created using various traits of human like face, iris, fingerprint, EEG, gait, voice. Multimodal systems, designed for commercial applications, have been put into practice. These systems vary in terms of fusion levels and algorithms employed for their implementation. Iffath F et al. have devised an innovative approach for audio-visual person recognition, merging auditory and visual cues through a distinct deep learning architecture. This involves extracting high-level features utilizing a pre-trained ResNet architecture from an assortment of user-preferred audio and image samples. To effectively amalgamate these audio and visual elements, they introduce a novel deep learning-based fusion technique named residual-aided intermediate fusion (RAIF)(Iffath & Gavrilova, 2023). S. Abdullahi et al. introduce the FS-STMFPFV-Net, a succession of filtered spatial and temporal multimodal networks designed for fingerprint and finger vein recognition. In this model, fingerprint and finger vein images are aligned within the image generator to establish image sequences. Extracting spatial sequence-oriented information, they integrate these sequences across five layers of a deep convolutional neural network fusion model(Abdullahi et al., 2023). G. Choi et al. illustrate a driver identification system employing a multi-stream CNN and multi-TF (time-frequency) images to translate ECG and EMG signals from diverse driving contexts into 2D spectrograms. The proposed system comprises three stages: pre-processing ECG and EMG signals, transforming to multi-TF images, and using a multi-stream CNN for driver identification(Choi et al., 2023). A. Buriro et al. introduce a comprehensive tetra-model behavioral biometric authentication method for smartphones, known as MBBS (Multimodal Behavioral Biometric System). MBBS leverages four distinct modalities for user authentication, encompassing touch-screen swipes, taps on "text-independent" 8-digit number combinations, touch-screen name writing, and micro-movements of the hand. Furthermore, MBBS incorporates a Generative Adversarial Network (GAN)-powered data augmentation architecture to elevate security and accuracy(Buriro & Ceol, 2023). A. Rahman et al. present a self-organized operational neural network (Self-ONN) based ensemble model, unifying keyboard dynamics and EEG signals. This multimodal and session-invariant approach capitalizes on the fusion of these inputs for enhanced recognition performance and reliability.(Rahman et al., 2022).

3 RESEARCH METHODOLOGY

3.1 Sensory Organs In Biometrics

Sensory organs are essential to biometrics, because they produce distinctive physical or behavioural characteristics that can be used to identify people. These distinguishing traits as shown in figure 2 are used by biometric technologies to confirm and authenticate user identity. Several typical sensory systems utilised in biometrics as shown in figure 3 are:

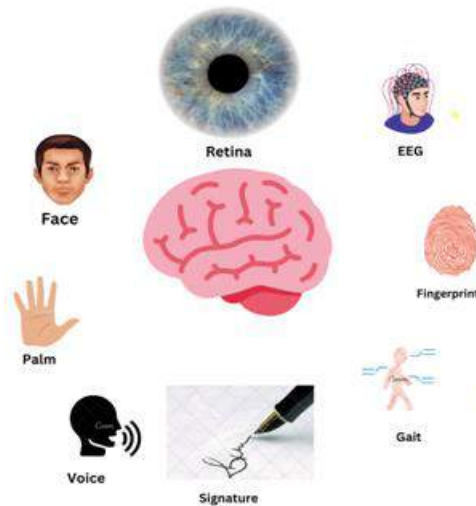


Figure 2: Sensory inputs available for biometric system

Fingerprint: Fingerprint biometrics are one of the most widely used and established methods. The patterns of ridges and furrows on the fingertips are unique to each individual, making fingerprints a reliable biometric trait.

Face: Facial recognition is another popular biometric modality. The unique facial features, such as the arrangement of eyes, nose, and mouth, can be captured and compared for identification purposes.

Iris: The intricate patterns in the coloured portion of the eye are used in iris recognition to identify individuals. The patterns on an individual's iris are very distinctive and persistent across their lifetime.

Retina: Retinal biometrics entails photographing the distinct blood vessel patterns at the retina of the eye. The arrangement of the retinal blood vessels is highly individualised and constant.

Voice: To confirm a person's identification, voice biometrics examine the distinctive properties of their voice, such as pitch, tone, and other vocal traits.

Hand Geometry: Finger lengths and palm sizes are measured as part of hand geometry biometrics, which also examines the size and contour of the hand.

Signature: In order to authenticate a person, signature biometrics record and examine each person's individual writing style.

Gait: As a distinctive biometric attribute, gait recognition focuses on examining a person's walking pattern, including stride length and walking speed.

EEG (Electroencephalogram): EEG biometrics use the particular brainwave patterns recorded from the scalp as an individual identifier.

Vein Patterns: To identify people, vein pattern biometrics employ the distinctive patterns of blood veins under the skin (Kaur et al., 2020).

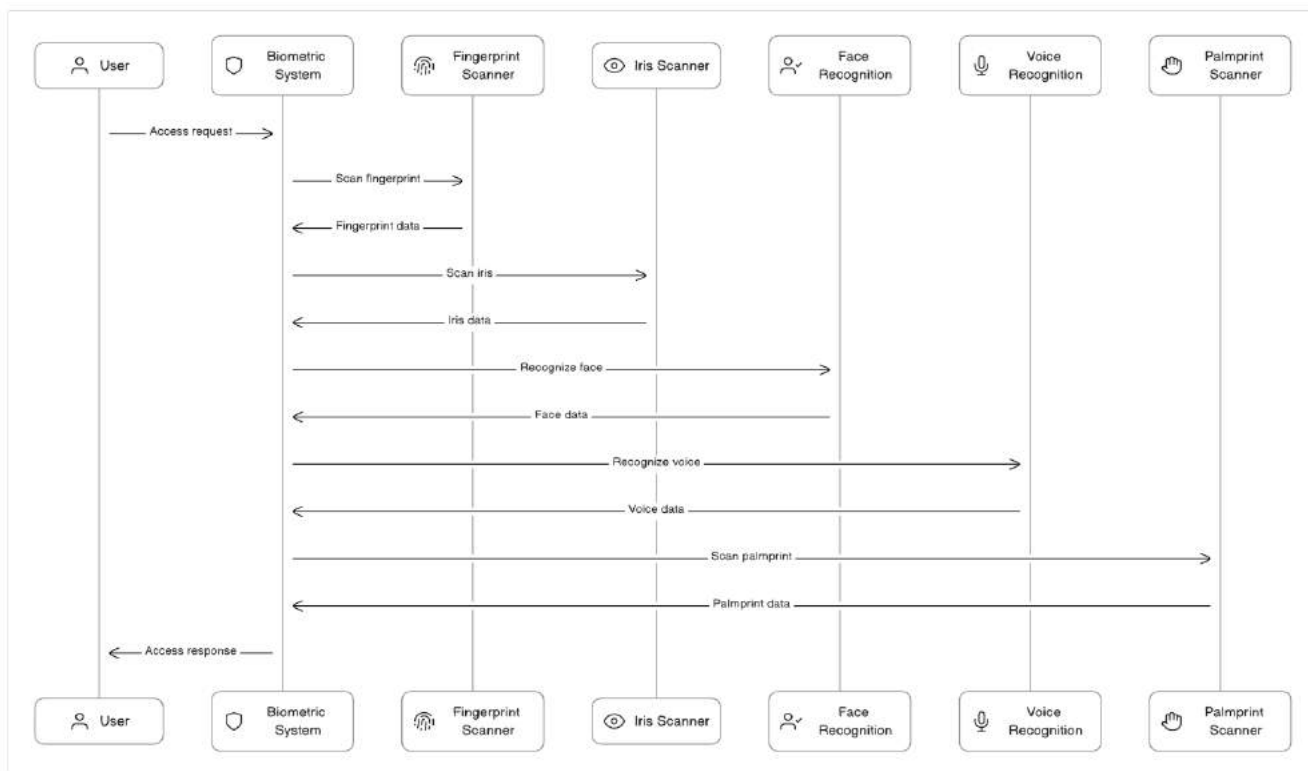


Figure 3: Types of biometric system

Each of these sensory organs provides a distinct and reliable set of biometric data, making them valuable tools for enhancing security and accuracy in various applications, such as access control, identity verification, and financial transactions. However, it is important to consider privacy and ethical considerations when using biometric data, as it involves the collection and storage of sensitive personal information.

3.2 Unimodal biometrics

Unimodal biometrics, which relies on a single biometric trait (e.g., fingerprint, face, iris), may not be enough to provide robust security in today's world for several reasons:

Vulnerability to Spoofing: Unimodal biometric systems are vulnerable to spoofing attacks, in which nefarious actors try to imitate or fake the biometric property. For instance, using excellent copies or fingerprint moulds can trick fingerprint sensors.

Non-universality: Not all individuals can use certain biometric traits due to various reasons, such as injuries, medical conditions, or disabilities. This limitation makes unimodal biometrics impractical for a diverse user population.

Performance Variability: Biometric traits can vary in their performance depending on environmental conditions, user cooperation, and the quality of the biometric sample. In some situations, unimodal systems may experience higher false acceptance or rejection rates.

Syntactic Attacks: Syntactic attacks manipulate the format or syntax of the biometric data to deceive the system. This can include altering the features or characteristics of the biometric trait.

Feature Substitution Attacks: In feature substitution attacks, specific features of the biometric trait are replaced with false or altered information to deceive the system.

Collusion Attacks: Collusion attacks involve multiple attackers working together to impersonate a genuine user by combining their biometric traits or knowledge.

To mitigate these attacks, it is essential to use advanced security measures, such as liveness detection to detect presentation attacks, encryption to protect biometric templates, and continuous research and development to improve the robustness of biometric algorithms. Additionally, the adoption of multimodal biometrics and

combining multiple biometric traits can add an extra layer of security and make it more challenging for attackers to compromise the system.

3.3 Sensory integration to make system multimodal

Certainly, multimodal biometrics can encompass a variety of configurations to enhance identity verification. These configurations include multiple sensors, multiple instances, multiple samples, and multiple traits, each contributing to the system's accuracy and security as shown in figure 4. The whole multimodal biometric system is strengthened by the inclusion of these many factors. The system can deliver a more accurate, safe, and reliable identity verification procedure by utilising a variety of sensors, instances, samples, and attributes. This will ultimately improve user experience and result in tighter security measures.

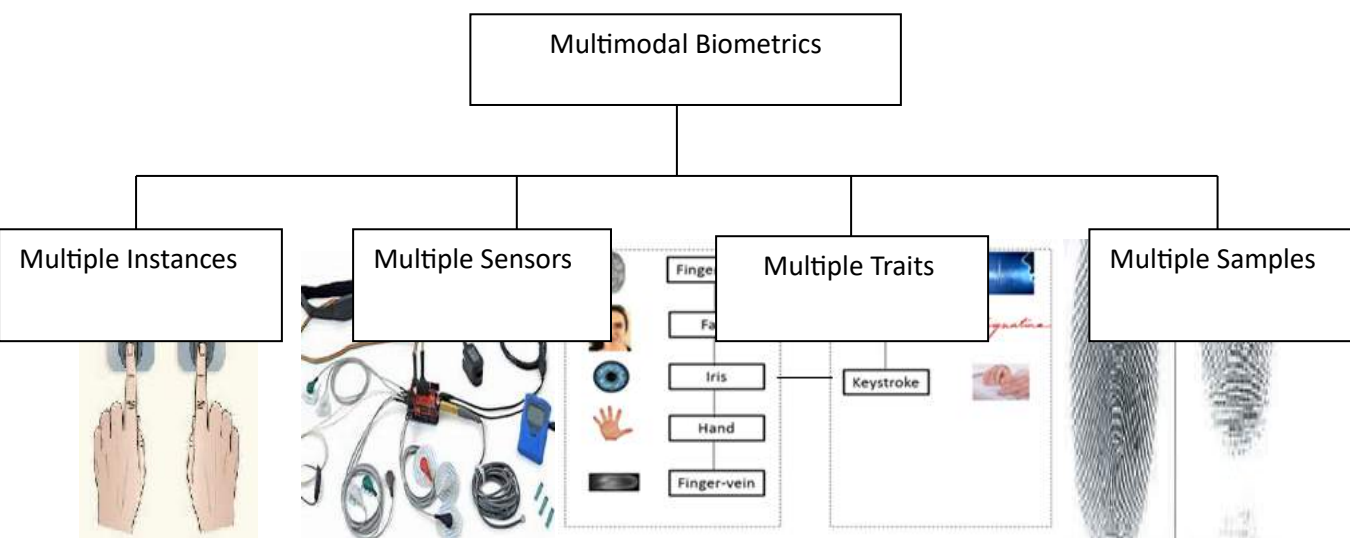


Figure 4: Multibiometrics Types

A multimodal biometric system's sensory integration process combines data from several sensory inputs or biometric attributes to improve the authentication process's accuracy, dependability, and security. Sensory integration tries to get over the drawbacks of individual unimodal systems and offer a more complete and reliable authentication solution by utilising the advantages of various biometric modalities. The following are some crucial components of a multimodal biometric system's sensory integration:

Redundancy and Robustness: Sensory integration adds redundancy to the authentication process. By using multiple biometric modalities, the system can still authenticate users even if one of the modalities fails or is compromised, improving overall system robustness.

Better Performance: When compared to unimodal systems, multimodal biometric systems frequently exhibit higher accuracy and lower error rates. Performance is improved overall thanks to the reduction of erroneous acceptances and denials caused by the combination of complementary biometric features.

Spoofing and Presentation assault Detection: By utilising several biometric modalities for liveness detection and presentation assault detection, sensory integration helps counteract spoofing attacks. When a recorded sample is used, for instance, integrating facial and voice biometrics can aid in the detection of presentation attacks.

Adaptive Learning: Using adaptive learning strategies, sensory integration can dynamically modify its fusion approach according to the effectiveness of each modality. Over time, this aids in the authentication process' optimisation.

Privacy and data protection: Sensory integration needs to take data protection laws and privacy issues into account. Different modalities of biometric data should be managed safely and in accordance with applicable privacy legislation.

Interoperability: To enable smooth integration into diverse applications, multimodal biometric systems should be created to assure interoperability across various platforms and devices.

By effectively integrating information from multiple biometric modalities, sensory integration enhances the overall security and user experience of multimodal biometric systems, making them an attractive option for applications that demand high levels of authentication accuracy and robustness.

3.4 Fusion Levels in Multimodal Biometrics

In a multimodal biometric system, there are three primary levels of fusion: feature level fusion, score level fusion, and decision level fusion.

Feature Level Fusion: This involves combining the raw biometric data from different modalities at a feature extraction stage. The goal is to create a more comprehensive and informative representation of the individual's biometric traits. For example, in face and fingerprint recognition, feature level fusion might involve extracting distinctive features from both modalities and then merging them for more accurate identification.

Score Level Fusion: At this level, the individual modalities are processed independently, and a confidence score or similarity score is generated for each modality. These scores are then combined using a predefined algorithm to make a final decision. For instance, in voice and signature recognition, the scores from both modalities could be averaged or weighted to reach a more accurate verification decision.

Decision Level Fusion: In this approach, decisions from individual modalities are taken separately and then combined to make a final decision. Each modality's decision contributes to the overall result, and the combination could be done through voting mechanisms, rules-based approaches, or machine learning techniques. This level of fusion helps in reducing the risk of errors caused by any single modality (Bala et al., 2022).

The goal of these fusion strategies is to increase the biometric system's overall performance by utilising the advantages of several modalities and addressing their unique shortcomings.

4. CONCLUSION

In conclusion, multimodal biometrics has emerged as a groundbreaking solution that overcomes the limitations of unimodal biometrics. By overcoming challenges including handling noisy data, overcoming non-universality difficulties, controlling interclass similarities, overcoming non-universality difficulties, and defeating spoofing attempts, multimodal systems improve accuracy and security in identity verification. However, the design and implementation of such systems require careful consideration of factors like modal selection, fusion level determination, and feature redundancy management. As technology continues to advance, resolving these challenges will contribute to the continued evolution and adoption of multimodal biometric solutions in various domains requiring secure authentication.

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CORPORATE SOCIAL RESPONSIBILITY AND TECHNICAL ADVANCEMENTS IN THE HEALTHCARE SECTOR: A CASE-STUDY-BASED

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To ensure the enduring welfare of society, a pivotal aspect within the framework of corporate social responsibility(CSR) is combating corruption. Utilizing IT can help to reduce this inclination toward pollution. The impact on health organizations hasn't been specifically studied, though. In this study, the introduction of new, specialized technology into the health care sector is evaluated together with the effects of an experiment meant to combat corruption. According to a corporate anti corruption/uncorrupted policies, long term proactive strategy and semi structured open interview planning from the thirteen Health companies that took part in the pilot project,a mimetic approach is employed inside companies to propagate positive impacts. Procurement management procedures, open-access database and schanges to personnel, technological improvements, procurement management procedures, information dissemination, and public participation are some of the variables that the research has identified as encouraging whistleblowing. It concentrates more on how the anti corruption/uncorrupted systems has changed and how stake holders see health care institutions as a new kind of social responsibility. This study is the first that we are aware of that looks at the anti corruption/uncorrupted procedure using Corporate social responsibility(CSR) that is now being implemented at healthcare institutions all over the world from this perspective.

Keywords: Corporate social responsibility, Anti-corruption, healthcare, information technology(IT) and Corruption.

1. INTRODUCTION

Businesses have long been required to consider how their actions can impact the social, cultural, and environmental spheres as part of their Corporate Social Responsibility(CSR) (Esposito et al., 2021). In the interest of the overall well-being, it is imperative to conscientiously assess and manage the potential short- and long-term impacts that an organization's activities might exert on the social environment (Esposito & Antonucci, 2022). As a result, CSR is placing growing emphasis on a sustainability strategy that gives priority to anti-corruption measures as a prominent element among several other areas of concern(Naeem & Welford, 2009). This study, therefore, aims to investigate the influence of anti corruption initiatives on organizations and their correlation with transformative technologies, elucidating the interplay between the two. According to Cucciniello et al.(Esposito et al.,2019), public corruption is the practice of officials, bureaucrats, or politicians engaging in criminal acts such as offering or accepting monetary or non-monetary rewards. This behaviour is commonly linked to giving presents, providing improper assistance, and exploiting power to gain an advantage.. Modern technologies are essential in facilitating the creation of policies, internal-control mechanisms, and the reporting of both internal and external criminal activity in order to combat corruption and set a benchmark for transparency, trust, efficiency, minimal bureaucracy, and instantaneous reporting(Adam & Fazekas,2021). The public sector stands out as having the biggest number of corruption incidents that have been documented, while internationally, the health sector occupies a dominant position in terms of impact on social and economic institutions, coming in second only to the military(Aregbeshola, 2016).

Distinct institutional theories have been found to have distinct effects on organizations and various players, according to the research. Therefore, the studies points are as under:

RQ1: What long-term effects did the pilot project's implementation have on the organizations?

RQ2. What elements influence the present anti-corruption policy, and what part does information technology play in it?

This study shows that the execution of pilot projects has an impact on organizational growth, and these impacts may be seen over the long and medium terms using the prism of institutional theory. The implementation of relevant measures, which have a significant impact on the macro aspects within firms, may support the acceptance of the advised anti-corruption methods. To expedite organizational transformation and address corruption effectively, a multitude of strategies and technical solutions demand extensive research and development. The insights could potentially assist policymakers across Europe and various global regions in introducing pilot tools. While all four organizations have experimental programs, Transparency International stands out as the sole entity actively implementing visible initiatives, showcased on its official website.

2. LITERATURE REVIEW

The previous research (**Morrison et al., 2019**) works should be described in the form of “The impacts of corporate social responsibility on organization citizenship behavior and task performance in hospitality”, the findings demonstrated that CSR positively impacts social identity, which in turn improves employee OCB and ultimately task performance. The sequential mediation roles between CSR and task performance are played by social identity and OCB. **Abhinav Nagraj et al., (2018)** “Medical Services and Corporate Social Responsibility(CSR) approach in rural areas of Haryana”, the results of the study indicate urgent need of improve medical service for betterment of health of rural population. **Lubis (2018)** “Corporate social responsibility(CSR) in health sector: A case study in the government hospitals in medan”, CSR activities should be applied strategically and should be implemented with regard to the core business of the hospital. **Sanil S Hishan et al., (2020)** “Corporate social responsibility(CSR) in hospitals: Need for transparent CSR initiative for internal and external stakeholder”, this study goes extensively into the world of corporate hospitals in India and the general healthcare industry. Finding and creating the proper balance between these institutions' social and economic objectives is its main goal. The study also explores how corporate hospitals are affected by CSR modeling. **Liang et al. (2007)** delineated cognitive, coercive, and institutional regulatory pressures as influential elements that shape and direct organizational behaviour. The relational aspect plays an equally vital role in facilitating both horizontal and vertical service integration, allowing individuals and entities to blend existing elements while not solely relying on historical continuity. **Esposito et al., (2023)** The adoption of e-government, which influences transparency, openness, public engagement, effectiveness, efficiency, and accountability, serves as a contemporary illustration of how technology is molding organizational governance.

3. RESEARCH METHODOLOGY

The research employs an interventionist approach. Throughout the three engagement phases, the author closely observed the organizations as they underwent the design phase in order to gain knowledge about the organizational transformation process (Jönsson & Lukka, 2006). The constructive method offers recommendations for how to carry out the business process without altering the goals or influencing how different players behave (Grossi et al., 2021). A questionnaire with open-ended questions was used to gather information on the compiler's background and career path, the organization's Head of Corruption Prevention (HCP), and the activities of individuals charged with preventing corruption. The survey also sought to understand the extent of interaction between audit and control systems, the significance of critical aspects, success determinants, replicability, and effects of implemented, executed, and refined actions, procedures, and anti-corruption measures, along with any encountered obstacles. The following stage encompassed a second round of data collection and validation, achieved through interviews with the RPCs, General Managers, and Administrative Managers who had been part of the initial pilot project (analysis of the interviews involved coding the responses). A content analysis of the three years corruption plans was done in order to pinpoint the elements and catalysts that were responsible for substantial changes, using the pilot project that was developed and disseminated throughout the original and subsequent project stages as a basis. The techniques help in triangulating the information obtained, presented, and used, in addition to verifying the organizational stance on anti-corruption tactics, tools and processes from the standpoint of institutional theory.

3.1 Selecting of variable and future prospective

The methods support the triangulation of the information acquired, presented, and used as well as the institutional theory based validation of the organizational position on anti corruption/uncorrupted strategies, tools, and procedures. They effectively implemented anti-corruption measures thanks to thorough internal training conducted by senior management and efficient coordination between planning, control, and other administrative institutions.

Whistleblowing

All pilot organizations receive supports in developing more pragmatic protocols to protect individuals who report instances of corruption. A researcher was employed by the HCPs to compose an essay encompassing an analysis of the reports, along with recommendations for the optimal path forward. During the preliminary assessment by the authorities, distinct concerns arose about the range of tools that pilot projects had access to and were utilizing.

Open data

Through partnering with Opensensors data, the pilot project broadened its expertise in "data creation, management, and reuse" to contribute to the advancement of businesses. The following four aims were successfully achieved: (1) identification of datasets within the pilot structure; (2) meticulous analysis of data creation, handling, and reuse; (3) identification of specific intervention areas and establishment of minimum objectives for the initial experimental year related to internal data management and reuse; and (4) offering assistance to fellow pilot offices in devising procedures and organizational frameworks to enhance the data flow within the facilities.

Update of 3 year corruption prevention plans—Purchasing sector

Informed by the results of analysis and research conducted by project collaborators, the pilot effort furnished essential aid in revising the mandated three years Corruption Prevention Plans(CPP) a strategy aimed at preventing corruption within an organization, with a specific focus on the procurement sector.

Conflict of interests

The system, rooted in mapping and cross-referencing diverse databases (conferences, publications, purchases, vacations, permits, reimbursement requests, and mission allowances), empowers corruption prevention managers to swiftly trigger risk alerts, surpassing the perceived inefficacy of the obligatory self-declaration system.

Results and Discussion

By recognizing factors that impact organizations, the analysis of outcomes and consequences eases the process of conducting medium and long-term assessments. The interviews substantiate the idea that actors refrain from sharing adoption tools because public organizations require an extended period to embrace a logical approach. The central components of the implemented organizational transformation primarily involve the adoption of policy declarations and best practices, in addition to the creation and distribution of anti corruption/uncorrupted tools. The enactment of clearly outlined procedures and the precise scheduling of actions by the internal corruption prevention manager form the additional significant variables. Additionally, organizations ought to institute consistent regulations and protocols for identifying straightforward anti corruption/uncorrupted tools. Engaging in actor interviews and scrutinizing the selected factors to affirm the connections exposed noteworthy aspects within the variables. The second research looks at how ingress agreements and integrated IT tools help management confirm interruptions. The third step aids in understanding how the issues identified and the instruments supplied may, over the medium to long term, cause organizations to adopt a mimetic approach, which also affects the coercive aspects already in place. At its core, the strategy is built upon the concept of civic access,

embracing the idea that individuals universally seek information access, including content that the government has chosen to keep confidential.. Additionally, extensive access enables those who submit requests to get extra materials that might not always be required for disclosure. During International Anti-Corruption Day, the majority of businesses arranged conferences to educate the public and various associations about tools to combat corruption. In one instance, the accessibility of the organization is related with the mission report, which acts as a social tool to encourage transparency and communicate achieved results and objectives.. Users are the primary reason for the decline in accessibility, as they accomplish this through email correspondence and establishing direct connections among offices. However, compared to the early stage, when it was totally missing, tool and strategy development has improved(Smith et al., 2003).

Another goal set forth by the initiative and embraced by healthcare institutions is the incorporation of novel standardized methods and technologies. To uphold the importance of care access for clinicians fulfilling both public and private roles within the institution, most organizations have implemented guidelines to handle conflicts of interest concerning patient waiting list access. An additional widespread approach involves the mandated rotation of employees in high-risk corruption areas, a legal requirement across all healthcare organizations. This organizational strategy encompasses practical measures such as collaboration, role separation, and mentorship among individuals working in corruption-prone sectors. As demands increased and care access became limited, public health services reconfigured their operational functions to cover only emergency and cancer treatments. In tackling the second research query, the primary phase entails recognizing the overarching and technological elements that wield the most substantial impact on the organizational structure. Training is vital to achieve widespread impact and foster systemic transformation. Management covers player interactions, process roles, and addressing conflicts of interest. While the integrity agreement and new processes are compelling the organization to adapt, there remain specific areas that could be enhanced. Within these considerations, it's important to underscore that open access data offers only a limited portion of information access. Following the introduction of project variables, the examined organizations underwent a noteworthy multilevel transformation, engaging individuals and implementing novel governance structures. Despite progress in relations, data access, and public involvement, the problem of inadequate final reporting weakens result transparency for external observers. While the training covers employees from all organizations, it falls short in adequately emphasizing data mining and the productive use of big data. Given the growing popularity of managing digital purchasing platforms, system engineering is glaringly absent from the list of process managers. However, at least nine groups have made their purchase plans explicit. The achievement of full implementation in whistleblower processes is acknowledged when digitalization indicators are followed and essential requirements are fulfilled.

4. CONCLUSION

Within the healthcare sector, the influence of corruption on organizations has been a longstanding subject of discourse. Tackling this matter necessitates novel approaches and tactics(Borgonovi & Esposito, 2017). Experimental endeavors such as the HIAP hold the potential to stimulate both public and commercial entities in this context. This analysis employs an empirical approach, considering neo institutional critiques solely from a theoretical standpoint(Macfarlane et al., 2013)..To foster proactive engagement as outlined in CSR literature, managerial accountability and transparency, the initiative has concomitantly integrated diverse aspects of e-government and innovative technologies, which play a pivotal role across internal, external and relational domains(Neupane et al., 2014). Mimetic transformation illustrates a contemporary shift towards giving greater significance to experiential factors within interactions among individuals and social entities. As noted that comprehensive technological improvement inside public institutions hasn't happened yet. According to this study, just a small portion of the government's electronic health system has been completely adopted. These elements demonstrate the use of technical tools in CSR to fight corruption. Real-time information access, online data sharing, results dissemination, and the use of digital platforms for supply chain operations adjustments are some of these tools(Zhang & Kimathi, 2022). The study presents limitations, such as the absence of comparisons with similar initiatives in the Indian context, insufficient exploration of the effects of employees' and users' behaviors, and the inability to precisely assess the immediate reduction in disruption cases since the introduction,

compounded by organizational difficulties stemming from COVID-19. Evidence of the project's influence may eventually become apparent in a situation like the health system in Haryana.

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AGE AND GENDER RECOGNITION SYSTEM USING MACHINE LEARNING

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This research explores the field of Facial Recognition to predict the age and gender of the subject using Machine Learning. The document begins with an overview of machine learning, which includes its principles and numerous algorithms such as supervised, unsupervised, and reinforcement learning. Feature Extraction, vital to Machine Learning, is also discussed. Detailed analysis of the project is also given along with results taken from the real-world. Potential usage of the system is also highlighted along with the limitations. Relevant solutions are also given to further help the research.

Keywords – Age, Gender, Machine Learning, Recognition

1. INTRODUCTION

Age and gender recognition refers to the process of routinely figuring out the age and gender of individuals based totally on diverse visible cues, which include facial capabilities, frame characteristics, or vocal patterns. It is a subfield of computer vision and machine learning that makes use of algorithms and statistical models to investigate and classify individuals into distinctive age groups and gender.

Age recognition pursuits to estimate the age variety or specific age of someone, normally categorized into groups along with toddler, adolescent, person, or senior. Gender recognition, however, focuses on figuring out the gender of a character, usually as male or woman.

Age and gender recognition has usage in various fields like Healthcare, Entertainment and Gaming, Security and Surveillance, and Human-Computer Interaction.

The goal of this paper is to provide a complete knowledge of age and gender recognition using machine learning strategies. It targets to explore the concepts and methodologies of machine learning, discuss the significance of age and gender recognition in various fields, and give an in-depth task demonstrating the utility of machine learning for age and gender prediction. The paper intends to provide insights into the challenges, future prospectives, and capability upgrades on this discipline.

2. SCOPE

In terms of scope, this paper focuses mainly on age and gender recognition using machine learning algorithms. It covers fundamental machine learning concepts, such as supervised and unsupervised learning, as well as feature extraction strategies. The paper delves into the specific aspects of age and gender recognition, including data collection and preprocessing, feature extraction, model training and evaluation, and performance metrics. Moreover, it includes a detailed project that showcases the practical implementation of age and gender recognition using machine learning. The project covers various topics, such as dataset description, training and evaluation methods, and result analysis.

However, it is essential to acknowledge the constraints of this paper. Firstly, while the document primarily focuses on the technical aspects of machine learning algorithms and their application in age and gender recognition, it does not extensively cover moral, legal, and societal implications related to the use of this technology. Secondly, the project provided in the paper serves as an illustrative example and may not encompass all possible approaches or variations in age and gender recognition. Different datasets, feature extraction methods, or models may yield diverse results. Thirdly, the paper does not offer an exhaustive evaluation of every available machine learning algorithm or technique for age and gender recognition, as the field is rapidly evolving. Finally, the performance of age and gender recognition models heavily relies on the quality and representativeness of the training data, and limitations within the dataset used for the task may impact the generalizability of the results.

Considering these limitations, it is helpful to interpret the information provided in this paper with caution and conduct further research for specific applications or specialized requirements.

3. OVERVIEW OF MACHINE LEARNING

Machine learning, a prominent subfield of artificial intelligence, has revolutionized various industries and applications. It enables computers to learn from data and make predictions or decisions without being explicitly programmed. Understanding the principles and methodologies of machine learning is essential for exploring its vast potential. In this section, we will provide an overview of machine learning, delving into its definition, fundamental principles, and different types of algorithms. We will also explore the concept of feature extraction, a critical aspect of machine learning models. By gaining insights into the workings of machine learning, we can lay a solid foundation for comprehending its application in age and gender recognition.

A. Definition and principles

Machine learning is a branch of artificial intelligence that focuses on the development of algorithms and fashions that permit computer systems to analyse from statistics and make predictions or selections without being explicitly programmed. It entails the automatic extraction of patterns and insights from statistics, permitting systems to enhance and adapt their overall performance over the years.

The essential standards of machine learning can be summarized as follows:

- **Data-driven technique:** Machine learning relies on information as its number one source of records. It leverages huge datasets to uncover patterns, relationships, and tendencies that can be used for prediction, classification, or decision-making.
- **Generalization:** Machine learning ambitions to broaden models which could generalize well to unseen or new statistics. Instead of memorizing unique examples, models examine underlying styles and regulations from the training facts to make correct predictions or choices on previously unseen instances.
- **Feature extraction and representation:** Capabilities are important additives of machine learning models. They seize the applicable information from the input data and transform it right into a suitable representation that the model can understand and utilize for studying.
- **Model training and optimization:** Machine learning algorithms learn from data by means of adjusting the parameters or structure of a version to minimize the distinction among predicted outputs and real goals. The technique of training involves iterative optimization techniques, which includes gradient descent, to discover the most reliable model configuration.
- **Evaluation and validation:** Evaluating the overall performance of machine learning models is crucial to evaluate their accuracy and generalization abilities. Validation techniques, consisting of go-validation and holdout sets, are used to estimate the version's performance on unseen records and save you overfitting.
- **Set of rules selection and tuning:** Different machine learning algorithms, which includes decision trees, support vector machines, and neural networks, have unique strengths and weaknesses. The choice of algorithm depends on the nature of the problem and the characteristics of the facts. Moreover, hyperparameter tuning enables optimize the model's performance by way of adjusting parameters that are not discovered from the records.

Overall, machine learning revolves across the core idea of extracting data and making predictions from data. By means of leveraging those standards, machine learning algorithms can automate tasks, discover hidden patterns, and permit sensible decision-making in an extensive variety of domain names.

B. Categorizing Machine Learning Algorithms

Machine learning algorithms can be extensively categorised into numerous kinds primarily based on the learning undertaking they perform. Some of the common types of algorithms are:

- **Classification:** Classification algorithms are used to expect specific labels or classes for new instances based totally on labelled training data. They study patterns and relationships in the information to assign the appropriate class labels. Popular class algorithms include decision trees, random forests, guide vector machines (SVM), and logistic regression.
- **Regression:** Regression algorithms are applied whilst the purpose is to expect continuous numerical values. Those algorithms analyse the relationships among enter variables and the corresponding output variable to make predictions. Linear regression, polynomial regression, and guide vector regression are examples of regression algorithms.
- **Clustering:** Clustering algorithms organizes similar information points collectively primarily based on their inherent similarities or distances. They do not require categorized records and intention to find out hidden styles or structures inside the data. Okay-manner clustering, hierarchical clustering, and DBSCAN (Density-based Spatial Clustering of Applications with Noise) are popular clustering algorithms.
- **Dimensionality reduction:** Dimensionality reduction algorithms reduce the wide variety of input features at the same time as preserving the most applicable facts. They assist in visualizing high-dimensional facts and getting rid of noise or inappropriate capabilities that could prevent the learning method. Principal Component Analysis (PCA) and t-SNE (t-disbursed Stochastic Neighbour Embedding) are normally used dimensionality reduction techniques.
- **Neural networks:** Neural networks are a category of machine learning algorithms inspired by way of the functioning of the human mind. They consist of interconnected artificial neurons organized in layers and can learn complex styles and representations. Deep learning, a subset of neural networks, has finished amazing achievement in numerous domain names, including picture and speech recognition. Convolutional neural networks (CNN) and recurrent neural networks (RNN) are famous forms of neural networks.

These types of machine learning algorithms serve different purposes and are carried out relying at the unique assignment, dataset, and problem at hand. Understanding the traits and capabilities of every kind can help in selecting the maximum suitable algorithm for a given problem.

4. SUPERVISED & UNSUPERVISED LEARNING

Supervised learning is a type of machine learning where the model learns from categorized training data to make predictions or classify new, unseen instances. The algorithm is provided with input records and the corresponding correct outputs, permitting it to research the mapping among the input and output variables. Examples of supervised learning algorithms consist of selection bushes, support vector machines (SVM), and neural networks. For instance, in e mail spam detection, a supervised learning algorithm may be educated on categorised emails (spam or no longer junk mail) to accurately classify new incoming emails.

Unsupervised learning involves studying unlabelled facts to discover styles, relationships, or structures within the statistics. The set of rules learns from the inherent structure or distribution within the records without specific steerage or categorized examples. Clustering algorithms like k -means and hierarchical clustering are usually utilized in unsupervised learning. As an instance, in customer segmentation, an unsupervised learning algorithm can group similar customers together based on their shopping conduct, permitting businesses to tailor their advertising and marketing strategies to precise patron segments.

5. FEATURE EXTRACTION

Feature extraction plays a crucial role in machine learning as it aims to identify and capture the most relevant information from the raw input data. It helps to transform complex, high-dimensional data into a more compact and representative feature space, which improves the performance of machine learning models in several ways:

- **Dimensionality Reduction:** Feature extraction techniques reduce the dimensionality of the input data by selecting or creating a subset of informative features. This reduces the computational complexity of the model

and helps to overcome the curse of dimensionality, where the performance of the model deteriorates as the number of features increases.

- **Noise and Redundancy Removal:** Feature extraction helps in eliminating irrelevant or redundant features that may introduce noise or unnecessary complexity into the learning process. By focusing on the most informative features, it enhances the model's ability to generalize and make accurate predictions.
- **Improved Learning and Generalization:** Effective feature extraction can uncover underlying patterns or relationships in the data that are not apparent in the original representation. By capturing the essential characteristics of the data, it enables the machine learning model to learn more efficiently and make better generalizations on unseen instances.
- **Interpretability and Visualization:** Feature extraction techniques can create a transformed feature space that is more interpretable and visually understandable. This can aid in gaining insights and understanding the relationships between features, facilitating better decision-making and problem analysis.

A. *Techniques for Feature Extraction*

There are various techniques for feature extraction in machine learning. Here are a few commonly used methods:

Principal Component Analysis (PCA): PCA is a dimensionality reduction technique that identifies orthogonal directions (principal components) in the data that capture the most significant variations. It projects the data onto these components, creating a lower-dimensional representation while preserving the maximum variance.

- **Linear Discriminant Analysis (LDA):** LDA is a dimensionality reduction technique that aims to find a feature space that maximizes class separability. It identifies the directions that maximize the between-class scatter while minimizing the within-class scatter.
- **Independent Component Analysis (ICA):** ICA seeks to find statistically independent components in the data. It assumes that the observed data is a linear mixture of these independent components and attempts to separate them.
- **Feature Selection Techniques:** Feature selection methods aim to identify a subset of the most relevant features without transforming the original data. They use various criteria, such as statistical tests, correlation analysis, or information-theoretic measures, to select the most informative features.
- **Deep Learning-based Feature Extraction:** Deep learning models, such as Convolutional Neural Networks (CNN) and Autoencoders, can be utilized to automatically learn hierarchical representations from raw data. These models can extract high-level features that capture complex patterns and structures in the data. These techniques can be applied depending on the specific characteristics of the data and the requirements of the problem at hand. Effective feature extraction is essential for enhancing the performance, interpretability, and generalization ability of machine learning models.

6. USING MACHINE LEARNING FOR AGE AND GENDER RECOGNITION

A. *Importance and Application*

Age and gender recognition technology has an extensive variety of packages throughout different industries. Here are some awesome examples:

- **Retail and advertising and marketing:** Age and gender recognition may be applied in retail environments to provide personalized shopping studies. It enables centered advertising and product tips primarily based on clients' age and gender, enhancing client engagement, and enhancing income effectiveness.
- **Security and surveillance:** Age and gender recognition systems can assist in improving safety and surveillance measures. They can be hired in access control systems, public spaces, and airports to perceive people of particular age or gender for protection functions or demographic analysis.
- **Healthcare and gerontology:** Age recognition can aid in healthcare settings by using automatically estimating the age of patients, which can be precious in figuring out suitable medical remedies and customized care plans. Moreover, gender recognition can help in responsibilities consisting of patient monitoring, demographics analysis, and clinical research studies.

- **Amusement and gaming:** Age and gender recognition can beautify user reviews within the entertainment and gaming enterprise. It permits personalized content material suggestions, targeted advertising, and adaptive gameplay features based on users' age and gender options.
 - **Human-Computer Interaction (HCI):** Age and gender popularity can contribute to improved HCI with the aid of permitting structures to evolve to customers' age and gender characteristics. As an example, consumer interfaces can be custom designed to better fit the choices and needs of different age organizations and genders. The adoption of age and gender recognition technology may have numerous effects on industries and society:
 - **Enhanced client engagement:** Industries inclusive of retail and advertising can benefit from age and gender recognition through delivering extra personalized and targeted studies to customers. This will lead to improved patron engagement, expanded delight, and better conversion quotes.
 - **Improved security and protection:** Age and gender recognition systems can toughen safety features by means of permitting better identity and tracking of individuals in diverse settings. This can beautify public safety, save you unauthorized get entry to, and aid in regulation enforcement efforts.
 - **Efficiency and automation:** Age and gender recognition technology automates the technique of identifying and categorizing individuals based totally on age and gender. This reduces the want for guide intervention, saves time, and increases operational performance in numerous industries.
 - **Records-driven insights:** By means of amassing and studying age and gender data, industries can benefit valuable insights into client behaviour, choices, and marketplace traits. This data can force knowledgeable selection-making, product development, and advertising strategies.
 - **Moral concerns:** The use of age and gender recognition generation raises ethical concerns, which includes privacy concerns and ability biases. It is far essential to ensure that those structures are designed and deployed in an accountable and obvious way, considering privacy guidelines, and warding off discrimination primarily based on age or gender.
- Overall, age and gender recognition technology has the capacity to convert industries, improve client studies, and provide precious insights. But it is miles essential to carefully navigate the ethical and privacy aspects even as reaping the blessings of those advancements.

B. Data collection and Preprocessing

Collecting accurate and consultant data is important for training age and gender recognition models. Right here are a few common data collection methods and considerations:

- **Public datasets:** Publicly available datasets, including the IMDB-wiki dataset or the Adience dataset, offer categorized snap shots with age and gender statistics. These datasets provide a various range of individuals and may function a place to begin for schooling models.
- **Custom datasets:** Developing a custom dataset includes collecting pictures or videos from unique sources or environments. This will encompass shooting images using cameras, internet scraping, or partnering with corporations or establishments to acquire information from centered demographics.
- **Data privacy and ethics:** When accumulating data, it is important to make certain compliance with data privacy rules and obtain essential consent from individuals worried. Protective touchy information and respecting moral considerations is vital to hold believe and uphold privacy rights.
- **Data range:** The dataset need to encompass a wide range of age groups, gender identities, ethnicities, and other applicable demographic factors to make sure model generalization and avoid biases.
- **Labelling and annotation:** Accurate labelling and annotation of the records are essential. Human annotators can manually assign age and gender labels to the dataset, ensuring quality manipulate and consistency within the labelling process.
- **Data balance:** Attempt to keep a balanced distribution of age and gender labels within the dataset to avoid biases and ensure honest representation. Adequate illustration of each age group and gender class contributes to a strong and independent model.
- **Information Augmentation:** Augmenting the dataset via applying modifications like rotation, scaling, or including noise can help increase the dataset length, improve model overall performance, and decorate model generalization.

Before training a model for age and gender recognition, several preprocessing steps are normally finished on the accumulated information:

- **Facts cleaning:** Remove any corrupt or unusable facts from the dataset, making sure that most effective images or films are included for training.
 - **Image resizing and Standardization:** Resize the images to a regular resolution to make sure uniformity in the dataset. It is also advisable to standardize the colour channels or carry out histogram equalization to account for versions in lighting situations.
 - **Face detection and alignment:** Apply face detection algorithms to discover and extract faces from the pictures. Face alignment techniques can be used to normalize the face orientation and enhance consistency throughout one-of-a-kind pictures.
 - **Normalization and feature scaling:** Normalize the pixel values of the pictures to a commonplace range (e. G. , 0 to 1) or follow feature scaling techniques like suggest normalization to make certain that the enter features are inside a comparable scale.
 - **Records break up:** Divide the dataset into schooling, validation, and checking out sets. The education set is used to teach the version, the validation set facilitates in tuning hyperparameters and evaluating model overall performance, even as the testing set offers an independent assessment of the very last educated version.
 - **Facts augmentation:** Apply information augmentation strategies, which includes random cropping, flipping, or rotation, to create additional schooling samples and boom the version's robustness.
- Via following those preprocessing steps, the records are ready for educating the age and gender recognition model, making sure its satisfactory, consistency, and compatibility with the chosen machine learning algorithms.

7. IMPLEMENTATION

A. Project Overview

The project specializes in developing an age and gender recognition system using machine learning techniques. The aim of the project is to build a model which could accurately estimate the age and gender of individuals primarily based on input facts, such as snap shots or motion pictures. This challenge is prompted via the extensive range of packages in numerous industries, such as retail, security, healthcare, and entertainment.

The project involves several key stages, starting with data collection. Datasets containing labelled images or videos with age and gender information are gathered from public sources or created using custom data collection methods. Considerations regarding data privacy, ethics, and diversity are considered during the data collection process.

After data collection, the project moves to the preprocessing stage. The collected data is cleaned, and images are resized and standardized to ensure consistency. Face detection and alignment techniques are applied to locate and normalize the faces within the images. Data normalization and feature scaling are performed to prepare the data for model training.

Next, the project involves selecting and implementing appropriate machine learning algorithms for age and gender recognition. This may include the use of deep learning models, such as convolutional neural networks (CNNs), which have shown excellent performance in image-based tasks. The models are trained using the pre-processed data, optimizing for accurate age and gender predictions.

The performance of the trained models is evaluated using various evaluation metrics, such as accuracy, precision, recall, and F1-score. The models are validated using a separate validation set to fine-tune hyperparameters and ensure optimal performance.

Once the models are trained and validated, they are tested on a separate testing set to assess their generalization capabilities. The final model is then ready for deployment, where it can be integrated into applications or systems to perform real-time age and gender recognition tasks.

Throughout the project, considerations are given to the limitations and challenges associated with age and gender recognition. This includes addressing potential biases, handling variations in lighting conditions, and managing the diversity of age groups and gender identities in the dataset.

The project aims to provide insights into the effectiveness and practicality of age and gender recognition systems, highlighting their potential applications in industries and society. By developing an accurate and robust model, the project contributes to the advancement of machine learning techniques in understanding and analysing human characteristics.

B. Dataset Description

In order to expedite the development procedure and leverage current advancements in the subject, this project applied three pre-trained models: one for age estimation, one for gender recognition, and one for face detection. The usage of pre-skilled models appreciably reduced the time and computational sources required to educate those models from scratch.

The pre-educated version for age estimation was educated on a large-scale dataset and had learned to estimate age from facial features. It was first-rate-tuned and tailored to the precise necessities of the project. This model could take an input photo of a face and predict the estimated age of the individual.

Further, the pre-trained version for gender recognition was trained on a numerous dataset and had received the capability to figure gender based totally on facial attributes. It became also best-tuned and custom designed for the challenge. Given an input image, this version should determine the gender of the person depicted within the picture.

Lastly, the pre-trained version for face detection was used to perceive and find faces inside images or video frames. This model had been educated on widespread quantities of information and become capable of as it should be detecting faces below various conditions and orientations. It furnished the necessary input for the age and gender recognition models by setting apart the regions of interest.

By means of combining these pre-skilled models, the undertaking blanketed all three elements: age estimation, gender recognition, and face detection. The pre-trained models served as powerful starting factors and provided a basis on which to construct the integrated age and gender recognition machine. This approach not only reduced the training time but also benefited from the expertise and knowledge encapsulated inside the pre-trained fashions. Furthermore, fine-tuning the pre-trained models on project-specific records allowed for personalisation and optimization, ensuring that the models were well-suited for the mission's objectives. This mixed technique provided a robust and efficient solution for age and gender recognition, allowing correct predictions and real-time performance in various situations.

C. Calculation of Probability by the model

The prediction probabilities in this model are obtained from the output of the pre-trained models. The breakdown of the mathematical calculations involved is as follows:

1. Face Detection:

- The face detection model (**face_net**) uses the Single Shot MultiBox Detector (SSD) architecture to detect faces in an image.
- The model predicts the bounding box coordinates for each detected face along with a confidence score.
- The confidence score represents the likelihood of a detected region being a face.
- The output of the face detection model is processed in the **get_faces()** function, where a confidence threshold is applied to filter out weak detections.

- The bounding box coordinates are then adjusted and stored as faces to be processed further.
2. Gender Prediction:
- The gender prediction model (**gender_net**) is a Convolutional Neural Network (CNN) trained to classify gender.
 - The face image extracted from each detected face is preprocessed by resizing it to a fixed size of 227x227 pixels and applying mean subtraction.
 - The preprocessed image is then passed through the gender prediction model to obtain the predicted probabilities for each gender class (male and female).
 - The **get_gender_predictions()** function takes the preprocessed face image as input and returns the output probabilities.
 - The index of the highest probability in the output corresponds to the predicted gender.
 - The predicted gender and its associated probability are stored.
3. Age Prediction:
- The age prediction model (**age_net**) is another CNN trained to classify age into predefined intervals.
 - Similar to gender prediction, the face image is preprocessed by resizing it to 227x227 pixels and applying mean subtraction.
 - The preprocessed image is passed through the age prediction model to obtain the predicted probabilities for each age interval.
 - The **get_age_predictions()** function takes the preprocessed face image as input and returns the output probabilities.
 - The index of the highest probability in the output corresponds to the predicted age interval.
 - The predicted age interval and its associated probability are stored.
4. Displaying Results:
- The predicted gender and age, along with their corresponding probabilities, are used to create a label string.
 - The label string is displayed on the frame, along with a bounding box around the detected face.
 - The label includes the gender, gender confidence score (probability), age interval, and age confidence score (probability).

It is important to note that the specific mathematical details of the neural network architectures, training procedures, and input/output processing are determined by the models themselves and the frameworks used for training and inference (such as Caffe in this case). The script utilizes the pre-trained models to perform the predictions and display the results.

D. Results and Analysis

The age and gender recognition model, trained using pre-trained models and applied to live feed analysis, has successfully fulfilled its intended purpose and functions as expected.

The model exhibits high accuracy in predicting the age of individuals from live feeds. However, it is worth noting a slight issue were, in some cases, the predicted age group may be slightly higher than the actual age. Nevertheless, this discrepancy can be overlooked as the predicted age groups generally align closely with the true age of the individuals. The model's ability to estimate age in real-time from live feeds is a significant achievement, enabling a wide range of applications.

The face detection capability of the model is highly effective, successfully identifying faces even in challenging scenarios. It demonstrates the ability to detect multiple faces within a single frame and accurately detects faces even when they are far away. This robust face detection functionality ensures that subsequent age and gender recognition processes receive reliable input, leading to improved accuracy in the final predictions.

The model's gender recognition component operates swiftly, promptly adjusting between gender predictions. Initially, there may be instances where the model initially detects a gender as female but quickly corrects itself to either male or female. However, this instantaneous adjustment showcases the model's adaptability and responsiveness to real-time changes in the input feed. Despite the initial flickering, the gender recognition performance stabilizes to a high degree of accuracy.

In conclusion, the age and gender recognition model, trained using pre-trained models and deployed for live feed analysis, operates as expected and delivers reliable results. While there may be minor instances where the predicted age group slightly surpasses the individual's actual age, the overall performance remains highly satisfactory. The model's exceptional face detection capability, coupled with swift gender recognition, contributes to its success. These results, along with the attached samples, demonstrate the model's proficiency and establish its potential for practical implementation in a variety of contexts.

FIGURES

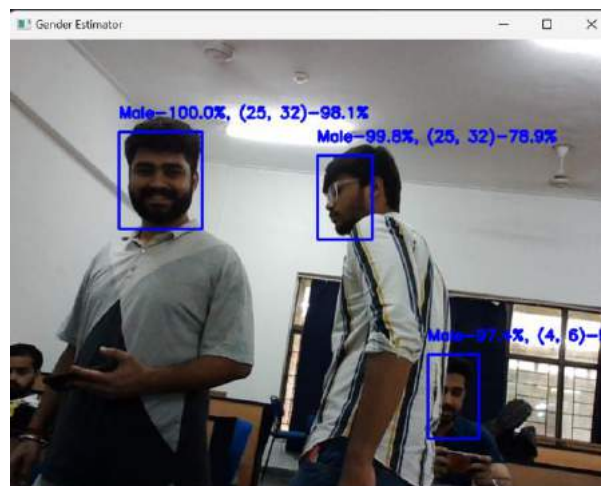


Figure 1: Output for Person 1, 2, 3

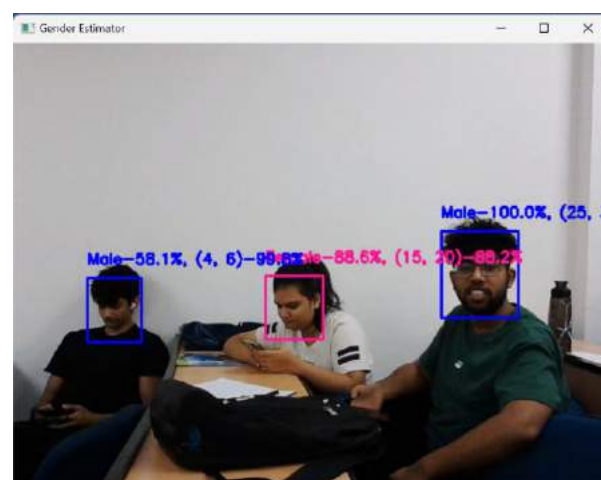


Figure 2: Output for Person 4, 5, 6

Person	Gender (Probability)	Age (Probability)
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1	Male (100%)	25-32 (98.1%)
2	Male (99.8%)	25-32 (78.9%)
3	Male (97.4%)	4-6 (98.1%)
4	Male (58.1%)	4-6 (99.8%)
5	Female (88.6%)	15-20 (88.2%)
6	Male (100%)	25-32 (98.5%)

Table 1: Output of the Model

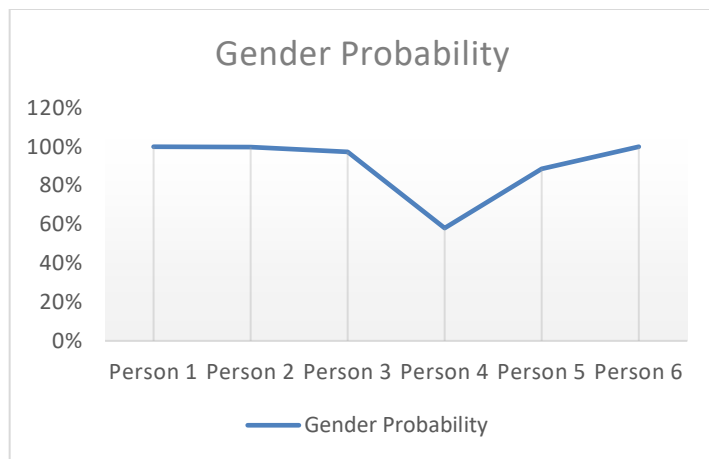


Chart 1: Person-Gender Graph

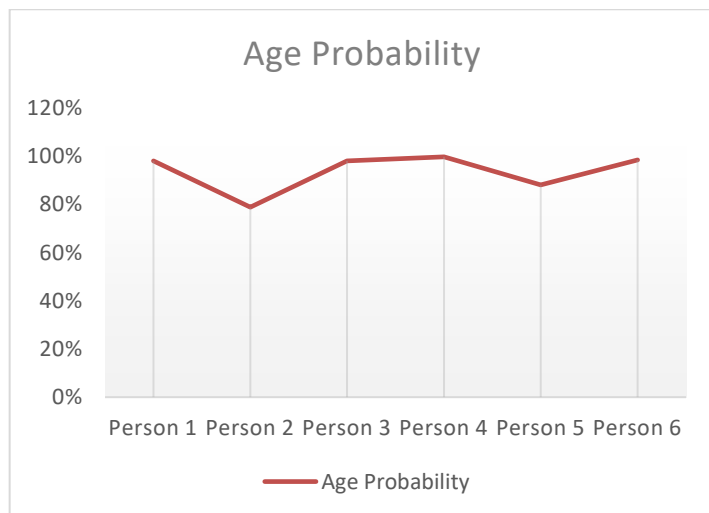


Chart 2: Person-Age Graph

8. CHALLENGES AND FUTURE DIRECTIONS

A. Challenges in Age and Gender Recognition

Several problems influence the accuracy and reliability of age and gender recognition systems. The diversity of facial traits resulting from elements along with lights situations, position variations, and facial expressions is one of the most tough tasks. Because of this range, predicting age and gender merely based on face trends may be challenging. Moreover, skewed predictions might result from imbalanced datasets wherein certain age or gender groups are underrepresented. The accumulating and use of facial facts raises ethical and privacy issues, complicating the development and implementation of age and gender recognition structures. To cope with those troubles, advances in statistics gathering, algorithm development, and the adoption of truthful and privacy-

conscious methodologies ought to be made which will assure accurate and unbiased forecasts whilst respecting person privacy rights.

B. Limitations and Difficulties faced in the project

Throughout the project, certain limitations and challenges were encountered, which influenced the performance and scope of the age and gender recognition system. Some of the key challenges include:

1. **Data Availability and Diversity:** Acquiring a diverse and extensive dataset with representative age and gender distributions posed a challenge. Imbalanced datasets can lead to biased model predictions.
2. **Real-Time Processing:** Implementing the model to work in real-time from live feed requires efficient algorithms and hardware considerations to achieve satisfactory performance.
3. **Age Prediction Accuracy:** Estimating an individual's precise age solely from facial features is inherently complex, and the model occasionally produced age predictions slightly higher than the actual age.

C. Ethical and Privacy considerations

The deployment of age and gender recognition systems raises significant ethical and privacy concerns. Some of the main considerations include:

1. **Data Privacy:** Handling and storing sensitive facial data require robust privacy measures to ensure the protection of individuals' identities.
2. **Bias and Fairness:** Ensuring the model's fairness and lack of bias across diverse age and gender groups is critical to prevent discrimination and uphold ethical standards.
3. **Informed Consent:** Obtaining informed consent from individuals whose data is used for training the model is essential to respect their privacy rights.

D. Limitations of Current Approaches

Current approaches to age and gender recognition still face several limitations that hinder their accuracy and reliability. One significant limitation is the difficulty in accurately estimating age solely based on facial features, as age-related changes vary greatly among individuals. Moreover, gender recognition can be challenging for individuals with non-binary gender identities or ambiguous facial characteristics. Additionally, existing models heavily rely on the quality and diversity of the training data, and biases in the data can lead to skewed predictions. Lighting conditions, facial poses, and variations in age and gender distributions also impact the accuracy of current approaches. Overcoming these limitations requires further advancements in data collection, model architectures, and fairness-aware training techniques to ensure more accurate and unbiased age and gender recognition systems.

E. Issues with Existing Age and Gender Recognition Models

Numerous obstacles exist in current age and gender recognition models, including:

- **Accuracy variant:** Models may additionally exhibit varying accuracies depending on elements consisting of statistics quality, training methods, and model architectures.
- **Age and gender ambiguity:** Estimating age and gender from facial features alone may be challenging, especially for individuals with ambiguous or non-binary gender identities.
- **Age progression and regression:** Predicting age for youngsters or aged people might be extra difficult due to full-size age-associated modifications in facial appearance.

F. *Factors Affecting Accuracy and Reliability*

Several factors influence the accuracy and reliability of age and gender recognition models, including:

1. **Data Quality:** The quality and diversity of the training data significantly impact model performance.
2. **Lighting and Pose Variations:** Variations in lighting conditions and facial poses can affect the model's ability to make accurate predictions.
3. **Age and Gender Distribution:** Biased or imbalanced datasets can lead to skewed predictions, particularly for underrepresented groups.

G. *Possible Solutions and Improvements*

To address the challenges and limitations, the following solutions can be considered:

- **Data Augmentation:** Augmenting the dataset with synthetic samples can help mitigate data scarcity and improve model generalization.
- **Ensemble Learning:** Employing ensemble techniques with multiple models can enhance prediction accuracy and reliability.
- **Fairness-aware Training:** Implementing fairness-aware training methods can reduce biases in predictions and ensure equitable performance across different demographic groups.

To enhance the system's performance, the following improvements can be explored:

- **Contextual Information:** Incorporating contextual information, such as social interactions or speech analysis, can complement facial features for better age and gender recognition.
- **Multi-Modal Fusion:** Integrating data from other sensors or modalities, such as audio or depth sensors, can enhance the model's robustness and accuracy.
- **Transfer Learning:** Leveraging knowledge from related tasks or domains through transfer learning can boost the model's performance in scenarios with limited labelled data.

H. *Emerging Trends and Technologies*

Recent advancements in age and gender recognition have proven promising outcomes, along with:

- **Deep studying architectures:** Deep studying models, including convolutional neural networks (CNNs) and recurrent neural networks (RNNS), have accomplished considerable upgrades in age and gender recognition accuracy.
- **Generative adversarial networks (GANs):** GANs have been used to generate artificial facial images for augmenting training data, addressing data scarcity problems.

Deep learning and neural networks have revolutionized age and gender recognition by enabling more accurate and robust models. These technologies have allowed models to learn complex representations directly from data, leading to improved performance. Deep learning techniques, combined with large-scale datasets and powerful

hardware, have the potential to further advance age and gender recognition capabilities, opening doors to new applications and research areas.

9. CONCLUSION

Age and gender recognition using machine learning is a hastily evolving area with good sized implications in numerous domain names. This report has provided an outline of machine learning, its principles, and the software of device studying algorithms which include classification, regression, clustering, dimensionality reduction, and neural networks in age and gender recognition.

The report has highlighted the significance of characteristic extraction in machine learning and mentioned diverse strategies for extracting meaningful capabilities from statistics. It has also explored the challenges, limitations, and ethical considerations involved in age and gender recognition projects.

The project overview demonstrated the successful development of a model that can detect age and gender from live feeds using pre-trained models. The model exhibited impressive face detection capabilities, including the ability to detect multiple faces and faces at varying distances. While there was a slight issue with age prediction, where the predicted age group sometimes exceeded the actual age, overall performance was satisfactory.

The report further discussed the applications of age and gender recognition in various industries and the potential impact on society. It emphasized the need for robust data collection methods, careful preprocessing steps, and ethical considerations to ensure privacy and fairness in age and gender recognition systems.

Additionally, the report identified the limitations of current approaches, including issues with existing models and factors affecting accuracy and reliability. It proposed possible solutions and improvements to address these limitations, such as data augmentation, ensemble learning, fairness-aware training, and incorporating contextual information.

Finally, the report highlighted emerging trends and technologies in age and gender recognition, particularly the impact of deep learning and neural networks. Recent advancements in deep learning architectures and techniques like generative adversarial networks have shown promising results, opening new possibilities for improved age and gender recognition systems.

In conclusion, age and gender recognition using machine learning has immense potential and can significantly impact various fields. While there are challenges and limitations to overcome, ongoing research and advancements in technology continue to drive progress in this area. By addressing the limitations, incorporating ethical considerations, and leveraging emerging trends, we can develop more accurate, reliable, and fair age and gender recognition systems that contribute to a better understanding of human demographics and support a wide range of applications in industries and society.

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MAJOR PROBLEMS FACED BY FARMERS IN MARKETING OF TOMATO IN HARYANA

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Tomatoes are one of the most widely grown vegetables in Haryana and are an important commercial crop for farmers in state. The demand for tomatoes has increased significantly due to growing popularity for processed and ready to eat food. Perishability of tomatoes demands great attention of farmers in marketing of tomatoes to ensure availability of tomatoes in optimum conditions to ultimate consumers. By considering these facts, the study was conducted with the objective to study problems faced by farmers in marketing of tomato in Haryana. The analysis of data was done with the Garrett ranking technique. The results concluded that the major problems faced by farmers at marketing level were unstable prices during peak harvesting period, high transportation cost due to distant markets, lack of refrigerated vehicles, high spoilage and losses during transportation, presence of large number of intermediaries and non-availability of Minimum Support Price. It was suggested to build processing units in major tomato producing belts and also to develop small centers facilitated with facilities of grading, sorting, packaging and storage at village or block level. Government and private sector should take consideration to provide transportation facilities facilitated with refrigeration facilities to avoid spoilage and losses during long distance travel of tomatoes.

KEYWORDS: Tomato, Marketing, Problems, Farmers, Vegetables

1. INTRODUCTION

Tomato (*Lycopersicon esculentum*) is a ubiquitous vegetable, and because of its significant nutritional content, it is also one of the most important "protective foods." Tomatoes are in high demand all year since they are utilized in almost all Indian recipes. Because of the perishability, seasonality, and bulkiness of vegetables and fruits, marketing them can be difficult. Marketing of extremely perishable items poses difficulties due to customers' diverse consumption patterns and inadequate supply chain infrastructure. The presence of a large number of stakeholders, insufficient cold chain capacity, high packaging costs, high transportation costs and a lack of temperature-controlled transportation facilities, high post-harvest losses, poor marketing efficiency, and a low producer's share in consumer's price, as well as high price bearing by consumers, are the major obstacles in existing supply chains of fresh vegetables in India (Negi and Anand, 2015). Growers often sell vegetables to middlemen, who gather produce from numerous small farmers and sell it to commission agents or dealers. fee agents are middlemen that locate buyers for the local middleman and receive a fee on the transactions they make. They usually discover the bigger players or dealers that buy a lot of veggies. The dealers then gather all little quantities, aggregate them into huge types, and sell them to the wholesaler. Keeping the aforementioned factors in mind, the study was carried out to investigate significant marketing challenges experienced by farmers in marketing and to solicit solutions from farmers to address these problems and improve efficiency.

2. METHODOLOGY

The present study was carried out in Kurukshetra, Karnal and Yamuna Nagar districts of Haryana as these districts have great share under area and production of tomato in state and a total of 70 farmers from each district were interviewed to collect the data. Thus, in total 210 tomato growers were interviewed to collect the required information. The data were collected to study major problems faced by farmers in marketing of tomato, during 2021-22. Besides simple averages and percentages, Garrett's ranking technique and 5-point Likert scale were used to realize the objectives of the study. Major problems were also divided in 4 categories i.e., extremely serious, very serious, serious and not so serious based on the overall mean score criteria that problems with mean score of above 75 are extremely serious, very serious (50-75 mean score), serious (25-50 mean score) and not so serious (below 25).

3. RESULT AND DISCUSSION

Major problems faced by the farmers in marketing of tomato are presented in Table 1. The perusal of data presented in Table 1 revealed that unstable prices during harvesting period was identified as the most prominent problem faced by farmers with mean score of 82.90 and ranked first and extremely serious problem on severity scale followed by high transportation cost due to distant markets and ranked second with mean score of 76.29 as majority of the farmers sell their produce in distant markets like Azadpur Mandi of Delhi and markets of Gurgaon, Saharanpur, Dehradun and Chandigarh to avail good prices, which ultimately demands very high transportation charges. Lack of refrigerated vehicles and cold chain facilities with mean score of 63.90 (ranked 3rd), high spoilage and losses during transportation with mean score of 62.83 (ranked 4th), presence of large number of intermediaries in marketing process with mean score of 60.40 (ranked 5th), non-availability of MSP with mean score of 55.59 (ranked 6th) and lack of processing units near production point with mean score of 52.82 (ranked 7th) were categorized as very serious problems on risk severity scale. Cumbersome process of registration and getting J form under BBY (Bhawantar Bharpayi Yojana) with mean score 47.69 (ranked 8th) followed by poor marketing facilities with mean score of 43.39 (ranked 9th), high cost of packing material with mean score of 42.41 (ranked 10th), lack of information about government schemes and subsidies taking procedure for farmers with mean score of 38.48 (ranked 11th) and lack of availability of market information with mean score 27.62 (ranked 12th) respectively, were found serious on risk severity scale. Lengthy procedure for getting credit from government institutions for marketing purpose with mean score 24.69 (ranked 13th) and lack of knowledge about grading and packaging with mean score of 19.69 (ranked 14th) were categorized as not so serious risk severity scale.

The results are in line with Baskaur (2011), Kumar (2019) and Rashmi *et al.* (2020). Baskaur (2011) investigated problems in vegetable farming in Sonapat, Gurgaon, Kurukshetra, and Hisar districts of Haryana and results of study reported that shortage of labour during peak season, high labour costs and financial difficulties were major production problems whereas major marketing challenges were inadequate and overpriced transportation and lack of information about prospective markets in large cities. Kumar (2019) observed similar marketing constraint faced by tomato growers of Nuh district of Haryana. He reported that the lengthy procedure for obtaining credit from government institutions for marketing purposes, the expensive nature of transportation, exorbitant price fluctuation, no provision of minimum support prices, inadequacy of appropriate credit facilities, inclusion of a large number of intermediaries in the marketing process, lack of market information, and the considerable distance from the point of production to the market were major problems faced by farmers in marketing. Rashmi *et al.* (2020) stated that tomato producers face difficulties due to unexpected shifts in market prices, commission agent charges are high, high transportation costs and distant markets were major constraints in marketing of tomato in Karnataka.

Table: 1: Major problems faced by farmers in marketing of tomato

Sr. No.	Particulars	D1	D2	D3	Overall Mean Score	Rank	Risk Severity
1	Unstable prices during harvesting period	81.26	83.43	84.00	82.90	1	Extremely Serious
2	High transportation cost due to distant markets	77.20	76.37	75.30	76.29	2	
3	Lack of refrigerated vehicles/chilled vans and cold chain facility	65.04	64.64	62.03	63.90	3	Very Serious
4	High spoilage and losses during transportation	61.60	61.81	65.07	62.83	4	
5	Presence of large number of intermediaries in marketing process	60.71	59.81	60.69	60.40	5	
6	Non availability of Minimum Support Price	49.86	58.93	57.99	55.59	6	
7	Lack of processing units near production point	58.13	49.80	50.54	52.82	7	
8	Cumbersome process of registration and getting J-form under Bhawantar Bharpayi Yojana	47.69	47.43	47.94	47.69	8	Serious
9	Poor market facilities	41.51	44.03	44.64	43.39	9	
10	High cost of packing material	44.17	41.51	41.55	42.41	10	
11	Lack of information about government schemes and subsidies taking procedure for farmers	39.01	39.11	37.31	38.48	11	
12	Lack of availability of market information	28.03	24.23	30.61	27.62	12	
13	Lengthy procedure for getting credit from government institutions for marketing purpose	21.09	28.71	24.27	24.69	13	Not So Serious
14	Lack of knowledge about grading and packaging	22.89	19.06	17.11	19.69	14	

Note: D1 represents district Kurukshetra, D2 represents Karnal and D3 represents Yamuna Nagar, respectively

4. CONCLUSION

Marketing of tomatoes due to its high perishability and bulkiness nature needs careful attention at each and every stage of marketing so that farmers could avail high prices and consumers can get quality products. It is recognized that if improvement in income of tomato producers is to be made, they must be modernized in terms of knowledge, adoption, and other personal, social, and economic aspects. Government and other agencies should focus on development of well-planned logistics system to ensure better income to producers and quality tomatoes to consumers. It is required that FPOs should operationalized more actively to provide platform to farmers to market and sell their produce in more organized form. Farmers should be encouraged to use product differentiation strategies like quality certification which also help them to tap opportunity of premium markets with better price realization. Training should be provided to farmers to enhance their marketing skills by making them understand market dynamics, grading and packaging requirements, negotiation techniques and branding strategies.

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MODIFIED PICARD MANN HYBRID ITERATIVE PROCESS AND ITS CONVERGENCE ANALYSIS

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In this paper, we have introduced a new fixed-point iterative process. This process is modified Picard-Mann hybrid iterative process. It converges faster than the previously introduced iterative processes such that Picard, Mann, Noor, Ishikawa iterative process and the hybrid processes Picard-Noor, Picard-Ishikawa, Picard-Mann etc. in the Berinde's sense. We provide a numerical example to support our claim.

Keywords: contraction mapping, new iterative process, fast convergence, stability.

1. INTRODUCTION & PRELIMINARIES

Various fixed point iterative processes have been introduced such that Picard, Mann, Ishikawa and Noor iterative processes. Various hybrid iterative processes like Picard-Mann, Picard-Ishikawa, Picard-Noor were also introduced. These hybrid processes were found to converge faster than many iterative methods in Berinde's sense. we are introducing a new iterative process. we prove that its convergence rate is better than many of the iterative methods in Berinde's sense. Stability and data dependency of the process is also proved. There are four sections in this paper. First section includes introduction part. Second section

Throughout this paper, A denotes a non-empty closed convex subset of a Banach space X .

For a self-map $F: A \rightarrow A$, a point $x \in A$ is a fixed point of F if $F(x) = x$.

A map $F: A \rightarrow A$ is said to be a contraction map if $\exists \theta \in (0,1)$ such that

$$\|Fx - Fy\| \leq \theta \|x - y\|$$

for all $x, y \in A$.

(1)

Some well-known iterative methods are:

Picard iteration method [2]

This iteration is defined for any fixed x_1 , by the sequence $\{x_n\}_{n=1}^{\infty}$ as

$$x_{n+1} = Fx_n \quad (2)$$

Mann iteration method [3]

This iteration is defined for any fixed x_1 , by the sequence $\{x_n\}_{n=1}^{\infty}$ as

$$x_{n+1} = (1 - a_n)x_n + a_n Fx_n \quad (3)$$

Where $\{a_n\}$ is a real sequence in $(0,1)$.

Ishikawa iteration method [4]

This iteration is defined for any fixed x_1 , by the sequence $\{x_n\}_{n=1}^{\infty}$ as

$$\begin{aligned} x_{n+1} &= (1 - a_n)x_n + a_n Fy_n \\ y_n &= (1 - b_n)x_n + a_n Fx_n \end{aligned}$$

Where $\{a_n\}$, $\{b_n\}$ are real sequences in $(0,1)$. (4)

Noor iteration method [5]

This iteration is defined for any fixed x_1 , by the sequence $\{x_n\}_{n=1}^\infty$ as

$$\begin{aligned} x_{n+1} &= (1 - a_n)x_n + a_n F y_n \\ y_n &= (1 - b_n)x_n + b_n F z_n \\ z_n &= (1 - c_n)x_n + c_n F x_n \end{aligned}$$

Where $\{a_n\}$, $\{b_n\}$, $\{c_n\}$ are real sequences in $(0,1)$. (5)

Definition 1. [1] If $\{x_n\}_{n=1}^\infty$ and $\{y_n\}_{n=1}^\infty$ are real sequences with $x_n \rightarrow x$ and $y_n \rightarrow y$ and that $\lim_{n \rightarrow \infty} \frac{|x_n - x|}{|y_n - y|} = 0$ then $\{x_n\}_{n=1}^\infty$ converges to x faster than $\{y_n\}_{n=1}^\infty$ converges to y .

Definition 2. [1] If $\{x_n\}_{n=1}^\infty$ and $\{t_n\}_{n=1}^\infty$ be fixed point iterative processes, such that $x_n \rightarrow p$ and $t_n \rightarrow p$. Suppose $\|x_n - p\| \leq a_n$ and $\|t_n - p\| \leq b_n$ for all $n \in N$, where $\{a_n\}_{n=1}^\infty$ and $\{b_n\}_{n=1}^\infty$ ($a_n > 0, b_n > 0$). If $\{a_n\}_{n=1}^\infty$ converges faster than $\{b_n\}_{n=1}^\infty$, then $\{x_n\}_{n=1}^\infty$ converges faster than $\{t_n\}_{n=1}^\infty$ to p .

Some hybrid iterative processes are:

Picard-Mann hybrid iterative method [8]

This hybrid iterative process is defined, for any fixed x_1 in X , by the sequence $\{x_n\}_{n=1}^\infty$ as

$$\begin{aligned} x_{n+1} &= F y_n \\ y_n &= (1 - a_n)x_n + a_n F x_n \end{aligned}$$

Where $\{a_n\}$ is a real sequence in $(0,1)$. (6)

Picard-Krasnoselskii hybrid iterative method [9]

This hybrid iterative process is defined, for any fixed x_1 in X , by the sequence $\{x_n\}_{n=1}^\infty$ as

$$\begin{aligned} x_{n+1} &= F y_n \\ y_n &= (1 - \delta)x_n + \delta F x_n \end{aligned}$$

Where $\delta \in (0,1)$. (7)

Picard-Ishikawa hybrid iteration method [10]

This hybrid iterative process is defined, for any fixed x_1 in X , by the sequence $\{x_n\}_{n=1}^\infty$ as

$$\begin{aligned} x_{n+1} &= F y_n \\ y_n &= (1 - a_n)x_n + a_n F z_n \\ z_n &= (1 - b_n)x_n + b_n F x_n \end{aligned}$$

Where $\{a_n\}$, $\{b_n\}$ are real sequences in $(0,1)$. (8)

Picard-Noor hybrid iteration method [22]

This hybrid iterative process is defined, for any fixed x_1 in X , by the sequence $\{x_n\}_{n=1}^\infty$ as

$$\begin{aligned} x_{n+1} &= F y_n \\ y_n &= (1 - a_n)x_n + a_n F z_n \end{aligned}$$

$$\begin{aligned} z_n &= (1 - b_n)x_n + b_n Fw_n \\ w_n &= (1 - c_n)x_n + c_n Fx_n \end{aligned}$$

Where $\{a_n\}$, $\{b_n\}$, $\{c_n\}$ are real sequences in $(0,1)$. (9)

The above iterative methods motivated us to introduce a new iterative method, which is given as follows:

For any fixed x_1 in X , by the sequence $\{x_n\}_{n=1}^\infty$ as

$$\begin{aligned} x_{n+1} &= F^2 y_n \\ y_n &= (1 - a_n)x_n + a_n Fx_n \end{aligned}$$

Where $\{a_n\}$ is a real sequence in $(0,1)$. (10)

Lemma 1. Let θ be such that $0 \leq \theta < 1$, and let $\{\varepsilon_n\}_{n=1}^\infty$ ($\varepsilon > 0$) be a sequence, with $\lim_{n \rightarrow \infty} \varepsilon_n = 0$. Then for any sequence $\{\rho_n\}_{n=1}^\infty$, $\rho > 0$, satisfying $\rho_{n+1} \leq \theta \rho_n + \varepsilon_n, n=1, 2, 3, \dots$, we have $\lim_{n \rightarrow \infty} \rho_n = 0$.

2. CONVERGENCE AND STABILITY ANALYSIS

Theorem 1. Let $F: A \rightarrow A$ be a self-mapping on A and let F satisfy (1). If the process (10) generates the iterative sequence $\{x_n\}_{n=1}^\infty$, then $\{x_n\}$, converges to a fixed point of F .

Proof. By Banach contraction theorem a unique fixed point x of F exists. We will prove that $x_n \rightarrow x$ as $n \rightarrow \infty$. Using (10) we have

$$\begin{aligned} \|y_n - p\| &= \|(1 - a_n)(x_n - p) + a_n(Fx_n - p)\| \\ &\leq (1 - a_n)\|x_n - p\| + a_n \theta \|x_n - p\| \\ &= (1 - (1 - \theta)a_n)\|x_n - p\| \\ &\leq (1 - (1 - \theta)\lambda)\|x_n - p\| \end{aligned}$$

So,

$$\begin{aligned} \|x_{n+1} - p\| &= \|F^2 y_n - p\| \\ &\leq \theta \|F y_n - p\| \\ &\leq \theta^2 \|y_n - p\| \\ &\leq \theta^2 (1 - (1 - \theta)\lambda)\|x_n - p\| \end{aligned}$$

By lemma 1, $\lim_{n \rightarrow \infty} \|x_n - x\| = 0$

So, x_n converges to x as $n \rightarrow \infty$.

Hence the proof.

Note:- The uniqueness of the fixed point is given by Banach contraction principle.

Theorem 2. let $F: A \rightarrow A$ be a self mapping on A and let F satisfies (1). If the process (10) generates the iterative sequence $\{x_n\}_{n=1}^\infty$ then (10) is F -stable.

Proof. Suppose (10) generates the sequence $x_{n+1} = T_{F,x_n}$ which converge to a unique $x^* \in \text{Fix}(F)$ (by theorem (1)). Let $\{t_n\}_{n=1}^\infty$ be any sequence in A and $\varepsilon_n = \|t_{n+1} - T_{F,x_n}\|$. We will show that $\lim_{n \rightarrow \infty} \varepsilon_n = 0$ iff $\lim_{n \rightarrow \infty} t_n = x^*$.

Let $\lim_{n \rightarrow \infty} \varepsilon_n = 0$. We have

$$\begin{aligned} \|t_{n+1} - x^*\| &\leq \|t_{n+1} - T_{F,x_n}\| + \|T_{F,x_n} - x^*\| \\ &\leq \varepsilon_n + \theta^2(1 - (1 - \theta)\lambda)\|t_n - x^*\| \end{aligned}$$

Now $\theta \in (0,1)$, $a_n \in (0,1) \forall n \in N$ and $\lim_{n \rightarrow \infty} \varepsilon_n = 0$.

Using lemma 1, we get $\lim_{n \rightarrow \infty} t_n = x^*$.

Conversely, let $\lim_{n \rightarrow \infty} t_n = x^*$

$$\begin{aligned} \varepsilon_n &= \|t_{n+1} - T_{F,x_n}\| \\ &\leq \|t_{n+1} - x^*\| + \|T_{F,x_n} - x^*\| \\ &\leq \|t_{n+1} - x^*\| + \theta^2(1 - (1 - \theta)\lambda)\|t_n - x^*\| \end{aligned}$$

This implies that $\lim_{n \rightarrow \infty} \varepsilon_n = 0$.

Hence (10) is F stable.

We now prove the fast convergence of (10) than others in Berinde's sense.

Theorem 3. Let $F: A \rightarrow A$ be a contraction satisfying (1) with a unique $x \in \text{Fix}(F)$. For same initial value $x_1 \in A$, consider the iterative sequences generated by (2), (3), (4), (5), (9) and (10) with $\{a_n\}$, $\{b_n\}$, $\{c_n\}$ being real sequences in $(0,1)$ satisfying $0 < \lambda \leq a_n, b_n, c_n < 1$ for some $\lambda > 0$ and for all $n \in N$.

Then $\{x_n\}_{n=1}^{\infty}$ defined by (10) (our process) converges to x faster than others.

Proof. Using (10) we have

$$\begin{aligned} \|y_n - p\| &= \|(1 - a_n)(x_n - p) + a_n(Fx_n - p)\| \\ &\leq (1 - a_n)\|x_n - p\| + a_n \theta \|x_n - p\| \\ &= (1 - (1 - \theta)a_n)\|x_n - p\| \\ &\leq (1 - (1 - \theta)\lambda)\|x_n - p\| \end{aligned}$$

So,

$$\begin{aligned} \|x_{n+1} - p\| &= \|F^2 y_n - p\| \\ &\leq \theta \|F y_n - p\| \\ &\leq \theta^2 \|y_n - p\| \\ &\leq \theta^2(1 - (1 - \theta)\lambda)\|x_n - p\| \end{aligned}$$

$$\leq$$

$$\dots$$

$$\leq (\theta^2(1 - (1 - \theta)\lambda))^n |x_1 - p|.$$

Let $a_n = (\theta^2(1 - (1 - \theta)\lambda))^n$

Using (2) $|x_{n+1} - p| \leq \theta^n |x_1 - p|$

Let $b_n = \theta^n |x_1 - p|$

As $\frac{a_n}{b_n} \rightarrow 0$ as $n \rightarrow \infty$.

So [10] converges faster than [2].

Now Using (3)

$$\begin{aligned} ||x_{n+1} - p|| &= ||(1 - a_n)(x_n - p) + a_n(Fx_n - p)|| \\ &\leq (1 - a_n)||x_n - p|| + a_n \theta ||x_n - p|| \\ &= (1 - (1 - \theta)a_n)||x_n - p|| \\ &\leq (1 - (1 - \theta)\lambda)||x_n - p|| \\ &\cdot \\ &\cdot \\ &\cdot \\ &\leq (1 - (1 - \theta)\lambda)^n |x_1 - p|. \end{aligned}$$

Let $c_n = (1 - (1 - \theta)\lambda)^n |x_n - p|$.

$\frac{a_n}{c_n} \rightarrow 0$ as $n \rightarrow \infty$.

So [10] converges faster than [3].

Using (6)

$$\begin{aligned} ||x_{n+1} - p|| &= ||Fy_n - p|| \leq \theta ||y_n - p|| \leq \theta [|(1 - a_n)(x_n - p) + a_n(Fx_n - p)|] \\ &\leq \theta [(1 - a_n)||x_n - p|| + a_n \theta ||x_n - p||] \\ &= \theta (1 - (1 - \theta)a_n)||x_n - p|| \end{aligned}$$

$$\leq \theta(1 - (1 - \theta)\lambda)|x_n - p|$$

$$\cdot$$

$$\cdot$$

$$\cdot$$

$$\leq (\theta(1 - (1 - \theta)\lambda))^n|x_n - p|.$$

Let $d_n = [\theta(1 - (1 - \theta)\lambda)]^n|x_1 - p|$.

$$\frac{a_n}{d_n} \rightarrow 0 \text{ as } n \rightarrow \infty.$$

So [10] converges faster than [6].

Using (9)

$$|x_{n+1} - p| = |Fy_n - p| \leq \theta|y_n - p|$$

$$|w_n - p| = |(1 - c_n)x_n + c_nFx_n - p| \leq (1 - c_n)|x_n - p| + c_n|Fx_n - Fp|$$

$$\leq (1 - c_n)|x_n - p| + c_n\theta|x_n - p|$$

$$= (1 - c_n(1 - \theta))|x_n - p|$$

$$|z_n - p| = |(1 - b_n)x_n + b_nFw_n - p| \leq (1 - b_n)|x_n - p| + b_n|Fw_n - Fp|$$

$$\leq (1 - b_n)|x_n - p| + b_n\theta|w_n - p|$$

$$= (1 - b_n)|x_n - p| + b_n\theta[(1 - c_n(1 - \theta))|x_n - p|]$$

$$\leq [1 - b_n + b_n\theta(1 - c_n(1 - \theta))]|x_n - p|$$

$$= [1 - b_n(1 - \theta)(1 + c_n\theta)]|x_n - p|$$

$$|y_n - p| = |(1 - a_n)x_n + a_nFz_n - p| \leq (1 - a_n)|x_n - p| + a_n|Fz_n - Fp|$$

$$\leq (1 - a_n)|x_n - p| + a_n\theta|z_n - p|$$

$$\leq (1 - a_n)|x_n - p| + a_n\theta[(1 - b_n(1 - \theta)(1 + c_n\theta))|x_n - p|]$$

$$= [1 - a_n(1 - \theta)(1 + b_n\theta(1 + c_n\theta))]|x_n - p|$$

$$|x_{n+1} - p| \leq \theta[1 - a_n(1 - \theta)(1 + b_n\theta(1 + c_n\theta))]|x_n - p|$$

$$\leq [1 - a_n(1 - \theta)(1 + b_n\theta(1 + c_n\theta))]|x_n - p|$$

$$\leq [1 - a(1 - \theta)(1 + b\theta(1 + \theta c))]^n ||x_1 - p||$$

Let $e_n = [1 - a(1 - \theta)(1 + b\theta(1 + \theta c))]^n ||x_1 - p||$

$\frac{a_n}{e_n} \rightarrow 0$ as $n \rightarrow \infty$.

So [10] converges faster than [9]. Hence the proof.

Example

Now we give a numerical example to support our claim.

Example 1. Let $A = [1,25] \subseteq X = R$ and $F: A \rightarrow A$ be defined by

$$F(x) = (x+24)^{1/3}$$

For all $x \in A$. Choose $a_n = b_n = c_n = 0.5$ for each $n \in N$. with initial value $x_1 = 20$.

The convergence is effected by the values taken for a_n, b_n, c_n .

Clearly, F is a contraction map and $Fix(F) = \{3\}$. Table 1 shows the comparison of the convergence rates of the processes (10), (2), (3), (4) and (5), (9). Calculation in table 1 is done using MATLAB.

Table 1

Step	Our process	Picard	Mann	Ishikawa	Picard-Mann	Picard-Noor
1	20.000000000000000	20.000000000000000	20.000000000000000	20.000000000000000	20.000000000000000	20.000000000000000
2	3.010876525246633	3.530348335326063	11.765174167663032	11.647366078775978	3.294732157551954	3.291054909357043
3	3.000007735590617	3.019515306601869	7.529953162607493	7.402258745997276	3.005648777148326	3.005481428702942
4	3.000000005502121	3.000722615061918	5.344566837886251	5.242191079888928	3.000108477124344	3.000103420107380
5	3.00000000003913	3.000026763282053	4.214501907950995	4.142303865930707	3.000002083235410	3.000001951333421
6	3.000000000000003	3.000000991232341	3.629412689181518	3.582035992828175	3.00000040007263	3.000000036817836
7	3.000000000000000	3.000000036712308	3.326272718554686	3.296584717587478	3.00000000768315	3.00000000694680
8	3.000000000000000	3.000000001359715	3.169154270863968	3.151134464421982	3.00000000014755	3.00000000013107
9	3.000000000000000	3.00000000050360	3.087703102955502	3.077016956785218	3.00000000000283	3.00000000000247
10	3.000000000000000	3.000000000001865	3.045473927645047	3.039247620859340	3.000000000000005	3.000000000000004
11	3.000000000000000	3.000000000000069	3.023578601269677	3.020000572572700	3.000000000000000	3.000000000000000
12	3.000000000000000	3.000000000000002	3.012225814357283	3.010192309404176	3.000000000000000	3.000000000000000
13	3.000000000000000	3.000000000000000	3.006339276984310	3.005194016417845	3.000000000000000	3.000000000000000
14	3.000000000000000	3.000000000000000	3.003287023324011	3.002646880393915	3.000000000000000	3.000000000000000
15	3.000000000000000	3.000000000000000	3.001704379994299	3.001348855597787	3.000000000000000	3.000000000000000
16	3.000000000000000	3.000000000000000	3.000883751925528	3.000687379653547	3.000000000000000	3.000000000000000
17	3.000000000000000	3.000000000000000	3.000458241560607	3.000350290149056	3.000000000000000	3.000000000000000

18	3.0000000000000000	3.0000000000000000	3.000237606687122	3.000178508620710	3.0000000000000000	3.0000000000000000
19	3.0000000000000000	3.0000000000000000	3.000123203454489	3.000090968382808	3.0000000000000000	3.0000000000000000
20	3.0000000000000000	3.0000000000000000	3.000063883269227	3.000046357686991	3.0000000000000000	3.0000000000000000

3. Conclusion

Above proved theorems and provided numerical example shows that our process is faster than (2), (3), (4), (5), (6), (9). So, there is some scope of further improvement in this area increasing cost of function in other iterative processes.

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FABRICATION AND MORPHOLOGICAL INVESTIGATION OF COBALT OXIDE NANOPARTICLES SUITABLE FOR ELECTROCHEMICAL APPLICATIONS

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Cobalt oxide nanoparticles are synthesized by using an enhanced sol-gel technique. The organized samples are characterized in order to connect their structural and chemical properties in the synthesized state by using XRD, FTIR and SEM-TEM spectroscopy, etc. The Powder XRD crystallographic analysis was used to follow the crystalline behavior, homogeneity, and phase purity of the sample. The cubic structure of Co_3O_4 was observed from the XRD pattern and crystallite size using the Debye Scherer equation. The presence of the constituent functional groups in the synthesized nanoparticles of silica-mixed cobalt oxide is endorsed by FTIR spectroscopy. SEM-TEM micrograph certifies the crystallization of well-developed nanoparticles of silica mixed cobalt oxide in nanosize. Cobalt having a high valence state could also be achieved without any calcination condition which is enchanting for catalytic applications for its strong oxidation ability. Particularly as electrodes, cobalt oxide exhibits good electrochemical performance in alkaline solutions, and redox processes occurring at the surface.

Keywords: Sol-gel, Co_3O_4 , XRD, SEM, TEM, etc.

1. INTRODUCTION

Transition metal oxide nanoparticles distributed in an inorganic matrix have been engrossed for their structural, magnetic, optical, and catalytic properties. Such metal oxide nanostructures dispersed in silica matrix are freshly projected as gas sensors, electrodes, and catalysts (Jozwiak, 2004). The binary formation of silica-mixed cobalt oxide exhibits additional properties in the field of electro-optic, magneto-optical, sensing, and energy conversion (Thota, 2009). Cobalt oxide (Co_3O_4) has an approximate lattice constant of 8.02 \AA and reveals a normal spinel structure with a cubic closed packing structure. Cobalt oxide having a valency of more than three is unstable in the ordinary environment because of its distinctive features. The color of cobalt oxide (Co_3O_4) changes to yellow when Li^+ ions have been inserted, so it is also used as an active optical material (Barreca, 2001). Numerous fascinating properties of cobalt oxide are reported due to its ability to change the particle shape in a controlled manner (Zhang, 2008). Therefore, many efforts have been made to synthesize silica-mixed cobalt oxide binaries to obtain spherical nanoparticles with the perfect size for practical purposes (Makhlouf, 2013). Silica matrix has captivated much interest due to its low cost, less toxicity, and small pollution effects as compared to other polymer matrices (Meng, 2015). In literature, several forms of Co_3O_4 like nanoparticles, nanofilms, nanoflowers, and nanowires are attained using different physical and chemical methods (Niu, 2009, Pal, 2010). To explore more, we have used the enhanced sol-gel technique for cobalt oxide nanoparticles dispersed in the silica matrix and investigated its structural and morphological features (Khoza, 2012, Tonya, 2017).

2. USED CHEMICALS & METHODOLOGY

The chemical supplies used in the synthesis of silica mixed cobalt oxide binaries were tetraethyl orthosilicate (TEOS, transparency > 98%), spectroscopical score ethyl alcohol ($\text{C}_2\text{H}_5\text{OH}$ 99.8%), analytical grade $[\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}]$, double distilled water catalyzed by hydrochloric acid (HCl). The preparation of the ready sample was supported by the sol-gel process labeled in Fig.1. The gels were then matured at room temperature for one

week and to end dehydrated in steps from 30°C to 110°C for five days to generate the as-groomed sample 'K1'. Some as-groomed powder was shifted into another crucible and then placed in the furnace at 900°C for 3h termed as 'K2'. Both the prepared samples were characterized by well-known techniques like XRD, FTIR, SEM, and TEM to explore their structural outcomes.

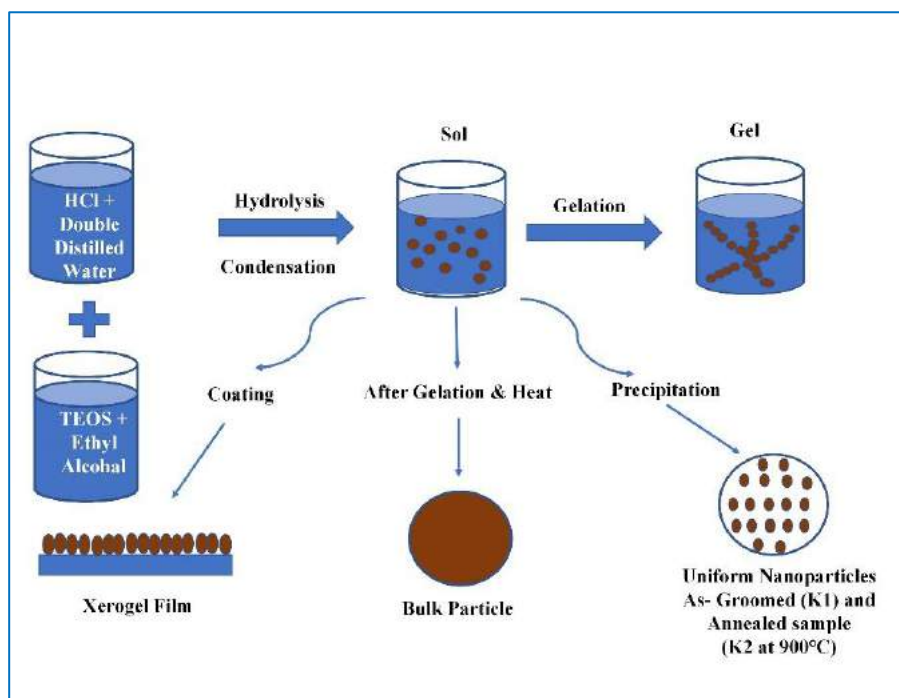


Figure 1. Synthesis 'sol-gel' route synthesized silica-mixed cobalt oxide nanoparticles.

3. RESULTS & DISCUSSION

3.1 XRD ANALYSIS

In Fig. 2(a), the XRD pattern is shown to study the phase and crystalline features of the prepared oxide nanoparticles. Sample K1 expresses some asymmetrical peaks at the angle 25.38° and 35.30° which resemble metal-ethanol (C_2H_5OH) peaks [Rani, 2019]. Minor peaks with fluctuating intensity also exist in as-groomed sample K1 at $2\theta \sim 31.28^\circ$, 36.79° , and 51.86° designated for crystalline silica (Ahlawat, 2013). The small hump at $2\theta \sim 22.13^\circ$ displays the amorphous nature of silica corresponding to JCPDS card no. 29-0085 (Goswami, 2018). When the temperature has increased in the K2 sample, sharp peaks are extensively attained with boosted intensity. The intensified peaks illustrate the growth of Co_3O_4 nanoparticles with cubic phase.

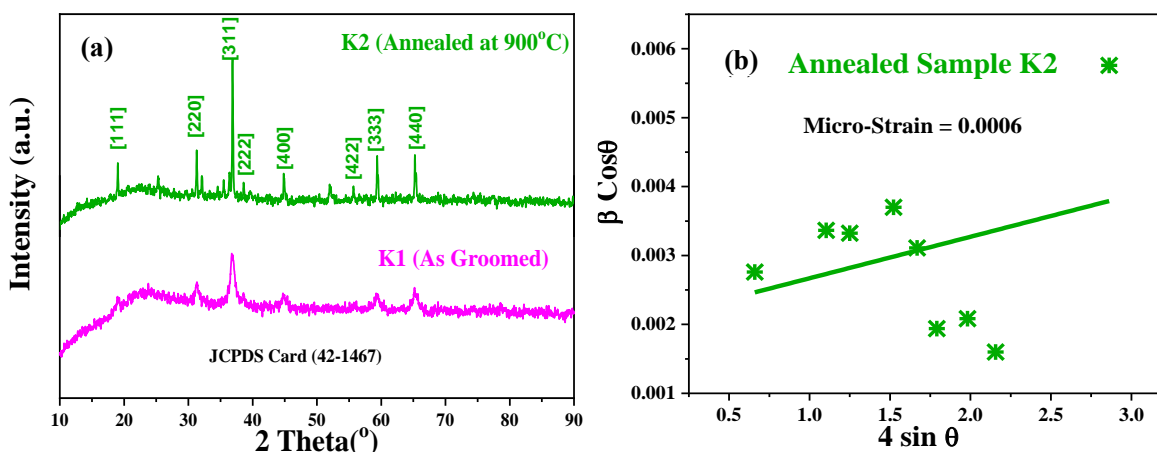
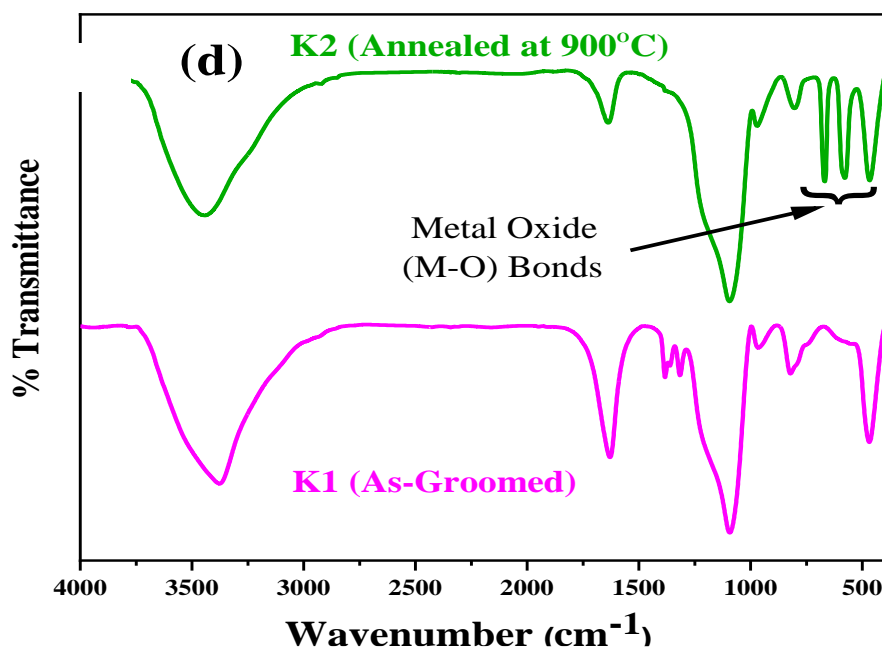


Figure 2. (a) XRD spectra (b) W-H Plot synthesized silica-mixed cobalt oxide nanoparticles.

The diffractogram is well matched with JCPDS files (PDF # 00-042-1467) having 2θ values $\sim 19.12^\circ$, 32.03° , 36.43° , 38.67° , 44.92° , 55.69° , 59.40° , and 65.30° referred to (111), (220), (311), (222), (400), (422), (333) and (440) planes. Moreover, the lattice parameter for annealed sample K2 has value 'a' = 8.065 Å, and unit cell volume 'VK2' is considered as 524.58 Å (Niu, 2009). The average nanocrystallite size is evaluated as 30 and 40 nm respectively for both K1 and K2 samples using the following equation: $D = k\lambda/\beta\cos\theta$, where D is an average crystallite size, K is 0.9 considered as the shape factor, the wavelength of X-ray is λ , and θ is the diffraction angle. It is to be apparent that the micro-strain and nanocrystallite size, both are the origin of peak broadening in the XRD patterns. The effect of the micro-strain could be evaluated by the Williamson-Hall plot for annealed samples as shown in Fig. 2(b). In the annealed sample K2 micro strain have values i.e., 0.0006 corresponding to extensional strain respectively.

3.2 FTIR ANALYSIS

Fourier transform infrared spectroscopy collects all high-resolution data over the wide spectral range of 4000-400 cm^{-1} . FTIR is a more efficient way to obtain information regarding compounds/elements stability as depicted in Fig. 3. The K1 sample contains a large amount of water due to stretching and -H-O-H- bending at the surface. In the K2 sample, the water absorption band becomes wide to some extent between 3400-3000 cm^{-1} (Jozwiak, 2004, Thota, 2009).

**Figure 3.** Vibrational FTIR Spectra of synthesized silica-mixed cobalt oxide nanoparticles.

The asymmetric and symmetric stretching vibration of the -Si-O-Si- bond is obtained at ~ 1100 and 800 cm^{-1} in both the prepared samples corresponding to the silica gel network (Barreca, 2001, Zhang, 2008). One may notice near the lower wavenumber side; the fingerprint region includes the characteristic metal-oxygen (Co-O) bonds. The spectra present significant peaks at 567 and 663 cm^{-1} corresponding to stretching vibrations of the Co-O bond in Co_3O_4 oxide nanoparticles (Tonya, 2017). The sharpness of the peak with high absorption intensity proved that cobalt is successfully embedded in silica.

3.4 SURFACE TEXTURE ANALYSIS BY SEM AND EDX

SEM micrograph of the prepared sample displays the surface morphology with identical shapes as shown in Fig. 4. The as-groomed samples show the amorphous nature of the prepared sample with the presence of silica.

However, the annealed sample represents an agglomeration of nanoparticles due to thermal treatment (Khoza, 2012). This type of surface topography illustrates the homogenous dispersion of Co_3O_4 nanoparticles in the silica matrix. EDX spectra give the elemental composition percentage for the prepared sample K1. The topmost intensify peaks of oxygen and silica have 57.84 wt % and 19.43 wt % respectively. The medium or average intensified peak of cobalt is due to the controlled amount present at starting level of the prepared sample with 22.72 wt %.

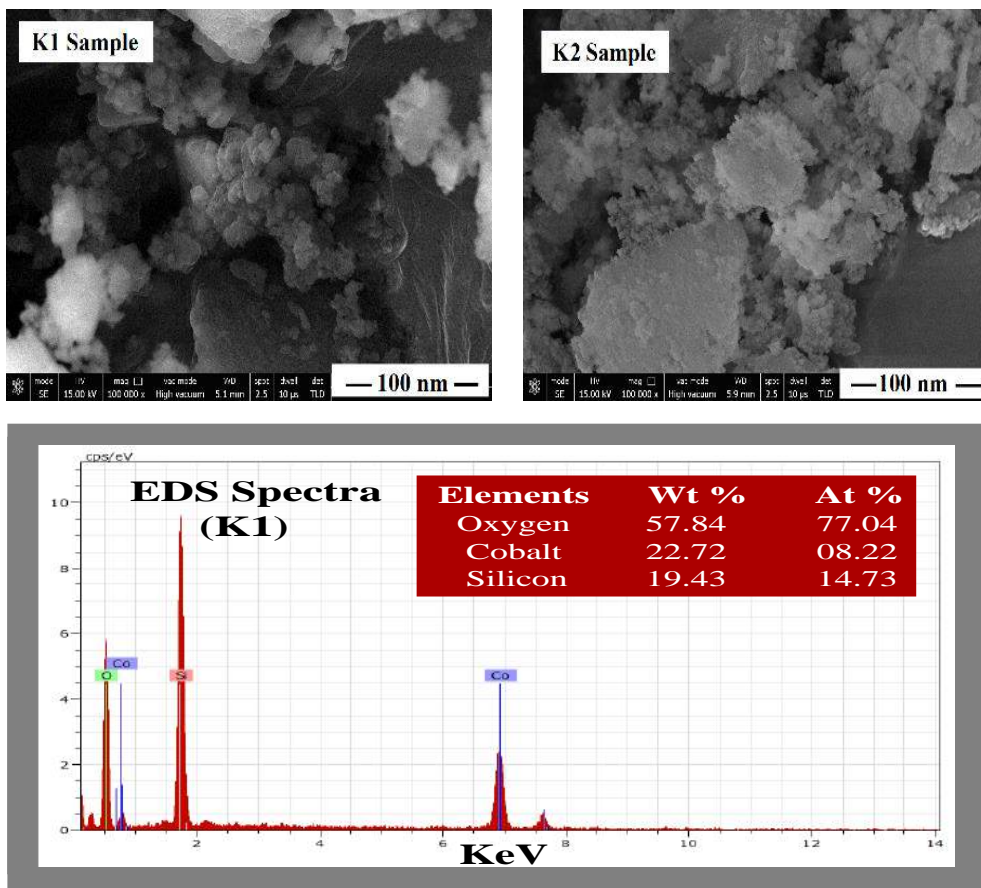


Figure 4. SEM images and EDX spectrum of silica mixed cobalt oxide nanoparticles.

3.4 TRANSMISSION ELECTRON MICROSCOPE (TEM)

Transmission electron microscopic images disclose the nanocrystallinity of the prepared samples. Fig. 5 represents the characteristic micrographs attained from cobalt oxide at nanoscale dimensions. The indefinite shapes have appeared with comparable agglomerations that can be accompanied by the high surface energy of the nanometric particles (Goswami, 2018). One may notice the size of particles and their agglomerates are similar, around 20 and 30 nm as depicted in respective micrographs. Controlled agglomeration is helpful to overcome the challenges related to sample integrity, dusting, flowability, and density, etc. The selected area electron diffraction (SAED) pattern and HR-TEM image for the K2 sample are also depicted in Fig. 5.

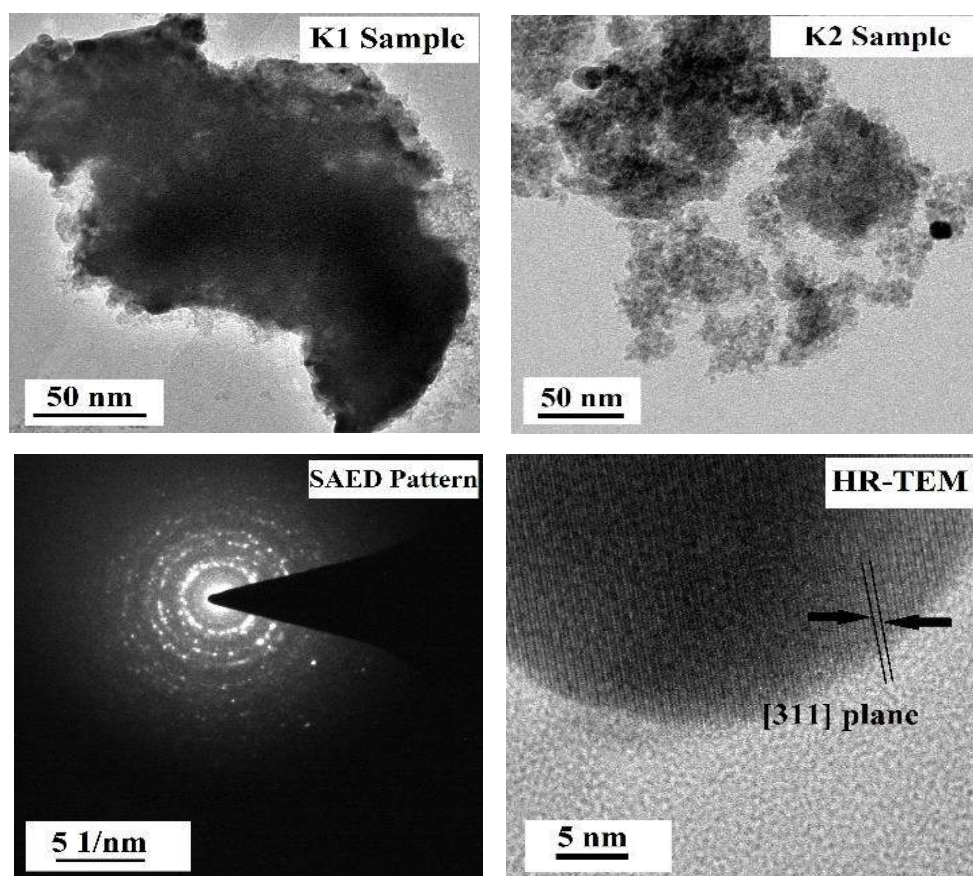


Figure 5. TEM micrograph of as-groomed (K1) and annealed sample (K2) of silica-mixed cobalt nanoparticles.

5. CONCLUSIONS

We have successfully synthesized silica-mixed cobalt oxide nanoparticles by using an enhanced sol-gel technique. Average nanocrystallite size was obtained as 30 and 40 nm for K1 and K2 samples respectively using the Debye-Scherrer formula. The lattice constant corresponding to the cubic structure of Co_3O_4 is determined as 8.065 Å. The sharp and intensified peaks are evident in the XRD pattern of Co_3O_4 . FTIR notified the characteristic band at 567 cm^{-1} owing to Co^{3+} -O vibration in octahedral form while the band at 663 cm^{-1} is attributed to Co^{2+} -O vibration in the tetrahedral site of the lattice. SEM micrograph shows the powdered surface of the particles with their specific elemental composition. TEM micrograph represents the average particle size ~ 20 -30 nm that tends to increase with temperature. In summary, the synthesized silica mixed cobalt oxide nanoparticles possess suitable applications in the form of sensors and electrochemical electrodes.

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INVESTIGATION OF STRUCTURAL AND OPTICAL PROPERTIES OF STRONTIUM SILICATE

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Pure Phase Sr_2SiO_4 nano ceramic was synthesized by citric acid-assisted sol-gel technique and further analyzed by XRD, SEM, TEM, FTIR, and PL techniques. The XRD analysis confirms the sample's crystalline nature, homogeneity, and phase purity. The presence of the constituents in the synthesized ceramic has been evaluated by FTIR spectroscopy. TEM was used to certify the crystallization of well-developed orthorhombic Sr_2SiO_4 particles in nano size. SEM images emphasize the texture and shape of the prepared nanopowder. The most prominent emission peak appears at 465 nm using the excitation wavelength of the NUV region i.e., 295 nm. Also, the excitation spectrum is depicted after holding the emission at 465 nm. Therefore, the structural, and optical investigations convey that Sr_2SiO_4 ceramic is a better host material for the advanced study of silicate-based ceramic nanopowder. The presently prepared silicate could be a definitive choice for practical applications, especially in photonic devices.

Keywords: Sr_2SiO_4 ceramic, XRD, FTIR, Excitation, Emission spectra, etc.

1. INTRODUCTION

Recent research and development in material science have attracted the attention of researchers toward the eminent luminescent materials which have numerous photonic applications in display technology and lightening materials like fluorescent lamps, light emitting diodes (LEDs), scintillators and plasma display panels, sensors, television tubes, radar screens, and compact fluorescent lamps, etc (Verma, 2019). The inorganic nanostructured phosphors have taken an important role in the new exploration of the optoelectronic device. At the nanoscale dimensions, there is a drastic change in all the physical and chemical properties such as the large fraction of surface atoms, high surface energy, spatial confinement and reduced imperfections, etc. Due to these properties, they are frequently used in different areas of photonics such as light-emitting diodes, optical memory, solid-state lighting, traffic signals, and luminous paint, etc (Singh, 2020).

The glass-ceramics exhibit high thermal and chemical stability at high temperatures. Also, ceramic nanomaterials are relatively inexpensive and can be easily formed by thermal annealing without affecting their external geometry. The glass-ceramics made up of silicates have been regarded as appropriate material for the research exploration (Trusovaa, 2018). Silicates have some essential properties such as easy synthesis using inexpensive raw material, low sintering temperature, better formability, multicolor phosphorescence, resistance for alkali and oxygen, transparency to visible light, better durability, and flexibility of different color emission with rare earth ions as dopant (Hameeda, 2019). The selection of silicates as a host material is a better choice as they have a low dimensional structure so it is easy to impart other ions for the exploration of new luminescent materials.

Significant research work has been done in the field of silicate-based nano phosphors at national and international platforms. In this direction, **Panith et al. (2019)** have prepared magnesium silicate hydrate by hydrothermal

crystalline and investigated the dye degradation properties of synthesized hydrated and non-hydrated MgSiO_3 . **Masli et al. (2019)** synthesized calcium silicate nanopowder and examined the crystal structure and chemical composition of the nanopowder by necessary characterization techniques. The focus of their study was on the effect of the mixing ratio of CaOSiO_2 on the properties of calcium silicate. **Joseff et al. (2021)** synthesize MSiO_3 (M= Ba, Ca, Mg) by combustion method. In their report, the silicates were evaluated by irradiation of UV light and studied Hydrogen Evolution Reaction (HER) by the photocatalysts. **Quan et al. (2012)** prepared SrSiO_3 powder by chemical deposition method and studied the effect of sintering temperature on phase composition, and microstructure and concluded that this method of synthesis is superior to the solid-state reaction method. **Jia Xu et al. (2016)** have prepared BaSiO_3 doped with Eu by solid state and precipitation reaction method. They have worked on the luminescent properties of synthesized phosphor. **Ernawati et al. (2021)** synthesized CaSiO_3 by solid-state reaction method and reported that the prepared CaSiO_3 composite is promising for dye removal in contaminated aqueous solution. It is pertinent that the deep examination of structural parameters like crystallite size, lattice parameters, the volume of the unit cell, microstrain, and dislocation density is still lacking in aforesaid reports of metal silicates. Some researchers have studied strontium silicate ceramics but have not explored the optical outcomes at the level of commercial relevance. Therefore, by taking into consideration these observations, we have synthesized (Sr_2SiO_4) strontium silicate and investigated its structural and optical properties. The method of synthesis adopted here is the citric acid-assisted sol-gel technique which has advantages such as easy setup, high chemical homogeneity, less undesirable content, time-saving and low cost. Due to chemical and thermal stability, the stoichiometry of the reacting precursors does not change in citrate mediated sol-gel method and defect-free crystallites are induced in this chemical route. Furthermore, we have used different tools and characterization techniques for the morphological, structural, and optical investigations of the sample.

2. MATERIALS AND METHODS

The ceramic with the general formula Sr_2SiO_4 was synthesized by the citric acid-assisted sol-gel technique. The chemicals used as a precursor for the formation of the required phosphor are high-purity strontium nitrate $\text{Sr}(\text{NO}_3)_2$ (99%), tetraethylorthosilicate (TEOS)($\text{C}_2\text{H}_5\text{O}$)₄Si (99%), ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) (99%) and citric acid ($\text{C}_6\text{H}_8\text{O}_7$) (99.5-102%) supplied by Sigma Aldrich. The whole process of synthesis is shown pictorially in Fig. 1(a). All the precursors are mixed in the proper stoichiometric ratio. Firstly, $\text{Sr}(\text{NO}_3)_2$ and TEOS were dissolved in distilled water with continuous stirring on a magnetic stirrer at temperature $\sim 60^\circ\text{C}$. A few drops of ethylene glycol were added to the mixture. Citric acid was added dropwise to the prepared solution to perform the chelation process. For the formation of gel, the mixture was allowed to stir for 2h at the same temperature of 60°C . Thus, we obtained a colorless, viscous, and consistent gel which was placed in an oven for 3h at 225°C for the dehydration process. To avoid moisture, the sample was placed in a desiccator while cooling down to room temperature (RT). By using an agate mortar and pestle, the dried sample was ground into a fine powder and annealed at 850°C for 3h in a muffle furnace. Finally, the nanopowder of required strontium silicate (Sr_2SiO_4) was obtained by further grinding the annealed sample. Different characterization tools and techniques were used to analyze the structural and optical properties of ceramic nanopowder.

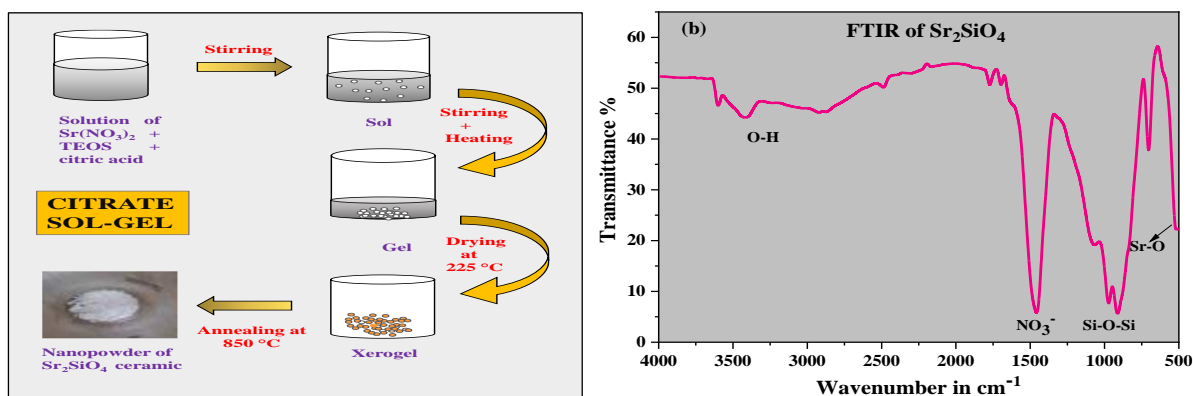


Figure 1(a): Pictorial representation of the complete synthesis route adopted. **(b)** FTIR spectra of Sr_2SiO_4 ceramic nanopowder.

3. RESULTS AND DISCUSSION

3.1 IDENTIFICATION OF FUNCTIONAL GROUPS BY FTIR

Fourier transform infrared spectroscopy (FTIR) characterization technique was used for identifying the certain functional group existing in the synthesized nanopowder by a Bruker Tensor-27 FTIR analyzer in the wavenumber range of $500\text{--}4000\text{ cm}^{-1}$. The FTIR spectra as shown in Fig. 1(b) show the absorption peaks at 515, 694.02, 909.862, 976.794, 1455, 1692.73, 1767.189, 2474, 3420, 3594.64 in cm^{-1} wavenumbers. The absorption band around $2500\text{--}3600\text{ cm}^{-1}$ shows the symmetric stretching vibration of a hydroxyl group (OH) which is due to the moisture present in the environment. The peak around 1448 cm^{-1} corresponds to NO_3^- group which reveals that NO_3^- is not completely diminished during the synthesis (Singh, 2020). Strontium silicate peaks have been reported at 729, 817, 1352, 1318, 1774 and 2410 cm^{-1} and some missing peaks at these wavenumbers the absence of nitrate precursor in the sample. The peaks at 1407.28 and 1596.04 cm^{-1} could be ascribed to vibrations of the Si-O bond or SrO available at octahedral and tetrahedral site (Zahedi, 2018). In the present sample, the peaks in the region of $800\text{--}900\text{ cm}^{-1}$ are due to stretching vibrations of the Si-O-Si and SiO_4^- groups (Tandel, 2018). The band in the region of $500\text{--}700\text{ cm}^{-1}$ is attributed to the bending of SiO_4^- , SrO_4^- , and Si-O-Si groups (Sahu, 2016). Thus, the overall FTIR spectroscopic analysis under IR irradiation confirms the pure crystalline form of nanopowder which has a wide range of applications in the field of material science.

3.2 CRYSTALLOGRAPHIC ANALYSIS

An X-ray diffraction study was carried out to determine the crystal structure and to emphasize the nature of the lattice phase available in the synthesized nanopowder. The data was obtained by using an XPERT PRO x-ray diffractometer at a step difference of 0.02°s^{-1} employing an X-ray beam with wavelength 1.54056 \AA . Fig. 2 depicts the XRD pattern of the sample in three sections with distinct 2θ angles.

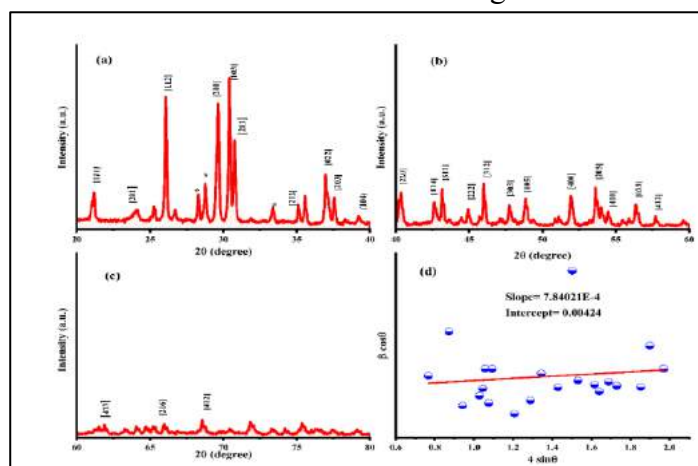


Figure 2: XRD pattern of Sr₂SiO₄ nanopowder having distinct 2θ range (a) from 20° to 40°. (b) from 40° to 60°. (c) from 60° to 80°. (d) W-H plot of Sr₂SiO₄ ceramic nanopowder.

It is clear from graph that Sr₂SiO₄ ceramic has a fair agreement with the JCPDS card no. 39-1256 which suggests that the method of synthesis is flavorful to produce a highly crystalline dense and pure form of the required ceramic nanopowder (Pan, 2016). Some peaks of the secondary phase are also observed corresponding to the β-Sr₂SiO₄ phase. The structure of the sample is orthorhombic with space group P_{nma}. Standard unit cell parameters for this structure have values a= 5.683Å, b= 7.142Å, c= 9.94 Å, volume= 403.583Å³ and α=β=γ=90° (Yesilkaynak, 2021). The most famous Debye-Sherrer's formula is used to calculate the average crystallite size of Sr₂SiO₄ ceramic whose equation is given as

$$D = \frac{k\lambda}{\beta \cos\theta} \quad (1)$$

Here, D is the average crystallite size in nm, λ is the wavelength of the X-Ray (1.54056Å), k is the Scherrer's constant whose value is considered nearly equal to 1 for spherical particles, θ is the diffraction angle and β is the full width at half maxima (FWHM) of the peaks in the XRD pattern. Thus, by using XRD data the average crystallite size of Sr₂SiO₄ was found to be 29 nm corresponding to the most prominent diffraction peak. Williamson Hall (W-H) plot is used for a better understanding of the strain effect. The plot is also useful for calculating the crystallite size which confirms the nanoparticle formation of Sr₂SiO₄ powder. The W-H equation is given as

$$\beta_{hkl} \cos(\theta)_{hkl} = \frac{k\lambda}{D} + 4\epsilon \sin(\theta)_{hkl} \quad (2)$$

The sample has a 7.84021x10⁻⁴ microstrain and a corresponding crystallite size of 32 nm was calculated by extrapolating the graph between β_{hkl}cos(θ)_{hkl} along the y-axis and 4sinθ along the x-axis portrayed in Fig. 2(d). Due to annealing at high temperatures, many defects and imperfections are generated. Keeping this in view, the dislocation density of the prepared crystalline material is also estimated which gives the number of dislocations per unit volume. The theoretical formula of calculation for dislocation density (δ) is given by the following equation

$$\delta = \frac{1}{D^2} \quad (3)$$

Using the XRD data dislocation density is found to be 1.697x10⁻³ nm⁻² which indicates that the synthesized nanopowder is highly dislocated due to formation at nanoscale dimensions.

3.3 TEXTURE ANALYSIS BY SEM

The surface morphology of Sr₂SiO₄ is inspected by scanning electron microscope (SEM) Hitachi Japan SU8010 series and the obtained image is shown in Fig. 3 (a). The shape of the particles is spherical but irregularly arranged also these nanoparticles are tightly agglomerated. However, a highly dense surface texture can be observed in Fig. 3(a) which predicts the small and large grains of Sr₂SiO₄. To confirm the elementary composition on the surface of the strontium orthosilicate phosphor Energy-Dispersive X-ray analyzer was used. The spectrum of EDAX is shown in Fig. 3(b). The exact atomic and weight percentages of the elements Sr (strontium), Si (silicon), O (oxygen) are mentioned in the inset of EDAX spectrum of the Sr₂SiO₄ ceramic nanopowder.

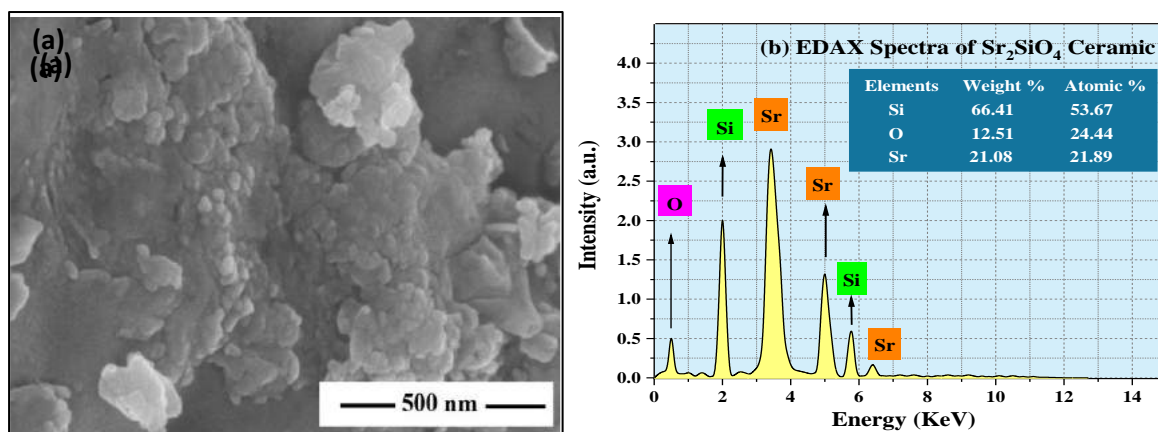


Figure 3(a): SEM

image and (b) EDAX spectrum of Sr_2SiO_4 ceramics.

3.4 TRANSMISSION ELECTRON MICROSCOPE (TEM)

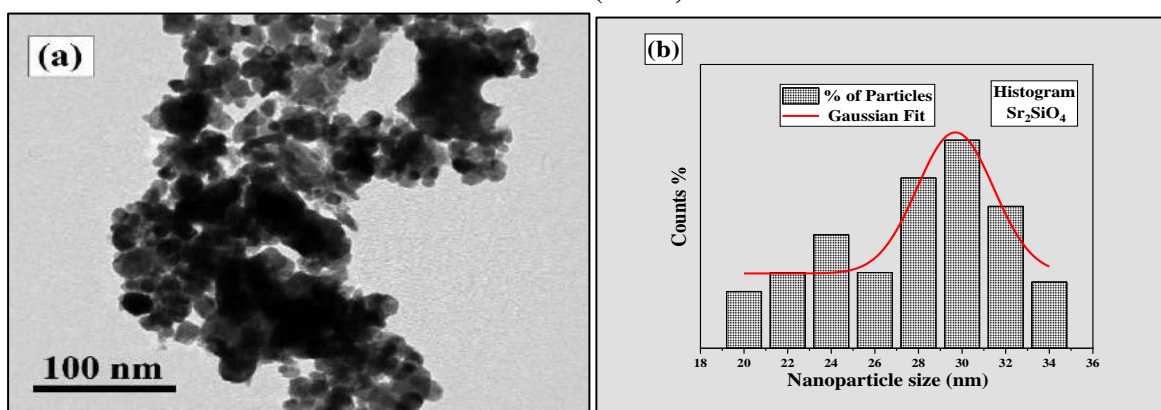


Figure 4(a): TEM micrograph and (b) histogram for the particle size distribution of Sr_2SiO_4 ceramic nanopowder. To analyze the internal structure and nanocrystallinity of the sample, a high-energy electron beam was passed through the sample known under the technique of Transmission Electron Microscopy (TEM). The micrograph obtained from TEM JEOL JEM2100 plus is displayed in Fig. 4(a). It is clear from the micrograph that the particles are spherical in shape with distinct grain boundaries. By using Image J software, the average particle size was calculated from the micrograph and plotted in a bar graph known as a histogram. It is noticed that the particles are in the nano range but have uneven size distribution. The histogram provided the percentage of particle size distribution in the nano range which is exhibited in Fig. 4(b). Further, the peaks with the mathematical Gaussian function were employed to find the average size of the prepared Sr_2SiO_4 ceramic nanopowder which is found to be ~ 30 nm.

3.5 PHOTOLUMINESCENCE (EMISSION & EXCITATION SPECTRA)

The practical applicability of the prepared Sr_2SiO_4 ceramic nanopowder was executed by photoluminescence analyzer Perkin Elmer LS 55. The Spectrophotometer of the PL analyzer has an excitation wavelength range of about 200–800 nm and the Xenon lamp is the source of excitation. The data of excitation and emission spectra were recorded using the process in which UV-visible light from a Xenon lamp was allowed to pass through a monochromator and then incident on the sample.

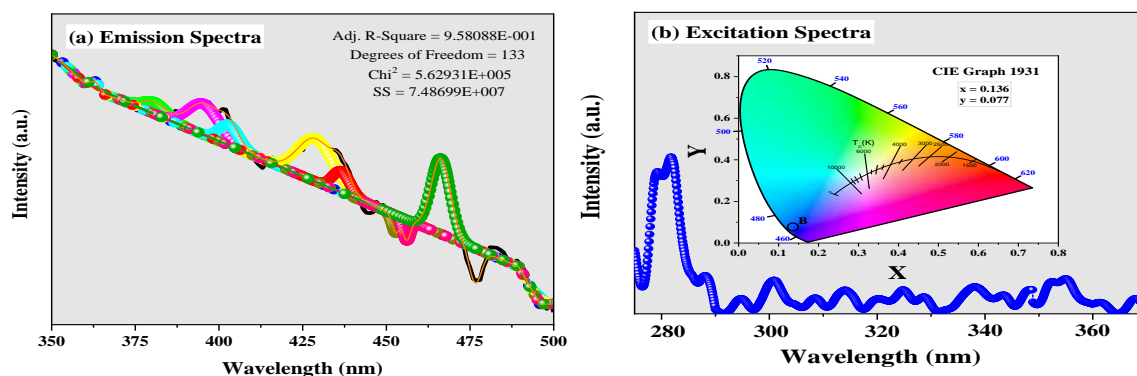


Figure 5(a): Emission spectrum (b) Excitation spectrum and its inset depicts the CIE chromaticity graph of Sr_2SiO_4 ceramic nanopowder.

Emission Spectrum: Fig. 5(a) shows the emission spectrum in the wavelength range of 350-500 nm. The broader asymmetric band was fitted by Gaussian Curve fitting and the details of peaks obtained after Gaussian Fitting of the observed data of emission spectra are given in Table 2. The emission spectrum of the Sr_2SiO_4 sample is shown in Fig. 5 with the excitation wavelength of 295 nm. The spectrum exhibits many peaks in which a strong sharp peak at 465 nm was prominently noticed which lies in the blue region of the electromagnetic spectrum (Singh, 2015). In Fig. 5(a), the other important peaks are found at 381, 395, 403, 429, and 437 nm wavelengths. The peaks are devoted to various defect centers induced in the prepared sample due to annealing at 850°C (Alemi, 2015). The maximum height of the peaks, full width at half maxima (FWHM) and area under each peak are also evaluated. The detailed features of various peaks are given in Table 2 obtained from the Gaussian fitting data analyzer.

Table 2. Details of peak's position, area, FWHM, and height of the observed emission Spectra.

Peak	Position	Area	FWHM	Max Height
1	381	21137.71	8.73004	2274.622
2	395	69262.68	10.9979	5916.399
3	403	29319.86	7.07739	3891.853
4	429	109723.4	12.4776	8261.066
5	437	26313.07	6.0875	4060.694
6	465	104201.4	6.72476	14556.75

Excitation Spectrum: The excitation spectrum of Sr_2SiO_4 nanopowder was investigated by using the same device Perkin Elmer LS 55 as depicted in Fig. 5(b). For recording the excitation spectrum, the emission of the sample was held at 465 nm. Basically, UV-visible light is allowed to fall on the sample, and the intensity of scattered light with respect to wavelength in nm gives information about the excitation spectrum of the sample. The excitation spectrum was recorded within the spectral range of 200-900 nm but displayed only within the range 270-370 nm wavelength. It is noticed that 295 nm is a prominent excitation peak while many small peaks are also visible in the prescribed range owing to the defect/imperfection states present in the host material. The excitation

peak at 295 nm is devoted to the charge transfer states of $\text{Sr}^+-\text{O}^-/\text{Si}^+-\text{O}^-$ available in the Sr_2SiO_4 ceramic nanopowder (Wang, 2022).

One may also notice that the CIE chromaticity graph has been recorded in the inset of Fig. 5(b). The blue emission color of the sample is significantly observed. The x and y coordinates are calculated as 0.136 and 0.077 for the prepared Sr_2SiO_4 ceramic nanopowder. It is suggested that the emission wavelength lying in the visible region can be easily tuned further by doping with any rare earth or transition metal ions. Hence, Sr_2SiO_4 alkaline earth metal silicate nanopowder is a better host material for the advancement of silicate ceramics and is a prominent host material for rare earth ions with many brilliant features such as high thermal stability, long life, and easy synthesis using inexpensive raw materials.

4. CONCLUSION

We have successfully synthesized Sr_2SiO_4 ceramic by citric acid-assisted sol-gel technique. The XRD pattern revealed the orthorhombic phase and an average crystallite size of about 29 nm. The FTIR analysis confirmed the existence of constituent elements having vibrations in the IR region. The surface morphology of the sample is examined by SEM and TEM micrographs and EDS confirms the elemental composition. PL results suggest the presence of defects like F/F^+ centers generated due to applied heat treatment. Highly dense and crystalline Sr_2SiO_4 ceramic powder is a potential candidate to be used as a host matrix as well as a refractory structural material. The blue luminescence emphasized the utilization of prepared powder in the lamp and in display devices.

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AN IN-DEPTH EXAMINATION ON MOTIVATING FACTORS AND PROBLEMS ENCOUNTERED BY ENTREPRENEURS: EVIDENCES FROM INDIA

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The study aimed to know about motivating factors as well as problems faced by entrepreneurs in Himachal Pradesh. Descriptive research design has been used in the present study. A total of 157 respondent's response is collected through a customized structured questionnaire which included 25% of women entrepreneurs with the help of judgmental sampling. Data has been analyzed by data reduction techniques factor analysis to get the justifying results of motivating and problems of entrepreneurs. It has been found that four factors out of twenty have been explored i.e. motivation methods which encourage becoming entrepreneurs, dissatisfaction with previous job and good scope for market potential, self/family influence and financial assistance and unemployment and attaining social status motivating factors in case of Himachal Pradesh State. It has also been found that four dimensions out of twenty five statements of problems have been extracted which are lack of motivation and internal problem, problems outside the business, lack of marketing, encouragement and higher rate of credit transaction and less marketing and high dependence of family and relatives problems faced by entrepreneurs of Himachal Pradesh state.

Keywords: Market Potential, Financial Assistance, Social Status, Higher rate of Credit Transaction

1. Introduction

Entrepreneurship is taken as a driver of economic development and also included as fourth production factor in macroeconomics of production function (Audretsch and Keiibach, 2004). Now days, entrepreneurs experiment new things in order to progress, which one will improve economic life (Rosenberg and Birdzell, 1986).

Entrepreneurship helps in economic development. One of the main improvements in economic development is to increase standard of living and growth of the economy as whole (Barro, 1991).

Entrepreneurship is a dynamic force. Development does not occur naturally when economic conditions are in favor; a force is needed to use them. Entrepreneurs have ability to perceive opportunities which other does not have (Sayigah, 1962).

2. Literature review

Punitha et al (1999) examined the problems and constraints faced by women entrepreneurs in the Pondicherry region. A sample of 120 females enterprises were personally interviewed during the period June to July 1999 out of which 42 belonged to rural and 78 to urban areas. The major problems faced by rural women entrepreneurs are competition from better quality products and marketing problems. The problems for urban entrepreneurs are, apart from the competition from better quality products, are the difficulty in getting loans. The least problems faced by both rural and urban women entrepreneurs are ignorance about schemes, distance from market and ignorance about agency and institutions.

Das (1999) studied about women entrepreneurs in Tamil Nadu and Kerala. The study examined the problems faced by women in initiating, running and succeeding in business and differences between the experiences of women from developing worlds. Different reason to start business among women entrepreneur broadly classified into three categories: chance, forced and created or pulled entrepreneurs. He also mentioned that there are similarities between three groups (chance, forced and created or pulled entrepreneurs) on the basis of certain

demographic variables but different in terms of sales volume, expected growth and success factors. This study also underscored the difficulties faced by women in getting funds for setting up business and meeting the working capital requirements. The women in the study differ from western counterparts in family background, marital status, family conflicts incubator organizations issues and environmental factors.

Anitha and Kaxmisha (1999) studied that entrepreneurs are motivated by both pull and push factors and evidenced that entrepreneurs are no longer born but they can be made. They suggested that in order to make the women entrepreneurship movement to be a success government and non-governmental organizations have to play a vital role. Women entrepreneurs in backward areas need special assistance and timely marketing of goods.

Micheline and Leo (2000) analyzed the individual choice for self-employment and entrepreneurial success. They observed that entrepreneurial activity is found to be successfully undertaken by individuals who succeeded in increasing their entrepreneurial abilities and reducing the risk of starting businesses through a learning process that takes place through professional experience and apprenticeship or alternatively formal education. The learning processes takes place both before and after entry into the industry, as firm grow into a large size. However, financial constraints continue to play a major restraining role for entrepreneurship and firm growth.

Ahl and Marlow (2012) argued that there exists an occluded gender bias within the entrepreneurship discourse. This is contrary to the neo-liberal views on entrepreneurship that propose only personal efforts as determinants of reward and status. The study highlight that even though there have been calls to use feminist theories as analytical frames, there are scant evidences of such applications. The study argued that there are gendered assumptions that limit epistemological scope of research in this area and positions women entrepreneurs as either failed or reluctant subjects. The study proposed that there is a need to build a reflexive critical perspective. This can help in evaluating the current theoretical approaches on women entrepreneurship within the broader ambit of entrepreneurship research.

Chauhan and Aggarwal (2017) studied the role and implication of youth entrepreneurship in Indian economy. The study also throws a light on the challenges faced by youth entrepreneurs and steps that should be undertaken to tackle these challenges efficiently and encourage young individuals to start their ventures. The study found that Youth entrepreneurship is that one tool which can save any nation from drawing in the sea of high unemployment, poverty and stagnation. The list of benefits that young entrepreneurs provide to a nation is never ending.

Bastain and Sidani (2018) assessed the literature at the macro, meso and micro analysis levels and addresses the obstacles, challenges, motivations and characteristics of female entrepreneurship in the Middle East and North Africa region. The analysis based on a gender aware, narrative review, which is an appropriate method when aggregating studies of different methodological approaches, covering broad and fragmented topics in different settings. The study found that important gaps in the field are lack of theoretical foundations; an over emphasis on macro level indicators, such as culture and religion and an under emphasis on organizational level variables; a lack of studies that analyze female entrepreneurship within ethnic groups, or studies that acknowledge the complex social, cultural and religious diversity of the region; and inattention to particular regional experiences (e.g. refugees crisis) and emerging trends.

Panda (2018) identified and ranked constraints faced by women entrepreneurs in developing countries. It offers a framework to differentiate between the constraints faced by male and female entrepreneurs. The paper engaged in an exhaustive literature review and uses a qualitative methodology to categorize and rank entrepreneurial constraints. The study found that constraints faced by women entrepreneurs in developing countries arise from gender discrimination, work-family conflict, difficulty in raising capital, lack of infrastructure, unstable business, economic and political (BEP) environments, lack of training and education and personality differences. The study suggested that in addition to financial constraints, unstable BEP environments need to be addressed as top priorities.

Agarwal (2019) described about women entrepreneurship and innovations based upon personal and business characters. She also tried to understand how innovation in Entrepreneurship leads to success and growth of an enterprise. 100 women entrepreneurs were chosen for data collection from India. Well-structured questionnaires used for data collection. She used different tools for data analysis *i.e.* mean, standard deviation, Cronbach's alpha and ANOVA Result showed that women entrepreneur innovation of women associated with different factors education, type of finance, location of business, annual income and job security.

3. Objective of the Study and Research Methodology

3.1 Objective of the study

To know about motivating factors as well as problems encountered by entrepreneurs in Himachal Pradesh.

3.2 Research Design

Descriptive research design has been used in the present study to have a better understanding of the requirement and significance of entrepreneurship.

3.3 Data Collection

Primary data is collected through customized structured questionnaire.. A structured questionnaire is classified into three parts, part one covered demographic profile, the part two covered motivating factors, the part three covered problems faced by entrepreneurs. The present study covers problems and motivation factors conducted in the northern region state *i.e.* Himachal Pradesh.

3.4 Sample Profile

A total of 157 respondent's response is collected through a customized structured questionnaire with the help of judgmental sampling to cover 157 entrepreneurs from Himachal Pradesh, which included 25% of women entrepreneurs. Researcher visited various cities *i.e.* Baddi, Sirmour, Solan and Una to collect data from different entrepreneurs of Himachal Pradesh. The age, gender, and other demographic and socio-economic data of entrepreneurs have also recorded.

3.5 Data Analysis

Data collected through questionnaires and tabulated by using Excel and SPSS software, interpretation of data. Different statistical techniques are used for the analysis of data. According to the nature of data, appropriate statistical tools are applied, such as data reduction techniques factor analysis are used for motivating and problems of entrepreneurs. The statistical techniques are used after considering the objectives, scales used and characteristics of data normality. **Data Adequacy for Factor Analysis**

Factor analytical technique has been applied to the twenty statements in order to extract dimensions influencing the motivating factors that drive individuals towards entrepreneurship. In order to carry out factor analysis, following steps have been followed. Initially, suitability of data for factor analysis has been tested through correlation matrix and all twenty statements used in the study have been found to be highly correlated. Further Overall Measure of Sampling Adequacy (MSA)-KMO has been computed and the calculated value of KMO (Kaiser-Meyer-Olkin) is found to be 0.715 which indicates that the sample is adequate enough to conduct factor analysis. Bartlett's Test of Sphericity also shows statistically significant number of correlations among the variables. Hence, all the parameters discussed above support the application of factor analysis.

Extraction method and number of factors extracted

Principal Component Analysis (PCA) has been used for extracting factors and the number of factors to be retained is based on latent root criterion, variance explained and Scree plot analysis. Conclusions were obtained through orthogonal rotations with Varimax. Dimensions influencing the motivating factors that drive individuals towards entrepreneurship with eigen values greater than one is used as a criterion to determine the number of factors and all factor loadings greater than 0.45 (ignoring the sign) were retained (Hair et al., 2010).

4. Results and Discussions

4.1 Dimensions influencing motivating factors that drive individuals towards entrepreneurship-A Factor Analytical Approach (Himachal state)

Factor analytical technique has been applied to the twenty statements using the steps described in the previous analysis on the data of Himachal state. The analysis yielded a four factor solution explaining 51.969 per cent of total variance explained. The results of factor analysis in this regard are presented in Table 4.1.1.

Table 4.1 Dimensions influencing motivating factors-Factor Analysis (Himachal Pradesh)

Statements	Factors				Communalities
	F1	F2	F3	F4	
Encouragement from family members inspiring your entrepreneurial ambitions.	0.616				0.624
Strong desire to achieve something independent in life.	0.608				0.527
Govt. Schemes & Funds availability to start a new venture	0.607				0.527
The existence of traditional/ hereditary atmosphere makes you to enter into the entrepreneurial field.	0.583				0.519
Your family background generates in you an inclination to take up entrepreneurial activity.	0.548				0.504
The existence of idle funds prepares you to enter into the enterprise.	0.534				0.487
The existence of infrastructural facilities in your area.	0.510				0.428
Advanced entrepreneurial experience instills confidence in you to start the enterprise.	0.504				0.483
Self interest stimulating a desire to achieve something new.	0.497				0.464
Ambition to provide employment opportunities through your enterprise	0.482				0.411
Seeking a challenge in the field of entrepreneurship	0.413				0.424
Scope for using technical knowledge in the entrepreneurial field	0.405				0.402
Seeking a self-employment as the basis for building your enterprise	0.401				0.400
Dissatisfaction with the previous job compelling you to start the enterprise		0.693			0.554
Good scope for market potential and expansion of the concerned enterprise, motivate you to start the enterprise		0.425			0.435
Acquiring self prestige by starting enterprise			0.546		0.521

Ambition of family members inducing you to enter into the entrepreneurial world.			0.530		0.514
Availability of financial assistance serves as a spark in forming your entrepreneurial idea.			0.457		0.465
Problem of unemployment accelerates the process of generating entrepreneurship in you.				0.560	0.456
Attaining social status by your involvement in the enterprise.				0.559	0.411
Eigen values	4.456	1.895	1.635	1.408	Σ 9.394
Explained variance %	23.279	11.477	9.174	8.039	
Cumulative variance %	23.279	34.756	43.93	51.969	
KMO (Kaiser-Meyer-Olkin) = 0.710, Bartlett's Test of Sphericity = Approx. Chi-Square = 772.775, df = 190, Sig. = 0.000					

1. Motivation methods which encourage to become entrepreneur (F1)

The first factor has been titled as “Motivation methods which encourage to become entrepreneur” which includes thirteen variables i.e. encouragement from family members inspiring your entrepreneurial ambitions, strong desire to achieve something independent life, govt. schemes and amp; funds availability to start a new venture, the existence of traditional/hereditary atmosphere make you to enter into entrepreneurial field, your family background generates in you an inclination to take up entrepreneurial activity, the existence of idle funds prepares you to enter into the enterprise, advanced entrepreneurial experience instills confidence in you to start the enterprise, self interest stimulating a desire to achieve something new, ambition to provide employment opportunities through your enterprise, seeking a challenge in the field of entrepreneurship, scope for using technical knowledge in the entrepreneurial field, seeking a self employment as the basis for building your enterprise, dissatisfaction with previous job compelling you to start the enterprise, good scope for market potential and expansion of the concerned enterprise, motivate you to start the enterprise, acquiring self prestige by starting enterprise, ambition of family members inducing you to enter into the entrepreneurial world, availability of financial assistance serves as a spark in forming your entrepreneurial idea and seeking a self employment as the basis for building your enterprise. The factor explained 23.279 per cent of total variance and considered to be a key factor in explaining the motivating factors inducing respondents to become entrepreneur.

2. Dissatisfaction with previous job and good scope for market potential (F2)

Second factor has been labeled as “Dissatisfaction with previous job and good scope for market potential” which includes two variables i.e. dissatisfaction with the previous job compelling you to start the enterprise and good scope for market potential and expansion of the concerned enterprise, motivate you to start the enterprise. This factor explained the value of total variation is 11.477 per cent in factor analysis. This factor suggests that respondents who are not satisfied with their previous job and find any major potential in market may think to become entrepreneurs.

3. Self/family influence and financial assistance (F3)

The third factor has been tagged as “Self/family influence and financial assistance” and includes three variables i.e. acquiring self prestige by starting enterprise, ambition of family members inducing you to enter into entrepreneurial world and availability of financial assistance serves as a spark in forming your entrepreneurial idea. This factor explained 9.174 per cent of total variance and explicated that respondents’ own and family

influence drives them to become entrepreneurs. Moreover, the financial assistance if easily available, make them good entrepreneurs as well.

4. Unemployment and attaining social status (F4)

The fourth factor has been named as “Unemployment and attaining social status” which includes two variables i.e. problem of unemployment accelerates the process of generating entrepreneurship in you and attaining social status by your involvement in the enterprise. This factor explained the value of total variation is 8.039 per cent in factor analysis and highlighted the importance of attaining social status in respondents making them good entrepreneurs. Moreover, the unemployment accelerates the generation of entrepreneurship tremendously among respondents.

4.2 Dimensions of problems faced by entrepreneurs-A Factor Analytical Approach (Himachal Pradesh State)

Factor analytical technique has been applied to the twenty five statements using the steps described in the previous analysis on the data of Himachal Pradesh state. The analysis yielded a four factor solution explaining 53.474 per cent of total variance explained. The results of factor analysis in this regard are presented in Table 4.2.

Table 4.2 Dimensions of problems faced by entrepreneurs-Factor Analysis (Himachal Pradesh)

Statements	Factors				
	F1	F2	F3	F4	Communities
Lack of Motivation and Encouragement by Govt.	0.695				0.575
Lack of support from banks	0.665				0.590
Lack of knowledge about legal aspects	0.637				0.560
Shortage of own funds	0.621				0.572
Frequent work stoppages	0.618				0.537
Corruption and Political Interference	0.569				0.427
Lack of knowledge about modern technologies	0.563				0.419
Lengthy File wok and Formalities for loan	0.535			-	0.512
Tough competition from larger and established units	0.529				0.454
Absenteeism	0.496				0.505
Lack of Technical training	0.488				0.545
Lack of Skill Enhancement workshops	0.470				0.544
High Interest Rates charged by Banks	0.434				0.432
Managing workers at work place		0.539			0.560
High wage rates		0.525			0.437
Lack of marketing facilities		0.509			0.425
Lack of knowledge about various forms of government's financial assistance		0.472			0.421
Inability to provide securities for loan		0.450			0.406
Non-availability of skilled workers		0.426			0.401
Inadequate fixed capital.		0.431			0.408
Lack of marketing skills			0.564		0.522

Lack of encouragement from family and society			0.511		0.418
Higher rate of credit transactions			0.437		0.426
Lack of marketing centre				0.436	0.449
Higher dependence on family and relatives				0.403	0.400
Eigen values	5.068	2.894	2.078	1.478	Σ 11.518
Explained variance %	22.773	12.477	10.311	7.913	
Cumulative variance %	22.773	35.25	45.561	53.474	
KMO (Kaiser-Meyer-Olkin) = 0.728, Bartlett's Test of Sphericity = Approx. Chi-Square = 1109.505, df = 300, Sig. = 0.000					

1. Lack of motivation and internal problem (F1)

The first factor has been titled as "Lack of motivation and internal problem" which includes thirteen variables i.e. lack of motivation and encouraged by govt., lack of support from banks, lack of knowledge about legal aspects, shortage of own funds, frequent work stoppages, corruption and political interference, lack of knowledge about modern technologies, lengthy file work and formalities for loan, tough competition from larger and established units, absenteeism, lack of technical training, lack of skill enhancement workshops and high interest rates charged by banks. This factor explained the value of total variation is 22.773 per cent in the factor analysis and highlighted that there is lack of motivation in respondents to start their enterprise with their own means. Moreover, this factor got the highest weightage as most of the problems get merged in it hence, these problems itself are the pivot around which the decision to set up an enterprise rotates.

2. Problems outside the business (F2)

Second factor has been labeled as "Problems outside the business" which includes seven variables i.e. managing workers at work place, high wage rates, lack of marketing facilities, lack of knowledge about various forms of government financial assistance, inability to provide securities for loan, non availability of skilled workers and inadequate fixed capital. This factor explained the value of total variation is 12.477 per cent in the factor analysis. Moreover, the problems outside the business are actually the basic foundations on which an enterprise exists and with the time grows. Therefore, it is required to fix these problems to accelerate the base of entrepreneurship.

3. Lack of marketing, encouragement and higher rate of credit transaction (F3)

The third factor has been tagged as "Lack of marketing, encouragement and higher rate of credit transaction" includes three variables i.e. lack of marketing skills, lack of encouragement family and society and higher rate of credit transactions. This factor explains 10.311 per cent of total variance and highlighted the problems of marketing skills, family encouragement etc.

4. Less marketing and high dependence of family and relatives (F4)

The fourth factor has been named as "less marketing and high dependence of family and relatives" which includes two variables i.e. lack of marketing centre and higher dependence of family and relatives. This factor explained the value of total variation is 7.913 per cent in the factor analysis.

5. Conclusion and Recommendations

Different from previous studies, the present study is to investigate the motivating factors as well as problems faced by entrepreneurs in Northern India. It has been found with respect to the dimensions of motivating factors in case of Himachal Pradesh State, four factors have been explored out of twenty factors. These factors are motivation methods which encourage becoming entrepreneurs, dissatisfaction with previous job and good scope for market potential, self/family influence and financial assistance and unemployment and attaining social status. With regards to the dimensions related to the problems faced by entrepreneurs of Himachal Pradesh state, four

dimensions of problems have been extracted out of twenty five statements. These dimensions are lack of motivation and internal problem, problems outside the business, lack of marketing, encouragement and higher rate of credit transaction and less marketing and high dependence of family and relatives. Based on the study, it has been suggested to policy makers and regulatory authorities to create, aware and implement the more easily and innovative financial schemes to encourage the new start-ups especially for women entrepreneurs and unemployed youth.

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IMPACT OF SELECTED VARIABLES FOR ADVERTISEMENT THROUGH DIFFERENT SOCIAL MEDIA PLATFORMS: AN EMPIRICAL STUDY

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In the modern era of marketing, competition between the producers is increasing day by day and this competition innovates the way which attract customer more difficult. Cost and mode of enticing and retaining customer is also swelling day by day. A company always tries to achieve highest sale with their minimum or reasonable budget. It is also important for a company to make sure that they will get target return on their investment. To achieve the target of sale, they should have to make strategies for promote their production and brand. Promotion of Products is the vital source to endorse the brand. Promotion of Brands performs an important role in modern era. After Covid-19 the market situation for Company and Customer has completely changed. This study helps to measure the impact of different variables on different Social Media Platforms for Advertisement.

Keywords: Advertisement, Social Media, Consumer Perception, Buying Behaviour, Reliability, Trust Worthy, Informative.

1. Introduction:

From last 2 decades, the market faced a major swing in business control and customer interaction. The innovation of mobile phones, the Internet and different e-commerce sites turned a wonderful result on businesses and marketing activities. The growth of social media is accelerating and directly affects the businesses now a day and also in the future. Businesses that walk with new technologies turn more and more benefits. It's the reason why technology-driven companies such as Microsoft, Amazon, Yahoo and Google grew more and more. And also in a short duration, other digital platforms like social media become the most precious medium for the young marketplace today. Internet promotional tool is the new advertising concept and entrepreneurs know how Internet media can generate worth for their business.

Young generation in Indian market is more social compare to other countries and collects or share information that is important to them. Internet platform helps in making cooler for people to connect with their social networks and as a result trade can proceeds from that understanding. More and more of customers, either for personal use, B2C or B2B reasons use Internet media in every aspect of their daily life.

Internet connectivity includes both social media and networking sites. Social media is a tool for sharing and discussing information. It can also be pronounced as an online media which cheers every member for feedback and contribution. Social media app may also be described as a mobile application connected through internet inclusive of activities where people create gratified, share and bookmark it. It is a network at a prodigious rate. On the other hand, these networking sites exploit social media technology to connect with people and build relationships. Networking site is an online platform which works with forms societies of interest to connect to others.

Role of Internet in Advertising:

- Internets in contemporary drift become an aspect of political activism, national strategies, public policy, public relations, brand management and also an intra-company communication. In this new era, this marketing tool is used to inform customers about the company's products, offers for customers, through which we can say social media plays an imperious role in marketing.
- Internet now a day, helpful in providing an identity about the companies and the products or services what they will offer.

- Internet is helpful in creating relationships with people who are unaware about the products or service, what the companies represent.
- Internet helps to associate themselves with their peers that may be serving the same target market.
- Internet also useful to communicate and interact with consumers look for.

Internet blogs and sites for advertisement:

On Internet Social Media is helpful in interaction with one another individuals and also develops the relationship. When an organization joins this platform, people may also interact with the product or company. That interaction feels personal to social media users because it creates direct interactions with product and company. Social Media Platform permits an individual to respond comments or thoughts made by the product being promoted. By responding, all of the user connections are able to see the information or message, therefore reach up to more and more people. Different Internet Platform now a day, acts as word of mouth. Because the information is being snuff out there and is getting reply, more response is brought to the product/company. Social media, products/companies exchange their ideas and interact with customers. This personal interaction can lodge a feeling of loyalty into customers and potential customers.

2. Literature Review:

Shahir Bhatt and Amola Bhatt (2012) in their research paper **Factors influencing Online Shopping : An Empirical Study in Ahmedabad** writes about the factors which influence the perceptions of consumers regarding online shopping. The study has revealed ease/attractiveness of website, service quality of websites and website security as the three important factors which have prominently emerged from the study. The paper has proved that that these factors are related to specific type of consumers classified as occasional, frequent and regular consumers. The study shows that the regular buyers are most influenced by the ease/attractiveness and service quality of website, whereas the occasional buyers value website security to a greater extent.

Simona Vinerean, Iuliana Cetina, Luigi Dumitrescu & Mihai Tichindelean (June,2013) in their exploratory research work **The Effects of Social Media Marketing on Online Consumer Behaviour**, have tried to determine the students pattern of using social media and social networking sites in relation to their reactions to the advertisements on social media, where they have the freedom to choose the information they engage with. The aim of this research paper is to empirically investigate what type of social media users, have a positive outlook regarding advertising on social networking sites. This study has contributed to the existing knowledge, of consumer behaviour in an online environment and on developing positive reactions to online advertisements and have also presented new ways to classify the online consumers, which served as a basis for psychographic segmentation, based on respondents online activities.

Garima Gupta (January-June 2013) in the research paper **Assessing the Influence of Social Media on Consumer's Purchase Intentions** has made an attempt to determine the impact of social media on product evaluation and the resulting decision-making process of Indian consumers. The results are supportive of the fact that social media does affect purchase intentions. More Specifically, there is a positive and strong impact of three factors namely peer communication, perceived product informativeness and the level of product involvement on consumers purchase intentions in the context of social media. The author concludes that as the products offered online cannot be examined, perceived information on social media and its spread through communication among peer groups facilitates consumer's evaluation and purchase related decision.

An attempt is being made to examine how social relationship factors relate with eWOM being transmitted via social networking sites by **Shu-Chuan Chu, Yoojung Kim(2011)** in their study **"Determinants of consumer engagement in electronic word-of-mouth (eWOM) in social networking sites"**. As more and more marketers incorporates Social media in their promotional activities, there is a need to investigate the determinants that

impact the consumers engagement in eWOM via social networks. eWOM is based on three aspects : opinion seeking behaviour, opinion giving behaviour and opinion passing behaviour. Opnion seekers depend on others advice to make purchase decision. Opinion givers exert a great influence on others opinions.

Akeem, U. O., (2010) in their study “**Customer Attitude towards I.A. and Online sales -A case study of Mtn Nigeria**” find out that, Majority of companies operating in Nigeria do not advertise on internet. Whereas, those com-panies, who advert-ise online, record significant growth in sales volume.

Lai, C. S., and Hsu, H. C., (2010) in their research “**Gender Attitude on Web Advertising: A study in Taiwan**” found that male than female evaluates an interactive advertisement than a non interactive one with stronger attitude whereas, female than male evaluates a non interactive one with stronger attitude.”

Need for the Study

In today’s society, most of the people are influenced through social media, everyone are much interested in popularizing or socializing themselves in several social media like You Tube, Face book, Instagram, WhatsApp etc. by updating their status or posting stories. This sort of culture has induced people to channelize themselves by posting videos like dub smash, songs, dance or posting any social information. This has been popular nowadays in Instagram, YouTube, Face book etc., where people let out their own videos through media advertising. This may be done for sake of name, fame, to derive monetary benefits or even giving awareness to people through social message. This study focuses on how YouTube benefits people in media and what is the role of YouTube in such media advertising.

Research Methodology:

The main objective of this study is to measure Impact of Selected Variables for Advertisement through Different Social Media Platforms. It consist online questionnaires with primarily close-ended questions. However, respondents from northern India were randomly identified based on them being located in urban and rural areas.

Target Population and Sampling

The survey population included all working woman and house wife in both cities. Due to the large size of the targeted population was carried out so as an observational study could be performed. In this study, a simple random sampling has been used where a sample is selected for study from a larger group (a population). Each individual is chosen entirely by chance and each member of the population has an equal chance of being included in the sample. A total of 500 responses were collected.

3. Objectives of the study

1. To investigate the variables having an effect of advertising on Social Media.
2. To study the impact of variables used in the study has an effect of advertising on Social Media.

Factors have been designed to achieve this objective. Initially Confirmatory Factor Analysis has been applied to confirm the identified constructs/factors. Mean and Standard Deviation has been calculated with the help of SPSS for each indicator/statement of all confirmed constructs. For detailed analysis further post-hoc-analysis has been done. In the end, percentage analysis also has been done to study when internet users prefer Social Media Advertisements.

Confirmatory Factor Analysis (Measurement Model)

Measurement model demonstrates the relationship between a L.V. (latent variable)/Factor/construct and its measured variables/items/Indicators. Over the past decades, there has been a huge body of research & debate on the threshold value of ‘model fit indices.’

Table No. 1: Fitness Indexes (Threshold values)

CMIN/DF	GFI	AGFI	CFI	RMSEA
(Chi-square/ df)	Goodness of fit)	(Adjusted goodness of fit)	(Comparative fit)	(Root mean square error of approximation)

< 3 good, < 5 permissible	>.95 great, >.90 good, .80-.90 acceptable <.80 unacceptable	>.80	>.95 great >.90 good .80-.90 acceptable <.80 unacceptable	<.05 good; .05-.10 moderate; >.10 bad
Sensitive with sample size	Higher value indicates better model fit		Lower value indicates better model fit	

In the present study, above mentioned criteria has been used to confirm model fitness. GFI, AGFI & CFI are goodness of fit indices where as other are the badness of fit. For goodness of fit higher the better and for badness of fit, lower the better. Analysis has been done on the basis of all above mentioned Threshold Values. All the latent variables discussed in study are:

- 1) Reliability
- 2) Trust Worthy
- 3) Informative

Construct- Reliability:

Table No. 2: Value of fit indices of First factor (Reliability)

CMIN/D F	GFI	AGFI	CFI	RMSE A	Cronbach's alpha
0.37	1	0.993	0.999	0	0.716

The identical loading for the entire indicator is statistically higher than that of acceptable level. It imitates that all the six indicators result good for Reliability factor. So, the convergent validity of the factor Reliability is measured to be satisfactory. As far as model-fit is considered the value of goodness of fit indices (GFI, CFI) are perfect i.e. 1, 0.999 separately and AGFI is 0.993, which is greater than the acceptable level as per Threshold value fit index model. On the other hand, RMSEA value 0.000 and CDMIN/DF value 0.37 demonstrate a very good fit model. To check the construct reliability, Cronbach's alpha is calculated, which is 0.761, greater than the minimum value of 0.70. As a result, it may be concluded that Reliability measurement model is consistent and valid.

Construct – Trust Worthy

Table No. 3: Value of fit indices of Second factor (Trust Worthy)

CMIN/D F	GFI	AGFI	CFI	RMSE A	Cronbach's alpha
1.290	0.981	0.968	0.980	0.051	0.749

All the indicators of Trust Worthy are representing strong standardized loadings on the construct. The identical loading for all indicators is statistically higher than that of acceptable level. It imitates that all the six indicators result good for Trust Worthy factor. So, the convergent validity of the factor Trust Worthy is measured to be satisfactory. As far as model-fit is considered the value of goodness of fit indices (GFI, CFI) are perfect i.e. 0.981, 0.980 separately and AGFI is 0.968, which is greater than the acceptable level as per Threshold value fit index model. On the other hand, RMSEA value 0.051 and CDMIN/DF value 1.290 demonstrate a very good fit model. For check the construct reliability, Cronbach's alpha is calculated, which is 0.749, greater than the minimum value of 0.70. As a result, it may be concluded that Reliability measurement model is consistent and valid.

Construct – Informative

Table No. 4: Value of fit indices of Third factor (Informative)

CMIN/D F	GFI	AGFI	CFI	RMSE A	Cronbach's alpha
2.135	0.986	0.981	0.986	0.046	0.783

All the indicators of construct Informative are showing very high standardized factor loading. All indicators are the strongest indicator of Informative. On the other hand, GFI = 0.986, AGFI = 0.981 and CFI = 0.986 are great. REMSEA and CMIN/DF (0.046 and 2.135) also meet the requirement of fit indices. Hence, the above model is good fit model. As far as reliability is concern the Cronbach's alpha 0.783 is also above the threshold value 0.70. On the basis of above, it is concluded that the Informative construct is reliable.

3. Assessment of Constructs Reliability

Scale reliability is estimated by using Cronbach's Alpha which is also known as co-efficient Alpha. Cronbach's alpha measures internal consistency of the items. According to Kline, 2004 "It represents the degree to which responses are consistent across the items within measure". Table No. 5.22 shows that all the constructs have Cronbach's Alpha value exceeding 0.70 which is above the threshold value 0.70. Internal consistency of all the constructs ranged from 0.716 to 0.872. So, it can be concluded that all constructs are statistically reliable or good consistency among the items within each dimension.

Table No. 5: Assessment of Internet users Constructs Reliability

Construct	No of Items	Cronbach's Alpha value
Reliability	6	0.716
Trust Worthy	6	0.749
Informative	5	0.783

Table No. 6: Assessment of Factor Loading

Construct	Measured Variable (Indicator)	Factor Loading
Reliability	q16.5	0.96
	q16.6	0.88
	q16.3	0.84
	q17.9	0.71
	q17.3	0.72
	q16.9	0.76
Trust Worthy	q16.8	0.77
	q19.6	0.71
	q17.4	0.64
	q16.4	0.83
	q16.2	0.77
	q16.1	0.57
Informative	q16.10	0.67
	q16.12	0.71
	q19.3	0.72
	q20.4	0.69
	q18.4	0.69

4. Findings:

Standardized factor loading of Reliability is 0.71-0.96; CMIN/DF is 0.370 which is below 3 i.e. good, GFI (Goodness of fit Index) is 1.000 i.e. great because greater than 0.950, AGFI (Adjusted goodness of fit) is 0.993 i.e. goodness for fit because greater than 0.800, CFI is 0.999 great Comparative fit because larger than 0.950, RMSEA (Root mean square error of approximation) is 0 i.e. good because less than 0.05.

Standardized factor loading of Trust Worthy is 0.57-0.83; CMIN/DF is 1.290 which is below 3 i.e. good, GFI (Goodness of fit Index) is 0.981 i.e. great because greater than 0.950, AGFI (Adjusted goodness of fit) is 0.968 i.e. goodness for fit because greater than 0.800, CFI is 0.980 great Comparative fit because larger than 0.950, RMSEA (Root mean square error of approximation) is 0.051 i.e. moderate because in range 0.05-0.10.

Standardized factor loading of Informative is 0.67-0.72; CMIN/DF is 2.135 which is below 3 i.e. good, GFI (Goodness of fit Index) is 0.986 i.e. great because greater than 0.950, AGFI (Adjusted goodness of fit) is 0.981 i.e. goodness for fit because greater than 0.800, CFI is 0.986 great Comparative fit because larger than 0.950, RMSEA (Root mean square error of approximation) is 0.046 i.e. good because less than 0.05.

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CYBERSECURITY: ENSURING DIGITAL PROTECTION IN THE MODERN ERA

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The rapid advancement of technology and the pervasive nature of the internet have brought numerous benefits to society. However, they have also given rise to significant cybersecurity challenges. This research paper examines the field of cybersecurity, focusing on the importance of digital protection and the evolving nature of cyber threats. The paper discusses key concepts, strategies, and technologies employed in cybersecurity, along with the legal and ethical considerations involved. Furthermore, it explores various types of cyber threats, such as hacking, malware, social engineering, and data breaches. The paper concludes by highlighting the need for collaborative efforts between individuals, organizations, and governments to address these challenges effectively.

Keywords: Cybersecurity, Digital, Hacking, Threats, Malware etc.

1. Introduction

In today's interconnected and digitized world, the importance of cybersecurity cannot be overstated. The rapid advancement of technology has revolutionized the way we communicate, work, and conduct business. However, this progress has also introduced new vulnerabilities and threats that can compromise the security and integrity of information systems, networks, and data. Cybersecurity, therefore, plays a critical role in safeguarding individuals, organizations, and nations against these evolving risks.

2. Understanding Cybersecurity

Cybersecurity can be defined as the practice of protecting computer systems, networks, and data from unauthorized access, damage, disruption, or misuse. It encompasses a wide range of measures and strategies designed to identify, prevent, detect, and respond to cyber threats. These threats can come in various forms, such as malicious software (malware), phishing attacks, data breaches, ransomware, and denial-of-service (DoS) attacks, among others.

2.1 Importance of Cybersecurity

The importance of cybersecurity in today's interconnected world cannot be overstated. Here are some key reasons highlighting its significance:

- i. **Protection of Sensitive Data:** Cybersecurity measures are crucial for safeguarding sensitive information such as personal data, financial records, intellectual property, and trade secrets. Breaches in security can lead to identity theft, financial fraud, and unauthorized access to critical data, causing significant harm to individuals and organizations.
- ii. **Prevention of Financial Loss:** Cyber-attacks can result in substantial financial losses for businesses and individuals. The costs associated with data breaches, system downtime, incident response, and recovery can be astronomical. Implementing effective cybersecurity measures can help minimize the risk of financial losses caused by cyber incidents.

- iii. **Preservation of Reputation and Trust:** A single cybersecurity incident can severely damage an organization's reputation. Customers, clients, and partners place their trust in companies to protect their data and privacy. Failing to do so can lead to a loss of trust, a decline in customer loyalty, and negative publicity, which can have long-term consequences for the organization's viability.
- iv. **Protection of National Security:** Cyber threats have the potential to disrupt critical infrastructure and pose risks to national security. Government agencies, defence systems, and vital services such as energy, transportation, and healthcare are prime targets for cyber-attacks. Robust cybersecurity measures are necessary to protect national interests, maintain public safety, and preserve the functioning of essential services.
- v. **Safeguarding Privacy:** With the increasing digitization of personal information, privacy has become a significant concern. Cybersecurity measures help protect individuals' privacy by preventing unauthorized access to personal data and ensuring compliance with privacy regulations and policies.
- vi. **Prevention of Intellectual Property Theft:** Intellectual property (IP) theft is a significant concern for businesses and individuals. Cybersecurity measures help safeguard valuable intellectual property, including patents, copyrights, and trade secrets, from theft or unauthorized disclosure. Protecting IP fosters innovation, competitiveness, and economic growth.
- vii. **Mitigation of Operational Disruptions:** Cyber-attacks can disrupt the normal functioning of businesses and organizations, leading to significant operational disruptions. This can result in loss of productivity, disruption of services, and potential financial repercussions. Effective cybersecurity measures help minimize the impact of such disruptions and ensure business continuity.
- viii. **Compliance with Legal and Regulatory Requirements:** Many industries and sectors have specific legal and regulatory requirements regarding the protection of sensitive data and cybersecurity practices. Organizations need to comply with these requirements to avoid legal consequences, financial penalties, and reputational damage.
- ix. **Defence against Evolving Cyber Threats:** Cyber threats continue to evolve and become increasingly sophisticated. Cybersecurity measures must constantly adapt to new attack vectors and techniques employed by cybercriminals. Regular monitoring, risk assessments, and proactive security measures help identify vulnerabilities and prevent potential attacks.
- x. **Promotion of Trustworthy Digital Ecosystems:** A strong cybersecurity posture contributes to the overall trustworthiness of the digital ecosystem. When individuals, organizations, and governments prioritize cybersecurity, it creates a safer and more secure environment for online interactions, transactions, and collaborations.

In summary, cybersecurity is of paramount importance in our interconnected world. It protects sensitive data, prevents financial losses, preserves reputation and trust, ensures national security, safeguards privacy, prevents intellectual property theft, mitigates operational disruptions, ensures compliance, defends against evolving threats, and promotes trustworthy digital ecosystems. Investing in robust cybersecurity measures is essential to mitigate risks and maintain a secure and resilient digital environment.

2.2 Cyber Threat Landscape

The threat landscape in cybersecurity is constantly evolving, with cybercriminals becoming increasingly sophisticated and innovative in their techniques. Their motivations can range from financial gain and espionage to activism and sabotage. Furthermore, the proliferation of interconnected devices and the rapid growth of the Internet of Things (IoT) have expanded the attack surface, making it more challenging to secure digital ecosystems.

The consequences of cyber-attacks can be severe and wide-reaching. They can result in financial losses, reputational damage, privacy breaches, and even disruption of critical infrastructure. Governments, businesses, and individuals all face significant risks in the digital realm, necessitating a comprehensive and collaborative approach to cybersecurity.

2.3 Types of Cyber Attacks

Cyber-attacks come in various forms, each with its own objectives, techniques, and consequences. Here are some common types of cyber-attacks:

Malware: Malware is a broad category that includes various malicious software such as viruses, worms, Trojans, ransomware, spyware, and adware. Malware is designed to infiltrate systems or networks, disrupt operations, steal data, or gain unauthorized access.

Phishing: Phishing attacks involve deceptive tactics to trick individuals into revealing sensitive information such as passwords, credit card numbers, or social security numbers. Attackers often masquerade as trusted entities through emails, websites, or instant messages, aiming to exploit human vulnerabilities.

Denial-of-Service (DoS) and Distributed Denial-of-Service (DDoS): DoS attacks aim to overwhelm a target system, network, or website with a flood of traffic, rendering it inaccessible to legitimate users. DDoS attacks involve multiple sources, often using botnets, to orchestrate the attack. The objective is to disrupt services or extort victims.

Man-in-the-Middle (MitM) Attack: In a MitM attack, the attacker intercepts and alters communication between two parties, often without their knowledge. This allows them to eavesdrop, manipulate data, or impersonate one of the parties involved, compromising the confidentiality and integrity of the communication.

SQL Injection: SQL injection attacks exploit vulnerabilities in web applications that accept user input and interact with a back-end database. Attackers inject malicious SQL statements into the input fields, tricking the application into executing unintended commands, potentially compromising the database or gaining unauthorized access.

Zero-day Exploits: Zero-day exploits target vulnerabilities in software, hardware, or operating systems that are unknown to the vendor or developer. Attackers leverage these undiscovered vulnerabilities to infiltrate systems before they can be patched or mitigated.

Social Engineering: Social engineering attacks manipulate human psychology to trick individuals into divulging sensitive information or performing actions that benefit the attacker. This can include techniques such as pretexting, baiting, phishing, or impersonation to exploit trust or manipulate emotions.

Advanced Persistent Threats (APTs): APTs are sophisticated and targeted attacks that typically involve a prolonged effort by a skilled adversary. APTs often combine multiple attack techniques, including social engineering, malware, and network infiltration, to gain persistent access, conduct reconnaissance, and exfiltrate valuable data.

Crypto jacking: Crypto jacking involves the unauthorized use of someone's computing resources, such as CPU power or electricity, to mine cryptocurrencies. Attackers typically achieve this by infecting systems with malware or by exploiting vulnerabilities in websites or applications.

Insider Threats: Insider threats refer to attacks or security breaches initiated by individuals with authorized access to systems, networks, or data. These individuals may be employees, contractors, or partners who misuse their privileges intentionally or unintentionally, causing damage, theft, or data leakage.

It is important to note that cyber-attack techniques are continually evolving as attackers adapt to advancements in technology and security measures. Organizations and individuals must remain vigilant, implement robust security measures, and stay updated on emerging threats to protect against cyber-attacks.

3. Cybersecurity Strategies and Technologies

Effective cybersecurity strategies involve a combination of technical solutions, policies, and practices. Organizations need to implement robust security measures such as firewalls, encryption, intrusion detection systems, and vulnerability management. Additionally, promoting a culture of cybersecurity awareness and providing training to employees are essential to mitigate human-related risks.

3.1 Security Governance and Policies

Governments also play a crucial role in cybersecurity by enacting legislation, developing national cybersecurity frameworks, and fostering international cooperation to combat cybercrime. Public-private partnerships are increasingly vital in sharing threat intelligence, coordinating incident response, and developing best practices to address emerging challenges.

4. Legal and Ethical Considerations

Looking ahead, the field of cybersecurity will continue to evolve in response to emerging technologies and threats. Artificial intelligence, machine learning, and quantum computing are among the areas that will shape the future of cybersecurity. Ethical considerations, privacy protection, and the need for robust cybersecurity in critical infrastructures will also remain at the forefront of research and practice.

5. Future Trends and Challenges

Future trends and challenges in cybersecurity are shaped by the rapid evolution of technology, emerging threats, and changing cyber landscape. Here are some key trends and challenges to consider:

Artificial Intelligence (AI) and Machine Learning (ML): AI and ML technologies are being leveraged by both cybersecurity defenders and attackers. AI-powered tools can enhance threat detection, anomaly detection, and incident response. However, attackers can also use AI to automate attacks and develop sophisticated evasion techniques, making it a challenge to stay ahead of advanced threats.

Internet of Things (IoT) Security: The proliferation of interconnected devices in the IoT introduces new security challenges. IoT devices often have limited computing power and lack robust security features, making them vulnerable to attacks. Securing the IoT ecosystem requires addressing issues such as device authentication, data privacy, and secure communication protocols.

Cloud Security: As organizations increasingly adopt cloud services, securing cloud environments becomes crucial. Challenges include data breaches, misconfigurations, insider threats, and ensuring the security of data stored and transmitted through cloud platforms. Adopting robust security measures and ensuring strong access controls are essential in this context.

Quantum Computing and Post-Quantum Cryptography: Quantum computing has the potential to break current cryptographic algorithms, posing a significant challenge to data confidentiality and integrity. Post-quantum cryptography research aims to develop new encryption algorithms that can resist attacks by quantum computers.

Supply Chain Security: Attacks on the supply chain have become a significant concern. Adversaries target software and hardware components, compromising the integrity and security of the entire supply chain. Ensuring secure supply chains requires comprehensive risk assessments, strict vendor management practices, and validation of software and hardware integrity.

Cyber Threat Intelligence and Information Sharing: Collaboration and sharing of threat intelligence between organizations, industries, and governments play a crucial role in identifying and mitigating cyber threats. Establishing effective information sharing frameworks while addressing legal, privacy, and trust concerns remains a challenge.

Privacy and Data Protection: With increased data collection and processing, protecting individuals' privacy becomes critical. Striking a balance between utilizing data for security purposes and respecting privacy rights poses ongoing challenges. Compliance with privacy regulations and implementing privacy-by-design principles are essential in this context.

Skills Gap and Workforce Development: The demand for cybersecurity professionals continues to outpace the availability of skilled personnel. Bridging the skills gap requires investing in cybersecurity education, training programs, and attracting diverse talent. Additionally, retaining experienced cybersecurity professionals is crucial for organizations to maintain effective security programs.

Cyber-Physical Systems and Critical Infrastructure: As more critical infrastructure systems become interconnected, vulnerabilities and potential consequences of cyber-attacks increase. Protecting critical infrastructure, such as power grids, transportation systems, and healthcare facilities, requires robust security measures, regular assessments, and resilient incident response capabilities.

Legal and Policy Frameworks: Developing and implementing effective legal and policy frameworks to address cyber threats and cybercrime is an ongoing challenge. International cooperation, harmonization of laws, and addressing jurisdictional issues are essential for combating cyber threats globally.

Addressing these future trends and challenges in cybersecurity requires a proactive and comprehensive approach involving collaboration between industry, government, academia, and individuals. Constant research, innovation, and adaptive security measures are crucial to stay ahead of evolving threats and protect the increasingly digital and interconnected world we live in.

Conclusion

In conclusion, cybersecurity is an ever-growing concern in the digital age. It is a multidimensional field that requires continuous adaptation, collaboration, and innovation to stay ahead of cyber threats. By implementing robust security measures, fostering awareness, and embracing emerging technologies, individuals, organizations, and governments can strive to ensure a secure and resilient digital environment.

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SOCIAL NETWORKING SITES' CONTRIBUTION IN TALENT MANAGEMENT: A STUDY OF NATIONAL CAPITAL REGION IN INDIA

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Talent Management and recruitment drive in any organisation plays a vital role in the organization efforts towards achieving their vision and mission. Without skilled workforce, organization's management can't even think about breath and survive in this competitive era. In this regard adequate recruitment policy is must for any organization. The modern staffing policy i.e. right people, at the right place, at a right time is need to ensure for both side from employees as well as from employers. This will bring the win-win situation for recruiters and employees. With the traditional recruitment methods, companies were not able to attract a large volume of quality workforce. But with the technological invention and intervention, its' becoming easy for the recruiters to approach to the large scale of potential employees with different geographical area. The study focused on the major aspect on e-recruitment practices contribution to the talent management and how its beneficial to conversion of organization as a talent pool. With this prime objective, using five point likert scale, a structured questionnaire was used to conduct survey for a sample of 400 respondents (300 employees and 100 employers) in NCR area. The General Linear Model (Univariate) was applied for data analyses. The study revealed about the different prospective of E-Recruitment Practices' Contribution in Talent Management and revealed that talent management concept can be more effective and positive for both employers as well as employees if recruiter and employee involved in recruitment drive via using various electronic media and platforms.

Keyword: E-Recruitment, Recruitment, Talent Management, Workforce

1. Introduction:

Due to global scenario, the labour market continues expand across the boundaries creating new challenges and opportunities. Geographical mobility of the workforce increased in quest of well-paying jobs and better living conditions (Deniss Sceulovs,2017). The employers and employees want to take the benefits of the win-win situation. With the challenging task of acquiring talent, company strive to find more cost-effective, efficient, and successful methods to operate its recruitment. In the corporate world, hiring is always necessary, and corporations spend a fortune on it. (G. Aspridis,2013). With the fast growing technology and digital based e-economy corporate required equally fast growing talent from their diversified workforce. If they aren't updated to reflect the status of technology today, contemporary organisations' abilities will quickly become obsolete, much like technology itself. (Bimal Chandra Nayak 2020). However, particularly since 2005, a new form of information sharing networks popularly known as social media (SM) has been influencing the functions of HR professionals to a greater extent than before. In a today era the prominence of usages of social networking sites becomes widespread (Meeya Nawazkhan 2021). Social media such as Facebook, LinkedIn, Twitter, Google and Xing have millions of users and the number is increasing at a good pace every year. A social networking site (SNS) is a special type of online social platform where the users can interact with each other through posting pictures, videos and comments, like and dislike; and share the contents. (Sajjad Hosain 2021). The role of social networking sites, such as twitter, linkedin and the facebook, to assist decision for talent acquisition is becoming more popular among the corporates to avoid negligent hiring claims. (Roth et al. (2016; McFarland and Ployhart, 2015; Bohnert and Ross, 2010). Now a days Social networking sites become an important recruiting tool for employer as well

as recruiter to cover a large pool of qualified and potential candidates that might not be possible to reach through traditional method of recruitment (Ugo Chuks Okolie et. al.2017). It is estimated that more than 3.6 billion people are using social media worldwide in 2020 and the usage is expected to reach 4.41 billion approximately in 2025 (Clement, 2020). SNS help create a broad recruiting net and hire applicants from non-traditional sources. Kavitha and Pillai (2011) demonstrated in a study on SNS in India that almost 85Percent of the applicants are passive or not looking for a job actively. For this purpose SNS provide a large scale of platform for the employers where they can pool out talented personnel from the diversified area and potential employees also can get opportunities at vast scale. This paper examines the contribution of the e-recruitment toward the talent management for the employers with reference to the Indian company. The examination of topic will thus provide numerous practical implications for recruiters, and fill several topical and methodological research gaps.

2. Review of literature

The review of literature provides the deeply understanding of the methodology used by the earlier studies and also the limitations of various available estimation procedures, database, logical interpretation and understanding conflicting results. A brief review of some of the earlier studies conducted on impact of e-recruitment on talent management is discussed in this section.

(Dodo Khan Alias & Khalid Malokani;2022) studied how talent management techniques affected e-recruitment in Karachi's public and private higher education institutions through questionnaire method. Three independent variable i.e. talent identification, talent development and talent retention and one dependent variable were taken for testing the developed hypothesis and found that these variable have positive impact on the e-recruitment in public and private higher education institution in Karachi. (Banerjee Poulami;2012) carried out a research on the impact of social networking sites on the e-recruitment from the both the point of view employers as well as potential employees. The revealed a significant shift in trend away from traditional methods of recruitment and toward modern techniques such as social networking sites. However, there is still gap for improvement and the utilisation of various benefits through such sites. (Hosain Sajjad; 2021) discussed the mounting role of social media (SM) or social networking sites (SNSs) on various human resource management (HRM) practices. it was found that Facebook and LinkedIn are the two most accepted sites among the hiring professionals where the first one mostly provides behavioural information and the second one provides job-related information. Finally, it was revealed that organizations can develop a strong corporate branding through the presence in SM. (Rathee Rupa et. al.; 2020) explored the impact the social networking sites on recruitment process through the primary study. The study includes the various social networking sites like facebook, twitter, linkedIn etc. It was found that there was a positive perception regarding the use of SNSs for e-recruitment. Further the results also revealed that various aspects of e-recruitment like information quality, popularity and privacy of data influenced the perception of e-recruitment. The study also provided certain implications for recruiting organizations. (Rahman Mushfiqur; 2020) demonstrated how social media shape the recruitment and selection processes of individuals in developing countries. It further explores the impacts of social media on business productivity, cost efficiency, widening of search, less employee turnover and competitive advantage mediated by adopting e-recruitment processes. This research adopts social network theory to discuss the findings and highlight the new mechanisms that legitimise business manipulation in e-recruitment process by exploring the usage of social media. The findings show that e-recruitment has immense advantages to businesses. However, the authors also consider the dark side of social media and e-recruitment process by considering social network theory as a manipulation tool in organisations of developing countries. (Bimal Chandra Nayak; 2020) studied the effect of social media in organisation through the primary study and structured & semi-structured question were prepared for the interview with employees working with various Software and Research & Development sectors, Human Resources and Talent Management

professionals working for information technologies companies, IT-enabled (Business Process Outsourcing) BPO, and KPO (Knowledge Process Outsourcing) Services, as well as talent acquisition organizations, confirm the utilization of social media for social recognition & employee engagement in their organizations. (Jeske Debora; 2015) made the arguments in defence of social media screening as well as issues that arise and may effectively erode the reliability and utility of such data for employers. The authors begin by taking into account the current legal frameworks and regulations in place in the UK and the USA, as well as the ensuing moral issues that develop when employers access and exploit social networking content for employment purposes. Second, there are a number of justifications for using social networking content, each of which is examined from a variety of perspectives. These justifications include issues with impression management, bias and discrimination, data security and protection, and impression management. In the end, the current state of research cannot definitively say if data from social networks is useful in recruiting. (Banerjee Poulami;2012) carried out a research on the impact of social networking sites on the e-recruitment from the both the point of view employers as well as potential employees. The revealed a significant shift in trend away from traditional methods of recruitment and toward modern techniques such as social networking sites. However, there is still gap for improvement and the utilisation of various benefits through such sites. (Temple; 2011) studied the comparison of internet based participant recruitment methods of Cannabis and the effectiveness of three Internet based strategies in recruiting cannabis users for an online study. Consideration of the recruitment data leads us to recommend that researchers use multipronged Internet based recruitment campaigns with appropriately detailed recruitment messages tailored to the population of interest and located carefully to ensure they reach the intended audience. Further, the study suggests that building rapport directly with potential participants, or utilising derived rapport and implicit endorsements, is an important aspect of successful Internet based participant recruitment strategies.

3. Problem Statement of the study

In Recruitment Drive, placing the Right Candidate, at the right place with the adequate skills is utmost task. The study tried to analysis that how e-recruitment effect on the talent management in the organisations in NCR Area.

4. Research Methodology Research Design and Sampling Plan

The present research is exploratory cum descriptive in nature, primary data has been collected from a sample of 400 respondents (300employees and 100 employers) from diverse socio-economic backgrounds and regions from the National Capital Region using judgmental sampling technique through a structured questionnaire, with a 5-interval likert scale from Strongly Disagree (measuring 1) to Strongly Agree (measuring 5) has been employed to measure the psychographics (attitudes, interests and opinion) of respondents. Secondary data has been collected from diverse offline and online national/international research papers and publications. The Research Instrument (Questionnaire) finalized after conducting Pilot study and obtaining valuable feedback and suggestions, which comprises thirty-five research statements eliciting critical information from the respondents (apart from relevant demographic information having a bearing on their psychographic attitudes, interests and opinions) and has been divided into four sections covering the four broad research objectives.

Profile of Respondents

Table No 1: Demographic Profile of Respondent

Variables	Groups	Frequency	Percent
Gender	Male	330	82.5
	Female	70	17.5
Residence	Metro	264	64.0
	Non-metro	136	36.0

Age	≥ 20 < 30	207	51.8
	≥ 30 < 40	157	39.3
	≥ 40 < 50	33	8.3
	≥ 50 < 60	3	0.8
Education	Graduate	103	47.7
	Post-Graduate	297	52.3
Family-Income(p.m)	≥ 10,000 < 20,000	61	8.3
	≥ 20,000 < 30,000	171	32.7
	≥ 30,000 < 40,000	122	30.5
	40,000 and above	46	28.5
E-recruitment stakeholder	HR Professional	100	25.0
	Employees	300	75.0

Source: Primary Data

Table No.1 shows that out of 100 respondent of employer majority of the respondents were male 85.0 percent while the Female respondents were 15.0 percent. On the other side out of 300 respondent of employee majority of the respondents male were 81.7 percent while the Female respondents were 47.2 percent. There are 64.0 percent respondents are belonging to the metro and 36.0 percent are belonging to the non- metro. According to nature of job 25.0 percent respondents are HR Professional and 75.0 percent respondents are General employees. Most of respondents (51.8 Percent) are belonging to age group of $\geq 20 < 30$, 39.3 percent respondents are belongs to age group of $\geq 30 < 40$. On the other side 8.3 percent respondents are belongs to age group of $\geq 40 < 50$ while .8 percent respondents are belonging to age group of $\geq 50 < 60$. According to education 47.7 percent respondents are graduates and 52.3 percent respondents are post-graduate. If we talk about family-income (p.m) of respondents that 8.3 percent respondents are belongs to income group of Rs. $\geq 10,000 < 20,000$ whereas 32.7 percent respondents are belongs to income group of Rs. $\geq 20,000 < 30,000$, 30.5 percent respondents are belong to income group of Rs. $\geq 30,000 < 40,000$ while only 28.5 percent respondents are belongs to income groups of 40,000 and above.

5. Data Analysis

The analysis of data was done using General Linear Model (Univariate). The details data analysis is as below:

Table No 2: Univariate Analysis

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Model	5265.488 ^a	11	478.681	489.358	0.00
Gender	0.10	1	0.10	0.10	0.74
Residence	0.03	1	0.03	0.03	0.84
Age	6.65	3	6.65	6.80	0.00*
Education	0.43	1	0.14	0.14	0.93
Family-Income	0.22	3	0.22	0.22	0.63
E-Recruitment Stakeholder	9.19	1	5.39	5.40	0.00*
Error	380.512	389	0.978		
Total	5654.000	400			

Source: Primary Data

a. R Squared = 0.933 (Adjusted R Squared = 0.931) *Sig at 5Percent level

Table No. 2 shows that majority of respondents across categories as there being no significant difference in respondents opinion (gender, residence, education and family income-wise) with regard to agreement with the

research statement, In their quest for right talent, corporate recruiters have started to look beyond job portals and started tracking their target workforce on social networking sites but there is significant difference with regard to age and e-recruitment stakeholder-wise (p-value is less than 0.05). The value of adjusted R Squared is 93.1 percent, which represents that percentage of variation explained by all variables.

Table No. 3: Univariate Analysis

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Model	5572.200 ^a	11	506.564	440.048	0.00
Gender	0.19	1	0.19	0.16	0.68
Residence	0.21	1	0.21	0.18	0.66
Age	1.22	3	1.22	1.06	0.30
Education	5.76	1	1.92	1.66	0.17
Family-Income	3.08	3	3.08	2.67	0.10
E-Recruitment Stakeholder	12.44	1	4.14	3.60	0.01*
Error	447.800	389	1.15		
Total	6020.000	400			

Source: Primary Data a. R Squared = 0.983 (Adjusted R Squared = 0.987) *Sig at 5Percent level
 Table No. 3 shows that that the majority of respondents across categories as there being no significant difference in respondents opinion (gender, residence, age, education and family income-wise) with regard to agreement with the research statement , Corporate recruiters perforce need to pay attention to all those social networking sites which are patronized in large numbers by their target workforce but there is significant difference with regard to e-recruitment stakeholder-wise (p-value is less than 0.05). The value of adjusted R Squared is 98.7 percent, which represents that percentage of variation explained by all variables.

Table No. 4 : Univariate Analysis

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Model	5572.200 ^a	11	506.564	440.048	0.00
Gender	0.19	1	0.19	0.16	0.68
Residence	0.21	1	0.21	0.18	0.66
Age	1.22	3	1.22	1.06	0.30
Education	5.76	1	1.92	1.66	0.17
Family-Income	3.08	3	3.08	2.67	0.10
E-Recruitment Stakeholder	12.44	1	4.14	3.60	0.01*
Error	447.800	389	1.151		
Total	6020.000	400			

Source: Primary Data a. R Squared = 0.926 (Adjusted R Squared = 0.924) *Sign at 5Percent level
 Table No. 4 shows that majority of respondents across categories as there being no significant difference in respondents opinion (gender, residence, age, education and family income-wise) with regard to agreement with the research statement, Corporate recruiters are increasingly making use of social networking sites as an important recruiting tool as these are the sites where their target workforce voluntarily spends most of their time, effort and energy, but there is significant difference with regard to e-recruitment stakeholder-wise (p-value is less than 0.05). The value of adjusted R Squared is 92.4 percent, which represents that percentage of variation explained by all variables.

Table No. 5: Univariate Analysis

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Model	5987.569 ^a	11	544.324	546.528	0.00
Gender	3.27	1	3.27	3.28	0.07
Residence	2.98	1	2.98	2.99	0.08
Age	8.40	3	8.40	8.44	0.00*
Education	1.81	1	0.60	0.60	0.61
Family Income	25.62	3	25.62	25.72	0.00*
E-Recruitment Stakeholder	26.15	1	8.71	8.75	0.00*
Error	387.431	389	0.996		
Total	6375.000	400			

Source: Primary Data a. R Squared = 0.939 (Adjusted R Squared = 0.938) *Sign at 5Percent level

Table No. 5 shows that majority of respondents across categories as there being no significant difference in respondents opinion (gender, residence and education) with regard to agreement with the research statement, Corporate recruiters are attracted to Social Networking Sites (like LinkedIn, Facebook and Twitter) as these have become home to the largest pool of most qualified and talented human resources in India and abroad” but there is significant difference with regard to age, family income and e-recruitment stakeholder-wise (p-value is less than 0.05). The value of adjusted R Squared is 93.8 percent, which represents that percentage of variation explained by all variables.

Table No. 6 : Univariate Analysis

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	5475.593 ^a	11	497.781	457.331	0.00
Gender	0.18	1	0.18	0.16	0.68
Residence	0.17	1	0.17	0.16	0.68
Age	0.00	3	0.00	0.00	0.94
Education	1.49	1	0.49	0.45	0.71
Family-Income	3.64	3	3.64	3.34	0.06
E-Recruitment Stakeholder	8.40	1	8.40	8.22	0.02*
Error	423.407	389	1.088		
Total	5906.000	400			

Source: Primary Data a. R Squared = 0.928 (Adjusted R Squared = 0.926) *Sign at 5 Percent level

Table No. 6 shows that majority of respondents across categories as there being no significant difference in respondents opinion (gender, residence, education, age and family income-wise and e-recruitment stakeholder-wise) with regard to agreement with the research statement, Other than friends and family, Facebook connects people with their business associates, organizations and interest groups making it an important social media tool for corporate recruiters to engage potential talent but there is significant difference with regard to e-recruitment stakeholder-wise (p-value is less than 0.05). The value of adjusted R Squared is 92.6 percent, which represents that percentage of variation explained by all variables.

Table No. 7: Univariate Analysis

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Model	5000.818 ^a	11	454.620	326.780	0.00

Gender	2.15	1	2.15	1.55	0.21
Residence	0.09	1	0.09	0.07	0.79
Age	1.88	3	1.88	1.35	0.24
Education	6.53	1	2.17	1.56	0.19
Family-Income	15.31	3	15.31	11.00	0.02*
E-Recruitment Stakeholder	23.40	1	7.80	5.60	0.00*
Error	541.182	389	1.391		
Total	5542.000	400			

Source: Primary Data a. R Squared = 0.902 (Adjusted R Squared = 0.900) *Sign at 5Percent level

Table No. 7 shows that majority of respondents across categories as there being no significant difference in respondents opinion (gender, residence, education, age) with regard agreement with the research statement, E-recruitment (using social networking sites) is contributing to better talent management opportunities for corporate recruiters than traditional means of recruitment, but there is significant difference with regard to family income and e-recruitment stakeholder-wise (p-value is less than 0.05). The value of adjusted R Squared is 90.0 percent, which represents that percentage of variation explained by all variables.

Table No. 8: Univariate Analysis

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Model	5843.596 ^a	11	531.236	376.822	0.00
Gender	3.53	1	3.53	2.50	0.11
Residence	1.34	1	1.34	0.95	0.33
Age	2.63	3	2.63	1.87	0.17
Education	7.07	1	2.35	1.67	0.24
Family-Income	0.73	3	0.73	0.52	0.47
E-Recruitment Stakeholder	2.97	1	0.99	0.70	0.55
Error	548.404	389	1.410		
Total	6392.000	400			

Source: Primary Data a. R Squared = 0.914 (Adjusted R Squared = 0.912) *Sign at 5Percent level

Table No. 8 shows that majority of respondents across categories as there being no significant difference in respondents opinion (gender, residence, education, age, family income and e-recruitment stakeholder-wise) with regard to agreement with the research statement, E-recruitment (using social networking sites) is contributing to better career planning opportunities for both employed and unemployed qualified professional. The value of adjusted R Squared is 91.2 percent, which represents that percentage of variation explained by all variables.

6. Findings and Suggestions

This section explores the difference between the traditional recruitment and e-recruitment (using social networking sites). Social networking sites are a great platform where corporate recruiters and potential employees can interact with each other. This chapter present the findings and on the behalf of those findings few suggestions have been suggested which can be beneficial for both i.e. employees and employers.

Findings:

1. In earlier times, aspiring employees used internet to find out useful information about job openings on online job portals but now-a-days presence of a large number of skilled employable workforce on social networking sites has made it necessary for corporate recruiters

to track their target workforce on social networking sites and get to know more about them (their likes, dislikes, interests, passions as so on). Since there are a lot of job opportunities available to talented workforce today and hopping from one company to another is as simple as a click of a mouse; corporate recruiters need to actively engage their target workforce and this is possible by understanding and tracking them (and analysing their online activities on social networking sites) which helps in talent management and retention of quality workforce.

2. Social networking sites (Facebook, LinkedIn, Twitter etc.) share a lot of valuable and privy information about the personality, behaviour, interests and passion of potential employees and how they express themselves in the virtual world through various posts, tweets and sharing of

personal and professional information. This privy information could be very handy in ascertaining whether a particular candidate shall be the right fit in the corporate culture of a particular company and whether s/he will prove to be a loyal, committed, ambitious and hard-working employee.

3. With unprecedented growth and popularity of social networking sites; corporate recruiters can-ill afford to ignore the online labour market-place where their target workforce spends most of their time, effort and energy in venting their heart out and expressing their private views, opinions, thinking, values and beliefs; which could be very useful to corporate recruiters in ascertaining whether a potential employee is a right fit or not.

4. Some of the most qualified and talented human resource professionals in India make themselves available on social networking sites like (Facebook, LinkedIn, Twitter etc.) and corporate recruiters can know more about their online activities or how those people think and behave in their real lives which is vital information for corporate recruiters.

5. Apart from the socially-interactive fun activities, Facebook could be seriously harnessed in interacting and liaisioning with business associates, organizations and other interest groups and thus could be utilized as a serious tool for interaction and engagement with other professionals in one's field of interest/expertise. Thus, corporate recruiters can very well engage their potential talent on these social networking sites whether these are out-and-out professional sites or social interaction sites like facebook.

6. Due to instantaneous IM (Internet Massaging) facility available on social networking sites (like Facebook, LinkedIn Twitter etc.) these sites could be used to spread quick information about job vacancies and other important stuff which is one of the reason why these sites are so popular among young urban professionals.

7. Youtube is the place where one could watch any type of infotainment (information plus entertainment) which could be shared with peers and friends (on their Facebook and other social networking sites) and they could also upload their skill-related videos besides watching, downloading and interacting with useful videos of experts and specialists in their field. Such type of Youtube related activity might help corporate recruiters in understanding the peculiar tastes and preferences of potential recruits.

8. Skype and Google+ have emerged as the most preferred social networking sites for video chatting by professionals because of these being dedicated sites for such activity and since majority of people have also got Gmail account. Google+ has a small edge over Skype in helping potential recruits getting interviewed by corporate recruiters in real-time.

9. In today's IT (Information Technology) era; one is stuck in a time-warp without internet and e-recruitment (using social networking sites) comes as manna from heaven providing good career planning opportunities for all kinds of professionals.

10. The concept of talent management has received a shot in the arm with employment of e-recruitment (using social networking sites) helping recruiters discern the right type of talent (from a large pool of employees) and help companies find the best talent available in the labour market place.

Suggestions: It is observed that mostly companies (especially small scale industry) are satisfied with their current recruitment process. They are not so much aware how e-recruitment (using social media) is more effective in reaching their target workforce and recruit right talent in the organisation. It is suggested that there should be

more awareness about the online recruitment and it should be used at the frequently basis. Through the E-Recruitment (using Social Networking Sites) corporate recruiters can spread the information about job vacancies like a wild fire which provide a large selection area where corporate recruiters can easily find their better quality target workforce. For this purpose corporate recruiters should use the social networking for job posting and giving other relevant information about their organisation where information can be reached to the large scale of population. Tradition means of recruitment have the lengthy and complex process which requires more time, energy and effort. E-recruitment (using social networking sites) gives the facilities to the corporate recruiters to accomplish the recruitment objectives in effective and efficient way with less time, efforts, energy and cost. So corporate recruiters should be aware through e-recruitment (using social networking sites) how recruitment processes get done in effective and efficient way. The omnipresent nature of internet and real-time communication of social networking sites (like Facebook, LinkedIn, Twitter etc.) make e-recruitment (through social networking sites) very time-saving as well as time-effective compared to traditional means of recruitment which are quite unwieldy, effort-intensive and time-guzzling in comparison. So Organization should use social networking sites to their recruitment processes which provide the facilities of time-saving as well as time effective.

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TALENT ACQUISITION VIA SOCIAL MEDIA: BUILDING THE DREAM TEAM

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Talent acquisition is the procedure of finding and hiring capable employees for organizational requirements. This process is frequently handled by a human resources team. The simplicity of access and connections of online hiring strategies have influenced recruiters to use them. The success of the organization depends on finding the right candidate for the right job, but talent attraction and acquisition are still difficult tasks. Social networking sites enable businesses to communicate with prospective employees and develop talent by bridging the gap between getting hired and job-seeking. Therefore, the paper discusses how firms can select the best applicants from social networking sites such as Facebook, LinkedIn, and Twitter. The paper also attempts to investigate the strengths and weaknesses of social media recruitment, the impact of social media on talent acquisition, and current difficulties faced during talent acquisition via social media.

Keywords: Talent management; Social sites; Recruitment; Selection; Social media

1. Introduction

The strategies, techniques, and procedures for locating, enlisting, and retaining the people resources a business needs fall under the umbrella of talent acquisition. It entails creating, putting into practice, and assessing programs for finding, attracting, hiring, and orienting talent (SHRM,2022). Organizations throughout the world are struggling to find and develop the necessary talent in the current business environment, which is characterized by a talent shortage. Employers are experimenting with various methods of recruiting entire talent and ways to develop it. Among human resources managers today, social networking sites are seen to be one of the most sought sources for hiring. HR professionals anticipate using social networks not only for hiring but also for growing their talent pool. Three main elements make up a business: people, materials, and machines. Many management experts nowadays claim that business is made up of people, things, machines, money, and information (Satpute,2016). While management might imply different things to different people, the definition is constant. Management is explained in a variety of ways and terminology. Simply put, management is the act of using its constituent parts to get the greatest results and accomplish the intended goal. A company is made up of several non-living components, but there's just one alive component—men, frequently known as people. The company's most valuable resource is its human capital, as it is the only one that enables other resources to function as needed. The individuals in charge of human resources are those who make all decisions and set the criteria using which plans and choices are made. The only resource that can comprehend demands and determine the best course of action is human resources. Simply put, human resource management is the procedure used to manage and maximize the potential of the employees who work for the company. Human resources were defined by Michael J. Jucius as "a whole consisting of interrelated, interdependent, and interacting physiological, psychological, sociological, and ethical components." Balaji et al. 2016 described that to attain individual, organizational, and social goals, the administration of human resources includes the planning, organizing, directing, and managing of human resource

acquisition, development, compensation, integration, maintenance, and separation. Humans are the company's working force, and they must be appropriately regulated and managed for them to function well and produce the greatest results. The several departments that make up human resource management are responsible for carrying out the necessary tasks. Some of the several forms of human resource management include human resource planning, human resource development, human resource information systems, human resource compensation planning, and human resource industrial relationships. Human resource planning is the process of analyzing and forecasting the amount of labor the company will need, then selecting and hiring personnel accordingly. Planning is incredibly crucial for us to be able to have an adequate number of applications and an accurate quantity of prospects. Finding an appropriate applicant for the position is crucial. To complete the task at hand and make the best choice, we must discover the right talent. The most crucial phase of human resource management is the recruitment and selection process, which requires careful consideration and thorough investigation. In this case, talent acquisition is also important. Finding talent and hiring it for the right position is crucial. Buried talent must be discovered and developed to achieve future objectives.

Recruiters nowadays must deal with the limitless opportunities and difficulties that the highly linked, high-tech global community presents. The days of using conventional methods to find and recruit talent are long gone (Singh, 2014). Today, some of the most widely utilized platforms are social media. Everyone, from employers to recruitment firms to applicants, is present on social media channels with the main objective to create an impression on the target audience. The most effective tools now accessible to recruiters are social networking sites, mainly Facebook and LinkedIn. Facebook reached 1.32 billion quarterly active users in June 2014, and 1.07 billion of those were mobile users (Facebook, Inc., 2014). In the second quarter of 2014, mobile devices accounted for 45% of all unique visitors to LinkedIn, which has over 313 million registered members worldwide (LinkedIn Corporation, 2014). Twitter has 271 million monthly active users as of June 30, 2014, and 211 million of those users were on mobile devices, making up 78% of all monthly active users (Twitter, Inc., 2014). Compared to 2014, recruiters will use 7.8 more social media platforms on average in 2022 to find and recruit passive applicants. With 77% of employers using it, LinkedIn is the most popular recruitment medium, followed by Facebook (63%). On LinkedIn, the proportion of users with a college degree (51%), is almost identical to that on Instagram (49%). A growing number of firms are increasingly understanding that premium prospects may be reached using social networks swiftly and at a reduced cost as opposed to the traditional approaches utilized by recruiters, as the use of LinkedIn by professionals keeps increasing. When it comes to identifying, recruiting, and screening the top talent pool available to meet recruitment objectives, social networks can provide recruiters with a competitive edge. Given the paucity of research in this area, particularly about talent management, social networking sites appear to offer a significant opportunity for human resources management researchers who adopt conceptual, empirical, and practitioner-oriented applications. The research on social networking sites and human resource management can be broadly categorized into three main categories: employee recruitment and selection, Bohnert et al. 2010; Brown, 2011; Clark et al. 2010; Kellard et al. 2017; and Workplace relationships study on organization security procedures concerning employee security. A social network of people who interact through particular social media, potentially crossing political and geographic boundaries to pursue shared interests or goals. Social interaction between individuals who produce, share, or trade knowledge and thoughts in virtual communities (Tyagi, 2017). Communities of people using social networking sites are some of the most prevalent virtual communities. Social media is defined as "a collection of Internet-based tools that expand upon the theoretical and technical underpinnings and enable the production and sharing of user-generated content."

They bring about significant and widespread modifications to how organizations, communities, and people communicate. Any website that allows users to build public profiles there and establish interactions with other

site users who visit their profiles is referred to as a "social networking site." Individuals seeking ways to interact with other business-related contacts typically move to sites like LinkedIn, but one needs to understand which social media is above Twitter, Facebook, LinkedIn, and Blogs. Social networking sites may be employed to define grassroots Web sites, online discussion forums, chatrooms, and other social spaces online. Some of the most effective tools accessible to recruiters today are social networking sites like Facebook, Twitter, and LinkedIn. Approximately 40 million users were registered on LinkedIn in 2009; by 2016, that number has risen to almost 140 million. As use grows, more companies are realizing that social networks provide a quicker and more affordable way than traditional recruitment techniques to connect with high-quality prospects. To accomplish an organization's recruitment goals, social networks can provide recruiters an advantage in finding and attracting the best applicants. Numerous factors influence why job searchers utilize social media. Even if it may not be the most popular pastime on social media, job searching is an essential one. Accordingly, branding, product announcements, acquiring consumers, and maintaining relationships with current customers are some of the primary activities that drive business users to social media. LinkedIn, Facebook, and Twitter are the social media platforms most frequently utilized for hiring. Budgets for hiring using social media are extremely little. Only 15% of businesses invest over five percent of their total human resources expenditure on the Internet, and many don't invest any money at all. Only 29% of businesses have staff members that are solely responsible for hiring via social media. The rest of the paper covers a literature review, objectives, research methodology, strengths and weaknesses of social media recruitment, the impact of social media on talent acquisition, current difficulties in talent acquisition, conclusion, future implications, and advice.

2. Literature Review

Social networking sites allow users to create public or semi-public profiles, build a list of interacting users, and communicate. They allow users to access and navigate their connections and those created by others within the system Boyd & Ellison, 2007. Social network theory and social capital concepts emphasize the importance of interactions among actors, contrasting conventional organizational research perspectives that focus on individual players Brass et al.2004. Burt, 2010 highlighted social networking's fundamental tenet: actors were immersed in linked interactions, offering possibilities and limitations on behavior. Adler and Kwon, 2002 emphasized the importance of social capital in understanding social network processes. Burt, 2000 identified two network configurations for social capital development: network closure theory, which involves tightly coupled parts, and structural hole theory, which suggests individuals link disparate, unconnected parts through networks. The strength of weak ties hypothesis, developed by sociologist Mark Granovetter in 1973, suggested that weaker relationships can enhance information transmission and relationship building. Granovetter applied this idea at the group level, arguing that communities with strong relationships have stronger local cohesion but weaker worldwide cohesion, while groups with weak ties have weaker local cohesion but higher global cohesion. In a similar vein, Burt,2000 highlighted the importance of networks within and among groups, highlighting their growth into social capital. Research showed that strong ties provide emotional support, while weak ties provide non-redundant information and diverse viewpoints. Social capital research supports this distinction. Social networks were crucial for individual outcomes like work attitudes, job performance, and employment search, as well as innovation, efficiency, and group survival (Brass et al., 2004; Vlaisavjevic et al. 2016).

Hiring and selecting new employees were crucial ongoing processes in businesses, involving fair assessments of applicants' abilities and deficiencies for hiring purposes, as Sutherland and Wöcke, 2011 emphasised. Recruitment involved attracting and inspiring potential employees to apply for positions, traditionally done through paper job postings in newspapers (Holm, 2012). The rise of social media had significantly impacted hiring procedures for businesses. As a recruiting tool, businesses can post job openings and seek preferred employees, increasing

visibility and access to a larger pool of individuals, giving them a competitive edge. Russell and Stutz, 2014 suggested that social media can be an effective weapon for organizations to leverage. The choice of recruitment method often depends on the position's characteristics and the availability of the required abilities. Some businesses used social media for recruitment when locating the necessary talents or competencies Gunnigle et al., 2011. Social media allowed job advertisements to reach people far away or in other countries, unlike traditional newspaper advertisements. These platforms promote interpersonal interaction and teamwork through information technologies. Facebook, Twitter, and LinkedIn were the three most popular social media platforms, used daily by thousands of millions of individuals. These platforms were considered information technologies that promote interpersonal interaction and teamwork Kane et al., 2014. According to Johnson et al. 2013, Facebook is primarily used for personal connections and communication with friends, family, and colleagues. Companies can advertise job openings on their pages, but this was often done informally. Facebook can also help in hiring by gathering applicant details through their profiles, despite not being widely known as a recruiting platform.

Twitter is a microblogging platform that allowed users to freely, privately, and publicly express their views, information, and links. With a 140-character limit, users can tweet about any subject Johnson et al. 2013. Companies can use Twitter to advertise job openings by adding the hashtag #Jobs to each Tweet, making the message visible to followers and job-related tweets. Searching for "jobs" or #jobs will display any tweets with this feature. Twitter often outperforms Facebook in job advertisements, but its impact is modest compared to LinkedIn. Similar to Facebook's lack of recruitment intent, Twitter's impact is modest. Social networking sites are web-based services that allow users to create public or semi-public profiles, list connections with others, and view and navigate their connections and those created by others within a bounded system Boyd & Ellison, 2007. Social network theory and social capital theory differ from conventional organizational research views by emphasizing interactions among actors rather than individual players in isolation. This approach distinguished itself from individual players in isolation Brass et al. 2004. Social network theory posits that individuals were embedded in interrelated relationships, offering possibilities for behavior and imposing restrictions Burt, 2010. Adler and Kwon, 2002 emphasized the importance of social capital in understanding social network processes. Burt, 2000 connected network theory to social capital. Burt, 2000 identified two network configurations that contribute to the development of social capital: network closure, which involves closely coupled parts, and structural gaps, which connect disparate, unconnected parts. These theories help explain how individuals create social capital and how these configurations influence their overall well-being. Structural Hole Theory is a concept similar to Mark Granovetter's 1973 "Weak Ties" Theory, which emphasized the importance of relationships with weaker ties. This theory suggested that lesser relationships can offer advantages for information transmission and relationship building, such as accessing employment information through acquaintances. Granovetter's theory argued that societies with strong relationships have poor global cohesion but higher local cohesion, while communities with numerous weak ties have the opposite effect. In a similar vein, Burt, 2000 highlighted the importance of networks within and across groups, arguing they extend beyond contacts to form social capital. Additionally, there are advantages to using social networking sites for recruitment, such as speeding up the process, attracting more applicants, and enhancing the company's brand Martic, 2022. Businesses now place a greater emphasis on organizational fit as a potential retaining tactic. The usage of social media is frequently a technique for HR professionals to solve this problem and minimize the difficulty of finding those who suit the company's culture, which is sometimes not an easy effort and something that a lot of HR specialists may find worrisome. While recruiters look for candidates who match their requirements, those same potential candidates also look for organizations that satisfy their requirements Alarcon, 2019. Organizational fit also works both ways. Social media, however, isn't always a good thing and can have a bad effect on how decisions are made. Vicki Morris, the current chief executive officer of Face-to-Face Marketing, provided an example of the way social

media can adversely affect applicants' hiring decisions by describing in an interview how she has made unfavorable hiring judgments based on what she discovered on an applicant's social media Taylor, 2021. Morris revealed that she was in charge of selecting candidates for employment and making decisions about whom to hire. Morris decided to check out a candidate's Facebook and Instagram accounts before the interview after discovering one day that she met every requirement on paper. Instances of "profanity used in captions" and "nude photos" from a "planned photoshoot" were among the things she discovered. Morris decided the applicant "did not have a profile that would be fit to represent the family-friendly business" based on the social media posts he or she had made. Morris declined to hire the applicant, citing "That it might be a potentially huge credibility hit to the company." (Taylor, 2021).

3. Objectives

- To study the strengths and weaknesses of social media recruitment
- To examine the impact of social media on talent acquisition
- To identify the current difficulties of talent acquisition

4. Research Methodology

The research strategy is based on secondary data. Furthermore, it was gathered from a variety of resources, such as books, journals, websites, newspapers, and multiple sources on the internet.

Strengths of Social Media Recruitment

- **Efficient in terms of time:** Social media recruitment is a terrific tool for businesses to locate and employ the best people while saving time. Additionally, it saves time in the search for capable individuals. We may reach across to more individuals in less time, increasing the likelihood that you'll find the ideal applicant for the job (Chesser, L. 2023).
- **Deeper connections:** Social media recruitment involves more than simply advertising job openings on social media; it also entails cultivating relationships with prospective workers. Social media may be used as a tool to assess a person's interest in your business as well as their personality and core beliefs. Finding someone that can blend into the atmosphere of your business & be able to consistently do their finest work will be made easier by doing this.
- **Cost-effective:** Hiring via social media is affordable since there are no associated printing or shipping charges. Additionally, there are no pay-for-play job boards and recruiting firms, which can result in a 30% reduction in the cost of advertising on websites and job portals.
- **Reach a bigger talent pool:** Employers may connect with those applying from all over the world through social media, which is not achievable with more conventional techniques like newspaper advertisements or job fairs.
- **Reach a specific audience:** One of the most effective instruments in the job sector is social media. It enables firms to advertise jobs to a very focused and narrow clientele. Social media can drastically lower unemployment rates in this way.

Weaknesses of Social Media Recruitment

- **Finding candidates with the exact skill sets is challenging:** Finding individuals that fit the desired skill set can be challenging, which is one of the drawbacks of social networking (Gibson, E. 2022).
- **Time-consuming to browse through accounts:** It takes effort to look through all the various social media sites and identify

- **Lacks diversity:** Based on personal preferences and preconceptions, the recruiter can select from a wide range of prospects. It results in an absence of diversity inside these businesses as they opt not to hire individuals who do not fall into simple categorizations since they decide who they think will work best for their firm. This results in a hiring bubble where only individuals who are more suitable for the organization have an opportunity to get hired.
- **Can lead to recruiting prejudices:** A variety of biases can influence hiring choices, and online profiles may contribute to difficulties with partiality and favoritism. A recruiter's impression of a candidate's skills could be significantly impacted by a single Facebook post or LinkedIn post from someone. Social media profiles frequently contain a wealth of details about a person's life, which might result in an incomplete or biased portrayal, even if it only highlights the good. In the end, this contributes to the growth or maintenance of unjust biases.
- **Data on candidate profiles might not be current:** The data available on social media may not be current, which is another drawback.
- **Low job applications from inactive candidates:** Another drawback is the possibility of receiving insufficient applications from people who are not actively seeking employment. For an individual to decide to quit their current job in favor of a different new opportunity, many things must be taken into account. Many people decide the changeover isn't worth the risk Chesser, L. 2023.
- **Reducing social media use Details for job advertisements:** It can be challenging to include all the necessary details about a position in a single tweet at times. For instance, if you have work where you have certain hours or need to retain anonymity. Fortunately, there is a place in your posts for more content. Job searchers will devote more time getting to know your firm when you optimize your social media and only provide pertinent information. It can be challenging for a candidate to condense their resume into 140 characters. Employers find it hard to access all the information they require about you as a result.
- **Contacting applicants on social media can be challenging for recruiters:** It can be challenging for recruiters to start a conversation with potential candidates on social media. It can be difficult because the majority of social media platforms do not provide private messaging to people who are not already linked.
- **Having trouble safeguarding their brand's reputation:** Some businesses may have trouble striking the right balance between using social media to successfully recruit new employees and maintaining their reputation. When a business announces hiring opportunities on social media, for instance, it might receive an abundance of applications and decide to call just one or two candidates. If they weren't called, applicants would react furiously and say negative things about the business. Additionally, candidates may reject positions offered by businesses with subpar social media. However, these businesses can work with reputation management firms to improve their public image.
- **Costly social media hiring is possible:** You may need to pay some money for your job listings to receive the required exposure. There are numerous ways to inbound, even though this concept may deter businesses with few resources or a weak online presence.
- **Not all candidates use social media:** A final point to remember is that not all professionals are going to have a profile on every social media site. Even though Facebook is one of the more popular online social networks, some people have had enough of it or just wish to stop using it altogether.

5. Impact of Social Media on Talent Acquisition

- **Aids talent sourcing:** With the popularity of social media sites like Twitter, Reddit, and Freelance, LinkedIn there are more opportunities than ever to find applicants. In addition, by utilizing social media to post job openings, recruiters can use it to network and find talent. Recruiters can connect with the talent they might not have otherwise discovered by using keywords, hashtags, or in groups. Additionally, businesses with a strong social media presence frequently experience an increase in applications if their brand is well-received by

audiences. Applicants will seek out recruitment or the job center on their own if a company's material is compelling enough (Brett Farmiloe, 2022).

- **Displays corporate culture visually:** social media is now a terrific method to introduce fresh talent to culture. The entry of Gen Z into the workforce has coincided with a hotter job market. We have seen great results from social media recruiting initiatives like movies to advertise positions or team images to emphasize culture because this generation is visually motivated. The issue for talent acquisition teams is to stay current with the rapidly evolving social media platforms.
- **Discovering connections between candidates:** Talent acquisition organizations must discover a variety of venues in today's fiercely competitive job market to draw in as many people as they can to create a pipeline. Teams can interact with a wide range of active and passive prospects via social media, but connecting with those candidates' relationships is just as crucial. When you consider expanding your pipeline and informing those who may not have been motivated to visit your job board, this is quite helpful.
- **Levels the recruiting playing field:** Previously, talent acquisition was solely dependent on job advertisements to draw prospects to their employment sites, and the businesses with the largest budgets won the majority of the best candidates. However, social media's natural network effect has leveled the playing field and made it possible for candidates to get a more accurate glimpse into how employers treat and respect their employees. The capacity for both employers and employees to find the abilities they deserve has never been greater.
- **Increases understanding of candidates' backgrounds:** Before social media, a candidate's CV and a few quick interviews were the only ways for employers to determine whether they were a good fit for a position or business. Nowadays, social media offers a far more in-depth look at candidates' business networks, personal lives, and social activities: LinkedIn, Facebook, Twitter, Instagram, etc. Employers are therefore able to make better-hiring judgments based on how candidates' personal brands and online behaviors align with the company's ideals. Social media may give employers important information about how well applicants will represent their company's image once they get hired because employees represent the company both at work and outside of it.
- **Enables potential talents to find employers:** There is a wealth of information available on using social networks to target people you might not otherwise be able to reach, discovering candidates without paying a fee, leveraging social recruiting, and the practice of headhunting as a competitive advantage. But it's important to keep in mind that this also applies in the opposite direction. Prospective employees, particularly members of Generation Z, judge whether they would fit in with the company's culture and ideals by looking at the brand's social media presence. Additionally, they now have more access to what people who are already working there are proactively saying, and they will be using social media to examine issues like flexible scheduling, well-being, inclusivity, and sustainability.
- **Increase potentially damaging bias:** While social media offers a resource & outlet for many beneficial uses, it also exposes hiring managers and recruiters to several harmful biases when making decisions throughout the screening, interviewing, and hiring processes. Similar to how a résumé may not always reflect or emphasize all of a prospect's qualifications, social media frequently only shows a small percentage of the total candidate. Because of an issue they support, a political stance, or, worst case scenario, racial, religious, or age prejudice, an applicant might not get a call. The absence of social media or closed public profiles can also cause prejudice as people worry about what an applicant might be concealing.
- **Drives transparency and engagement:** In the past, recruiting was impersonal and commercial. Mobile and social apps, however, may now be made to be straightforward and user-friendly. People have always spoken about your company, but the advent of social networking and internet discussion boards has revolutionized the search for top personnel. Engage staff members and gather information to assist you in developing a corporate

culture worth tweeting about! In today's linked and mobile world, candidates have high expectations, thus recruiters must concentrate on making their lives easier on mobile.

- **Exposes reputation:** Social media has a wide range of effects on the acquisition of talent, but none are more significant than reputation. This could refer to the standing of your recruiters, your staff, or your corporate brand. There is nothing to hide in a world where connectedness is always present. Your Glassdoor rating isn't the only factor anymore. Applicants are given access to a comprehensive set of social networking tools that depict life at your business. The story will be managed by branding and talent acquisition.
- **Making the world smaller:** In my experience, social networking has had a good effect on the hiring process. There are several tools available to engage candidates who are both active and passive in a way that is relevant, original, and consistent with organizational goals. Online communities are so widely used, making the globe of talent acquisition smaller and more intimate. Social media is not only made it easier to connect with a broader pool of people, but it has also given recruiters a platform to discuss best practices, research hiring trends, and solicit assistance.
- **Offers voice to candidates:** To attract and hold onto critical talent, businesses need to be deliberate about meeting the requirements of our changing workforce. Employers now have to deal with candidates and employees who have "raised the bar" for them by utilizing social media to set expectations. Their use of social media to share their opinions on important employment issues, both positive and negative (such as job unhappiness, a lack of business DEI efforts, or the applicant experience), has been on the rise. The widespread use of social media has changed the landscape of talent acquisition and requires recruiters to be more inventive in their hiring processes.
- **Enhances advertising and data analytics:** Social media has aided in the recruitment of talent by making it possible to post job openings, information about career fairs, and other openings inside the company. Before social media, newspapers and flyers were the main forms of advertising. Because of social media, businesses may now spend less on things like paper, ink, and cartridges. Utilizing social media also enables data analytics to monitor the performance of the advertisement, including the number of clicks, views, and other metrics. With this knowledge, one can choose the best route to pursue while advertising positions.
- **Forces businesses to manage their discourse:** If your business is just getting off the ground or is entering a new market, the world of social media might resemble a "Choose Your Own Adventure" book, with unknown paths to go and unforeseen detours along the road. For a while, "we must do everything & post everything" was the mantra for being current on social media. Companies now need to change their course and concentrate on caring and sharing. Tell the tale. regard for the neighborhood. Start online dialogues about issues that are important to your organization. To encourage learning and development, post case studies or instructive learnings to LinkedIn groups. Speak at a public gathering or volunteer your time to a neighborhood cause. The way is clear with increasing market presence. There is developed a footprint. Candidates are aware of your name. And look at that! Building a pipeline for filling those open positions has already begun.
- **Eliminates the middleman:** The intermediary is gone. Direct job postings on social media are made by HR, CEOs, and other staff members. Recruiters receive private messages from job seekers. In the past, job seekers had to send their resumes, with the only options for follow-up being a phone call or an email. But nowadays, a direct message serves as a fast cover letter and interviews are frequently scheduled after a job posting. In summary, the procedure is quick.

6. Current Difficulties in Talent Acquisition

Talent acquisition has been practiced for many years. Companies participate in the process of acquiring talent when they hire college applicants. Educational institutions also do it by luring new students to their institution since they want the top students to join their team. To acquire the best people, businesses, and institutions must

overcome several obstacles that arise throughout the talent acquisition process. A few of the present-day difficulties are:

- **Catching the focus of the ideal applicant is challenging:** Recruitment managers find it challenging to decide which path to take and what source to trust for hiring due to intense market rivalry and widespread automation. The act of poaching entails several techniques for finding the ideal candidate in competing businesses and luring them in with better terms (NLB, T. 2023).
- **Best applicants are receiving numerous offers concurrently:** While this may be exhilarating for the applicant, it can be challenging for the person in charge of recruiting to regulate the rate of attrition when the most qualified candidate receives many job offers from other organizations. It may be challenging to deal with the various job offers that an applicant receives because it is impossible to choose the ideal position before joining a firm. However, businesses must also be prepared for the possibility that a perfect applicant may decide to leave and accept a position elsewhere.
- **No method exists to monitor the recruiting success rate:** Although there are online recruiting methods, some businesses do not monitor job advertising and do not know how to handle the applications that are sent. The HR manager is now facing a difficult challenge: managing applications that have been received. The typical issue with this might be that the proper people are not seeing the job ad at the appropriate time. The second possibility is that recruiters don't keep track of the job advertisements they publish and how people respond to them. The third justification for posting job openings online is that hiring managers are unsure of how well the job descriptions are doing.
- **Privacy:** The right to privacy is the assertion by individuals, groups, or institutions to control the disclosure of their data. Social media's expansion has blurred the lines between personal and professional lives, making it difficult for graduates to choose who shares information and who deserves access. This has led to growing social connections and increased information sharing on social media. Employers should consider theoretical constructions when screening candidates for employment to avoid an invasion of privacy. The data used by the human resources team to decide whether to hire a candidate is unclear, making it difficult to determine job relevance based on graduates' profiles.
- **Reliability and accuracy:** Employers often face challenges in ensuring the reliability and accuracy of information on potential candidates' online profiles when using social media in their recruiting process. Employers must speak with applicants face-to-face to verify the accuracy of the information. However, social media information is more reliable and precise than traditional forms like cover letters or curriculum vitae. This is because potential employees are not aware that potential employers will read their profiles, allowing them to be themselves and be the best fit for companies.
- **Background check:** Conducting a background check on potential workers using social media in the recruiting process is crucial for companies to maintain a proactive reputation. Hiring the right candidate with the correct profile is essential for choosing the ideal employee, as it also aligns with the company's culture and values. Many businesses are now using their own social media rules to manage difficult circumstances involving the brand, workers, and social media.
- **Concern over legality:** Employers must address legality concerns, such as background checks and the ability to choose potential employees based on information found on social media. While the internet can reveal information about job applications, using social media sources with caution and a clear understanding of human resource managers' needs is crucial. Legal regulations are still being developed, and pending lawsuits prohibit businesses from using social media for background checks. This may deter other businesses from using social media for hiring applicants. For example, if human resources use social media to choose applicants without online profiles, the business may be held liable for discrimination. Enterprise management should be aware of these issues and offer advice on hiring practices. To successfully use social networking sites as a recruiting tool,

companies must consider the following success elements: a clear understanding of the information human resource managers are seeking, implementing specific rules in the organization to ensure safety and avoid discrimination, being aware of potential legal issues and offering advice on hiring practices.

7. Conclusion

The focus has changed away from conventional methods of recruiting and choosing due to the usage of social networking sites for hiring. Social networking sites may also have an impact on the applicant's experience and the employer's reputation. If social networking sites are utilized to advertise job openings, and recruiting locations, or to send candidates to company websites, they may be effective recruitment tools. A corporation can therefore gain a competitive edge if the outcome is to hire personnel more quickly and at a lower cost than rivals. Additionally, it makes it possible to hire younger people and include passive prospects. Additionally, social media may make it possible for employers to anticipate future workers' performance, giving them the benefit of knowing whom to hire. There are various risks associated with using social networking sites for employment, particularly during the screening and selection process. Social networking sites are raising further questions about the legality of using this tool during the recruiting process. Employers utilizing Social networking sites are recruiting an array of workers or attracting more prospects. Because social media sometimes lacks both validity and dependability, employers should take the veracity of the material obtained into account. Due to a dearth of study, it is yet unknown how social networking sites will ultimately affect the employment process. However, given the facts of the situation, more companies are going to keep following this trend. As a result, employers need more information on this practice to assess its true impact on the recruiting process. Finally, it's important to reiterate that the study offered mostly focuses on employers in industrialized nations.

Future Implications and Advice

Despite the expansion of social networking site recruitment, businesses must expand their social media hiring procedures because certain employees do not use social media for employment. According to the paper, the majority of organizations only use their websites, thus to effectively recruit fresh talent, they must also make use of other channels like job fairs, newspapers, job portals, and social media. The majority of businesses only use LinkedIn for recruiting purposes as opposed to other social media platforms. Therefore, businesses should use additional platforms like Facebook, Instagram, Twitter, etc. Companies should focus on social media platforms that enable interaction with their target audience and make it simple to determine whether a candidate is an appropriate cultural match for the organization. Social media platforms may be effectively used by businesses to recruit employees, as they help to better match applicant skills with job needs and raise the profile of their company's image. Additionally, while social media job boards and referrals recruiting are completely free, employers can reach prospects faster and at less expense using social media.

Employers should use social media to spread information about their organization, attract applicants they might not have found using conventional hiring procedures, and easily connect with passive candidates who don't frequently visit job boards. Consequently, using social media may be your sole chance to connect with them. There are some limitations to social media recruitment. People don't trust social media platforms because of fraudulent job postings and bogus businesses or start-ups. Both job seekers & recruiters have trouble finding candidates. Therefore, it is recommended that there be fair and transparent hiring processes so that employers can identify the best candidates for open positions and that people will regard social media as a reliable hiring tool. The majority of employees believe social media sites are effective for hiring. However, raising public knowledge of social media hiring is crucial.

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EFFECT OF MUSCLE ENERGY TECHNIQUE WITH DIAPHRAGM RELEASE TECHNIQUE ON RESPIRATORY PARAMETER AND CRANIO-VERTEBRAL ANGLE IN FORWARD HEAD POSTURE

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When the head is positioned abnormally forward over the top of the trunk in the sagittal plane, this posture is referred to as a forward head posture (FHP). In this posture on the upper cervical vertebrae (C1–C2) extension occurs, while the lower cervical vertebrae (C3–C7) are made to flex. The aim of this study was to evaluate the effectiveness of muscle energy technique on muscle of myokinetic chain with diaphragm release technique on respiratory parameter and craniovertebral angle in FHP. 60 subjects by convenience random sampling were selected for 2 weeks treatment and treatment was provided according to inclusion and exclusion criteria. The results of present study shows the significant improvements in $M\pm SD$ values of neck disability index, craniovertebral angle, and respiratory parameters in intervention group. The conclusion of study is that the application of muscle energy technique with diaphragm release technique on muscles of myokinetics chains is statistically improve the craniovertebral angle and respiratory parameters in forward head posture.

Keywords: Forward head posture, FHP, Muscle energy technique, MET, Diaphragm release technique.

1. INTRODUCTION:

In modern society due to excessive use of smart-phones and computers changes occur in the normal posture which lead to neck pain, headache, and musculoskeletal disorders which may develop forward Head Posture (FHP) [Jung, S. I.; et al.;2016]. Reading while seated and gazing down at a desk or other horizontal surface, can contribute to FHP development. People may not be aware of their poor posture, so they hold it for extended periods of time. This strained position can lead to further ruptured cervical inter-vertebral discs as well as other negative effects like TMJ (temporomandibular joint) dysfunction and persistent low back pain [Lee, S. M., et al.;2016]. FHP affects the respiratory functions and muscle strength [Kapreli E., et al.; 2009]. In the forward head posture the upper thorax move anterior and lower thorax shift anterior and inferior [Koseki T., et al., 2019]. The angle between a horizontal line across the C7 spinous process and a line connecting the middle of the tragus to the C7 spinous process is known as the craniao-ververtebral angle. [Lau HM., et al.; 2010]. Normal cranio-vertebral angle is 49.9 degrees [Worlikar, A. N.; et al.,2019]. In FHP muscle imbalances occurs, where some muscles, like the pectoralis major, levator scapulae, sternocleidomastoid, anterior scalene, posterior cervical extensor, and upper trapezius, become short or stiff while others, like the deep cervical neck flexor, rhomboid, and serratus anterior muscles, become inhibited or weak [Solakoglu O., et al.; 2020]. Every inch that the head is positioned anteriorly places an additional 10 lbs (4.5 kg) of weight on the cervical spine, which causes problems with the musculoskeletal, vascular, and neurological systems [Kage., et al.; 2016].

The manual diaphragm release technique is an Intervention intended to directly stretch the diaphragmatic muscles fibre thereby increase the chest wall mobility. The manual diaphragm release technique (MDRT) is a procedure designed to improve chest wall mobility by stretch the diaphragmatic muscle fibre [Ricard F., et al.; 2009].

The muscle energy technique (MET) is a soft tissue osteopathic manipulation method developed to improve the function of the musculoskeletal system and reduce pain. Subject participates actively in the treatment through

isometric and/or isotonic contractions of muscles which to be treated [Sumeyye Cildan Uysal., et al.;2018]. It can be used to increase the length of shorten, contracted or spastic muscle; to increase the strength of a physiologically weakened muscle or group of muscles; to reduce localized oedema and to mobilize an articulation with restricted mobility [Toshniwal P, et al.; 2019].

1.1 Aim of the study

To evaluate the effectiveness of MET on muscle of myokinetic chain with diaphragm release technique on respiratory parameter in FHP.

1.2 Objectives

- To evaluate the effectiveness of MET on muscles of myokinetic chain with diaphragm release technique on lung volumes and capacity.
- To evaluate the effectiveness of MET on muscles of myokinetic chain with diaphragm release technique on chest expansion.
- To evaluate the effectiveness of MET on muscles of myokinetic chains with diaphragm release technique on craniovertebral angle.
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1.3 Hypothesis

Alternate Hypothesis

There is may be a significant effect of MET on muscles of myokinetic chains with diaphragm release technique on respiratory parameter in FHP.

Null Hypothesis

There is may not be a significant effect of MET on muscles of myokinetic chains with Diaphragm release technique on craniovertebral angle and respiratory parameter in FHP.

2. LITEATURE REVIEW

A study was carried out in 2015 to assess the forward head posture in sitting and standing situations by *Shaghayegh Fard B et al* this study compared the craniovertebral angle (CVA) between a healthy group and a group of FHP in both sitting and standing positions. In this case-control study, 25 normal people (21.9 ± 5 years) and 25 FHP subjects (22.9 ± 2 years) took part. A substantial difference in the CVA between the FHP and healthy groups was revealed by the independent t test's results ($P < 0.001$).

Researchers *Mazieiro D F et al* did a study in 2017 to assess the immediate benefits of diaphragmatic myofascial release in sedentary women on the flexibility of the posterior chain muscles, the range of motion of the lumbar spine, the strength of the respiratory muscles, and the mobility of the chest wall. On 75 sedentary women between the ages of 18 and 35, a randomized, placebo controlled experiment was conducted. The sample was divided into two groups at random; the Intervention group underwent two sessions of diaphragmatic myofascial release therapy, while the control group underwent two sessions of placebo therapy. The findings of this study demonstrate that manual diaphragm release techniques significantly increased chest wall mobility immediately following Intervention.

Joshi R et al, 2022 conducted a study to determine the effects of posture correction exercises and the muscular energy technique (MET) on pain and function in individuals with non-specific chronic neck pain and forward head position. According to this study's findings, muscular energy technique (MET) should be used in the

treatment of non-specific chronic neck pain in people with forward head position since it produces noticeably better improvements than neck range of motion exercises.

Rocha T et al conducted study in 2013. It was determined that Manual Diaphragm Release Technique improves respiratory muscle functionality (strength and mobility), inspiratory capacity, and exercise performance in COPD subjects after evaluating the effects of the technique on diaphragm mobility, chest wall kinematics, and functional exercise capacity.

3. RESEARCH METHODOLOGY

Study design was Randomized controlled trial. The study was approved by departmental research committee (DRC) via letter number PTY/2022/1440 dated 30/11/2022. The study was also approved by the institutional ethical committee (IEC) of Guru Jambheshwar University of Science & Technology via letter number PTY/2023/174 dated 11/4/2023. The study duration was 2 weeks. The sample size was randomly allocated.

Sample size was 60 subjects by convenience random sampling. **The inclusion criteria** was subjects with cranio-vertebral angle less than 49.9 degree, age between 20-35 years old, who are not receiving any treatment for forward head posture and both the genders were included in the study. Subjects were **Excluded from study** who were taking Medical/health care for neck, shoulder, or lower back pain over the past year, musculoskeletal pain, body mass index (BMI) >30, orthopaedics problems like arthritis, neurological problems like significant cognitive deficit, severe peripheral neuropathy, any associated co morbidity like cardiac and pulmonary disease, any associated pathological disease and malignant disease and any psychological disorders.

Procedure The 60 subjects who had FHP with CVA<49.9° measured with Kinovea.Setup.0.8.15 After selection of subject according to criteria a written informed consent was taken from subject. All subject divided into group 1 was intervention group (received diaphragmatic release technique and MET on muscles of myokinetic chain) and group 2 was control group (received sham treatment) for 2 weeks. Each session was approx. for 40-55 minutes. The entire outcome measured at baseline than after the intervention. **Respiratory parameters measured** Using Spiro Excel software. Photograph was taken in lateral view to measure the **cranio-vertebral angle**. The subject was asked to sit on a chair in a relaxed position and making cervical spine to be relaxed. Subject was instructed, to flex and extend the head three times and then rest it in a comfortable position. Then C7 spinous process was identified by palpation with active flexion and extension and tragus of ear marked with black marker. During analysis two points were marked with the black marker, one was on 7th cervical spine and second was on tragus of external auditory meatus in order to find the points in the photos. Clear photograph of the subject's was taken and uploaded on the software for the analysis. The **neck disability index** measured by using a self-rated disability questionnaire. Chest expansion measured using tailoring measuring tape. Diaphragm Release Technique applied with subject in supine position with forearms pointing in the direction of the subject's shoulders, the therapist positioned themselves at the subject's head and established physical contact with the pisiform, hypothenar area, and the last three fingers bilaterally to the underside of the seventh to tenth rib costal cartilages. The therapist gently pulled the points of contact with both hands during the inspiratory phase, moving them slightly laterally and in the direction of the head also raised the ribs. A deeper contact was made with the inner costal margin during exhale while resistance was maintained. The therapist gradually widened the depth of touch within the costal margin throughout the following respiratory cycles. The manoeuvre was carried out in two sets of 10 deep breaths each, separated by a minute. For MET, the subject was instructed to exert about 20% of his strength. The subject was instructed to hold their breath throughout the 7 seconds that this isometric contraction was maintained before being allowed to relax and let out their breath. The muscle was stretched to its

new length during the relaxation time, and the stretch force was sustained for 10 seconds. Over the course of two weeks, the treatment was repeated at least three times per session [Toshniwal P, *et al.*; 2019].

3.1 Results

The demographic data, pre and post values of NDI, CVA, PFR, FVC and FEV₁ were recorded. A total of 30 participants of mean age 26.03 year (± 4.18) years, mean height cm 168.76 cm (± 6.01) and 67.5 Kg (± 5.77), kg of mean weight and mean BMI 23.69 (± 1.40) were taken through the random sampling and were divided into 2 groups.

Table 1.1: Analysis of NDI, CVA, PFR, FVC and FEV₁ variables (before and after) within group 1 and group 2.

Variables		N	Mean	Std. Deviation	t-value	p-value
NECK DISABILITY INDEX	PRE	30	22.9	3.2	14.4	0.0001*
	POST	30	9.3	4.06		
CRENIOVERTIBRAL ANGLE	PRE	30	46.7	2.03	8.54	0.0001*
	POST	30	51.2	2.05		
PEAK FLOW RATE	PRE	30	7.36	0.71	4.57	0.0001*
	POST	30	8.12	0.57		
FORCE VITAL CAPACITY	PRE	30	4.23	0.36	4.89	0.0001*
	POST	30	4.59	0.18		
CHEST EXPANSION	PRE	30				
	POST	30				
FLOW EXPIRATE VOLUME IN 1 SC.	PRE	30	3.34	0.56	3.64	0.0001*
	POST	30	3.84	0.5		

The standard deviation of NDI in intervention group, pre intervention 3.2 and post intervention 4.06 and p value was 0.0001, CVA in intervention group, pre intervention 2.0 and post intervention 2.05 and p value was 0.0001, peak flow rate in intervention group, pre intervention 0.71 and post intervention 0.57 and p value was 0.0001, FVC in intervention group, pre intervention 0.36 and post intervention 0.18 and p value was 0.0001 and FEV₁ in intervention group, pre intervention 0.56 and post intervention 0.5 and p value was 0.0001. The result of within group comparison showed significant improvement in NDI, CVA, peak flow rate, FEV, FEV₁ in intervention group.

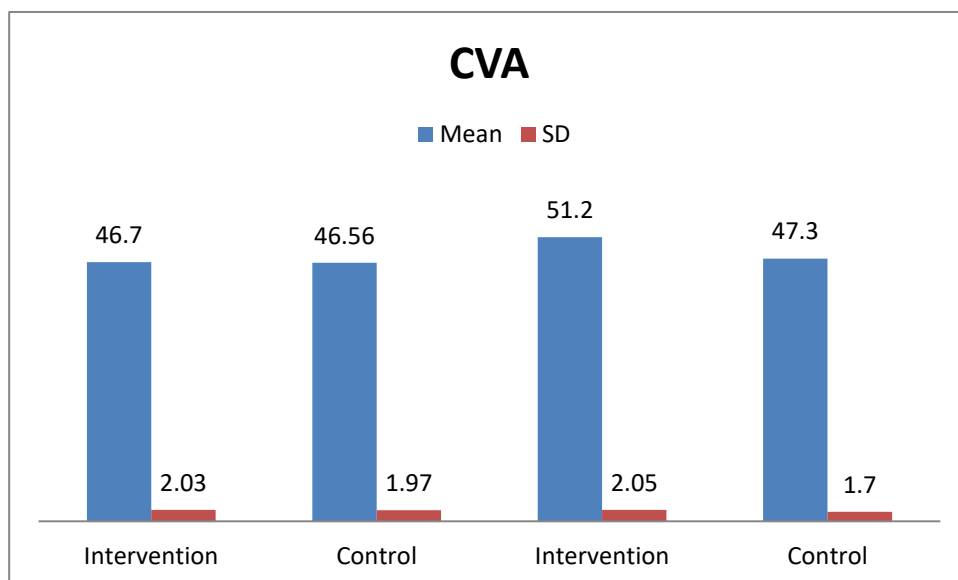


Figure 1 show significant improvement in CVA after the intervention

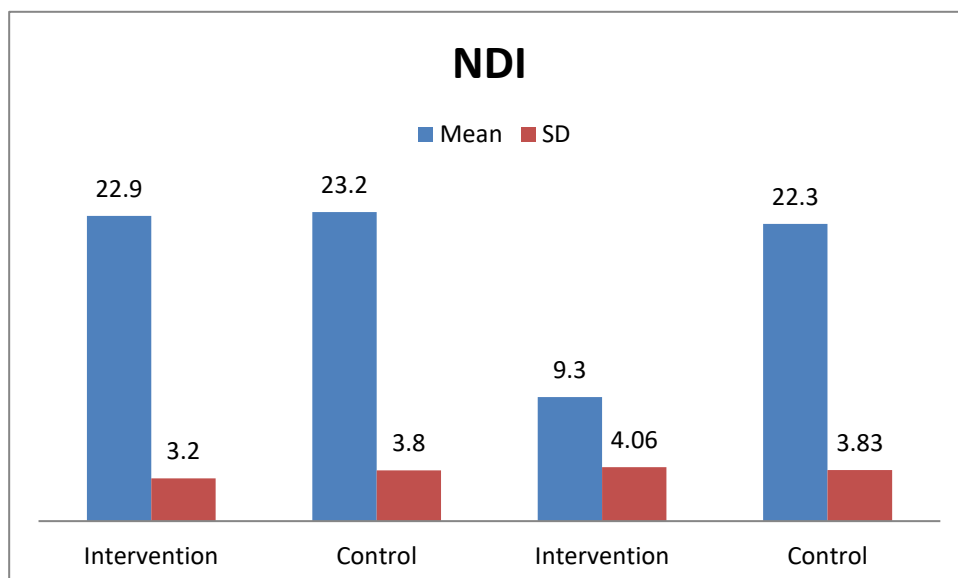


Figure 2 show significant improvement in NDI after the intervention

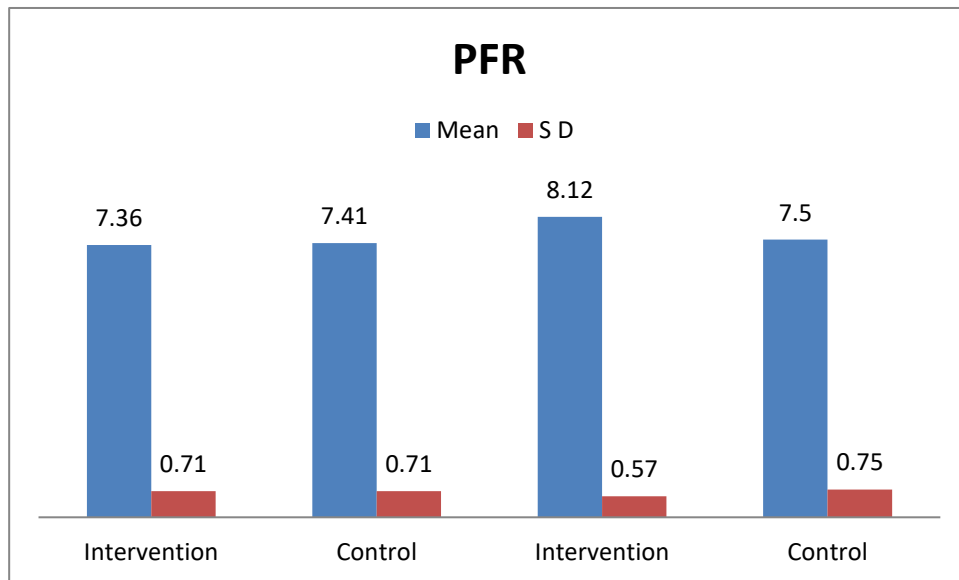


Figure 3 show significant improvement in PFR after the intervention

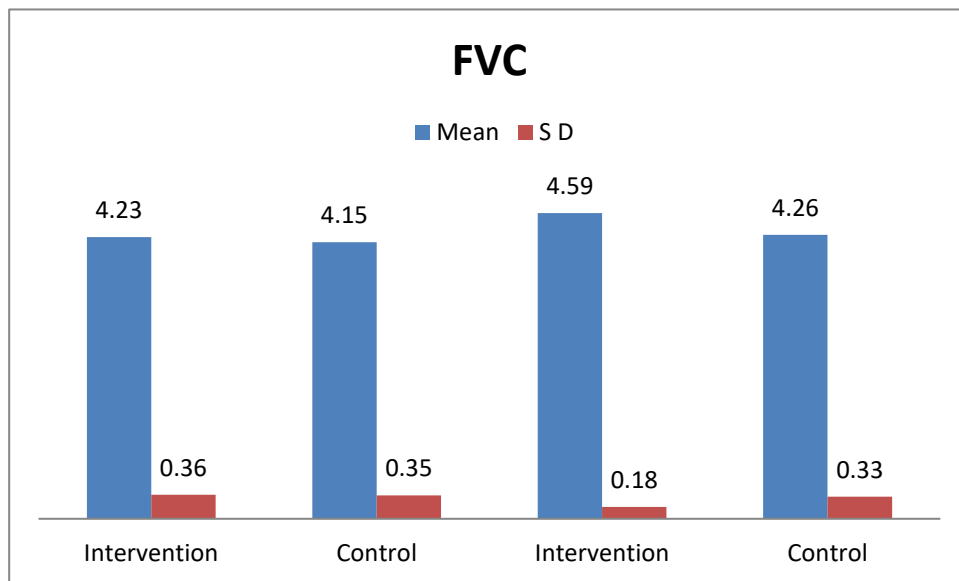


Figure 4 show significant improvement in FVC after the intervention

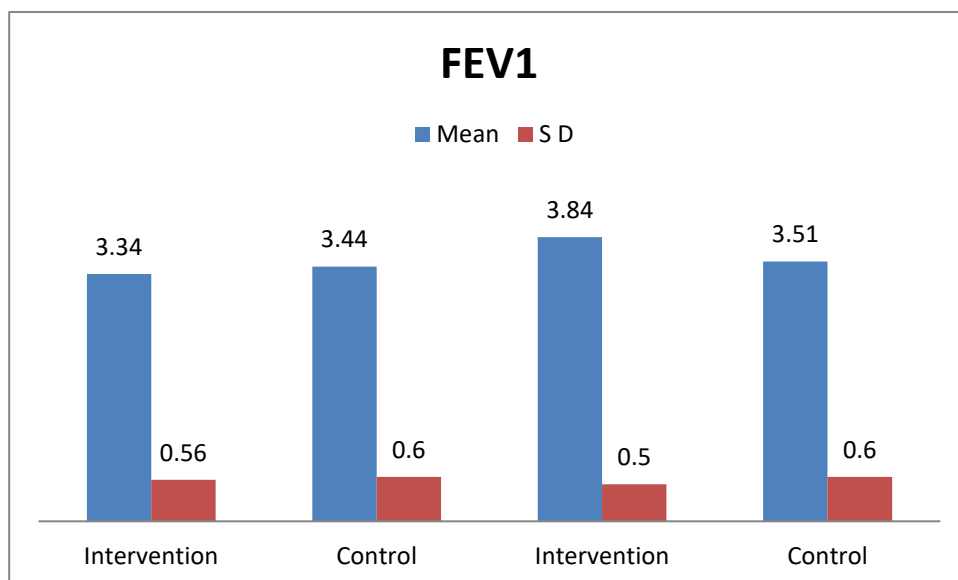


Figure 5 show significant improvement in FEV1 after the intervention

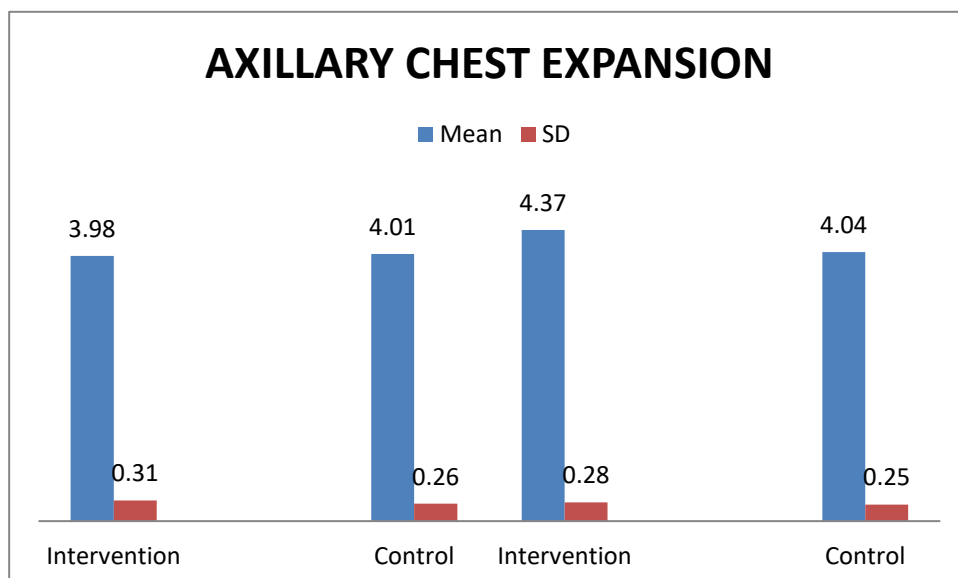


Figure 6 show significant improvement in axillary chest expansion after the intervention

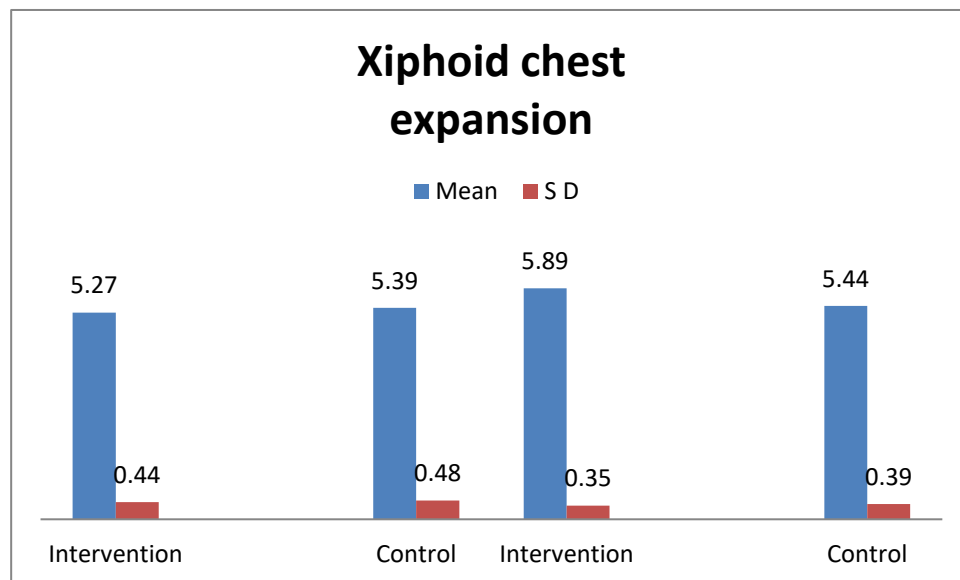


Figure 7 show significant improvement in xiphoid chest expansion after the intervention

3.2 Discussion

The purpose of this study was to determine the effect of muscle energy technique with diaphragm release technique on craniovertebral angle and respiratory parameters in forward head individuals. The results of this study showed that the application of muscle energy technique on muscles of myokinetic meridians improve the forward head posture. MET application on muscles of myokinetics chain significantly improves the craniovertebral angle in forward head.

Chiu et al reported that maintaining a FHP for a long period of time increases the load on noncontractive structures, causing abnormal stress on the extension muscle in the posterior craniocervical area, which can lead to myofascial pain. *Haytham M. et al.; 2023* Have also demonstrate that muscle energy technique can be conceded as essential technique in treatment of forward head posture, as it improves craniovertebral angle, shoulder angle, pain intensity and pain pressure threshold in subjects with forward head posture. There was another study by *Joshi R, Poojary N, (2022)*: "The Effect of Muscle Energy Technique and Posture Correction Exercises on Pain and Function in Patients with Non-specific Chronic Neck Pain Having Forward Head Posture-a Randomized Controlled Trail" also show the significant results of muscle energy technique on CVA. Their findings indicated that muscle energy technique should be used in the treatment of non-specific chronic neck pain in those with forward head posture since the combined effect of MET and posture correction exercises gives noticeably larger benefits than neck range of motion treatment.

Results of our study also show a greater significant improvement in the diaphragm mobility, chest wall excursion and respiratory parameters. *Nair A et al 2019* also show significant results of diaphragm release technique in that study which was conducted to compare the effects of diaphragmatic stretch and manual diaphragm release technique on diaphragmatic excursion and chest expansion in patients with COPD. Results of this study showed that diaphragm release technique significantly improve the chest expansion.

Strength of present study is that this is the first study determining the effect of muscle energy technique with diaphragm release technique on craniovertebral angle and respiratory parameters in forward head posture individual. This study involves application of muscle energy techniques on myokinetic chain and their effect on forward head posture and respiratory parameters.

A limitation of this study is that this study was conducted on small sample size without any sample size calculation methods. MET is applied on selected muscle of myokinetic meridians

Additionally, further researches should be done on large sample size. To further explore the effectiveness of MET and diaphragm release on respiratory function and chest expansion one and more than one meridian should be selected to managing the forward head posture effectively.

4. CONCLUSION

It can be concluded that the application of muscle energy technique with diaphragm release technique on muscles of myokinetics chains is statistically improve the cranio vertebral angle, neck disability index and respiratory parameters in forward head posture.

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EFFECT OF PNF & MET ON LOW BACK PAIN WITH TIGHT HAMSTRINGS IN FEMALE GYM GOERS

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Background: Hamstring tightness affects the lumbar pelvic rhythm. Proprioceptive neuromuscular facilitation (PNF) and Muscle energy technique (MET) improve hamstring length, pain and discomfort.

Methods: A total of 30 females of mean age 28.467 ± 5.704 years, height 162.391 ± 4.853 cm and 63.2 ± 10.489 kg of weight were taken and divided into 2 groups (PNF, n=15 and MET, n=15). The VAS, the Berg Balance Scale and the Manual Muscle Testing were measured at the baseline visit.

Results: The standard deviation of VAS in PNF group, pre intervention .915 and post intervention .915 and p value was <0.05 and the standard deviation of BBS in PNF group, pre intervention 2.92 and post intervention 2.712 and p value was <0.05 which shows the results is not significant. The results also shows that the standard deviation of VAS in MET group, pre intervention .915 and post intervention .915 and p value was <0.05 and the standard deviation of BBS in PNF group, pre intervention 2.92 and post intervention 2.712 and p value was <0.05 which shows that there was a significance difference were made.

Conclusion: The study concluded that MET should be used for people who have tight hamstrings because it significantly reduced tightness, discomfort, and balance when compared to PNF stretching.

Keywords: Hamstring tightness, PNF, MET, LBP, Gym

1. INTRODUCTION

Proprioceptive Neuromuscular Facilitation (PNF) stretching have been demonstrated to increase both active and passive ranges of motion while also increasing muscle elasticity. Autogenic inhibition, reciprocal inhibition, stress relaxation, and the gate control theory are the four hypothesised physiological processes for enhancing ROM. The Golgi tendon organs (GTOs) in the tendons of the Target muscle or in the antagonist muscle to the Target muscle detect damaging stimuli (such as a stretching sensation or during a contraction), which triggers each of these proposed mechanisms. Autogenic inhibition occurs because of inhibitory signals given by the same muscle's GTOs, autogenic inhibition, which takes the form of a decrease in excitability, happens in a contracted or stretched muscle. Reciprocal inhibition occurs when the opposite muscle is deliberately engaged, the target muscle experiences reciprocal inhibition, which manifests as a decrease in brain activity. The target muscle relaxes as the opposing muscle contracts to increase its contraction force. Stress relaxation occur when the musculotendinous unit (MTU), which consists of the muscles and their linked tendons, is under constant stress. The gate control theory occurs when two different stimuli, like as pressure and pain, simultaneously activate their respective receptors (Hindle KB *et al.*, 2012).

Another technique used for stretching is Muscle Energy Technique (MET), a manual technique created by osteopaths, is currently used in physiotherapy, massage therapy, and athletic training facilities, among other physical treatment disciplines (Jaiswal PR *et al.*, 2022). Developed by Fred Mitchell, Sr. and Jr. to treat soft tissue, move stiff joints, stretch constrictive muscles and fascia, alleviate pain, and enhance lymphatic drainage

and circulation. A manual therapy procedure known as a MET is one in which the patient contracts in a carefully controlled position and direction in opposition to a counterforce applied by the manual therapist. The execution of MET is typically carried out with lower forces than those of PNF in order to recruit tonic muscle fibres that are associated with tonic motor units, which require lower action potentials to be recruited than phasic muscle fibres. This could be argued to be similar to PNF. These latter are activated during PNF and frequently take place at forces more than 25% of the individual's maximum force. Another distinction between MET and PNF is that, the contraction is carried out at the first point of tissue resistance rather than at the conclusion of a joint's range of motion in MET (Thomas E *et al.*, 2019). MET is said to strengthen muscles, lengthen shorter or constricted muscles, act as lymphatic or venous pumps to help drain blood or fluid, and increase the range of motion (ROM) of restricted joints. The MET has been shown to be more beneficial than static stretching since it reduces pain and discomfort and typically results in more changes, either short-term or long-term, in the target tissue. The increased stretch tolerance following the contract-relax exercise programme may be the cause of the increased range of motion. MET has been shown to be effective in reducing lumbopelvic pain as one of the interventions and in reducing the disability in acute low back pain when combined with resistance training and neuromuscular re-education (Jaiswal PR *et al.*, 2022).

Low back problems may have increased as a contributing factor of hamstring stiffness (Masood K *et al.*, 2020). According to clinical observations, hamstring tightness affects the lumbar pelvic rhythm. Movement limitations or postural asymmetries probably cause the lumbar spine to move in a compensatory manner, which in turn increases stress on the spinal soft tissues and raises the risk of low back pain (LBP). More than 80% of the people have low back pain (LBP), at some point in their lives, making it one of the most frequent musculoskeletal complaints. The primary factor for years lived with a disability (YLDs) is this ailment (Jandre Reis FJ *et al.*, 2015).

As hamstring tightness affects the lumbar pelvic rhythm, which increases stress on the spinal soft tissues and causes low back pain (LBP). Also, impairment of postural control in low back pain patients highlight the increased postural instability in these patients as a result of disorders of lumbar and spinal muscle strength, coordination etc. Many studies indicates that PNF & MET lengthen the hamstring, builds muscle and increase the range of motion of restricted joints. So, the significance of this study is to reduce pain, increase strength and improve the Quality of Life of female gym goers who are struggling with chronic low back pain with tight hamstrings. Postural stability to the females is provided by improving balance.

1.1 Aim of the Study:

The aim of the study is to examine the effect of PNF & MET on female gym goers in low back pain with tight hamstrings.

1.2 Objectives of the study:

To evaluate:

- The effect of PNF on Low Back Pain.
- The effect of PNF on Balance improvement.
- The effect of PNF on Strength.
- The effect of MET on Low Back Pain.

- The effect of MET on Balance improvement.
- The effect of MET on Strength.

1.3 Alternate Hypothesis:

There may be the effect of PNF and MET on female gym goers in low back pain with tight hamstrings.

1.4 Null Hypothesis:

There may not be any effect of PNF and MET on female gym goers in low back pain with tight hamstrings.

1.4 Significance of the study:

As hamstring tightness affects the lumbar pelvic rhythm, which in turn increases stress on the spinal soft tissues and causes low back pain (LBP). Also, impairment of postural control in low back pain patients highlight the increased postural instability in these patients as a result of disorders of lumbar and spinal muscle strength, coordination etc. Many studies indicates that PNF & MET lengthen the hamstring, builds muscle and increase the range of motion of restricted joints. So, the significance of this study is to reduce pain, increase strength and improve the Quality of Life of female gym goers who are struggling with chronic low back pain with tight hamstrings. Postural stability to the females is provided by improving balance. This study has no harm to the society.

2. REVIEW OF LITERATURE

- Gunn LJ *et al.*, 2019 proposed a study on Instrumented Assisted Soft Tissue Mobilization and Proprioceptive Neuromuscular Facilitation technique improve hamstring flexibility better than static stretching alone: a randomized clinical trial. The total number of individuals recruited was 48. N = 17 (11 males and 6 females) in the IASTM investigation. N = 23 for the PNF study (7 males and 16 females). In the PNF trial, participants ranged in age from 21 to 65 (32 ± 14.2 , mean \pm SD), while in the IASTM study, participants ranged in age from 20 to 30 (24 ± 2.0). Using a passive straight leg raise (IASTM) or an active straight leg raise (PNF), the hip flexion range of motion was assessed both before and after stretching. Participants stretched their own limb in a self-static position while receiving the alternative treatment on the opposite leg. IASTM or PNF to one lower extremity and SS to the other lower extremity were the two therapies that each participant received. When measuring the lower extremity, the inclinometer was “zeroed out”. Wilcoxon signed-rank test was used instead of a paired t-test. The intraclass correlation value for hip flexion measurements was 0.97 in both investigations, and the smallest detectable change was 4.26. The interactions between time and intervention were significant in both trials ($p < 0.05$). PNF and IASTM therapies led to higher gains in hip flexion range than static stretching, according to follow-up analyses. These results show that PNF and IASTM treatments are superior to static stretching for hamstring flexibility. When compared to an identical static stretching programme, these interventions offer more effective alternatives for increasing flexibility in the clinic and enable faster development.

- Shamsi M, Mirzaei M, Shahsavari S, Safari A, Saeb M 2020 proposed a study for modelling the effect of static stretching and strengthening exercise on balance in low back pain with shortened hamstrings: a randomized controlled clinical trial. The three groups—static stretching ($n = 15$), strengthening training in the extended hamstring position ($n = 15$), and control ($n = 15$)—were assigned to 45 patients by a block randomization procedure. 15 patients out of 49 were female, or 31%. The mean age was 37.73 years ($SD = 11.4$). Patients

included were between the ages of 18 and 60, experiencing non-specific LBP for more than three months, VAS pain level of 3 to 6, evident hamstring muscle shortening, and pain intensity of 3 to 6 overall. All three groups received the same traditional physiotherapy regimen, which included 15 minutes of heat therapy (hot pack) and 15 minutes of transcutaneous electrical nerve stimulation (high frequency TENS) to the low back. With the individuals lying on their backs with their knees completely extended, the first group underwent passive static stretching (SS) of the hamstring using a spring for three sets of two minutes each and two minutes of rest in between. The subjects in the second intervention group, known as the strengthening in lengthened position (SLP) group, extended their hips against a spring while seated on a chair with their thighs supported on a surface and their knee joints fully extended. In control group only TENS and hot pack is provided. Each group underwent three therapy sessions over the course of a week, for a total of 12 sessions. Each participant underwent the Y-Balance test in three different reach directions to check their balance. The findings demonstrate that participants in the static stretching exercise improved their balance more than the control group, according to the GEE model, when other variables were controlled ($\beta = 9.58$, p -value = 0.014). Additionally, the balance state significantly improved at study's end compared to baseline (P -value = 7.71, 0.001). Additionally, there was a substantial increase in balance in all three reach directions, with the anterior reach direction showing the highest improvement (varied from $\beta = 6.16$ to 11.59). The patients' height also had an impact on their balance ($\beta = 0.28$, P -value = 0.034). They concluded that in low back pain patients with hamstring tightness, static stretching exercise improved dynamic balance more effectively than muscle strengthening exercise in a prolonged position.

- Masood K, Riaz H, Ghous M, Iqbal M 2020 proposed a study to state comparison between dynamic oscillatory stretch technique and static stretching in reduced Hamstring flexibility in healthy population: a single blind randomized control trial. Among the 83 participants ranging from age 20 to 40 years, 42 (%) belonged to group 1 with an average age of 24.22 ± 4.09 years, and 41 (%) to group 2, with an average age of 25.85 ± 3.93 years. Young, healthy people with tight hamstrings were randomly assigned to groups 1 and 2, with the first receiving exposure to oscillatory stretching, and the latter receiving exposure to static stretching. Using a valid clinical measuring technique and a quantitative pain rating scale, it was determined how painful it was to stretch the hamstrings during a passive straight leg raise. A dominating tightness in the left hamstring muscles was present in 27 (67.5%) members of the Dynamic Oscillatory Stretch group and 31 (77.7%) members of the Static Stretching group. Measurements were made at the baseline, right away (10 minutes), and an hour after the intervention. In comparison to group 2 at post-intervention examinations, group 1 significantly improved in both hamstring flexibility and subjective pain indicators ($p < 0.05$). In conclusion, it was discovered that dynamic oscillatory stretching approach outperformed static stretching technique in terms of increasing hamstring flexibility and pain threshold.

- Jaiswal PR, Qureshi I, Phansopkar PA 2022 proposed a study on the effectiveness of Mulligan's Two-Leg Rotation versus Muscle energy technique in subjects with tight hamstring. An intervention with a six-day per week duration was planned to compare TLR to MET. The following were employed as outcome measures: lumbar range of motion (LROM), active knee extension (AKE), modified Oswestry disability questionnaire (MODQ), and numerical pain rating scale (NPRS). The investigation lasted for six months. Total of 30 participants were included and were divided into two equal groups (15 each). Group A received TLR (Mulligan's two-leg rotation) and Group B received MET (muscle energy technique). For Group A the mean and standard deviations are 31.60 ± 5.51 and for Group B the mean and standard deviations are 27.06 ± 5.94 . Descriptive and inferential statistics, as well as Student's paired and unpaired t-tests, were used to conduct the statistical analyses. Statistical Package for Social Sciences (SPSS) version 27 (IBM Corp., Armonk, NY, USA) SPSS 27.0 was used for the study, and a p -value of 0.05 was considered significant. To determine which treatment reduced hamstring tightness and

improved hamstring flexibility, increased lumbar range of motion, and decreased discomfort, the findings of groups A and B were compared. The pre- and post-scores for groups A and B were compared using a paired t-test. An unpaired t-test was used to assess the post-mean differences between groups A and B in terms of their values. They concluded that the results of the data analysis indicate that TLR should be used for people with hamstring tightness since, when compared to MET, it significantly reduced tightness and pain.

- Alshammari F, Alzoghbieh E, Kabar MA, Hawamdeh M 2019 proposed a study on a novel approach to improve hamstring flexibility: a single-blinded randomized control trial. A total of 60 volunteers between the ages of 18 and 24 were enrolled, and three therapy groups were randomly assigned to them. Using a straightforward goniometer, the range of motion of the knee was measured with the hip in 90° of flexion to determine the degree of hamstring flexibility. A passive hamstring stretch (PS) was given to participants, followed by two sets of 10 repetitions of the tibial nerve neurodynamic technique (ND), three sets of 10 repetitions of the active knee extension-quadriceps activation (QA), or just a passive hamstring stretch (PS). Statistical Package for the Social Sciences version 21 was used to analyze the data. In comparison to the PS group, the QA group's hamstring flexibility significantly increased $13.4 \pm 12.1^\circ$ vs. $6.2 \pm 6.4^\circ$, $p = 0.05$). In the PS group, hamstring flexibility increased by $6.2^\circ \pm 6.4^\circ$ ($30.5^\circ \pm 10.8^\circ$ vs. $36.6^\circ \pm 9.5^\circ$, $p = 0.001$), in the ND group by $9.3^\circ \pm 6.2^\circ$ ($26.7^\circ \pm 10.9^\circ$ vs. $36.0^\circ \pm 9.5^\circ$, $p = 0.001$), and in the QA group by $13.4^\circ \pm 12.1^\circ$ ($20.3^\circ \pm 9.0^\circ$ vs. $33.4^\circ \pm 8.9^\circ$, $p = 0.001$). The PS and ND approaches do not appear to be as effective as activating the quadriceps after passively stretching the hamstrings.

- Jandre Reis FJ, Macedo AR 2015 proposed a cross-sectional study on the Influence of Hamstring tightness in Pelvic, lumbar and Trunk Range of Motion in Low Back Pain and asymptomatic Volunteers during Forward Bending. 67 people were selected for the sample out of convenience. 26 females and 41 males, with a combined average age of 28.2 years, made up the sample. Males' average weight and height were 78.5 kg (SD = 8.7 kg; $x_{\min} = 63$ kg, $x_{\max} = 96$ kg) and 1.77 m (SD = 0.05 m; $x_{\min} = 1.67$ m, $x_{\max} = 1.92$ m), respectively. Females had the following values: 1.62 m ($x_{\min}=1.54$ m, $x_{\max}=1.76$ m; SD, 0.05 m), and 60.8 kg ($x_{\min}=50$ kg, $x_{\max}=75$ kg; SD, 6.8 kg). The active knee extension (AKE) test, which may be self-monitored, was used to gauge hamstring muscle tightness. The Pelvic Tilt, Trunk Flexion's and Lumbar Motion forward bending range of motion was measured using a bubble inclinometer. The statistical study comprised descriptive data, group comparisons, and a correlation between anterior PT, TF, and regional LM and hamstring tightness (AKE) with $p \leq 0.05$. They found that the mean AKE for all participants was 115.5° for Trunk Flexion, 50.0° for Lumbar Motion, and 65.1° for Pelvic Tilt. The mean AKE for the right knee was 155.2° and the left knee was 154° . They concluded that the range of motion in the pelvis and Trunk Flexion was restricted in participants with Low Back Pain, but the lumbar spine's amplitudes during forward bending were larger.

- Yu S *et al.*, 2022 proposed a study to investigate the gender difference in effects of proprioceptive neuromuscular facilitation stretching on flexibility and stiffness of hamstring muscle. 30 wholesome college students [15 males and 15 females, age 21.13 ± 0.35 years, height 1.73 ± 0.04 m, weight 61.33 ± 5.97 kg, and body mass index (BMI) 20.26 ± 1.73 kg/m²; females, age 21.27 ± 0.80 years, height 1.59 ± 0.05 m, weight 51.31 ± 7.42 kg, and BMI 20.30 ± 2.53 kg/m²] are selected. This study used healthy volunteers in a self-controlled trial. Before and right away after stretching, the Straight Leg Raise test, Range of Motion of the hip joint, and muscle stiffness in the lower limbs were all measured. The muscles of the dominant leg were tested for stiffness, including the biceps femoris (BF), semitendinosus (ST), medial gastrocnemius (MG), lateral gastrocnemius (LG), and soleus (SOL). They found a statistically significant difference between the SR test before and after stretching was observed ($F = 24.268$, $p = 0.001$). The results of the SR test for genders did not change with stretching time, and

there was no relationship between gender and time. The improvement in the SR test did not differ between the male and female groups ($F = 0.172$, $p = 0.681$). Throughout the trial, there was a substantial sex impact, with females outperforming males in terms of flexibility ($F = 18.487$, $p = 0.001$). Also, male and female ROM performance before and after PNF stretching. $F = 68.444$, $p < 0.001$ showed that there was a statistically significant difference between the mean ROM before and after stretching. Gender and time had no association, and neither gender's mean ROM altered as the stretching time increased. Between the male and female groups, there was no difference in the improvement of ROM ($F = 2.118$, $p = 0.157$). Females showed larger hip ROM than males did at each time point, indicating a significant sex impact persisted throughout the trial ($F = 11.645$, $p = 0.002$) and the reduction in muscular stiffness did not differ between the male and female groups. SO, they concluded that PNF stretching reduced muscle stiffness and increased hamstring flexibility. The triceps surae muscles' stiffness can also be reduced by stretching the hamstrings. Males always have more muscle stiffness than females both before and after stretching. Nevertheless, there was no gender difference in the improvement in stretching.

- Guex K, Gojanovic B, Millet GP 2012 proposed a study on the Influence of hip-flexion angle on hamstrings isokinetic activity in sprinters. Ten top-level sprinters (5 men and 5 women; average age, height, and weight: 21.2 ± 3.6 years, 175 ± 6 cm, and 63.8 ± 9.9 kg) volunteered for this study. Participants engaged in five seconds of the right leg's maximum isometric hamstring contraction at 45 degrees of knee flexion, five seconds of the right leg's maximum concentric and eccentric knee flexion-extensions at 60 degrees each, and five seconds of the right leg's maximum eccentric knee flexion-extensions at 150 degrees each. Between sets, they took a 4-minute break. Hip-flexion angles of 0° and 60° were measured in the first set of measurements, which were carried out simultaneously with another set of measurements. Hip-flexion angles of 0° and 60° were measured during the first set of measurements, which were followed by measurements of 30° and 90° 14 days later. Both sets of measurements were taken at the same time of day. The sequence of assessments was not random. Findings of the study shows no difference in the peak torque of the quadriceps for any condition across all hip-flexion angles, whereas the peak torque of the hamstrings was significantly higher in eccentric conditions at 90° of hip flexion than at 30° and 60° ($p < 0.05$) and was lower at 0° of hip flexion than at any other angle ($p < 0.001$). The hamstrings-to-quad ratio grew as hip flexion grew. With respect to all hip-flexion angles, there was no change in the root mean square of the lateral or medial hamstrings for any condition ($p > .05$). All types of muscle contractions were controlled by the hip-flexion angle; the greater the hip flexion, the greater the peak torque of the hamstrings.

- Messer DJ, Bourne MN, Williams MD, Najjar AA, Shield AJ 2018 proposed a study on Hamstring Muscle Use in Women During Hip Extension and the Nordic Hamstring Exercise: A Functional Magnetic Resonance Imaging Study. In this study, six recreationally active women with mean \pm SD ages of 22.5 ± 5.9 years, heights of 170.5 ± 7.5 cm, and weights of 59 ± 6.9 kg were included. This study underwent a cross-sectional investigation in which functional magnetic resonance imaging (fMRI) on both thighs was performed on six recreationally active women without a history of lower-limb injuries before and right away following five sets of six bilateral eccentric contractions of either the Nordic exercise or the 45° hip extension exercise on both thighs. Pre- and post-exercise scans using fMRI were utilised to quantify transverse (T2) relaxation durations, and the percentage increase in T2 was employed as an indication of muscle activation. In comparison to the Nordic exercise, the 45° hip extension exercise showed a substantially larger biceps femoris long head-to-semitendinosus ratio ($p = 0.028$). The biceps femoris long head, semitendinosus, and semimembranosus all showed a larger increase in T2 following the 45° hip extension exercise ($p \leq 0.001$), as well as semimembranosus and semitendinosus ($p < 0.001$). In comparison to the biceps femoris short head and long head, the semitendinosus

experienced a higher T2 increase during the Nordic exercise ($p < 0.001$) and $p = 0.002$). Despite the fact that the semitendinosus is highly activated during both exercises in women, the Nordic exercise favourably engages that muscle while the hip extension exercise more uniformly recruits all of the biarticular hamstrings.

- Kuszewski M, Gnat R, Sobota G, Mysliwiec A 2015 conducted a study on the Influence of Passive Stiffness of Hamstrings on Postural Stability. A sample of 50 subjects was chosen, and data from 41 people (33 males and 8 women) between the ages of 21 and 29 (mean = 23.3, SD = 1.1) were included. Used was a quasi-experimental repeated measurements ex post facto design. Sampling was chosen to be convenient. Passive knee extension was evaluated in the supine position in stage one of the study to gauge hamstring stiffness. In stage two, the body is positioned on a stabilometric platform while measuring the amount of postural sway in the antero-posterior direction, both with and without visual control. They observed that both the main impact for the groups and the interaction effect for MoS% were not significant, according to the analysis of variance. The repeated factor's main effect is significant $F(1,38) = 17.8$; $p < 0.001$. Between the outcomes on the PKES and MoS% for the two trials, there was no discernible link. According to the findings, it was not possible to say with certainty that hamstring stiffness affects the method employed to maintain postural stability.

- Allam NM *et al.*, 2022 conducted research on correlation between hamstring muscle tightness and incidence of low back pain in female students at Jouf University, Saudi Arabia. The study comprised 100 females with hamstring tightness of at least 15 degrees, their age varied from 18 to 24 years, the mean \pm age and BMI were respectively 20.87 ± 1.19 years and 23.43 ± 4.09 kg/m². 95% of the time, the right side predominated and 5% of people had a left-side bias. The Active Knee Extension (AKE) and Straight Leg Raising (SLR) tests were used to measure hamstring shortening, and the Oswestry Disability Index (ODI) was used to assess the degree of functional disability. According to the findings, the dominant limb was noticeably more flexible during straight leg raising and the AKE than the non-dominant leg. The dominant and non-dominant legs had mean \pm SD AKEs of 25.17 ± 7.1 and 25.93 ± 7.34 degrees, respectively. The dominant and non-dominant legs' mean \pm SD SLRs was 19.83 ± 8.76 and 22.03 ± 9.23 degrees, respectively. ODI was 4.84 ± 5.65 on a mean \pm SD basis. And the AKE and SLR of the dominant side were significantly lower than those of the non-dominant side ($p < 0.05$). The ODI and AKE of the dominant side had a weakly positive non-significant connection ($r = 0.162$, $p = 0.1$), as did the non-dominant side ($r = 0.071$, $p = 0.48$). There was a slight negative non-significant association between the ODI and SLR of the dominant side ($r = -0.29$, $p = 0.77$) and the non-dominant side ($r = -0.53$, $p = 0.6$). Hence, in female students at Jouf University, there was no correlation between the degree of hamstring tightness and LBP.

- Mistry GS, Vyas NJ, Sheth MS 2014 proposed a study on comparison of hamstrings flexibility in subjects with chronic low back pain versus normal individuals. It was a comparative study and a convenience sample of 60 people was drawn, ranging in age from 20 to 60 with 30 patients in each group. Patients in Group A had low back discomfort that persisted despite not receiving any physiotherapy, while Group B consisted of healthy people who were of a similar age and gender. People with a history of knee discomfort spreading outward, a deformed knee, or fractures around the knee joint were eliminated from both groups. Active knee extension testing was used to gauge hamstring flexibility in patients with low back pain lasting longer than three months as well as healthy persons who had not participated in any flexibility programs. The Mann Whitney U test was used to examine the hamstring flexibility for groups A and B. Mean degree of hamstring tightness resulted out to $A=31.63^\circ \pm 8.34^\circ$, $B=14.30^\circ \pm 9.70^\circ$, $U=81.00$, $p < 0.01$. And hence they concluded that the patients with chronic low back pain and healthy, age- and gender-matched people showed a substantial difference in hamstring flexibility.

- Kumar P, Moitra M Efficacy of Muscle Energy Technique and PNF Stretching Compared to Conventional Physiotherapy in Program of Hamstring Flexibility in Chronic Nonspecific Low Back Pain. For the study, 30 male and female participants with chronic nonspecific low back pain and tight hamstrings were recruited. Their ages ranged from 20 to 40. Range of motion (ROM) of the active knee extension test, as determined by the goniometer, and pain intensity, as determined by the numerical pain rating scale (NPRS), were the pre-post outcome measures. A Muscle energy technique (PIR), PNF stretching (Contract Relax) and control group static stretching. The treatments were administered for a total of four weeks on five days each week. The results demonstrated that MET and PNF stretching dramatically improved hamstring flexibility in three groups, significantly reducing low back discomfort and increasing active knee extension range of motion. The study's findings support the use of PNF stretching and muscular energy method. Group A is muscle energy technique, Group B is PNF stretching and Group C is conventional physiotherapy in static stretching. The analysis revealed that there was statistically significant difference between pre and post scores of NPRS and goniometer in all groups. Group B is showing more improvement than group A and C at p value < 0.05 . The mean and standard deviation value of pre NPRS of Group A was 5.1 ± 0.875 , Group B was 5.1 ± 0.875 , and Group C was 5.1 ± 0.875 respectively. No significant difference was found among 3 groups in terms of Pre NPRS. The mean and standard deviation value of post NPRS of Group A was 2.1 ± 0.737 , Group B was 1.3 ± 0.483 , and Group C was 2.5 ± 0.527 respectively. Here, significant difference was found among 3 groups in terms of post NPRS after 4 weeks of intervention. The mean and standard deviation value of pre-ROM of Group A was 121.6 ± 4.467 , Group B was 121 ± 1.886 , and Group C was 122.1 ± 1.524 respectively. No significant difference was found among 3 groups in terms of Pre NPRS. The mean and standard deviation value of post ROM of Group A was 131.5 ± 2.415 , Group B was 134.4 ± 2.366 , and Group C was 130.9 ± 2.961 respectively. Here, significant difference was found among 3 groups in terms of post ROM after 4 weeks of intervention. The findings of this study show that hamstring flexibility can be significantly increased by using the muscular energy technique, PNF stretching, and static stretching. So, it is determined that MET, PNF, and static stretching can be used as an efficient treatment technique to lessen pain, enhance range of motion, and raise flexibility of the tight hamstring in chronic low back patients.

- Youdas JW, Krause DA, Hollman JH, Harmsen WS, Laskowski E 2005 proposed a study on the influence of gender and age on hamstring muscle length in healthy adults. In the study, 214 persons (108 women and 106 men, ages 20 to 79) took part who had no known history of hip or knee joint problems or recent hamstring strain. A goniometer was used to calculate the PSLR (trunk-thigh angle) and PA (thigh-leg angles). To examine the effects of two independent variables—gender and age—on two dependent variables—PSLR and PA. A 2-way analysis of variance (ANOVA) was performed. An alpha of < 0.05 . was used to determine statistical significance. They concluded that for both methods of measurement, HML was significantly different across sexes ($p < 0.001$), with women showing more flexibility than men. For PSLR and PA, the gender gap was 8 degrees, whereas it was 11 degrees. Age has no impact on HML. This study gives physical therapists an idea of what HML levels is typically like in healthy men and women.

- Yıldırım MS, Ozyurek S, Tosun OÇ, Uzer S, Gelecek N 2016 conducted a randomized controlled trial on comparison of effects of static, proprioceptive neuromuscular facilitation and Mulligan stretching on hip flexion range of motion. In this randomized trial, a total of 40 students with bilateral hamstring tightness (mean age: 21.5 1.3 years, mean body height: 172.8 8.2 cm, and mean BMI: 21.9 3.0 kg m⁻²) participated, of whom 26 finished the research. The subjects were split into four groups, each of which used a different stretching technique: (I) standard static stretching; (II) PNF stretching; (III) the Mulligan traction straight leg raise (TSLR) technique; and (IV) no intervention. Two physiotherapists were blinded to the groups and used a digital goniometer to measure

the hip flexion range of motion (ROM) using the passive straight leg lift test before and after 4 weeks. Analysis was done on the 52 extremities of 26 patients. In all three intervention groups ($p < 0.05$), hip flexion range of motion increased after four weeks, but not in the group that received no intervention. PNF stretching and Mulligan TSLR technique were found to be superior to conventional static stretching in initial-final evaluation hip flexion ROM differences between groups ($p < 0.001$) ($p = 0.016$ and $p = 0.02$, respectively). Mulligan TSLR technique and PNF stretching did not differ significantly from one another ($p = 0.920$). Hip flexion range of motion (ROM) initial-final assessment differences were comparable with standard static stretching and no intervention ($p = 0.491$). When both hamstrings are tight, a 4-week stretching intervention improves hip flexion range of motion. Instead of standard static stretching, PNF stretching and Mulligan TSLR method are preferable. Hence, stretching can be done for hamstring tightness using any of these two methods.

3. METHODOLOGY

3.1 Procedure

This experimental study was conducted in three gyms namely Burnout Gym and Spa situated in Azad Nagar, Detox Gym situated in Sector-15 and CrossFit Gym situated in Police Line Area which are urban areas of Hisar, Haryana. Total of 30 participants who were suffering from Chronic low back pain for 3 months were included in the study. All participants read and signed the consent form before their participation. Ethical approval was acquired from the Departmental Ethics Committee, Department of Physiotherapy of GJUS&T (Guru Jambheshwar University of Science & Technology) Hisar (PTY/2023/174). Age group- 20-40 years (Masood K *et al.*,2020), only females were included in the study with nonspecific Low Back Pain (LBP) for more than 3 months and pain intensity according to VAS- 3-6 (Shamsi M *et al.*,2020). Hamstring tightness with passive straight leg raise (PSLR) test positive were included.

A total of 30 females with chronic low back pain more than 3 months were selected in this study from urban areas particularly gym goers. The participants were selected between the age group of 20-40 years. The participants were allocated into 2 groups randomly, (15 each group). Final instructions were given to all the participants about the study before starting the procedure.

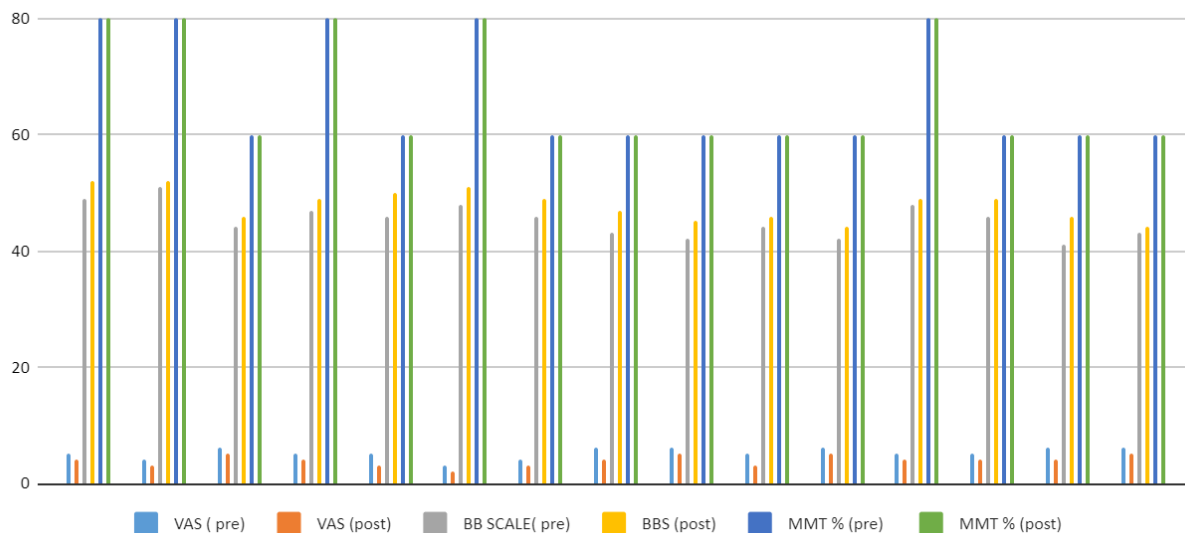


Figure 1: Post intervention Range of Motion of subject

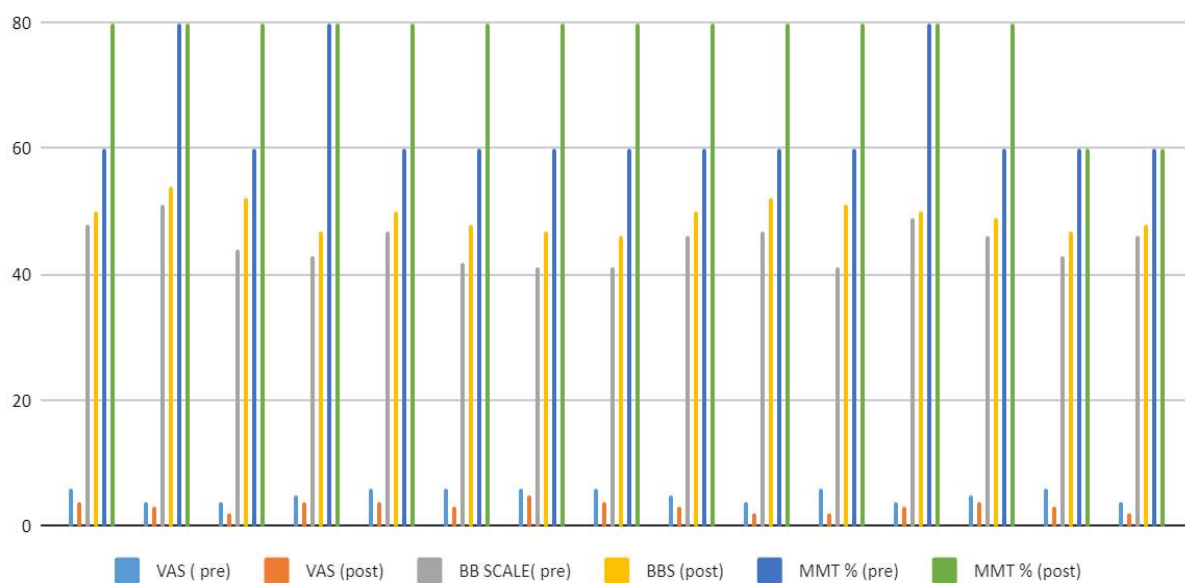
The demographic data, pre and post values of VAS, Berg Balance Scale and MMT were recorded. The entire data was organized in Microsoft Excel, which was then analyzed. Descriptive statistics table and individual descriptive statistics for PNF and MET were made then by using t-test of two sample assuming equal variances the final results were generated. p-value was compared and graphical display for both the interventions (PNF & MET) VAS pre post values of VAS, Berg Balance Scale and MMT are shown by bar graphs and line graphs.

3.2 Results

Our total observations are 30. So, for this particular sample our minimum age is 21years and maximum age is 38years so, the mean age is 28.467 years with the standard variation of 5.704. Now for height, minimum height for our sample is 170.18cm and minimum height is 154.94cm. So, the mean height is 162.391cm with a standard deviation of 4.853. Similarly, for weight minimum weight of the patient is 47 kgs and maximum weight of the patient is 88 kgs so, the mean is 63.2 kgs with the standard deviation of 10.489.



Graph 1: Outcome measures with PNF Variables



Graph 2: Outcome measures with MET Variables

The standard deviation of VAS in PNF group, pre intervention .915 and post intervention .915 and p value was <0.05 and the standard deviation of BBS in PNF group, pre intervention 2.92 and post intervention 2.712 and p value was <0.05 which shows the results is not significant. The results also shows that the standard deviation of VAS in MET group, pre intervention .915 and post intervention .915 and p value was <0.05 and the standard deviation of BBS in PNF group, pre intervention 2.92 and post intervention 2.712 and p value was <0.05 which shows that there was a significance difference were made.

3.3 Discussion

This study was conducted to examine the effect of PNF & MET on female gym goers in low back pain with tight hamstrings. The entire data collected for the study included demographic data, Visual Analog Scale recorded pre

and post intervention similarly Berg Balance Scale pre and post values and Manual Muscle Testing pre and post values. Out of 30 patients belonging to age group 20 to 40 years, their mean and standard deviation was computed for all the demographic characteristics and it was found to be 28.46 ± 5.70 years for age, 162.39 ± 4.85 cm for height, 63.2 ± 10.48 kgs for weight and 24.03 ± 3.61 kg/m² for body mass index (BMI). The result of this study showed that pain and balance are highly affected by hamstrings tightness whereas, there was a minimal change in strength of the musculature. The readings for VAS were found to be 3.53 ± 0.97 post intervention which was 5.13 ± 0.9 pre intervention. Similarly, for Berg Balance Scale the readings post intervention were 48.66 ± 2.56 where as it was 45.16 ± 2.98 pre intervention. So, this definitely shows that the pain is decreased and balance has been improved. In MET (Muscle Energy Technique) group the balance improvement, pain reduction was more than PNF (Proprioceptive Neuromuscular Facilitation) group whereas change in strength was not so much in both the groups but it was slightly more in MET group.

In 2019, study to investigate Instrument-assisted soft tissue mobilization and proprioceptive neuromuscular facilitation techniques improve hamstring flexibility better than static stretching alone, participants stretched their own legs while standing still while receiving the opposing intervention on the opposite limb. According to the findings, with a minimum detectable change of 4.26 and strong reliability (intraclass correlation coefficient = 0.97), hip flexion measurements performed well in both experiments. Time and intervention interacted significantly in both experiments (p 0.05). PNF and IASTM therapies led to higher gains in hip flexion range than static stretching, according to follow-up analyses. (Gunn LJ *et al.*, 2019).

More than merely dynamic stretches are involved in the MET-enhanced hamstring flexibility. In order to increase muscle length, MET uses a combination of mechanical (such as plastic and viscoelastic changes in the connective tissue components of the muscle) and neurophysiological (such as changes in stretching tolerances) variables. Inhibiting Golgi tendon reactions has been linked with MET's effectiveness. According to Thomas *et al.*'s review, MET is helpful in reducing subjective pain, impairment, and joint range of motion in both symptomatic and asymptomatic people. There is also additional evidence that MET is an effective treatment for acute low back pain and improves related disability indices. Results of MET on the hamstring muscle's elasticity in national football teams showed that MET helps to improve hamstring lengthening, which helped them stay injury-free and gain more flexibility (Jaiswal PR *et al.*, 2022).

In 2014, a cross sectional study another study assessing the influence of hamstring tightness in Pelvic, Lumbar and Trunk range of motion in low back pain and asymptomatic volunteers during forward bending. According to the findings, the asymptomatic group had 32 people, while the Low Back Pain group had 36 members. The mean for Pelvic Tilt, Lumbar Motion, and Trunk Flexion in the control group were 66.7° , 64.5° , and 104.6° , respectively. In the symptomatic group, the corresponding values were 57.0° , 79.8° , and 82.2° . The range of motion in the pelvis and Trunk Flexion was restricted in participants with Low Back Pain, but the lumbar spine's amplitudes during forward bending were larger (Jandre Reis FJ *et al.*, 2014).

The limitation of this study was the sample size. Future research should focus on using large sample sizes. It is advised to conduct more research using change in balance as a primary endpoint in order to achieve more satisfying and generalized results. Other potential influencing elements should be searched out and looked into since different existing components may potentially change the equilibrium. Age variety and different outcome measures can also be taken into consideration for future studies.

4. CONCLUSION

In this study, we compared the effectiveness of two widely utilized techniques. In order to examine the effectiveness of the PNF and MET approaches, this research gave both groups the same number of sessions (4

weeks). The results show that MET should be used for people who have tight hamstrings because it significantly reduced tightness, discomfort, and balance when compared to PNF stretching.

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FIELD NOTES ON MARKETING OF GINGER CROP IN HARYANA, INDIA

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The paper aims to analyse the marketing channels of ginger crop in Haryana and highlight the constraints in the marketing of ginger crop and to suggest solutions. The present study tried to analysis the marketing channels, price spread and marketing efficiency of ginger crop in Haryana, India. The study was conducted in Panchkula district of Haryana. To know the marketing efficiency Acharya's Approach have been used in the present study. The study was based on primary data and data have been collected with the help of pre-tested schedule. In the present study mainly, five channels were adopted by ginger producers. The findings depicted that marketing channel-V is the most efficient channel with 44.82 points, followed by channel-IV, III, II, and I. It can be concluded that channel-V provides ginger at the lowest price to consumers and the highest price for producers.

Keywords: Ginger, marketing, price spread, marketing efficiency, Marketing Channels.

1. INTRODUCTION

Agriculture and its allied sectors are the primary and most important source of income for over 58 per cent of India's population. About 70 per cent of rural residents in India still depend on agriculture for their living. The total amount of foodgrains produced in India in 2019–20 was 296.65 million tonnes. India is the largest importer, producer, and consumer of pulses in the world, which shows 27 per cent, 25 per cent, and 12 per cent, respectively. According to the Food and Agriculture Organization of the United Nations (FAO) website, India is the world's second-largest producer of wheat, sugarcane, rice, cotton, groundnuts, fruits, and vegetables. The agricultural sector significantly impacts India's gross domestic product (GDP). Farming, horticulture, logging, hunting, fishing, mining, and forestry are some essential economic sub-segments that grow up the agricultural sector. For the past 20 years, the horticulture sector has played a crucial role in agriculture and the GDP with the help of these subsectors. In this study, specific spice crop (Ginger) from the horticulture sector has been analysed.

Ginger is an important spice crop of India and Haryana. Philip Kotler highlighted that a marketing channel performs the work of moving goods from producer to consumers. India and Haryana both produce significant amounts of this spice. It's called "Adrakh." In the kitchen, it is frequently utilized. Ginger grows best in clay loam or red loamy soils with good drainage. Common varieties of ginger include IISR Varada, IISR Mahima, Karthika, Suprabha, and Suruchi. Green ginger also comes in the Rio-De-Janerio, Varadha, and Dry Ginger: Nadia and Maran varieties. Direct and transplanting methods are employed to plant ginger. It is sown in the first week of May–June. The ginger crop should be cultivated for nearly eight months. Producing new spices are harvested beginning in the sixth month, although the ideal time to harvest is when the leaves become fully yellow and dry out. In the district Panchkula, positive growth rate (significant growth rate) was found in the area, productivity and production during 2001-02 to 2017-18. The area under ginger has been grown at 2.2 per cent per annum. Ginger production grew at 4.5 per cent per annum. The productivity of ginger registered a growth rate of 2.2 per cent per annum (Lal and Rohtas, 2022). Some of the related study of marketing has been discussed under:

2. LITERATURE REVIEW

Chalise *et al.* (2019) studied “Economics of Production of Marketing of Ginger in Sunsari District, Nepal.” The study was conducted at Bishnupaduka (Dharan-20) and Panchakanya (Dharan-6) of the Dharan sub-metropolitan city of Sunsari district. In the study, eighty farmers and twenty traders were selected randomly. Primary data were collected through a well-prepared schedule. Three marketing channels were recorded, viz., farmers-wholesalers-retailers-consumers, farmers-commission agents-wholesalers-retailers and farmers-retailers-consumers in the study. The most common type of marketing channel was Farmers-Wholesalers-Retailers-Consumer (FWRC), followed by 40 per cent of the respondents. 21.20 per cent of respondents followed the marketing channel of Farmers-Retailers-Consumers (FRC), whereas 17.50 per cent of respondents followed the marketing channel of both FWRC and FCWRC. 16.20 per cent followed the FWRC and FRC marketing channels, whereas only 5 per cent followed the marketing channel of Farmers- Commission agents–Wholesalers-Retailers-Consumers. The study found NRs. 27.77 marketing margin of ginger with 80.65 per cent producer’s share. The study also found some marketing problems farmers face: high fluctuation in market price, lack of processing facilities, lack of storage facilities, lack of proper transportation facilities, quality issues, unawareness of market price information, unorganized market and the low market price of ginger.

Kala *et al.* (2020) studied “an economic analysis of marketing and constraints for green chilli in Jaipur district of Rajasthan.” The study was based on primary data collected from the farmers and market intermediaries through a pre-structured schedule by personal interview method for 2017-18. Multistage purposive and sampling procedures were used to select districts, tehsils and respondents. For marketing costs and margins in the marketing of green chilli, five village traders, ten wholesalers-cum-commission agents and 15 retailers were selected randomly. Garrett’s ranking method was used to measure the absolute margin, percentage margin and constraints in the marketing of green chilli. The study revealed that the farmers adopted three types of marketing channels; channel-I (producer—village trader—wholesaler-cum-commission agent—retailer—consumer), channel-II (producer—wholesaler-cum-commission agent—retailer—consumer) and channel-III (producer—consumer). The total marketing costs for the sale of green chilli were higher in channel-I (500.40 per quintal) followed by channel-II (491.34 per quintal) and no marketing cost was involved in channel-III. The village traders, wholesaler-cum-commission agents and retailers received Rs. 158.42 (4.16 per cent), Rs. 205.55 (5.4 per cent) and Rs. 289.05 (7.5 per cent) margin in channel-I and the same margin was received in channel-II. Among the functionaries, retailers got higher margins due to selling green chilli at high prices to consumers. The producer's share in consumer rupee was highest in channel-III than channel-I and channel-II in the sale of green chilli. Major constraints faced by farmers in marketing green chilli were observed as low price, lack of good storage facility in mandi, fluctuation in the market price of produce, difficulty in maintaining quality standards, high transportation cost, imposition of cut in the weight of the produce by the buying firm due to shrinkages of moisture in green chilli and delay in making payment to the farmers for weeks or months.

Dukpa and Ezung (2020) analysed vegetable marketing efficiency in the Phek district of Nagaland. The study was based on primary as well as secondary data. Primary data was collected through the field survey with the help of pre-tested questionnaires and secondary data from various published sources. Three Vegetables, cabbage, beans and potato, were selected for the study due to their significance in production and marketing in the Phek district. Three hundred farmers from twelve villages and 25 from each village were selected randomly. The shepherds market efficiency method and Acharya-Agarwal modified method were used to analyze the related data. The result revealed three marketing channels observed in the study; channel I: producer-consumer, channel II: production-retailer (village traders)-consumers, and channel III: producer-wholesaler (village agents/traders)-consumers. The net price received by farmers in terms of consumer rupee was 92.90 per cent on the marketing of cabbage, 98.99 per cent on beans and 97.41 per cent on the potato for channel-I. In channel-II, the net price

received by the producer in terms of consumer rupee was 54.13 per cent for cabbage, 70.32 per cent for beans marketing and 62.17 per cent for potato marketing. The net price received by producers in terms of consumer rupees was 28.89 per cent on cabbage and 41.87 per cent on potato marketing. The study concluded that, from the marketing efficiency method of Shepherds and Acharya-Agarwal, channel-I was the most efficient marketing channel for the all-selected vegetables.

Verma and Kumar (2015) carried out a study on marketing behaviour of cumin in Jodhpur district of Rajasthan state where cumin is cultivated extensively. The study examined various economic aspects of cumin such as assessment marketable surplus, sale pattern, and channels involved in marketing of cumin. Out of which two tehsils namely looni and falodi were selected on the basis of highest production and area. Six villages were selected randomly from selected tehsils. A sample of sixty cumin growers was selected randomly. The present study based on primary data that were collected from the respondent farmers by personal by interviewing them with the help of a set of pre tested schedule. The marketable and marketed surplus ranged between 95 to 97% on different sized farms. The sample farmers disposed 85.74% surplus cumin seed in the Mandor regulated market and only 14.26% quantity was disposed in the villages to village traders of the surplus cumin seed, 53% was sold in the first quarter immediately after harvest (March to May) and others 47% was marketed in remaining three quarters of the year (Aug. to Feb.). Small sized farmers disposed off their total surplus cumin seed in one lot as against this medium and large sized farmer disposed off their total surplus in two and more lots. Following two marketing channels were identified in the study area for marketing of cumin. Channel I: Producer – Village trader – Wholesaler- Retailer – Consumer. Channel II: Producer –Wholesaler- Retailer – Consumer. Among these channels, 75% quantity of cumin moved through channel –II and 25% quantity were moved through channel-I.

3. RESEARCH METHODOLOGY

Research methodology is a way to solve the research problem systematically. This includes how a researcher plan to tackle things, e.g., sampling design, collection methods, and methods of inquiry. Therefore, the present study consists of a detailed explanation of the methodological point of the study, e.g., selection of district, collection of data, various statistical tools, etc. The present study conducted in Panchkula district of Haryana because this district produced highest average ginger in last five year. This study required primary data. That was collected from spices crop grower farmers through a personal interview method with the help of a well-prepared pre-tested interview schedule for 2020-21. The sample of 80 respondents (who grew spice crops) was randomly drawn from Panchkula district of Haryana. To find out the marketing cost and margins from various channels eighty farmers, twelve village traders, twelve wholesaler, twelve retailer were selected from field/market of selected districts. In this study five marketing channels have been undertaken. Further, for knowing the marketing efficiency, Acharya's Approach have been used in the present study. According to Acharya, an ideal measure of marketing efficiency can be calculated by using the formula:

$$\text{Marketing Efficiency} = \frac{\text{Net selling price of grower}}{\text{Total marketing cost} + \text{Total marketing margin}}$$

The price spread calculated the difference between the price paid by the consumer and the price received by the spice's grower for a similar quantity of farm production. It is expressed in terms of the percentage of consumer rupees through the following formula:

$$\text{Price Spread} = \frac{\text{The price paid by the consumers} - \text{net price received by spices growers}}{\text{The price paid by consumers}} \times 100$$

4. RESULTS AND DISCUSSION

The present section is further divided into three sub-sections as follow:

- 4.1 Marketing channels for ginger crop in Panchkula district of Haryana
- 4.2 Price spread of ginger crop in Panchkula district of Haryana
- 4.3 Marketing efficiency of selected marketing channels for ginger crop in Panchkula district of Haryana
- 4.4 Problems faced by farmers in the marketing of spices crops in Haryana

Marketing channels, price spread, and marketing efficiency of ginger crop have been studied. In the marketing of spices crop (ginger), producers, village traders, whole-sellers (or commission agents), retailers, and consumers were engaged. Before discussing marketing channels, price spread, and marketing efficiency in detail, these intermediaries need to be adequately defined, and definitions are given below:

Producer: Producers of ginger crop are mainly farmers who produce the ginger crop on the farm. He is the primary source of marketing channels.

Village trader: A village trader is the buyer of ginger crop, and he directly buys from the producer at the village level and sells it to the ultimate consumer or wholesaler.

Whole seller (or commission agent): Whole seller or commission agent is a middleman between buyer and seller in the wholesale market, representing either buyer or seller. He usually takes over the physical handling of the product, arranges for its sale, collects the amount from the buyer, takes off his expenses and commission, and sets aside the balance for the seller.

Retailer: The retailer buys spices from the wholesaler or producer at wholesale prices and sells them to consumers at retail prices. Generally, he performs the function of storing and distributing their products to the consumers.

Consumer: The consumer is the ultimate source of marketing channels and the last or ultimate user of spices crops for consumption purposes.

However, all the intermediaries in marketing ginger crop are actively engaged between the producer's space and the ultimate buyer. All the adopted marketing channels describe the way of selling the ginger crop; hence, the journey starts from harvesting ginger crop to the pocket of the ultimate consumer. The details are explained as follows:

4.1 Marketing Channels for Ginger Crop in Panchkula District of Haryana

Marketing channels describe the methods of selling and purchasing the spices crops. It is a journey that starts from harvesting (of ginger crop) to the pocket of the ultimate consumer. Table 1. shows the marketing channels adopted by ginger producers in the Panchkula district of Haryana. Mainly, five channels were adopted by ginger producers. Among the marketing channels operated in the field, the producer is the sole originator of spices crops, and the consumer is the ultimate user of these crops. However, many intermediaries have been functioning between the producers and consumers.

Channel-I has five agents: producer, village trader, wholesaler, retailer, and consumer. The producer is the sole originator of a crop, and the consumer is the ultimate user of that crop. Subsequently, village traders, wholesalers, and retailers are the marketing channels' intermediaries. However, this channel has the longest supply chain. In channel-II, two intermediaries, i.e., wholesaler (through commission agent) and retailer, have been engaged beside the producer and consumer.

Table 1: Marketing Channels for Ginger Crop in Panchkula District of Haryana

Channels	Intermediaries in the Channels
Channel-I	Producer → Village trader → Wholesaler (through commission agent) → Retailer → Consumer
Channel-II	Producer → Wholesaler (through commission agent) → Retailer → Consumer
Channel-III	Producer → Village trader → Retailer → Consumer
Channel-IV	Producer → Retailer → Consumer
Channel-V	Producer → Consumer

Source: Field survey

In the same way, in channel-III, village traders and retailers are engaged between producer and consumer. In channel-IV, the only retailer is engaged between producer and consumer, and retailers purchase the spices crops directly from the producer and sale to the consumer. Finally, in channel-V, there is no engagement of intermediaries between producer to consumer; in this channel, consumers directly purchase the spices crops from producers.

4.2 Price Spread of Ginger Crop in Panchkula District of Haryana

The price spread is the difference between the consumer's price and the producer's net price for the equivalent quantity of spices crops. However, it includes the margin of intermediaries and marketing costs at different levels. Table 2 shows the price spread of ginger crop through marketing channel-I in the Panchkula district of Haryana. The value and cost of production are depicted in Rs. per quintal. In marketing channel-I, the producer, village trader, wholesaler (through commission agent), retailer, and consumer are engaged.

Further, the sale price of the producer or purchase price of the village trader was Rs. 4060.00 per quintal. In the marketing of the ginger crop, the expenses borne by the producer were Rs. 99.00 per quintal. After the deduction of expenses paid by produce (from the sale price of the ginger crop), the net price received by the producer was Rs. 3961.00 per quintal. In the next step, expenses borne by village traders were the cost of gunny bags and sutli charges (Rs. 27.50), weighing (Rs. 6.00), loading & unloading charges (Rs. 15.00), and transportation costs (Rs. 49.75). Hence, the total cost borne by the village trader was Rs. 98.25, and the village trader's margin was Rs. 824.75. Subsequently, the sale price of village trade or purchase price of wholesalers was Rs. 4983 per quintal.

Further, the sale price of the wholesaler or purchase price of the retailer (Rs. 6078.85) contains the purchase price of the wholesaler (Rs. 4993), a margin of the wholesale (Rs. 675.30), and expenses borne by the wholesaler (Rs. 420.55), i.e., marketing fee, commission charges, storage, and spoil during storage.

Ultimately, in this marketing channel, the farm product is supplied by retailers to the consumer. Therefore, the sale price of the retailer or purchase price of the consumer includes the purchase price of the retailer (Rs. 6078.85), net margin (Rs. 1159.70), and expenses borne by the retailer (Rs. 134.45). Hence, the consumer's purchase price was Rs. 7373.00 per quintal.

Thus, the difference between the price paid by the consumer (Rs. 7373.00) and the price received by the producer (Rs. 4060.00) is the price spread (Rs. 3412.00 per quintal). However, the longer the marketing channel of farm produce, the larger the price spread for that farm produce.

Table 2: Price Spread of Ginger crop in Panchkula District of Haryana through Channel-I*(Rs. per quintal)*

Sr. No.	Particulars	Value
1.	Sale price of producers/purchase price of village traders	4060.00 (55.07)
2.	Expenses borne by the producers	
	i. Transportation cost	62.00 (0.84)
	ii. Storage expenses	37.00 (0.50)
	Sub-total (i and ii)	99.00 (1.34)
3.	Net price received by the producers (1-2)	3961.00 (53.72)
4.	Expenses borne by the village traders	
	i. Cost of gunny bags and sutli charges	27.50 (0.37)
	ii. Weighing	6.00 (0.08)
	iii. Loading/unloading charges	15.00 (0.20)
	iv. Transportation cost	49.75 (0.67)
	Sub-total (i to iv)	98.25 (1.33)
5.	Total cost borne by village traders (1+4)	4158.25(56.40)
6.	Sale price of village traders/purchase price of wholesalers	4983.00 (67.58)
7.	Net margin of village traders (6-5)	824.75 (11.19)
8.	Expenses borne by wholesalers	
	i. Marking fee @ 2 per cent	99.66 (1.35)
	ii. Commission @ 4 per cent	199.32 (2.70)
	iii. Storage	21.91 (0.30)
	iv. Spoilage during storage @ 2 per cent	99.66 (1.35)
	Sub-total (i to iv)	420.55 (5.70)
9.	Total cost borne by wholesalers (6+8)	5403.55(73.29)
10.	Sale price of wholesalers/purchase price of retailers	6078.85 (82.45)
11.	Net margin of wholesalers (10-9)	675.30 (9.16)
12.	Expenses borne by retailers	
	i. Packing material	67.00 (0.90)
	ii. Transportation cost	15.00 (0.20)
	iii. Loading and unloading	5.00 (0.07)
	iv. Storage	24.65 (0.33)
	v. Rent of shop/cart	22.80 (0.31)
	Sub-total (i to iv)	134.45 (1.82)
13.	Total cost borne by retailers (10+12)	6213.30 (84.27)
14.	Sale price of retailers/purchase price of consumers	7373.00 (100)
15.	Net margin of retailers (14-13)	1159.70 (15.72)
Price spread (14-3)		3412.00

Source: Field survey

Note: Figures in parentheses are the percentage of the consumer's price.

In economic terms, existing literature highlighted that the marketing channels should be as short as possible, which benefits both the producers and consumers.

Table 3 shows the price spread of ginger crop through marketing channel-II in the Panchkula district of Haryana. In marketing channel-II, the producer, wholesaler (through commission agent), retailer and consumer are the main agents. The sale price of the producer or purchase price of the wholesaler was Rs. 4250.00 per quintal. In the marketing of the ginger crop, total expenses borne by the producer were Rs. 139.75 per quintal. After the deduction of expenses paid by produce (from the sale price of the ginger crop), the net price received by the producer was Rs. 4110.25 per quintal. Subsequently, the sale price of the wholesaler and purchase price of the retailer was Rs. 5286.25 per quintal, which is the addition of the purchase price (Rs. 4110.25), margin (Rs. 675), and expenses borne by the wholesaler (Rs. 361.25). Finally, the retailer is the ultimate supplier of spices in this marketing channel. Therefore, the sale price of the retailer or purchase price of the consumer includes the purchase price of the retailer (Rs. 5286.25), net margin (Rs. 1160), and expenses borne by the retailer (Rs. 134.50). Hence, the purchase price of the consumer was Rs. 6580.75.00 per quintal.

Table 3: Price Spread of Ginger in Panchkula Market through Channel-II

(Rs. per quintal)

Sr. No.	Particulars	Value
1.	Sale price of producer/purchase price of wholesaler	4250.00 (64.58)
2.	Cost borne by the producer	
	i. Transportation cost	86.00 (1.31)
	ii. Gunny bags/plastic bags	27.50 (0.42)
	iii. Loading charges	5.00 (0.08)
	iv. Storage losses @ 0.5 per cent	21.25 (0.32)
	Sub-total (i to iv)	139.75 (2.12)
3.	Net price received by producer (1-2)	4110.25 (62.46)
4.	Cost incurred by the wholesaler cum commission agent	
	i. Market fee @ 2 per cent	85.00 (1.29)
	ii. Commission @ 4 per cent	170.00 (2.58)
	iii. Storage	21.25 (0.32)
	iv. Spoilage during storage @ 2 per cent	85.00 (1.29)
	Sub-total (i to v)	361.25 (5.49)
5.	Total cost borne by wholesaler (1+4)	4611.25(70.07)
6.	Sale price of wholesalers/purchase price of retailers	5286.25 (80.33)
7.	Net margin of wholesaler (6-5)	675.00 (10.25)
8.	Expenses borne by retailers	
	i. Packing material	66.85 (1.01)
	ii. Transportation cost	15.20 (0.23)
	iii. Loading and unloading	5.00 (0.08)
	iv. Storage	24.65 (0.37)
	v. Rent of shop/cart	22.80 (0.35)
	Sub-total (i to iv)	134.50 (2.04)
9.	Total cost borne by retailers (6+8)	5420.75 (82.37)
10.	Sale price of retailer/purchase price of consumer	6580.75 (100)
11.	Net margin of retailer (10-9)	1160.00 (17.63)

Price spread (10-3)	2470.50
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Source: Field survey

Note: Figures in parentheses are the percentage of the consumer's price.

Thus, Rs. 2470.50 per quintal is the price spread for marketing channel-II, which is lower than the price spread of channel-I. Hence, channel-II is more beneficial to producers and consumers than channel-I because producers receive a higher price for their produce, and consumers purchase at a lower price.

Table 4: Price spread of ginger in Panchkula market through Channel-III

(Rs. per quintal)

Sr. No.	Particulars	Value
1.	Sale price of producers/purchase price of village traders	4150.00 (65.18)
2.	Cost incurred by the producer	
	i. Transportation cost	62.00 (0.97)
	ii. Storage losses @ 0.5 per cent	20.75 (0.33)
	Sub-total (i to ii)	82.75 (1.30)
3.	Net price received by producer (1-2)	4067.25 (63.88)
4.	Expenses borne by the village traders	
	i. Gunny bags/plastic bags	27.50 (0.43)
	ii. Weighing	6.00 (0.09)
	iii. Loading/unloading charges	15.00 (0.24)
	iv. Transportation cost	49.75 (0.78)
	Sub-total (i to iv)	98.25 (1.54)
5.	Total cost borne by village traders (1+4)	4248.25(66.72)
6.	Sale price of village traders/purchase price of retailers	5073.25 (79.68)
7.	Net margin of village traders (6-5)	825.00 (12.96)
8.	Expenses borne by retailers	
	i. Packing material	67.00 (1.05)
	ii. Transportation cost	15.20 (0.24)
	iii. Loading and unloading	5.00 (0.08)
	iv. Storage	23.75 (0.37)
	v. Rent of shop/cart	22.80 (0.36)
	Sub-total (i to v)	133.75 (2.10)
9.	Total cost borne by retailers (6+8)	5207.00(81.78)
10.	Sale price of retailer/purchase price of consumer	6367.00 (100)
11.	Net margin of retailer (10-9)	1160.00 (18.22)
	Price spread (10-3)	2299.75

Source: Field survey

Note: Figures in parentheses are the percentage of the consumer's price.

Table 4 shows the price spread of ginger crop through marketing channel-III in the Panchkula district of Haryana. Producers, village traders, retailers, and consumers are the main agents in this marketing channel. The sale price of the producer or purchase price of the village trader was Rs. 4150.00 per quintal. In the ginger crop marketing, the producer's total expenses were Rs. 82.75 per quintal. After the deduction of expenses borne by produce (from the sale price of ginger crop), the net price received by the producer was Rs. 4067.25 per quintal.

Further, the expenses borne by the village trader were defined as the expenses of gunny bags/plastic bags (Rs. 27.50), weighing (Rs. 6.0), loading & unloading charges (Rs. 15.00), and transportation costs (Rs. 49.74), which increases the purchase price of retailers. After including the net profit margin of village traders (Rs. 825.0), the sale price of village traders or retailers' purchase price was increased to Rs. 5073.25 per quintal. In marketing channel-III, the retailer is the ultimate intermediate supplier of spices. Therefore, the sale price of the retailer or purchase price of the consumer includes expenses borne by the village retailer (Rs. 133.75) and net margin (Rs. 1160). Hence, the consumer's purchase price was Rs. 6367.00 per quintal.

The price spread for marketing channel-III was found to be Rs. 2229.75 per quintal, which is lower than the price spread of channel-I and II. Hence, channel-III is more beneficial to producers and consumers than channel-I and II because producers receive a higher price for their produce, and consumers purchase at a lower price.

Table 5: Price spread of ginger in Panchkula market through Channel-IV

(Rs. per quintal)

Sr. No.	Particulars	Value
1.	Sale price of producers/purchase price of retailers	4950.00 (79.29)
2.	Cost incurred by the producer	
	i. Transportation cost	62.00 (0.99)
	ii. Storage losses @ 0.5 per cent	24.75 (0.40)
	Sub-total (i and ii)	86.75 (1.39)
3.	Net price received by producer (1-2)	4863.25 (77.90)
4.	Expenses borne by retailers	
	i. Packing material	67.25 (1.08)
	ii. Transportation cost	15.20 (0.24)
	iii. Loading and unloading	5.00 (0.08)
	iv. Storage	23.75 (0.38)
	v. Rent of shop/cart	22.80 (0.37)
	Sub-total (i to v)	134.00 (2.15)
5.	Total cost borne by retailers (1+4)	5084.00(81.43)
6.	Sale price of retailer/purchase price of consumer	6243.00 (100)
7.	Net margin of retailer (6-5)	1159.00 (18.56)
	Price spread (6-3)	1379.75

Source: Field survey

Note: Figures in parentheses are the percentage of the consumer's price.

Table 5 shows the price spread of ginger crop through marketing channel-IV in the Panchkula district of Haryana. Only retailers are the intermediary between producers and consumers through this marketing channel. In this channel, the sale price of the producer or purchase price of the retailer was Rs. 4950.00 per quintal. After the deduction of total expenses borne by the producer, i.e., transportation cost (Rs. 62.00) and storage losses (Rs. 24.75 per quintal), the net price received by the producer has left Rs. 4863.25 per quintal, which is higher than channel-I, II, and III's price. Further, the sale price of the retailer or purchase price of the consumer was Rs. 6243.00 (including expenses borne by the retailer (Rs. 134.00) and net margin (Rs. 1160). Hence, the consumer's purchase price was just Rs. 6243.00 per quintal, again lower than channels-I, II, and III's purchase prices of consumers.

However, producers receive higher prices for their crops, and consumers purchase at lower prices than in the abovementioned channels. The price spread for marketing channel-IV was Rs. 1293.00 per quintal, lower than channels-I, II, and III.

Table 6 shows the price spread of ginger crop through marketing channel-V in the Panchkula district of Haryana. In marketing channel-V, there is no intermediary between producers and consumers. Producers directly sale to consumers, and there were no intermediaries between both. However, it is the most efficient marketing channel for the ginger crop in Haryana from the point of view of consumers' and producers' surplus. Consumers pay a minimum price for ginger; producers receive the highest price for their crop. The sale price of the producer or purchase price of the consumer was Rs. 4900.00 per quintal. The price spread was Rs. 106.95 per quintal, equal to the cost incurred by the producer (Rs. 106.95).

Table 6: Price spread of ginger in Panchkula market through Channel-V

(Rs. per quintal)

Sr. No.	Particulars	Value
1.	Sale price of producer/purchase price of consumer	4900.00 (100)
2.	Cost incurred by the producer	
	i. Packing material	67.25 (1.37)
	ii. Transportation cost	15.20 (0.31)
	iii. Storage losses @ 0.5 per cent	24.50 (0.50)
	Sub-total (i and iii)	106.95 (2.18)
3.	Net price received by producer (1-2)	4793.05 (97.82)
Price spread (3-1)		106.95

Source: Field survey

Note: Figures in parentheses are the percentage of the consumer's price.

4.3 Marketing Efficiency of Selected Marketing Channels for Ginger Crop in Panchkula District of Haryana

Marketing efficiency is defined as the market output (satisfaction) ratio to market input (cost of resources). According to Acharya (2003), marketing efficiency is measured as the ratio of (price received by farmers) and (total marketing cost plus net marketing margin). Further, it depicts that (a) the higher the total marketing cost, the lower the efficiency, (b) the higher the net marketing margin, the lower the efficiency; and (c) the higher the price received by farmers, the higher the efficiency, and (d) the higher the price paid by the consumer, the lower the efficiency.

Table 7 shows the marketing efficiency of the ginger crop under different marketing channels. The study showed that the lowest consumer purchase price was found under channel-V, and the lowest net marketing costs and margins of intermediaries were also the lowest in channel-V. However, channel-V is the most efficient marketing channel for ginger crop in the Panchkula district of Haryana, and the highest marketing efficiency is for channel-V. Thus, it can be concluded that the lower the number of intermediaries in marketing crops, the higher the marketing efficiency. The findings depicted that marketing channel-V is the most efficient channel with 44.82 points, followed by channel-IV, III, II, and I. Channel-V provides ginger at the lowest price to consumers and the highest price for producers.

Table 7: Marketing Efficiency of Ginger Crop under Different Channels*(Rs. per quintal)*

Sr. No.	Particulars	Channel- I	Channel- II	Channel- III	Channel-IV	Channel-V
1.	Consumer's purchase price (RP)	7373	6580.75	6367	6243	4900
2.	Net marketing costs (MC)	653.25	495.75	232.00	134.00	106.95
3.	Total margins of intermediaries (MM)	2659.75	1835.00	1985.00	1159.00	-
4.	Net price received by producer (FP)	3961.00	4110.25	4067.25	4863.25	4793.05
	Marketing efficiency	1.20	1.76	1.83	3.76	44.82

Source: Field survey

4.4 Problems Faced by Farmers in the Marketing of Spices Crops in Haryana

The leading problems faced by farmers in the marketing of spices crops were high fluctuation in market prices, difficulties in the maintenance of quality standards, exploitation by intermediate agencies, lack of storage facilities, distant market, weight cuts due to poor quality of output, a small quantity of production, non-availability of adequate processing units/mills, and delay in payment by traders. The detailed findings are exhibited as follows:

High price fluctuation in the market: The price of the spices crop has highly fluctuated. About 90.62 per cent of farmers reported it as a leading problem in the marketing of spices crops. Most of the time, farmers fail to anticipate the actual price of their crops. Ultimately, their produce was sold at harvesting sessions market prices. But, without proper storage facilities, they couldn't get the actual price of the crop. In the Panchkula district, 93.75 per cent of ginger growers reported it as a major problem, followed by 97.50 per cent of turmeric growers in Yamunanagar, 88.75 per cent in Karnal (Garlic farmers), and 82.50 per cent of fenugreek growers in Yamunanagar district of Haryana. However, from the farmers' side, the volatile market price is a major problem in marketing spices crops.

Difficulty in maintaining quality standards: To maintain the quality standard of spices crops is another constraint in marketing spices crops. Low-quality spices produce automatically wiped out from the market. Hence, maintaining the standard quality of their products was a big challenge for farmers. Moreover, the quality of a product determines the market value of the produce. Therefore, the greater the quality of spices, the higher the crop's market price. About 84.68 per cent of surveyed farmers reported it as one of the biggest challenges for farmers. They must maintain their product's quality to get a better market price. Ginger producers in Panchkula (88.75 %), Turmeric producers in Yamunanagar (91.25 %), Garlic producers in Karna (85.00 %), and Fenugreek producers in Yamunanagar (84.68 %) highlighted it as a challenge for farmers.

Exploitation by intermediate agencies: Farmers were exploited by intermediate agencies. According to the surveyed farmers, the intermediaries of the mandis, also known as commission agents, buy farmers' produce below the Market price when they come to the mandis to sell their agricultural produce. They perform this with the support of the government inspector, who evaluates the quality of the farmer's products in the mandis, and they to be sold at a cheaper price intentionally determines products to be of low quality. A significant chunk of the profits from farmers' crops goes to commission agents. The farmers left with a very small share. So, about 74.69 per cent of farmers reported that they were exploited in the marketplace by intermediaries in Haryana. The percentage share of ginger farmers was 82.50 per cent in Panchkula, followed by 88.75 per cent of turmeric

farmers in Yamunanagar, 85.00 per cent of garlic farmers in Karnal, and 42.50 per cent of fenugreek farmers in Yamunanagar. However, turmeric grower was the most affected farmers, and fenugreek growers were the least affected (or exploited) farmers at the marketplace by intermediaries. Ultimately, it is a big issue among spice farmers, and government should take some necessary steps to reduce these intermediaries.

Lack of good storage facilities: The unavailability of proper and good storage facilities was also a major constraint in taking advantage of high market prices. Storage facilities are costly, and such types of facilities require a big investment in the construction of warehousing. Farmers fail to get this type of facility because of insufficient finance.

5. CONCLUSION

It can be concluded that among the marketing channels adopted by farmers of ginger in the Panchkula district of Haryana, channel-V (direct from the producer to the ultimate consumer) is the most efficient marketing channel because, by this channel, the producer receives reasonable price for their crop. On the other hand, the consumer received goods at the lowest prices. Hence, both the consumer and producer surplus are maximized.

6. SUGGESTIONS

It derived from the results of the current study. These suggestions would contribute to minimizing cultivation costs, improving marketability, and maximizing the returns from growing spice crops. The suggestions are as follows:

1. High price fluctuation and low prices were the main problems that most surveyed faced (spices growers). Therefore, the government should set a minimum support price to secure higher returns on spice crops.
2. high cost of inputs used in spice growing, such as seed, chemicals, plant protection, etc. The government should offer subsidies on these items so that struggling farmers can grow spice crops. The study findings also revealed that the price of seeds, fertilizer, and plant protection greatly impacted the yield.
3. They lost a significant portion of their crops due to the high price of these things. Therefore, the government should provide subsidies for farmers to receive a considerable payment for their produce.
4. According to the survey, some spice growers experienced difficulties due to the market availability of fraudulent seed and pesticide brands. Therefore, the government should investigate these items and suspend the licenses of enterprises that offer higher-quality seeds and pesticides.
5. Another issue identified by the respondents was the inadequacy of technical guidance for the proper operation of sowing, new plantation technology, grading, and processes. Therefore, the government must consistently organize workshops for farmers to give innovative technical knowledge, through seminars, workshops, and conferences. Furthermore, a campaign including print materials, radio, television, and helplines should be used to teach farmers about the crops used to produce spices.
6. In a hilly area, a lack of transportation options and high transportation costs end up paying for a huge proportion of marketing costs. Therefore, the government needs to find affordable public transport options for the products produced from spices.
7. The problem of spice production getting rejected is also highlighted in the spice market. Various factors contribute to product rejection. Some of these included poor-quality standards, adverse influence, the perishable nature of the goods, etc. Therefore, the government and the horticultural department should try to eliminate the intermediary role. Therefore, spice sales and purchases should be performed under government involvement.
8. Research should be conducted to evaluate the standard of spice crops, technology, equipment knowledge, current demand and supply gap, processing spices, and the export and import of spice crops.

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INSURTECH IN INDIA: ANALYSIS BASED ON ANNUAL REPORT OF INDIA INSURTECH ASSOCIATION (IIA)

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Like many other technological and digital innovations in financial sector, Insurance sector in India is also adopting advanced technologies to innovate and improve insurance products and services. InsurTech's aim is to provide more accessible, affordable, and efficient services for improving the customer experience. This paper offers evolution story and present scenario of Indian InsurTech sector and attempts to look at some of the most exciting InsurTech innovations and their influence on the insurance sector. The article also attempts to examine the trends in Indian InsurTech sector. It also assesses the present state of Indian InsurTech sector and factor responsible for its rapid development. This study makes use of secondary data which have examined digital transformation in the insurance market in India. It was based on completely secondary data collected from Boston Consulting Group (BCG) and India InsurTech Association (IIA) for the year 2022. Compound Annual Growth Rate (CAGR) and descriptive statistics was applied for analysis the data. Finally, this paper highlighted the significant growth in recent years on various parameters in India. As per the recent rounds of capital infusion, Indian InsurTech firms are capitalizing on technology to offer innovative Insurtech products and custom-built services at reasonable cost, which is the most crucial factor for approving InsurTech in India. Considering the potential Indian insurance market size, if Insurtech firms provide services on this front, Indian InsurTech will witness great transformation that will reshape the entire insurance sector.

Keywords – Insurance technology, Indian InsurTech association, Compound annual growth rate (CAGR), Capital infusion, Leveraging on technology.

1. INTRODUCTION

As per the Insurance Regulatory and Development Authority of India (IRDAI), India will be the sixth-largest insurance market within ten years, Surpassing Germany, Canada, Italy and South Korea. The emergence of the covid-19 pandemic highlighted the necessity for consumers to invest in products that would increase financial security, one of them being life insurance and health insurance has a capacity to boost the healthcare ecosystem. This expansion of the insurance market is being supplemented by important government initiatives, strong democratic factors, conducive regulatory environment, increased partnerships, product innovations, vivid distribution channels and recent technological innovations. These developments help in the growth and also helping to approach consumers in a decentralised way. So, both IRDAI, the Insurance and InsurTech industries are determined to achieve India's mission of "Insurance for all by 2047." But Indian insurance sector before the advent of technology was only controlled by offline channels like corporate agents, offline brokers or banks. Today, accelerated digital transformation, product innovation and progressive regulation policies have made it

easy for consumers to buy variety of insurance services over numerous distribution channels with the click of a button. These digitization and use of technology in insurance sector is InsurTech– the future of Indian insurance sector.

What is InsurTech?

InsurTech is the use of technological automation that is specially designed to make the present insurance model more efficient. By the use of technology like data analysis, IoT, and AI, Machine learning InsurTech provide more affordable and accessible products to insurers. Advent of InsurTech make easier to effectively process claims, evaluation of risk, processing of contracts InsurTech is subpart of fintech, as both are modern solutions that are revolutionizing their traditional industry.

2. LITERATURE REVIEW

Sarkar Swapan (2021) “The Evolving Role of InsurTech In India: Trends, Challenges And The Road Ahead” the author attempts to assess the major trends in Indian InsurTech and also measured the problems, that the industry needs to overcome and authors have also pointed out key drivers of growth of InsurTech in India.

Kumar Satuluri Ramesh and Radhika Ravi (2021) in their paper “digital transformation in Indian insurance industry” examined application of block chain technology and data security in insurance sector. Further, the author concludes that digital innovation will surely have a great and positive impact on profitability of insurance companies.

Suryavanshi Urvashi (2022) “The Insurtech Revolution in Insurance Industry: Emerging Trends, Challenges and Opportunities” the author explained the development of the insurance technology sector in India as well as the current state of insurance technology and InsurTech industry structure and InsurTech startup in India its fintech trends in India.

India InsurTech Association (IIA): “India InsurTech Landscape and Trends” identify dominating trends and key players’ views in the Indian InsurTech landscape the organisation have evaluated overall performance of InsurTech industry in India.

3. OBJECTIVES

- To study the role of Insurtech in the insurance industry
- To evaluate growth pattern of InsurTech sector in India.
- To understand factors responsible for rapid growth of Insurtech.
- To know the Latest trends and new market players of industry.
- To study the role of InsurTech in enhancing consumer’s experience.

4. METHODOLOGY

This study is completely based on secondary source of data. Researchers have reviewed a large number of

articles, research papers, published annual reports of the InsurTech sector, presentations, talks, and lectures by subject-matter experts. Quantitative Data has been collected from the IIA-BCG-Annual-InsurTech-Landscape-and-Trends-Report 2022. The researchers have used descriptive statistics methods and Compound annual growth rate (CAGR) to achieve the present study objectives. The results were concluded.

Compound Annual Growth Rate Formula

$$\text{CAGR} = \left(\frac{\text{Final Amount}}{\text{Initial Amount}} \right)^{(1/\text{Years})} - 1$$

Origin of InsurTech

InsurTech emerged around 2010 as an offset of “fintech.” It is most consistently refer to the use of apps, wearables, big data, machine learning, and other advanced technologies to automate and improve processes of the insurance value chain – from marketing and policy origination through underwriting, services, and claim. although there is not any pinpoint information available about its origin but the emergence of InsurTech has been gradual, but the InsurTech has been constantly used from last 10 years. Similar to fintech – new technology that aims to improve and mechanize the use of financial services – InsurTech essentially leverages technology to improve efficiency and drive advancement within the insurance industry. The InsurTech ecosystem is complemented by many private-sector initiatives, like innovation hubs and accelerators, as well as public-sector regulatory environment that are to InsurTech.

Indian insurance sector

Insurance not only contributes to the business world but it also influences economic development of a country. Insurance is the solid foundation of the economy, and while it is not be something you love, it is something you need to support your business. In a variety of ways, insurance companies contribute to the strength and vitality of our economy. Insurance companies assist businesses in reducing risk and protecting their employees, providing financial security to its customers, help in the funding of economic development projects, favourable impact on the financial system's stability, insurance contributes to an increase in GDP.

While India’s insurance sector has been growing dynamically in recent years, its share in the global insurance market remains abysmally low. The insurance sector has witnessed many changes over the years including: Nationalisation of life (LIC Act 1956) and non-life sectors (GIC Act 1972). Constitution of the Insurance Regulatory and Development Authority of India (IRDAI) in 1999. Opening up of the sector to both private and foreign players in 2000. Increase in the foreign investment cap to 26% from 49% in 2015. The recent notification of 100% foreign direct investment (FDI) for insurance intermediaries (announced in the Union Budget of 2019-20) has further liberalised the sector. The insurance sector experienced significant expansion following liberalisation. The insurance industry led by innovative, creative product lines, active distribution channels, focused advertising, and promotional efforts by the insurers.

There are five major segments of InsurTech in india.

Digital Brokers: PolicyBazaar, Ditto, TurtleMint and Paytm.

Corporate Insurance Brokers: Nova Benefits **Insurance SaaS**

companies: Ensuredit and Riskcovry **Digital Insurance**

Underwriters: Acko and Digit

Health Clubs: Kenko and Even

Current position insurance market in India: India is currently rated ninth (tenth in 2020) in the world for the life insurance industry. In 2021, India's global life insurance market share was 3.23% (3.11% in 2020). In comparison to the global life insurance premium, which climbed by 9.91% (4.5% inflation-adjusted real growth) in 2021, life insurance premiums in India increased by 14.16% (8.5% inflation-adjusted real growth)

India's insurance premium volume stands at \$ 127 Bn as of 2021 (Life – 76%, Non-Life – 24%). Total insurance premium in India increased by 13.5% in 2021 as against a global average of 9%.

- India's share in global life insurance market was 3.23% in 2021. Life insurance premium in India increased by 14.2% in 2021 whereas global life insurance premium increased by ~10%.
- India has 67 insurers of which 24 are life insurers, 26 are general insurers, 5 are stand-alone health insurers, and 12 are re-insurers (March 2022)
- The Indian Insurance market is expected to reach \$200 BN by 2027.
- India is 9th largest Life Insurance Market globally
- India is the 14th largest Non-Life Insurance market globally.
- Ayushman Bharat PM-JAY is the largest health assurance scheme in the world and is funded by the Government.

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InsurTech in India

Consumers comfort and flawlessness are taking everything toward digitization in today's world. Digitalization has impacted multiple aspects of our life, including insurance. With the equipment of Internet of Things ("IoT") connected devices, Artificial Intelligence ("AI"), Big Data analytics, and Machine Learning ("ML"), the mechanism for obtaining insurance in this era has completely transformed. Transformation from the traditional insurance with rigid choices to the Introduction of customised and personalised Insurance Policies, based on a minimised risk assessment of the consumer.

The insurance sector in India has witnessed a great revolution with the arrival of InsurTech platforms. Additionally, the outbreak of covid pandemic forced consumers to adopt a digital- first mindset, which strengthen the development of InsurTech in India.

According to the report, funding at global in InsurTech has grown seven times in the last five years, and continued to grow at this pace even during Covid-19. Europe is strongest player in InsurTech funding. "Funding in 2021 is symbol of sustained investor interest. It has expanded from \$290 million in 2020 to \$800-900 million in 2021

India has also shown sturdy momentum in InsurTech, and its equity funding has doubled in the last two years. Its rapid growth led to the emergence of 22 InsurTech unicorns in 2021 globally, according to a recent report jointly brought out by Boston Consulting Group (BCG) and India Insurtech Association (IIA).

Factor responsible Growth of InsurTech in India:

According to the report, the growth of InsurTech is driven by a shift in consumer interest and a increase in equity funding. Post pandemic, the demand for insurance products has increased. Other factors contributing to the growth include:

- **Improved Distribution** - Digital brokers like Policy Bazaar have turned the B2C model on its head. You can easily compare and choose from a plenty of insurance products. The rise of B2B2C players is enhancing the access to efficient and affordable products.
- **Technology for good** -Technological advancement has improved reach and conversion. Data analytics has further helped to identify and target new customers.
- **Customised Products** - The InsurTech segment has quickly adapted to [personalising health & wellness products](#). This has helped insurance underwriting and enhanced pricing propositions.
- **The emergence of the National Health Stack** - The insurance penetration in India is extremely low at 4.2% compared to global leaders (*In 2019, Taiwan’s insurance penetration was the highest at 20% followed by South Africa and Korea at 14% and 11% respectively*). The national health stack by the growth of digital infrastructure will help improve insurance penetration in India
- **20+ global InsurTech players**

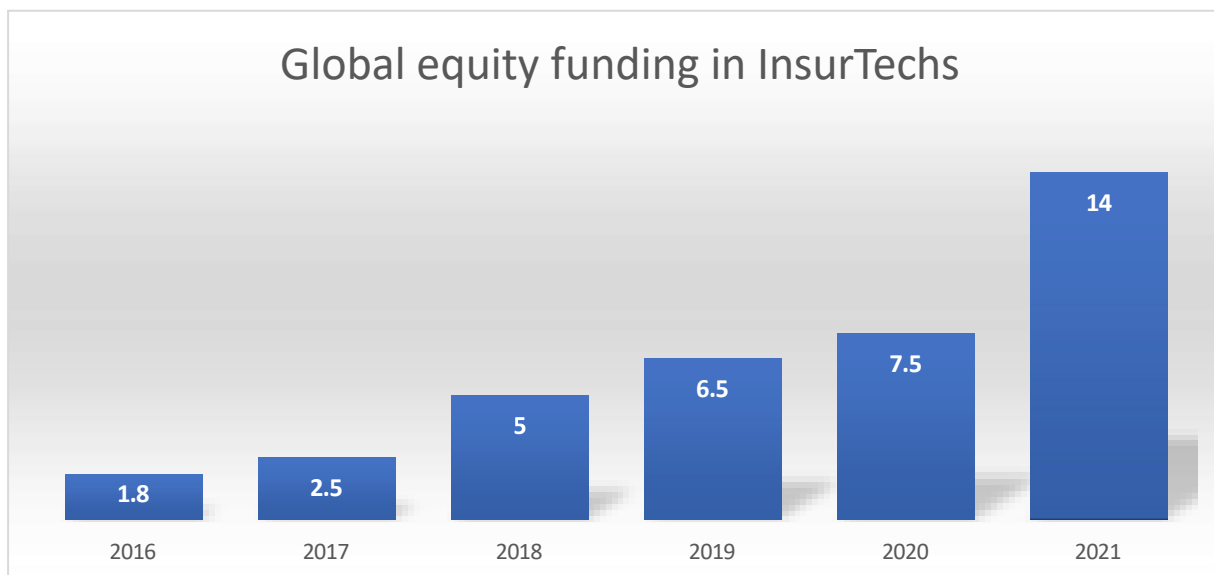
Country	United states	United kingdom	India	France	Austria	Israel	Mexico
NO. of new unicorns	12	4	3	2	1	1	1
1	Agenr sync	Brought by many	Akco	Alan	Bolttech	Earnix	konfio
2	At-bay	Marshmallow	Digit insurance	Shift technology			
3	Bitsight	Tractable	Policy bazaar				
4	Clear cover	Zego					
5	Coalation						
6	Collective health						
7	Ethos						
8	Security score card						
9	Side car health						
10	The zebra						
11	Wrapbook						
12	Healthcare.com						

□

(Source: Indian Insurtech report 2022)

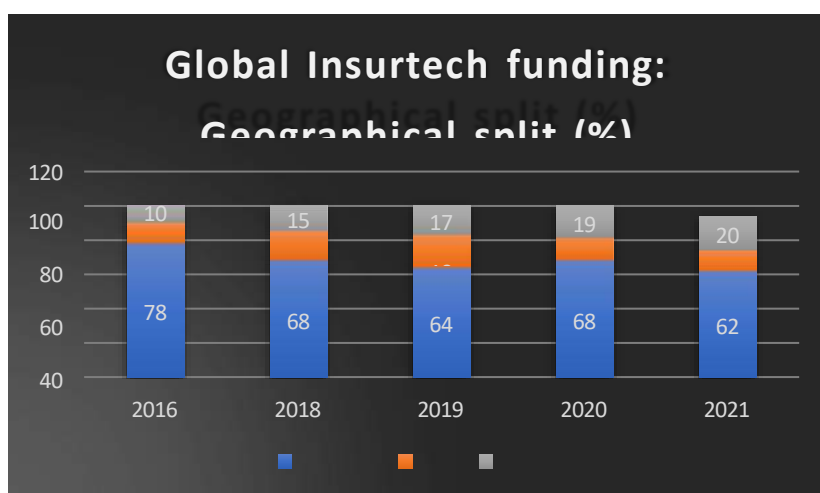
Global funding in InsurTechs has grown 7 times in the last 5 years; continued the pace even during COVID -19. The global InsurTech market size was valued at USD 5.45 billion in 2022 and is expected to grow at a compound annual growth rate (CAGR) of 52.7% from 2023 to 2030. The compound annual

growth rate (CAGR) from year 2016-2021 is 56.3 As per the **World InsurTech Report, 2022** the global InsurTech market is predicted to increase at a compound annual growth rate (CAGR) of 29.2 percent from \$8.07 billion in 2021 to \$10.42 billion in 2022.



(Source: Indian Insurtech report 2022)

After splitting global Insurtech market geographically in 3 continent America, Asia and Europe. Europe has shown the strongest trend in Insurtech funding with compound annual growth rate (CAGR) of 50% FY2019-2021. Whereas percentage in America has declined to 19% and Asia with negative compound annual growth rate (CAGR) of (-6%)

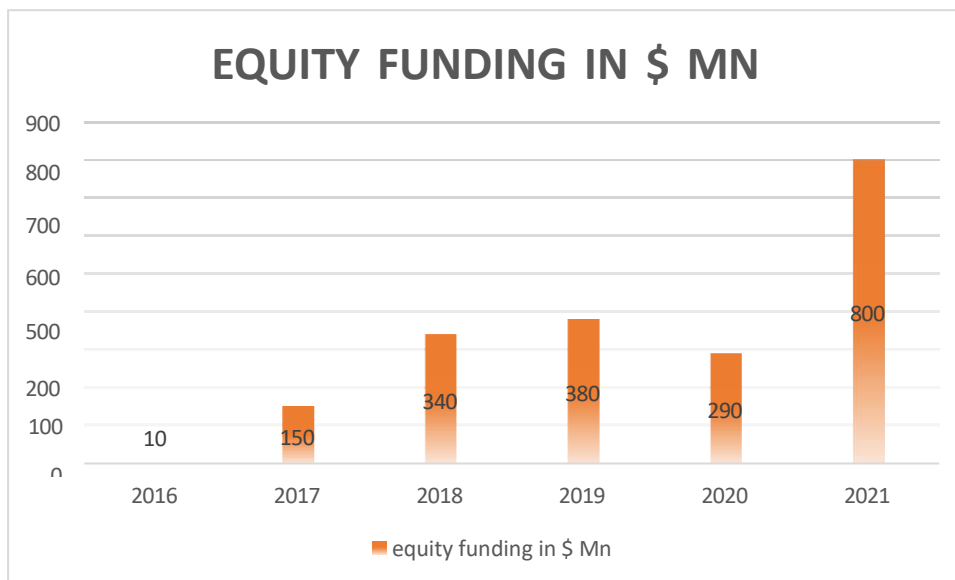


(Source: Indian Insurtech report 2022)

Whereas The Indian InsurTech market has grown significantly over the last few years, especially with

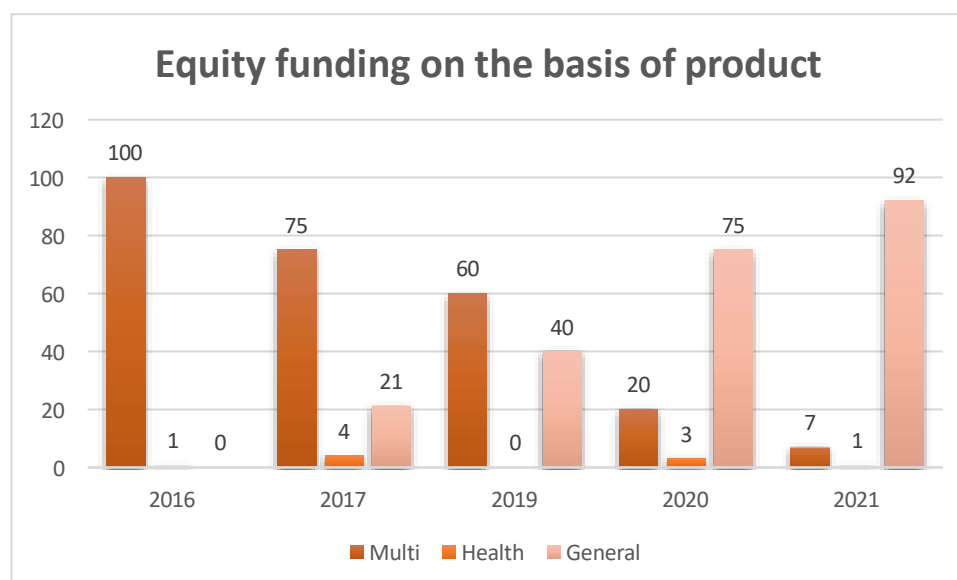
considerable double growth in past two years. Funding to Indian InsurTechs has grown with 34% compound annual growth rate (CAGR) from 2017-20. In 2021, Indian InsurTech companies raised a total of US\$800 million in equity funding in 2021.

In India, there is an expansion in funding from a gentle base of \$11 million in 2016 to \$287 million in 2020. This trend has continued with Riskcovry raising \$5 million in March 2021, Onsurity raising \$16 million in August 2021, and Pazcare raising around \$3.5 million. Globally 9 insurtech unicorns have emerged with Policybazaar, Digit, and Acko from India entering this exclusive club. Funding in InsurTech sector has witnessed a great Rise from the 10 million in 2016 to peak of 800 million in 2021.



(Source: Indian Insurtech report 2022)

Deep dive into equity funding: On the basis OF IIA report, Further the InsurTech funding in India is divide on the bases of product line including General Insurance, Health Insurance and Multi Insurance. Figures has shown that equity funding in general Insurance InsurTech have grown tremendously FY2016 to 2021.



(Source: Indian Insurtech report 2022)

General insurtech product line shows compound annual growth rate (CAGR) of 121% and for the period of 2 years from 2019 to 2021. There is huge downfall has seen in Multi InsurTech product with compound annual growth rate (CAGR) of (-50%).

5. Upcoming Trends in India's InsurTech industry

Embedded Insurance

In Embedded Insurance Services of insurance is tied with the transaction of a product or service. It could be a hard bundle where it is complementary like a warranty, or in a form soft bundle where the customer has to small increment. Because a drastic increase in online transactions over different categories like payments, pharmacy, medical consults, gadgets and cars, there was a large push on creating sachet or micro-insurance products that could be embedded across multiple categories.

AI, IoT and Machine Learning in Underwriting

The insurance industry is now shifting from traditional modes of underwriting risks that suits to a more personalised risk assessment. This revolution is taking place with interaction of Artificial Intelligence (AI), Internet of Things (IoT) devices and Machine Learning (ML). These led to the growth of parametric insurance, in which not only the premium is

automatically computed basis on AI and ML, but claims payment also automated. Flight delay insurance, crop insurance, and flood insurance are some of the examples of Indian InsurTechs are showing solid success. Flourishing these technologies should lead to an underwriting process that is completely automated and personalised, that even with minor size of past data is available. For example "Pay as you Drive" Smart apps and boxes for cars to observe your driving habits and home safety practices have been around in the west for a while. These dynamically bring down or up your premium without any human intervention.

Bespoke Product Bundles and Hyper Personalisation

InsurTechs started to combine multiple such products by assessing personalised risks based on demographics, geographies and habits. Why can't a term life, health plan, car insurance and home insurance be sold at the same time. These plans will be separately bought by customers anyway past a certain life stage.

Penetration in Tier 2 and Tier 3 markets

Due to payment wallets and cheap data rates digital adoption increase in smaller cities, this enabled insurance companies to offer affordable health policies alongside popular apps and streaming video services.

There is some innovation on payment modes With easier KYC and customer profiling as well – Well, where monthly or even daily payments have been tried with some success.

Automation in Claims and Customer Service

InsurTechs come with a digital wave that is applicable across all operations from day 1, including claims and servicing. Digitised claims with 24-hour turnaround is now fulfilling expectation of every consumer. Tasks such as policy correction, downloads, claims submission, renewals, etc is completely automated through self-service portals and bots for customer service.

Conclusion

InsurTech has a bright future. Although in India it has not yet shown its real potential. But by examining the market trends it has been observed that the insurance industry has expanded with the help of InsurTech. In India insurance industry, market penetration, and client interest use this platform as a long-term investment tool which result, there is a great chance that InsurTech will improve the Indian insurance industry. The most important factor responsible for the rapid adoption of Insurtech in India is use of innovative technology to provide affordable customised services. India will soon become a great InsurTech industry if it continued to grow in same pace.

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FIELD NOTES ON MARKETING OF GINGER CROP IN HARYANA, INDIA

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The paper aims to analyse the marketing channels of ginger crop in Haryana and highlight the constraints in the marketing of ginger crop and to suggest solutions. The present study tried to analysis the marketing channels, price spread and marketing efficiency of ginger crop in Haryana, India. The study was conducted in Panchkula district of Haryana. To know the marketing efficiency Acharya's Approach have been used in the present study. The study was based on primary data and data have been collected with the help of pre-tested schedule. In the present study mainly, five channels were adopted by ginger producers. The findings depicted that marketing channel-V is the most efficient channel with 44.82 points, followed by channel-IV, III, II, and I. It can be concluded that channel-V provides ginger at the lowest price to consumers and the highest price for producers.

Keywords: Ginger, price spread, marketing efficiency, Marketing Channels.

1. INTRODUCTION

Agriculture and its allied sectors are the primary and most important source of income for over 58 per cent of India's population. About 70 per cent of rural residents in India still depend on agriculture for their living. The total amount of foodgrains produced in India in 2019–20 was 296.65 million tonnes. India is the largest importer, producer, and consumer of pulses in the world, which shows 27 per cent, 25 per cent, and 12 per cent, respectively. According to the Food and Agriculture Organization of the United Nations (FAO) website, India is the world's second-largest producer of wheat, sugarcane, rice, cotton, groundnuts, fruits, and vegetables. The agricultural sector significantly impacts India's gross domestic product (GDP). Farming, horticulture, logging, hunting, fishing, mining, and forestry are some essential economic sub-segments that grow up the agricultural sector. For the past 20 years, the horticulture sector has played a crucial role in agriculture and the GDP with the help of these subsectors. In this study, specific spice crops from the horticulture sector are analyzed. This chapter briefly discusses horticulture and food grain crops in India and Haryana (present and historical background). This chapter further discusses the study's specific objectives, scope, significance, and limitations.

Ginger is an important spice crop of India and Haryana. Philip Kotler highlighted that a marketing channel performs the work of moving goods from producer to consumers. India and Haryana both produce significant amounts of this spice. It's called "Adrakh." In the kitchen, it is frequently utilized. Ginger grows best in clay loam or red loamy soils with good drainage. Common varieties of ginger include IISR Varada, IISR Mahima, Karthika, Suprabha, and Suruchi. Green ginger also comes in the Rio-De-Janerio, Varadha, and Dry Ginger: Nadia and Maran varieties. Direct and transplanting methods are employed to plant ginger. It is sown in the first week of May–June. The ginger crop should be cultivated for nearly eight months. Producing new spices are harvested beginning in the sixth month, although the ideal time to harvest is when the leaves become fully yellow and dry out.

2. LITERATURE REVIEW

Chalise et al. (2019) studied “Economics of production of marketing of ginger in Sunsari district, Nepal.” The study was conducted at Bishnupaduka (Dharan-20) and Panchakanya (Dharan-6) of the Dharan sub-metropolitan city of Sunsari district. In the study, eighty farmers and twenty traders were selected randomly. Primary data were collected through a well-prepared schedule. For analysing the cost of production, the variable cost items and fixed cost items were considered. The study revealed that the total average variable cost and total average fixed cost for ginger production were Rs. 6, 54,226.9 and 66,555 per hectare. So, the total cost was Rs. 7,20,781.9 per hectare. The gross income from one hectare was Rs. 14,86,406.13. The study concluded that the producer got a net profit of Rs. 7,65,624.23 per hectare.

Chalise et al. (2019) studied “Economics of Production of Marketing of Ginger in Sunsari District, Nepal.” The study was conducted at Bishnupaduka (Dharan-20) and Panchakanya (Dharan-6) of the Dharan sub-metropolitan city of Sunsari district. In the study, eighty farmers and twenty traders were selected randomly. Primary data were collected through a well-prepared schedule. Three marketing channels were recorded, viz., farmers-wholesalers-retailers-consumers, farmers-commission agents-wholesalers-retailers and farmers-retailers-consumers in the study. The most common type of marketing channel was Farmers-Wholesalers-Retailers-Consumer (FWRC), followed by 40 per cent of the respondents. 21.20 per cent of respondents followed the marketing channel of Farmers-Retailers-Consumers (FRC), whereas 17.50 per cent of respondents followed the marketing channel of both FWRC and FCWRC. 16.20 per cent followed the FWRC and FRC marketing channels, whereas only 5 per cent followed the marketing channel of Farmers- Commission agents-Wholesalers-Retailers-Consumers. The study found NRs. 27.77 marketing margin of ginger with 80.65 per cent producer’s share. The study also found some marketing problems farmers face: high fluctuation in market price, lack of processing facilities, lack of storage facilities, lack of proper transportation facilities, quality issues, unawareness of market price information, unorganized market and the low market price of ginger.

Kala et al. (2020) studied “an economic analysis of marketing and constraints for green chilli in Jaipur district of Rajasthan.” The study was based on primary data collected from the farmers and market intermediaries through a pre-structured schedule by personal interview method for 2017-18. Multistage purposive and sampling procedures were used to select districts, tehsils and respondents. For marketing costs and margins in the marketing of green chilli, five village traders, ten wholesalers-cum-commission agents and 15 retailers were selected randomly. Garrett’s ranking method was used to measure the absolute margin, percentage margin and constraints in the marketing of green chilli. The study revealed that the farmers adopted three types of marketing channels; channel-I (producer—village trader—wholesaler-cum-commission agent—retailer—consumer), channel-II (producer—wholesaler-cum-commission agent—retailer—consumer) and channel-III (producer—consumer). The total marketing costs for the sale of green chilli were higher in channel-I (500.40 per quintal) followed by channel-II (491.34 per quintal) and no marketing cost was involved in channel-III. The village traders, wholesaler-cum-commission agents and retailers received Rs. 158.42 (4.16 per cent), Rs. 205.55 (5.4 per cent) and Rs. 289.05 (7.5 per cent) margin in channel-I and the same margin was received in channel-II. Among the functionaries, retailers got higher margins due to selling green chilli at high prices to consumers. The producer's share in consumer rupee was highest in channel-III than channel-I and channel-II in the sale of green chilli. Major constraints faced by farmers in marketing green chilli were observed as low price, lack of good storage facility in mandi, fluctuation in the market price of produce, difficulty in maintaining quality standards, high transportation cost, imposition of cut in the weight of the produce by the buying firm due to shrinkages of moisture in green chilli and delay in making payment to the farmers for weeks or months.

Jashree and Umesh (2020) conducted a study entitled “An economic analysis of red gram seed production in Chikkaballapura district of Karnataka, India.” The study based on primary data which was collected for the agricultural year 2016-17. Two red gram seed varieties, BRG-1 and BRG-2, were selected among the major

seeds. Thirty farmers cultivating each variety viz; BRG-1 and BRG-2 varieties were chosen randomly in the study area. The study revealed that the net returns per hectare of BRG-1 and BRG-2 were Rs. 33946 and 29122, respectively. The rate of return per rupee of expenditure was higher in the case of the BRG-1 variety (Rs. 1.58) than in the BRG-2 variety (Rs. 1.56). Some major constraints the farmers face during production; plant protection constrains, credit constraints, agro-climatic factors, economic constraints and institutional constraints.

Dukpa and Ezung (2020) analysed vegetable marketing efficiency in the Phek district of Nagaland. The study was based on primary as well as secondary data. Primary data was collected through the field survey with the help of pre-tested questionnaires and secondary data from various published sources. Three Vegetables, cabbage, beans and potato, were selected for the study due to their significance in production and marketing in the Phek district. Three hundred farmers from twelve villages and 25 from each village were selected randomly. The shepherds market efficiency method and Acharya-Agarwal modified method were used to analyze the related data. The result revealed three marketing channels observed in the study; channel I: producer-consumer, channel II: production-retailer (village traders)-consumers, and channel III: producer-wholesaler (village agents/traders)-consumers. The net price received by farmers in terms of consumer rupee was 92.90 per cent on the marketing of cabbage, 98.99 per cent on beans and 97.41 per cent on the potato for channel-I. In channel-II, the net price received by the producer in terms of consumer rupee was 54.13 per cent for cabbage, 70.32 per cent for beans marketing and 62.17 per cent for potato marketing. The net price received by producers in terms of consumer rupees was 28.89 per cent on cabbage and 41.87 per cent on potato marketing. The study concluded that, from the marketing efficiency method of Shepherds and Acharya-Agarwal, channel-I was the most efficient marketing channel for the all-selected vegetables.

Samriti et al. (2020) worked on trends in area, production and productivity and trade of chickpeas in India. The study was based on secondary data that were collected from food and agriculture organization (FAO), corporate statistical database (FAOSTAT) and agriculture statistics at a glance (India) for the period of 2000-01 to 2017-18. To analyse the trends of chick pea average, percentage and compound growth rate methods were used. The study revealed a positive growth rate of 3.1, 4.7 and 1.5 per cent in the area, production and productivity of chickpeas during the study period (2000-01 to 2017-18), respectively. It was also found that there was a significant increase in the area, production and productivity of chick pea in India.

3. METHODOLOGY

The present study required primary data. Primary data was collected from spices and traditional crop grower farmers through a personal interview method with the help of a well-prepared pre-tested interview schedule for 2020-21. The sample of 80 respondents (who grew both spice and traditional crops) was randomly drawn from Panchkula district. To find out the marketing cost and margins from various channels eighty farmers, twelve village traders, twelve wholesaler, twelve retailer were selected from field/market of selected districts. Further, for knowing the marketing efficiency, Acharya's Approach have been used in the present study. Cost benefit ratio is also calculated.

4. RESULT AND DISCUSSION

Marketing channels, price spread, and marketing efficiency of ginger crop have been studied. In the marketing of spices crops, producers, village traders, whole-sellers (or commission agents), processors, retailers, and consumers were engaged. Before discussing marketing channels, price spread, and marketing efficiency in detail, these intermediaries need to be adequately defined, and definitions are given below:

Producer: Producers of spices crops are mainly farmers who produce the spices crops on the farm. He is the primary source of marketing channels.

Village trader: A village trader is the buyer of spices crops, and he directly buys from the producer at the village level and sells it to the ultimate consumer or wholesaler.

Whole seller (or commission agent): Whole seller or commission agent is a middleman between buyer and seller in the wholesale market, representing either buyer or seller. He usually takes over the physical handling of the product, arranges for its sale, collects the amount from the buyer, takes off his expenses and commission, and sets aside the balance for the seller.

Processor: A processor is a middleman between the producer and consumer of the turmeric crop, who grinds the turmeric lumps and sells turmeric powder in the wholesale or retail market.

Retailer: The retailer buys spices from the wholesaler or producer at wholesale prices and sells them to consumers at retail prices. Generally, he performs the function of storing and distributing their products to the consumers.

Consumer: The consumer is the ultimate source of marketing channels and the last or ultimate user of spices crops for consumption purposes.

However, all the intermediaries in marketing spices crops are actively engaged between the producer's space and the ultimate buyer. All the adopted marketing channels describe the way of selling the spices crops; hence, the journey starts from harvesting spices crops to the pocket of the ultimate consumer. The details are explained as follows:

Marketing Channels for Ginger Crop in Panchkula District of Haryana

Marketing channels describe the methods of selling and purchasing the spices crops. It is a journey that starts from harvesting (of spices crops) to the pocket of the ultimate consumer. Table 1. shows the marketing channels adopted by ginger producers in the Panchkula district of Haryana. Mainly, five channels were adopted by ginger producers. Among the marketing channels operated in the field, the producer is the sole originator of spices crops, and the consumer is the ultimate user of these crops. However, many intermediaries have been functioning between the producers and consumers.

Channel-I has five agents: producer, village trader, wholesaler, retailer, and consumer. The producer is the sole originator of a crop, and the consumer is the ultimate user of that crop. Subsequently, village traders, wholesalers, and retailers are the marketing channels' intermediaries. However, this channel has the longest supply chain. In channel-II, two intermediaries, i.e., wholesaler (through commission agent) and retailer, have been engaged beside the producer and consumer.

Table 1: Marketing Channels for Ginger Crop in Panchkula District of Haryana

Channels	Intermediaries in the Channels
Channel-I	Producer → Village trader → Wholesaler (through commission agent) → Retailer → Consumer
Channel-II	Producer → Wholesaler (through commission agent) → Retailer → Consumer
Channel-III	Producer → Village trader → Retailer → Consumer
Channel-IV	Producer → Retailer → Consumer
Channel-V	Producer → Consumer

Source: Field survey

In the same way, in channel-III, village traders and retailers are engaged between producer and consumer. In channel-IV, the only retailer is engaged between producer and consumer, and retailers purchase the spices crops directly from the producer and sale to the consumer. Finally, in channel-V, there is no engagement of intermediaries between producer to consumer; in this channel, consumers directly purchase the spices crops from producers.

Price Spread of Ginger Crop in Panchkula District of Haryana

The price spread is the difference between the consumer's price and the producer's net price for the equivalent quantity of spices crops. However, it includes the margin of intermediaries and marketing costs at different levels. Table 2 shows the price spread of ginger crop through marketing channel-I in the Panchkula district of Haryana. The value and cost of production are depicted in Rs. per quintal. In marketing channel-I, the producer, village trader, wholesaler (through commission agent), retailer, and consumer are engaged.

Further, the sale price of the producer or purchase price of the village trader was Rs. 4060.00 per quintal. In the marketing of the ginger crop, the expenses borne by the producer were Rs. 99.00 per quintal. After the deduction of expenses paid by produce (from the sale price of the ginger crop), the net price received by the producer was Rs. 3961.00 per quintal. In the next step, expenses borne by village traders were the cost of gunny bags and sutli charges (Rs. 27.50), weighing (Rs. 6.00), loading & unloading charges (Rs. 15.00), and transportation costs (Rs. 49.75). Hence, the total cost borne by the village trader was Rs. 98.25, and the village trader's margin was Rs. 824.75. Subsequently, the sale price of village trade or purchase price of wholesalers was Rs. 4983 per quintal.

Further, the sale price of the wholesaler or purchase price of the retailer (Rs. 6078.85) contains the purchase price of the wholesaler (Rs. 4993), a margin of the wholesale (Rs. 675.30), and expenses borne by the wholesaler (Rs. 420.55), i.e., marketing fee, commission charges, storage, and spoil during storage.

Ultimately, in this marketing channel, the farm product is supplied by retailers to the consumer. Therefore, the sale price of the retailer or purchase price of the consumer includes the purchase price of the retailer (Rs. 6078.85), net margin (Rs. 1159.70), and expenses borne by the retailer (Rs. 134.45). Hence, the consumer's purchase price was Rs. 7373.00 per quintal.

Thus, the difference between the price paid by the consumer (Rs. 7373.00) and the price received by the producer (Rs. 4060.00) is the price spread (Rs. 3412.00 per quintal). However, the longer the marketing channel of farm produce, the larger the price spread for that farm produce.

Table 2: Price Spread of Ginger crop in Panchkula District of Haryana through Channel-I

(Rs. per quintal)

Sr. No.	Particulars	Value
1.	Sale price of producers/purchase price of village traders	4060.00 (55.07)
2.	Expenses borne by the producers	
	iii. Transportation cost	62.00 (0.84)
	iv. Storage expenses	37.00 (0.50)
	Sub-total (i and ii)	99.00 (1.34)
3.	Net price received by the producers (1-2)	3961.00 (53.72)
4.	Expenses borne by the village traders	
	v. Cost of gunny bags and sutli charges	27.50 (0.37)
	vi. Weighing	6.00 (0.08)
		98.25 (1.33)

	vii. Loading/unloading charges	15.00 (0.20)	
	viii. Transportation cost	49.75 (0.67)	
	Sub-total (i to iv)		
5.	Total cost borne by village traders (1+4)	4158.25(56.40)	
6.	Sale price of village traders/purchase price of wholesalers	4983.00 (67.58)	
7.	Net margin of village traders (6-5)		824.75 (11.19)
	Expenses borne by wholesalers		
	v. Marking fee @ 2 per cent	99.66 (1.35)	
8.	vi. Commission @ 4 per cent	199.32 (2.70)	
	vii. Storage	21.91 (0.30)	
	viii. Spoilage during storage @ 2 per cent	99.66 (1.35)	
	Sub-total (i to iv)		420.55 (5.70)
9.	Total cost borne by wholesalers (6+8)	5403.55(73.29)	
10.	Sale price of wholesalers/purchase price of retailers	6078.85 (82.45)	
11.	Net margin of wholesalers (10-9)		675.30 (9.16)
	Expenses borne by retailers		
	vi. Packing material	67.00 (0.90)	
	vii. Transportation cost	15.00 (0.20)	
12.	viii. Loading and unloading	5.00 (0.07)	
	ix. Storage	24.65 (0.33)	
	x. Rent of shop/cart	22.80 (0.31)	
	Sub-total (i to iv)		134.45 (1.82)
13.	Total cost borne by retailers (10+12)	6213.30 (84.27)	
14.	Sale price of retailers/purchase price of consumers		7373.00 (100)
15.	Net margin of retailers (14-13)		1159.70 (15.72)
	Price spread (14-3)		3412.00

Source: Field survey

Note: Figures in parentheses are the percentage of the consumer's price.

In economic terms, existing literature highlighted that the marketing channels should be as short as possible, which benefits both the producers and consumers.

Table 3 shows the price spread of ginger crop through marketing channel-II in the Panchkula district of Haryana. In marketing channel-II, the producer, wholesaler (through commission agent), retailer and consumer are the main agents. The sale price of the producer or purchase price of the wholesaler was Rs. 4250.00 per quintal. In the marketing of the ginger crop, total expenses borne by the producer were Rs. 139.75 per quintal. After the deduction of expenses paid by produce (from the sale price of the ginger crop), the net price received by the producer was Rs. 4110.25 per quintal. Subsequently, the sale price of the wholesaler and purchase price of the retailer was Rs. 5286.25 per quintal, which is the addition of the purchase price (Rs. 4110.25), margin (Rs. 675), and expenses borne by the wholesaler (Rs. 361.25). Finally, the retailer is the ultimate supplier of spices in this marketing channel. Therefore, the sale price of the retailer or purchase price of the consumer includes the purchase price of the retailer (Rs. 5286.25), net margin (Rs. 1160), and expenses borne by the retailer (Rs. 134.50). Hence, the purchase price of the consumer was Rs. 6580.75.00 per quintal.

Table 3

Price Spread of Ginger in Panchkula Market through Channel-II

(Rs. per quintal)

Sr. No.	Particulars	Value
1.	Sale price of producer/purchase price of wholesaler	4250.00 (64.58)
2.	Cost borne by the producer	
	v. Transportation cost	86.00 (1.31)
	vi. Gunny bags/plastic bags	27.50 (0.42)
	vii. Loading charges	5.00 (0.08)
	viii. Storage losses @ 0.5 per cent	21.25 (0.32)
	Sub-total (i to iv)	139.75 (2.12)
3.	Net price received by producer (1-2)	4110.25 (62.46)
4.	Cost incurred by the wholesaler cum commission agent	
	v. Market fee @ 2 per cent	85.00 (1.29)
	vi. Commission @ 4 per cent	170.00 (2.58)
	vii. Storage	21.25 (0.32)
	viii. Spoilage during storage @ 2 per cent	85.00 (1.29)
	Sub-total (i to v)	361.25 (5.49)
5.	Total cost borne by wholesaler (1+4)	4611.25(70.07)
6.	Sale price of wholesalers/purchase price of retailers	5286.25 (80.33)
7.	Net margin of wholesaler (6-5)	675.00 (10.25)
8.	Expenses borne by retailers	
	vi. Packing material	66.85 (1.01)
	vii. Transportation cost	15.20 (0.23)
	viii. Loading and unloading	5.00 (0.08)
	ix. Storage	24.65 (0.37)
	x. Rent of shop/cart	22.80 (0.35)
	Sub-total (i to iv)	134.50 (2.04)
9.	Total cost borne by retailers (6+8)	5420.75 (82.37)
10.	Sale price of retailer/purchase price of consumer	6580.75 (100)
11.	Net margin of retailer (10-9)	1160.00 (17.63)
Price spread (10-3)		2470.50

Source: Field survey

Note: Figures in parentheses are the percentage of the consumer's price.

Thus, Rs. 2470.50 per quintal is the price spread for marketing channel-II, which is lower than the price spread of channel-I. Hence, channel-II is more beneficial to producers and consumers than channel-I because producers receive a higher price for their produce, and consumers purchase at a lower price.

Table 4: Price spread of ginger in Panchkula market through Channel-III

(Rs. per quintal)

Sr. No.	Particulars		Value
1.	Sale price of producers/purchase price of village traders	4150.00 (65.18)	
2.	Cost incurred by the producer		
	iii. Transportation cost	62.00 (0.97)	
	iv. Storage losses @ 0.5 per cent	20.75 (0.33)	
	Sub-total (i to ii)		82.75 (1.30)
3.	Net price received by producer (1-2)		4067.25 (63.88)
4.	Expenses borne by the village traders		
	v. Gunny bags/plastic bags	27.50 (0.43)	
	vi. Weighing	6.00 (0.09)	
	vii. Loading/unloading charges	15.00 (0.24)	
	viii. Transportation cost	49.75 (0.78)	
	Sub-total (i to iv)		98.25 (1.54)
5.	Total cost borne by village traders (1+4)	4248.25(66.72)	
6.	Sale price of village traders/purchase price of retailers	5073.25 (79.68)	
7.	Net margin of village traders (6-5)		825.00 (12.96)
8.	Expenses borne by retailers		
	vi. Packing material	67.00 (1.05)	
	vii. Transportation cost	15.20 (0.24)	
	viii. Loading and unloading	5.00 (0.08)	
	ix. Storage	23.75 (0.37)	
	x. Rent of shop/cart	22.80 (0.36)	
	Sub-total (i to v)		133.75 (2.10)
9.	Total cost borne by retailers (6+8)	5207.00(81.78)	
10.	Sale price of retailer/purchase price of consumer		6367.00 (100)
11.	Net margin of retailer (10-9)		1160.00 (18.22)
Price spread (10-3)			2299.75

Source: Field survey

Note: Figures in parentheses are the percentage of the consumer's price.

Table 4 shows the price spread of ginger crop through marketing channel-III in the Panchkula district of Haryana. Producers, village traders, retailers, and consumers are the main agents in this marketing channel. The sale price of the producer or purchase price of the village trader was Rs. 4150.00 per quintal. In the ginger crop marketing, the producer's total expenses were Rs. 82.75 per quintal. After the deduction of expenses borne by produce (from the sale price of ginger crop), the net price received by the producer was Rs. 4067.25 per quintal.

Further, the expenses borne by the village trader were defined as the expenses of gunny bags/plastic bags (Rs. 27.50), weighing (Rs. 6.0), loading & unloading charges (Rs. 15.00), and transportation costs (Rs. 49.74), which increases the purchase price of retailers. After including the net profit margin of village traders (Rs. 825.0), the sale price of village traders or retailers' purchase price was increased to Rs. 5073.25 per quintal. In marketing channel-III, the retailer is the ultimate intermediate supplier of spices. Therefore, the sale price of the retailer or

purchase price of the consumer includes expenses borne by the village retailer (Rs. 133.75) and net margin (Rs. 1160). Hence, the consumer's purchase price was Rs. 6367.00 per quintal.

The price spread for marketing channel-III was found to be Rs. 2229.75 per quintal, which is lower than the price spread of channel-I and II. Hence, channel-III is more beneficial to producers and consumers than channel-I and II because producers receive a higher price for their produce, and consumers purchase at a lower price.

Table 5: Price spread of ginger in Panchkula market through Channel-IV

(Rs. per quintal)

Sr. No.	Particulars		Value
1.	Sale price of producers/purchase price of retailers	4950.00 (79.29)	
2.	Cost incurred by the producer		
	iii. Transportation cost	62.00 (0.99)	
	iv. Storage losses @ 0.5 per cent	24.75 (0.40)	
	Sub-total (i and ii)		86.75 (1.39)
3.	Net price received by producer (1-2)		4863.25 (77.90)
4.	Expenses borne by retailers		
	vi. Packing material	67.25 (1.08)	
	vii. Transportation cost	15.20 (0.24)	
	viii. Loading and unloading	5.00 (0.08)	
	ix. Storage	23.75 (0.38)	
	x. Rent of shop/cart	22.80 (0.37)	
	Sub-total (i to v)		134.00 (2.15)
5.	Total cost borne by retailers (1+4)	5084.00(81.43)	
6.	Sale price of retailer/purchase price of consumer		6243.00 (100)
7.	Net margin of retailer (6-5)		1159.00 (18.56)
Price spread (6-3)			1379.75

Source: Field survey

Note: Figures in parentheses are the percentage of the consumer's price.

Table 5 shows the price spread of ginger crop through marketing channel-IV in the Panchkula district of Haryana. Only retailers are the intermediary between producers and consumers through this marketing channel. In this channel, the sale price of the producer or purchase price of the retailer was Rs. 4950.00 per quintal. After the deduction of total expenses borne by the producer, i.e., transportation cost (Rs. 62.00) and storage losses (Rs. 24.75 per quintal), the net price received by the producer has left Rs. 4863.25 per quintal, which is higher than channel-I, II, and III's price. Further, the sale price of the retailer or purchase price of the consumer was Rs. 6243.00 (including expenses borne by the retailer (Rs. 134.00) and net margin (Rs. 1160). Hence, the consumer's purchase price was just Rs. 6243.00 per quintal, again lower than channels-I, II, and III's purchase prices of consumers.

However, producers receive higher prices for their crops, and consumers purchase at lower prices than in the abovementioned channels. The price spread for marketing channel-IV was Rs. 1293.00 per quintal, lower than channels-I, II, and III.

Table 6 shows the price spread of ginger crop through marketing channel-V in the Panchkula district of Haryana. In marketing channel-V, there is no intermediary between producers and consumers. Producers directly sale to consumers, and there were no intermediaries between both. However, it is the most efficient marketing channel for the ginger crop in Haryana from the point of view of consumers' and producers' surplus. Consumers pay a minimum price for ginger; producers receive the highest price for their crop. The sale price of the producer or purchase price of the consumer was Rs. 4900.00 per quintal. The price spread was Rs. 106.95 per quintal, equal to the cost incurred by the producer (Rs. 106.95).

Table 6: Price spread of ginger in Panchkula market through Channel-V

(Rs. per quintal)

Sr. No.	Particulars	Value
1.	Sale price of producer/purchase price of consumer	4900.00 (100)
2.	Cost incurred by the producer	
	iv. Packing material	67.25 (1.37)
	v. Transportation cost	15.20 (0.31)
	vi. Storage losses @ 0.5 per cent	24.50 (0.50)
	Sub-total (i and iii)	106.95 (2.18)
3.	Net price received by producer (1-2)	4793.05 (97.82)
Price spread (3-1)		106.95

Source: Field survey

Note: Figures in parentheses are the percentage of the consumer's price.

Marketing Efficiency of Selected Marketing Channels for Ginger Crop in Panchkula District of Haryana

Marketing efficiency is defined as the market output (satisfaction) ratio to market input (cost of resources). According to Acharya (2003), marketing efficiency is measured as the ratio of (price received by farmers) and (total marketing cost plus net marketing margin). Further, it depicts that (a) the higher the total marketing cost, the lower the efficiency, (b) the higher the net marketing margin, the lower the efficiency; and (c) the higher the price received by farmers, the higher the efficiency, and (d) the higher the price paid by the consumer, the lower the efficiency.

Table 7 shows the marketing efficiency of the ginger crop under different marketing channels. The study showed that the lowest consumer purchase price was found under channel-V, and the lowest net marketing costs and margins of intermediaries were also the lowest in channel-V. However, channel-V is the most efficient marketing channel for ginger crop in the Panchkula district of Haryana, and the highest marketing efficiency is for channel-V. Thus, it can be concluded that the lower the number of intermediaries in marketing crops, the higher the marketing efficiency. The findings depicted that marketing channel-V is the most efficient channel with 44.82 points, followed by channel-IV, III, II, and I. Channel-V provides ginger at the lowest price to consumers and the highest price for producers.

Table 7: Marketing Efficiency of Ginger Crop under Different Channels

(Rs. per quintal)

Sr. No.	Particulars	Channel- I	Channel- II	Channel- III	Channel-IV	Channel-V
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1.	Consumer's purchase price (RP)	7373	6580.75	6367	6243	4900
2.	Net marketing costs (MC)	653.25	495.75	232.00	134.00	106.95
3.	Total margins of intermediaries (MM)	2659.75	1835.00	1985.00	1159.00	-
4.	Net price received by producer (FP)	3961.00	4110.25	4067.25	4863.25	4793.05
	Marketing efficiency	1.20	1.76	1.83	3.76	44.82

Source: Field survey

Thus, it can be concluded that among the marketing channels adopted by farmers of ginger in the Panchkula district of Haryana, channel-V (direct from the producer to the ultimate consumer) is the most efficient marketing channel because, by this channel, the producer receives reasonable price for their crop. On the other hand, the consumer received goods at the lowest prices. Hence, both the consumer and producer surplus is maximized.

Problems Faced by Farmers in the Marketing of Spices Crops in Haryana

The leading problems faced by farmers in the marketing of spices crops were high fluctuation in market prices, difficulties in the maintenance of quality standards, exploitation by intermediate agencies, lack of storage facilities, distant market, weight cuts due to poor quality of output, a small quantity of production, non-availability of adequate processing units/mills, and delay in payment by traders. The detailed findings are exhibited as follows:

High price fluctuation in the market: The price of the spices crop has highly fluctuated. About 90.62 per cent of farmers reported it as a leading problem in the marketing of spices crops. Most of the time, farmers fail to anticipate the actual price of their crops. Ultimately, their produce was sold at harvesting sessions market prices. But, without proper storage facilities, they couldn't get the actual price of the crop. In the Panchkula district, 93.75 per cent of ginger growers reported it as a major problem, followed by 97.50 per cent of turmeric growers in Yamunanagar, 88.75 per cent in Karnal (Garlic farmers), and 82.50 per cent of fenugreek growers in Yamunanagar district of Haryana. However, from the farmers' side, the volatile market price is a major problem in marketing spices crops.

Difficulty in maintaining quality standards: To maintain the quality standard of spices crops is another constraint in marketing spices crops. Low-quality spices produce automatically wiped out from the market. Hence, maintaining the standard quality of their products was a big challenge for farmers. Moreover, the quality of a product determines the market value of the produce. Therefore, the greater the quality of spices, the higher the crop's market price. About 84.68 per cent of surveyed farmers reported it as one of the biggest challenges for farmers. They must maintain their product's quality to get a better market price. Ginger producers in Panchkula (88.75 %), Turmeric producers in Yamunanagar (91.25 %), Garlic producers in Karna (85.00 %), and Fenugreek producers in Yamunanagar (84.68 %) highlighted it as a challenge for farmers.

Exploitation by intermediate agencies: Farmers were exploited by intermediate agencies. According to the surveyed farmers, the intermediaries of the mandis, also known as commission agents, buy farmers' produce below the Market price when they come to the mandis to sell their agricultural produce. They perform this with the support of the government inspector, who evaluates the quality of the farmer's products in the mandis, and they to be sold at a cheaper price intentionally determines products to be of low quality. A significant chunk of the profits from farmers' crops goes to commission agents. The farmers left with a very small share. So, about 74.69 per cent of farmers reported that they were exploited in the marketplace by intermediaries in Haryana. The

percentage share of ginger farmers was 82.50 per cent in Panchkula, followed by 88.75 per cent of turmeric farmers in Yamunanagar, 85.00 per cent of garlic farmers in Karnal, and 42.50 per cent of fenugreek farmers in Yamunanagar. However, turmeric grower was the most affected farmers, and fenugreek growers were the least affected (or exploited) farmers at the marketplace by intermediaries. Ultimately, it is a big issue among spice farmers, and government should take some necessary steps to reduce these intermediaries.

Lack of good storage facilities: The unavailability of proper and good storage facilities was also a major constraint in taking advantage of high market prices. Storage facilities are costly, and such types of facilities require a big investment in the construction of warehousing. Farmers fail to get this type of facility because of insufficient finance.

Suggestions

It derived from the results of the current study. These suggestions would contribute to minimizing cultivation costs, improving marketability, and maximizing the returns from growing spice crops. The suggestions are as follows:

1. High price fluctuation and low prices were the main problems that most surveyed faced (spices growers). Therefore, the government should set a minimum support price to secure higher returns on spice crops.
2. The study found that one of the biggest challenges faced by the farmers was the
3. high cost of inputs used in spice growing, such as seed, chemicals, plant protection, etc. The government should offer subsidies on these items so that struggling farmers can grow spice crops. The study findings also revealed that the price of seeds, fertilizer, and plant protection greatly impacted the yield.
4. They lost a significant portion of their crops due to the high price of these things. Therefore, the government should provide subsidies for farmers to receive a considerable payment for their produce.
5. According to the survey, some spice growers experienced difficulties due to the market availability of fraudulent seed and pesticide brands. Therefore, the government should investigate these items and suspend the licenses of enterprises that offer higher-quality seeds and pesticides.
6. The study found that soil testing facilities were not used by most of the farmers. This is a result of farmer; lack of awareness about these facilities. The horticultural department should take some steps to educate people about soil testing through a testing programme like seminars, workshops, conferences, etc. Therefore, producers can benefit from their crops.
7. Another issue identified by the respondents was the inadequacy of technical guidance for the proper operation of sowing, new plantation technology, grading, and processes. Therefore, the government must consistently organize workshops for farmers to give innovative technical knowledge, through seminars, workshops, and conferences. Furthermore, a campaign including print materials, radio, television, and helplines should be used to teach farmers about the crops used to produce spices.
8. Credit facilities must be made available to farmers so they can easily pay for labour, farm yard manure, irrigation costs, and the rental value of land in addition to inputs (seed, fertilizer, insecticides, etc.). Hybrid and high-quality seeds should always be available to remedy poor output issues. The spices farmers would benefit financially from crop loans, and the earlier suggested minimum support prices.
9. The study findings showed that the main problem concerning farmers was a lack of skilled labour. Therefore, it is important to concentrate on the skill development of the labour force involved in the production of spice crops to solve this problem. These skills are related to planting, picking weeds, processing, collecting, packing, polishing, etc. Therefore, the horticultural department and government should introduce programs.
10. In a hilly area, a lack of transportation options and high transportation costs end up paying for a huge proportion of marketing costs. Therefore, the government needs to find affordable public transport options for the products produced from spices.

11. The problem of spice production getting rejected is also highlighted in the spice market. Various factors contribute to product rejection. Some of these included poor-quality standards, intermediaries' adverse influence, the perishable nature of the goods, etc. Therefore, the government and the horticultural department should try to eliminate the intermediary role. Therefore, spice sales and purchases should be performed under government involvement.

12. Farmers depend on the horticulture department for skills training (plant protection, sowing, disease, and nutrient, etc.). Therefore, the department needs to make arrangements for specialist visits so they can guide the farmers. Furthermore, the government should take steps to lower experts' workloads so they can provide their best effort during duty days.

13. Research should be conducted to evaluate the standard of spice crops, technology, equipment knowledge, current demand and supply gap, processing spices, and the export and import of spice crops.

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ORGANIZATIONAL, INDIVIDUAL, AND SOCIODEMOGRAPHIC FACTORS THAT INFLUENCE PRO-ENVIRONMENTAL BEHAVIOR OF EMPLOYEES

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Anthropogenic climate change currently poses a threat to existing systems of human societies. Human behavior is a major contributor to environmental pollution. Employees play an important role in reducing or eliminating the negative environmental effects produced by business firms. The present study identifies several organizational factors (green human resource management practices, corporate environmental policy, supervisory support behavior for environmental initiatives, and environmental transformational leadership) as well as various individual and socio-demographic factors such as environmental knowledge, environmental concern, social norms, green commitment, age, gender, education, etc. that influence pro-environmental behavior of employees at the workplace. In this study, we propose a conceptual framework that gathers organizational, individual, and socio-demographic factors together in one model to understand the complex mechanisms that predict pro-environmental behavior in the workplace.

Keywords: Pro-environmental Behavior, Climate Change, Organizational Factors, Individual Factors, Sociodemographic Factors.

1. INTRODUCTION

Recent years have seen an increase in issues carried on by anthropogenic climate change, such as natural disasters (such as floods and brushfires) and the deterioration of ecosystems. Since the 1980s, human demands on the environment have vastly surpassed the biosphere's potential for regeneration. The long-term survival of biological life is increasingly threatened by the quick and growing depletion of natural resources, pollution, and biodiversity loss brought on by human activities, particularly economic ones like industrial production, electricity generation, transport, and agriculture. As a result of climate change, natural disasters, and a lack of natural resources, the environment is deteriorating day by day. These changes have encouraged governments all across the world to make bold commitments, like the Paris Agreement's objective of achieving net-zero carbon emissions by 2050. India ranked third among all nations in terms of CO₂ emissions in 2020 with 2411.73 million tonnes (world population review) and 180th out of 180 in terms of environmental performance in 2022. Environmental sustainability has also evolved into an ethical and strategic imperative for organizations. Environmental sustainability is defined as the responsible interaction with the natural environment to ensure the continuing quality of life on Earth (World Commission on Environment and Development Report, 1987). The environment becomes polluted as a result of organizational and human actions like the burning of fossil fuels, the emission of carbon monoxide, and over-logging. Employee behavior frequently determines how environmental programs are successful because human activity is a key contributor to climate change. Today, several organizations have economic, social, and environmental performance goals as part of their triple-bottom-line strategy (Elkington, 1998). In addition to being accountable to their shareholders, corporations must also take care of the safety and well-being of their customers, employees, and other stakeholders i.e., corporate social responsibility.

Employees can be recognized as an indispensable part of any organization. Because being actively participating in organizational activities, employees may significantly modify their working environment by incorporating green initiatives into their daily work routine. Because of this, employee behavior regarding the implementation of environmental initiatives is essential for organizational greening. Human behavior is a major contributor to

environmental pollution. Understanding and promoting employee pro-environmental behavior, such as recycling, waste management, energy consumption reduction, or any other behavior that consciously seeks to minimize the negative effects of one's actions on the environment, is one strategy to lessen the negative environmental impact and promote the positive environmental impact of organizations on the environment (Kollmuss and Agyeman, 2002).

In the present study firstly, we will identify the factors that influence pro-environmental behavior of employees. Next, it will explain the category-wise factors that influence pro-environmental behavior. In the last section, we will depict an integrative conceptual framework.

Pro-environmental behavior (PEB)

Pro-environmental behavior (PEB), also known as green, sustainable, environmentally friendly, or eco-friendly behavior, is defined as behaviors in which individuals take preventive actions toward saving the environment. Employee's pro-environmental behavior has been defined as the "willingness to engage in pro-environmental activities" (Scherbaum, Popovich, & Finlinson, 2008, p. 827). It includes switching off PCs or lights when no usage, recycling, reducing carbon emissions, and adopting green initiatives to protect the environment from hazards or disasters. The implementation of these initiatives mostly depends on the engagement of an individual in these activities. Employee pro-environmental behaviour (PEB) enables organizations to reduce their carbon footprint (Roberston & Barling, 2013), as well as future environmental deterioration and climate change. PEB encourages consistency in an organization's socially and ecologically responsible aims as a means of promoting sustainable growth and organizational success.

2. OBJECTIVES

The objectives of the current study are:

To study the organizational factors that influence the pro-environmental behavior of employees at the workplace.
To identify the individual factors that influence the pro-environmental behavior of employees at the workplace.
To study the sociodemographic factors that influence the pro-environmental behavior of employees at the workplace.

3. RESEARCH METHODOLOGY

The paper is predominantly based on secondary data supported by previous studies identified in various articles, research papers, and online publications.

4. FACTORS AFFECTING THE PRO-ENVIRONMENTAL BEHAVIOR OF EMPLOYEES

Based on previous studies, the factors are categorized into three parts i.e., organizational factors, individual factors, and sociodemographic factors:

4.1 Organizational factors

Organizational factors include green human resource management practices, corporate environmental policy, supervisory support behavior for environmental initiatives, and environmental transformational leadership which predict employees' pro-environmental behavior are discussed below in detail:

Green human resource management practices

Green HRM is an integration of environmental management with human resource management. Green HRM is the application of human resource management practices to encourage corporate organizations to use resources optimally and to achieve environmental sustainability (Kulsum, 2019). Green HRM practices influence employees' green behaviors to protect the environment (Cherian & Jacob, 2012). There are various HR practices

applied by organizations like green recruitment and selection, green training and development, green rewards and compensation, green employee empowerment, and green performance management. They have a significant impact on employees' pro-environmental behavior (Dumont et al., 2016; Saeed et al., 2018; Pham et al., 2019).

Corporate environmental policy

A government's or organization's compliance with environmental-related laws, rules, and other policy processes is known as its environmental policy. These concerns generally include air and water pollution, waste management, ecosystem management, maintenance of biodiversity, and the management of natural resources, wildlife, and endangered species. For instance, in terms of environmental policy, it might be possible to develop a globally eco-energy policy to address the problems of global warming and climate change. Ramus and Steger (2000) and Raineri & Paille' (2016) have demonstrated that corporate environmental policy, as expressed through a firm's environmental strategy, management systems, and practices, can foster an environment that signifies organizational support and, eventually, leads to innovative environmental behaviors.

Supervisory support behavior

Employees' motivation to work towards environmental activities is influenced by supervisory/managerial behaviors that encourage employees' environmental initiatives. Managers have a pivotal role in firms that want to encourage innovation, growth, and change. The most important characteristics of supervisors who support environmental behavior in organizations were invention, training and education, communication, information sharing, incentives and appreciation, and management of objectives and obligations. Ramus and Steger (2000) have successfully demonstrated that supervisory support behavior positively contributes to employees' pro-environmental behavior. Leadership support behavior has a significant impact on employees' intention to act environmentally friendly (Blok et al., 2015).

Environmental transformational leadership

A dynamic and effective leadership style, transformational leadership is characterized by four associated behaviors: (a) idealized impact (i.e., focusing on and inspiring ethical behavior), (b) inspirational motivation (i.e., rising employee motivation and optimism), (c) intellectual stimulation (i.e., encouraging employees to take on novel approaches for themselves), and (d) individualized consideration (i.e., demonstrating situations related to individual employees). Environmental transformational leaders influence their followers to participate in pro-environmental behaviors at work when the leaders have a tight bond with their followers. Because of this, followers are more likely to choose to actively engage in environmentally beneficial activities out of their own free will than out of a sense of obligation. Environmental transformational leadership predicted employees' PEB in public and private organizations in Kazakhstan (Omarova & Jo, 2022).

4.2 Individual factors

Individual factors may include environmental knowledge, environmental concern, social norms i.e., descriptive norms and injunctive norms, and green commitment that influence the pro-environmental behavior of employees are discussed below:

Environmental knowledge

Environmental knowledge refers to an individual's understanding of environmental problems and their potential solutions. Cheng and Wu (2015) defined environmental knowledge as the knowledge of environmental challenges and potential solutions to those challenges like environmental preservation. Employees who know environmental management, waste management, and resource efficiency are more likely to engage in pro-environmental

behavior at work, such as turning off computers, lights, and fans after office hours, saving water and electricity, printing on both sides of the paper, using electronic media to reduce paper use, avoiding disposable teacups, and using the stairs rather than elevators (Barr, 2007). According to Afsar, Badir, and Kiani (2016), employees' environmental knowledge influences their intentions to engage in pro-environmental behaviors. Mansoor & Wijaksana (2021) found that environmental knowledge has a significant and positive impact on PEB.

Environmental concern

According to Afsal and Atalar (2016) and Mansoor and Noor (2019), environmental concern is regarded as a fundamental spirit that reflects how concerned a person is with threats to the universe, the consequences of those risks for future generations, and the harmony of nature. As they have a higher tendency and intention to engage in eco-friendly behavior, people who are worried about the environment demonstrate more protective behavior towards the environment (Chekima et al. 2016; Nabilla 2019). Strong environmental concern beliefs are associated with a higher likelihood of engaging in environmentally friendly behavior, according to a substantial amount of prior research (Mansoor and Noor 2019; Newton et al. 2015).

Social norms

Social norms can be defined as a set of “rules and norms that are understood by members of a group, and that guide and/or constrain human behavior without the force of laws” (Cialdini & Trost, 1998, p. 152). Social norms are shared beliefs about what constitutes appropriate behavior in a particular situation. There are two types of social norms (1) injunctive norms i.e., what most people approve in a given culture which is expressed through rewards and punishments, and (2) descriptive norms, which is observed behavior in certain circumstances i.e., behavior implemented most of the people. The recent studies conducted by (Mouro & Duarte, 2021; Terrier & Marfaing, 2015) social norms have a significant influence on an individual's pro-environmental behavior.

Green Commitment

Employee commitment is defined as their psychological condition concerning how closely they feel connected to their organization. According to previous studies, commitment controls an individual's behavior (Afsar, Al-Ghazali, & Umrani, 2020). According to Kim et al. (2019), a person's psychological attachment, dedication to the organization's goals and ideals, and sense of duty toward its objectives all play an important role in their sense of commitment to the preservation of the environment. The term "internal and duty-based motivation to preserve the natural environment" is used to describe employee GC. Therefore, according to Montabon, Pagell, and Wu (2016), an employee's GC is an emotional attachment, identification, and involvement as well as a concern for the workplace environment.

4.3 Socio-demographic factors

Many socio-demographic factors influence the pro-environmental behavior of employees. These factors include age, gender, education, marital status, income, experience, working level, etc. The socio-demographic stream suggests a focus on "exploring" who is more environment-mentalist: high-income/low-income persons, men/women, and rich/poor countries. Although the associations are not extremely strong, education and age are positively related to environmental concern, belief, and behavior. Dunlap et al. 2000 in their study asserted that no analysis of gender with environmental issues has been found. According to several studies by researchers (Straughan and Roberts 1999; Kilbourne and Polonsky 2005), the attitudes, roles, and skills that men and women adopt determine their PEB.

Organizational Factors

- Green human resource management
- Organizational environmental policy
- Supervisory Support Behavior
- Environmental Transformational

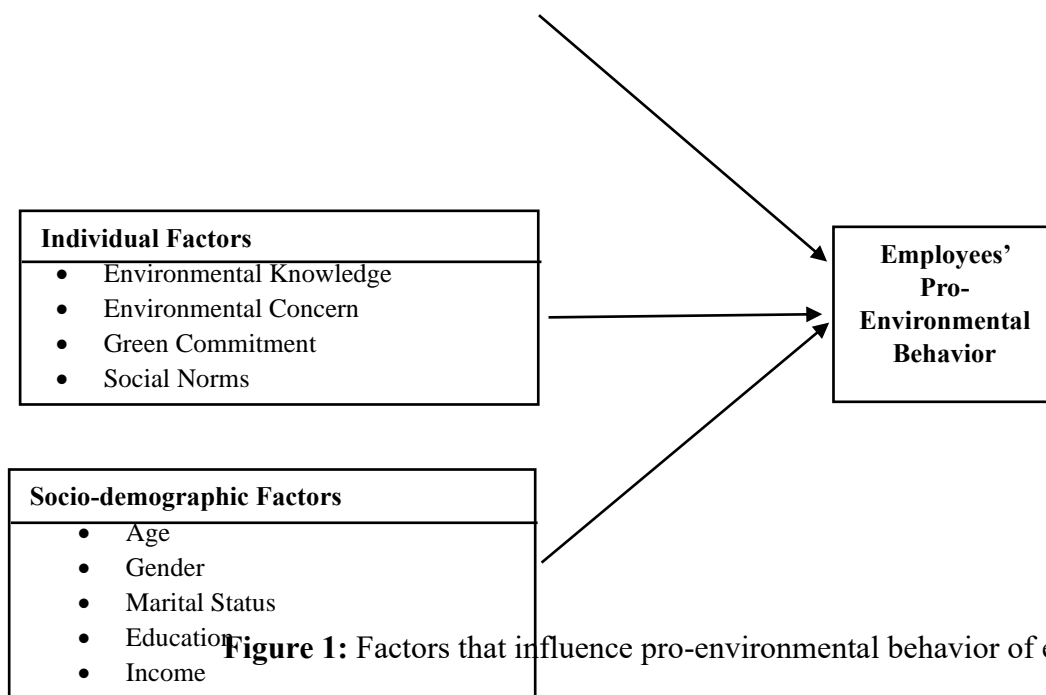


Figure 1: Factors that influence pro-environmental behavior of employees.

5. CONCLUSION

PEB is a developing and essential performance construct that has got increased attention from organizational researchers and practitioners over the past two decades. The literature on pro-environmental behavior has grown quickly in recent years, but there is still space for improvement. Environmental sustainability is an important factor for societal and organizational development. Environmental sustainability is endangered by several environmental problems. Many of these problems have roots in human behavior, they can be managed by changing the relevant human behavior, which may lessen their negative environmental effects. The current study identified the factors which are divided into three categories i.e., organizational (green human resource management practices, corporate environmental policy, supervisory support behavior for environmental initiatives, and environmental transformational leadership), individual (environmental knowledge, environmental concern, social norms, and green commitment), and socio-demographic (age, gender, education, marital status, and income) factors which predict the pro-environmental behavior of employees.

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WORK-LIFE BALANCE AMONG EDUCATORS: A STUDY ON THE INTERSECTION OF PERSONAL AND PROFESSIONAL LIFE

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This research examines work-life balance among school teachers in Haryana, focusing on the challenges they face and the role of perceived organizational support. A survey was conducted with a sample size of 200 teachers in Haryana. The findings reveal moderate work-life balance challenges and high organizational support. Statistical analyses indicate significant positive relationships between workload, time pressure, lack of control over work schedules, and perceived organizational support. The study emphasizes the importance of reducing challenges and enhancing support for teachers to promote work-life balance. These insights inform interventions and policies that foster a supportive work environment, benefiting both teachers and students.

Keywords: Work, Life, Balance, Teachers

1. INTRODUCTION:

Achieving an optimal alignment between an individual's professional and personal life is essential to foster personal satisfaction, well-being, and professional achievement. Work-life balance entails effectively managing and allocating one's time, energy, and commitment to both work responsibilities and personal endeavours. It involves deriving fulfilment and meaningful experiences from various spheres of life without compromising productivity or success in one's career (Kirchmeyer, 2000). Teachers have the power to inspire and positively impact lives, contributing to meaningful change in the world on a daily basis. They play a crucial role in shaping students' personalities by providing high-quality education. However, when teachers experience stress, excessive workloads, and job dissatisfaction, along with an imbalance between work and family life, it significantly impairs their ability to deliver optimal education and foster the development of successful students (Burke, 2002).

Work-life balance is an ongoing effort to allocate time for household tasks, maintain social connections, engage in personal activities such as prayer and self-growth, and meet work-related obligations (Yogeshwaran, 2016). According to Smith et al. (2011), work-life balance primarily involves employees having a significant level of control over when, where, and how they perform their job duties, allowing for the pursuit of a fulfilling personal life beyond work. Work-life balance entails navigating workplace stress while managing the daily pressures of family, friends, and personal needs. It involves effectively managing multiple responsibilities in both personal and professional domains (Swathi & Mohapatra, 2015). Work-life balance is a pervasive concern that affects organizations, employees, and society as a whole. Imbalance occurs when individuals prioritize one aspect of life while neglecting the other, making work-life balance an increasingly challenging issue for both employees and employers. The balance between work and family life is influenced by psychological factors, such as job satisfaction, which holds greater significance for employees in professional roles (Clarke et al., 2004). In the realm of work-life balance, job satisfaction and job stress are intertwined factors that contribute to attaining the desired equilibrium between work and personal lives for employees.

Work-Life Balance and the Education Sector

The education sector places significant responsibilities and work pressures on professionals, with seemingly endless academic tasks. Teaching professionals often face challenging decisions regarding their career options and domestic life. Work-life balance is a crucial aspect that must be achieved to ensure effective functioning both at work and at home. The imbalance between work and personal life adversely affects both the family and job of female teachers, which can only be resolved when organizations and families receive the necessary support, allowing female teachers to contribute excellently (Uddin et al., 2013).

Women prove to be valuable assets in the workplace, and it is essential for organizations to identify the causes of imbalances (Morgenstern, 2008). Work-life initiatives encompass various strategies, policies, and practices implemented and maintained in the workplace to address the quality of work, life, and work-family conflicts. Broadly defined, work-life balance entails a healthy integration of employees' professional and personal responsibilities. Successfully achieving a work-life balance leads to the creation of a more satisfied and productive workforce, contributing to the growth and progress of an organization (Shravanthi, 2013). The psychological engagement of individuals in their work and their involvement in family duties are vital components of work-life balance (Kowitha, 2018). Work-life balance is receiving increasing attention in the workplace due to its potential to significantly impact productivity, organizational profitability, and employee relationships with management. It plays a vital role in reducing work-related stress, improving morale, and fostering better teamwork. Employees have two valuable assets: their family and their work. When a conflict arises between family and work responsibilities, it has detrimental effects on both the employee and the organization. The competing demands of work and family roles, coupled with limited time, physical energy, and psychological resources, lead to negative outcomes in both domains (Greenhaus & Beutell, 1985). Therefore, work-life balance can be defined as achieving a satisfactory level of involvement or 'fit' between the multiple roles in an individual's life (Hudson, 2005).

Teachers have the power to awaken a students' belief in themselves and make a profound impact on their lives. Albert Einstein once said, "It is the supreme act of the teacher to awaken joy in creative expression and knowledge." However, if teachers fail to maintain physical and mental balance, they will be unable to effectively develop students and contribute to the betterment of the nation. Teachers play a crucial role in shaping the personalities of their students, requiring them to bring novelty to their ideas and demonstrate dependability in their behaviour. The relationship, communication, and behaviour of teachers with their students serve as a means to foster emotional regulation, critical thinking, problem-solving aptitude, and social skills. Education is a symbol of humanism, tolerance, and the pursuit of developmental ideas. It represents the progress of the human race towards higher goals and objectives, making educational institutions the revered centres of knowledge. In the teaching profession, work-life balance holds particular significance. With global competition and evolving dynamics in the education sector, teachers must fulfil their responsibilities with a focus on skills and high performance. However, to deliver results effectively, teachers must also strive for balance and contentment. A school's success is not solely dependent on its infrastructure but on motivated academicians who possess exemplary character and integrity. An atmosphere of trust, flexibility, and empathy is essential for teachers to flourish and guide students as true mentors. As teachers, they wear multiple hats, representing various roles.

Unfortunately, in the education sector, which employs a large number of workers, the ability to balance work life and personal life has become a challenge due to global dynamics and environmental changes. Teachers are the backbone of a school, and their job extends far beyond assigned hours. It involves mentoring, guiding, and conducting research. However, there is a negative perception in society that stereotypes the teaching profession as an easy job lacking hard work and talent. This misconception overlooks the immense effort and dedication required of teachers. In this challenging scenario, teachers must create a learning environment that facilitates clear understanding for all students. It is crucial for society to recognize the true nature of the teaching profession and support teachers in their pursuit of creating a positive and impactful educational experience for students.

Teachers often experience a significant imbalance between the demands of their personal lives and the demands of their work. In addition to the responsibilities of their teaching profession, teachers also need to attend to personal and familial concerns (Teody, 2017). Strong evidence supports the association between overtime work hours and lower levels of work-life balance. Worktime arrangements have a notable impact on work-life balance (Albertsen et al., 2008).

Work-life balance is particularly crucial for individuals working in educational institutions as they contribute to knowledge creation for all sectors of society. Therefore, an imbalance between family and work life among academics can have detrimental effects on other sectors (Greenhaus, Collins, & Shaw, 2003). The contribution of high school teachers in the Indian education system is vital, and thus, it is essential to focus on their work-life balance. According to Veenhoven (1991), achieving an appropriate balance between job and personal life leads to greater contentment and happiness in individuals.

2. REVIEW OF LITERATURE:

Santiago (2023) conducted a qualitative study using phenomenology to explore the work-life balance experiences of public school primary teachers during the COVID-19 pandemic. The findings revealed changes in workload, both constructive and adverse experiences, challenges faced by teachers, coping techniques employed, and strengthened values and faith during the pandemic.

Chadda and Talwar (2022) focused on the impact of work-life balance (WLB) and self-efficacy (SE) of faculty members on their satisfaction and effectiveness in higher education institutes (HEIs) in India. The study highlighted the importance of HEIs in India's growth and the role of faculty members in shaping the youth. The findings indicated a positive correlation between WLB, SE, satisfaction, and effectiveness. The study contributes to the understanding of these variables in the critical education industry. However, it is important to note that the data collection was limited to the Delhi-NCR region, which is a limitation of the study.

Mathews, O.A., Jeremiah, K.M., & Ursulla, O.A. (2021) examined the influence of work-life balance characteristics on job satisfaction among teachers in public secondary schools in Nairobi County, Kenya. Supervisor support and gender were investigated as factors affecting job satisfaction. The study utilized a descriptive survey design with a sample of 670 teachers and 67 principals from 83 public secondary schools. Data were collected through interviews and questionnaires. Descriptive statistics, correlation analysis, and multiple regression were used for data analysis. The findings indicated supportive principals, particularly in granting personal needs and training opportunities. No significant gender-based differences in job satisfaction were observed. The study suggests policy formulation by the Teachers Service Commission to enhance work-life balance among teachers and recommends conducting comparative studies in rural areas.

Eby et al. (2020) identified several key themes and trends in work-life balance research. They found that the majority of studies focused on the impact of work-life balance on employee outcomes, such as job satisfaction, organizational commitment, and well-being. The review also highlighted the importance of organizational support, flexible work arrangements, and individual strategies for managing work and family responsibilities. The study contributes to the understanding of work-life balance by synthesizing the existing literature and providing a roadmap for future research. It underscores the significance of work-life balance for both employees and organizations, emphasizing the importance of supportive work environments and flexible policies to promote employee well-being and satisfaction.

Ghosh and Bhattacharya (2019) examined the factors influencing work-life balance among teachers in India. The findings revealed that excessive workload, lack of support from school administrators, and inadequate work-life balance policies were significant factors hindering teachers' work-life balance. The authors stressed the importance of organizational support and policies tailored to the unique needs of teachers.

Rao and Sharma (2018) found that work-life balance has a 360-degree impact on employees, affecting their personal and professional lives. Imbalances in work-life negatively impact employee satisfaction, physical and mental health, commitment to work and family, and overall job performance. Organizations that prioritize work-life balance and offer flexibility retain talented employees and gain a competitive edge.

Sharma and Sharma (2018) explored the work-life balance strategies employed by teachers in the Indian context. The findings highlighted the significance of effective time management, prioritization of tasks, and seeking support from family and colleagues as key strategies adopted by teachers to maintain work-life balance. The authors emphasized the need for organizational policies that promote flexibility and provide resources to support teachers' work-life balance efforts.

Sparks and Cooper (2017) examined the work-life balance experiences of primary school teachers in the United Kingdom. The study found that teachers experienced significant work-related demands, leading to work-life conflict and compromised personal well-being. The authors emphasized the need for supportive organizational practices and policies to enhance teachers' work-life balance.

Sanchez et al. (2016) conducted a study to enhance scholars' understanding of work-life balance (WLB) policies in small and medium enterprises (SMEs). The study utilized fuzzy-set qualitative comparative analysis and aimed to determine if there is a common pattern of behavior among SMEs when implementing WLB policies. The findings revealed that the implementation of WLB policies in SMEs is contingent upon how the firm perceives the benefits associated with such policies. If the firm does not perceive organizational performance benefits, they are unlikely to implement WLB policies. The study highlighted that the main determining factor for implementing WLB policies is the perceived market-based benefits, and a higher perceived benefit of improved organizational performance makes the implementation of WLB policies more attractive to human resource managers. The implementation of WLB policies aims to improve working conditions for employees and enhance the productivity of the organization.

Malik (2015) conducted a study to examine the influence of work-life balance on the marital status and gender of employees in various companies in Delhi and NCR. The sample consisted of 70 employees in first-line management, selected through convenient sampling. The results indicated a significant relationship between work-life balance and marital status. Although the gender impact on work-life balance was found to be marginal, the interaction effect between gender and marital status was also found to be significant.

Feldman, and Butts (2014) identified strategies such as setting boundaries between work and personal life, effective time management, seeking social support, and engaging in self-care activities. Additionally, flexible work arrangements, such as reduced hours or telecommuting, can contribute to improved work-life balance

Demerouti, Bakker, Geurts, and Taris (2009) demonstrated that teachers with better work-life balance experience reduced burnout, increased job satisfaction, and higher commitment to their profession. Moreover, organizations that prioritize work-life balance create a positive work environment, leading to improved teacher retention and productivity

O'Driscoll, and Kalliath (2005) found that teachers often experience high levels of work-related stress, long working hours, and difficulties in separating work from personal life. These challenges can lead to negative consequences such as burnout, reduced job satisfaction, and conflicts in personal relationships.

Summary The existing literature highlights the challenges faced by school teachers in achieving work-life balance, including work-related demands, personal responsibilities, and organizational factors. Strategies such as setting boundaries, effective time management, and seeking support can contribute to work-life balance. Attaining a work-life balance has positive implications for teacher well-being, job satisfaction, and retention. Organizational support and policies that promote work-life balance are crucial in fostering a conducive work environment for teachers.

3. RESEARCH METHODOLOGY:

Research Objectives:

1. To identify the key challenges that school teachers in Haryana face in achieving work-life balance.
2. To explore the strategies employed by teachers to cope with work-life balance challenges.
3. To assess the perceived level of organizational support provided to teachers in achieving work-life balance.
4. To examine the implications of work-life balance on teacher well-being, job satisfaction, and retention.

Research Design :

This study adopts a mixed-methods research design to provide a comprehensive understanding of work-life balance among school teachers in Haryana. The quantitative component involves a survey to gather data on work-life balance challenges, perceived organizational support, and demographic characteristics. Sampling and Participants

A purposive sampling technique was employed to select participants from primary and secondary schools across different districts in Haryana. The sample will include both male and female teachers with varying levels of experience and responsibilities. A target sample size of approximately 200 teachers will be sought to ensure an adequate representation of perspectives and experiences.

Data Collection:

Quantitative Data A structured questionnaire was developed based on previous research and theoretical frameworks. The questionnaire consists of validated scales and items assessing work-life balance challenges, perceived organizational support, and demographic information. Measures such as the Work-Life Balance Scale (Clark, 2000) and the Perceived Organizational Support Scale (Eisenberger, Huntington, Hutchison, & Sowa, 1986) may be adapted for use in this study.

The survey was administered electronically using online survey platforms. Participants were provided with a link to access the questionnaire, and they were given a specific timeframe to complete it. To ensure confidentiality, participant identities will remain anonymous, and data will be securely stored.

5. DATA ANALYSIS AND INTERPRETATION:

Table 1: Demographic Characteristics of Participants

Demographic Variable	Frequency	Percentage
Gender		
Male	80	40%
Female	120	60%
Age (years)		
25-35	50	25%
36-45	80	40%
46-55	50	25%
Above 55	20	10%
Teaching Experience (years)		
1-5	60	30%
6-10	80	40%

Demographic Variable	Frequency	Percentage
11-15	40	20%
Above 15	20	10%
Educational Qualification		
Bachelor's degree	30	15%
Master's degree	160	80%
Ph.D.	10	05%

Source: Survey

Table 1 provides an overview of the demographic characteristics of the participants. Out of the total sample of 200 school teachers in Haryana, 80 participants (40%) identified as male, while 120 participants (60%) identified as female. The age distribution shows that the majority of the participants (40%) fall within the age range of 36-45 years. In terms of teaching experience, the largest group (40%) reported having 6-10 years of experience. Educational qualifications reveal that 15% of the participants hold a bachelor's degree, 80% have a master's degree, and 5% possess a Ph.D.

Table 2: Descriptive Statistics of Work-Life Balance Challenges

Work-Life Balance Challenges	Mean	Standard Deviation
Workload	3.45	0.98
Time Pressure	3.12	0.86
Role Conflict	2.78	0.92
Lack of Control over Work Schedules	3.21	0.94

Source: Survey

Table 2 depicts the mean and standard deviation of work-life balance challenges experienced by school teachers. On a scale from 1 to 5, the participants reported a mean score of 3.45 (SD = 0.98) for workload, indicating a moderate level of perceived workload. The mean scores for time pressure, role conflict, and lack of control over work schedules were 3.12 (SD = 0.86), 2.78 (SD = 0.92), and 3.21 (SD = 0.94), respectively. These findings suggest that the teachers perceive moderate levels of time pressure, role conflict, and lack of control over their work schedules.

Table 3: Descriptive Statistics of Perceived Organizational Support

Perceived Organizational Support	Mean	Standard Deviation
Perceived Support	4.21	0.78

Source: Survey

Table 3 displays the mean and standard deviation of perceived organizational support among the school teachers. The participants reported a mean score of 4.21 (SD = 0.78) for perceived organizational support on a scale from 1 to 5. This indicates a relatively high level of perceived support from the organization.

Table 4: Correlation Matrix of Work-Life Balance Challenges and Perceived Organizational Support

	Workload	Time Pressure	Role Conflict	Lack of Control	Perceived Organizational Support
Workload	1.00	0.62	0.45	0.55	0.32
Time Pressure	0.62	1.00	0.58	0.47	0.26
Role Conflict	0.45	0.58	1.00	0.39	0.18

	Workload	Time Pressure	Role Conflict	Lack of Control	Perceived Organizational Support
Lack of Control	0.55	0.47	0.39	1.00	0.31
Perceived Organizational Support	0.32	0.26	0.18	0.31	1.00

Source: Survey

Table 4 illustrates the correlation coefficients between work-life balance challenges (workload, time pressure, role conflict, and lack of control) and perceived organizational support. The correlation coefficients range from -1 to +1. The results indicate that workload is positively correlated with time pressure ($r = 0.62$), role conflict ($r = 0.45$), and lack of control over work schedules ($r = 0.55$). Time pressure and lack of control over work schedules also show a positive correlation with role conflict ($r = 0.58$ and $r = 0.39$, respectively). Perceived organizational support demonstrates a positive but relatively weak correlation with all work-life balance challenges, with correlation coefficients ranging from 0.18 to 0.32.

Table 5: Regression Analysis of Perceived Organizational Support on Work-Life Balance Challenges

	B	SE	β	t	p
Constant	3.89	0.42		9.26	<0.001
Workload	0.27	0.08	0.28	3.35	0.001
Time Pressure	0.18	0.06	0.20	3.00	0.003
Role Conflict	0.12	0.07	0.13	1.71	0.091
Lack of Control over Work Schedules	0.24	0.09	0.25	2.70	0.008

Source: Survey

Note: B = Regression Coefficient, SE = Standard Error, β = Standardized Coefficient, t = t-value, p = p-value

Table 5 presents the results of the multiple regression analysis, with perceived organizational support as the dependent variable and work-life balance challenges (workload, time pressure, role conflict, and lack of control over work schedules) as the independent variables. The beta coefficients (β) represent the standardized regression coefficients, indicating the strength and direction of the relationship between each independent variable and the dependent variable, when controlling for other variables.

The results show that workload ($\beta = 0.28$, $p = 0.001$) and time pressure ($\beta = 0.20$, $p = 0.003$) have a significant positive relationship with perceived organizational support. This suggests that higher levels of perceived workload and time pressure are associated with higher perceptions of organizational support. However, the relationship between role conflict ($\beta = 0.13$, $p = 0.091$) and lack of control over work schedules ($\beta = 0.25$, $p = 0.008$) is not statistically significant. The constant term ($\beta = 3.89$, $p < 0.001$) represents the average level of perceived organizational support when all independent variables are held constant.

6. Conclusion:

This study aimed to explore work-life balance among school teachers in Haryana by examining work-life balance challenges, perceived organizational support, and their relationships. Based on the findings, it is evident that work-life balance is a significant concern for school teachers in Haryana. The challenges they face, such as workload and time pressure, can potentially impact their well-being and job satisfaction. The results also highlight the importance of perceived organizational support in mitigating work-life balance challenges among teachers. To promote better work-life balance for teachers in Haryana, interventions should focus on reducing workload and time pressure, while simultaneously enhancing organizational support. Strategies such as workload

redistribution, flexible scheduling, and supportive leadership can contribute to a more conducive work environment that fosters work-life balance. Furthermore, initiatives aimed at improving communication, resources, and policies within educational institutions can enhance perceived organizational support and alleviate work-life balance challenges.

In conclusion, this study underscores the significance of work-life balance among school teachers in Haryana. By identifying the challenges, they face and the role of organizational support, the findings provide valuable insights for educational policymakers, administrators, and school leaders to develop effective interventions and policies that prioritize work-life balance, ultimately enhancing the well-being and job satisfaction of teachers in Haryana.

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BEHAVIORAL FINANCE: A NEW APPROACH FOR INVESTORS

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Evolving Time and education have started pointing out the importance of a person's behaviour and psychology in their decision-making capability and capacity. The study of Behavioral Finance helps to explore the factors and reasons that affect a person's decision-making regarding investing and other financial decisions. The objective of the present research is to understand how people are affected by various factors when they make investment decisions. The paper concludes that extensive advertisements of investing applications, courses, and success stories of successful investors in social media are important factors that affect investing activity.

Keywords: Behavioral Finance, Behavioural Bias, Financial Avenues, Investment Avenues, Portfolio selection

1. INTRODUCTION

"Behavioral Finance" is a fascinating area of study that delves into the intricate relationship between human psychology and investment decision-making. It sheds light on the reasons behind the occasional emergence of irrational behaviour in financial markets, even when rationality and market efficiency are expected (Abu Karsh, S.M. 2018; De Bondt, Werner F. M. 1998; Tversky, A., & Kahneman, D. 1982). Behavioural Finance is unique when compared to other traditional theories related to Investor's decision-making. Normally the theories suggest that the Investor is very Rational and so is its decision making. They make everything seem monotonous as if human Being is just another machine or as if we live in a simulated world or a simulation (De Bondt et al. 2013). Amongst these theories, Behavioral Finance opens a beautiful window of creativity, uniqueness, and art and it makes humans feel like humans. Humans are said to be social animals and if a person is so involved with society how is it possible that it does not consider facts and events around it when making an important decision (Dominicand Ambuj, 2020). Traditional financial theories were well-designed to help people make thoughtful financial choices, yet they were unable to explain the stock market disturbances. These irregularities or disruptions occasionally manifested as stock market bubbles, market underreactions or overreactions, momentum shifts, and reversals. Behavioural Finance embraces these unique characteristics of humans, it states how differently can one think, what factors might affect the decision-making of Investors and how with just little tweaks in someone's surroundings reality may change which could understandably show how one's decision-making is not necessarily a rational one (Venkatapathy&Sultana 2016; Prosad et al. 2015).



Figure-1 Behavioural Finance

Source: <https://www.mbaknol.com/financial-management/an-introduction-to-behavioral-finance/>

Behavioural finance investigates the economic, financial, sociological and psychological factors that affect how individuals and institutions make investment decisions. Behavioural finance factors that impact investment techniques and decision-making include overconfidence, fear, and cognitive and emotional aspects (Atif Sattar et al. 2020). Making investment decisions is a complex mental process that is influenced by the decision-maker's psychological traits. These behavioural characteristics frequently have a detrimental impact on the decision-making process due to a lack of knowledge (Leppinen, 2013).

Behavioral finance is described as merging the twin disciplines of psychology and economics to explain why and how individuals make decisions that appear to be irrational or illogical when they save, invest, spend, and borrow money. The study of behavioural finance examines the impact of psychology on financial markets and decision-making processes. Since psychology studies human conduct, judgement, and welfare, it can also offer crucial information about how actual human behaviour deviates from conventional economic theories (Shefrin, 2001). The discipline of behavioural finance applies information from both financial theory and psychology to closely connect market phenomena and human behaviour (Fromlet, 2001; Muradoglu, G. and Harvey, N. 2012). The goal of behavioural finance is to better explain and comprehend how investors' emotions and cognitive errors (mistakes of the mind) affect their decision-making. It merges the fields of psychology, sociology, and other behavioural sciences to analyze collective behaviour, anticipate financial markets, and explain individual behaviour (Katper, Naveeda et al. 2019). Different theories are present and heavily studied and researched, but their limitations restrict their applicability, use and other aspects. Behavioral Finance on the other hand seemed to be more welcoming and with fewer limitations to the dynamic environment and hence it stood out. Unlike Other Finance Theories, Behavioral Finance does not assume that the Investor makes Rational Decisions. While others keep characterizing humans as rational beings always making rational decisions, Behavioral Finance cares about

various factors before stating something about investors. It states that the person about whom everything is being discussed is human, yes but how this single person is different, unique, or similar from others is considered critically. Not just one's education but also one's behaviour, environment, skillset, profession, experience etc. are properly considered. When deciding to invest in the security market, psychological considerations are key. Because of this, it is crucial to thoroughly research each of these aspects to understand how they affect the current situation (Mittal, S. K. 2019).

Aspects of Behavioural Finance

Mental Accounting: Mental accounting is the inclination of individuals to earmark money for specific purposes.

Herd Behavior: The theory of herd behaviour suggests that people frequently mimic the financial practices of the majority, often leading to significant market fluctuations in stock trading.

Emotional Gap: The "emotional gap" refers to the act of making decisions under the influence of strong emotions, such as anxiety, anger, fear, or excitement. Emotions often play a significant role in steering individuals away from rational decision-making.

Anchoring: Anchoring occurs when an expenditure level is linked to a specific reference point. Examples include justifying spending based on different levels of personal satisfaction or consistently adhering to a predetermined budget.

Self-attribution: Self-attribution is the inclination to base decisions on one's own knowledge or abilities, often stemming from innate talent in a particular field.

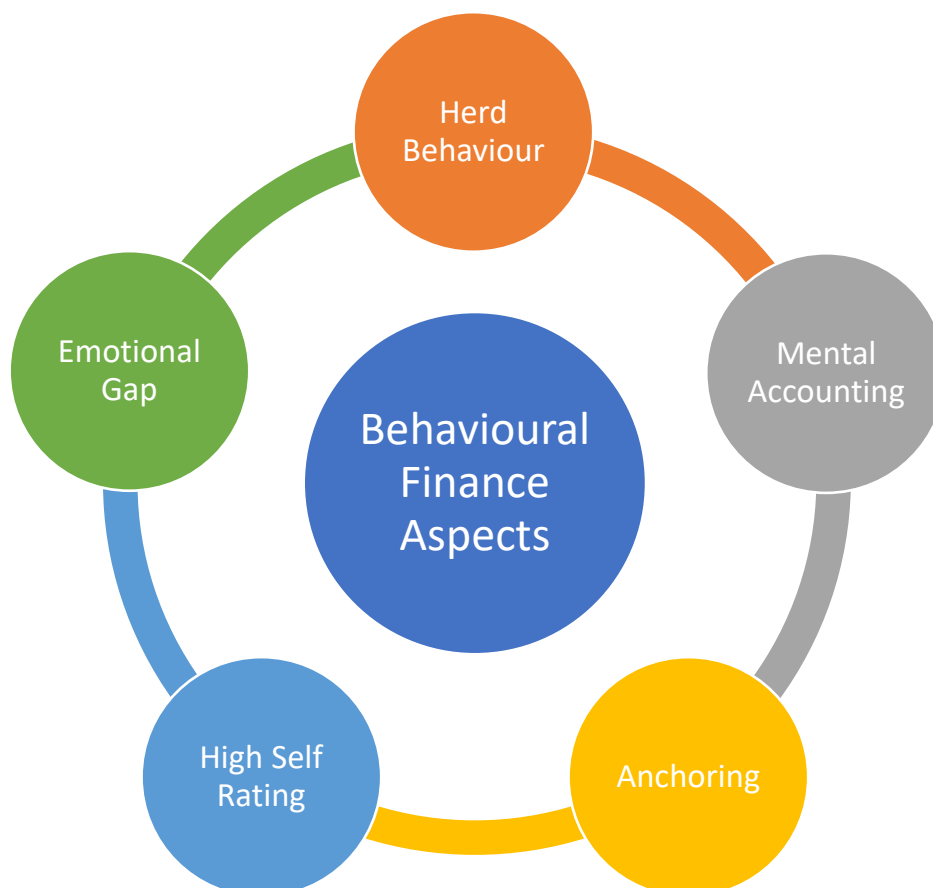


Figure-2 Aspects of Behavioural Finance

Source: <https://www.quora.com/What-is-the-significance-of-studying-behavioral-finance>

Behavioural finance describes how behavioural biases affect investment choice. Fischer and Gerhardt (2007) list the some factors as basic behavioural characteristics that affect investors: fear, love, greed, optimism, herd instinct, propensity to focus on recent experiences, and propensity to overestimate oneself and one's knowledge. Shefrin (2000) divides these biases into Heuristic-driven biases and frame-dependent biases.

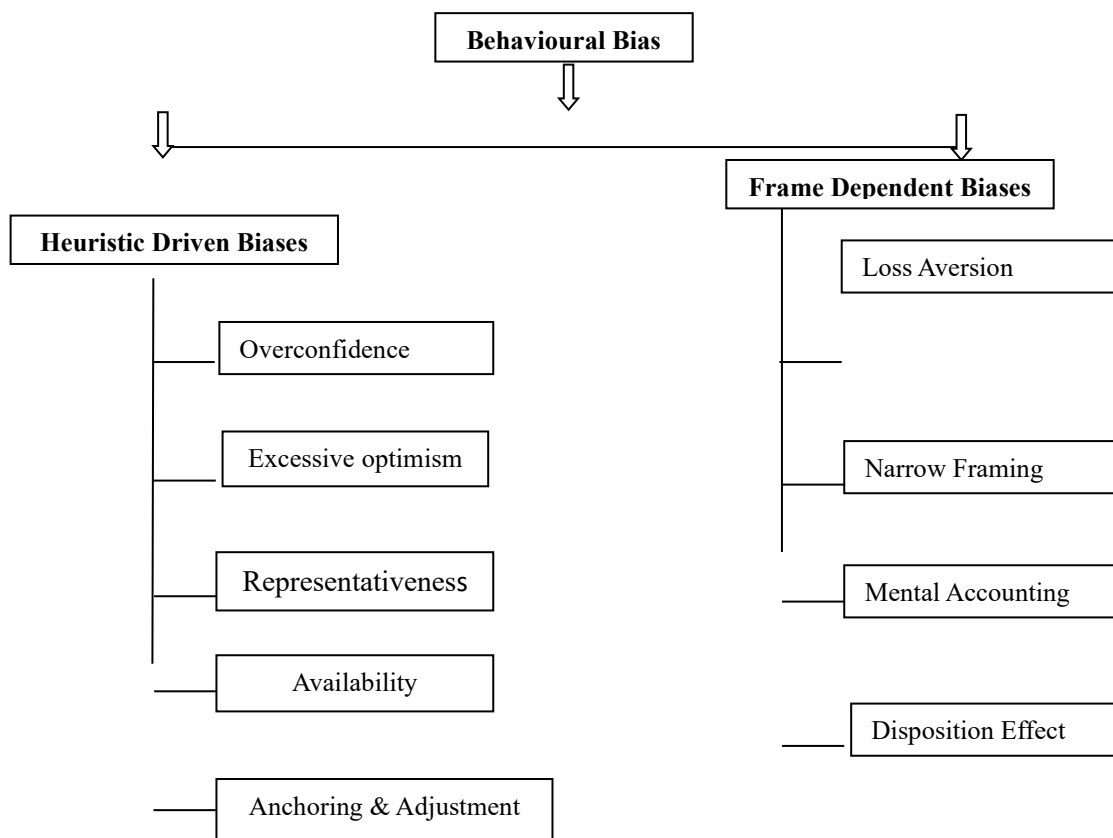


Figure-3 Behavioural Biases

Source: Shefrin, H. (2000)

Irrational attitudes or actions that can unintentionally affect how we make decisions are known as behavioural biases. Emotional biases and cognitive biases are the two subtypes into which they are usually divided. Emotional biases include making decisions based on feelings rather than verifiable information or allowing feelings to cloud our judgment. Cognitive biases are mistakes we make in our thinking as we analyse or evaluate the information that is at our disposal.

2. LITERATURE REVIEW

Kandpal V. & Mehrotra R. (2018) have tried to examine investor behavior towards investment patterns as well as the variables that investors consider while making investment decisions. In Uttarakhand, faculty members were polled utilising a questionnaire. According to the study, behavior has a significant impact on the ability to make wise investment decisions. As a result, when choosing a particular investment option, investors must consider a variety of factors, including their financial situation, risk tolerance, liquidity, and expected returns. They must

also consider their goals in life, spending patterns, expenses, and income, as well as their perception of investments and changes in their lifestyle.

Upadhyay and Shah (2019) explored the fundamental aspects of behavioral finance, shedding light on how individuals' thought processes differ when they invest in various financial instruments. This study provided valuable insights into consumers' investment considerations, focusing on the specifics of what factors they weigh when making investment decisions. The primary objectives included understanding the impact of behavioral finance on investors and researching its relevance to their decision-making processes. The study also aimed to find out the factors influencing investors' choices to invest and examine the relationship between behavioral finance and other pertinent theories.

Kapoor S. & Prasad J. (2017) conducted an analysis of the evolutionary journey of behavioral finance throughout the history of finance. Their work presented early instances of peculiar behavioral patterns in stock markets documented by researchers. Beginning with a discussion of traditional finance, the study scrutinized conventional theories, particularly when they fell short. It then emphasized the significance of behavioral finance and its unique role in bridging the gap between real-world financial dynamics and traditional theoretical constructs.

Nerea Igor Amunarriz (2017) in her research explains inadequacies that have been discovered in the fundamental assumptions of neoclassical finance theories have given rise to behavioural finance in recent decades. The reader might discover a thorough description and examination of the traditional models in that project. The shift that led to the establishment of the behavioural approach, the primary ideas and writers who have contributed to its formation, and lastly the foundation upon which present financial knowledge and understanding is built were discussed.

OBJECTIVES

- To understand how people see investment in today's modern time.
- To understand factors affecting the decision of a modern-day investor.
- To get to know Investing options generally preferred by Investors in today's time.

3. RESEARCH METHODOLOGY

A researcher can describe their intended study approach by using research methodology. It's a methodical, logical strategy to address a research issue. A methodology describes how a researcher will conduct their study in order to get accurate, trustworthy data that meets the goals and objectives of the research work.

Table 1: Research Methodology

Research design	Descriptive research design
Population	Investors in Bilaspur City
Sampling method	Purposive sampling
Sample size	184
Data	Primary Data
Data Collection	Through Questionnaire

4. DATA ANALYSIS AND INTERPRETATIONS

The decision-making process links with the decision-makers psyche as well as situational and environmental factors. Making decisions is a complex mental activity that is influenced by the decision-maker's psychological traits. Behavioural finance has become an element of decision-making because it challenges the assumptions of modern finance and maintains that market anomalies may be identified by understanding investor psychology in the process of making decisions.

Demographic profile of the respondents

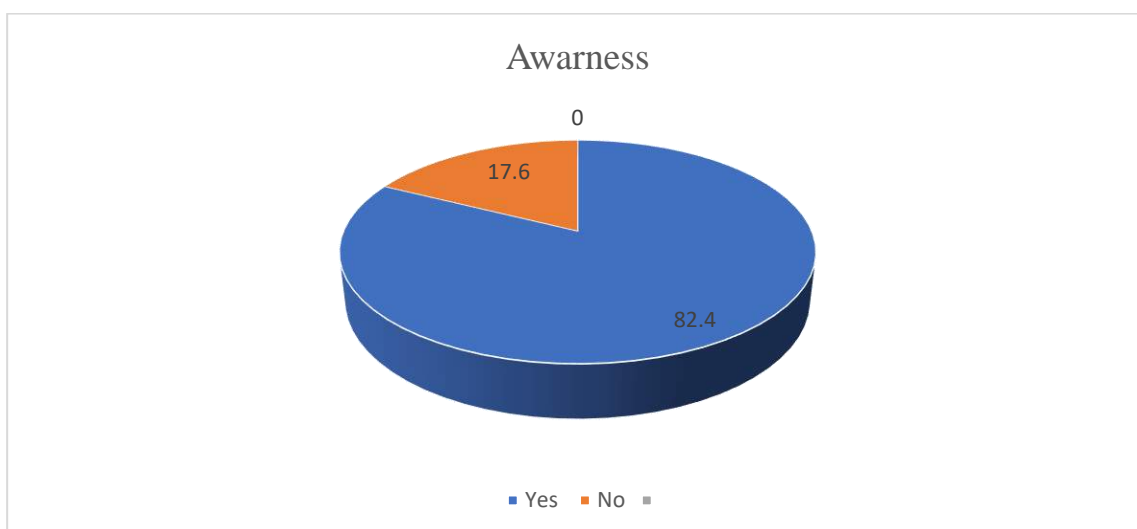
Amongst the participants in the research, there were people with different age groups. Maximum Participants were from age 20-25 years i.e., above 54%, people from age 25-35 years were more than 21%, people from 18-20 years were around the same ratio 21% and there were also people whose ages were more than 35 years.

Different backgrounds include people in professions like Chartered Accountants, Company Secretary, Associates, Audit Analyst, Stock traders and people from non-commerce backgrounds like Engineers, Yoga instructors etc. Many people were employed in different jobs, some were practising, and some were self-employed. 66.7% of people identified were already employed but were still enrolled in one course or another, thus they preferred to call themselves students.

Due to this diversity, different ideas emerge in people regarding investment and finance. People here have different incomes, and most of them choose to keep them confidential, many choose not to disclose but almost everyone identified some amount as income.

Awareness Regarding Investment

Investors typically accept the loss of some present value in exchange for an uncertain future payoff when making an investment. Making several judgements could be necessary, including selecting the right instruments to invest in, combining different instruments, determining the investment amount, taking timing into account, and more. Standard finance theory presupposes that investors must make rational investment decisions, whereas behavioural finance presupposes that investors generally depart from making rational decisions (Sewwandi, 2015). Sometimes investors know about it, and other times they don't. And lastly, capital appreciation is what matters most to an individual investor. If people are content with the capital gains, they receive from only one or two investment options, they are unlikely to consider additional investment options that could provide a higher return.



Source: Authors calculation

Figure-4 Awareness of investment

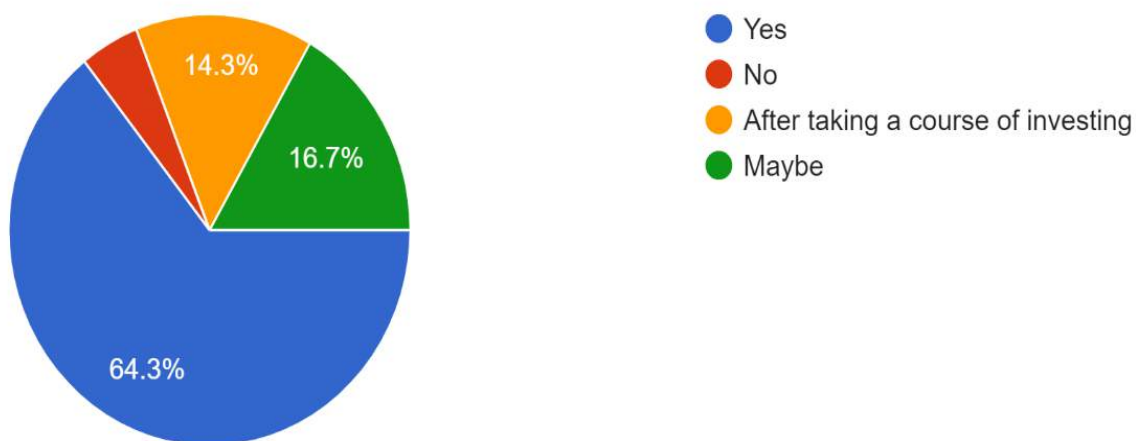
Most of the respondents are aware of the investment avenues but very less have had formal education about trading in the stock market. When these people were asked if they tried investing in the past 82.4% of people said Yes, they had made investments in past in the financial securities.

Preferred Investment Assets

People might select safe as well as risky assets in relatively mixed ratios to ultimately minimize risk and earn a return from investment. Thus, it was believed people might invest some amount in Fixed Deposit or Bonds and then in Shares or commodities. People responded that they invest in various assets, namely Fixed Deposits, Gold, Mutual Funds, Shares, Property, Equity derivatives, Insurance Policies etc. Among these Assets in which the Maximum People invested is Shares, more than 45% of people invested in this. Next was Mutual Funds with investments of more than 28%, Gold with more than 21% and Fixed Deposit was chosen by at least 19% of people and other investments had investment percentages of less than 10%. Many people invested in more than one asset; however around 28% of People stated that they have not invested yet.

Interest in Investment

The expectation was that due to the hype of investment in this modern era, every 6th person out of 10 might be interested in investment and every 4th out of 10 will or might end up investing some amount. Participants were asked if they would invest soon. More than 64% of people said Yes, 14.3% people said they would but after taking a course on investing, 16.7% people said they might, and only around 4-5 % of people said No.



Source: Authors calculation

Figure-5 Interest in Investment

Investment Decision's Base

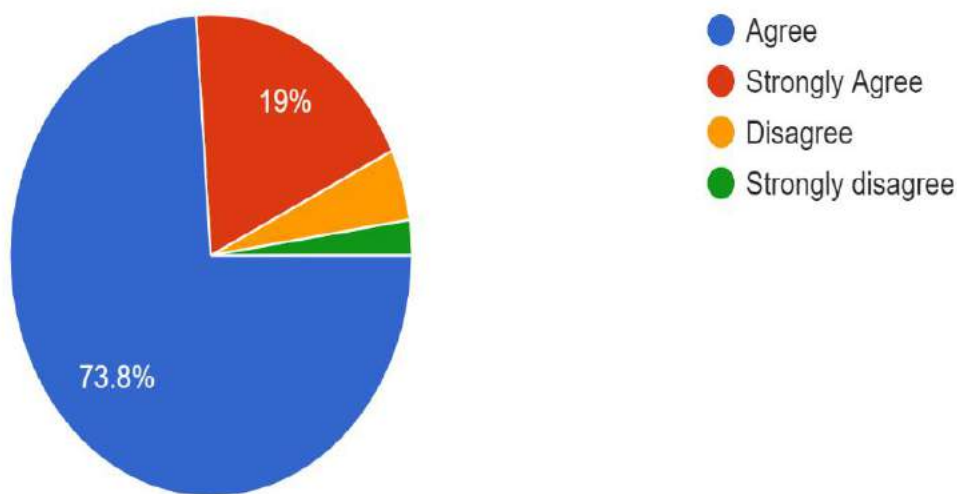
Most people might base their decisions on their professional knowledge only and might follow a certain theory or method to invest and get the maximum return. Even after being aware of Behavioural Finance, it was thought that the existence of other traditional theories of Finance might have a huge influence and would aid Investors super heavily in their Investing decision-making. People might put their opinions first when compared to any other person. They were believed to trust their knowledge more than their intuition and gut feeling as it is the

game of numbers after all and logic seems to rule when numbers are involved. When people were asked about how they make investment decisions they responded that for this purpose they:

- Consult with a specialist.
- Take finance TV channel's advice.
- Friend's advice
- Check Market Status
- Perform Self-study and research.
- Based on Self intuition etc.

The person is ready to believe the word of an experienced investor even if such a person far surpasses in educational qualifications when compared to the experienced investor. This was the place where the magic of behaviour seemed to work. The essence of influence and the invisible strings diverting, inverting, twisting, selecting etc. were more visible making the human mind look very connected to its surroundings.

Less than 10% said their investment decision was based on their own research and study. Specialist Advice, Market Status and Finance TV Channels were the greatest influencing factors in their decision-making. When people were asked if things other than the person's own knowledge affected decision-making regarding Investment and Finance, 73.8% of people agreed, 19 % strongly agreed thus if we consolidate these; 92.8% of people agreed and that is a huge amount. This awareness in people itself is the basis of behavioural finance.



Source: Authors calculation

Figure-6 Investment decision base

The thoughts of the public regarding investment are changing. Earlier many people used to refer to investment, especially in shares as Similar to Gambling but now this mindset is switching. People see investment as a professional activity and Investing as a Profession. This change could be due to many factors but the most common is due to Extensive advertisement of Investing applications, courses, and success stories of successful investors in social media.

People who have done studies or courses regarding investment tend or wish to try investing at least once. Many switch to traditional investment instruments like Fixed Deposits and Gold due to lesser risk. Many People don't invest in Bonds and Debentures generally even if the risk in them is significantly lesser. Most of the Youngsters are interested in investing from their pocket money or monthly expenses that they receive from home to enjoy

additional returns. Today's youngsters who generally invest their money end up taking at least one course regarding investment or other, this course could be free or even pain.

5. CONCLUSION

Theoretical knowledge alone does not play 100% part in Investor's investing. There are many other factors that affect one's behaviour, hence, investing decisions. There are many investors who are involved in investing without having prior educational knowledge or qualifications in that field. In today's modern world with better technologies, it is making not only education regarding investing easy but also the investing process simplified and more accessible, due to this Investing is welcomed by more people.

Factors affecting the decision of a modern-day investor are more than their own studies and research. They include advice from experts, market conditions, TV channels regarding Finance etc. investing options generally preferred by Investors in today's time are investing in Shares, Mutual Funds, Gold, Fixed Deposits, Property etc. People investing might make some poor judgements because of these biases, which are transferred into their behaviours. These choices are referred to as market oddities because they have the potential to disrupt markets on a minor or even massive scale. Such abnormalities might be avoided since they could have a detrimental impact on both the financial health of the person and the whole economy, which is possible with awareness and studies of Behavioral Finance.

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