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Prevalence of Refractive Errors and their Association with Demographic Factors

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Abstract **Original Research Article**

Background: Refractive errors (REs) are one of the most important causes of visual impairment globally and are affected by demographic and socioeconomic determinants. ***Objective:*** The aim of this study was to assess the prevalence of refractive errors and their association with demographic factors. ***Methods & materials:*** This cross-sectional observational study was conducted in the Department of Ophthalmology, TMSS Medical College & Rafatullah Community Hospital, located in Bogura, Bangladesh from July 2024 to June 2025. Total 300 participants presented for a routine or symptomatic ocular examination were recruited. ***Result:*** Mean age was 25.6 ± 8.1 years with a slight female predominance (53.3%). The most common comorbidity was hypertension (25% and 23.3% had a family history of refractive errors. Myopia was most prevalent among participants aged 15–19 years (37.5%), whereas hyperopia was more frequently observed in the older age groups. Astigmatism was relatively evenly distributed across all age categories, ranging from 25.0% to 33.3%. Emmetropia was observed in approximately one-quarter of participants across most age groups. Age distribution of refractive errors was statistically significant ($p = 0.041$). Refractive errors were not significantly associated with sex ($p = 0.78$). ***Conclusion:*** This study reveals a significant burden of refractive errors among young adults. Hyperopia was more frequent in older participants, while astigmatism was evenly distributed across ages. Age showed a significant association with refractive error patterns, but sex did not demonstrate any notable relationship.

Keywords: Prevalence, Refractive Errors, and Demographic Factors.

INTRODUCTION

Visual impairment remains one of the most prevalent and serious non-communicable conditions globally, with major public health, economic, and individual significance. Uncorrected refractive errors (UREs) remain the most prevalent cause of moderate and severe visual impairment across the globe, according to recent estimates, and impact hundreds of millions of people of all ages. [1] There is evidence from the Global Burden of Disease study that refractive errors are a significant cause of years lived with disability, and in middle- and low-income nations, they go undetected and untreated, worsening existing health inequities. [2] Notably, refractive errors are among the most easily correctable vision disorders with glasses, contact lenses, or refractive surgery but remain very under-addressed in the majority of health systems globally. [3]

Refractive errors (REs) are vision defects that result in the inability of light to directly focus on the retina, causing blurry vision. The three principal forms are myopia (nearsightedness), where the light is focused in front of the retina; hyperopia (farsightedness), where it is focused behind; and astigmatism, where abnormal corneal curvature causes distorted or blurred vision at all distances. All these are readily correctable by simple means and therefore their uncorrected prevalence is particularly disturbing. [4] Myopia, in particular, has drawn global attention with its rapidly increasing prevalence among children and young adults, a trend now referred to as the "myopia epidemic". [5]

Recent global research shows a significant increase in the prevalence of myopia, which is predicted to affect up to 50% of the global population by 2050, with a very high rise in East and Southeast Asia. [6] The increasing tendency has a strong association with

lifestyle changes, including increased screen time, excessive academic pressures, reduced outdoor activities, and urbanization. [7,8] Furthermore, the problem is being fueled by rapid demographic change: population ageing has led to increased incidences of hyperopia and presbyopia, especially in adults over the age of 50. [1] These age-related refractive shifts also underscore the need for population-specific vision care programs.

Demographic determinants of REs are relevant to know for designing effective interventions. Age, sex, socioeconomic status, education, and urban–rural residency have all been linked to the prevalence and development of refractive errors. [2,9] For instance, children in urban settings are more likely to develop myopia than those in rural settings due to reduced time outdoors and excessive near-work. [7] Similarly, access to refractive care services is often inversely associated with income level, further disadvantaging those in already disadvantaged settings. [2,3] Despite mounting global evidence, the majority of national and regional health systems still lack sufficient evidence to understand how these demographic circumstances specify the burden of REs in their populations.

The public health significance of this inquiry is both urgent and complicated. Uncorrected REs have been shown to impair educational attainment, reduce economic productivity, and diminish quality of life—all avoidable consequences with early and low-cost interventions.[3] There is also proof for the cost-effectiveness of early detection programmes, particularly school-based screening, in relation to achieving significant long-term cost savings and improved developmental outcomes. [5] In the absence of local epidemiological data, however, activities remain fragmented and inadequately targeted. Following these observations, the present study aims to estimate the prevalence of refractive errors and examine their association with key demographic determinants in Bangladesh.

Objectives

To assess the prevalence of refractive errors and their association with demographic factors.

METHODS & MATERIALS

This cross-sectional observational study was conducted in the Department of Ophthalmology, TMSS Medical College & Rafatullah Community Hospital, located in Bogura, Bangladesh from July 2024 to June 2025. Total 300 participants presented for a routine or symptomatic ocular examination were recruited in this study. Inclusion criteria encompassed all patients aged between 15-35 years who presented for a routine or symptomatic ocular examination and consented to participate in the study. Patients with media opacities (e.g., mature cataract, corneal opacity) or systemic conditions affecting visual acuity (e.g., diabetic retinopathy, neurological disorders) were excluded to avoid confounding factors.

Each participant underwent a comprehensive ophthalmic evaluation, including unaided and best-corrected visual acuity assessment, retinoscopy, and subjective refraction under appropriate lighting conditions. Cycloplegic refraction was performed in pediatric and young adult patients when necessary. Refractive errors were classified into myopia, hyperopia, and astigmatism based on spherical equivalent values in accordance with standard definitions. In addition to clinical assessments, a structured questionnaire was administered to collect demographic data, including age, sex, education level, with the aim of analyzing potential associations with refractive status.

All examinations were carried out by qualified ophthalmologists or trained optometrists, ensuring consistency in measurement techniques and data recording. Data were anonymized and coded prior to statistical analysis. Informed written consent was obtained from all participants and the guardians of minors. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 22.

RESULTS

Table-I shows the demographic characteristics of the study patients. The study included a total of 300 patients with a mean age of 25.6 ± 8.1 years. The largest proportion of participants were in the 20–24 years age group (40%), followed by those aged 15–19 years (26.7%), 25-29 years (20%), and 30-35 years (13.3%). In terms of sex distribution, females (53.3%) slightly outnumbered males (46.7%). With respect to education, nearly one-third (30%) of the participants had a secondary education, while 23.3% had attained primary education, 20% higher secondary education, and 13.3% had graduate-level or above qualifications. Notably, 13.3% of the study population reported no formal education. Figure 1 further illustrates the distribution of residence among the patients.

Table-II shows that the most common comorbidity was hypertension (25%), followed by diabetes mellitus (20%) and cardiovascular disease (10%). Lifestyle-related risk factors included a history of smoking (16.7%), obesity (13.3%), and prolonged near work (>6 hours/day), which was reported by 30% of patients. Additionally, 23.3% had a family history of refractive errors.

Table-III demonstrates the distribution of refractive error types. Regarding refractive error patterns, myopia was the most common type (33.3%), followed by astigmatism (30%), and hyperopia (13.3%), while 23.3% of the participants were emmetropic.

Table-IV presents the association of refractive errors with age group. Myopia was most prevalent among participants aged 15–19 years (37.5%) and 20–24 years (33.3%), whereas hyperopia was more frequently observed in the older age groups, particularly 25–29 years (25.0%) and 30–35 years (25.0%). Astigmatism was relatively evenly distributed across all age categories, ranging from 25.0% to 33.3%. Emmetropia (normal vision) was observed in approximately one-quarter of participants across most age groups, with the lowest proportion in the 25–29 years category (16.7%). Statistical analysis revealed a significant association between refractive error types and age group ($p = 0.041$), indicating that age is an important determinant of refractive error distribution in this population.

Table-V highlights the association of refractive errors with sex. When examined by sex, no statistically significant association was observed ($p = 0.78$). Myopia was slightly more common among males (35.7%) than females (31.3%), while hyperopia had a nearly identical distribution across sexes (14.3% in males and 12.5% in females). Astigmatism was marginally more frequent in females (31.3%) compared to males (28.6%), and emmetropia was also slightly higher among females (25%) than males (21.4%).

Table-I: Demographic characteristics of the study patients (N=300)

Characteristics	Number of Patients	Percentage (%)
Age Group (Years)		
15-19	80	26.67%
20-24	120	40%
25-29	60	20%
30-35	40	13.33%
Mean ± SD	25.6 ± 8.1 years	
Sex		
Male	140	46.67%
Female	160	53.33%
Education Level		
No formal education	40	13.30%
Primary	70	23.30%
Secondary	90	30.00%
Higher Secondary	60	20.00%
Graduate and above	40	13.30%

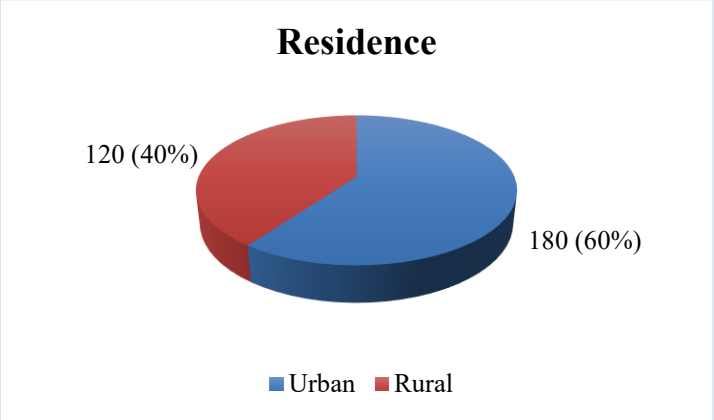

Figure 1: Distribution of residence among the study patients (N=300)

Table-II: Distribution of comorbidities and risk factors among the study patients (N=300)

Comorbidities / Risk Factors	Number of Patients	Percentage (%)
Diabetes mellitus	60	20.0%
Hypertension	75	25.0%
Cardiovascular disease	30	10.0%
Smoking history	50	16.7%
Family history of refractive errors	70	23.3%
Prolonged near work (>6 hrs/day)	90	30.0%
Obesity (BMI ≥30)	40	13.3%

Table-III: Distribution of refractive error types (N=300)

Refractive Error Type	Number of Patients	Percentage (%)
Myopia	100	33.3%
Hyperopia	40	13.3%
Astigmatism	90	30.0%
Emmetropia (normal)	70	23.3%

Table-IV: Association of refractive errors with age group

Age Group (Years)	Myopia (n/%)	Hyperopia (n/%)	Astigmatism (n/%)	Emmetropia (n/%)	P-value
15–19	30 (37.5%)	5 (6.2%)	25 (31.2%)	20 (25.0%)	0.041*
20–24	40 (33.3%)	10 (8.3%)	40 (33.3%)	30 (25.0%)	
25–29	20 (33.3%)	15 (25.0%)	15 (25.0%)	10 (16.7%)	
30–35	10 (25.0%)	10 (25.0%)	10 (25.0%)	10 (25.0%)	

*=significant

P-value obtained from chi-square test

Table-V: Association of refractive errors with sex

Sex	Myopia (n/%)	Hyperopia (n/%)	Astigmatism (n/%)	Emmetropia (n/%)	P-value
Male	50 (35.7%)	20 (14.3%)	40 (28.6%)	30 (21.4%)	0.78
Female	50 (31.3%)	20 (12.5%)	50 (31.3%)	40 (25.0%)	

P-value obtained from chi-square test

DISCUSSION

This current study analyzed the prevalence and pattern of refractive errors in an adult population, with special reference to their association with demographic variables such as age, sex, educational level, and co-morbidities. The findings showed that myopia (33.3%) was the most common refractive error, followed by astigmatism (30%) and hyperopia (13.3%), while 23.3% of the sample was emmetropic. Interestingly, age was a strong predictor of the type of refractive error, while sex was not statistically significant.

In this study, hypertension (25%) and diabetes mellitus (20%) were the most common comorbidities among patients with refractive errors, while lifestyle factors such as smoking (16.7%), obesity (13.3%), and prolonged near work (30%) were also prevalent. These findings are consistent with large-scale cohort studies that have demonstrated significant associations between refractive errors and systemic conditions, including diabetes, hypertension, and obesity. [10] Hypertension, in particular, has been linked to higher risk of visual impairment and uncorrected refractive errors, as observed in Ethiopian patients.[11] Similarly, cardiovascular health has been associated with near vision decline in older adults, underscoring the role of systemic vascular conditions in ocular outcomes.[12]

Smoking, reported by 16.7% of our participants, is another important factor, as prior studies confirm its contribution to ocular morbidity in patients with multiple comorbidities, especially diabetes and hypertension.[13] Genetic predisposition was evident in 23.3% of participants with a family history of refractive errors, a factor well established in the literature as influencing refractive development.[14] Additionally, prolonged near work, reported by 30% of patients, aligns with evidence linking extended near work and reduced outdoor activity to higher risk of myopia progression.[10]

This prevalence of myopia in this study is in agreement with the findings reported in various populations where myopia has been found to be the most prevalent refractive defect in adults. In the case of the PERSIAN Eye Cohort Study in Iran, for instance, astigmatism and myopia were the most prevalent refractive defects, with hyperopia rising with advancing age. [15] Similarly, research done in Colombia in preadolescents and children revealed that myopia and astigmatism were the most common conditions with a decrease in emmetropia with age.[16] These findings validate the worldwide trend that myopia is a common refractive error among both young and middle-aged persons, with hyperopia rising later in life.

The present study demonstrated a significant association between age and refractive error distribution among young adults in Bangladesh. Myopia was most prevalent in the 15–19 years and 20–24 years age groups, whereas hyperopia was observed more frequently in older participants (25–35 years). Astigmatism was relatively consistent across all age categories, while emmetropia was lowest among those aged 25–29 years. These findings suggest that age plays an important role in the pattern of refractive errors in this population.

Our results are consistent with prior studies conducted globally. In South India, myopia was more frequent among younger individuals, while hyperopia increased with age.[17] Similarly, large-scale

population-based studies in Singapore and Australia have shown that myopia predominates in younger groups, whereas hyperopia becomes more common with advancing age.[18] A recent Iranian study also reported a higher burden of hyperopia in older adults and myopia in younger cohorts.[19] Data from the United States further support these trends, with adolescents demonstrating high rates of myopia and older adults showing a shift toward hyperopia.[20]

Sex-based comparisons within this study found no statistically significant association between sex and type of refractive error ($p = 0.78$). Myopia was however found to be more common among males (35.7%) than females (31.3%), and hyperopia was similar in both genders, with astigmatism slightly higher in females. These findings are in line with global data, wherein sex was not generally an important predictor of refractive error. Little sex-dependent variation was observed in astigmatism and myopia by a Macedonian study, while a very large German survey of over 130,000 applicants for refractive surgery also found little male-female differences. [21,22] Parallel results were observed in Iraq, where a systematic review held that sex was not significantly associated with the prevalence of refractive error.[23]

Finally, socio-demographic and education factors must be emphasized as predictors of refractive error distribution. In this study, nearly one-third of the subjects had only secondary education, and 13.3% had no formal education. Past studies have repeatedly shown a correlation between higher education and higher prevalence of myopia, commonly explained by near-work-related demands and lifestyle behaviors.[24] Although education did not become a direct determinant in our dataset, its role as a possible contributor cannot be discounted.

Overall, findings from this study are in general agreement with international and regional reports validating the global patterns of high myopia and astigmatism in young and middle-aged adults, the rise of hyperopia in older adults, and the comparatively less effect of sex on the distribution of refractive error.

Limitations of the study

In our study, there was small sample size and absence of control for comparison. Study population was selected from only Bogura, so may not represent wider population. The study was conducted at a short period of time.

CONCLUSION

This study highlights a considerable burden of refractive errors among young adults in Bangladesh, with myopia being the most common type, particularly in the 15–24 years age group. Hyperopia was more frequent among older participants, while astigmatism was evenly distributed across age categories. Age showed a significant association with refractive error patterns, whereas sex did not demonstrate any meaningful relationship. These findings emphasize the importance of early screening and preventive strategies to reduce the impact of uncorrected refractive errors in this population.

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