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Refractive Status Occurrence and Correlation with Anthropometry and Ocular Biometric Parameters In Students in North Indian University

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ABSTRACT
Refractive error, a problem that is easy to detect and treat, continues to be a major contributor to preventable visual impairment in today's society. It is considered as the second most common cause of blindness in India after cataract. The aim of the present study was to ascertain the refractive status and its correlation with anthropometry and ocular biometric parameters in Students in North Indian University. All study participants (18-to-25-year students) were screened for their refractive status using Snellen's chart, distant and near vision. Refractive error was measured and graded according to spherical equivalent power. Distance Jaeger's chart was used for near vision. Retinoscopy was performed to determine the refractive error, along with phoropter refraction/ subjective refraction., to ascertain the presence and degree of myopia, hyperopia, or emmetropia. Corneal curvature, Anterior chamber depth and Axial length were measured by IOL Master and Central cornea thickness was measured by ultrasonic pachymeter. The results were analyzed using T-test, correlation and multi variate linear regression to identify mean values and assess correlation between the specific anthropometric measurements and ocular biometric parameters. All variables were summarized by descriptive statistics followed by correlation testing by Pearson's Correlation Coefficient r. Our study concluded that myopia was the most prevalent refractive error in medical students with 63% being myopic. Prevalence of ametropia, hypermetropia and Astigmatism was found at 33%, 1% and 3 % respectively. The Grading of Low, Moderate and High myopia was found to be approx. 60%, 33.3% and 6.1% respectively. Approx. 23% of respondents with myopia had positive family history (history of one or both the parents having refractive errors), whereas 77 % of myopic cases did not give any family history of refractive error. Axial length was found positively correlated in myopia cases {Pearson's Correlation Coefficient 'r' value was 0.56 (rt), 0.58 (lt)}and was found to have increased in myopic respondents compared to ametropic respondents. Negative correlation was found between central corneal thickness and corneal curvature in our study across the different refractive errors in our study. No Significant Correlation was found between BMI and myopia in our study. Fair correlation was observed between BMI and Emmetropia, however no statistically significant correlation between BMI and Hypermetropia and Astigmatism was found in our study. The study concluded that myopia was the most prevalent refractive error in students in the identified university in north India followed by prevalence of emmetropia, hypermetropia and astigmatism respectively. A significant percentage of respondents had positive family history of myopia. Positive correlation was seen between axial length with myopia. No statistically significant correlations were observed of anthropometric indicators with Hypermetropia and Astigmatism.

INTRODUCTION

Refractive errors emerge as the leading cause of visual impairment as well as the second leading cause of vision loss globally, accounting for about 43% of visual impairment with approx. 88.4 million cases1 worldwide. The prevalence of Uncorrected Refractive Errors (URE)-related vision problems ranges from 12.3-57.1%[1]. 6.8 million cases of blindness and 101.2 million cases of visual impairment in 2010 were attributed to uncorrected refractive errors[2]. In India, 2.69 million adults aged 16-39 years suffer from uncorrected refractive errors, with an age-related prevalence of 0.63%[3]. Anthropometric variables have been shown to influence the presence of various types of refractive error in one way or another[3]. The refractive power of the cornea and the lens, the depth of the anterior chamber and the axial length, which are interdependent rather than independent variables determine the refractive state or spherical equivalent (SE) of the eye. Ocular biometry has been associated with systemic biometric factors such as age, gender, body mass index (BMI), height and weight in multiple studies[4,5,6]. Several studies have linked refractive errors to ocular health. However, the lack of a thorough and systematic synthesis of these interactions in various types of refractive errors limits our understanding of refractive errors and its association with ocular and systematic biometric factors. Numerous studies have reported correlation between refractive error and anthropometric and ocular biometric variables in children[7-10] however, relatively few have examined the same relationship in young adults especially in Northern India. The aim of this study is to investigate the risk variables associated with the above correlation in North India in young college going medical students for early diagnosis of refractive error and timely intervention of ametropia to prevent visual disability arising from refractive errors.

Objectives: To assess the prevalence of different refractive errors (Myopia, Hypermetropia, Astigmatism) in medical students in a university of north India and further assess correlation between refractive status, anthropometric parameters and ocular biometric parameters as associated risk factors.

MATERIALS AND METHODS

The present study was a hospital-based observation cross sectional study carried out in the Department of Ophthalmology, Integral Institute of Medical Sciences and Research, Lucknow. Uttar Pradesh, India. Medical students enrolled in Integral University, Lucknow of the age group 18-25 years were included in the study during the period of February 2022 to July 2023. Patients with past history of ocular surgery or ocular trauma and associated ocular or systemic co-morbidities as well as those not giving consent were excluded from the study. Approval from Institutional research and Ethical Committee was taken before the start of the study. The study had a sample size of 417 (which was based on estimated mean prevalence of Uncorrected refractive error in young adults in India[5]) and considering a confidence interval of 95%, absolute precision of 5% and factoring in the drop out cases. Informed consent was taken from each respondent before enrollment in the study. Anthropometric measurements (Height, Weight and BMI) were recorded. Details of associated factors including socio-demographic details of the individual, family history related to refractive error, time spent in near work and outdoor activities were recorded using a semi structured questionnaire. Screening for refractive status was done using Snellen's chartfor distance visual assessment and Jaeger's chart was used for near vision. Wet Retinoscopy was used to determine the refractive error, along with phoropter/subjective refraction and autorefraction., to ascertain the presence and degree of myopia, hyperopia, astigmatism or emmetropia. Refraction was done for each eye. Refractive error was measured and graded according to spherical equivalent power. Corneal curvature, Anterior chamber depth and Axial length were measured by IOL Master (ZEISS 700) and Central cornea thickness was measured by ultrasonic pachymeter (NIDEK TONOPACHY NT 530 P). At least two readings for each eye were taken and the average was calculated as the measured axial length. Additional two readings from each eye were taken for Central corneal power (CK) and Central radius of curvature (CR) and average value was considered. All data obtained was entered in excel sheets and was followed by Correlation testing of variables using Pearson's Correlation Coefficient r. Inter group comparison was done using sample t test. The changes were two tailed and comparisons of variables with P value less than 0.05 was taken as a statistically significant.

RESULTS AND DISCUSSIONS

A total of 417 students were included inthe study, 29 students out of the enrolled total number of students did not participate giving a response rate of 93% (n-388). All respondents were pursuing MBBS course in the college and included medical students and interns in the age group of 18-25 years. The Mean age of respondents was 22±2.9 years. 245 respondents were female (63%) compared to 143 male respondents (37%) (Table 1). Myopia was the most prevalent refractive error in medical students with 244 (63%) of students in the age group of 18-25 years being myopic

Table 1. Characteristics of Participating Students (n-388)

SN	Variable	Frequency (n)	Percentage (%)
1.	**Age Group**		
	18-21 years	221	56.9%
	22-25 years	167	43.0%
2.	**Gender**		
	Male	143	36.8%
	Female	245	63.1%

Table 2. Family History of Myopia Among Medical Students (n-244)

SN	Variable	Frequency (n)	Percentage (%)
1.	**Family History**	**57**	**23.3%**
	In One Parent	43	29.0%
	In Both Parents	14	13.2%
2	No Family History	187	76.6%

Table 3: Co-Relation of Axial Length with Refractive Errors

	Mean (Lt)	Mean (Rt)	Median (Lt)	Median (Rt)	Std Deviation (Lt)	Std Deviation (Rt)	Std Error (Lt)	Std Error (Rt)	Correlation coefficient ®	Resulting P-value
Ametropia (261)	23.03	23.11	22.8	23.01	0.79	0.68	0.12	0.11	0.09	p<0.001
Myopia (244)	25.25	25.33	24.83	24.94	1.11	1.13	0.15	0.15	0.77	p<0.001
Emmetropia (127)	23.36	23.27	23.09	23.11	0.88	0.65	0.14	0.11	0.14	p<0.001
Astigmatism (13)	22.26	23.21	22	22.19	0.88	0.65	0.14	0.11	0.09	p>0.70
Hypermetropia(4)	21.6	22.8	21.3	21.5	0.78	0.59	0.13	0.1	0.10	p>0.75

Table 4: Co-relation of Anterior Chamber Depth with Refractive Errors

	Mean (Lt)	Mean (Rt)	Median (Lt)	Median (Rt)	Std Deviation (Lt)	Std Deviation (Rt)	Std Error (Lt)	Std Error (Rt)	Correlation coefficient ®	Resulting P-value
Ametropia (261)	3.13	3.15	3.11	3.17	0.65	0.59	0.09	0.08	0.16	p<0.001
Myopia (244)	3.56	3.68	3.26	3.31	0.44	0.43	0.06	0.06	0.71	p<0.001
Emmetropia (127)	3.09	3.11	3.01	3.06	0.57	0.54	0.09	0.09	0.12	p<0.001
Astigmatism (13)	3.03	3.09	3.01	3.07	0.53	0.46	0.06	0.08	0.07	p>0.70
Hypermetropia (4)	2.8	2.68	2.6	2.51	0.47	0.45	0.07	0.08	0.02	p>0.75

Table 5: Correlation Analysis of Ocular Parameters

S/N	Correlation analysis using Karl Pearsons Test	Correlation coefficient (r)	Resulting P-value
1	Myopia Grade and CCT	0.129	0.065
2	Corneal Curvature and CCT	-0.326	0.001
3	Axial Length and CCT	-0.085	0.019

Table 6: Central Corneal Thickness in different Grades of Myopia

S/N	Grade of Myopia	Mean	SD	Range
1	Low Grade Myopia	535.3	34.87	436-600
2	Moderate Grade Myopia	534.2	40.99	436-616
3	High Grade Myopia	512.2	26.79	469-567
	Total	531.9	36.8	436-616

Table 7: Correlations of Anthropometric Parameters (r value) with Refractive Errors

	Parameter	Axial Length (Rt)	Axial Length (Lt)	Ant Chamber Depth (Rt)	Ant Chamber Depth (Lt)	Resulting P-value
Myopia	Height	0.68	0.66	0.49	0.43	p<0.001
	Weight	0.28	0.24	0.38	0.36	
	BMI	0.26	0.25	0.23	0.21	
Emmetropia	Height	0.56	0.58	0.32	0.36	p<0.001
	Weight	0.24	0.21	0.34	0.32	
	BMI	0.29	0.27	0.43	0.46	
Hypermetropia	Height	0.32	0.41	0.31	0.34	p<0.2
	Weight	0.29	0.44	0.33	0.31	
	BMI	0.29	0.27	0.24	0.28	
Astigmatism	Height	0.21	0.5	0.12	0.33	p<0.2
	Weight	0.17	0.24	0.44	0.42	
	BMI	0.22	0.20	0.29	0.36	

while percentage of students who had Emmetropia, hypermetropia and Astigmatism were127 (33%), 04 (01%) and 13 (03%) respectively. (Fig. 1)

187 out of 244 myopics (76.6%) did not show any family history. 57 out of 244 myopic students (23.3%) gave history of parental myopia. Of the 57 myopic students who reported history of parental myopia, 43 (29.0%) students had single parent myopic and 14 (13.2%) students had both parents myopic.(Table 2). Out of the 776 eyes of 388 students, 488 eyes (244 students) showed myopia. Of these, 296 eyes (148 students both eyes) had mild myopia (power<-2 diopters, 60.6%), 162eyes (81 students both eyes) had moderate myopia(power >-2to-5 diopters, 33.3%) and 30 eyes (15 students both eyes) had highmyopia (power>-5 diopters, 6.1%). (Fig. 2).

In terms of correlation with ocular parameters, Mean Axial Length (in mm) of myopic respondents (n-244) was 25.3±1.34 and as compared to (n=127) 23.3±0.94 in emmetropic respondents (Table 3). Mean Anterior Chamber Depth (ACD) for myopic respondents was 3.57mm compared to 3.06mm in Astigmatism, 2.74mm

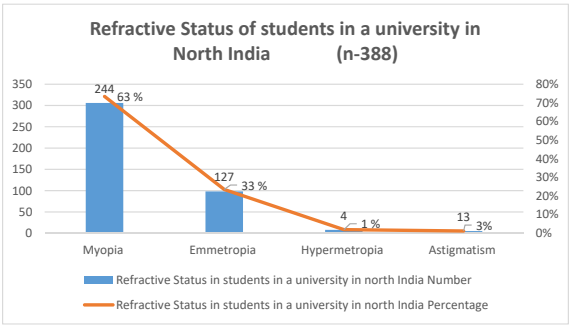

Fig. 1: Refractive Status of Students in a University in North India (n-388)

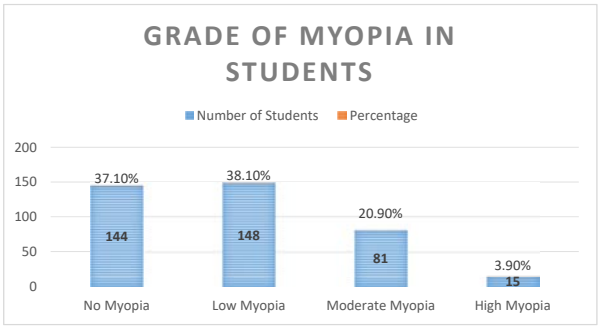

Fig. 2: Grading of Myopia (n-388)

in Hypermetropia and 3.09mm in emmetropic respondents (Table 4). Correlation between different ocular parameters was also ascertained in the study, however no positive correlation emerged between corneal curvature and Central Corneal Thickness (CCT) (Pearson r=-0.326, p=0.001)., or Axial length and Central Corneal Thickness (Pearson r=-0.085, p=0.019) in our study across the participants with different refractive status. (Table 5). Central corneal thickness was also found varying in different grades of myopic respondents. The mean value was found low in high myopic respondents (512.2) and was found high (535.3) in low myopic respondents.(Table 6). Compared to the Central corneal thickness, A reverse pattern was observed for Corneal curvature in myopic cases, with highest corneal curvature being seen in high myopic cases and a low corneal curvature was found in low myopic cases. In terms of correlation with anthropometric parameters, good correlation was found between height and axial length {Pearson's Correlation Coefficient 'r' value was 0.56 (rt), 0.58 (lt)} in emmetropic eyes. Good correlation was also reported between height and axial length in our study in myopic eyes.{Pearson's Correlation Coefficient 'r'=0.68 (rt), 0.66 (lt)}. No statistically significant correlation was seen in Hypermetropic as well as astigmatism cases. (Table 7).

Interpretation

- r ≥0.7 implies strong correlation
- | r=0.5-0.7 implies good correlation
- r=0.3-0.5 implies fair correlation and
- | r =<0.3 implies poor correlation

Refractive errors are amongst the leading causes of vision loss worldwide therefore it has been the concern of researchers worldwide to determine the patterns of its prevalence among different populations and to determine the risk factors impacting its prevalence for early detection, treatment and prevention of vision loss due to refractive errors[1]. The present study was conducted among young college going medical students in the age group of 18-25 years and aimed at estimating the prevalence of different refractive errors as well as assessing correlation of type of refractive error with anthropometric and ocular biometric parameters. The prevalence of myopia found in the study correlates with many national and international studies with MBBS students as respondents[11,12]. The prevalence of myopia revealed by the present study was lower than those previously reported in study by Abuallut *et al.* in identified districts of Saudi Arabia[11]. and from a similar study reported from China[12]. At the same time, the prevalence of myopia was found higher than the prevalence reported in studies from Pakistan and Malaysia[13,14]. The study findings were also compared with the prevalence of myopia in different states in India. The myopia prevalence in this study was lower than as reported in previous study from Andhra Pradesh[15] however, it was higher than the prevalence recorded in other states like West Bengal, Odisha, Gujarat[15,16,17]. In the study conducted by Onal[14] mild, moderate and high myopia were observed in 81%, 17.6% and 1.4% of students, respectively, whereas findings from our study reported 60.6%, 33.3% and 6.1% respectively. The findings from our study were similar in terms of the mild myopia emerging as the most common occurrence but differs in terms of relatively increased occurrence of moderate and high myopia in our study. Reports by Gopalakrishnan[15] and Woo[12] revealed that myopia was more prevalent in female students than male students. Finding from our study are similar, with females having higher prevalence of myopia (77%) compared to males (62%) which could be due to more numbers of female participants in our study. At the same time, this study shows higher percentage of Emmetropia, Hypermetropia and Astigmatism in males (29%, 3% and 6%) compared to females (21%, 0% and 2%) respectively. Previous studies which have shown correlation between body measurements and its association with refractive errors included study by Teikari J M *et al.* in which height was found positively

associated with myopia in male participants, no such correlation was observed in female participants[14]. In our study fair correlation was observed between BMI and emmetropia. No Significant Correlation was seen between BMI and myopia in our study. No statistically significant correlation was observed between the anthropometric indicators and refractive errors-Hypermetropia and Astigmatism. In terms of correlation between ocular biometric parameters with refractive errors, Positive correlations were found between height and axial length in myopic and emmetropic eyes while no statistically significant correlation was seen in Hypermetropic as well as astigmatism cases. The findings from our study showed minor variation from the study of Yin Wong *et al* . on Chinese population in Singapore (2001)[15] which found the mean axial length to be 23.23±1.17mm, which was slightly lower than found in our study. In our study a weak significant correlation was seen in the relationship between Central Corneal Thickness (CCT) and corneal curvature. It implies that central corneal thickness increases with a decrease in corneal curvature and central corneal thickness decreases with an increase in corneal curvature. A similar negative correlation was seen between AL and CCT. Kadhim and Farhood also documented a statistically significant (weak) negative correlation between average corneal curvature and CCT (Pearson r =-0.097, p=0.048)[14].

CONCLUSION

The present study concluded that myopia was the most prevalent refractive error in students in the identified university in north India with 63% of students in the age group of 18-25 years being myopic. With prevalence of hypermetropia and astigmatism being very low of 1% and 3% respectively. The presence of low, moderate and high myopia was found in 60 %, 33.3% and 6.1% students respectively. Approx. 23% of respondents with myopia had positive family history, whereas 77% of myopic cases did not show any family history. In terms of correlations between ocular biometric parameters with different refractive errors, it was found that axial length is positively correlated in myopia cases and was found increased in myopic respondents compared to emmetropic respondents only.

Limitation: Positive correlations were found between height and axial length in myopic and emmetropic eyes while no significant correlation was seen in Hypermetropic as well as astigmatism cases. No Significant Correlation was found between BMI and myopia in our study. Fair correlation was observed between BMI and emmetropia. No statistically significant correlations were however observed between anthropometric indicators with Hypermetropia and Astigmatism. Thus, our study further corroborates the findings of previous studies with most students included in the study suffering from myopia and their ocular parameters and anthropometric parameters in alignment with the findings found in different types of refractive errors. The large percentage of students suffering from myopia warrants regular screening among college-going students. The early diagnosis of ocular anthropometric risk factors in myopia, especially those associated with positive family history can help in early detection and timely management of refractive errors to prevent amblyopia in children and visual disability in adults.

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