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FOREWORD

The Office of Research, Innovation, and Commercialization (ORIC) of Dow University of Health Sciences (DUHS), and Baqai Medical University (BMU), successfully hosted the 21st International Conference on Statistical Sciences of Islamic Countries Society of Statistical Sciences (ISOSS) from 9-11 December 2024. The three-day Conference brought together well-known experts, researchers, and students worldwide to talk about the Conference theme "Mobilizing Data Science & Big Data to Achieve SDGs". The Conference was held the first two days at DUHS, and the third day was at BMU.

The Inauguration Ceremony was graced by the Chief Guest, Dr. Syed Muhammad Tariq Rafi, Chairman of the Sindh Higher Education Commission. Other distinguished Guests of Honor included Prof. Dr. Nusrat Shah, Vice-Chancellor of the Shaheed Mohtarma Benazir Bhutto Medical University (SMBBSU), and Patrons-in-Chief Prof. Dr. Mohammad Saeed Quraishy, Vice-Chancellor of DUHS, and Prof. Dr. Iftikhar Ahmed Siddiqui, Vice-Chancellor, Baqai Medical University. The Conference Chairmen were Prof. Dr. Nazeer Khan and Prof. Dr. Kashif Shafique, and the Conference Secretary was Dr. Abdur Rasheed. The Secretary General of ISOSS, Prof. Dr. Zahoor Ahmed, was also one of the distinguished guests.

The Conference featured five international and five national guest speakers, who delivered talks on various aspects of statistical sciences. The international keynote speakers included:

Dr. Shahjahan Khan (Bangladesh/Australia), presented a keynote speech on "Statistical Models in Meta-Analysis with Applications in Health Sciences". He has also presented another talk on "Best practices in writing and publishing research articles in indexed journals and creating impact".

Dr. Syed Ejaz Ahmed (Canada), delivered a keynote speech on "Machine Learning and Statistical Strategies in High-dimensional Data Analysis".

More than two hundred delegates from all over Pakistan attended this Conference. Over 100 abstracts were accepted for oral presentations in pure statistics and its applications in biological sciences, artificial intelligence, environment and space sciences, economics, business, information technology, education, data sciences, management and marketing.

In addition to the Conference, 11 Pre-Conference Workshops were also organized at seven collaborative universities and institutes of the Conference, with more than 200 faculty members, students, and researchers participated.

On the third day, a Business Session was held to discuss the activities of ISOSS and for future planning. This session was chaired by the Former President of ISOSS, Prof. Dr. Shahjahan Khan. The next Islamic Countries Conference Series (ICCS-16), may be held in Qatar, and the 22nd International Conference on Statistical Sciences (ICSS-22) may be held at the Sindh Agriculture University, Tandojam, Pakistan.

The Conference was a resounding success, providing a platform for researchers and experts to share their knowledge and ideas on how statistical sciences can be applied to achieve the Sustainable Development Goals (SDGs). Prof. Dr. Iftikhar Ahmed Siddiqui, the Vice Chancellor of BMU and the conference Patron-in-Chief, closed the conference.

Professor Dr. Nazeer Khan
Chairman of the Conference

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TRAJECTORIES OF HEMATOLOGICAL PARAMETERS AND THEIR RELATIONSHIP WITH RISK OF MORTALITY AMONG ACUTE ORGANOPHOSPHORUS POISONING PATIENTS – A LATENT PROFILE ANALYSIS

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ABSTRACT

Acute organophosphorus poisoning (OPP) is one of the major causes of mortality among patients presenting to critical care departments in developing countries. Various mortality predictors have been identified; however, the role of repeated measurements of hematological in determining the risk of mortality is not so clear yet. Therefore, the present study examined the relationship between hematological parameters trajectories and mortality among OPP patients using latent-profile-analysis (LPA). This was a retrospective cohort study, using laboratory investigations data of 299 OPP patients admitted at Civil Hospital Karachi during Aug'10 to Sep'16. Demographic and clinical data along with hematological parameters including Hemoglobin, total-leukocyte-count (TLC), and Platelets were retrieved from medical records. The trajectories of these parameters were formed using LPA. The trajectories were used as independent variables to determine the risk of mortality using Cox-Proportional-Hazards models. A total of 299 patients' data was included with a mean age of 25 years in survived and 32 years in dead patients. The overall ICU-mortality was 13.7% (n=60) in this cohort of patients. In trajectory analysis, very-high-increasing TLC, normal-declining platelets trajectory observed highest mortality i.e. 30.0%, and 50.0% respectively, compared with other trajectory of the same parameters. On multivariable analysis patients with normal-declining platelets were four times [HR: 4.2, 95% CI: 1.6-11.0] more likely to die compared with those who had normal-stable platelets. The trajectories of platelets was significantly associated with increased risk of mortality among OPP patients.

KEYWORDS

Latent Profile Analysis; OP Poisoning; Hematological parameters; Repeated Measures.

1. INTRODUCTION

Poisoning with organophosphorus (OP) is a serious global health concern, especially in areas where agriculture is practiced, and these substances are widely employed as pesticides. Because acute OP poisoning inhibits acetylcholinesterase, acetylcholine builds up at nerve synapses and neuromuscular junctions, which can cause significant morbidity and fatality. A cholinergic crisis results from this enormous buildup because it continually stimulates the muscles, glands, and structures of the central nervous system [1]. Reliable patient outcome predictors are urgently needed to improve care and treatment techniques, given the serious nature of OP poisoning.

Because these pesticides are used so extensively in agriculture, there is a notably high incidence of OPP in Asia. An estimated 3 million incidents of pesticide poisoning occur worldwide each year, and an estimated 300,000 deaths are attributed to OP chemicals [2, 3]. Depending on the degree of poisoning and the accessibility of medical assistance, studies have found that the death rate from OPP can vary greatly, with some citing death rates as much as 40% [1, 4].

Researchers have investigated hematological characteristics as possible biomarkers for several illnesses, including poisoning incidents. These measures could offer valuable information on the physiological reactions and possible problems linked to acute OPP. Parameters such as white blood cell count (WBC), hemoglobin (Hb), hematocrit (HCT), platelet count, and various others may reflect the underlying systemic stress and inflammatory responses in poisoned patients [5, 6]. Predicting patient outcomes and customizing therapeutic measures can be made easier with an understanding of the trajectories of various hematological markers.

The predictive relevance of these hematological markers has also been underlined by studies undertaken in Asia, including India and Nepal. For instance, a study conducted in Nepal found that in cases of OP poisoning, aberrant hematological indicators, such as raised WBC and decreased platelet counts, were linked to a higher death rate [6]. Likewise, studies conducted in Bangladesh have demonstrated that hematological alterations can function as preliminary markers of patient results [7].

Laboratory analysis of blood play's important role in diagnosis of intoxicated patients, since drugs with biochemical substances produce biochemical changes. However, their role in assessing the severity of poisoning and prognosis of these patients is still not very well studied biochemical and hematological parameters [8-11].

Hematological parameters (including hemoglobin, WBC and platelets count) have not shown any links with MV or mortality among OP patient [12].

A statistical technique called latent profile analysis is used to determine subgroups within a population based on factors that are observed. It is especially helpful for locating hidden correlations and patterns in large, complicated data sets in medical research [13-16].

Many statistical approaches (including Mann-Whitney U test, two independent sample t test, Chi-square test, fisher's exact test, Logistic regression, ROC curve, and Survival analysis) were used in finding relation and to predict the risk of mortality. But in such

studies where the vital status parameters and laboratory investigations were observed at baseline measurement, ranges, cut-off to predict the mortality of OPP patients [9, 11, 12, 17-19].

As these parameters are dynamic and tends to change substantially and sometime also quite rapidly. In such a scenario, the approach of linking single measurements at the time of presentation with mortality during follow-up might not be an appropriate method. An important question is whether the mean level of a parameter changes over time; if it does, it should be determined whether that change leads to certain latent groups that are different than the classifications made based on single baseline measurement of the same variable. Accordingly, this single observation approach might be prone to misclassification bias.

For dynamic variables, the LPA offers a superior substitute for tracking and estimating growth trajectories across time. Structural Equation Modeling (SEM) advances basic longitudinal analysis of data to include latent variable growth over time while modeling both individual and group changes using slopes and intercepts [20]. Traditional variable-centered analysis methods include analysis of variance, multiple regression, and multilevel models; in contrast, person-centered methods like LCGA concentrate on finding previously unidentified subpopulations of persons that have comparable characteristics [21]. To the best of our knowledge, there is no previous study which has assessed the latent trajectories of hematological parameters in OPP patients and their relationship with mortality. Therefore, the current study's objectives were to use survival analysis to ascertain risk between individual classes based on patterns of mortality derived from individual response (hematological parameters) and to assess the growth trajectory of these parameters among OPP patients using LPA and comparison of the two approaches (repeated measures of the same parameters levels vs trajectories) in finding mortality risk.

2. METHODS

This OPP patient cohort, which included those above 13, was retrospective in nature. This study covered all patients admitted from August 2010 to September 2016 at the Dr. Ruth K.M. Pfau / Civil Hospital Karachi, Pakistan medical intensive care unit (ICU). This study included patients who were both male and female. A total of 299 patients recorded were included in this study whose hematological parameters were available. A total of 449 patient’s data considered for the final analysis. Civil Hospital / Dr. Ruth K.M. Pfau Karachi is a prominent tertiary care hospital situated in the Sindh province of Pakistan, with an annual patient turnover of about four million.

2.1 Study Variables

Medical records were used to gather information about each patient, including their age, gender, length of stay in the intensive care unit (ICU), and time since poisoning. Hematological data (platelets count, TLC, and hemoglobin) were also obtained within 0–96 hours after admission from medical records at 12-hour intervals. Since they constructed the latent class using the first four days of data, the first follow-up day fell on the first day of the fifth day in the ICU. In this investigation, these hematological parameters were repeatedly measured over the course of the hospital stay. To evaluate the course of patients during their ICU stay, mortality data was collected.

2.2 Latent Classes

Hematological parameter trajectories over time are detected using LPA. This is a type of finite mixture modeling form that is intended to identify latent classes of people over time by observing similar movements of a determinant [22]. First-order polynomials were used in our models. Data files were initially made for every hematological parameter. Models were created individually for each parameter and class (two, three, and four) in accordance with standards [23] We ran all of the models to get the posterior probabilities for each pathway for each individual. Latent classes are taken out of the generated output files. Later, the classes switched to STATA and included more hematological and demographic characteristics. Based on a minimum Akaike Information Criterion (AIC), a Bayesian Information Criterion (BIC), and high log likelihood, we estimated the best-fitting trajectories [24]. To have enough number of subjects in each of the classes, three or four classes were selected from linear models.

2.3 Statistical Analysis

Microsoft Office 365 Excel was used to enter and manage the data. Figures were shown using STATA software version 15, and latent classes were produced by inferential analysis and MPlus software. The baseline disparities between the deceased and the living were evaluated. To detect difference in age, total ICU stay and hematological parameters between dead and alive individuals, compared using Wilcoxon rank sum test based on data distribution, while association of mortality with gender was assessed using chi-square test.

The entire length of an ICU stay was used to define risk time for survival analysis. Using the Cox proportional hazards models shown in Table 2, we calculated the unadjusted and adjusted Hazard Ratios and corresponding confidence intervals for death by assigned trajectory. We adjusted for age and the approximate amount of time from poisoning in the multivariable analysis. The proportional hazards assumption was found to be satisfactory and not broken when we used the Phtest to analyze it and displayed the smoothed Schoenfeld residuals over time [25]. A p-value of less than 0.05 was deemed statistically significant.

Ethics Approval and Consent to Participate

The study was approved by the statuary body Institutional Review Board (IRB) of Dow University of Health Sciences (DUHS) (Ref No. IRB-560/DUHS/Approval/2015/75) and Board of Advanced Studies and Research (BASR) (BASR/No./02505/Sc.) of University of Karachi-Pakistan. The methods were performed in accordance with the relevant guidelines and regulations of IRB. The study was approved by the IRB of DUHS with an exemption from requiring written informed consent.

3. RESULTS

Between June 2016 and November 2016, a total of 499 patients (regardless of gender) met the eligibility requirements for the 6-month data collection period. Out of the total, 200 patients' records were excluded due to incomplete data, wrong registration, self-reported history of chronic conditions such as hypertension, diabetes mellitus, osteoarthritis, asthma, or pregnant women, less than 3 days ICU stay. The final study comprised data from 299 patients, with an average age of 25.4 ± 9.7 years (ranging from 13 to 70 years)

and an overall ICU-mortality of 13.7% (n = 41). While gender, and length of ICU stay did not significantly differ between dead and alive individuals, hematological parameter (such as TLC), age, and the amount of time since poisoning were significantly higher in the dead compared to the alive. (Table 01)

Table 1
Descriptive Statistics (Median (IQR)) of Baseline Characteristics with Mortality

Characteristics	Alive (N = 258, 86.3%)	Dead (N = 41, 13.7%)	P-value
Gender			
Female	131 (87.3)	19 (12.7)	0.598~
Male	127 (85.1)	22 (14.9)	
Age (years)	23 (18 – 28)	27 (20 – 40)	0.009**
Elapsed time (hours)	5.2 (2.5 – 8.4)	10.0 (8.0 – 12.5)	< 0.001**
ICU stay (days)	5.7 (3.8 – 10.8)	7.5 (4.1 – 10.5)	0.519
Hematological			
Hemoglobin (g/dl)	12.5 (11.0– 14.0)	12.6 (11.0 - 13.8)	0.937
TLC (/µl) '000	12 (09 - 16)	15 (11 - 19)	0.013*
Platelets (/µl) '000	228 (183 - 286)	213 (147 - 294)	0.323

**Significant at 1%; IQR, Interquartile Range (25th–75th Percentile);
TLC: Total Leukocyte Count; ~Chi-Square Test, Wilcoxon Rank Sum Test;
ICU: Intensive Care Unit.

We assigned labels to the trajectories based on their modeled graphic patterns (Figure 01). We defined first part of labels based on the start of Hematological parameters ranges [26-28] (e.g. low, normal, high, very high, extremely high) and second part on their repeated measure patterns (e.g. consistent, stable, declining, increasing, remitting (up then down or vice versa)). Based on mean intercept and slope of individuals pattern, we identified three distinct trajectories (normal-stable, low-consistent, and normal-remitting) of hemoglobin in 299 patients (mortality in normal-stable was 32/241=13.3%, while mortality in low-consistent was 6/49=12.2%, and mortality in normal-remitting was 3/9=33.3%) (Figure 01a).

Four trajectories (high-declining, very high-increasing, extremely high-declining, and high-declining) were identified for TLC. The mortality for high-declining was 24/221=10.9%, mortality for very high-increasing was 3/10=30.0%, extremely high-declining was 1/7=14.3%, and high-stable was 13/61=21.3%) (Figure 01b)

Three trajectories (normal-stable, normal-increasing, and normal-declining) were identified for platelets count. The mortality for normal-stable was 36/281=12.8%, mortality for normal-increasing was 0/8=0%, and mortality for normal-declining was 5/10=50.0% (Figure 01c)

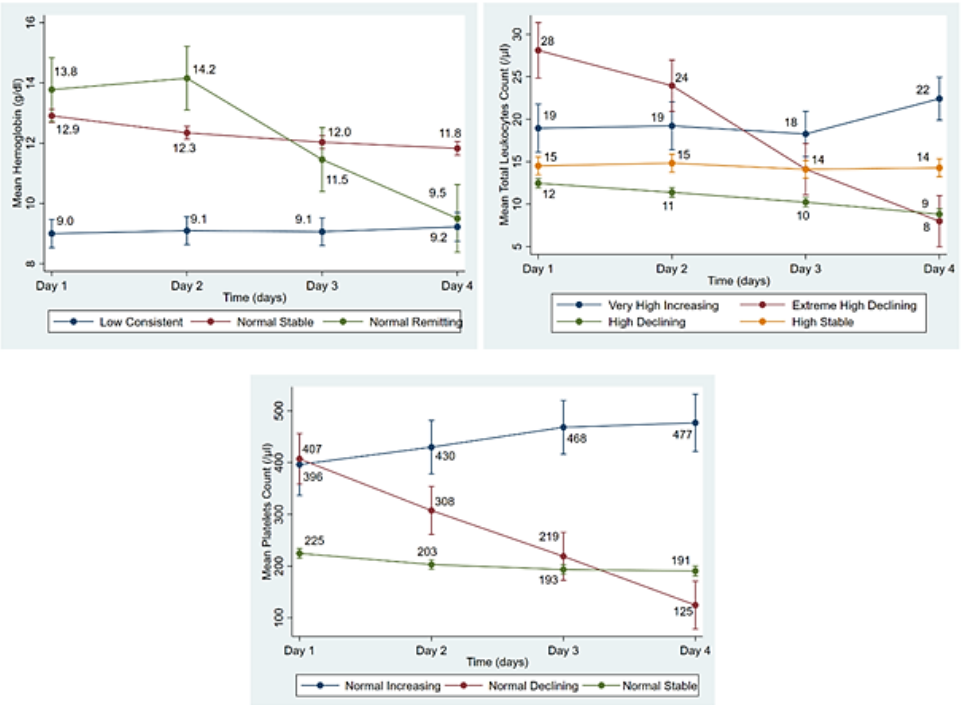

Figure 1: Trajectories of Hematological Parameters from Day 1 to 4

On multivariable analysis after adjusting for age, when modeled repeated measure with time interaction, platelets count was not significantly associated with the risk of mortality [HR: 1.00, 95% CI: 0.99 - 1.00, p-value = 0.002]. However, on multivariable analysis after adjustment for age and elapsed time, when modeled latent classes, patients with a normal-declining platelets count trajectory were four times more likely [HR: 4.2, 95% CI: 1.6 - 11.0, p-value = 0.004] to die compared with those who had normal-stable trajectory of platelets count (Table 2).

Table 2
Relationship of Mortality with Hematological Parameters = Latent Profile Analysis

Vital Parameters	Alive N=258 (%)	Dead N=41 (%)	Total N=299	P-value	Unadjusted HR (95% C.I)	Adjusted HR (95% C.I)
Hemoglobin					0.99 (0.98, 1.01)[RM]	0.99 (0.98,1.01)[RM]
Normal Stable	209 (86.7)	32 (13.3)	241		1.0	1.0
Low Consistent	43 (87.8)	06 (12.2)	49	0.217~	0.8 (0.3, 1.9)	0.7 (0.3, 1.7)
Normal Remitting	06 (66.7)	03 (33.3)	09		1.2 (0.3, 4.1)	1.4 (0.4, 4.8)
TLC					1.00 (0.99, 1.00)[RM]	1.00 (0.99,1.01)[RM]
High Declining	197 (89.1)	24 (10.9)	221		1.0	1.0
Very High Increasing	07 (70.0)	03 (30.0)	10	0.051^	1.7 (0.5, 5.6)	1.4 (0.4, 5)
Ext. High Declining	06 (85.7)	01 (14.3)	07		0.9 (0.1, 7.0)	1.5 (0.2, 11.6)
High Stable	48 (78.7)	13 (21.3)	61		1.4 (0.7, 2.8)	1.3 (0.7, 2.7)
Platelets count					0.999 (0.998,0.999)[RM]	1.00 (0.99,1.00)[RM]
Normal Stable	245 (87.2)	36 (12.8)	281		1.0	1.0
Normal Increasing	08 (100)	0 (0)	08	0.008**^	-	-
Normal Declining	05 (50.0)	05 (50.0)	10		2.9 (1.1 – 7.5)	4.2** (1.6 – 11.0)

Adjusted Covariate: Age & Elapsed Time; ~Chi-Square Test; ^Fisher Exact Test;
**Significant at 1%; HR: Hazard Ratio; Ext: Extremely, [RM]Repeated Measures Used

DISCUSSION

According to our research, approximately one in eight patients who suffer from OP poisoning pass away in the intensive care unit. Higher age and longer elapsed time since consumption were substantially linked to death in cases of OP poisoning. Furthermore, individuals in normal-declining platelets count trajectory, had significantly high mortality compared to individuals in normal-stable and normal-increasing platelets count trajectories. Similarly, individuals in normal-declining platelets count trajectory had nearly four times increased risk of mortality compared with those who were in normal-stable platelets count categories.

By using LPA to hematological parameters in patients with acute OPP poisoning, researchers can identify distinct patterns that may be linked to different mortality risk

levels. This method provides a thorough understanding of how differences in hematological responses can impact a patient's prognosis.

Our study's mortality rate is similar to that of other published studies on OP poisoning from various regions, including neighboring countries [17, 29-34], However, our study's mortality rate (13.4%) seemed higher than that of a published study (4.11%) [17] from another tertiary care setting in our metropolis. Although the overall ages of patients in their study and our study was comparable, however, the previously published study had a considerably high percentage of women (73%) [17] compared to our study (52.5%). Because it is already widely recognized that women tend to have a lower risk of death and a lower success rate when attempting suicide than men, the low mortality in the prior study can be explained by the high percentage of women [35, 36]. Second, the fact that patients in the prior study were treated in the general medical ward suggests that the poisoning cases were mild to moderate in severity [17]. However, the patients in our cohort were all directly transferred from emergency rooms to intensive care units, which is indicative of more severe poisoning cases with worsening clinical conditions. This helps to explain why our study's mortality rate was higher than that of previous studies. Significant mortality predictors were age and the amount of time following poisoning ingestion. The results are in line with other studies that have been reported [17, 29, 30].

The LPA shown that trajectory of normal-declining platelets count was significantly associated with increased risk of mortality among OP poisoning patients. These results were somewhat not clear. The association was checked of platelets count with MV, RDW, or base deficit in European and Asian studies and shown non significance [11, 12, 37].

Our trajectory analysis and previous studies, show that TLC was not significantly associated with risk of mortality among OPP patients [30, 38-41].

In a comparison of the two techniques repeated measures and latent trajectories, on multivariable analysis, when modeled repeated measure platelets count level does not increase the risk of mortality. However, when modeled latent classes patients in normal-declining class were four times more likely to die compared with those who had normal-stable platelets count level. This reveals that repeated measure approach does not predict risk of mortality using platelets count levels while latent class trajectories predicted a high risk of mortality using platelets count levels.

This study was unique in that it considered multiple observations of parameters in the first two to four days of poisoning and linked them with mortality, whereas previous studies only included baseline measurements of parameters (including laboratory and vital signs) and examined their relationship with mortality. Because our method is more in line with actual circumstances, where people suffering from OPP have differing levels of these characteristics, the results may be more useful in therapeutic contexts. This study has examined more accessible, relatively inexpensive biochemical parameters and shown more clinical utility and are much more convenient than expensive laboratory-based markers and may be considered for use in clinical settings for future OPP patients admitted for intensive care.

The current scoring systems in use [32, 39, 42-47] rely on clinical data, laboratory investigation cut-offs taken at any time, and variables-centered approaches a novel strategy

offered by SEM [48] that concentrate on the relationships among variables while taking repeated measurements and observing their patterns. The person-centered LPA method utilized in this study identified trajectories using latent classes. People vary between classes but are similar within them [21].

It is important to consider the study's strengths and limitations before making any conclusions. This study was distinctive in that it examined the link between hematological parameters and mortality among OPP patients by making repeated observations of these parameters over the first four days of the patients' admission to intensive care. To the best of our knowledge, this is the first study to use latent profile analysis to ascertain the association between hematological markers and mortality. Because data from a tertiary care hospital's intensive care unit was included in the current study, the sample size was appropriate, and the results are applicable to our situation. One of the study's flaws is that it used an estimate of the quantity of poisoning from medical records, which may not have been seen by the physicians because the information was gathered from medical record keeping.

CONCLUSION

Latent classes of hematological parameter were a significant predictor of mortality among acute OPP patients. Further, clinician should consider the pattern of initial days in prognosis of acute OPP patients. Regarding the two approaches, LPA gives more insight significant trajectories in comparison to parameters levels collected repeatedly.

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MANAGEMENT OF PAIN PERCEPTION AND ANXIETY IN PEDIATRIC DENTISTRY DURING LOCAL ANESTHESIA VIA VIRTUAL REALITY AS A DISTRACTION TECHNIQUE

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ABSTRACT

This study investigates the effect of virtual reality (VR) as a distraction technique in pediatric dentistry to manage pain perception and anxiety during local anesthesia. Using standardized tools the **Wong-Baker FACES Pain Rating Scale** and the **Frankl Behavioral Rating Scale** we evaluated the outcomes in children aged 4–12 years undergoing dental procedures. The study revealed a significant reduction in anxiety and pain levels when VR was utilized, confirming its efficacy over conventional methods.

1. INTRODUCTION

Anxiety is a transitory emotional state characterized by subjective feelings of tension and physiological symptoms such as muscle tension, tachycardia, and dizziness. In pediatric dentistry, anxiety is often a barrier to effective treatment.

Traditional distraction techniques, including conversation and music, have evolved with the integration of modern technology such as VR, which immerses children in a simulated environment to reduce fear and stress. Virtual Private Theater Systems (VPTS) that combine video and audio have shown promising results in improving compliance and decreasing discomfort in pediatric patients.

While international research supports the role of VR in dentistry, there is limited data from Pakistan. This study aims to fill that gap by evaluating pain and anxiety levels in children during anesthesia administration using VR, and examining associations with demographic variables such as age and gender.

2. MATERIALS AND METHODS

This comparative study was conducted at Dow International Dental College, specifically within the Operative Surgery and Oral Maxillofacial Surgery departments. The study involved a total of 36 pediatric participants aged 4–12 years, selected based on inclusion criteria that required undergoing dental procedures involving local anesthesia and being ASA Class I or II. Patients above 12 years of age, those with ASA Class III or higher, and those with incomplete response sheets were excluded.

Participants were divided equally into two groups of 18 each: Group A received distraction using virtual reality (VR) devices, while Group B underwent standard conventional distraction methods.

Anxiety and pain were measured before and after anesthesia administration using the Frankl Behavioral Rating Scale and Wong-Baker FACES Pain Rating Scale, respectively. Additionally, pulse oximeter readings were used to monitor heart rate as a physiological indicator of stress. Informed consent was obtained from the parents or guardians, and ethical clearance was granted by the Institutional Review Board of Dow University of Health Sciences (IRB-2913/DUHS/Approval/2023/14).

Data were analyzed using SPSS version 21.0, with descriptive statistics used for continuous variables, frequencies for categorical data, and statistical tests including chi-square and t-tests to evaluate significance, with a p-value of <0.05 considered statistically significant.

3. RESULTS AND DISCUSSION

The mean age of the children was 8.5 years (SD = 1.89), with 52% of the participants being male. The average heart rate increased from 101 beats per minute before the intervention to 110 beats per minute post-intervention.

Pain responses as measured by the Wong-Baker scale were distributed as follows: 14 children reported no hurt, 7 reported a little hurt, 10 reported a little more hurt, 9 reported even more hurt, 3 reported a lot of hurt, and 6 reported worst pain. Behavioral responses using the Frankl scale showed 4 definitively negative, 7 negative, 17 positive, and 22 definitively positive reactions.

A significant association was found between intervention type and behavioral scale responses ($\boldsymbol{p = 0.021}$). Further analysis revealed a moderate positive correlation between time and pain score ($\boldsymbol{r^2 = 0.432}$, $\boldsymbol{p = 0.002}$), and a negative correlation between time and behavioral scores ($\boldsymbol{r^2 = -0.529}$, $\boldsymbol{p = 0.000}$). Additionally, there was a moderate negative correlation between pain and behavioral scores ($\boldsymbol{r^2 = -0.683}$, $\boldsymbol{p = 0.000}$).

These results affirm the effectiveness of VR in reducing pain and anxiety during local anesthesia administration in pediatric dental patients.

4. COMMENTS AND CONCLUSION

This study supports the use of virtual reality as an effective non-pharmacological intervention to manage pediatric dental anxiety and pain. The findings demonstrate statistically significant improvements in patient behavior and pain tolerance when VR is employed.

Given its success, further implementation of VR in dental clinics in Pakistan is recommended.

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COMPARATIVE ASSESSMENT OF COGNITIVE IMPAIRMENT WITH VITAMIN D AMONG PATIENTS WITH AND WITHOUT DIABETES

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ABSTRACT

Background: Vitamin D is important for many bodily functions, including cognitive health. Vitamin D deficiency is correlated with cognitive impairment, especially in the elderly. People with diabetes are likely to have a Vitamin D deficiency and, therefore, at an increased risk of cognitive decline. This study aims to establish the association between Vitamin D deficiency and cognitive impairment among diabetic and non-diabetic elderly patients.

Methodology: A cross-sectional study was held at the National Institute of Diabetic and Endocrinology, Karachi, targeting seniors 35 years and above. Data collection was done between 2022 and 2024 using a sample of 349 respondents. The study embraced the quantitative approach to compare Vitamin D levels with cognitive impairment cases, identifying diabetic and non-diabetic respondents. Cognitive functioning was assessed using a Mini-Mental State Examination (MMSE).

Results: Different demographic factors were significantly linked to cognitive impairment. Females result in a higher proportion of cognitively impaired individuals at 69.3% than males at 30.7% (p-value = 0.043). Participants aged between 55–65+ years were more cognitively impaired at 47.4% than those in the 35–54 year category at 52.6%. Vitamin D deficiency was highly associated with cognitive impairment; while 45.3% of participants with low levels of Vitamin D were impaired in cognition, only 10.9% of participants with adequate levels showed impairment (p-value < 0.001). The effect of Vitamin D supplementation was also significantly positive for the level of cognitive functioning (p-value = 0.01). Then, the risk factors revealing p-value ≤ 0.1 were subjected to multi-variable analysis. Education was significantly associated with cognitive impairment whereby, those who lacked formal education were 58.6 times more likely to have impairment than postgraduate results (OR 95% CI, 12.1–283) (p-value < 0.01). Vitamin D deficiency has four times higher odds of impairment as well OR 95% CI, 1.8–8.9 (p-value < 0.01).

Conclusion: This study highlights the association of Vitamin D deficiency with cognitive impairment, especially in elderly diabetic patients. Its supplementation might be an important preventive method against cognitive decline among at-risk populations, which can be hypothesized based on the current evidence. Further studies are necessary to explore the mechanism and the long-term effects

1. INTRODUCTION

Diabetes mellitus represents a cluster of metabolic disorders, beginning with the onset of insulin resistance, progressing to impaired insulin secretion and deficiency, leading to increased glucose production and reduced glucose utilization. The complications arising from this multifaceted ailment are a significant contributor to global mortality rates. When insulin is insufficient or ineffective, the body's cells face challenges in processing carbohydrates, resulting in a series of metabolic events ultimately culminating in elevated blood sugar levels [1, 2]. Among the various factors influencing diabetes and its progression, vitamin D has emerged as a potential modulator of glucose metabolism Vitamin D, categorized as a modified steroid, is synthesized in the skin when exposed to sunlight and plays a pivotal role in calcium and phosphorus metabolism. The Recommended Dietary Allowance (RDA) for vitamin D stands at 400 IU or 10 mg. It exerts its effects by binding to specific receptors on target cells, subsequently influencing gene expression [3]. Vitamin D deficiency significantly increases the risk of all-cause dementia and Alzheimer's disease, emphasizing its potential role in cognitive health [4]. Vitamin D undergoes a critical transformation in the liver, leading to the formation of 25-hydroxy vitamin D [25(OH) vitamin D] [5]. There exist two primary variants: vitamin D2 (ergocalciferol) and vitamin D3 (cholecalciferol) [6, 7] The primary source of vitamin D in humans, comprising approximately 90%, is vitamin D3, synthesized in the skin as 7-dehydrocholesterol, primarily located in the stratum basale and stratum spinosum, following exposure to ultraviolet B (UV-B) radiation. Vitamin D2, in contrast, is acquired through dietary sources and results from the ultraviolet conversion of ergosterol, a compound found in fungi. Both forms of vitamin D circulate in the bloodstream, bound to vitamin D-binding protein (DBP). For these vitamin D metabolites to become biologically active, they must undergo a two-step hydroxylation process [7] Initially, vitamin D2 and D3 undergo hepatic hydroxylation, mediated by the vitamin D25-hydroxylase enzyme (CYP27A1), leading to the creation of the inactive steroid precursor, 25-hydroxy-vitamin D (25[OH]D). This 25[OH]D represents the primary circulating and stored form of vitamin D. Subsequent to this stage, further hydroxylation takes place, primarily under the influence of 25-hydroxyvitamin D-1-α-hydroxylase, which is predominantly found in the kidneys and placenta, resulting in the active metabolite 1,25 hydroxyl-vitamin D [1,25 [OH]2 D. Importantly, this renal process is finely regulated, influenced by factors such as parathyroid hormone, serum calcium levels, and phosphorous levels, establishing a complex physiological regulatory feedback system [6, 7].

Elderly people are frequently suffering from cognitive impairment, and this condition is getting more and more common. It manifests up as an impairment in memory, attention, and cognitive function that is more severe than one might expect considering their age and educational background. Even though cognitive impairment doesn't always cause problems with day-to-day activities, in older people, it can eventually lead to dementia. It is possible to improve cognitive function and prevent or delay the progression of impairments by putting preventive measures and appropriate therapies into effect [8].

This study examines the relationship between Vitamin D deficiency, Type 2 Diabetes Mellitus (T2DM), and cognitive impairment due to their significant impact on health and well-being. Living in a third-world country like Pakistan, we've noticed a significant increase in diabetes cases in recent years. According to the International Diabetes

Federation, around 26.7% of adults in Pakistan, which is approximately 33 million people, will be affected by diabetes in 2022. This is a considerable number. Our research focuses on understanding the potential complications of diabetes and Vitamin D deficiency, especially with cognitive impairment. Current research and healthcare approaches have limitations and gaps, including inconsistent methodologies and outcomes. Our study seeks to address these issues by conducting a comprehensive investigation, contributing to the advancement of knowledge in this field. Ultimately, our findings may lead to more informed decision-making and improved healthcare practices for individuals and communities affected by these conditions

Analyzing the joint influence of Vitamin D deficiency and Type 2 Diabetes Mellitus on cognitive function. Not having enough Vitamin D, dealing with Type 2 Diabetes Mellitus (T2DM), and cognitive impairment are big challenges for both people and society. When these conditions come together, we need to understand them better. Our research aims to fill a gap in society by evaluating how these factors impact the daily lives of aging individuals.

2. LITERATURE REVIEW

The literature review forms the basis for this research, offering a thorough examination of existing studies concerning the complex relationship between Vitamin D deficiency, Type 2 Diabetes Mellitus (T2DM), and cognitive impairment [9]. This critical analysis provides insights into the background, trends, and knowledge gaps in this field, serving as the foundation for our investigation [10].

2.1 Vitamin D Deficiency and Cognitive Impairment

Vitamin D deficiency marks billions of people worldwide, including developed and under-developing countries [11]. Relatively only a few countries have their relative data on vitamin D deficiency. On 28 October 2022, the Nutrition Survey Foundation revealed that about 49% of the British adult population is unaware of having vitamin D deficiency while the National Diet and Nutrition survey reveals that about 1 in 6 adults have vitamin D deficiency unknowingly [12].

The research was carried out in the USA associated with Vitamin D deficiency among young adults 26010 participants were selected for the appropriate research of which 10,047 were found insufficient and 9,764 were deficient, research suggested that about 30% of the US population had a sufficient amount of vitamin D, 70% of their population was fall into the category of deficient and insufficient. As a result of studies that have been previously taken, we can say that vitamin D deficiency is beginning to raise a worldwide problem. A systematic review along with meta-analysis was carried out to find that adult South Asians are severely deficient in vitamin D, many factors emerged as underlying variables to explain this worldwide relation of vitamin D status among disparate populations. South Asian nations represent over 24% of the total world population according to the World Bank Organization [11]. This systematic research for The World Data Bank has possessed about 2998 study articles observed from different research databases by using a search engine strategy. The results of this systemic review and meta-analysis reveal that Pakistan has the highest prevalence of vitamin D deficiency about 73% in their population 225.2 million population followed by Bangladesh having a 67% Vitamin D deficiency ratio in

the 166.3 million population, India has 67% of the Vitamin D Deficiency in about 1.393 billion population, Nepal with 57% and Sri Lanka with 48% of having vitamin D deficiency ratio, respectively. Moreover, a review of statistics by gender, indicated that women were more likely than men to be vitamin D deficient in South Asia [13].

Nearly 50% of people have insufficient amounts of vitamin D. Billion people worldwide experience hypovitaminosis D due to inadequate vitamin D intake to meet daily needs, insufficient or little sun exposure, kidney dysfunction that prevents the kidneys from converting Vitamin D to its active form, or insufficient absorption of vitamin D from the gastrointestinal tract. People who primarily eat vegan food frequently have low vitamin D intake, particularly those who have a milk allergy or lactose intolerance [14, 15].

Lack of vitamin D in children is referred to as rickets, a degenerative disorder that causes skeletal abnormalities and bone softening as a result of improper mineral absorption by the bones. Infants can get rickets if they are breastfed for a long period. In the United States, it is most commonly found among breastfed black infants. Low vitamin D intake in adults and adolescents can result in osteomalacia, much like rickets do in children, A degenerative condition when the minerals in the bone are not effectively absorbed weakening the bone [16].

Numerous studies have explored the connection between Vitamin D deficiency and cognitive impairment. Research findings in this area have been intriguing yet occasionally inconclusive. Some studies suggest that insufficient Vitamin D levels may be linked to cognitive decline, especially in older adults [17]. However, the exact mechanisms behind this association are still under investigation. Inconsistencies in study designs, populations, and measurement methods have contributed to varying results.

An investigation was conducted at the Department of Psychiatry and Psychotherapy at Technische Universität München in Germany. Their investigation, which included a comprehensive analysis of data from both cross-sectional and longitudinal studies, revealed a robust correlation between cognitive impairment and Vitamin D deficiency. The study involved a substantial participant pool of 7,688 individuals, amalgamating findings from five cross-sectional and two longitudinal studies. The collective results consistently indicated a significantly elevated risk of cognitive impairment among those with insufficient levels of Vitamin D compared to individuals with normal Vitamin D status [18]. A significant study by Little Johns et al. [4] conducted a large-scale investigation into the relationship between Vitamin D status and cognitive decline. Their results indicated that individuals with severe Vitamin D deficiency had a higher risk of cognitive impairment [19]. This finding emphasizes the need for further research into Vitamin D's potential role in cognitive health.

2.2 Diabetes Mellitus and Cognitive Impairment

Cognitive impairment refers to a person's disability to think, learn, focus, remember, draw conclusions, and make judgments that affect their day-to-day activities. People may notice changes in their cognitive function in addition to the mild impairment, but they are still able to carry out their everyday tasks. Moderate-level impairment may gradually lose the ability to converse or write, as well as the ability to understand the significance of anything, leading to the inability to live independently [20].

Simultaneously, the link between Diabetes Mellitus and cognitive impairment has garnered substantial attention. Individuals with Diabetes Mellitus are reported to have an elevated risk of developing cognitive deficits and dementia [21]. The underlying pathophysiological mechanisms, including insulin resistance and vascular factors, have been implicated in the cognitive decline observed in DM patients. Diabetes Mellitus [22] can cause cognitive impairment through various mechanisms. Elevated blood sugar levels can damage brain cells, inflammation in the body and brain can disrupt cognitive processes, insulin resistance affects brain insulin signaling, and vascular changes can reduce blood flow to the brain, increasing the risk of cognitive decline [23]. Additionally, hypoglycemia resulting from diabetes treatments and coexisting conditions like hypertension can exacerbate cognitive dysfunction. However, not everyone with DM will experience cognitive impairment, and proper disease management can help mitigate these risks [20].

A study was conducted involving 60 diabetic patients, with 30 having well-controlled diabetes and another 30 without diabetes. Utilizing the modified Mini-Mental State Examination, it was observed that individuals with diabetes exhibited lower MMSE scores compared to those without diabetes. Furthermore, diabetes was associated with increased odds of cognitive decline, as evidenced by MMSE scores [11]. Additionally, A cohort of 462 individuals with diabetes was examined, revealing a significant association between diabetes and lower scores on cognitive function. Notably, all markers of brain pathology showed a significant correlation with the presence of diabetes. This comprehensive analysis underscores the impact of diabetes on cognitive health, highlighting the interconnectedness between diabetes and various indicators of brain pathology [11]

2.3 Interplay between Vitamin D Deficiency, T2DM, and Cognitive Impairment

The interplay between Vitamin D deficiency, T2DM, and cognitive impairment is a relatively nascent area of investigation. Recent research has begun to explore the potential synergy between these factors. A study by Malik et al. [23] suggested that low Vitamin D levels were associated with a higher risk of T2DM, which, in turn, could contribute to cognitive impairment. These findings hint at a complex web of relationships that warrants further exploration.

3. RESULTS

3.1 Study Design

To explore the potential connection between vitamin D deficiency and cognitive impairment in older individuals in the context of type 2 diabetes mellitus, this study employed a cross-sectional Analytical research approach at NIDE from 2022 to 2024.

3.2 Study Settings

The investigation was conducted at the National Institute of Diabetic and Endocrinology (NIDE) in Karachi, a renowned healthcare institution specializing in the identification, management, and research of endocrine-related disorders and diabetes.

Participant recruitment and data collection will primarily occur at the NIDE outpatient department (OPD). This outpatient setting will facilitate the efficient identification of individuals and collect crucial information regarding their demographics, medical histories, and medication usage through structured interviews. Additionally, access to participants' medical records at NIDE will allow for the retrieval of supplementary data, including their previous vitamin D test results.

To assess the cognitive function of the participants, the Mini-Mental State Examination (MMSE) will serve as the standardized benchmark. These assessments will be conducted in a dedicated evaluation area within the OPD, providing participants with a calm and accommodating environment and ensuring consistency in all evaluation procedures.

3.4 Inclusion and Exclusion Criteria

Participants had to be 35 years of age or older to meet the study's inclusion criteria since they were more likely to suffer from cognitive impairment. Participants also had to give informed consent confirming that they understood the goals of the study and any possible risks. People with significant cognitive impairment, pregnancy, and serious medical issues were excluded from the study.

3.5 Sampling Technique

The sampling technique in our data collection method involves a convenient approach. We aim to recruit those patients with diabetes and without diabetes as well as those having vitamin D deficiency or not. This ensures that our sample represents both groups fairly and allows for a direct comparison of cognitive impairment associated with vitamin D deficiency in these two categories. Patients are selected based on their diabetes status (with or without) and their history of vitamin D deficiency testing

3.6 Data Collection Procedure

In our study, we aim to investigate Cognitive Impairment associated with vitamin D Deficiency in patients with and without diabetes. To achieve this, we included patients with and without diabetes, as well as patients with and without vitamin D deficiency, following the predefined sample size criteria. To assess cognitive impairment, we will employ the Mini-Mental State Examination (MMSE) as our primary evaluation tool. (SMMSE) a standardized evaluation tool that consists of a series of tasks and questions administered by a qualified professional. It was a performance-based and interview assessment. The findings are used to assess the person's cognitive functioning and the potential presence of cognitive impairments depending on how well they performed in completing the activities. This well-established and reliable instrument will enable us to gauge cognitive function across multiple domains, encompassing orientation, memory, attention, language, and visuospatial skills, utilizing a series of questions and activities. For diabetes status, we will rely on the patient's medical history, while for vitamin D deficiency, we will focus on individuals who have previously been tested for such a deficiency.

3.7 Sample Size

The minimum sample size calculated for this study was 300, with a margin of error of 5%, 95% CI, and 80 power of the study. The prevalence of cognitive impairment in Vitamin D insufficient and diabetic patients is 73.5%. Open Epi online version is used for the sample size calculation [24].

3.8 Study Population

The study population for this research consisted of elderly individuals residing in Karachi, visiting NIDE OPD. Inclusion criteria will be limited to individuals aged 35 years or older. The sample size was comprised of 349 individuals selected from the National Institute of Diabetes and Endocrinology (OPD).

3.9 Statistical Analyses

After collecting the data from the previous reports and patient history. We evaluated cognitive impairment using the Standardized Mini-Mental State Examination (SMMSE), and we analyzed data using SPSS version 21. In this study, we have used chi-square, univariate, and multivariate analysis to analyze the data

4. RESULTS

This study included a total of 349 participants Table 1. Shows the demographics of the study population.

Table 1
Demographics of Study Participant

Demographics		n (%)
Age	35-54	203(58.2%)
	55-65+	146(41.8%)
Gender	Male	124(35.5%)
	Female	225(64.5%)
Marital Status	Single	33(9.5%)
	Married	277(79.4%)
	Divorced	32(9.2%)
	Widowed	7(2%)
Type 2 Diabetes Mellitus	Yes	188(53.9%)
	No	161(46.1%)
HTN	Yes	104(29.8%)
	No	245(70.2%)
Cardiovascular Disease	Yes	7(2%)
	No	342(98%)
Thyroid Disorder	Yes	20(5.7%)
	No	329(94.3%)
Renal Disease	Yes	1(0.3%)
	No	348(99.7%)
Educational Status	Nil	90(25.8%)
	Primary	13(3.7%)
	Matriculation	78(22.3%)
	Intermediate	59(16.9%)
	Graduate	92(26.4%)
	Postgraduate	17(4.9%)
Family History related to any Psychological Disorder	Don't Know	74(21.2%)
	Yes	33(9.5%)
	No	242(69.3%)
Vitamin D Level	Insufficient (=>50 to <75 nmol/L)	282(80.8%)
	Sufficient (=>75 nmol/L)	67(19.2%)
Medication Taken to Treat Vitamin D Deficiency	Yes	179(51.3%)
	No	170(48.7%)
Standarized Mini Mental State Examination Results	Normal	157(45%)
	Possible Cognitive Impaired	192(55%)

There were 124 males (35.5%) and 225 females (64.5%). The age was divided into two different groups: 35-54, which included 203 participants (58.2%), and 55–65+, which included 146 participants (41.8%). Among the participants, 33 were single (9.5%), 277 were married (79.4%), 32 were divorced (9.2%), and 7 were widowed (2%). In terms of comorbidities, diabetes was the main factor considered in this study, with 188 participants (53.9%) having diabetes and 161 participants (46.1%) being non-diabetic. Upon finding the educational status, it was revealed that 90% of the participants were uneducated, 13 participants (3.7%) had education till the primary standard, and 78 participants (22.3%) had completed their studies till matriculation. Additionally, 59 participants (16.9%) had completed their education till intermediate, 92 participants (26.4%) had graduated, and 17 participants (4.9%) had completed their studies till post-graduation. Family history related to any psychological disorder was unknown in 74 participants (21.2%), 33 participants (9.5%) had a family history, and 242 participants (69.3%) did not have a family history related to any psychological disorder. Among the study participants, 14 (4%) had severe vitamin D deficiency, 93 participants (26.6%) were deficient, 175 participants (50.1%) were insufficient, and 67 (19.2%) were sufficient, showed no vitamin D deficiency. Furthermore, 136 participants (51.6%) were taking medication to treat vitamin D deficiency daily, while 169 participants (48.4%) were not taking medication.

In the examination of cognitive function, we identified significant associations with various factors Table 2. Illustrate these findings as follows. In terms of gender, among the 124 males, 59 participants (30.7%) were identified as cognitively impaired. However, among the 225 females, 133 participants (69.3%) were classified as cognitively impaired, indicating a significant relationship with cognitive impairment (p-value=0.04). Regarding age, of the 203 participants (58.2%) aged 35 to 54, 102 participants (65.0%) demonstrated normal cognitive function, and 101 participants (52.6%) were found to be cognitively impaired.

Among 146 participants (41.8%) aged 55 to 65+, 55 participants (35.0%) were normal, and 91 participants (47.4%) were identified as cognitively impaired, with a significant association between age groups (p-value = 0.22). Marital status showed a noteworthy association with impaired cognitive function. Among the 33 single participants (9.5%), 19 participants (12.1%) were normal, and 14 participants (7.3%) were cognitively impaired. Of the 277 married participants (79.4%), 114 participants (72.6%) were normal, while 163 participants (84.9%) were cognitively impaired. In the case of 32 divorced participants (9.2%), 22 participants (14.0%) were normal, and 10 participants (5.2%) were cognitively impaired. The 7 widowed participants (2.0%) included 2 participants (1.3%) with normal cognitive function and 5 participants (2.6%) cognitively impaired, revealing a significant association (p-value = <0.01).

Regarding Type 2 Diabetes Mellitus, of the 188 participants (53.9%) with diabetes, 76 (48.4%) were normal, and 112 (58.3%) were found to be cognitively impaired. Among the 161 non-diabetic participants (46.1%), 81 (51.6%) were normal, and 80 participants (41.7%) were identified as cognitively impaired, indicating an insignificant association with diabetes (p-value = 0.06).

In educational status, 90 participants (25.8%) were found to be uneducated, with 8 participants (5.1%) normal and 82 participants (42.7%) cognitively impaired. Additionally,

13 participants (3.7%) were educated till the primary standard included 31 participants (19.7%) normal and 47 participants (24.5%) were cognitively impaired. Further, 59 participants (16.9%) educated till intermediate comprised 34 (21.7%) normal and 25 (13.0%) cognitively impaired. Among the 92 graduates (26.4%), 67 (42.7%) were normal, and 25 (13.0%) were cognitively impaired. The 17 participants (4.9%) completing postgraduate studies included 14 (8.9%) normal and 3 (1.6%) cognitively impaired, demonstrating a significant association between cognitive impairment and educational status (p-value = <0.001).

Table 2
Assessment of Cognitive Impairment with Various Factors

		Standardized Mini Mental State Examination Results				p-value
		Normal		Impaired		
		n	N %	n	N %	
Age	35-54	102	65.0%	101	52.6%	0.02
	54-65+	55	35.0%	91	47.4%	
Gender	Male	65	41.4%	57	30.0%	0.04
	Female	92	58.6%	133	70.0%	
Marital Status	Single	19	12.1%	14	7.3%	<0.01
	Married	114	72.6%	163	84.9%	
	Divorced	22	14.0%	10	5.2%	
	Widowed	2	1.3%	5	2.6%	
Diabetes Mellitus	Yes	76	48.4%	112	58.3%	0.07
	No	81	51.6%	80	41.7%	
HTN	Yes	42	26.8%	62	32.3%	0.3
	No	115	73.2%	130	67.7%	
Cardiovascular Disease	Yes	3	1.9%	4	2.1%	1
	No	154	98.1%	188	97.9%	
Thyroid Disorder	Yes	11	7.0%	9	4.7%	0
	No	146	93.0%	183	95.3%	
Renal Disease	Yes	0	0.0%	1	.5%	1
	No	157	100.0%	191	99.5%	
Educational Status	Nil	8	5.1%	82	42.7%	<0.001
	Primary	3	1.9%	10	5.2%	
	Matriculation	31	19.7%	47	24.5%	
	Intermediate	34	21.7%	25	13.0%	
	Graduate	67	42.7%	25	13.0%	
	Postgraduate	14	8.9%	3	1.6%	
Family History Related To Any Psychological Disorder	Yes	69	43.9%	110	57.3%	0.01
	No	88	56.1%	82	42.7%	
Vitamin D Level	Insufficient (=>50 to <75 nmol/L)	111	70.7%	171	89.1%	<0.001
	Sufficient (=>75 nmol/L)	46	29.3%	21	10.9%	
Medication Taken to treat Vitamin D Deficiency	Yes	69	43.9%	110	57.3%	0.01
	No	88	56.1%	82	42.7%	

Family history related to any psychological disorder was unknown in 74 participants (21.2%), with 43 (27.4%) found to be normal and 31 (16.1%) cognitively impaired. Among the 33 participants (9.5%) with a family history, 13 (8.3%) were normal, and 20 (10.4%) were cognitively impaired. In contrast, the 242 participants (69.3%) without a family history included 101 (64.3%) normal and 141 (73.4%) cognitively impaired, revealing a significant association (p-value = 0.03). Among the study participants, 14 (4.0%) had severe vitamin D deficiency, with 3 (1.9%) normal and 11 (5.7%) cognitively impaired. Of the 93 participants (26.6%) deficient, 20 (12.7%) were normal, and 73 (38.0%) were cognitively impaired. Additionally, 175 participants (50.1%) were insufficient, with 88 (56.1%) normal and 87 (45.3%) cognitively impaired. The 67 participants (19.2%) with sufficient vitamin D levels included 46 (29.3%) normal and 21 (10.9%) cognitively impaired, revealing a significant association between vitamin D deficiency and cognitive impairment (p-value = <0.001). Furthermore, 180 participants (51.6%) taking medication for vitamin D deficiency daily included 69 (43.9%) normal and 111 (57.8%) cognitively impaired. Of the 169 participants (48.4%) not taking medicine, 88 (56.1%) were normal, and 81 (42.7%) were cognitively impaired, indicating a significant association with cognitive function (p-value = 0.01).

The univariate and multivariate analyses were executed, and the variables with a p-value ≤ 0.1 were further analyzed for multivariable analyses. In multivariate analyses, uneducated or primary education level patients had a significant effect on cognitive impairment (p-value <0.001), Odds ratio 31 (14-71) when compared with individuals whose education was graduate or post-graduate. Similarly, patients with education level matriculation or Intermediate had a 3.4 (1.9-6) times higher odds ratio (95% CI) than patients with education level graduate or postgraduate (p-value 0.001) The individuals with vitamin D insufficiency had higher odds (95% CI), 4 (2-9), with reference to the patients with sufficient vitamin D (P-value <0.001) (Table 3).

Table 3
Univariate and Multivariate Analysis

Patient Characteristics		Univariate Odds Ratio (95% CI)	P-value	Multivariate Odds Ratio	P-value
Age	35-55 Years	(Reference)			
	>55 Years	1.7 (1-2.6)	0.02	1 (0.6-1.8)	0.96
Gender	Female	(Reference)		-	
	Male	0	1		
Marital Status	Single	(Reference)			
	Married/Divorced/ Widowed	1.8 (0.8-3.6)	0.1		
Diabetes	No	(Reference)			
	Yes	1.5 (1-2.3)	0.07	1.5 (0.9-2.7)	0.13
Hypertension	No	(Reference)			
	Yes	1.3 (0.8-2.3)	0.26	-	
Cardiovascular	No	(Reference)			
	Yes	1 (0.2-5)	0.9		
Thyroid	No	(Reference)			
	Yes	0.7 (0.3-1.7)	0.36		
Renal Disease	Yes	(Reference)			
	No	0	1		
Education	Graduate/Postgraduate	(Reference)			
	Uneducated/Primary	24 (11.3 – 52)	<0.001	31 (14-71)	<0.001
	Matriculation/ Intermediate	3.2 (1.9 – 5.5)	<0.001	3.4 (1.9-6)	<0.001
Family History	Yes	(Reference)		-	
	No	0.8 (0.4-1.6)	0.5		
Vitamin D	Sufficient	(Reference)			
	Insufficient	3.4 (1.9 – 6)	<0.001	4 (2-9)	<0.001
Medications	No	(Reference)			
	Yes	1.7 (1- 2.6)	0.01	1.6 (0.9-2.7)	0.1

5. DISCUSSION

The discussion section of this study will investigate cognitive impairment association with age, diabetes mellitus, vitamin D deficiency, gender, educational status, and vitamin D supplementation. Cognitive impairment is a complex condition subject to several influences, and understanding the relationship may help pinpoint at-risk populations and inform possible interventions. Through comparative analysis with prior research, our results allow for an extensive exploration of each factor's contribution to cognitive decline, thereby concurrently addressing the discrepancies and gaps in the existing literature. Moreover, this discourse draws attention to two essential aspects: vitamin D levels and educational attainment, both of which have emerged as critical determining factors in the realm of cognitive health.

Association of Age with Cognitive Impairment:

Age was a significant factor showing a positive association with cognitive impairment; participants were divided into two age groups. The responses received from middle-aged (ages 35-54) were slightly higher, at 52.6%, than from elder-aged (55-65+), who showed 47.4%. The result indicated that cognitive impairment was significantly higher among the elder-aged group. However, in comparison with a previous study by Feart et al., 2017, older individuals with Vitamin D deficiency (n = 218) experienced higher cognitive impairment than those without Vitamin D deficiency (n = 151) [26]. Both studies highlighted that age significantly impacts cognitive function, particularly with a history of vitamin D deficiency.

Association of Diabetes Mellitus with Cognitive Impairment:

Our study shows an insignificant relationship between diabetes mellitus and cognitive impairment. Even though diabetes is thought to be the primary risk factor for both vascular health and cognitive decline, 58.3% of individuals suffering from diabetes showed cognitive impairment, while 48.4% of individuals with diabetes mellitus were found to be normal. Conversely, 41.7% without diabetes mellitus were found to have cognitive impairment, and 51.6% were found to be normal. Malik et al., 2022, conducted a study to explore the relationship between cognitively impaired individuals and type 2 diabetes mellitus patients, where they also found an insignificant relationship between both factors, as 75.60% of individuals were not cognitively impaired despite having type 2 diabetes, while 24.40% of individuals were found to have cognitive impairment [23].

Association of Vitamin D levels with Cognitive Impairment:

Our results show a significant association between cognitive impairment among individuals with insufficient vitamin D levels. About 89.1% of individuals with insufficient levels of vitamin D showed cognitive impairment, significantly higher than the other group, where 70.7% of individuals were found to have normal cognitive function. Conversely, participants with sufficient vitamin D levels showed a reduced percentage of cognitive impairment at 10.9%, while 29.3% were found to have normal cognitive function. Rajalakshmi et al., 2022, reported that among diabetic participants with vitamin D insufficiency, there was a higher rate of cognitive impairment (71.43%), while among diabetic individuals with sufficient vitamin D, 75% were observed to be cognitively impaired. Among non-diabetic individuals, 62.79% of those with insufficient vitamin D and 68.97% with sufficient vitamin D levels were found to be cognitively impaired, reporting an insignificant association between vitamin D insufficiency and cognitive outcomes across diabetic and non-diabetic groups [10]. In contrast, our study suggested a stronger relationship between vitamin D insufficiency and cognitive impairment. This discrepancy between findings suggests the absolute need for further investigation to explore the underlying mechanisms and association of vitamin D with diabetes and cognitive impairment. Similarly, the risk of developing cognitive impairment was observed to differ based on gender.

Association of Gender with Cognitive Impairment:

The results indicated that 69.3% of females are cognitively impaired, whereas only 30.7% of males are affected by cognitive impairment. This finding aligns with previous

studies by Xi et al., 2022 in which 28.6% of women were diagnosed with mild cognitive impairment (MCI), Moreover, 11.4% of women were diagnosed with dementia[25]. The study further highlighted that in post-menopausal women, age at menopause, reproductive period, and number of pregnancies and parities were associated with Mini-Mental State Examination scores. It was also reported that women are more likely to be at high risk of vitamin D deficiency, with a possible impact on cognitive impairment.

Association of Educational Status with Cognitive Impairment:

Our findings found significant associations between educational status and cognitive impairment. Moreover, the students were divided into six subcategories based on their qualification degrees, and participants with no educational level had a higher risk of cognitive impairment, as 42.7% showed signs of potential cognitive impairment compared to other groups. On the other hand, individuals with more advanced educational levels showed a reduced occurrence of cognitive impairment: the primary group had 5.2%, the matriculation group had 24.5%, intermediate 13.0%, graduate 13.0%, and postgraduate only 1.6%. These findings suggest that higher educational levels can lower the chance of cognitive decline. Zhong, Li, Liu, Wang, & Chen, 2024, conducted a similar study with 118 older participants, 79 of whom had higher education. In this group, 43.00% showed cognitive impairment, while 39 participants with lower education showed 61.50%, declaring that an individual's educational status has a stronger association with cognitive impairment [27].

Association of Medication with Cognitive Impairment

Our study found that medication for Vitamin D deficiency lowers the risk of cognitive impairment. Participants who were on medication showed improved cognitive outcomes (43.9%), whereas those who were not on vitamin D supplements showed a higher rate of cognitive impairment (57.3%). Petterson, 2017, revealed that serum levels of Vitamin D marked an increase in the high-dose group, from 67.2±20 to 130.6±26 nmol/L. In contrast, low-dose subjects increased modestly from 60.5±22 to 85.9±16 nmol/L.)[28]. Different methods were used to assess cognitive impairment, and the high-dose group showed significant improvement in cognitive function.

This study provides several avenues for further research studies. Chiefly, longitudinal studies should be conducted to ascertain how vitamin D supplementation affects cognitive function over time, including populations with diabetes. Such questions may reveal if maintaining optimal Vitamin D levels can prevent or slow cognitive impairment. Research into the impacts that neuro inflammation, oxidative stress, and vascular health have in these conditions could help in identifying potential therapeutic targets. Intervention research on the efficacy of Vitamin D supplementation in high-risk populations, particularly elderly diabetic patients, may even be an enabling public health measure that could help decrease cognitive decline. Synergistic effects of lifestyle adjustments, for instance, change in dieting and exercising in combination with Vitamin D supplementation lead to integrated approaches toward improvement of cognitive function in at-risk populations. Ultimately, follow-up studies should work towards involving populations of more diverse settings across regions to enable the generalizability of the results. Researchers can address populations with different exposure to sunlight, dietary patterns, and other genetic

composition and eventually achieve adequate knowledge regarding the association between Vitamin D, diabetes, and cognitive impairment.

6. CONCLUSION

In Conclusion, the current study indicates a significant relationship between vitamin D deficiency and cognitive decline in those, particularly older adults who have diabetes. The findings indicate that those displaying reduced levels of vitamin D are at an increased risk of experiencing cognitive decline, whereas supplementation with vitamin D appears to work as a protective agent in reducing this risk. Other demographic factors-including age, gender, and levels of education-have been also confirmed as predictors of cognitive function. A higher prevalence of cognitive impairment was associated with older age, female gender, and fewer years of education. Diabetes mellitus had a partial association with cognitive decline but did not become statistically significant. Vitamin D supplementation appears as a potential cost-effective approach for diminishing progressive cognitive decline in at-risk populations. More longitudinal studies are needed to fully characterize the mechanisms involved in these relations and better understand the maintained effects of vitamin D supplementation on cognitive health.

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8. CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

9. FUNDING

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A NEW ERA OF DNA VS NANO-READY WORKFORCE

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ABSTRACT

The most interesting behavior which highlights the complexity which arises from coupling both side and shift has to found for the sequencing. This research base on course nanotechnology which is available in course era and others to gained DNA Molecular models. The combination of nearest neighbor stacking within a strand and hydrogen bonding b/w complementary bases derives the formation of helical duplexes. We perform this fitting using a Bayesian analysis and confirm our finding using a simpler descriptive concentration for qualitative response (Seeman, 1982). There are major four strategies for the formation of pattern DNA. The advent of global functional genomics technologies and the data RNA provides, has opened the possibilities of creating qualitative predictive models of biological systems in humans (Roh et al., 2011).

DNA nanotechnologies has been developed to achieve controlled transformation by tiggers including physical workforces. Bayesian analysis will play a significant role in many biosciences activities. DNA microarray set sequences (AGTGTCCTA…….) which could detect multiple heavy metal ions within 5 min, the detection limit was down 10, 10, and 20 nM (Rothemund, 2006). For normal distribution in RNA the sign test is applicable in experiments where a qualitative response such as hit or miss is recorded. This will benefit for diagnosing future medicines (Zhang et al., 2014).

KEYWORDS

DNA, Bayesian analysis & Nano Technologies.

OBJECTIVES

The main objective in DNA finding sequence from various application on signal analysis with nanos. We use estimation method along frequency measured with first moment of helical twisted DNA. We generate the time frequency map of the of the synthetic nonstaionary seismic trace using the S-transform. We consider in our experiment for a simple signal DNA which includes three monophonic components at 10.20 and 30 Hz and two broad band spikes at 2 and 2.3s. In the propose method we provide a composite chirp signals which includes two probabilistic models (Zhao et al., 2012).

METHODOLOGY

The DNA region give a practical example and present how it relates to Data. Satellite DNA is only used for the sequence degree of repetition 10^3 - 10^7 at each locus (Jones et al., 2015). In DNA the R set which belongs to natural and real number set of all 20 Base pair which satisfy

$$R = \{x: f\ I\ (x)\ \geq\ 0, i =\ 1, 2, 3, 4 \ldots, n;\ n\ \mathcal{E}\ G\}$$

If follows immediately from the fact that G is convex then R is convex.

By using Baysian law we will proof it with conditional value of nanotechnology cell in RNA by using 30 to 40 sample of blood groups at random basically humans (Yang and Zhao, 2015).

CONCLUSION

The set G of human DNA can get a better sequence and series from raw data with the help of nanotechnolgical model. Our estimation will be straightforward ARIMA model by applying any mathematical software. The research will be helpful for future medicine in different problems (Cheng et al., 2019). In nano form materials can be analyzed with PCR and blood groups with any SPSS models for well condition human model in RNA.

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ASSOCIATION OF DRY EYES WITH DEGREES OF MYOPIA IN TYPE II DIABETES MELLITUS

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ABSTRACT

Background: This study was performed to assess the prevalence of dry eyes in myopic and type II diabetic patients and their contributing factors.

Methods: The sample size was 400. The study design was cross sectional and the study technique was non probability, convenient. Patients from ophthalmology and diabetic department of Dow University of health sciences were consecutively selected. Data collection consisted of a detailed clinical examination and a structured questionnaire. Dry eye was assessed with schirmer test.

Results: Out of 400 patients most of them were female 261(64.8%) and most of them were unemployed 359(89.8%. The variables age, diabetes duration, diabetes control (stage), myopia and degree of myopia showed a statistically significant association with the degree of dry eyes. In severe stage of dry eyes patients were mostly of age 60-65 (32.9%), in moderate stage most people were of age 45-50(46%), in mild stage most of people were of 45-50 age (39.8%) and for subjects with normal eyes were of age 60-65 (34.1%) there was significant association between degree of dry eyes and age distribution, had p value of ($p<0.001$). Dry eye was more frequent in diabetic patients for duration less than 5 years (36.6%), for 10-15 years (31.4%), for 5-10 years (29.3%), for 1-5 years (9.2%), for 15-20 years (8.3%), duration of diabetes and degree of dry eyes had significant relation ($p = 0.001$). Most of patients were of uncontrolled stage (51.6%). Stage of diabetes and degree of dry eyes had a significant relation ($p=0.001$). Myopia and degree of dry eye had significant relation ($p = 0.003$) out of which most patients have myopia in both eyes (91.1%). Degree of myopia and dry eyes severity had significant relation ($p = 0.043$). In this most patients had mild myopia (79.9%) then for moderate it was (17.9%) and for severe it was (2.2%).

Conclusion: Diabetes and dry eye appear to have a common association. Interventions to prevent dry eye is required in diabetic population. Enhancing patient awareness and self-management for dry eye in addition to early screening and detection, is especially critical for diabetic patients who are also myopic. However, examination for dry eye should be an integral part of the assessment of diabetic eye disease. Further cohort longitudinal

studies should be performed to determine the etiologic association between dry eyes and diabetes for prevention.

INTRODUCTION

TEAR FILM:

This layer cover conventional ocular outer surface; it's typically thought of two comprise the subsequent three tangled layers. It laid out following salient aims:

(a) It keeps save our eyes and prevent them from drying

(b) It wipes away the dust particles.

(c) It lessens the chance of eye infection.

(d) It makes the blinking more comfortable and effortless.

DRY EYE

Dry eye is the "multiple emission of radiation and ocular surface disease shows the symptoms of impaired vision, disturbances in vision, tear film vulnerability and there was damage to the ocular surface". Its miles followed through a growth within the absorption of the tear film.

PREVALENCE OF DRY EYES

It is the most widespread condition of the eye, which has an impact internationally. "The prevalence ranges of dry eyes in worldwide depending on environmental conditions are from 5% to 50%, At over the age of 40 it can reach up to 75%, and often the most affected ones are the women. In the middle of ages of 18 and 45, only 2.7% have dry eye disease".

THE MYOPIA

"It is an error in which rays of light come in contact with the eye parallel of the optic axis are lead to a focus in front of the retina when ocular accommodation is relaxed".

PREVALENCE OF MYOPIA

"We comprise the data covering the population of 2.1 million including 145 studies. 1406 million population were estimated in the category of the myopia (which makes the (22.9%) of the world population, the confidence interval [CI] was 95%, 932-1932 million (15.2%-31.5%) and the high myopia was estimated in 163 million people (which makes the world population of 2.7%, The CI was 95%, in 2000 86-387 million population which makes up the percentage of [1.4%-6.3%]. In 2050 we assume that the people suffering from myopia will be 4758 million which makes up the percentage of (49.8% of the world population;[95% CI, 43.4%-55.7%] which makes up the population of 3620-6056 million) and also we predict that the high myopia will be in the population of 938 million people which makes up the percentage of (9.8% of the world population ; also 479-2104 million which makes up the percentage of [95% CI, 5.7%-19.4%])". DIABETES MELLITUS:

"It is a chronic disease of metabolism, characterized by the elevated blood glucose levels in the body. It has several categories, including type i, type ii, gestational diabetes, newborn diabetes, and secondary causes due to endocrinopathies, steroid use, etc."

PREVALENCE OF DIABETIC MELLITUS

"The wide spread presence of diabetes in Pakistan was (11.77%, 16.98%, and 17.1%, in the year of 2016, 2018 and 2019) independently. In 2022, the DM affect 26.7% of adults in Pakistan, which makes up the whole cases roundabout to 33,000,000 in relation to the International Diabetes Federation. By the each passing year this number is appalling rise and also getting enlarge. We believe that there are so many patients which left untreated, which makes the definite incidence and drawback of change put down to the lack of medicaments."

TYPE II DIABETES MELLITUS

"It is a prolonged medical condition. It is indicated by the rise in the level of sugar in the blood because cells do not respond normally to insulin. It is also further characterized with the name of adult onset diabetes. Its most commonly found in mid and late adulthood.

PREVALENCE OF TYPE II DIABETES IN WORLD WIDE

Globally it is an opinion that 530 million adults were affected approx., with the international estimation include that the adult aged 20 to 79 years (1,2) were affected more which makes up the percentage of (10.5%). 98% of global detection of diabetes include the type ii diabetes but among the vast countries this percentage could vary.

PREVALENCE OF TYPE II DIABETES IN PAKISTAN

In agricultural sides of Pakistan there is a prevalence of 10.34% and in densely populated areas there is a prevalence of 14.81 % of type 2 diabetes mellitus. And in Pakistan 11.77% is the prevalence of type 2 diabetes. There is a high rise of occurring in masculine then feminine and in contrast to the urban areas have more frequent than in the rural areas.

METHODOLOGY

- Study design: Descriptive, Cross sectional and Analytical study
- Study setting: Diabetic department of Dow University of health sciences, Ojha campus
- Sample size: 400
- Sampling technique: Non probability, convenient

Study Method

- First we go to diabetic department then we select type II diabetic patients those who have degree of myopia
- Then we go to eye department and do objective refraction
- Then we will perform subjective refraction

- Then the patient will further proceed towards slit lamp examination
- And then last we do schirmer test to check degree of dry eyes in type II diabetes with myopia

Inclusion Criteria

- Age between 35-65 years
- Myopia
- Diabetic type II
- Patient give consent

Exclusion Criteria

- Age below 35 to above 65
- Other refractive errors (Hypermetropia and Astigmatism)
- Other types of DM

Tool: Schirmer Test.

LITERATURE VIEW

Dry eye disease (DED) is a prevalent condition among individuals diagnosed with diabetes mellitus (DM). Numerous studies have explored the occurrence and correlations of DED in this patient population.

- In the year 2018, china has done community-based study with the sample size of 1360 and the result was found that there was a significant association between the presence of DED and higher blood glucose. This study was based on questionnaire that provide basic assessment of the relation. The patients were studied in detail like their corneal sensitivity test, their tear-film production and absorption and also graded the diabetic retinopathy as per the scale given by the international. Total 1360 out of which 238 people were diagnosed with dry eye disease. This study elaborate the strong relationship between the DED and DM. The prevalence was 17.5%. Those subjects who have no proper metabolic control on themselves are more likely to prone with the disease. Here we can also find out that the screen examination regularly is necessary for the disease to diagnose early because early diagnoses of the disease has a good prognosis.
- A 2019 study conducted in Scotland revealed that 44% of diabetic patients experienced dry eye symptoms, with a notably higher incidence among those with type 2 diabetes mellitus (DM II). Similarly, research from China in 2018 identified a significant link between elevated blood glucose levels and the prevalence of DED
- In the year 2021, November, the University of Indonesia Diponegoro has done an analytical observational study with cross sectional design and purposive sampling having the sample size of 42 and the result was found that there was the significant relation between diabetic retinopathy and DES in patients with type II diabetes

mellitus. Due to metabolic dysfunction, oxidative stress type II DM patients have higher risk of dry eye syndrome (DES) which ultimately reduces the patients quality of life and if the patients did not get any therapy it can lead to blindness also by controlling and prevent DES it is mandatory to control its risk factors the patients were examine by using slit lamp, questionnaire and deep interview the patients were diagnose to have DES if the patients schemer test is less than 10mm further more in this study we have found that from 42 subjects, 19 patients from the total suffered from DES whereas 23 subjects didn't suffered. There was strong relation between DES and DR with type II DM patients.

- In 2023, a cross-sectional study in Western India reported that 43.81% of patients with DM II were affected by DED. Additionally, a 2021 study in Indonesia established a significant relationship between diabetic retinopathy and dry eye syndrome (DES) in individuals with DM IIA population-based cohort study in Taiwan examined the prevalence of DED among DM II patients, finding that 10,029 individuals were diagnosed with this condition.
- These findings underscore the notable connection between DED and DM, especially in those with type 2 diabetes. The elevated prevalence of DED in DM II patients may be linked to metabolic dysfunction, oxidative stress, and various other contributing factors.

CONCLUSION

Table 1

Out of 400 patients, majority were females 261 (64.8%) and 142 (35.2%) were male. A striking 89.8% of the patients were unemployed whereas only 10.3% were employed. The age group of 45-50 years represented the largest segment of the population at 32.9%. Other significant age groups included 60-65 years (26.2%) and 55-60 years (20.8%). The smallest group was those between 40-45 years (9.7%). The largest portion of patient had been living with diabetes for 15-20 years (29.9%), followed by those with disease for 10-15 years (24.9%) and below 5 years (23.4%).A near even split was observed between patients with controlled diabetes (48.4%) and those with uncontrolled diabetes (51.6%). The vast majority of patients (91.1%) had myopia in both eyes (OU), while 7.4% had myopia only in the right eye (OD) and just 1.5% had it in the left eye (OS). Most patients (79.9%) experienced mild myopia (3-6 dioptres) was present in 17.9% of the group.

Table 1

Gender	Male	142 (35.2)
	Female	261 (64.8)
Occupation	Unemployed	359 (89.8)
	Employed	41(10.3)
Age	40-45	39(9.7)
	45-50	133(32.9)
	50-55	42(10.4)
	55-60	84(20.8)
	60-65	106(26.2)
Diabetes Since	10-15 yrs	100(24.9)
	15-20 yrs	120(29.9)
	5-10 yrs	87(21.7)
	below 5 years	94(23.4)
Stage	Controlled	195(48.4)
	Uncontrolled	208(51.6)
Myopia	OD	30(7.4)
	OS	6(1.5)
	OU	367(91.1)
Degree of Myopia	Mild [0.5-3 DS]	322(79.9)
	Moderate [3-6 DS]	72(17.9)
	High [6DS above]	9(2.2)
Degree of Dry Eyes	Severe	146(36.3)
	Moderate	124(30.8)
	Mild	88(21.9)
	Normal	44(10.9)

Table 2

		Degree of Dry eyes				P-value
		Severe	**Moderate**	**Mild**	**Normal**	
Gender	Male	52 (35.6)	42 (34.1)	26 (29.5)	21 (47.7)	0.228
	Female	94 (64.4)	81 (65.9)	62 (70.5)	23 (52.3)	
Occupation	Unemployed	133 (91.7)	106 (86.2)	79 (90.8)	39 (90.7)	0.51*
	Employed	12 (8.3)	17 (13.8)	8 (9.2)	4 (9.3)	
Age	40-45	3 (2.1)	15 (12.1)	13 (14.8)	8 (18.2)	<0.001
	45-50	29 (19.9)	57 (46.0)	35 (39.8)	11 (25.0)	
	50-55	23 (15.8)	11 (8.9)	3 (3.4)	5 (11.4)	
	55-60	43 (29.5)	25 (20.2)	11 (12.5)	5 (11.4)	
	60-65	48 (32.9)	16 (12.9)	26 (29.5)	15 (34.1)	
Diabetes Since	10-15 yrs	49 (33.8)	23 (18.7)	19 (21.8)	9 (20.5)	<0.001
	15-20 yrs	52 (35.9)	32(26.0)	25(28.7)	10(22.7)	
	5-10 yrs	22 (15.2)	41 (33.3)	17 (19.5)	6 (13.6)	
	below 5 years	22 (15.2)	27 (22.0)	26 (29.9)	19 (43.2)	
Stage	controlled	51 (35.2)	64 (51.6)	51 (58.0)	27 (61.4)	<0.001
	uncontrolled	94 (64.8)	60 (48.4)	37 (42.0)	17 (38.6)	
Myopia	OD	4 (2.8)	11 (8.9)	14 (15.9)	1 (2.3)	0.003*
	OS	1 (0.7)	2 (1.6)	2 (2.3)	1 (2.3)	
	OU	140 (96.6)	111 (89.5)	72 (81.8)	42 (95.5)	
Degree of Myopia	Mild [0.5-3 DS]	107 (73.8)	98 (79.0)	74 (84.1)	41 (93.2)	0.043*
	Moderate [3-6 DS]	31 (21.4)	25 (20.2)	13 (14.8)	3 (6.8)	
	High [6DS above]	7 (4.8)	1 (0.8)	1 (1.1)	0 (0.0)	

Table 2

Among the participants, 52 (35.6%) males and 94 (64.4%) females are in the severe group, 42 (34.1%) males and 81 (65.9%) females in the moderate, 28 (29.5%) males and 67 (70.5%) females in the mild, and 21 (47.7%) males and 23 (52.3%) females in the normal. The p-value of 0.228 suggests that there is no statistically significant difference in gender distribution across the group. In terms of employment status, 133 (91.7%) participants in the severe group, 106 (86.2%) in the moderate, 79 (90.0%) in the mild, and 39 (90.6%) in the normal are unemployed. Meanwhile, 12 (8.3%), 17 (13.8%), 8 (8.2%), and 4 (9.3%) in the respective groups are employed. The p-value of 0.51 indicates no significant difference in employment status across the groups. Age distributions vary significantly across groups. For instance, in the first group, 3 (2.1%) participants are aged 40-45, 9 (6.2%) are 45-50, 23 (15.8%) are 50-55, 31 (21.4%) are 55-60, and 52 (36.6%) are above 60. Similarly, variations are observed in other groups, with a p-value of <0.001, indicating a significant difference in age distribution across the groups. Duration of diabetes is another area of significant difference. In the first group, 13 (9.2%) participants have had diabetes for 1-5 years, 43 (29.3%) for 5-10 years, 46 (31.4%) for 10-15 years, 12 (8.3%) for 15-20 years, and 52 (36.6%) for less than 5 years. There is notable variation in the other groups as well, with a p-value of 0.0, indicating a statistically significant difference in diabetes duration among the groups. The diabetes control stage is categorized as controlled or uncontrolled. In the first group, 51 (35.6%) participants have controlled diabetes, while 94 (64.4%) have uncontrolled diabetes. Other groups show different distributions, with a p-value of 0.001, suggesting a significant difference in the stage of diabetes control across the groups. Myopia is categorized by eye involvement: right eye (OD), left eye (OS), or both eyes (OU). For instance, in the first group, 4 (2.8%) participants have myopia in the right eye, 10 (7.2%) in the left eye, and 14 (10.1%) in both eyes. There are noticeable differences in myopia distribution in the other groups, with a p-value of 0.003, indicating a statistically significant variation in myopia occurrence across the groups. Degree of myopia is significantly associated with the severity of dry eyes, with a p-value of 0.043.

DISCUSSION OF RESULTS

Demographic Overview

Gender: The study population has more females (64.8%) compared to males (35.2%). This trend remains consistent across both employed and unemployed groups, with females being the larger proportion in both.

Employment: The majority of participants (89.8%) are unemployed, while only a small portion (10.3%) is employed. This high unemployment rate may impact lifestyle choices, potentially affecting diabetes management and control.

Age Groups: Participants range in age, with the largest groups in the 55-60 (20.8%) and 60-65 (26.2%) age brackets. This suggests that most participants are older adults, a demographic more likely to experience complications from diabetes.

Diabetes Duration

How Long They've Had Diabetes: The sample includes a significant number of individuals who have had diabetes for 15-20 years (29.9%), followed by those with 10-15 years (24.9%) and 5-10 years (21.7%) of diabetes. Fewer individuals have had diabetes for less than 5 years (23.4%). This indicates that the group mostly consists of long-term diabetics, which may contribute to an increased risk of complications.

Diabetes Control Status

Controlled vs. Uncontrolled Diabetes: Almost half of the participants have controlled diabetes (48.4%), while the other half have uncontrolled diabetes (51.6%). This distribution is important, as it may influence the presence of complications and help identify factors linked to better diabetes management.

Myopia and Severity of Myopia

Myopia Prevalence: Most participants have myopia in both eyes (91.1%). Only a small percentage have myopia in one eye only—7.4% in the right eye (OD) and 1.5% in the left eye (OS).

Severity of Myopia

Mild myopia is common (79.9%), while moderate myopia is less frequent (17.9%), and high myopia is rare (2.2%). This suggests that mild myopia is the most frequent type among diabetic patients in this study, which could be related to how long they have had diabetes or how well it's managed.

Diabetic Retinopathy Severity

Retinopathy Stages: A large portion of participants has severe diabetic retinopathy (36.3%), while moderate cases account for 31.6%, mild cases for 21.9%, and only 10.9% have normal findings. The high rate of severe retinopathy might be associated with long-term or poorly controlled diabetes, a critical concern for eye health in diabetic patients.

Key Associations and Statistical Findings

Gender and Employment: There’s no significant difference between gender or employment status when it comes to diabetes control *Age Groups*: The age group is significantly related to diabetes control, with certain age groups showing higher rates of controlled or uncontrolled diabetes. This may indicate that age influences a patient's ability to manage diabetes.

Duration of Diabetes: A strong association exists between diabetes duration and control status, where longer durations may make diabetes harder to control. This highlights the need for tailored interventions based on how long a patient has had diabetes.

Myopia: Both the presence and severity of myopia are significantly associated with diabetes control status. This could imply that well-managed diabetes reduces myopia progression, or that more severe myopia is linked to poorly controlled diabetes.

Retinopathy Severity: Although not directly analyzed for associations in the table, the high prevalence of severe retinopathy underscores the need for effective diabetes management strategies, especially in individuals with longer disease durations.

SUMMARY

This data suggests that age, diabetes duration, and myopia are key factors in understanding diabetes control outcomes and the risk of complications, such as retinopathy. The findings reinforce the importance of monitoring and managing diabetes carefully, especially in older adults and long-term diabetics, to reduce the risk of severe eye complications.

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THE ASSOCIATION AMONG SEVERITY OF MYOPIA AND ITS RISK FACTORS IN AGE GROUP 5-25 YEARS: AN ANALYTICAL CROSS-SECTIONAL STUDY

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ABSTRACT

Purpose: The association among Severity of Myopia and its risk factors in age group 5-25 Years: An Analytical cross-sectional study.

Objective: The objective of our study was to determine the impact of risk factors on the severity of myopia within the age group 5 to 25 years.

Methodology: This is an analytical cross-sectional study. The patients were recruited from the Ophthalmology department of Dow University Hospital and CHK. The sample size is 170. The inclusion criteria of this research were that the participants met the criteria of being between 5 and 25 years old and having myopia. The study excluded participants with vision problems other than myopia, including keratoconus, hypermetropia, cataracts, amblyopia, and other medical or surgical conditions that may influence vision.

Result: Out of total 175 patients, the median (25th – 75th percentile) age is 21 (16-22) years. The majority of the patients were females 132 (75.5%), and male were 43 (24.6%). In terms of the severity level, 68.6% of the participants, or 120 of them, had mild myopia, while 22.3%, or 39 participants, were moderate, and 9.2%, or 16 participants, were classified as severe. The 60% (9) individuals from primary education had severe myopia. While, in moderate and mild myopia individuals' majority of individuals were undergraduates, 70% (27) and 62.2% (74), respectively. The difference between the groups was statistically significant, (p-value <0.001). The dominant portion 66.9% (79) individuals with mild myopia had a screen time of more than 3 hours, similarly, greater part 69.2% (27) individuals with moderate myopia had screen time of more than 3 hours. While, preponderance 31.3% (5) individuals had screen time of 1-2 hours. While, other risk factor, (gender, reading distance, illumination in the room, break during near work, time spent outdoor, outdoor activities, vitamin intake and family history) had no association with severity of myopia.

Conclusion: Our study concluded significant association with severity of myopia and screen time. The education level were also associated with myopia severity. While few other risk factor (outdoor activity, near work and family history) were not associated. We need further longitudinal studies to know the cause for this association.

KEY WORDS

Myopia, Screen time, Risk factors, Outdoor activities, Karachi.

INTRODUCTION

Uncorrected refractive errors are a major public health issue all over the world. Myopia has become an epidemiological problem in recent years as the consequences of a major extend the number of incidents worldwide [1] and the second leading cause of visual impairment in the world [2].

The Myopia is a kind of refractive defect in which the eye is unable to view distant things well. It is also referred to as nearsightedness or shortsightedness [3].

The WHO (United Nations Agency) describes Myopia as "a condition in which the spherical equivalent objective refractive error is -0.50 dioptre (-.0.50 D) in either eye [4]."

There exist two categories of myopia. Myopia associated with pathology and simple kind of myopia. Dioptrics classification has been used to further categorize simple myopia into mild, moderate, and high categories [4].

The widespread of high and possibly pathological myopia above -6D is the around of 10 – 20%. By 2050, almost 50% of people on the world may be myopic, with 10% or so being extremely myopic, according to several predictions [5].

Myopia causes more vision problems because high myopia increases the risk of pathological eye changes such as cataracts, glaucoma and myopic degeneration, all of which can cause irreversible vision loss. In some communities where myopia is high, myopic degeneration has been found to be the most common cause of irreversible blindness [4].

Pathological myopia is a severe kind of myopia, sometimes known as shortsightedness. Pathological myopia is also referred to as degenerative myopia due to its eventual blinding effect. The Pathological myopia is characterized by the presence of pathologies linked to myopia at the eye's posterior for instance, Cystoid macular degeneration, posterior staphyloma (PS), Fuchs spot, Vitreous opacities, Weiss reflex (PVD) and so on [6].

The Main predisposing factor for the progression of myopia are extreme close work, family members with a history of myopia or nearsightedness, lesser amount of time spent on outdoor and increasing usage of computers and other electronic devices [7].

Myopia is influenced by genetics, but environmental and lifestyle factors are probably more responsible for its sharp rise in incidence. Previous research has shown a correlation between children's near-vision tasks like reading, studying and usage of screen and myopia [8].

A higher prevalent of myopia was discovered in children whose parents had a history of it, but Only a several researches have linked rising rates of myopia to increased usage of devices. Retinal detachment, cataract, glaucoma, extreme myopia, impaired vision and vision loss are all linked with progressive ocular abnormalities, and undetected myopia is the significant reason of preventable vision loss [4].

Myopia is frequent ophthalmic disorder in the world with affecting around 22.9% (1.406 billion) of the global population. A further 2.7% (163 million) of the population are evaluate to have server myopia (8) In Asia and Europe, the age-specific prevalence of myopia from 20 to 29 years old is 40-50% and 20-35%, respectively [7].

In united kingdom almost 200,000 people with pathological myopia [9]. Present frequency is predicted in USA is 23%, middle America 34.2%, North America and America Dimensional 32.4%(10). But in Indonesia 48.1% young adult over the aged 21 year are affected. In urban area of India frequency of myopia are 4.7%, 7.0% and 10.8% in 5, 10 and 15 year old children and 2.8%,4.1% and 6.7% in 7,10 and 15 year old children. Myopia was prevalence in Singapore in the 7, 8 and 9 year old cohort studies of risk factors, with rates of 29.0%, 34.7% and 53.1%, respectively. The frequency of myopia was 10.9%, 16.5% and 27.3% in 10, 12 and 15 year old Nepalese kid living in urban region. The prevalence of myopia in urban china is 5.7%,30.1 and 78.4% in 5, 10 and 15 year old children and kids, but in rural area of north china the frequency is approximately 0% in 5 year old children, 36.7% in males and 55.0% in females over aged 15 year, In rural area of south china 36.8%,43.0% and 53.9% in 13,15 and 17 year old kids and adult, myopia was most common 78.4% of Chinese children aged 15 living urban areas and least common 1.2% of rural Nepalese children aged 5 to 15. According to comprehensive cross sectional study conducted in Hong Kong. In children under seven years old, the frequency was 17.0%; in children eight years old, it rose to 37.5%; and in children eleven years old, it reached 53.1%. The frequency of myopia in children in South Africa was between 3% to 4%, rising to 6.3 and 9.6% in 14 and 15 year old children [11]. According to the national survey of Pakistan the prevalence of myopia is 36.5% [12].

OBJECTIVES

The purpose of this research project was to determine the elements that lead to the risk of myopia in individuals ranging in age from 5 to 22.

Significant of Study:

The importance of our study lies in explaining the relationship between certain potential risk factors, such as genetic background and environmental influences, and myopia in individuals aged 5 to 25 years.

Understanding these associated risk factors is crucial for primary prevention efforts, as awareness performs a vital function in alleviating the development of short sighted conditions also managing their progression.

We aim to educate the public regarding risk factors associated with myopia so as to detect it early to delay its progression. Timely intervention in correction of refractive errors will lead to improved vision and hence a better quality of life.

Statement of Problem:

Myopia affects 36.5% of the population of Pakistan, a developing nation where myopia is responsible for 11.5% of cases of blindness, making education and awareness of the condition extremely important.

Encouraging extracurricular activities at the school, college, and university levels can raise students' awareness of the implications of outside exposure. Reach a more intense insight into the relationship between myopia and electronic screen time is critical for providing informed guidance in areas such as learning, healthcare practices, and the formulation of Population health strategies.

LITERATURE REVIEW

According to study by Theophanous C et al. (2018) 60,789 KPSC patients that satisfied the inclusion criteria, and 41.9% of those enrolled had myopia. As their study Myopia prevalent elevated along with age, about 14.7% in 5 -7 year to 59.0% within the ages of 17 and 19. Pacific Islander or Asian participant (OR 1.64, CI 1.58-1.70) had a higher risk than White participants, but African Americans (OR 1.08, CI 1.03-1.13) had a lower risk of myopia. In the crude framework, Hispanic ethnicity had a significantly higher correlation with myopia than other than Hispanics (OR 0.91, CI 0.900.93). Having at least an hour of daily activity was linked to a lesser myopic incidence (OR 0.87, CI 0.85-0.89). This study shows myopia becomes more frequent as one grows older. Asian youngsters are more susceptible to myopia. Exercise has been linked to an a lesser rate of myopia [8].

Girls suffer a higher rate of myopia progression (-0.35D) at 24.1% than boys do (-0.32D).the age-related progression of myopia, which is 33.1% greater in children with (0.43D) between the ages of 7 and 9 and 29.4% in those with (0.43D) between the ages of 10 and 12 years. Different rates of advancement are linked to myopia severity, age groups, and sex [13].

The percentage of youngsters in the study group who had myopia raised from 17% to 20%. 43.3% of participants engaged in near activities for more than three hours per day; 48.9% of this group used electronic devices for more than half of this time; Just 9.7% of the participants went outside for more than 2.5 hours every day. Myopia is more common in people who spend more time using their mobile device, tablet device, or video games and engaging in close work ($p < 0.05$). Myopia in one or both parents has been proven to have a substantial correlation. If one or both parents have myopia, the likelihood of developing myopia rises from 9.7% to 28.3% (1).

The presence of myopia in either one of the parents (OR 14.2 2.82, p 0.001) or both of the parents (OR 14.2 1.66, p 0.001); daily time spent on activities close to work (OR 14.21, p 0.001); more limited visual distance while accomplishing close work movement (OR1⁄41.17, $p < 0.001$); what's more, cooperation in an after-school instructional exercise program (OR1⁄41.20, $p < 0.001$). On the other hand, resting following 30 minutes of close work action (OR 1⁄4 0.84, $p < 0.001$) and investing more energy taking part in outside exercises on ends of the week (OR 1⁄4 0.91, p 1⁄4 0.03) were essentially connected with a lower chance of nearsightedness [14].

Age, parental myopia and the time they spent on close -work tasks, were found to be correlated with myopia in children. The incidence of refractive defects varied by age category. With a contribution rate of 59.88%, children with increased myopia (1.50%) constituted the majority of participants. The frequency of myopia in the kids was 2.04 times more common 95% confidential interval (1.89–2.20; $p < 0.0001$) when both of the parents had the condition.

The kids at the ages of 11 and 12 had the greater risk of myopia, with a risk that was 11.54-fold 95% confidence interval (10.39–12.82; $p < 0.0001$) (15).

The findings revealed that myopia was positively correlated with having parents or siblings who had a favorable family history of using eye wear (or, 1.36 (1.02 to 1.83) $p < .03$). upon analyzing the observable adverse conditions, it was found that children with

myopia had a positive correlation with those who read or studied for more than four hours a day, both at home and at school (or, 2.94 (1.32 to 6.57) $p < .008$), and with those who spent more than two hours a day on computers, phone video games, and video watching (or, 8.33 (3.54 to 19.58) $p < .001$).The percentage of myopic children (n = 234) who engaged in outdoor sports or games for less than 1.5 hours per day was significantly lower than that of their counterparts who were not myopic.

Children who played outside for more than 1.5 hours a day showed a negative correlation with outdoor activities/play (only 10% of myopic children showed this correlation, compared to 52.2% of children who are non-myopic, $p < .001$. The results indicate that there is a negative association between spending time outside and activities that take place close to work. Specifically, the connection between outdoor activity and gaming hours is -0.275, $p < .001$, according to the sample person analysis [16].

Bibi et al. [18] studied Out of 330 Pakistani participants, 185 (56%) had myopia that worsened in 15 to 20 years old and 58.4% saw rapid progression. A family's record of the condition myopia was found in 52.5% of myopic individuals. Males had a lower probability of developing myopia than women (OR = 0.65). Among those surveyed, 23% experienced vision changes between the age of 10 and 15, 10.8% in 20 to 25 age, and just 7% before the age of 10. This study found that 83.7% of myopic participated in physical activity for not less than two hours each day, whereas 89.6% of non-myopic did the same. This study found no significant correlation between myopia and screen exposure duration, time spent studying, or study break. Myopia is more frequently occurring in females, persons who had a myopic family history, along with those who engage in minimal physical exercise [17].

METHODOLOGY

Study Design:

This is an analytical cross-sectional study. The patients were recruited from the Ophthalmology department of Dow University Hospital and CHK.

Sample Size:

The minimum sample size calculated for the study is 124. The prevalence of Myopia was 24% in patients with high myopia was found (19). 1 The estimated population was 425 as observed in last 6 month retrospectively. The power of the study was 80 and precision of 5%. The sample size was calculated by PASS 2021.

Sampling selection:

1) **Inclusion criteria:** The inclusion criteria of this research where participants meeting the criteria of being between 5 and 25 years old and having either myopia or a history of parental myopia.
2) **Exclusion Criteria**: patients who had age below 5 and above 25 years. The study excluded participants with vision problems other than myopia, including keratoconus, hypermetropia, cataracts, amblyopia, and other medical or surgical conditions that may influence vision.

Key Variables

Myopia is a dependent variable depend upon age, gender, near work, outdoor activity and positive family history, environmental factor, screen exposure, study hours which are independent variable of the research.

RESULT

Out of total 175 patients, the median (25^{th} – 75^{th} percentile) age is 21 (16-22) years (Figure 1), the median (25^{th} – 75^{th} percentile) of Spherical equivalent of Right eye and Left eye is -1.75 DS (-3.50 DS –0.75)

The visual acuity logmar right and left findings show that the majority of participants (44.6%), or 78 individuals, fell between 0.2 and 0.6. Next is the 0.8 to 1 range, which has 49 individuals (28%). Finally, 48 patients, or 27.4%, have values between 1.3 and 1.7.

According to the visual acuity right results, the largest percentage of participants—65 people, or 37.1% of the total—fall within the 6/36 and 6/60 range. The range of 6/9 to 6/24, which includes 64 individuals and represents 36.6%, comes in close second. Finally, 46 participants, or 26.3%, fall into the range of 3/60 to 1/60.

According to the VA-L data, the largest percentage of participants—67 people, or 38.3% of the total—occurs in the 6/9–6/24 interval. Next in line is the 6/36–6/60 range, which comprises 61 people and represents 34.9%. Lastly, 47 participants, or 26.9%, fall into the 3/60 to 1/60 range.

The majority of the patients were females 132 (75.5%), and male were 43 (24.6%) (Figure 2). It is stated that educational attainment is primarily undergraduate 59.9% (103), followed by secondary 16.3% (28) and primary 14.6% (25), Intermediate 5.3% (9), matriculation 4.1% (7) (Figure 3).

In terms of the severity level, 68.6% of the participants, or 120 of them, had mild myopia, while 22.3%, or 39 participants, were moderate, and 9.2%, or 16 participants, were classified as severe.

57.8 % (101) individual read at distances less than 50 cm, 35.5 % (62) participate at 50 cm and 6.9 % (12)more than 50 cm (Figure 12).

Under the lighting condition, 68.8% (120) participants respond that they use room or ceiling light most of time, while 4.6% can use natural light and 2.3% use desk lamp (Figure 8).

The largest group, 75 participants (43.4%), said they rarely take breaks, whereas 45 participants (26.1%) stated they usually do so. Furthermore, 42 participants (24.3%) said they occasionally do so, while 11 people (6.4%) stated they frequently take breaks.

Most of the participants (70), (total 43.3%) were outside for less than 30 minutes. 32 participants (19.8%) also went outside for (1-2) hours. A total of 26 participants (16.1%) spent more than three hours outside, whereas thirteen participants (13%) spent less than an hour outside. (8.1%) spent (2-3) hours outside (Figure 5).

Outside activity participation is also low, 66.7% (116) said they do not engage in outdoor activities while just 33.3% (58) of individual said they engage in outdoor activities (Figure 6).

Participants' screen time is noticeably high; 63.6% (110) report using screens for more than three hours every day. In addition, 8.7% ($n = 15$) report using screens for two to three hours a day, 14.5% (25) for one to two hours, 7.6% (13) for less than an hour, and just 5.8% (10) for less than half an hour a day (Figure 4).

While a significant but decreasing percentage of participants (64, or 36.8%) refused any consumption of omega-3 fatty acid supplements, the majority of participants (110, or 63.3%) indicated positive intake (Figure 11).

There were 145 participants (total 83.4%) who reported using vitamin D supplement. 29 participants (total 16.7%), however, did not consume any vitamin D supplement (Figure 9).

106 participants, or 61.7% of the total, said they had no family history of myopia. But 33 participants (19.2%) and 24 participants (14%), respectively, indicated that their mother and father had myopia. 9 individuals (5.3%) stated that both of their parents were myopic (Figure 7).

Table 1
Demographical Characteristics of Myopia

AGE		**21 (16-22)**
VA-CAT-R-LOG	0.2-0.6	78(44.6)
	0.8-1	49(28)
	1.3-1.7	48(27.4)
VA-CAT-LOG	0.2-0.6	78(44.6)
	0.8-1	49(28)
	1.3-1.7	48(27.4)
VA-R	6/9-6/24	64(36.6)
	6/36-6/60	65(37.1)
	3/60-1/60	46(26.3)
VA-L	6/9-6/24	67(38.3)
	6/36-6/60	61(34.9)
	3/60-1/60	47(26.9)
Gender	Female	132(75.5)
	Male	43(24.6)
Education	Primary	25(14.6)
	Secondary	28(16.3)
	Matriculation	7(4.1)
	Intermediate	9(5.3)
	Under-graduates	103(59.9)
Myopia Severity	Mild	120(68.6)
	Moderate	39(22.3)
	Severe	16(9.2)

Reading Distance	Less than 50 cm	101(57.8)
	50 cm	62(35.5)
	More than 50 cm	12(6.9)
Lighting	Desk lamp	4(2.3)
	Ceiling or room light	163(93.2)
	Natural light	8(4.6)
Break during Near Work	Always	45(26.1)
	Often	11(6.4)
	Sometimes	42(24.3)
	Rarely	75(43.4)
Time Spend Outdoor	Less than 30 minutes	70(43.3)
	Less than 1 hour	21(13)
	1-2 hours	32(19.8)
	2-3 hours	13(8.1)
	More than 3 hours	26(16.1)
Participates in Outdoor	Yes	58(33.4)
	No	116(66.7)
Screen Time	Less than 30 minutes	10(5.8)
	Less than 1 hour	13(7.6)
	1-2 hour	25(14.5)
	2-3 hour	15(8.7)
	More than 3 hour	110(63.6)
Omega 3 Fattyacid Food	Yes	110(63.3)
	No	64(36.8)
Vitamin D Intake	Yes	145(83.4)
	No	29(16.7)
Family History	No	106(61.7)
	Father	33(19.2)
	Mother	24(14)
	Both	9(5.3)

With a p-value of 0.001, this study indicates a substantial relation between schooling and the severity of myopia (Figure 3). Likewise, a p-value of 0.001 indicates that both the right and left va and logMar are significantly linked to the severity of myopia.

The p-value indicates that reading distance has no bearing on the severity of myopia (0.24) (Figure 12).

There are no significant differences between the myopia severity and the illumination data. (P value of 0.9) (Figure 8).

Break-taking behavior when near work does not significantly change, according to the results. The P value is 0.76 (Figure 10).

Spending time outside does not appear to be statistically associated with myopia severity, as indicated by the p-value of 0.156. The data does not give compelling evidence for a direct correlation between the two (Figure 5).

Outdoor activity participation and severity of myopia do not statistically significantly correlate, according to the P value (0.32) (Figure 6).

There is a substantial correlation between screen time and the occurrence of myopia, as indicated by the p-value, which shows how screen time affects the severity myopia. A p-value of less than 0.001 (Figure 4).

There is no significant relation between the severity of myopia and omega fatty acid consumption (0.07) (Figure 11). Similarly, with a p-value of 0.16, there is no relation between vitamin D intake and the severity of myopia (Figure 9).

The p value (0.73) indicates that there is no statistically significant correlation between myopia and family history (Figure 7).

Table 2
Association between Severity of Myopia and Demographical Characteristics

		Myopia Severity			
		Mild	Moderate	Severe	
		Median			
Age		21(17-19)	21(17-23)	12(8-14)	
Gender	Female	89(74.2)	35(89.7)	8(50.0)	
	Male	31(25.8)	4(10.3)	8(50.0)	
Education	Primary	11 (9.3)	5 (13.2)	9 (60)	<0.001
	Secondary	21 (17.7)	4 (10.6)	3 (20)	
	Matriculation	5 (4.3)	1 (2.7)	1 (6.7)	
	Intermediate	8 (6.8)	1 (2.7)	0 (0)	
	Under graduates	74 (62.2)	27 (71.1)	2 (13.4)	<0.001
VA-CAT-R-LOG	0.2-0.6	76(63.3)	2(5.1)	0(0.0)	
	0.8-1	36(30)	12(30.8)	1(6.3)	
	1.3-1.7	8(6.7)	25(64.1)	15(93.8)	
VA-CAT-L-LOG	0.2-0.6	76(63.3)	2(5.1)	0(0.0)	<0.001
	0.8-1	37(30.8)	12(30.8)	0(0.0)	
	1.3-1.7	7(5.8)	25(64.1)	16(100)	
VA-R	6/9-6/24	62(51.7)	1(2.6)	1(6.3)	<0.001
	6/36-6/60	51(42.5)	13(33.3)	1(6.3)	
	3/60-1/60	7(5.8)	25(64.1)	14(87.5)	
VA-L	6/9-6/24	65(54.2)	1(2.6)	1(6.3)	<0.001
	6/36-6/60	48(4.0)	13(33.3)	0(0.0)	
	3/60-1/60	7(5.8)	25(64.1)	15(93.8)	
Reading Distance	Less than 50 cm	68(56.7)	20(51.3)	13(81.3)	0.24
	50 cm	43(35.8)	17(43.6)	2(12.5)	
	More than 50 cm	9(7.5)	2(5.1)	1(6.3)	
Lighting	Desk lamp	3(2.5)	1(2.6)	0(0.0)	0.9
	Ceiling or room light	112(93.3)	36(92.3)	15(93.8)	
	Natural light	5(4.2)	2(5.1)	1(6.3)	

		Myopia Severity			
		Mild	Moderate	Severe	
		Median			
Break during Near Work	Always	33(27.7)	8(20.5)	4(26.7)	0.76
	Often	7(5.9)	3(7.7)	1(6.7)	
	Sometimes	25(21.1)	13(33.3)	4(26.7)	
	Rarely	54(45.4)	15(38.5)	6(40.0)	
Time Spend Outdoor	Less than 30 minutes	50(46.3)	18(47.4)	2(12.5)	0.156
	Less than 1 hour	15(13.9)	5(13.2)	1(6.3)	
	1-2 hours	20(18.5)	7(18.4)	5(31.3)	
	2-3 hours	8(7.4)	3(7.9)	2(12.5)	
	More than 3 hours	15(13.9)	5(13.2)	6(37.5)	
Participates in Outdoor	Yes	37(31.1)	13(33.3)	8(50.0)	0.32
	No	82(68.9)	26(66.7)	8(50.0)	
Screen Time	Less than 30 minutes	5(4.2)	1(2.6)	4(25.0)	<0.001
	Less than 1 hour	8(6.8)	5(12.8)	0(0)	
	1-2 hour	14(11.9)	6(15.4)	5(31.3)	
	2-3 hour	12(10.2)	0(0)	3(18.8)	
	More than 3 hour	79(66.9)	27(69.2)	4(25.0)	
Omega 3 fatty Acid food	Yes	70(58.8)	26(66.7)	14(87.5)	0.07
	No	49(41.2)	13(33.3)	2(12.5)	
Vitamin D Intake	Yes	101(84.9)	29(74.4)	15(93.8)	0.18
	No	18(15.1)	10(25.6)	1(6.3)	
Family History	No	71(60.2)	24(63.2)	11(68.8)	0.73
	Father	22(18.6)	8(21.1)	3(18.8)	
	Mother	17(14.4)	6(15.8)	1(6.3)	
	Both	8(6.8)	o(o)	1(6.3)	

Figures:

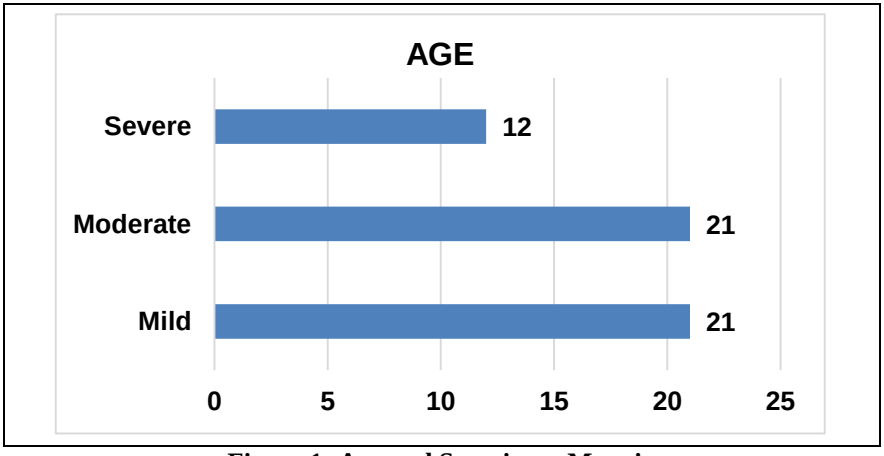

Figure 1: Age and Severity to Myopia

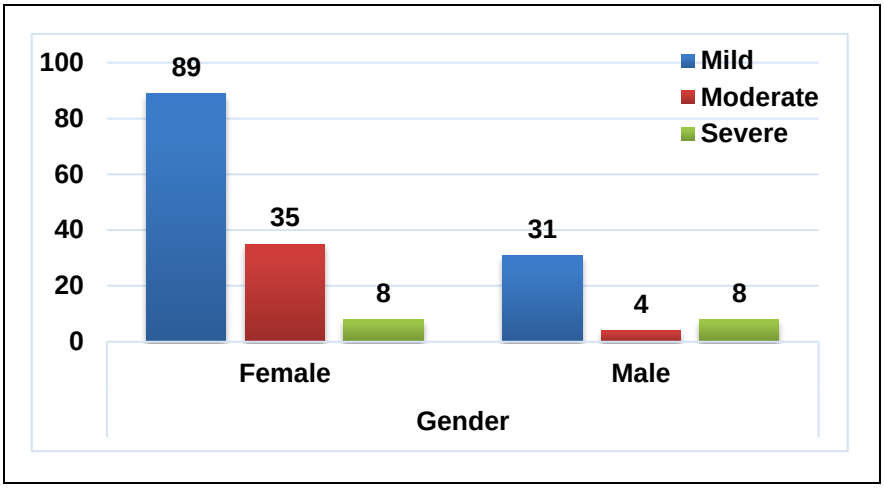

Figure 2: Gender and Myopia

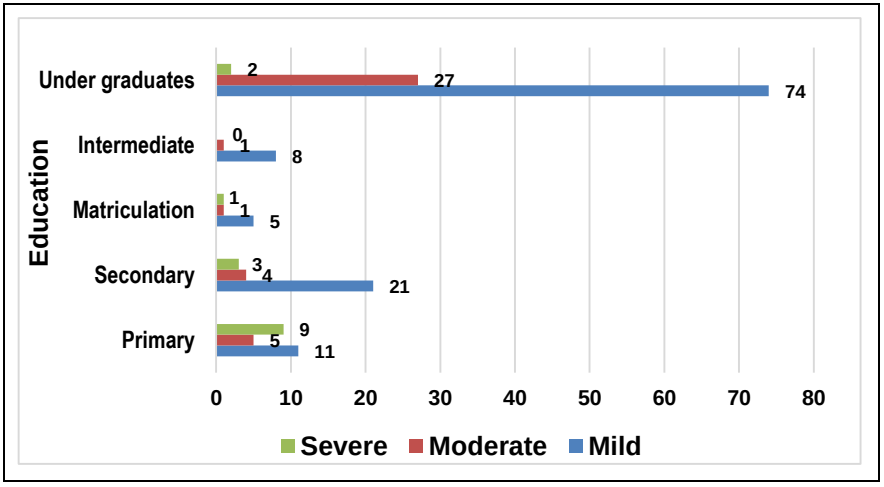

Figure 3: Education and Myopia

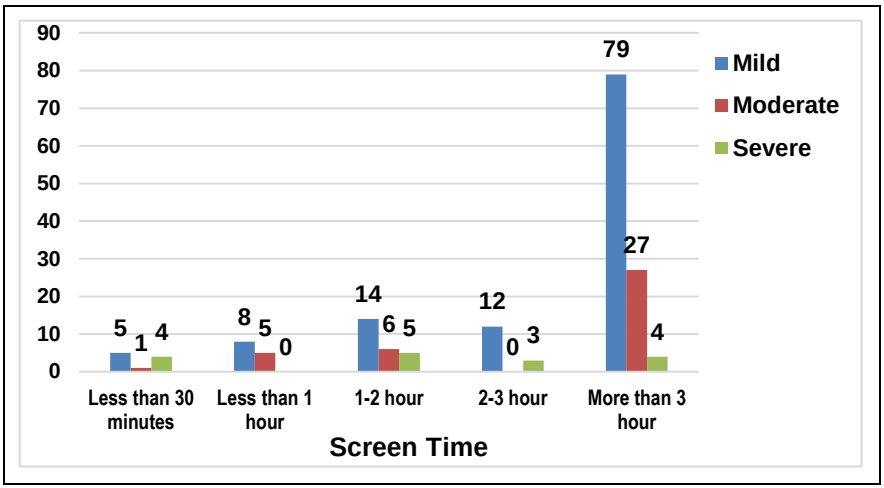

Figure 4: Screen Time and Myopia

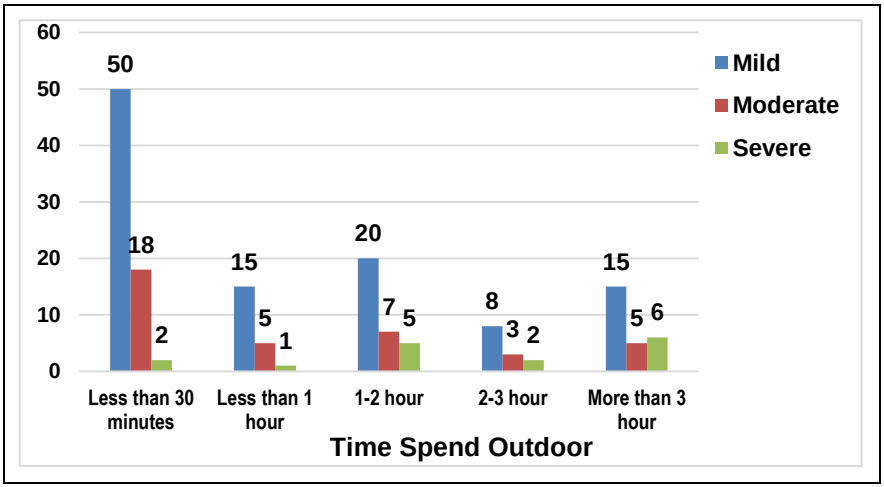

Figure 5: Time Spent Outdoor and Myopia

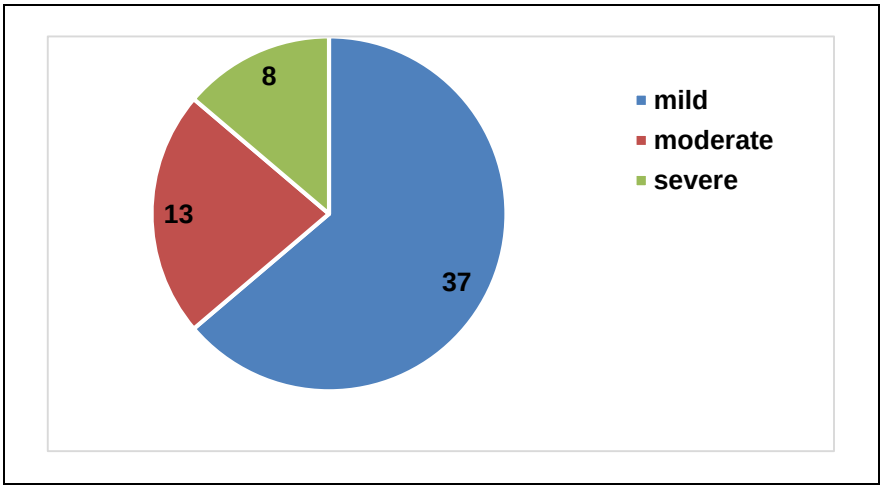

Figure 6: Participate in Outdoor and Myopia

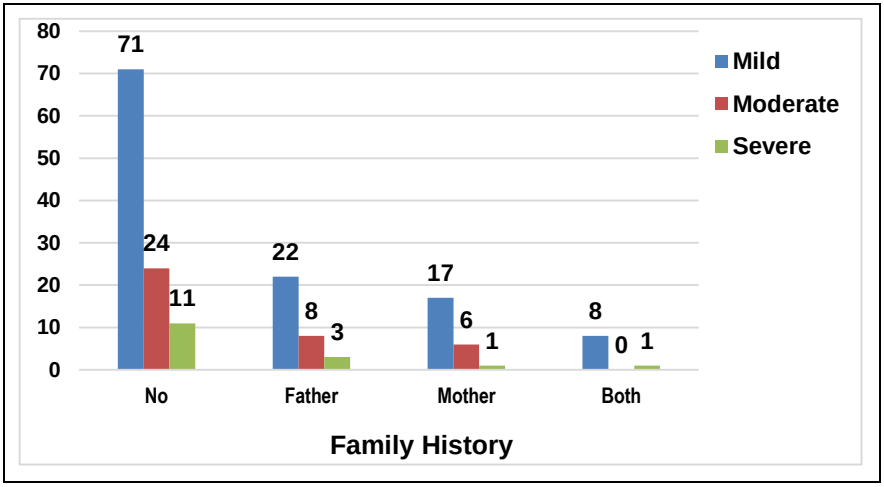

Figure 7: Family History and Myopia

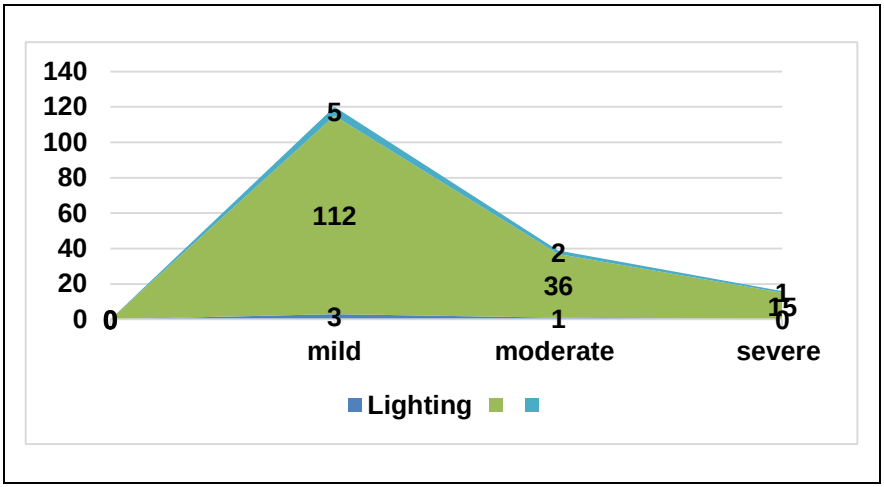

Figure 8: Lighting and Myopia

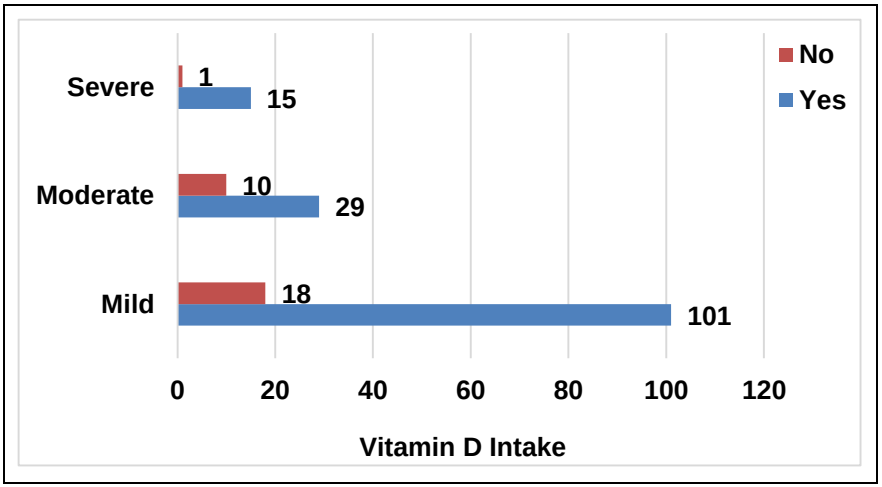

Figure 9: Vitamin D and Myopia

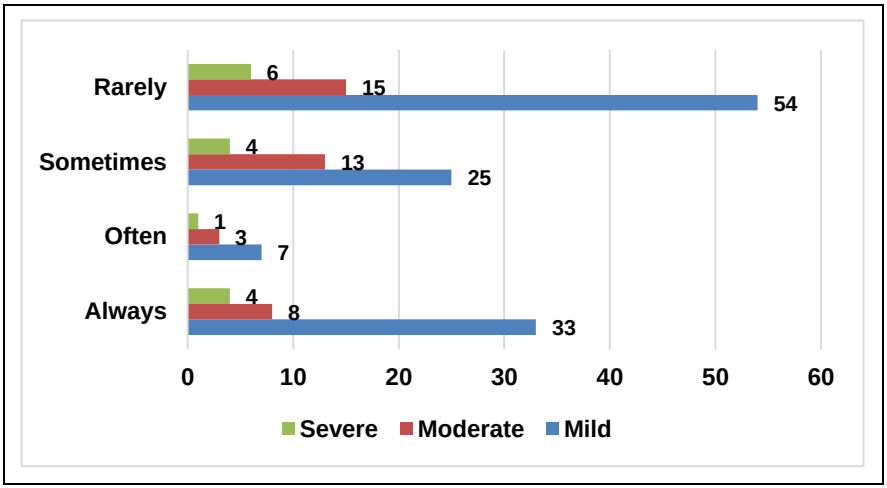

Figure 10: Break during Near Work and Myopia

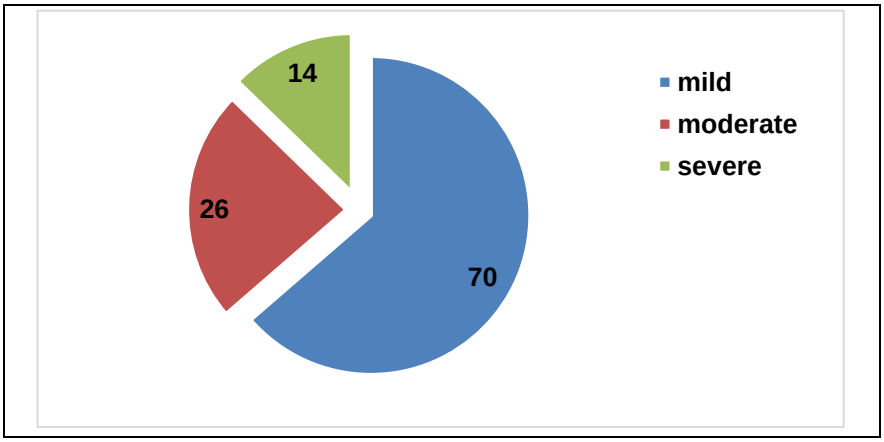

Figure 11: Omega 3 Fatty Acid and Severity of Myopia

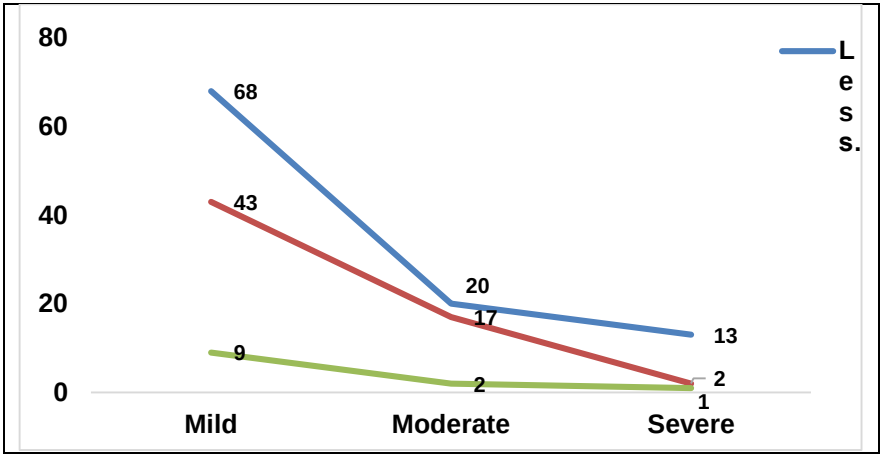

Figure 12: Reading Distance and Severity of Myopia

DISCUSSION

Our research showed a strong correlation between the degree of education and the severity of myopia. These results correlate with a European study that found that the risk of myopia increased as educational levels increased. Specifically, the study found that myopia rates were highest among those with higher education (36.6%), followed by secondary school (29.1%), and primary school (25.4%). This indicates that extended close Work throughout schooling raises myopia [20].

A study conducted in Singapore by M. Dirani, on the other hand, discovered that spending more time outside—an average of 3.24 hours per day—was substantially linked to less myopia. The duration of time spent outdoors, and additional factors related to genetics or environment could all be contributing reasons to these variations. In our study, no significant correlation was found between outdoor activity and myopia severity [21].

In our study there is no significant association between family history and myopia. The California study by Lisa A. Jones et al., on the other hand, discovered a high correlation between children's risk of become myopic and the presence of parental myopia. Among those children that developed myopia, 69% and 64%, respectively, of the children that developed myopia had a myopic mother and father. Furthermore, 45% of prospective myopes had two myopic parents, but only 21% of nonmyopes had this trait. These results suggest that a parent's myopia is a substantial risk factor for the onset of myopia in children [22].

IP JM et al.'s findings demonstrated a strong association between closer reading distances (<30 cm) and increased myopic refraction. IP JM et al.'s study focused on children, a group more susceptible to the effects of near work on myopia. Other factors, including as screen time or the amount of time spent on close work, may also have an impact on the development of myopia. However, our study's indicates that the degree of myopia is not significantly impacted by reading distance [23].

Our study's findings indicate a clear link between excessive screen usage and myopia development. Our findings demonstrate that extended screen time significantly increases the risk of myopia. With odds ratios of 2.24 in cross-sectional research and 2.39 in cohort studies, Zhiqiang Zong and colleagues' meta-analyses revealed that individuals who spend a lot of time on screens are more likely to develop myopia. Additionally, the risk of developing myopia rises with each additional hour spent in front of a screen each day. In order to help prevent myopia, our findings emphasize the necessity of methods to limit screen use, particularly for kids and young adults [24].

The research we investigated found there was no significant association between the severity of myopia and omega-3 fatty acid intake, in comparison to Zhang Y.'s Hong Kong study that found a higher risk of myopia with a reduced omega-3 intake. Participants in the group with the lowest omega-3 consumption had a greater myopic spherical equivalent and a longer axial length, according to Zhang's study. Higher consumption of saturated fatty acids was also linked to greater myopia and longer axial length, indicating a multifaceted role for dietary fats in the development of myopia [25].

In our study, we found no significant association between parental myopia and the severity of myopia. However, other studies, such as one conducted with schoolchildren of primarily White European ancestry, observed a strong correlation between the prevalence of myopia in children and a parental history of myopia [26].

According to earlier research, childhood myopia and parental history of myopia are related (Williams C, et al. IOVS 2005; 46: ARVO E-Abstract 4622 and Refs [27] and demonstrated how parental myopia has a dose-dependent effect. While there have been concerns raised over the accuracy of self-reporting of refractive status history [28]. It has been shown that the study's questions are reliable for determining whether myopia is present [29].

According to Xuejuan Jiang, PhD et al. JAMA Ophthalmol. 2020;138(5):501-509 doi:10.1001/jamaophthalmol.2020.0412, paternal myopia, particularly in both parents, was linked to a higher ratio of axial length to CCR before to school age, a lower chance of hyperopic refraction, and an increased risk of myopia. A considerably higher risk was related to parents who were younger at beginning. In addition to Asian children, this link of parental myopia was also observed in African American, Hispanic, and non-Hispanic white children, as well as in infants as young as 12 months. These findings imply that children of myopic parents are more likely to develop myopia well before they reach school age [30].

According to our study, there is no connection between myopia and vitamin D supplementation. However, other research, such as In the study by Veleva et al. the average blood 25(OH)D levels in participants without myopia showed notable variation across different groups. A statistically significant difference in serum 25(OH)D levels was observed between individuals with myopia and those without it. As the levels of 25(OH)D decreased, the likelihood of developing myopia increased [31]. In the present study (Jabbar et al. 2023), the baseline mean serum 25(OH)D values for individuals with myopia were higher than those for individuals with emmetropia, although follow-up values were similar between the two groups. Both studies indicate a direct correlation between lower vitamin D levels and a higher incidence of myopia [32]. Chu-Yao Yu et al. 2024 conclude

that, on average, myopes have lower serum vitamin D levels than non-myopes based on the analysis of earlier data. Myopia is associated with low levels of vitamin D in the blood. Controlling serum vitamin D levels could offer a novel strategy to stop or delay the onset of myopia [33]. A few studies have shown skepticism regarding the independent impact of serum vitamin D on the onset and progression of myopia [34].

CONCLUSION

Our study found that screen time, age, gender and education level are significantly associated with the severity of myopia, while other factors like outdoor activity and family history are not. Further studies are needed to understand the underlying causes.

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EXPLORING THE DYNAMICS OF TEXTILE RAW MATERIALS EXPORTS & IMPORTS IN PAKISTAN: A COMPARATIVE STUDY WITH SOUTH ASIAN NATIONS AND SUSTAINABLE SOLUTIONS USING AI

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ABSTRACT

This study investigates trends in textile raw material imports & exports in Pakistan and compares them to trends, problems, and possibilities in other South Asian nations using AI. Key factors such as trade policy, supply prospects, and raw material quality are examined to identify regional parallels and variations. The study also looks into sustainable solutions that use AI-powered technologies, with an emphasis on improving supply chain management, forecasting demand, and decreasing environmental impact. The study focusses on new techniques for improving the long-term viability and competitiveness of Pakistan's textile sector through the use of AI, as well as obtaining important insights from regional practices.

KEYWORDS

Textile Raw Materials, Textile Imports, Textile Exports, ARIMA Model, Export & Import Analysis and Opportunities.

1. INTRODUCTION

The textile industry plays a significant role in the economic development of South Asia and Pakistan is a major player in the import and export of raw materials. This report examines Pakistan’s textile raw material exports and compares its performance with countries in Southeast Asia such as Pakistan, Bangladesh and India. The study evaluates key economic indicators such as import and export, product and trade balance to identify competitive advantages and competitive advantages. It also explores sustainable business solutions through the use of artificial intelligence (AI) and highlights the potential of AI to improve supply chains, reduce costs and improve repair work.

2. METHODOLOGY

There are five methods that we have used in this research work for the export and import time series data. The time series data is collected from:

1. **Data Arrangement:**
   Data Collection: Relevant trade data on textile raw materials will be gathered from reliable sources such as government trade reports, international trade databases (e.g., UN Comtrade, WTO), and industry publications. Data Organization: Data will be arranged chronologically, categorized by export and import volumes, trade values, and key product categories.

2. **Visual Representation:**
   Graphical Tools: Data will be presented through bar charts, line graphs, and pie charts for a clear visual understanding of trade patterns and country-wise comparisons. Trend Analysis: Historical data trends will be highlighted to visualize trade fluctuations and growth patterns.

3. **Average Calculation:**
   Trade Averages: Mean values for export and import volumes will be calculated over the selected timeframe. This will provide an overall perspective on trade performance and stability. Average = Sum of Values/Number of Values

4. **Linear Forecasting:**
   Forecasting Model: A linear regression model will be applied to forecast future trade volumes based on historical data trends. This will help predict potential trade growth and future demand-supply scenarios.

   $\boldsymbol{x}$: $\boldsymbol{yt = \beta 0 + \beta 1 \times t + \varepsilon t}$.

5. **Coefficient of Variation:**
   Data Variability Analysis: The coefficient of variation (CV) will be calculated to measure trade data variability. A higher CV will indicate greater fluctuations, highlighting trade instability, while a lower CV will suggest more consistent trade patterns

   $$\boldsymbol{CV = \frac{\mu}{\sigma}}$$

   where:

   $\boldsymbol{\sigma}$ = standard deviation
   $\boldsymbol{\mu}$ = mean

By applying these analytical methods, the study will provide a comprehensive evaluation of Pakistan's textile raw material trade performance and explore sustainable trade solutions using AI-based predictive models.

3. VISUAL REPRESENTATIONS

DATA SETS:

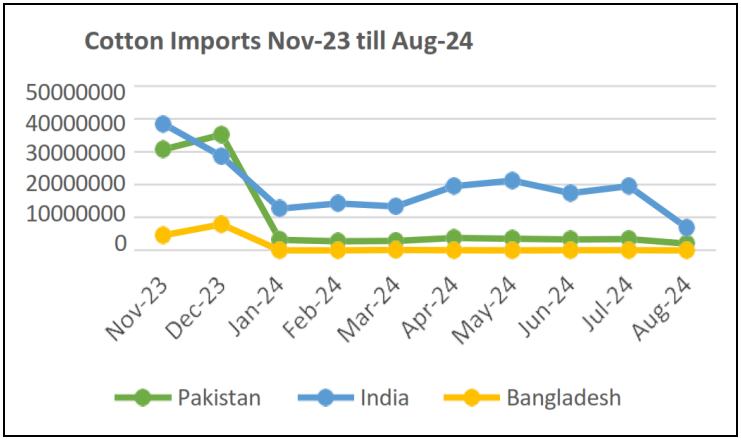

Figure 1: Showing the Data of Imports of Cotton from Nov. 2023 to Aug. 2024

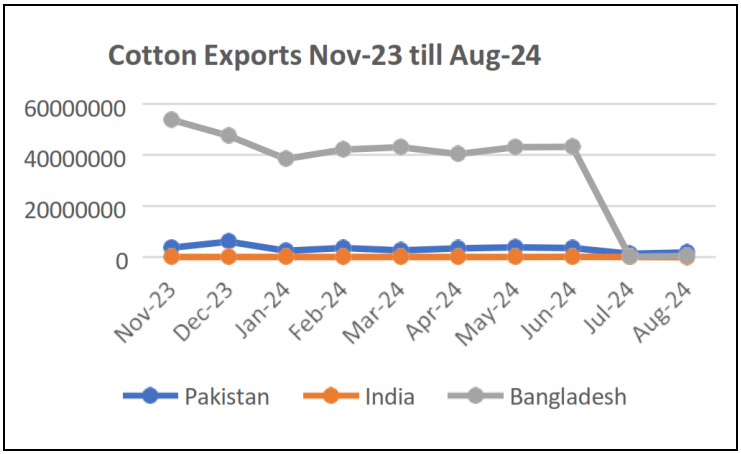

Figure 2: Showing the Data of Exports of Cotton from Nov. 2023 to Aug. 2024

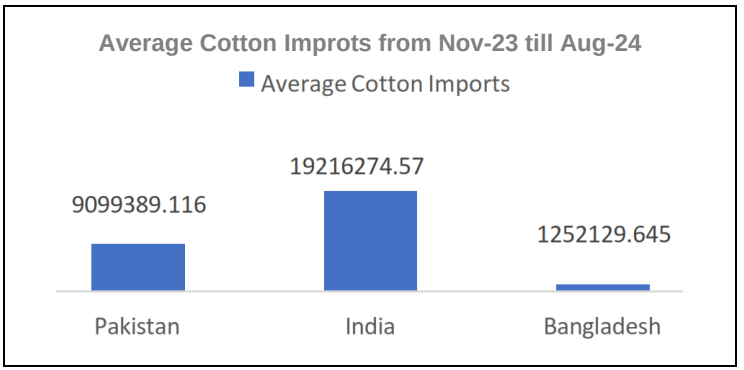

Figure 3: Showing Average of Cotton Imports

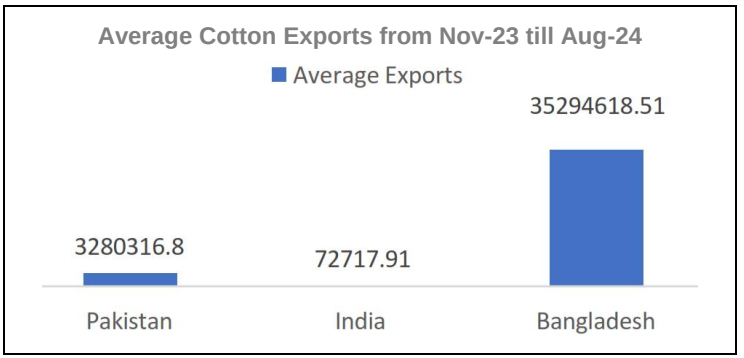

Figure 4: Showing Average of Cotton Exports

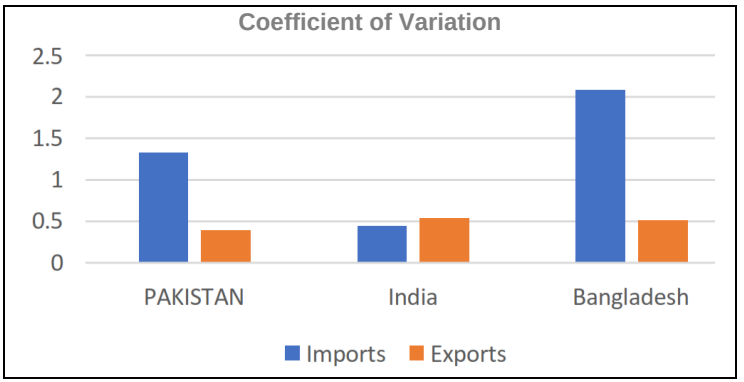

Figure 5: Showing Coefficient of Variation of Imports and Exports

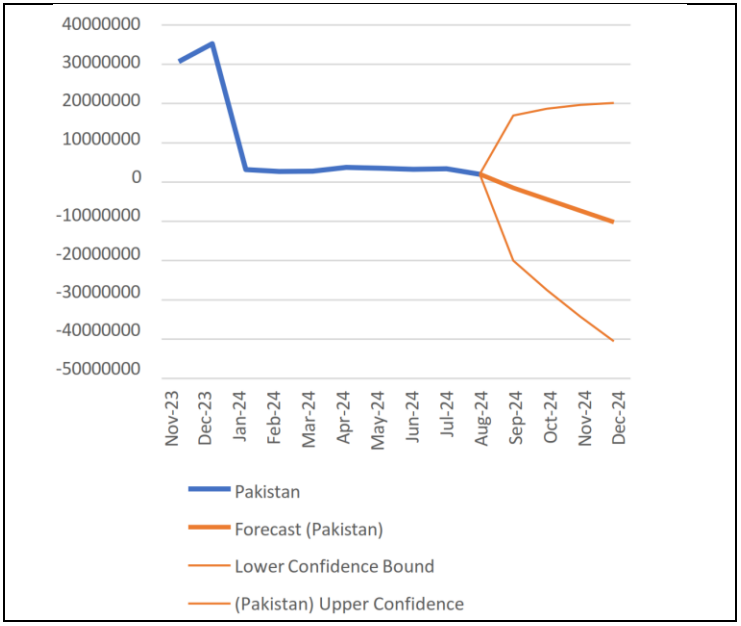

Figure 6: Showing Linear Forecast of Pakistan Imports till Dec. 2024

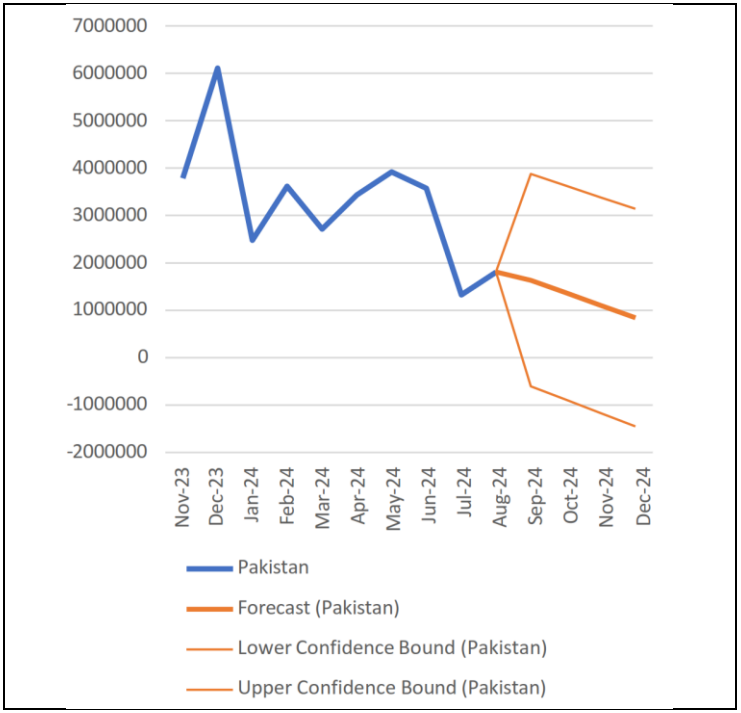

Figure 7: Showing Linear Forecast of Pakistan Exports till Dec. 2024

4. RESULTS AND DISCUSSIONS

This analysis highlights Pakistan's dependence on imported textiles, which poses economic risks due to trade deficits and price volatility. While India's domestic manufacturing strength gives it a competitive advantage, Bangladesh's dependence on imports supports its export- led economy. For example, demand forecasting, supply chain optimization, and forecasting can help Pakistan reduce its trade dependence, improve business models, and enhance international competitiveness. Coordinated policies, investment in local knowledge generation, and AI-driven business intelligence tools can increase the sustainability of the country's textile industry.

5. COMMENTS AND CONCLUSION

Comparing Pakistan's raw material import and export data with South Asian countries like India, Bangladesh provides important insights into regional trade. Pakistan is facing an economic crisis due to its heavy dependence on raw materials, especially cotton and synthetic fibres, and limited textile exports. While India has a competitive advantage due to its self-sufficient textile industry, Bangladesh's import-dependent textile industry is increasing its global garment exports. Economic assistance from Afghanistan and Iran is limited due to their small economies and geographical issues. Forecast models based on linear projections show potential for job growth, but this is only relevant for investment strategies and policy reforms. Coefficient of variation analysis also shows the instability of Pakistan's import pattern, indicating changes in price and foreign trade.

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ANALYZING AND FORECASTING TEXTILE INDUSTRY RELATED DATA USING AI-DRIVEN PREDICTIVE MODELS

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ABSTRACT

The textile industry is a fundamental pillar of the global economy, employing millions of individuals worldwide and contributing significantly to international trade and export revenues. This study utilizes AI techniques to analyze textile-related data across a range of international markets. By applying AI models, the study achieves highly accurate forecasting results. The aim is to elucidate the dynamic trends and performance of the global textile sector in major international markets. This analysis provides valuable insights into export patterns and supports strategic planning for future growth in the textile industry.

1. INTRODUCTION

With a 2022 valuation of $1.7 trillion, the worldwide textile industry is vital to global trade. It includes important industries including clothing, home textiles, and technological textiles, all of which have a major impact on global employment and economic stability. Despite its scale, the textile sector faces several difficult obstacles, such as shifting customer tastes, trade restrictions, and environmental issues.

This study employs AI-driven predictive models to analyze and forecast changes in the worldwide textile trade. This study uses historical data to find trends, forecast future events, and give stakeholders in the textile export industry useful information.

Objectives:

- Analyze global trends in textile trade.
- Highlight top-performing countries in textile exports and imports.
- Identify challenges impacting textile trade and provide strategic solutions.

2. METHODOLOGY

This study employs AI-driven techniques to analyze textile export data from 2015 to 2022. The Moving Average Forecasting method was implemented using MINITAB software to identify trends and patterns. Key data sources include:

- **Statista:** Global textile market insights.
- **WTO and Trademap:** Trade statistics and tariff data.
- **OEC:** Country-specific trade analysis.

Steps in the Methodology:

1. Data Collection: Gathering historical data on textile exports and imports.
2. Data Cleaning and Processing: Ensuring accuracy and relevance for analysis.
3. Model Implementation: Utilizing AI models to forecast trends.
4. Validation: Comparing model predictions with actual data for accuracy.

3. FINDINGS AND DISCUSSION

Global Textile Export Trends (2015-2022):

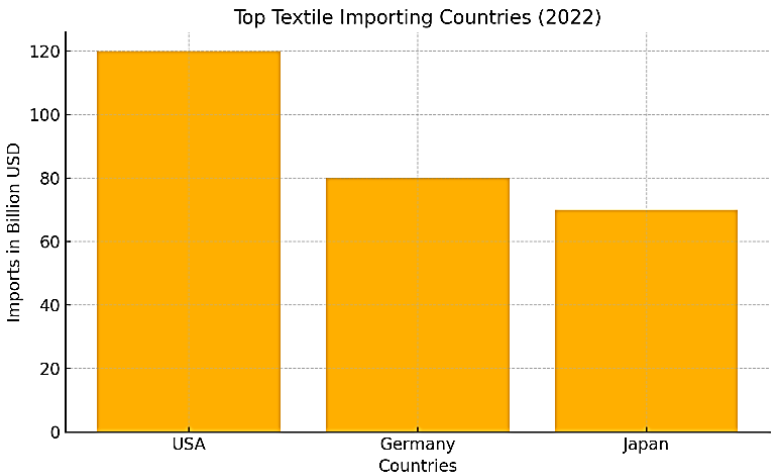
Textile exports grew from $630 billion in 2015 to $715 billion in 2022. A significant decline occurred in 2020 due to the pandemic, followed by a strong recovery in 2021.

Top Exporting Countries (2022):

- China: $150 billion - Cost-efficient mass production.
- India: $37 billion - Rich in raw materials and skilled labor.
- Bangladesh: $34 billion - Focus on ready-made garments.

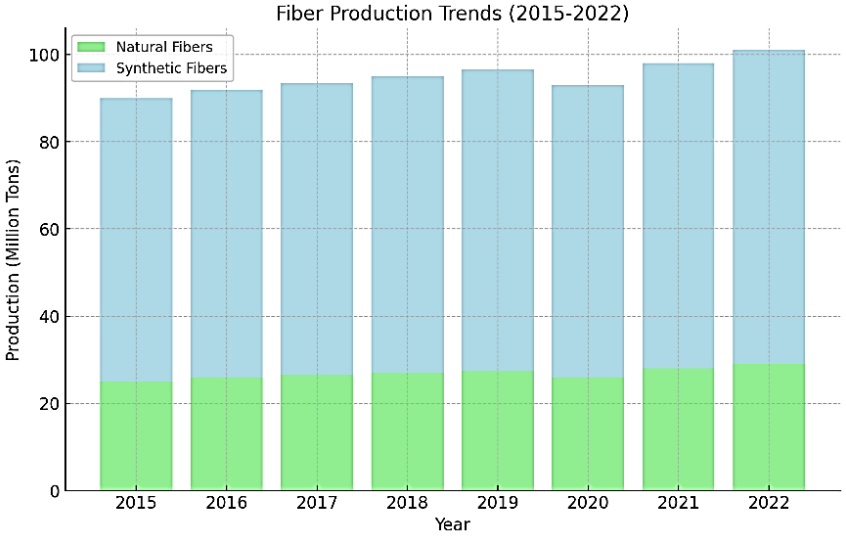
Top Importing Countries (2022):

- USA: $120 billion - High consumer demand.
- Germany: $80 billion - Luxury and industrial textiles.
- Japan: $70 billion - High-tech and advanced textiles.



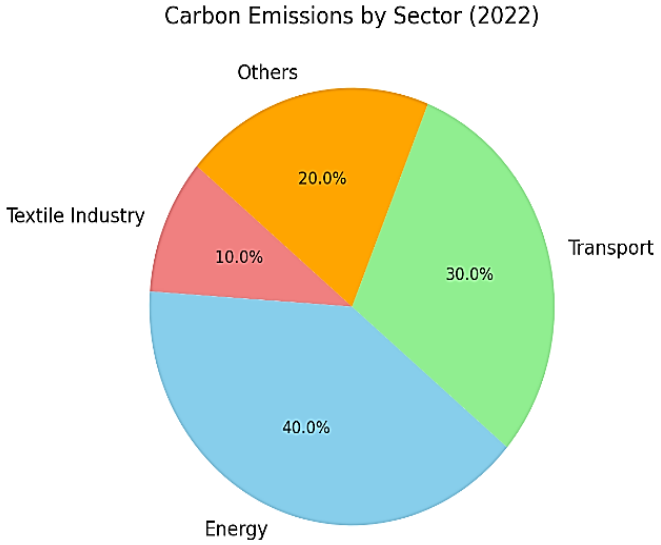
Fiber Production Trends (2015-2029):

- Synthetic fibers account for over 70% of global fiber production.
- Natural fibers such as cotton and wool have shown modest growth.



Environmental Impact:

- The textile industry contributes 10% of global carbon emissions.
- Significant water consumption and pollution from synthetic fibers and dyes are major concerns.



4. COMMENTS AND CONCLUSION

This study emphasizes how important AI is for predicting trends in the textile trade. Stakeholders can more effectively manage market dynamics and tackle issues like environmental sustainability and economic swings by examining historical data and putting prediction models into practice. The results highlight AI's capacity for strategic decision-making and provide a roadmap for further developments in the textile sector.

Future Work:

- Expanding the scope to include sustainability metrics.
- Integrating real-time data for improved forecasting accuracy.

5. ACKNOWLEDGEMENT

All praises and thanks are to almighty Allah, the most merciful and most beneficent. We offer our humble gratitude to the Holy Prophet MUHAMMAD ﷺ, who is forever a model of guidance and knowledge for humanity. Special thanks to our mentors, family, and peers for their unwavering support and guidance.

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FORECASTING OF LARGE SCALE MANUFACTURING (LSM) QUANTUM INDEX & ITS ROLE IN ECONOMIC DEVELOPMENT OF SINDH

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ABSTRACT

This study is designed to framework the QIM of Sindh for prediction of next four months ARIMA technique is applied in this study, we learned in ARIMA modeling technique for forecasting as while we run the ARIMA technique in Eviews9, in which AR and MA different order and at the AR(1) we get the lowest value of AIC in estimated model and preferred that it is adequate model for forecasting, also plot the AIC graph which forecast that QIM decrease in next four months which around 129.8, as compare previous month QIM of Sindh After that we compute the correlations among the QIM and development variables, as we mentioned in our report economic development and we discussed that we consider the proxy variables to check the association among them, because they linked with the economic development, so the proxy variables are, electricity ,gas and mining(choral, limestone) and the association between QIM and choral is 32%, and p-value is 0.1248 which is highly significant and we may say that it is failed to reject that there is association between them, correlation between electricity and QIM is 70%, according to the p-value that is 0.0001 which is less than 0.05 we can say that these two variables are highly associated, and the association between gas and QIM is 5% and the p-value is 0.8009, which tell that it is also failed to reject that there is association between gas and QIM, whereas 59% association between limestone and QIM and the p-value 0.002 which also show that null hypothesis is failed to reject. The province of Sindh is the second largest province of Pakistan. As our study belongs to the area of manufacturing industries so the Karachi which is the largest city of Sindh and Pakistan great Importance in the area of industrial economy. Due to the Karachi city which is the Economics hub of Pakistan, the province of Sindh contributes in the Economy with high shares. In Sindh for the measurement of the industrial change, the bureau of statistic, Government of Sindh is regularly particularly the MIPE report and computing QIM (quantum index of manufacturing) in the barometer of the indicator Change of province economy. It is noticed that the variable electricity is beneficial in our industrial sector because it has 70% association with quantum index of manufacturing, and the limestone has also positive effect on our industrial production there is 59% association between them, and it is noted that the QIM of four months decrease according our forecasting that is, 129.6, 129.5, 129.3, 129.6 these are the QIM values of next four months, and we may suggest that the industrial production should concentrate on these two variables, this research study may be helpful for industrial Sectors, planners and policy makers.

KEYWORDS

LSM, QIM, ARIMA Modeling, Economy of Sindh.

INTRODUCTION

Manufacturing is one of the main part of industry sector and it is consist of two main parts; large Scale Manufacturing (LSM) and small scale manufacturing (SSM) industries. The large scale Manufacturing industries (LSM) based on 10 or above employees, although the survey of small Scale manufacturing (SSM) focuses on small manufacturing industries where less than 10 Employees working. The role of Sindh province in large scale manufacturing industries is an Imperative. The manufacturing sector, share its 65% in industry according to the Pakistan Economic survey. Performance of Industrial sector is based on large scale manufacturing industries (LSM) as it holds 74.0% share in industry. Large scale of manufacturing industries having many sectors but Monthly Industrial Production and Employment Survey (MIPE) used 18 major sectors of LSM. The census of (large scale) manufacturing industries (CMI) is conducted/published by Pakistan Bureau of statistics (PBS). CMI 2015-16 manage the number of establishment manufacturing in Sindh 62,299. CMI is major source of industrial statistics.

Census manufacturing industries collect major measure such as production, investment, and structural Changes of the large manufacturing industries (LSM). The census manufacturing industries CMI is very essential because it has enormous role in assembling GDP. CMI is conducted after every Five years through mailing questionnaires. MI provide data on aggregate and assess of inputs and Outputs, census value added, benefaction to GDP, fixed assets, stocks, employment and employment cost and industrial taxes. Monthly industrial production and employment survey (MIPE) regularly conducted by provincial Bureau of statistic Sindh (BOS) since 1970s, it is survey basis report. The crucial statistics with Reference to industrial production and employment of large scale manufacturing (LSM) industries In Sindh provided by MIPE. Total number of employees in selected large Scale Manufacturing (LSM) industries according to The MIPE, April, 2023 of Sindh are 188,197 and the production worker are 141,158. We have Define Employment's quantity of LSM in three categories by different sectors, according the MIPE report huge amount of employees lies in Textile sector that is 88, 563, and the medium ratio of employees 24,430 are working in the Food sector, in Furniture sector there are very low ratio of employee 53 are working, in term of gender wise employees and production worker can be Shows in percentage as the total percent of Female employees is 5.5%, male employees 94.5%, Word employee states that entire persons give their time in the firm or any other working place and Get enumeration, and production worker are engaged in work directly linked with production like manufacturing, compiling, packing, repairing etc. CMI 2015-16 shows that the total number of Establishment is 42,578, in these establishments the number of employed persons are 2,340,966.

According to the CMI 2015-16 the total value production at producer price Rs. 11,181 billion Depicting an increase of 244.76% over Rest 3,243 billion in CMI 2005-06. Economic development is program, policies, or activities that seek to improve the economic wellbeing and quality of life for community. Manufacturing has crucial role in the economy, and Pakistan manufacturing sectors contribute 12.4% in gross domestic

product (GDP), and the sector Employees 16.1 percent of the country's labor force. This benefaction of large scale manufacturing LSM increase the growth rate of economy. CMI 2015-16 report shows that the total benefaction To GDP at fundamental prices stands at Rest 2,946 billion. The raising frame in Sindh is 473 units. There is highly significant role of education, health, electricity, gas, and mining. If the education.

Status of students is good it can be positively affected on industrial production, such as Sindh is considered as rich in mining I fit our industrial production move toward developing, in such a way Health, electricity, and gas are also very essential sectors in industrial production. In this report we check the impact of these mentioned variables with quantum index. These all sector linked with Industrial production.

REVIEW OF LITERATURE

Haraguchi (2017) examined that there is enormous role of manufacturing in the economic development in developing countries. It has been debated in current years that the significance of manufacturing decreases over the last 20-25 years, it is also displayed in this paper that it is not confirmed argument, that resulting in premature de-industrialization or non-industrialization in developing countries In the world of GDP, the components of manufacturing sector's and employment contribution have not changed since long time ago. This study concentrated that in recent years, china is developing country because it's manufacturing value added MAV share is 30% or above. This paper concluded with recommendation that the developing countries do not turn aside from manufacturing disclaim path of economic. Due to low performance of industrial sectors overall economic downtrend across different sectors in the ongoing (fiscal year from July 1 to June 30). Government's current year's measure due to dollar shortage has diminished the production, because there is powerlessness of industries to secure letters of credits. QIM sows that the LSMI output declined by 9.09% in March 2023 as compared to February 2023. Production of LSM major sectors has grew such as wearing apparel, furniture and other manufacturing (football) whereas decreased in food, tobacco, textile, coke & petroleum products, (BR, 2023). In accordance of Pakistan bureau of statistics (PBS) rebasing of QIM from 2005-06 to 2015-16, released report shows that, PBS states that weights that are currently used for QIM were derived from CMI, 2005-2006. It also came up that weights for the QIM industries are used as proxy indicator for large scale manufacturing industries to measure monthly basis growth. It is also presented that the LSM sector is considered as major contributor in national economy, and the contribution of LSM is 10.7 percent. Further stated that total amount that is used for computation of QIM for 2005-06 items 112 with cumulative weight of 70.3 percent whereas it increased to 123 items and 78.37% in QIM 2015-16. (Pro PK staff, 2022). Abbas G, (2023), studied on negative growth of LSM for five consecutive months, it is explained that recent fiscal year shows that throughout the industrial output economic growth will further fall in the next quarter, in term of electricity/gas the third quarter will be more inconvenient and it is also expected by the experts that in the winter supplies of gas will be interrupted to industrial units. It is further inspected by the economists that a downtrend caused by record energy and raw material prices. Furthermore, export-based manufactures productions already have indicated at decline due to higher cost of energy and other inputs. Meyler (1998) used ARIMA modeling for forecasting Irish inflation. It is suggested that more

focus on minimizing out of sample forecast errors than on maximizing the in the sample 'goodness of fit'. For the forecast performance the 'model mining' approach is used. Further it is illustrated in the study that the multivariate models are well-specified and generally perform better than ARIMA model. Author windup his study in such a way that the feasible method to better performance of forecasting is to attempt to fit an ARIMA model to a 'noiseless' version of the HICP. Emergence of Karachi as the Largest Industrial Region of Pakistan. Iqbal M., & Amp; et al. (2017) Karachi is the largest industrial center of country. The industrial development is expand in the other district of Karachi by stabling of new industries. In future Karachi become more efficient industries in the region. According to analytical data based on CMI (2005-2006). The growth of its industrial sector is sweeping through other neighborhoods. Through its opportunities and potentials, Karachi is steadily growing into the world' largest manufacturing region. Additionally, as other regions of the Karachi division are being developed for export purposes, its growth will accelerate in the near future. Karachi has developed into Pakistan' premier industrial region.

RESEARCH DATA

Crucial part of research and analysis is the data collection, main focus of this study is to forecast LSM quantum index by ARIMA modeling and data was gathered form bureau of statistics Sindh (BOS). In this study the main variable is quantum index manufacturing QIM variable and other are used that are the proxy variables (a copy of indirect variables) the main variable is quantum index manufacturing such as the health, education, electricity, gas and mining, we perform various statistical tests among QIM and these proxy variables. We consider these variables because they are highly linked with industrial production such as health is indirectly correlated with industrial production, good education positively effect on our industrial production, whereas electricity and gas also have key role in manufacturing, the use of mine materials is very vital they are used to construct roads and hospitals, they are require to build automobiles and houses, and for the many goods and services.

Quantum Index of Manufacturing (QIM)

Quantum index manufacturing QIM is said to be an index based on quantity of goods such as number or weight.

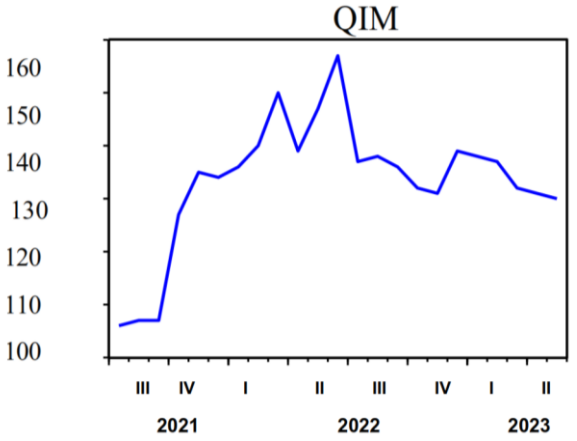

Figure 1: Trend of Quantum Index Manufacturing of LSM Industries at Base Year 2015-16

Above graph shows that QIM decrease in next four months

Forecasting Methods:

Time Series: A set of values of a variable collected at a regular interval. The observations in a time series, denoted by $Y1, Y2, Y3 \ldots, Yt$ with the equal interval of time (t).

ARIMA: Usually ARIMA is the compilation of AR, MA and I. The objective of ARIMA is to back cast and forecast of the given series.

- **AR Process:** A model that uses the dependent relationship between an observation and some number of lagged observations. Auto regressive AR models predict future values based on past values. The auto correlations of a pure AR (p) process should decay gradually at increasing lag length.
- **I:** It is stand for integrated the order of I (d), which reports the minimum number differences required to obtain a covariance- stationary series. The use of differencing of raw observations in order to make the time series stationary.
- **MA Process:** A model that uses the dependency between an observation and a residual error from a moving average model applied to lag observations. Moving average MA terms means the values of time series "q" times depends upon the error terms.

Unit Root Testing: Time series has the problem of unit root (non Stationary). In other words, the mean of time series does not remain constant over time due to trending. Unit root tests are performed to check the stationarity of the time series. Non-stationary time series gives spurious results. In this regard, augmented (Dickey & Fuller, 1979; Phillips, 1987) tests are applied for stationarity testing.

ANALYSIS & OUT COMES

a) Descriptive Statistic

In three fiscal years from July, 2019 to June, 2022, the average of QIM is 284.5333 with 48.60993 of standard deviation, Min QIM is 172.1 and Max QIM is 350.6. Sindh produced coal on average 638904.8 M. Ton, however the minimum production of the coal is 124889 M. Ton and the maximum production of coal is 482428 M. Ton. Similarly, the average production of limestone in Sindh during specified time duration is 638904.8 M. Ton along with minimum and maximum production of 117940 and 982968 M. Ton respectively.

Table 1
Descriptive Statistics

Variable	Unit	Mean	SD	Min	Max
QIM (atbase 2005-06 for correlations)	Index	284.5333	48.60993	172.1	350.6
Lime stone Production	M. Ton	638,904.8	263,759.6	117,940	982968
Electricity (Industri al Consumption)	MN.KWH	485.6667	69.57302	306	587
Gas (Industrial Consumption)	MCFT	532,474.9	73,174.1	391,637	624,202
Coal Production	M. Ton	390,310.6	83,288.27	124,889	482428

On average industrial consumption in Sindh is 485.6 million Kilowatt whereas minimum and maximum industrial consumption is 306 and 587 million kilowatt. In Sindh, 532474.9 Million cubic feet on average used in industrial sector, standard deviation is 73174.

b) Relationship between QIM and Supporting Development Variables

The relationship of Industrial Electricity Consumption and production of Limestone with Quantum Index of Manufacturing is found significant and positively related. Hence, the bi-directional relationship between the variables can be observed and the increase in the industrial electricity consumption and the production of Limestone may have positive impact on the QIM of Sindh.

Table 2
Correlation between QIM and development variables

Variables	Correlation	T-Value	P-Value
Coal	0.3220	1.59	0.1248
Electricity	0.7076	4.69	0.0001
Gas	0.0543	0.2552	0.8009
Limestone	0.5992	3.5107	0.002

The relationship between QIM and the production of Coal is found weak (i.e. 32%) which is statistically insignificant. Similarly, the variable of industrial gas consumption is also not significantly correlated with QIM. Thus, the association among the production of Coal and Industrial gas consumption has no significant impact on the industrial change of Sindh. However, the sign of associations of all the study's variables with QIM are positive and according to the economic theory.

c) Estimated ARIMA Model

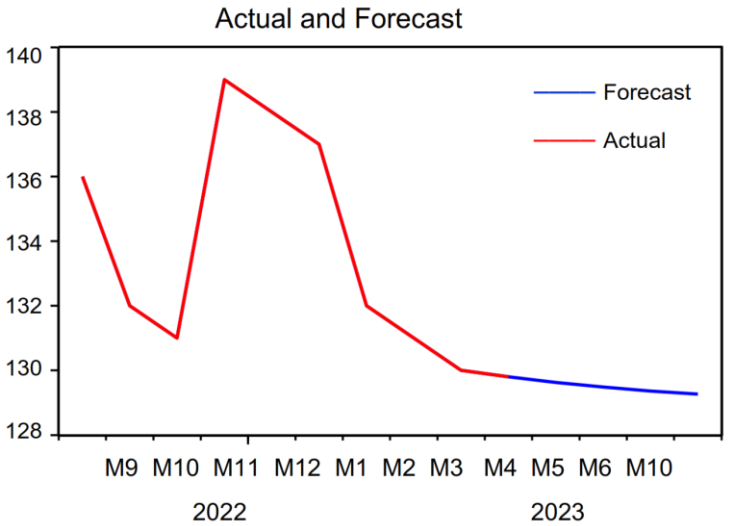

Figure 3: Four Month Forecasting of Quantum Index Manufacturing

Model	LogL	AIC*	BIC	HQ
(1,0)	-82.873299	7.156108	7.303365	7.195175
(1,1)	-82.873290	7.239441	7.435783	7.291531
(2,0)	-82.873291	7.239441	7.435783	7.291531
(1,2)	-82.840858	7.320072	7.565499	7.385184
(2,1)	-82.873282	7.322773	7.568201	7.387886
(2,2)	-82.359192	7.363266	7.657779	7.441400
(0,2)	-85.332335	7.444361	7.640704	7.496451
(0,1)	-86.378412	7.448201	7.595458	7.487268
(0,0)	-93.610892	7.967574	8.065745	7.993619

This graph perform the four months forecasting the red trend line indicate the actual observations basically that are the lagged observations, whereas the forecasting values shows that the quantum index manufacturing of LSM may be decreased in coming four months.

R-squared	Adjusted R-Squared	F Statistics	Prob (Fstatstic)	l AIC	D-W Stat
0.610550	0.573459	16.46109	0.000050	7.156108	1.985375

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	128.7888	6.0512	21.28318	0.0000
AR(1)	0.828046	0.082045	10.09261	0.0000
SIGMASQ	55.70173	17.00637	3.275345	0.0036

Above table show the values of different models. We consider the (1,0) model at the top of the table, which has the lowest value of AIC = 7.1, it shows the model is adequate for forecasting.

As we consider the (1,0) model for forecast now we check the output of that model in this table have the adjustment sigma is 55%, this table showing that the model has R^2 = 61%, Adj R^2 = 57%, lowest value of AIC = 7.1, DW = 98% it also shows the different output of model.

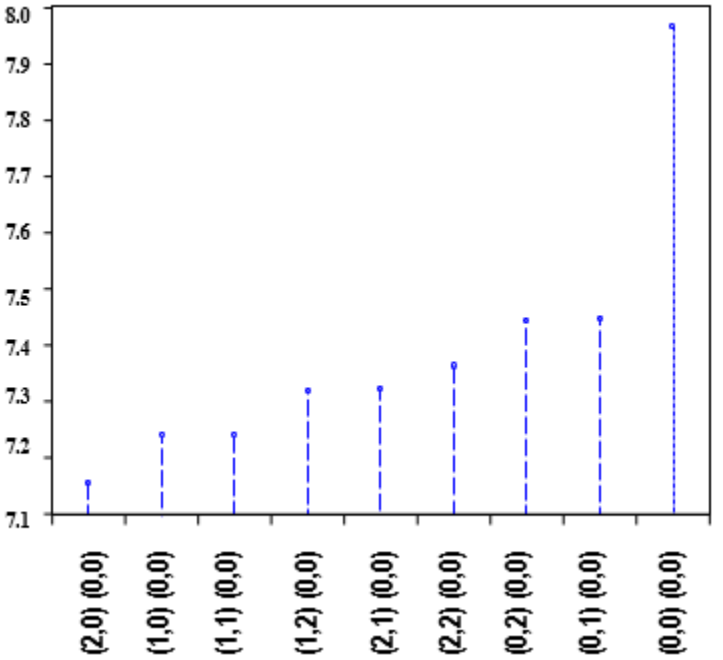

Figure 3: Akaike Information Criteria (AIC) Akaike Information Criteria

Usually this AIC graph consider the order of AR (1) and MA (0), as we can see that at the point of (1,0) (0,0) AR(1) we get the lowest value of AIC = 7.1, which shows that estimated model is good to forecast.

CONCLUSION

The province of Sindh is the second largest province of Pakistan. As our study belongs to the area of manufacturing industries so the Karachi which is the largest city of Sindh and Pakistan great importance in the area of industrial economy. Now we may conclude that the variable electricity is beneficial in our industrial sector because it has 70% association with quantum index of manufacturing, and the limestone has also positive effect on our industrial production there is 59% association between them, and it is noted that the QIM of four months decrease according our forecasting that is, 129.6, 129.5, 129.3, 129.6 these are the QIM values of next four months, and we may suggest that the industrial production should concentrate on these two variables, this research study may be helpful for planners and policy makers.

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