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Al-Shifa
Journal of Ophthalmology

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QUARTERLY PUBLISHED

- **Editorial: AI as Weapon Against Blindness in Premature**
- **Vision and Contrast in HIV Patients on HAART**
- **Squint Types and Gender Distribution in Islamabad**
- **Diabetes Duration Effect on IOP and Corneal Thickness**
- **HbA1c and Diabetes Duration Effect on Refractive Errors**
- **Academic Performance in Medical Students with Eye Disease**
- **Corneal Aberrations in High vs. Low Astigmatism**
- **Corneal Curvature and Axial Length in High Myopia**

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Al-Shifa Journal of Ophthalmology

A Journal of
Al-Shifa Trust Eye Hospital, Rawalpindi

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AI as a Weapon Against Blindness: A Game-Changer for Premature Infants

Muhammad Saad, Hassaan Ahmed Khan, Shafaq Najmi

Introduction:

A groundbreaking study published in JAMA Ophthalmology reveals a novel artificial intelligence (AI) breakthrough: a system capable of independently diagnosing severe cases of retinopathy of prematurity (ROP) – a major cause of blindness in premature infants – with flawless accuracy. This technological advancement has the potential to revolutionize how we combat this preventable cause of blindness, especially in regions with limited access to specialist care.

ROP: A Preventable Threat to Premature Infants

Retinopathy of prematurity (ROP) occurs in premature babies when abnormal blood vessel growth disrupts the retina, potentially leading to permanent vision loss[1]. The heartbreaking reality is that globally, at least 50,000 children has endured blindness due to ROP. Even in the technologically advanced United States, approximately 600 premature infants tragically lose their sight each year, a sobering reminder that more must be done[2]. The burden is most severe in low- and middle-income countries, where a critical shortage of eye specialists makes timely diagnosis and treatment extremely challenging.

The Transformative Power of AI

The scarcity of trained doctors in many parts of the world makes ROP a particularly devastating issue[3]. AI can bridge this gap, helping us catch cases early and connect babies to the treatment they urgently need.

To assess the effectiveness of this AI technology in real-world settings, the researchers conducted a diagnostic study using data collected from neonatal care units across the United States and India. The study analyzed thousands of eye images, collected over a decade, from both the Stanford University Network for Diagnosis of ROP (SUNDROP) and the Aravind Eye Care Systems (AECS) telemedicine programs.

Retinal imaging in infants typically involves the use of a specialized camera called a RetCam (Retinal Camera). This camera is designed to capture detailed images of the infant's retina. The RetCam is equipped with a light source and a lens system that allows for visualization of the retina through the pupil. It is often handheld and gently placed near the infant's eye to capture the images.

These images are then analyzed by an AI system to detect any signs of retinopathy of prematurity (ROP). A deep learning-based imaging process was developed to train the AI system in autonomously detecting more-than-mild ROP (mtmROP) and the urgent type 1 ROP. This training was based on prior data from the Imaging and Informatics in Retinopathy of Prematurity (i-ROP) study.

The i-ROP Deep Learning system takes the lead in the battle against ROP. Unlike manual image analysis, this AI analyzes retinal images autonomously, offering a vital lifeline for those without ready access to specialists. Past studies have shown its diagnostic precision, but this latest research confirms its remarkable real-world effectiveness. By analyzing thousands of retinal images, it flawlessly picked out all severe ROP cases, demonstrating its readiness to move beyond the lab and into clinical setting[4].

Remarkable Results

The results confirmed the AI's exceptional capabilities. It demonstrated impressive accuracy across both datasets, identifying severe ROP cases with high precision. Specifically, the study showed:

- **High Detection Rates:** The AI successfully detected a significant percentage of mtmROP and type 1 ROP cases (over 80%). This showcases its ability to flag the most critical cases requiring urgent intervention.
- **Early Warning System:** Remarkably, the AI flagged 100% of infants who went on to develop type 1 ROP before they received a clinical diagnosis. This suggests the AI could act as an invaluable early warning system to ensure timely treatment.

Conclusion:

Should regulatory approval follow, ROP could become another eye condition to be autonomously diagnosed by AI. This marks a crucial step toward using technology to increase healthcare access and effectiveness worldwide. But the i-ROP system's potential extends far beyond just diagnosis. In regions where specialists are scarce, AI could help guide less experienced doctors and nurses through the delicate treatment process, giving babies a greater chance at preserving their sight. This kind of collaboration, where AI supports and enhances human expertise, could reshape medical care in a world often short on expert resources. The i-ROP system is a blueprint for responsible AI integration–a tool that empowers clinicians rather than replacing them.

The social impact of this technology could be profound. Preventing blindness is about more than eyesight saved; it's about unlocking a child's full potential. It's a future where they can learn, thrive, and contribute fully to their communities. By harnessing the power of AI-powered detection, we invest in healthier, more inclusive societies where all children have the chance to see the world in its vibrancy.

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ORIGINAL ARTICLE

Visual Acuity and Contrast Sensitivity among Subjects with Human Immunodeficiency Virus Infection Receiving Highly Active Anti-Retroviral Therapy

Azmat Jehan[1], Sadiqullah Khan[1], Siraj Khan Safi[1], Sami Uddin[1]

Abstract:

Objectives: To assess visual acuity and contrast sensitivity among subjects with Human Immunodeficiency Virus (HIV) infection receiving Highly Active Anti-Retro Viral Therapy (HAART) and compare with the duration of treatment.

Methods: A total of 85 participants with Human Immunodeficiency Virus infection receiving HAART therapy were assessed for both visual acuity (VA) and contrast (CS) sensitivity. VA was taken for right eye and left eye separately with Log Mar chart. Refraction was done for refractive error. For Contrast Sensitivity, Pelli-Robson chart was used. Contrast Sensitivity was taken binocularly. Data was analyzed through (SPSS) software version 22.

Results: In this study, the total number of participants was 85, among which 82 were males and 03 were transgenders, who were receiving highly active antiretroviral therapy (HAART) for HIV infection. The mean age of the participants was 31.41 ± 5.19 years. The majority of subjects (84.7%) had VA of 0.00 log Mar (6/6) or better, while 15.3% had mild visual impairment. Normal contrast sensitivity was observed in 50.6% of subjects, while 45.9% had poor CS. The duration of HAART did not show any significant association with visual acuity (p=0.407); however, a significant association was observed between contrast sensitivity and duration of HAART (p=0.003).

Conclusion: People with HIV receiving HAART may experience changes in their visual function, specifically in contrast sensitivity. The duration of HAART treatment was found to be significantly associated with contrast sensitivity, while it has no effect on visual acuity. *Al-Shifa Journal of Ophthalmology 2025; 21(1): 9-16. © Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan.*

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Introduction:

Around 39 million people (0.7%) were infected with HIV globally in 2022.[1] Prevalence was higher among sex workers, gay and bisexual men, people who inject drugs, transgender people, and prisoners. The prevalence of HIV-related eye diseases varies depending on the geographic region, access to healthcare, and stage of the HIV infection [2]. Human Immunodeficiency Virus is an RNA virus that kills CD4 cells (T-helper cells). These T-helper cells protect our body from infection and disease[3,4]. If left untreated, Human Immunodeficiency Virus infection leads to Acquired Immunodeficiency Syndrome (AIDS). Apart from systemic disorder, it has a profound impact on the eyes, which leads to a decrease in visual functions such as visual acuity, contrast

sensitivity, color vision, and visual fields, which can be irreversible [5]. Disease processes affect these functions of the eye even in the absence of retinitis [6]. A study conducted in China has reported that before the introduction of HAART, there was a moderate to severe decrease of visual acuity in HIV-positive patients. Visual acuity dramatically improved from 1.00 Log MAR (6/60) to 0.50 Log MAR(6/18) with the use of HAART.[7]

A study conducted on HIV positive pediatric population using HAART therapy has shown significant improvement in visual acuity but changes in contrast sensitivity lead to poor performance in daily activities throughout life.[8,9] Active Anti-Retroviral Therapy (HAART) has led to a dramatic decrease in HIV-related morbidity and mortality in the developed as well as developing world[10]. It has been also effective in reducing rapidly progressive retinopathies due to HIV infection[11]. In 1992 before HAART availability in North America and Europe, about 50%–75% of the HIV-infected individuals were estimated to develop non refractive visual problems, and Cytomegalovirus (CMV) retinitis which was the leading cause of vision loss while this complication dropped dramatically since HART started [12,13.] In 2003 a study reported the incidence of (CMV) retinitis has decreased by 95% to 55% as compared to the rates seen in the early 1990s, presumably because of the widespread use of HAART [14]. A study at the University Malaya Medical Centre compared retinal nerve fiber layer (RNFL) thickness and visual function between people living with HIV (PLWH) and HIV-negative individuals in Malaysia. The average age of PLWH was 46.1 years, and all were on antiretroviral therapy (ART), with 61.2% having a CD4+ T-cell count over 500 cells/µl. There was no significant difference in visual acuity between the two groups, but PLWH had lower contrast sensitivity. Additionally, PLWH had significantly thinner RNFL in the temporal quadrant compared to HIV-negative controls[15]. The review examined the impact of HIV and antiretroviral therapy (ART) on retinal structure and function in people living with HIV (PLHIV) without retinitis. It found that PLHIV experienced noticeable thinning of the retinal nerve fiber layer (RNFL), particularly in the superior and inferior areas. Additionally, visual function was affected, with changes observed in various tests, including transient pattern VEP, electroretinograms (ERGs), contrast sensitivity, color vision accuracy, and perimetry tests, showing reduced mean deviation and pattern standard deviations[16]. This study can help raise awareness among healthcare professionals regarding the importance of monitoring visual function in patients with HIV receiving HAART treatment. Overall, the study has significant implications for improving the health and quality of life of patients with HIV in Pakistan.

Methodology:

This study was cross-sectional and conducted from June 2022 to November 2022 in the center of Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS), in Hayatabad Medical Complex (HMC), Peshawar. The study aimed to assess visual acuity and contrast sensitivity among subjects with human immunodeficiency virus infection receiving HAART and to compare visual acuity and contrast sensitivity with duration of HAART therapy among subjects with human immunodeficiency virus infection. Ethical approval was taken from the research committee of Hayatabad Medical Complex (HMC), Peshawar. Non-probability consecutive sampling technique was used. All participants, males, females, and transgender were included in this study who were aged 18 to 40 years and were already receiving active retroviral therapy for HIV infection. All those participants with HIV infection were excluded from the study who had ocular complications due to retinal disorders secondary to systemic

diseases such as diabetic mellitus, hypertension, tuberculosis, etc.

A proforma was used to collect data on medical records, current treatment, socio-demographic data, and duration of the disease and duration of HAART. Visual acuity was recorded on the EDTRS visual acuity chart in Log MAR. Both objective and subjective refraction were performed. A contrast sensitivity test using a Pelli-Robson chart was used to record contrast sensitivity at one meter. The values were recorded and noted on the Performa. Data were entered and analyzed using SPSS software version 22. Descriptive statistics and chi-square test analyses were carried out to describe variables and to identify factors associated with visual function and association between dependent and independent variables. A probability value (p-value) was calculated using Spearman's test for categorical values comparison and a p-value of <0.05 was considered statistically significant.

Results:

The total number of participants of this study was 85. Among them 82 (96.5%) were male and 03 (3.5%) were cross-gender.

There were 40 (47.1%) participants from ages 34-40 years and 13(15.3%) were from 18-25 years. The mean age of the participants was 31.41 ± 5.192.

Among them, 61 (71.8%) were married and 24 (28.2%) were unmarried. Most of the participants were having higher education 26(30.6%). 25(29.4%) of the participant were drivers followed by labor 21(24.70%)

Table 1: Demographic profile of the participants

Gender		Male N (%)	Transgender N (%)	Total N (%)
Age (Years)	18 to 25	12 (14.1)	01 (1.2)	13 (15.3)
	26 to 33	38 (44.70)	02 (2.4)	40 (47.1)
	34 to 40	32 (37.6)	0	32 (37.6)
	Total	82 (96.5)	03 (3.5)	85 (100)
	Mean age (Mean ± SD)	31.41 ± 5.192		

Table 2: visual impairment with best possible correction among patients receiving HAART therapy

Categories of visual impairment (range)		With best possible correction N (%)
Visual impairment	Normal 0.3 (6/12) or better	72 (84.7%)
	Mild VI <0.3 (6/12) to 0.5 (6/18)	13 (15.3%)
	Moderate VI < 0.5 (6/18) to 1.0 (6/60)	0

Table 3: Status of contrast sensitivity among patients receiving HAART therapy

Categories (range)		Number N (%)
Contrast sensitivity	Normal = 2.00	43 (50.6%)
	Poor < 2.00	39 (45.9%)
	Sever <1.5	03 (3.5%)

Table 4: Comparison of visual impairment with duration of highly active anti-retroviral therapy

Visual acuity (Log MAR)		Duration of HAART (in years)						
		1-3 N (%)	4-6 N (%)	7- 9 N (%)	10-12 N (%)	13-15 N (%)	Total N (%)	P value
Visual acuity with best possible correction	Normal 0.3 (6/12) or better	36 (42.4)	25 (29.4)	07 (08.2)	03 (3.50)	01 (1.20)	72 (84.7)	0.407
	Mild VI <0.3(6/12)-0.5(6/18)	04 (04.7)	06 (07.1)	02 (02.4)	0	01 (01.20)	13 (15.3)	
	Total	40 (47.1)	31 (36.5)	09 (10.6)	03 (3.50)	02 (02.4)	85 (100)	

Table 5: Comparison of contrast sensitivity with duration of highly active anti-retroviral therapy among people with human immune deficiency virus

Contrast Sensitivity		Duration of HAART (in years)						
		1-3 N (%)	4-6 N (%)	7-9 N (%)	10-12 N (%)	13-15 N (%)	Total N (%)	P-value
Contrast Sensitivity (CS)	Normal =2.00	25 (29.4)	10 (11.8)	07 (8.2)	03 (3.5)	0	72 (84.7)	0.003
	Poor CS <2.00	14 (16.5)	20 (23.5)	02 (2.4)	0	01 (1.2)	37 (33.6)	
	Sever CS <1.5	01 (1.2)	01 (1.2)	0	0	01 (1.2)	03 (3.6)	
	Total	40 (47.1)	31 (36.5)	09 (10.6)	03 (3.5)	02 (2.4)	85 (100)	

Discussion:

A cohort study was conducted on 1300 patients at 19 clinical trial centers, standardized measurements of visual acuity and contrast sensitivity were analyzed. They concluded that visual dysfunction is common in patients with AIDS without retinitis[17]. The same is the case in our study. According to a study conducted in Maryland, USA in 2006, 379 subjects with AIDS with follow-up of three months. Those subjects whose immune recovery with HAART therapy was stable or improved had a 50% lower risk of visual acuity loss.[18]. while in our study with a long duration of HAART therapy, the visual

acuity improved Defects in contrast sensitivity have been observed in an American study by Mueller A J et al in which they analyzed visual dysfunction in HIV-positive patients without retinitis in receiving Highly Active Antiretroviral Therapy (HAART) [19]. We also observed defects in contrast sensitivity in subjects taking HAART therapy.

A review was done on the low contrast sensitivity chart in HIV patients receiving HAART therapy, the low contrast sensitivity of the HIV-positive patients without retinopathy was found to be significantly lower than the age-matched controls ($p < 0.01$). This finding is probably attributable to pathology related to HIV in the visual pathways. Contrast sensitivity charts were found to be a useful diagnostic tool for HIV patients and presumed neuropathy [20]. A study was conducted in 2006 in Los Angeles, California in which the best corrected Visual acuity was 6/9 or better, with no media opacities, and no retinal pathologies. The mean age of subjects was 46 years. The abnormal contrast sensitivity was 7.0% [21]. The reason for the higher number of contrast sensitivity defects than our study may be because of starting late treatment, geographic differences of patients, or a smaller number of enrolled patients than our study. A study conducted in Thailand showed the incidences of VA loss to ≤20/50 and ≤20/200 were 0.22/eye-year (EY) and 0.12/EY, respectively. Risk factors for the incidence of VA loss to ≤20/50 were low CD4+ T-cell count (adjusted hazard ratio [aHR], 3.1), large area of retinitis (aHR, 3.7), and no immune recovery (IR) (aHR, 13.9). Risk factors for the incidence of VA loss to ≤20/200 were not receiving highly active antiretroviral therapy (HAART) (aHR, 4.4) and large retinitis area (aHR, 2.1) [22]. In our study, the duration of HAART therapy was one to three years and the visual outcome was better than 0.3 (6/12). The difference may be due to the mean duration of HAART therapy, which was one to three years in our study, which is less than the mean duration of HAART therapy in their study conducted in Singapore.

A study was done on patients who have control of disease in HAART treatment time. They reported a relationship between contrast sensitivity and duration of HAART treatment. They reported that contrast sensitivity was going low as the duration of HAART therapy was prolonged [23]. This study resembles our study (table 5).

In British, a study was conducted on 75 patients who were examined with their normal control with different durations of HAART treatment time. They used a highly sensitive computer graphics system to measure color vision and contrast sensitivity, they reported a relationship between contrast sensitivity and duration of HAART therapy with progression of HIV disease[24]. Contrast sensitivity is also affected in our study with the duration of HAART therapy.

A one-year longitudinal study was done in Ethiopia. They enrolled 240 patients who were on HAART therapy. Females accounted for 66.6% of the study participants, with male to female ratio of 1:2. Their mean age was 35.4 years. Visual acuity was normal in 90.1% of the patients, 7.2% had visual impairment and 2.7% were found to be bilaterally blind. Visual impairment and blindness was significantly associated with the duration of HAART in their study[25]. While in our study with a mean age of 31 years with normal visual acuity of 72%, but no significant association of visual impairment with duration of HAART was detected. The reason for this difference from our study may be because of gender (table 1), only males and transgender were there, and no female were in our study. Another reason may be because of the selection of patients. In our patient, no posterior segment pathology was detected.

Defect in contrast sensitivity has been observed in an American study by Muller et al. They analyzed visual dysfunction in HIV-positive patients without retinitis who

were on HAART treatment. In their study, 12% of eyes had low contrast sensitivity and 3 % of eyes had visual acuity worse than 6/12. They did not report any relationship between visual acuity/contrast sensitivity with duration of HAART therapy[26]. However, in our study significant association of contrast sensitivity with duration of HAART was ($p<0.05$) present. Poor contrast sensitivity was observed in 37 (33.6%) participants. Among them, 20 (23.5%) of the participants were using HAART from 4-6 years, and 14 (16.5%) ($p<0.003$) from1-3 years (table 5). While no significant association ($p>0.05$) was found between visual acuity impairment and duration of (HAART) therapy (table 4).

Longitudinal studies are needed to determine where changes in the retinal nerve fiber layer and systemic indicators such as frailty predict changes in visual function. It is recommended that further research on visual function be done as a case-control. Prospective case-control studies would be more informative where baseline data for the visual function is obtained and trends are monitored. Further research on the effects of HAART or duration of HAART therapy on visual function is recommended. There is a need for surveillance of visual function abnormalities in HIV-positive children on HAART.

Conclusion:

In our study visual acuity (VA) and contrast sensitivity (CS) were assessed in such people without any ocular manifestation and who were receiving HAART. This study's results show that poor contrast sensitivity (CS) is associated with the duration of use of HAART. Similarly, the results show that contrast sensitivity (CS) can be affected in people with HIV even if visual acuity (VA) is good.

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ORIGINAL ARTICLE

Frequency of Types of Squint and Gender Distribution Presenting to a Tertiary Care Hospital in Islamabad

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Abstract:

Objectives: To determine the frequency of various types of squint with gender distribution presenting to a tertiary care hospital in Islamabad.

Methods: This cross sectional study was conducted from 07-01-2021 to 15-03-2022. 57 patients with strabismus were selected for this study. After obtaining consent baseline features including age, gender, and eye involved were documented on the predesigned proforma. The cover-uncover test was performed to determine the type of squint including "exotropia" and "esotropia". The chi-square test was used as a test of significance.

Results: Among 57 patients 34 (59.65%) were males while 23 (40.35%) were females. The mean age was 21.51 ± 7.22 years. Squint was observed in the left eye only in 9 (15.79%), right eye only in 15 (26.32%), and in both eyes in 33 (57.89%) patients. The frequency of "Exotropia" was 50 (87.72%) while of "Esotropia" was 7 (12.28%). Among male patients (n = 34), "exotropia" was found in 29 (85.29%), and "esotropia" was found in 5 (14.71%) while in female patients (n = 23), "exotropia" was found in 21 (91.30%) and "esotropia" in 2 (8.70%) patients, (p = 0.498).

Conclusion: Exotropia is the more prevalent type of strabismus in our study population with higher frequency in the male population. *Al-Shifa Journal of Ophthalmology 2025; 21(1): 17-22.*

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Introduction:

Strabismus occurs when the ocular deviation is too great for the fusional process to correct, leading to a misalignment of the eyes in a binocular view. The status of ocular deviation can be either "constant" or "intermittent" depending on the fusional status of the eyes, and the deviation could also be "turned out" or "exotropia", "turned in" or "esotropia", "turned up" or "hypertropia", "turned down" or "hypotropia", "rotated out" or "excyclotropia" and "rotated in" or "incyclotropia" [1]. Amongst all these types "exotropia" has been reported to be the most common type of strabismus [2]. The most prevalent risk factors connected with the development of strabismus are a history of the condition running in the family, a person's ethnic background or racial origin, certain genetic abnormalities, a habit of smoking, premature birth, low weight at birth, a refractive defect and a neural impairment [3]. "Esotropic strabismus" is strongly linked to farsightedness of ≥ +3 Diopters and the risk of developing

strabismus rises with both the severity of astigmatism and by spherical equivalent of farsightedness [4].

Amblyopia from strabismus is a frequent eye condition that threatens the vision of patients. Most strabismic patients also report difficulties with binocular vision and depth perception, with their appearance, with their ability to learn, with their ability to interact socially and with the trauma of recurrent surgical repairs [5]. If strabismus is diagnosed and treated early on, it can have positive effects on patients' visual and socioeconomic well-being [6]. When it comes to restoring eyesight and correcting eye deviation without resorting to surgery, refractive surgery and vision therapy are best possible interventions while in later cases, surgery becomes the mainstay of treatment [7].

When it comes to frequency of strabismus and its various types, various epidemiological studies have reported variable frequency in different demographics. At one end, it has been found that the frequency of strabismus was quite high in the older adult population while others reported that children had a much higher frequency of having strabismus as compared to the adult population [8, 9]. Similarly, when it comes to gender distribution of squint, studies have reported varying results in younger and elderly population. In younger patients it has been reported that there is no significant gender difference in frequency of strabismus while in older population female patients have higher propensity of having squint [10, 11]. Based on such discrepancies in previous epidemiological studies we aimed to conduct this study in our local population to find out frequency of various types of squint and its gender distribution.

Methodology:

This cross sectional study was conducted at the ophthalmology unit of "FGPC Hospital, Islamabad" from 07-01-2017 to 15-03-2022, after obtaining approval from the ethical review board (ERB) of the aforementioned institution. In order to calculate appropriate sample size for our study we utilized WHO sample size calculator using formula 1.1 which is for estimation of population proportion with specified absolute precision [12]:

$$n = \frac{z^2_{1-\alpha/s} P(1-P)}{d^2}$$

To calculate sample size following assumptions were made; confidence level of 95%, absolute precision of 6.3% and anticipated frequency of strabismus as 6.2% [13]. The calculation with these parameters gave a sample size of 57.

For this study, strict inclusion and exclusion criteria were set. Participants who had an age of 6 years or more, were either male or female and had visible squint in one or both of their eyes were included in the study. Patients who had a history of previous ocular or squint surgery were aged less than 6 years and who did not give consent to be a part of this study were excluded from this research.

For selection of patients "non-probability consecutive sampling technique" was used. Once study pool was selected patients were interviewed to ascertain and document their age. Gender and eye(s) involved was also documented in a predesigned proforma as a part of documentation of baseline demographic characteristics. After that, to determine the type of squint "cover-uncover test" was used [14]. During this test, patients were first instructed to look at a distinct object placed right in front of them to determine which eye was deviated either nasally or temporally. Once determined, un-deviated eye was covered to see the movement of deviated eye. In case the previously temporally deviated un-covered eye moved nasally upon covering of opposite eye, patient was labelled to have "exotropia" while in case the previously nasally deviated un-covered eye moved temporally upon covering of opposite eye, patient was labelled to have "esotropia". Similar test was performed on the opposite eye to assess for "simple" or "alternating"

type of the squint. In case deviation was limited to one eye, squint was labelled as "simple", if it occurred in both eyes, squint was labelled as "alternating".

To analyze the data, Statistical Package for Social Sciences (SPSS) software version 21:00 was used. To represent quantitative data (age) we used mean +/- standard deviation. For representation of qualitative data (gender, type of squint) we used percentages and frequencies. Normality of data was checked using Shapiro-Wilk test [15]. The type of squint was stratified by gender and post-stratification Chi-square test was used. A p-value of < 0.05 was considered to be statistically significant.

Results:

A total of 57 patients were included in the study, 34 (59.65%) of which were males while 23 (40.35%) were females. The mean age of the study participants was 21.51 ± 7.22 years. Squint was observed in left eye only in 9 (15.79%), right eye only in 15 (26.32%), and in both eyes in 33 (57.89%) patients. The baseline demographics are tabulated below in Table I:

The frequency of "Exotropia" was 50 (87.72%) while of "Esotropia" was 7 (12.28%). This is depicted below in Figure 1.

Additionally, all the patients who had "Esotropia", had "simple esotropia". In the case of "Exotropia" (n = 50), 18 (36.00%) had simple while 32 (64.00%) had alternating exotropia. Type of squint was stratified by gender and it was found that among male patients (n = 34), "exotropia" was found in 29 (85.29%) and "esotropia" was found in 5 (14.71%) while in female patients (n = 23), "exotropia" was found in 21 (91.30%) and "esotropia" was 2 (8.70%), (p = 0.498). This data is given below in Figure 2.

Table I: Baseline Demographic Characteristics (n = 57)

Characteristic	Mean ± SD
Age	21.51 ± 7.22 years
Gender Male Female	Frequency (%) 34 (59.65%) 23 (40.35%)
Eye(s) involved Left Right Both	Frequency (%) 9 (15.79%) 15 (26.32%) 33 (57.89%)

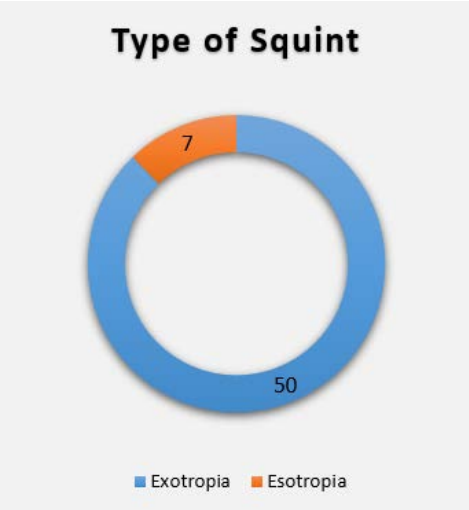

Figure 1: Type of Squint

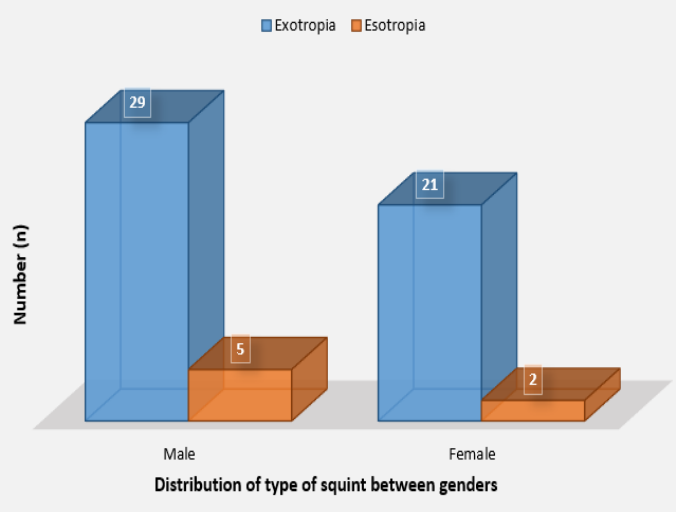

Figure 2: Gender Stratification of Type of Squint

Discussion:

Strabismus symptoms can potentially have a negative impact on a person's self-esteem, as well as their ability to participate in day-to-day activities and social activities [16]. Patients, especially children who have strabismus, for instance, have a lower chance of being invited to the birthday parties of their friends when compared to children who do not have strabismus [17]. In a recent population-based study, researchers found that preschoolers who had strabismus had a poorer quality of life in general when it came to their health, in comparison to children who did not have strabismus [18]. Patients who have chronic health diseases such as strabismus may be at risk for experiencing detrimental effects on their psychosocial wellness and development, in addition to the negative effects that these conditions have on their health-related quality of life. It has been found that patients with strabismus have a significantly higher incidence of psychiatric disorders including anxiety and depression than the general population does [19]. Therefore, it is essential to keep track of the burden of this disease in society.

In the present study, it was found that "exotropia (outward deviation of the eye)" was a much more common type of squint as compared to "esotropia (inward deviation of the eye)", [87.72% and 12.28%, respectively]. This was consistent with the results of a study conducted by Junejo *et al.* [20] in which "exotropia" was more frequent type. However, opposite to our study, Qanat *et al.* [21] reported "esotropia" to be the most prevalent type of strabismus. In present study, more patients were male (59.65%) indicating that frequency of strabismus is higher in male gender. This was opposite to what was reported by Junejo *et al.* [20] in which higher frequency was observed in female patients. Upon assessing the distribution of various types of squint in different gender groups, it was found that there was no statistically significant difference in the frequency of various types of squint between male and female patients (p = 0.498). This was congruent with the findings of a study conducted by Zhang *et al.* [10] but was opposite to what was reported in Martinez-Thompson *et al.* [11].

Based on these differences, it is recommended that epidemiological surveys should be carried out in different demographics of the world as this variation may be significant and help in proper estimation of disease burden. This will help in planning a comprehensive pathway to enroll and treat all the patients of strabismus in both genders and of any type. The limitations were inclusion of patients only from one institution, having a short follow-up period and a small sample size.

Conclusion

In conclusion, "Exotropia" is more prevalent type of strabismus in our study population with higher frequency in male population.

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ORIGINAL ARTICLE

Effect of Duration of Type II Diabetes Mellitus on Intraocular Pressure and Central Corneal Thickness

Sehrish Aslam[1], Naila Obaid[2], Tehmina Nazir Hussain[2], Shumaila Obaid[3], Haseeb Ahmed Khan[4]

Abstract:

Objective: To find out the effect of duration of type II diabetes mellitus on intraocular pressure and central corneal thickness

Methods: A total of 100 diabetic patients were included in the study after taking approval from Ethical Review Committee. Patients were selected for the data collection process in the Eye outpatient department. Slit lamp and retinal examinations were performed on all individuals. The central corneal thickness (CCT) was determined with a Quantel clinical pachymeter, and the intraocular pressure (IOP) was assessed with a Goldman applanation tonometer. Patients were divided into two groups based on the duration of their disease: Group A (diabetes less than 10 years) and Group B (diabetes more than 10 years).

Results: The mean age of patients was 47.1±8.94 years in group A and 72.86±6.04 years in group B. Group A

patients were found to have a mean CCT value of 532.400 ± 12.98 micrometer while Group B patients had a mean CCT of 553.120 ± 13.23 micrometer (p-value <0.05). Mean IOP in group A patients was 18.03 ± 0.749 mmHg and in group B patients was 19.58 ± 1.029 mmHg (p-value <0.05)

Conclusion: Prolonged duration of type 2 diabetes mellitus (disease duration >10 years) has been depicted to be significantly associated with increased Central Corneal Thickness (CCT) and raised Intraocular Pressure (IOP). *Al-Shifa Journal of Ophthalmology 2025; 21(1): 23-28.*

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Introduction:

Diabetes mellitus (DM) develops when the pancreas is unable to produce enough insulin, or when the body becomes insulin resistant, resulting in elevated blood glucose levels. This can cause micro- and macrovascular problems,

resulting in ocular manifestation such as diabetic retinopathy with alterations in corneal thickness and intraocular pressure. Diabetes patients frequently have corneal abnormalities and changes in intraocular pressure. Increased corneal thickness and edema of the cornea indicate corneal dysfunction, but higher IOP has been linked to glaucoma.[1,2,3] Lee et al. studied type 1 and 2 insulin-dependent DM patients and found that those with diabetes for less than ten years had greater corneal morphological abnormalities. Their report was complicated by the fact that the data from the two groups of diabetic individuals were

combined.[4] Choudhari et al. observed no change in CCT in type 2 DM, but identified a considerably higher rate of cell loss in type 1 DM.[5] A recent study found that CCT was considerably higher in the diabetic group, when compared to non diabetic group. Diabetic eye damage has also been linked to a prolonged disease duration and problems managing glucose levels.[6,7] Patients with type 2 diabetes who are unable to obtain effective glucose control with oral medicines are frequently treated with insulin, either alone or in combination with other oral medications.

Diabetic people have higher IOP compared to non-diabetic ones. High IOP and diabetes remain risk factors for glaucoma, while some authors disagree.[8,10,11,12,13] Another glaucoma study, the Nurses' Health Study, discovered a link between glaucoma and short-duration diabetic condition, whereas the Los Angeles Latino Eye Study revealed that glaucoma was more common in people with long-duration diabetes.[11,12] There is a need for more research to better understand how diabetes affects the cornea and IOP. Studies on CCT in diabetic individuals either did not include IOP measurements from the same subjects, were not well controlled, comprised people with retinopathy, or were not randomized. Few studies have examined the relationship between corneal metrics and diabetes duration. Additionally, there is a scarcity of research on the impact of glucose control on corneal parameters and IOP. The purpose of our study is to examine CCT and IOP in type 2 diabetic patients and relate any potential association with prolonged duration of disease.

Methodology:

This is a cross sectional prospective study conducted after taking approval from the Institutional Ethical Committee. The research comprised a total of 100 type 2 diabetic patients (having diabetes from the last 10 years) who visited the Eye OPD at the Institute of Ophthalmology, Fauji Foundation Hospital, Rawalpindi, from September 2021 to February 2022. Before enrollment, a comprehensive ophthalmic examination, including a complete medical history, slit-lamp examination, fundus camera retinal examination, and corneal topography was conducted on each subject. Exclusion criteria included past prescription lens use, past glaucoma or pseudo exfoliation, clear history of corneal illness, individuals with extremely dry eyes detected by a tear film breakdown time of fewer than 0.3 seconds, present intraocular inflammation, those who have undergone anterior segmental surgery, having comorbid diseases such as hypertension, and those who have received laser therapy. Patients using any topical medications were also excluded, but soft contact lens wearers were included in the study only if they discontinued contact lens use 24 hours before the examination.

Following selection, patients were then divided into two groups:

Group A (Patients with diabetes mellitus <10 years)

Group B (Patients with diabetes mellitus >10 years)

Slit lamp and retinal examinations were performed on all individuals. When administering medication for type II diabetes, the severity of the condition was noted, the corneal thickness was determined with a Quantel clinical pachymeter, and pressure inside the eye was assessed with a Goldman applanation tonometer after instillation of fluorescein dye and topical anesthetic. Relevant data were entered in a proforma, including the case numbers, name, gender, age, BMI, duration of diabetes mellitus, the thickness of the cornea, and intraocular pressure. To prevent variables and design prejudices, the exclusion criteria were adhered to strictly. Sample size was calculated with the help of WHO sample size calculator taking confidence level of 95%, a total precision (d) of 0.5, Mean of IOP in diabetics of 18.32 and an average standard deviation of the population of 2.52, a population sample dimension of 100 was chosen.[6] Data was

analyzed using a statistical analysis tool (IBM-SPSS V- 23). For quantitative variables such as age, IOP and CCT, Mean +/- SD was calculated. Frequency was computed for qualitative variable such as gender. Pearson correlation coefficient was applied to look at the relationship between CCT and IOP among diabetic patients. Independent sample T test was applied to compare CCT along with IOP among the two groups of diabetic patients with p-value <0.05 being considered statistically significant. Linear regression study was applied to plot the changes in CCT and IOP as the duration of diabetes mellitus increases in the patients.

Results:

Mean ±SD of age of the 100 diabetic patients was 59.98 ±15.00 years having an age range of 19 to 85 years. Out of 100 patients, 53 were males and 47 were females. The mean ± SD of BMI was 26.280±2.05 Kg/m2. The current study evaluated that mean ± SD of central corneal thickness was 542.76 ± 16.68 micrometer while the mean ± SD of intraocular pressure was 18.81 ± 1.18 mmHg. Among the diabetics, 5 of the patients were insulin-dependent while the rest of the patients were not insulin dependent. See Table 1.

The mean ± SD of age in Group A patients was 47.10 ± 8.94 years and in Group B patients was 72.86 ± 6.04 years (p-value <0.05). The mean ± SD of CCT in Group A was 532.40 ± 12.98 micrometer while in Group B was 553.12 ± 13.23 micrometer (p-value <0.05). The mean ± SD of IOP in Group A was 18.03 ± 0.749 mmHg and Group B was 19.58 ± 1.02 mmHg. (p-value <0.05). Independent sample T test revealed that increased CCT and raised IOP was found with longer duration of diabetes mellitus with p value <0.05. See Table 2.

Pearson correlation coefficient showed a significant relationship between CCT and IOP in the diabetic patients (p-value <0.001). See Table 3.

Linear regression analysis revealed a linear relationship for both CCT and IOP when compared to the duration of diabetes mellitus indicating that more prolonged exposure of the disease results in thicker corneas and raised intraocular pressure. See Figure 1,2.

Table 1: Clinic-demographics of diabetic patients n=100

Demographics	Mean±SD
Age (years)	59.98 ±15.00
Gender (male: female)	53±47
BMI (Kg/m2)	26.280±2.05
CCT (µm)	542.76 ± 16.68
IOP (mmHg)	18.81 ± 1.18

Table 2: Comparison of age-adjusted intraocular characteristics according to Independent sample t- test n=100

Intraocular characteristics	Mean±SD Group A (Diabetes duration <10 years) n=50	Mean±SD Group B (Diabetes duration >10 years) n=50	P Value
Age (years)	47.10± 8.94	72.86± 6.04	<0.001
CCT (µm)	532.400 ± 12.98	553.120 ± 13.23	<0.001
IOP (mmHg)	18.03 ± 0.749	19.58 ± 1.029	<0.001

Table 3: Association between CCT and IOP in diabetic patients according to Pearson correlation coefficient test n=100

Correlations	Central corneal thickness (µm)	Intraocular pressure (mmHg)
Pearson correlation coefficient	.325**	.325**
2- tailed significance	<0.001	<0.001
Number	100	100

**Correlation is significant at the 0.01 level (2- tailed)

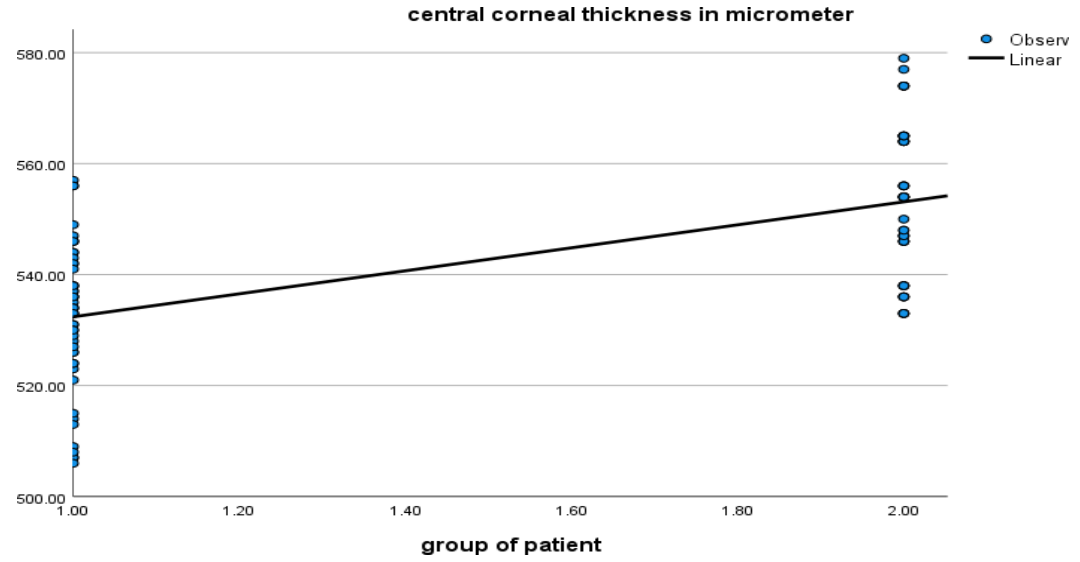

Figure 1: Plotting of CCT to compare both groups of diabetic patients

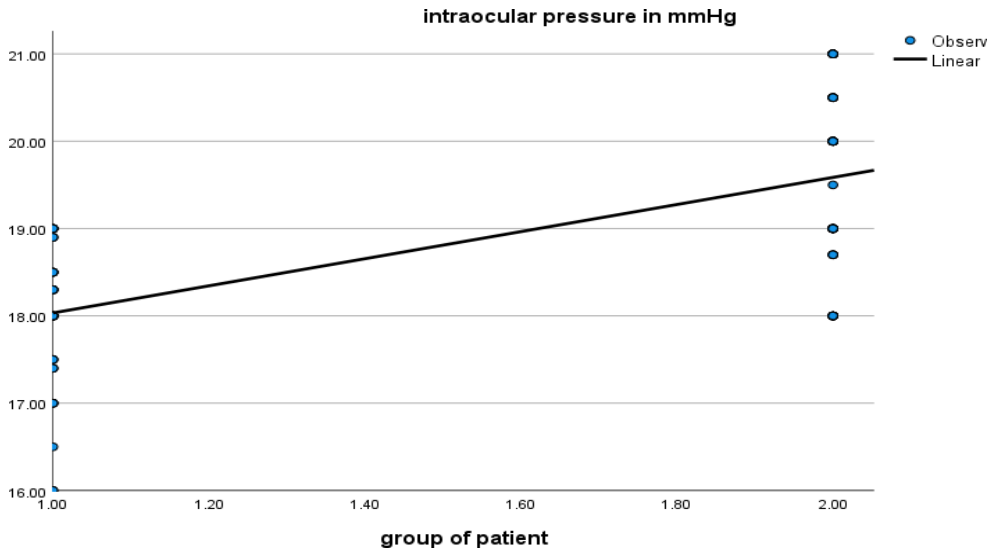

Figure 2: Plotting of IOP to compare both groups of diabetic patients

Discussion:

According to our study, the mean ± SD of CCT in Group A was 532.40 ± 12.98 micrometer while in Group B was 553.12 ± 13.23 micrometer (p-value <0.05). The mean ± SD of IOP in Group A was 18.03 ± 0.749 mmHg and Group B was 19.58 ± 1.02 mmHg. (p-value <0.05). Independent sample T test revealed that increased CCT and raised IOP was found with longer duration of diabetes mellitus with p value <0.05.

According to our study, the primary evaluation of the association between IOP and CCT in type 2 diabetic patients was significant according to Pearson correlation coefficient. Linear regression analysis revealed a linear relationship for both CCT and IOP when compared to the duration of diabetes mellitus indicating that more prolonged exposure of the disease results in thicker corneas and raised intraocular pressure which is supported by a study published by Shih and his colleagues who found that diabetes and hyperglycemia are associated with thicker CCT.[14] This association is important because thicker or thinner central corneas may lead to either overestimation or underestimation of IOP, which is a crucial risk factor for glaucoma. In fact, every 25 µm increase in CCT was associated with a 1 mm Hg change in IOP. Moreover, the study found that patients with diabetes had higher IOP, steeper corneal curvature, and shorter axial length compared to those without diabetes.[9] These findings highlight the importance of considering CCT when interpreting IOP measurements in patients with diabetes. Future research should investigate employing a dynamic contour tonometer to assess IOP in a comparable approach. Our study solely reports measured CCT and IOP on the same patients based on diabetes duration.

IOP was subsequently evaluated in our study using two duration categories: <10 years and >10 years. It has been depicted that IOP in patients having diabetes >10 years was significantly raised.

Researchers have proposed many explanations for observed changes in CCT and IOP, as well as their potential interrelationships in diabetic patients' eyes. It has been proposed that increased IOP leads the eye to have more cross-linking of collagen through the glycation process, which enhances the rigidity of the cornea and sclera to resist the damaging effect of increased IOP.[7,8,9,15] The rigidity then translates into higher IOP values. Sorbitol accumulates within the diabetic corneal endothelium cells and a decrease in Na+/K+ ATPase activity promote malfunction of the corneal endothelial cell layer, resulting in corneal hydration and higher CCT readings. Thus, corneal thickness provides indirect information on the function of the endothelial layer. This relationship should be investigated further on a sample of type II diabetes people using a tonometer that is unaffected by corneal factors.[4,15,16]

However, Al-Sereiti et al. found that patients with diabetes who had autonomic neuropathy had normal intraocular pressure. Autonomic denervation has been linked to peripheral diabetic neuropathy. It has been proposed that in autonomic neuropathy, the pupil/iris diameter is reduced, which enhances aqueous drainage and lowers the IOP.[17]

Conclusion:

Our study concluded that the duration of diabetes with type 2 mellitus has been depicted to be significantly associated with raised intra-ocular pressure. Overall, the relationship between CCT and IOP in diabetics is complex and multifaceted. Further research is needed to fully understand the implications of this association for glaucoma diagnosis and management. Additionally, evaluation of corneal endothelial structure might be advantageous in diabetic patients with daily assessments to stop the visual disability in the early period and for early intervention.

Limitations of our study were that it was a single center study. Further multiple centered studies should be conducted for clinical implication.

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ORIGINAL ARTICLE

Association of Hba1c and Duration of Diabetes with Refractive Errors in Type II Diabetic Patients

Aqsa Malik [1], Aqeel Rasheed[2], Anoosh Qayyum[3] , Gulsanga Khan[4], Muhammad Farooq[1], Maher Mustansar Ali Qasim[5]

Abstract:

Objectives: To evaluate the association between HbA1C levels, duration of diabetes, and refractive errors in patients with type II diabetes mellitus.

Methods: A cross-sectional study involving 200 patients with type II diabetes (400 eyes) was conducted over 3 months at the federal government Polyclinic Hospital. Eye examinations and HbA1C assessments were analyzed using SPSS v21, employing chi-square and regression analyses.

Results: Astigmatism (56%) was the most prevalent refractive error, followed by myopia (29.5%) and hyperopia (14.5%) with higher prevalence in males (52%) and patients aged >50 years (35%). Prediabetic patients exhibited the highest prevalence of refractive errors (62%). The duration of diabetes was significantly associated with refractive error severity ($\chi 2=30.21$, $p<0.001$).

Conclusions: Refractive errors, particularly astigmatism, are prevalent in diabetic patients. Longer duration of diabetes and suboptimal HbA1C levels exacerbate these changes. Routine eye exams and glycemic control are essential to prevent visual impairment. *Al-Shifa Journal of Ophthalmology 2025; 21(1): 29-36. © Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan.*

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Introduction:

According to the International Diabetes Federation, diabetes mellitus is a significant global health concern affecting approximately 537 million adults worldwide [1-2]. Type II diabetes mellitus accounts for more than 90% of these cases and is associated with a range of systemic and microvascular complications, including retinopathy, cataracts, and refractive errors [3]. Refractive errors in diabetic populations are influenced by fluctuations in blood glucose levels. Elevated glucose levels have been shown to cause myopic shifts, whereas lower levels often lead to hyperopic changes, reflecting the osmotic effects of glucose on the lens [4]. A systematic review published in 2019 revealed that transient refractive changes due to hyperglycemia are common in patients with type II diabetes with poor glycemic control, exacerbating these effects [5]. Furthermore, prolonged diabetes duration has been associated with cumulative damage to the lens contributing to progressive refractive changes and an

increased risk of uncorrected refractive errors [6].

Studies conducted in high-income countries have highlighted the burden of refractive errors among patients with diabetes, with prevalence rates of up to 62% [7]. However, research in Pakistan remains limited. This gap is significant given Pakistan's dual burden of a rising diabetes prevalence (estimated at 33 million adults) and limited access to comprehensive eye care services [7]. Factors such as low health literacy, poor glycemic management, and restricted availability of optometric services exacerbate the risk of diabetes-related visual impairments in this population. Despite advancements in diabetes care, the rising incidence of diabetes in Pakistan and the lack of accessible eye care infrastructure necessitate urgent attention. Refractive errors remain a leading cause of visual impairment, but they can be corrected easily if detected early. Moreover, the interplay between blood glucose levels, diabetes duration, and refractive changes underscores the need for regular ocular screenings in patients with diabetes. While global studies have explored the association between diabetes and refractive errors, there is a paucity of data from Pakistan, where the unique socioeconomic healthcare challenges may influence disease patterns. Understanding the prevalence and types of refractive errors in this population, along with their association with glycemic control and diabetes duration, is essential for developing targeted interventions. This study aimed to address this gap and contribute to the growing body of evidence on diabetes-related ocular complications.

The primary aim of this study was to evaluate the prevalence, types, and severity of refractive errors in patients with type II diabetes in Pakistan. Specifically, to assess the association between HbA1c and refractive errors, explore how glycemic fluctuations influence refractive outcomes, and examine the impact of diabetes duration on the severity of refractive errors.

Methodology:

A cross-sectional study was conducted at the federal government Polyclinic Hospital in Islamabad from 1st October to 31st December 2021. A purposive sample of 200 patients with type II diabetes aged 30 years or older was selected. While this sampling method was focused on specific patients, efforts were made to ensure the sample represented the wider population by including diverse age groups, gender, and duration of diabetes typically seen in a general hospital setting. Ethical approval was obtained from the Ethics Committee, and verbal consent was deemed sufficient due to the noninvasive nature of the study, which adhered to the Declaration of Helsinki.

The sample size was calculated using the formula: $n=Z2P(1-P)/d2$ n where $Z=1.96$ (95% confidence level), $P = 0.5$ (assumed prevalence of refractive errors), and $d=0.07$ (margin of error). This generated a minimum required sample size of 196, which was rounded up to 200 for feasibility. The inclusion criteria were type 2 diabetic patients aged ≥30 years with clear ocular media and no history of prior ocular surgery or retinopathy. The exclusion criteria were opaque ocular media, diabetic macular edema, or aphakia to avoid confounding factors affecting refractive error.

A structured questionnaire was used to capture demographic details, diabetes duration, and blood glucose levels. Comprehensive eye examinations included visual acuity assessment (Snellen or E chart for illiterate patients), refraction measurements using autorefractor and subjective refinement, and slit-lamp evaluations. HbA1C was measured by laboratory analysis and categorized per American Diabetes Association (ADA) standards as Normal: HbA1c levels <5.7%, Prediabetes: HbA1c levels between 5.7% and 6.4% and Diabetes: HbA1c levels ≥6.5%.

The data was analyzed using SPSS v21. Descriptive statistics were employed to summarize demographic and clinical

characteristics. The association between categorical variables, such as HbA1c levels, diabetes duration and the prevalence of refractive errors was assessed using the chi-square test. Regression analysis was utilized to explore the relationship between diabetes duration and refractive error severity. The chi-square test was chosen due to its suitability for analyzing categorical data, such as HbA1c ranges and refractive error types. The significant p-value (<0.001) obtained from the chi-square test indicates a strong association between diabetes-related factors and refractive error prevalence. To ensure the reliability of the regression models, key assumptions, including linearity, homoscedasticity, normality, and absence of multicollinearity, were carefully validated.

Results:

Two hundred patients with type II diabetes (400 eyes) were included in the study. The mean age of the participants was 51.09 ± 10.55 years, with male predominance (58.2%). Age significantly influenced the prevalence of refractive errors. The highest frequency of refractive errors was observed in patients aged >50 years (35%), followed by those aged 40–50 years (34%) and 30–40 years (31%). Interestingly, hyperopia was more frequently observed in females, whereas astigmatism was common in both genders. We found astigmatism to be the most prevalent refractive error, affecting 56% of patients, followed by myopia (29.5%) and hyperopia (14.5%). Occupational analysis revealed that teachers (39.5%) and housewives (26%) were the most affected groups, with astigmatism being the predominant refractive error across all occupations. Other occupational groups, including businessmen (9.5%) and physicians (5.5%), showed lower frequencies of refractive errors.

HbA1c was strongly correlated with refractive errors. The highest prevalence (62.5%) of refractive errors was observed in patients in the prediabetic range (5.7–6.4%), whereas astigmatism accounted for 29%. Patients with HbA1c ≥ 6.5% exhibited a prevalence of 36.5%, primarily driven by astigmatism (27%). In contrast, patients with normal HbA1c (<5.7%) exhibited the lowest prevalence of refractive errors (1%). The duration of diabetes was significantly associated with the severity and prevalence of refractive errors ($\chi^2 = 30.21$, $p < 0.001$). Patients with diabetes duration >5 years exhibited the highest prevalence of refractive errors (50%), with astigmatism being the dominant type (33%). In comparison, patients with diabetes duration <2 years had the lowest incidence of refractive errors (25.5%). The progression and severity of refractive errors, particularly astigmatism, were directly proportional to the duration of diabetes.

To further elucidate the relationship between diabetes-related factors and refractive error severity, regression analyses were conducted. Simple linear regression models demonstrated significant independent associations between HbA1c levels and diabetes duration with refractive error severity ($p < 0.05$). These findings were corroborated by multiple linear regression analyses, which adjusted for potential confounders such as age and gender. The adjusted regression models revealed that both HbA1c levels and diabetes duration remained significant predictors of refractive error severity, collectively explaining 75.1% of the variance ($r^2 = 0.751$). For every 1% increase in HbA1c, refractive error severity increased by 0.41 diopters, and for each additional year of diabetes, severity increased by 0.28 diopters.

Table 1: Distribution of Diabetic Patients by Age and Sex

Age Group	Frequency	Percentage (%)
30–40 years	62	31
40–50 years	68	34
>50 years	70	35
Gender		
Male	104	52
Female	96	48

Table 2: Types of Refractive Errors in Patients with Diabetic

Refractive Error	Frequency	Percentage (%)
Myopia	59	29.5
Hyperopia	29	14.5
Astigmatism	112	56.0

Table 3: Association between HbA1c and refractive error

Blood Glucose Level HbA1C (%)	Myopia (%)	Hyperopia (%)	Astigmatism (%)	Total (%)
<5.7	0.5	0.5	0	1
5.7–6.4	23.5	10	29	62.5
≥6.5	5.5	4	27	36.5

Table 4: Severity of Refractive Errors according to Diabetes

Duration of Diabetes	Myopia (%)	Hyperopia (%)	Astigmatism (%)	Total (%)
<2 years	11.5	3.5	10.5	25.5
2–5 years	8	4	12.5	24.5
>5 years	10	7	33	50

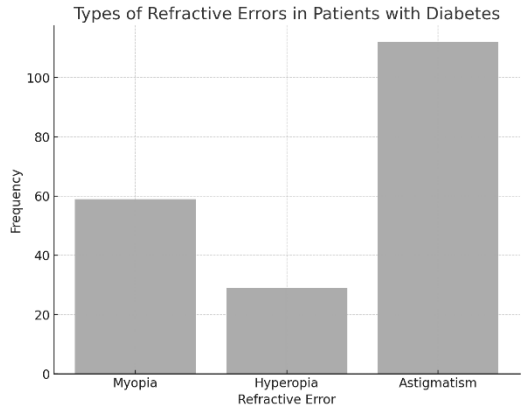

Figure 1

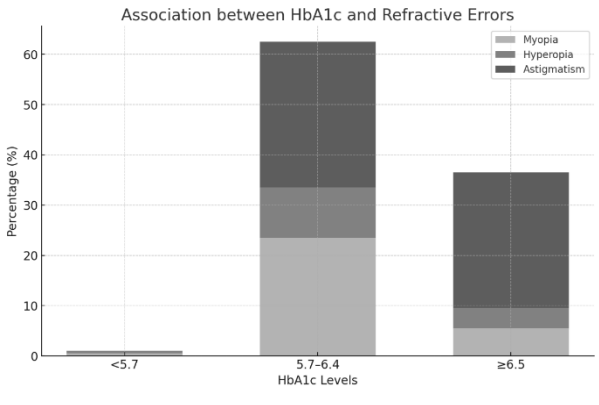

Figure 2

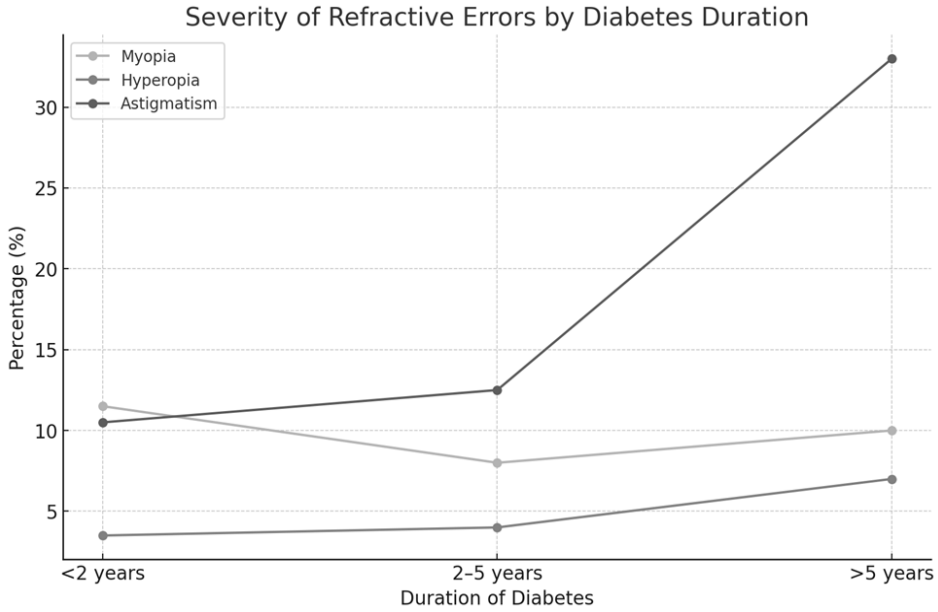

Figure 3

Discussion:

Our study found that astigmatism is the most common refractive error among patients with diabetes, consistent with findings from recent studies conducted in Pakistan and globally [7,8,9]. The high prevalence of astigmatism highlights the critical interplay between diabetes and ocular physiology, particularly alterations in lens and corneal structures driven by glycemic fluctuations. Chronic hyperglycemia influences lens curvature and refractive index, leading to changes in visual acuity [10]. These refractive shifts, especially astigmatism, are intensified in patients with prolonged diabetes duration, consistent with the findings of Sun H et al[11], who documented lens swelling and structural irregularities caused by hyperglycemia.

A significant observation in this study was the association between refractive errors and HbA1c levels, particularly in patients within the prediabetic range (5.7–6.4%). This transitional state of metabolic instability appears to precipitate refractive anomalies, emphasizing the impact of glycemic control on refractive stability. A recent study by Malik et al[9] and Wijesinghe et al[12] reported similar associations, attributing transient refractive errors to fluctuating blood glucose levels. Specifically, myopia often arises during hyperglycemia due to increased swelling of the lens, whereas hyperopia may occur in hypoglycemia or when lens changes are minor. These findings underscore the importance of maintaining optimal glycemic control to mitigate vision-related complications among individuals with diabetes.

Several recent studies have detailed the mechanisms underlying refractive changes in diabetes, with the lens serving as the primary site of glycemic impact. Changes in lens thickness, shape, and refractive index are driven by osmotic stress caused by hyperglycemia [12]. A systematic review by Das T et al [13] highlighted that increased lens thickness, a hallmark of diabetic lens pathology, significantly contributes to refractive instability. The extent of these changes varies among individuals and is influenced by glycemic control, duration of diabetes, and genetic predisposition.

This study observed a higher prevalence of refractive errors in males (52%) compared with females (48%), with astigmatism dominating both genders. Interestingly, hyperopia was more commonly observed among females, consistent with findings by Ahmed et al[7,8] and Zylbermann R et al [14], who attributed this trend to shorter axial lengths and shallower anterior chamber

depths in women. Similarly, age is a significant determinant of refractive error type and severity. Patients aged >50 years demonstrated a hypermetropic shift, aligning with findings from Saleem MI et al[15] and Farooq et al[16], who linked advancing age to increased hyperopia due to reduced lens elasticity and nuclear sclerosis. These age-related shifts underscore the compounded impact of aging and diabetes on refractive status, necessitating targeted interventions for older individuals with diabetes.

The overall prevalence of refractive errors in this study mirrors global trends, with rates comparable to those of studies in South Asia and the Middle East. For example, the prevalence of refractive errors in diabetic populations has been reported to be 58% in Indian studies[13] and 61% in Pakistan [7,8]. Such similarities underscore the universality of refractive complications in diabetes, despite ethnic and geographical differences. However, ethnic variations in refractive error types persist, as highlighted by Farooq et al[16] and Saleem MI et al [15] who observed a higher prevalence of myopia in certain populations. This variability highlights the influence of genetic and environmental factors on refractive outcomes in patients with diabetes.

Glycemic control is central to stabilizing refractive errors in diabetic individuals. Chronic hyperglycemia induces osmotic stress in the lens, thereby altering its refractive properties and leading to transient or permanent changes. Studies by Malik et al[9] and Saleem et al[15] emphasized the reversibility of these changes with improved glycemic control. For example, patients with diabetes transitioning from poor to moderate glycemic control often report a reduction in refractive shift. This highlights the necessity of routine monitoring of HbA1c levels in individuals with diabetes, not only for systemic health but also for maintaining stable vision.

Our study also revealed occupational disparities in the prevalence of refractive error, with higher rates of astigmatism observed among teachers and housewives. These findings may reflect differences in environmental exposure, visual demand, and healthcare access. For example, teachers often experience prolonged near-work strain, potentially worsening astigmatism. Meanwhile, limited healthcare access among housewives may delay diagnosis and treatment, thereby worsening refractive outcomes. These insights align with the findings of Farooq A et al [16], which called for targeted awareness campaigns addressing vision care in high-risk occupational groups.

Uncorrected refractive errors remain the leading cause of visual impairment worldwide. The socioeconomic impact is particularly profound in Pakistan, where untreated refractive errors limit educational and employment opportunities. As emphasized in the WHO's Vision 2020 initiative, addressing Uncorrected Refractive Error (URE) is crucial for alleviating preventable blindness [17]. A study conducted in Lahore quantified the economic burden of refractive errors, estimating annual productivity losses exceeding PKR 20 billion [18]. This highlights the urgent need for accessible and affordable vision care services, particularly for vulnerable populations.

While the study provides valuable insights, it has limitations. This cross-sectional, hospital-based study, conducted without a control group, relied on purposive sampling, which may have introduced selection bias. Hospital-based sampling limits the generalizability of the findings, as it captures a specific subset of the diabetic population—those actively seeking care—who may differ from the general diabetic population in terms of disease severity, healthcare access, and socioeconomic status. The lack of a control group prevents direct comparisons between diabetic and non-diabetic individuals, which could have clarified the unique contributions of diabetes to refractive errors. The small

sample size might also not fully represent the broader diabetic population, further limiting generalizability. Additionally, factors such as systemic hypertension, dyslipidemia, and genetic predispositions were not assessed, which may act as confounding variables.

Despite these limitations, the study emphasizes the importance of routine eye examinations in diabetes management, particularly for patients with poorly controlled diabetes or prolonged diabetes duration. Refractive errors like astigmatism are common in people with diabetes and can worsen with poor blood sugar control or longer diabetes duration. Monitoring HbA1c levels and maintaining good glycemic control can help prevent or stabilize these vision problems, especially in prediabetic individuals.

The study's results could inform vision screening programs in diabetic populations by identifying high-risk groups, such as individuals with poorly controlled blood sugar or long diabetes duration. Screening initiatives could prioritize these populations, ensuring early detection and timely correction of refractive errors. Targeted interventions, such as workplace vision screenings for teachers and improved healthcare access for housewives, could address occupational disparities. Public health efforts should focus on providing affordable vision care and raising awareness about diabetes-related eye health. Integrating routine vision screenings into diabetes management programs could enhance outcomes by preventing vision loss and improving quality of life.

Conclusion:

We found that refractive errors, particularly astigmatism, are highly prevalent among patients with type II diabetes. Prolonged diabetes duration aggravates refractive changes. Public health initiatives should focus on routine screenings and glycemic control to reduce visual impairment.

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ORIGINAL ARTICLE

Comparative Analysis of Academic Performance of Medical Students with Eye Diseases and Healthy Eyes

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Abstract:
Objectives: To examines the relationship between ocular diseases and academic performance among medical students.
Methods: Conducted as an observational comparative study at Mohiuddin Teaching Hospital, data were collected through questionnaires completed by a consultant ophthalmologist, alongside academic grades provided by the medical education department.
Results: A total of 418 medical students participated. The results show no statistically significant association between ocular disease and student grades, with a p-value of 0.267, indicating that any observed differences were likely due to chance.
Conclusion: The study suggests that factors other than eye health may play a more critical role in academic success for medical students. However, the study is limited to a single institution, and the findings should not be generalized without further research across diverse populations and settings. *Al-Shifa Journal of Ophthalmology 2025; 21(1): 37-42.*

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Introduction:

The maintenance of perfect health status in general and eye health, in particular, is pivotal in the undergraduate years of medical students. While students in general need to have sound health[1] medical students in particular should be at the peak of perfect health status[2] since the absorptive learning at this stage affects their professional skills in later life. Medical students tend to be involved in very long study hours which puts the well-being of their eyes at stake[3] and in the long run, affects their learning and social abilities[4].

Even the students aspiring to get enrolled in medical school have been engaged in much arduous study, the result being compromised eye health. Headache due to eye strain is one very common symptom noted among medical students very obvious outcome of straining, with the eyes having a challenged status[5]. . Some students report undefined musculoskeletal pains[6] which may also be due to eye strain and inadequate posture adoption to gain optimum sight of the reading material. The use of masks during hospital visits and operating room rotations has been

postulated to be the cause of dry eye in many retrospective studies- however a study in Jordan negated its association with dry eye among medical students[7]

Refractive errors top the list of eye diseases among medical students; however, it is adequately treatable. With the advent of the use of information technology in the study designs, long hours in front of screens have popped new disease entities among this specific age group: Dry eye disease, and asthenopia which were previously common among middle-aged individuals are now being increasingly reported among students in general and medical students in particular.

Studies have shown that among primary school students, the presence of refractive errors was associated with low academic performance[8]. In a study in China, myopic children were shown to be poorer at performance than emmetropes[9]. Another study demonstrated that those students who wear refractive corrections perform better than those who go unaided pointing out the importance of identification and timely treatment of the disease[10].

Refractive errors are the most common cause of treatable blindness worldwide, the other diseases being cataracts, age-related macular degeneration, and diabetic retinopathy[11].

The high prevalence rate of refractive errors and other diseases among medical students warrants studies[12] to look into the factors causing them so as to benefit the students and authorities of medical schools to provide a conducive learning environment so that the global burden of eye disease in young individuals can be offloaded to whichever extent possible.

Methodology:

This is an observational comparative study carried out in the ophthalmology department of Mohi-ud-din Teaching Hospital after approval from the ethical review board of Mohi-ud-din Islamic Medical College. The sampling technique employed was non-probability consecutive sampling. All the medical students who gave consent were included in the study. The data were collected on a questionnaire that was filled by a consultant ophthalmologist (at least three years of post-fellowship experience) and students' grades were entered, the data of which were provided by the medical education department. All medical students of both genders were included in the study. Those who refused were excluded from the study. The data was analyzed on SPSS version 21.0 by a qualified statistician. Mean and standard deviations were calculated for quantitative variables i.e. age. Qualitative variables like gender, class, grades, and eye diseases were expressed as frequencies and percentages.

Results:

The results show that gender distribution shows a stable pattern with more female students. Total of 134 males and 284 females (Figure I) with the mean age of 19.24 ± 1.031 years (1st year), 20.39 ± 0.937 years (2nd year), 21.29 ± 1.023 years (3rd year), 22.27 ± 0.873 years (4th year) and 23.24 ± 1.043 years (5th year) participated in the study. The p-value of 0.267 indicates that there is no statistically significant association between ocular disease status and student grades (Table 1). Typically, a p-value less than 0.05 is considered significant, so a p-value of 0.267 suggests that any observed differences are likely due to chance rather than a meaningful association. The lack of statistical significance (p-value = 0.267) implies that ocular disease status does not have a significant impact on students' grades. The academic performance of students does not significantly vary based on whether they have an ocular disease or not (Table 2). The proportions of students with ocular disease and healthy eyes are fairly consistent across the different grade categories (Table 3).

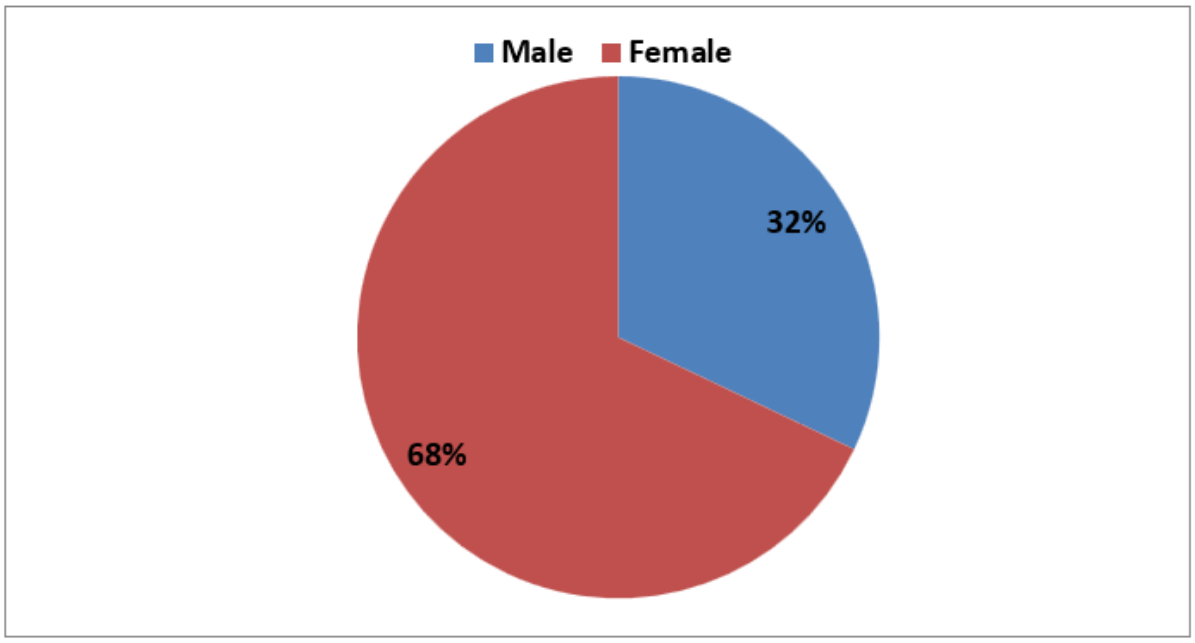

Figure 1: Gender Distribution in this study

Table 1: Association of status of Ocular disease and grade of student

Grade	Ocular Disease Status		Total	P-value
	Ocular Disease	Healthy Eyes		
Grade A- (70-84%)	55	67	122	0.267
Grade B (55-69%)	68	121	189	
Grade F (< 50%)	48	69	117	
Total	171	257	428	

Table 2: Association of different ocular diseases with Grades of Students

Ocular disease	Grade			Total	P-value
	Grade A- (70-84%)	Grade B (55-69%)	Grade F (< 50%)		
VISUAL LOSS					
Yes	26	39	24	89	0.986
No	96	150	93	339	
PAIN					
Yes	15	29	16	60	0.745
No	107	160	101	368	
ITCHING					
Yes	22	38	25	85	0.806
No	100	151	92	343	
RED EYE					
Yes	2	14	8	24	0.077
No	120	175	109	404	
Total	122	189	117	428	

Table 3: Association of Ocular Diseases with grades of students

Ocular Disease on Screening	Grade			Total	P-value
	Grade A- (70-84%)	Grade B (55-69%)	Grade F (< 50%)		
Healthy Eyes	67	121	69	257	0.841
Myopia	37	42	30	109	
Allergic Conjunctivitis	2	4	2	8	
Astigmatism	6	6	2	14	
Dry Eye	2	1	4	7	
Blepharitis	0	1	2	3	
VKC	0	1	0	1	
Convergence Insufficiency	1	5	3	9	
Color Blindness	1	1	1	3	
Myopia + Dry Eyes	1	2	1	4	
Myopia + Meibomianitis	2	3	2	7	
Astigmatism + Myopia	3	2	1	6	
Total	122	189	117	428	

Discussion:

The relationship between vision and academic performance at various educational levels has been the field of interest of many pediatricians and eye specialists for a long time, with special emphasis on visual factors associated with learning problems, while a lot of studies have been conducted in school students to find its association and obtained various results, our study specifically aimed to delve into this aspect among medical students. Among high school students it was noted in a study that the average score of academic results before the intervention was 56.39 ± 13.24 which was increased to 60.27 ± 14.94 after the intervention while in the private sector, before the intervention, the average score was 63.53 ± 17.50 which was improved to 67.12 ± 18.48. It was found to be statistically significant at *p*-value < 0.05[13]. Hence, the application of refractive correction led to the improvement of results which indicates refractive errors do have an impact on the academic performance of students. However, for medical students in our study, no significant association was obtained.

High school students who do not wear refractive corrections perform poorly. Not wearing spectacles was due to poor socioeconomic background. However, when correction was provided, those students showed a boost in their performance[14].

A study carried out in China showed that students who had poor vision performed better than those with better vision. Reading in bed, insufficient sleep, and screen time during weekdays and weekends were associated with higher odds of poor vision[15]. Since these factors were not taken into account for our study, newer studies could be aimed at finding an association between these factors and vision-related pathologies. Psychological stress is reported to be the cause of dry eye exclusively in medical students in a study carried out in Korea[16] however no association with grades was established.

A study on medical students in Nepal posits myopia to be the most common eye disease among medical students[4] however no association with academic performance has been investigated. In the literature cited above, no single and precise determinant of

academic performance has been determined. Our study has clearly proved that no association exists between eye disease and academic performance among medical students.

There could be other determinants of academic performance[17] among students other than medical issues[18] which could be researched. This study has the limitation of being localized to only one university of a specific area, where many environmental and social factors could interplay to affect the students: so, these results are not recommended to be quoted as a generalization.

Conclusion:

There is no association of any sort between the academic performance of medical students and eye disease of any type. Eye diseases do occur among the students at a significant frequency however, they do not affect the grades of the students. Students, in significant numbers, are, however, noted to have refractive errors which have an increasing trend in consecutive medical years connoting a need to investigate the cause, if any.

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ORIGINAL ARTICLE

Comparison of Aberrations in Corneal Topography Between Young Adults with More Than 1 Diopter Versus Less Than 1 Diopter Astigmatism

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Abstract:

Objectives: To evaluate the impact of anterior segment parameters and high-order and Low-Order aberrations on visual quality in young adults with different astigmatism levels using corneal topography.

Methods: The research was approved by the Ethical Review Board of the College of Ophthalmology and Allied Vision Sciences, Mayo Hospital (Ref # 1620/2023). The study was conducted on patients visiting Mayo Hospital, Lahore, with a sampling size of 74 eyes (34 in each group). Patients with > ± 1D astigmatism (study group) and < ± 1D astigmatism (control group) were recruited. Corneal astigmatism, keratoconus indices, keratometry findings, anterior segment parameters, high-order aberrations, and low-order aberrations were assessed and compared between groups. These parameters were measured using Sirius corneal Topography. All dependent and independent variables were considered. Data were entered and analyzed using SPSS 27.0. A P value ≤ 0.05 was considered significant.

Results: Thirty-seven eyes of 37 young adults and 37 eyes of 37 children were analyzed. The mean astigmatism was -2.3776 ± 2.25034 and -0.3878 ± 0.29369, respectively. Total corneal astigmatism was -3.03 ± 1.73 and -0.44 ± 0.25 diopters. Significant differences were seen in keratoconus-indices, mean corneal-thickness, high-order-aberrations (HOAs) and low-order-aberrations (LOAs), and visual quality were observed between the groups between.

Conclusion: Young adults with ± 1D astigmatism showed higher corneal astigmatism, thinner mean CT, and increased keratoconus indices, with higher HOAs and LOAs. *Al-Shifa Journal of Ophthalmology 2025; 21(1): 43-49. © Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan.*

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Introduction:

Optometrists and ophthalmologists must analyze corneal topography, anterior segment, aberrations, and astigmatisms to improve visual quality, as refractive errors can affect Visual acuity due to complex optical system defects[1]. Astigmatism is a refractive error that has a significant impact on the eye's optical characteristics[2]. Past studies have looked at the anterior region, corneal topography, and higher-order aberrations (HOAs) in children who have astigmatism > 2D [3]. Corneal topography is a non-invasive technique used to measure the shape and curvature of the cornea, crucial for refractive surgery and contact lens fitting, to assess visual perception. Visual quality includes not only sharpness but also sensitivity to contrast, an impression of depth, and the perceptual experience as a whole [4]. The ability of the

eye to concentrate light onto the retina is crucial to the sharpness of human vision. However, there are a number of factors that may affect the eyes optical skills, leading to distorted or blurred vision. Scheimpflug imaging, ultrasonic biomicroscopy, slit-lamp biomicroscopy, and anterior segment optical coherence tomography are all methods that fall under the umbrella of anterior segment imaging. Scheimpflug imaging is a corneal topography technique that uses a spinning camera to measure anterior segment parameters like central corneal thickness, anterior chamber depth, white-to-white distance, and pupil size. These factors are vital for several eye diagnoses, including glaucoma, cataracts, keratoconus, and the probability of angle closure, as well as for selecting the best intraocular lens implant and deciding if refractive surgery is necessary[5]. Astigmatism is a refractive error that occurs when the cornea or the lens has an irregular shape that causes light rays to focus at different points on the retina. Astigmatism, a condition affecting the corneal topography, anterior segment, and HOAs, can cause blurred vision, eye strain, headaches, and reduced contrast sensitivity in individuals of all ages. The uneven shape of the cornea causes corneal astigmatism, the irregular shape of the lens causes lenticular astigmatism, and a blend of the two causes mixed astigmatism [6]. The optical quality of the eye is also affected by the presence of aberrations, which are deviations from the ideal wavefront of light that passes through the eye [7]. Corneal topography assesses complex aberrations and affects visual quality. Poor illumination leads to worsening vision, causing symptoms like gloss, halos, starbursts, diplopia, and diminished contrast sensitivity.[7] Corneal abnormalities, trauma, illness, or surgery cause higher-order aberrations, while most visual impairments are low-order aberrations caused by uneven corneal curvature, which are easily corrected with corrective lenses.[8] Aberrometers are instruments that measure high-order and low-order aberrations by capturing and analyzing the form and abnormalities of the eye's optical system using wavefront technology.[9] Wave front technology focuses on the unique three-dimensional shape of a uniform wave front of light, governed by eye optical properties and Zernike polynomials. High-order aberrations (HOAs) are subtle optical system aberrations that affect vision clarity and accuracy. They can cause vision impairments like diminished contrast perception, double vision, halos, starbursts, excessive glare, and blurred vision.[10] Myopia, hyperopia, and astigmatism are examples of low-order aberrations (LOAs) that may coexist alongside higher-order aberrations (HOAs). Despite extensive research on corneal topography and refractive errors, prior studies have predominantly focused on children or individuals with high degrees of astigmatism (>2D), leaving a gap in understanding how moderate astigmatism (> ±1D) affects anterior segment characteristics and optical aberrations in young adults. Furthermore, while studies have examined high-order aberrations (HOAs) in various refractive conditions, their direct impact on visual quality, particularly in individuals with mild to moderate astigmatism, remains underexplored. Additionally, most previous research has not sufficiently addressed whether habitual spectacle prescription significantly improves visual quality in such cases. This study fills this gap by providing a detailed comparative analysis of anterior segment parameters, HOAs, and LOAs in young adults with different astigmatism levels, contributing to a more comprehensive understanding of their clinical implications.

Methodology:

The study was approved by the Ethical Review Board of the College of Ophthalmology and Allied Vision Sciences, Mayo Hospital (Ref # 1620/2023). The study was conducted on

patients visiting Mayo Hospital, Lahore, Sample size was calculated using a formula with a significance level (α) taken as 5%. Power of the study was (1-β): 80%. A sample size of 74, with 34 patients in each group was taken. with astigmatism > ± 1D (study group) and < ± 1D astigmatism (control group) were recruited.[3] Corneal astigmatism, keratoconus indices, keratometry findings, anterior segment parameters, high-order aberrations, and low-order aberrations were assessed and compared between groups. These parameters were measured using , Sirius Corneal Topography. All dependent and independent variables were considered. Data were entered and analyzed using SPSS 27.0. A P value < 0.05 was considered significant. The exclusion criteria include corneal scars, epithelial healing issues, previous ocular infections, pregnancy/breathing, previous corneal surgery/cross-linking, and other ocular diseases affecting corneal shape or quality.

Results:

A total of 37 young adults participated in the study group and 37 in the control group, with each group having 37 eyes. The mean astigmatism was -2.3776 ± 2.25034 and -0.3878 ± .29369 in the study and control groups, respectively ($p < 0.05$). The study found that corneal astigmatism was -3.03 ± 1.73 diopters in study group and -.44 ±.25 diopters in the control groups This difference was statistically significant ($p < 0.05$).

There was a notable disparity among the groups in the keratoconus indices, namely Sif (symmetry index front) in Diopters SIB (Symmetry Index Back) in Diopters, KVF (keratoconus vertex front) in Microns, KVB (keratoconus vertex back) in Microns, Bcvb (Baiocchi Colossi Versaci Back) in Diopters, BCVF (Baiocchi Colossi Versaci Front) in Diopters and Sim-k (simulated keratometry) in Diopters. When considering anterior segment factors, the average corneal thickness (CT) varied significantly between the groups. The data analysis was performed using SPSS 27.0 with a significance level set at $p \leq 0.05$. Independent Samples t-test – To compare the means of continuous variables.

Data analysis was conducted using SPSS 27.0, with a significance level of $p \leq 0.05$. Independent Samples t-tests were performed to compare the means of continuous variables across Tables 1, 2, and 3. Additionally, a Chi-square test was used for categorical data presented in Table 4.

Table 1: Keratometry values and Keratoconus indices

Keratometry Values and Keratoconus Indices				
		Mean	Standard Deviation	p-Value
Symmetry index front (Diopters)	Study Group	2.37	5.01	.008
	Control Group	.11	.40	
Symmetry index back (Diopters)	Study Group	.59	1.19	.002
	Control Group	-.02	.11	
Keratoconus vertex front (Microns)	Study Group	19.48	19.52	<.001
	Control Group	3.37	.92	
Keratoconus vertex back ((Microns)	Study Group	42.59	43.74	<.001
	Control Group	12.48	3.70	
Baiocchi colossi versaci front (Diopters)	Study Group	1.66	2.26	<.001
	Control Group	.15	.13	
Baiocchi colossi versaci back (Diopters)	Study Group	1.54	2.24	<.001
	Control Group	.07	.13	
Simulated keratometry (Diopters)	Study Group	46.07	3.80	<.001
	Control Group	43.87	1.10	

Table 2: Anterior Segment Parameters

ANTERIOR CHAMBER PARAMETERS				
		Mean	Standard Deviation	p-Value
Anterior Chamber Depth (mm)	Study Group	3.22	.34	.692
	Control Group	3.19	.26	
Pupil Diameter (mm)	Study Group	.26	.12	.025
	Control Group	.20	.10	
Anterior Chamber Width (mm)	Study Group	12.42	1.05	.007
	Control Group	11.90	.44	
Anterior Chamber Angle (Degree)	Study Group	42.70	6.02	.78
	Control Group	44.94	4.66	
Central Corneal Thickness (mm)	Study Group	.47	.07	<.001
	Control Group	.53	.02	
White-To-White Distance (mm)	Study Group	12.19	.34	.325
	Control Group	12.12	.27	
Corneal Astigmatism (Diopters)	Study Group	-3.03	1.73	<.001
	Control Group	-.44	.25	
Corneal Astigmatism Axis (Degree)	Study Group	94.62	72.60	.894
	Control Group	96.75	64.15	
Anterior Chamber Depth (mm)	Study Group	3.22	.34	.692
	Control Group	3.19	.26	

Table 3: Mean, SD and P value of High-Order Aberrations (HOAs)

Higher-Order Aberrations Parameters				
		Mean	Standard-Deviation	p-Value
RMS High-orderAberrations (microns)	Study Group	0.9335	0.96684	<0.01
	Control Group	0.2405	0.06240	
Comma Aberrations (microns)	Study Group	0.7270	0.92374	<0.01
	Control Group	0.1354	0.05743	
Spherical Aberrations (microns)	Study Group	0.1535	0.13730	0.59
	Control Group	0.1327	0.10057	
Residual Aberrations (microns)	Study Group	0.4665	0.40640	<0.01
	Control Group	0.1511	0.5924	

Table 4: Visual Quality Assessment

Visual Quality Assessment								
		Not at all Satisfied	Rarely Satisfied	Sometimes satisfied	Often satisfied	Extremely Satisfied	Total	p-Value
Clarity of Vision	Study Group	08	10	08	06	05	37	<0.001
	Control Group	06	07	02	05	17	37	
Colour Perception	Study Group	00	07	11	13	06	37	<0.001
	Control Group	00	07	00	05	25	37	
Overall Visual Comfort	Study Group	00	07	08	05	17	37	<0.001
	Control Group	00	07	04	08	17	37	

Discussion:

A comparative cross-sectional study was conducted to assess keratometry values, keratoconus indices, high-order aberrations, low-order aberrations, and quality of vision in individuals with >1D astigmatism and emmetropes or those with <1D astigmatism. The study included 74 eyes that were divided into two groups: the study and control groups. The study group had a mean SIf of 2.37, whereas the control group had a mean KVb of 19.42. The study group also had a mean BCVb of 1.66 and a mean SimK of 46.07. The study also evaluated anterior chamber parameters, such as the anterior chamber depth, pupil diameter, anterior chamber width, anterior chamber angle, central corneal thickness, white-to-white distance, corneal astigmatism, and Corneal Astigmatism Axis. [11]

The study found that the anterior chamber in hyperopes is shallower than that in myopes and hyperopes.[12 13]The study group had a mean Corneal Astigmatism Axis of 94.62 and for control group it was 96.75. The study also found that myopic astigmatism had more negative Y-trefoil and positive vertical coma, along with more oblate nasal and temporal corneal morphologies.[14, 15] High-order aberrations were found to be associated with all types of refractive errors, with a notable increase in spherical aberration in the hypermetropia group.[16] The cornea-induced high-order aberration is limited in normal corneas and regular refractive errors.[12, 17]

This study aimed to assess the quality of vision in young adults aged 18-35. The participants were categorized into two distinct groups: the study and control groups. Among the 74 participants, 38 were men and 36 women. The study population consisted of 21 males and 16 females. The control group consisted of 17 males and 20 females. The age cohort consisted of individuals aged 18–35 years.

The study group had a higher frequency of blurriness than the control group, with 5 individuals experiencing blurriness persistently. The control group consisted of 36 participants: most reported, occasional impaired vision and only one reported persistent hazy vision. The study group had a higher frequency of both diplopia and ocular fatigue than the control group.[18]

High-order aberrations were assessed and compared between the two groups, with astigmatism linked to high-order aberrations.[12] The study group experienced

halos more often, whereas the control group never experienced them.[19, 20] The low-order aberrations were also evaluated, with 33 participants experiencing blurriness more often than the control group.[21] The study group had more difficulty with focusing and distortions in peripheral vision, whereas the control group had less difficulty.[22]

The quality of vision was also assessed; among the participants in the study group, eight were dissatisfied with their vision acuity, ten were occasionally dissatisfied, eight were occasionally satisfied, six were frequently satisfied, and five were always satisfied.[23]

Conclusion:

Young adults with ± 1D astigmatism showed higher corneal astigmatism, thinner mean CT, and increased keratoconus indices, with higher High-order aberrations (HOAs) and low-order aberrations (LOAs).

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ORIGINAL ARTICLE

Corneal Curvatures, Anterior Chamber Depth and Axial Lengths in Pakistani High Myopic Cases

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Abstract:

Objectives: To determine correlations between the myopia and the Axial Length of the eye and the values of other ocular biometrics like corneal curvature and anterior chamber depth in high myopic patients of Pakistan.

Methods: Total 77 patients with refractive error of more than -5.00 D were included in this cross-sectional study. Ocular biometrics like axial length, keratometric readings and anterior chamber depth were documented. Axial lengths of eyes were measured by A-scan Ultrasonography. The mean value and ranges of ocular biometrics were calculated. Data was analyzed using SPSS version 22.

Results: Mean axial length of study participants was 26.3895±1.54274 mm, ranging from 21.56 mm to 29.21 mm. Mean keratometric values were (K1 of 44.41 D and K2 of 45.36 D). Our results showed no significant association between Axial Length (AL) and Anterior Chamber Depth **(**ACD), 2.998± 0.47680 with $p > 0.05$.

Conclusion: Myopia progression was directly associated with axial length. However, there is no statistically significant relationship of keratometric values and Anterior Chamber Depth **(**ACD) with severity of myopia. *Al-Shifa Journal of Ophthalmology 2025; 21(1): 50-55. © Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan.*

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Introduction:

Refractive errors are the leading cause of progressive painless deterioration of vision in children and young adults[1]. Myopia is reported to be the most common refractive error in Pakistani population[2]. It is becoming an alarming pandemic and 2.5 billion people could be affected worldwide by myopia by the end of this decade[3].It is paramount to closely monitor high myopia due to its association with irreversible sight threatening complications[4].Some of the most common complications are retinal detachment, glaucoma and myopic maculopathy[5].

High myopia is generally defined as myopia of -5.00 diopters or higher[6]. The prevalence of high myopia has been increasing over the last several decades, particularly in developed countries[7]. The reason is multifactorial.

High myopia and its association with axial length(AL) and other biometric components has fascinated the clinicians

from many years .Many studies on ocular components and growth of eye revealed that myopia is associated with long axial length[8]. Hassan Hashemi et al noted that strong correlation exist between corneal power and axial length in high myopic individuals[9]. Cornea have significant role in refraction of eye and corneal curvature CC has inverse association with AL[10].Determination of these parameters is helpful to ophthalmologists for management of refractive errors. Refractive state of eye thus depends on balance between eye size and its refractive components i.e., lens and cornea[11]. Axial length is major contributor of refractive error and is sum of anterior chamber depth (ACD), lens thickness and vitreous chamber depth. Higher axial length increase myopia but at the same time flatter cornea decrease refractive error[12].There is positive correlation between AL and ACD in myopic eyes[13].

Goal of our study is to measure ocular biometrics such as axial length, corneal curvature and anterior chamber depth and also study their mean and ranges in high myopic patients in Pakistani population.

Methodology:

This Observational cross-sectional study was conducted at Department of Ophthalmology, HBS medical and dental college, Islamabad from May 2017 to May 2024 after taking approval from the ethical review board of institution.77 Patients of an age with refractive error greater than -5D were included through non probability consecutive sampling technique. Patients with any pathology in eye causing induced myopia e.g., nuclear cataract were excluded**.** After inclusion in the study, patients were examined on slit lamp to rule out any other ocular disease. The patient's axial lengths of eyes were measured by A-scan Ultrasonography or by optical biometry (OA 2000 Tomy) in the hospital after taking their consent. Their keratometric values and anterior chamber depths were also noted.

Data were analyzed using IBM SPSS Statistics version 22. Descriptive statistics, including mean, standard deviation, minimum, and maximum values, were used to summarize ocular biometric parameters such as axial length, keratometric values (K1, K2), and anterior chamber depth (ACD).

To assess the relationship between axial length and other biometric parameters, an independent samples t-test was conducted by categorizing patients into two groups based on their autorefraction (AR) values: mild to moderate myopia (0 to -10 D) and high myopia (-10.1 to -30 D). The significance level was set at $p < 0.05$.

Pearson's correlation analysis was performed to evaluate the association between axial length and anterior chamber depth, as well as between axial length and keratometric values (K1, K2). A p-value of less than 0.05 was considered statistically significant for all tests.

Results were presented in the form of tables and figures, with confidence intervals (95%) provided for the independent t-tests to assess the precision of mean differences.

Results:

A total of 77 patients were included in this study with a mean age of 18.75 and a standard deviation of 7.635.

36.3 %(n=28) of the study population were males and 63.6 %(n=49) were females. This is shown in figure 1.

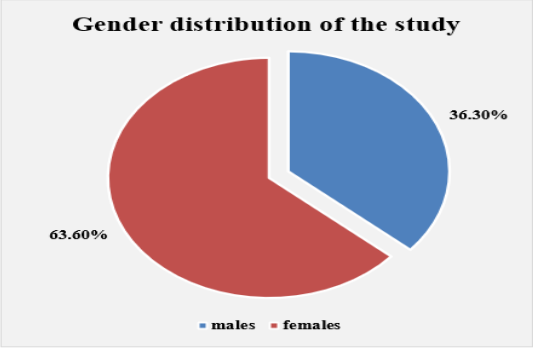

Figure 1. Gender distribution of the

Table 1. Best-corrected Vision in High Myopes

BCVA	Frequency	Percent
6/6	11	14.2%
6/9	8	10.3%
6/12	14	18.18%
6/18	12	15.58%
6/24	7	9.09%
6/36	6	7.79%
6/60	3	3.89%
CF	16	20.77%
Total	77	100%

Results:

The mean value of autorefraction (AR) was -11.1149 with a standard deviation of 3.78863. The maximum AR value recorded was -23.00, while the minimum was -6.00, resulting in a range of -17.00.

For keratometry (K) values, the mean K1 was 44.4066 with a standard deviation of 2.22596, a minimum value of 40.47, and a maximum value of 55.19. The mean K2 was 45.3631 with a standard deviation of 2.75899, ranging from 40.97 to 60.87.

The axial length measurements showed a mean value of 26.3895 with a standard deviation of 1.54274. The shortest recorded axial length was 21.56, while the longest was 29.21. The anterior chamber depth had a mean of 2.9981 with a standard deviation of 0.47680, with observed values ranging from 1.98 to 4.22.

To analyze the relationship between AR and axial length, AR values were categorized into two groups: one group included patients with AR values ranging from 0 to -10, while the second group comprised patients with AR values between -10.1 and -30. An independent samples t-test was conducted to compare axial length between these two groups, revealing a statistically significant relationship between high myopia and axial length ($p < 0.05$). This finding suggests that axial myopia is a predominant characteristic among highly myopic patients in our study population. The detailed statistical results of the t-test are presented in Table 2.

An Independent samples t-test was then applied between the two groups of AR and Anterior chamber depth. The result is shown in Table 3

Table 2. Independent Samples t-test between auto refraction (AR) and axial length

Variable	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
Axial Length	4.671	75	0.001	1.46534	0.31368	0.84046 – 2.09021

Table 3. Independent Samples t-test between AR and Anterior chamber depth

Variable	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
Anterior chamber depth	1.592	75	0.116	0.17242	0.10834	0.04339 – 0.38824

Discussion:

The relationship between axial length and myopia severity has been well-documented. In our study, a significant relationship (p value 0.001) was observed between axial length and the severity of myopia, with a mean axial length of 26.3895 mm (SD = 1.54274), ranging from 21.56 mm to 29.21 mm. These results are comparable to the findings reported in the study by Zafar et al. (2023) where the mean axial length in myopic patients was found to be 25.68 mm (SD = 1.63) for individuals with moderate myopia, increasing to 27.14 mm (SD = 1.57) for those with high myopia[14]. Arora et al (2019) and Herb EN (2019) study similarly documented the relationship between axial length and refractive error, noting an increase in axial length with higher myopia, supporting the premise that axial length is a critical biomarker for assessing and managing myopia severity[15,16].

The mean keratometric values (K1 of 44.41 D and K2 of 45.36 D) in our study were within the typical range for myopic patients. However, unlike axial length, keratometric readings did not show a statistically significant relationship with the severity of myopia. According to Zhang et al, (2023), myopes typically exhibit steeper corneal curvatures compared to emmetropic and hyperopic individuals. The study reported that myopic patients had a significantly larger average corneal curvature with a mean difference of 0.253 D (95% CI, 0.089 to 0.417 D; $p < 0.001$)[17]. Interestingly, Sun et al. (2023) found that while corneal curvature plays a significant role in the management of myopia, the amount of corneal refractive change did not directly correlate with the degree of myopia18. Their study emphasized that axial length, rather than keratometry, was a more reliable indicator for assessing the efficacy of myopia control. In terms of anterior chamber depth, our results showed no significant association between AR and ACD 2.9981 (SD =0.47680 $p > 0.05$). A study by Aziz JH (2020) on the correlation between axial length and anterior chamber depth, which evaluated a diverse range of subjects, found a statistically significant inverse relationship between ACD and axial length across various subgroups[19]. Specifically, the study showed that as axial length increased, ACD decreased significantly, suggesting a consistent pattern in myopic eyes ($p < 0.001$). This finding contrasts significantly with the results from Dogan et al. (2019), who reported a mean ACD of 3.94 ± 0.22 mm for myopic population[20]. This could be attributed to differences in population demographics, genetic predisposition, and environmental factors that affect anterior segment parameters. Similarly, in the study titled "Distribution of White-to-White Corneal Diameter and Anterior Chamber Depth in Chinese Myopic Patients," the mean ACD was significantly higher than in our findings[21]. This study reported a mean ACD of 3.64 ± 0.25 mm, showing a stronger relationship between ACD and myopia in their cohort. The study also highlighted that a deeper anterior chamber may contribute to the development of myopia, although this trend was not evident in our results.

The study has many limitations first it is cross sectional and comprised only myopic subjects, and ocular biometrics may differ from those of hyperopic and emmetropic subjects. Second, only the subjects of a single center were included in the study, and all of the participants were Pakistanis, this may limit the generalizability of our results. Regardless of these limitations, our results clearly provide information about axial length, anterior chamber depth, corneal curvature and their intercorrelations and the results are of great value for ophthalmologists and may provide insight into the mechanism underlying ocular biometrics in high myopic patients.

Conclusion:

In line with both regional and global research, our study concluded that axial length is a crucial factor in determining the

severity of myopia. Although our cohort's anterior chamber depth and keratometric values did not significantly correlate with Autorefraction, more studies in bigger populations are necessary to fully comprehend the significance of anterior segment parameters in the progression of myopia.

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