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Original Article

Prevalence, Pattern & Association of Refractive Error with Determinants Among School-Going Children of Peshawar

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Abstract

Objectives: To determine the prevalence and pattern of refractive error and its association with selected determinants among school-going children in District Peshawar.

Methodology: This Cross-sectional Study was conducted in the Department of Ophthalmology, MTI Lady Reading Hospital, Peshawar, from January to May 2026. We recruited participants through non-probability convenience sampling. Trained eye-care professionals assessed visual acuity and refractive errors. We analyzed the data using SPSS and evaluated associations with the chi-square test; we considered $p < 0.05$ statistically significant.

Results: Out of 400 patients, refractive errors were identified in 31.75% (127/400) of children, with myopia accounting for 44.88% (57/127) of cases. Among affected children, 44.09% were boys, 66.93% were aged < 8 years, and 75.59% had educated parents. Nearly half (49.61%) reported a monthly household income $> 60,000$ PKR, while 66.93% attended public schools. A positive parental history of refractive error was reported in 37.80%, while 57.48% had limited outdoor activity. Computer use, video gaming, and daily television viewing were reported by 29.13%, 42.52%, and 66.93%, respectively.

Conclusions: Refractive error showed moderate prevalence, and myopia revealed higher prevalence. Child gender, parents' literacy, family, and screen time showed associations; therefore, behavioral and school-based interventions were recommended.

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Introduction

Refractive error is one of the most common causes of visual impairment worldwide and represents an important, potentially correctable cause of reduced vision among children. The major forms of refractive error include myopia, hyperopia, and astigmatism [1-3]. Refractive error is a major condition in children worldwide, and a large proportion of children with refractive error live in LMICs [4-6]. Uncorrected refractive error negatively affects children's educational performance, activities, and quality of life. It could also be associated with reading and writing problems and harm psychosocial and developmental functioning [7-9]. Genetic, environmental, and behavioral factors all contribute to the prevalence of refractive error in children. Researchers have studied the following factors as possible causes of refractive abnormalities: family history, prolonged near-work activities, limited outdoor exposure, and increased use of electronic devices [10]. Increasing indoor activity and screen time have become salient issues for children's vision health. Regular school screening for refractive error can facilitate early detection and correction, prescription of corrective glasses, and referral for ophthalmic evaluation. These interventions can minimize the impact of uncorrected VIs on students' educational and developmental outcomes. Lack of easily available, preventive eye-care services remains a challenge for Pakistan, especially for children. School-based screening is a chance to detect children who may have undiagnosed refractive errors and ensure that they are managed appropriately. Therefore, assessing the burden and pattern of refractive error and its associated demographic, socioeconomic, familial, and behavioral factors is important for planning effective child eye-health interventions. This study aimed to determine the prevalence and pattern of refractive error among school-going children in Peshawar and to assess its association with selected demographic, socioeconomic, familial, environmental, and screen-related determinants. The findings may help support awareness, early detection, referral, and school-based vision-screening strategies in the local population.

Materials and Methods

The cross-sectional study was conducted in the Department of Ophthalmology, MTI Lady Reading Hospital, Peshawar, from January to May 2026. This study involved school-going children aged 5 to 15 in District Peshawar from both public and private schools.

Sample Size and Sampling

This included 400 children. We determined the sample size based on a 95% confidence interval, an absolute precision of 5%, and an anticipated prevalence of 50% for refractive error. The calculated sample size was 383, but we enrolled 400 children. We used non-probability convenience sampling to select participants.

Eligibility Criteria

Children aged 5–15 attending public or private schools were eligible for inclusion, provided they provided informed consent. Children who were not residents of District Peshawar, or who had any eye disease (except refractive error), including cataract, glaucoma, congenital eye disease, and neurological/psychological disease, were excluded. To determine visual acuity and refraction. To check eyesight and refractive error. A trained, qualified optometrist evaluated visual acuity using a Snellen chart. Children diagnosed with visual difficulties were referred to an ophthalmologist for a more thorough assessment. We refracted all parts of the document as needed. Visual acuity improved to 6/6, and we recommended corrective lenses. If this was not achieved, we performed a pinhole test and a fundus examination (if needed). We categorized refractive error as myopia (between –1 to –10 D), hyperopia (between +1 to +8 D), and astigmatism (1 to 4 D). The study used non-cycloplegic refraction.

Data Collection

We used a semi-structured questionnaire, and school teachers assisted with data collection. We translated it into the local language as needed. The questionnaire contained demographic and socioeconomic data such as gender, age, parental education, parental occupation, family monthly income, and type of school. We also collected details on family history of refractive error, as well as behaviors and environment (outdoor activities, near-work activities, viewing of television, computers, mobiles, and use of video games).

Participants were assigned unique ID numbers. The retrieved data were analyzed using SPSS 24.0.

Statistical Analysis

Data were analyzed using SPSS 24.0. Categorical variables were presented as frequencies and percentages. We evaluated associations between selected demographic, socioeconomic, behavioral, and environmental factors and refractive error using the chi-square test. We considered $p < 0.05$ statistically significant.

Results

The study included 400 school-going children. We identified refractive error in 127 (31.75%) children. Among those with refractive error, myopia was the most common pattern, accounting for 57 (44.88%) cases, followed by astigmatism in 47 (37.01%) and hyperopia in 23 (18.11%) children (Table 1).

Table 1. Prevalence and Pattern of Refractive Error Among School-Going Children in Peshawar (n = 400)

Pattern of refractive error	Frequency, n	Percentage (%)
Myopia	57	44.88
Hyperopia	23	18.11
Astigmatism	47	37.01
Total with refractive error	127	31.75

Percentages for individual refractive-error types are calculated among children with refractive error (n = 127). The overall prevalence of refractive error was 31.75% (127/400). Among the 127 children with refractive error, 56 (44.09%) were boys and 71 (55.91%) were girls. Most affected children were aged <8 years (85, 66.93%), while 42 (33.07%) were >8 years. Children below Grade VI constituted 70.87% of those with refractive error, compared with 29.13% in Grade VI or above. Sex was significantly associated with refractive error ($\chi^2 = 8.308$, $p = 0.002$), whereas age ($p = 0.152$) and class grade ($p = 0.119$) were not significantly associated with refractive error (Table 2). Parental education was significantly associated with refractive error. Among affected children, 31 (24.41%) had illiterate fathers and 69 (54.33%) had illiterate mothers. Father's education ($\chi^2 = 5.655$, $p = 0.008$) and mother's education ($\chi^2 = 6.005$, $p = 0.007$) were significantly associated with refractive error. Father's employment status was also significantly associated with refractive error ($\chi^2 = 6.111$, $p = 0.006$), whereas mother's employment status was not ($p = 0.283$). Similarly, household monthly income was significantly associated with refractive error ($\chi^2 = 4.868$, $p = 0.013$). The number of siblings was not significantly associated ($p = 0.138$). School type showed a significant association: 85 (66.93%) affected children attended public schools, and 42 (33.07%) attended private schools ($\chi^2 = 5.298$, $p = 0.010$) (Table 2).

Table 2. Association of Demographic and Socioeconomic Factors with Refractive Error Among School-Going Children in Peshawar (n = 400)

Variable	Category	Refractive error, n (%)	No refractive error, n (%)	Total, n (%)	χ^2	p-value
Sex	Boys	56 (44.09)	164 (60.07)	220 (55.00)	8.308	0.002
	Girls	71 (55.91)	109 (39.93)	180 (45.00)		
Age	<8 years	85 (66.93)	198 (72.53)	283 (70.75)	1.056	0.152
	>8 years	42 (33.07)	75 (27.47)	117 (29.25)		
Class grade	Below Grade VI	90 (70.87)	210 (76.92)	300 (75.00)	1.388	0.119
	Grade VI or above	37 (29.13)	63 (23.08)	100 (25.00)		
Father's education	Illiterate	31 (24.41)	101 (37.00)	132 (33.00)	5.655	0.008
	Literate	96 (75.59)	172 (63.00)	268 (67.00)		
Mother's education	Illiterate	69 (54.33)	111 (40.66)	180 (45.00)	6.005	0.007
	Literate	58 (45.67)	162 (59.34)	220 (55.00)		
Father's employment	Unemployed	21 (16.54)	78 (28.57)	99 (24.75)	6.111	0.006
	Employed	106 (83.46)	195 (71.43)	301 (75.25)		

Mother's employment	Homemaker	103 (81.10)	213 (78.02)	316 (79.00)	0.327	0.283
	Employed	24 (18.90)	60 (21.98)	84 (21.00)		
Monthly household income (PKR)	<60,000	64 (50.39)	171 (62.64)	235 (58.75)	4.868	0.013
	>60,000	63 (49.61)	102 (37.36)	165 (41.25)		
Number of siblings	None	29 (22.83)	78 (28.57)	107 (26.75)	1.178	0.138
	≥1	98 (77.17)	195 (71.43)	293 (73.25)		
School type	Public	85 (66.93)	153 (56.04)	238 (59.50)	5.298	0.010
	Private	42 (33.07)	120 (43.96)	162 (40.50)		

Values are presented as frequency (percentage). χ^2 , chi-square test statistic. We considered $p < 0.05$ statistically significant. Table 3 presents behavioral and environmental factors. A positive parental family history of refractive error was reported in 48 (37.80%) children with refractive error and was significantly associated with the outcome ($\chi^2 = 5.213$, $p = 0.011$). Engagement in outdoor activities was also significantly associated with refractive error ($\chi^2 = 5.862$, $p = 0.008$). Among children with refractive error, 54 (42.52%) reported engaging in outdoor activities, whereas 73 (57.48%) did not. Computer use was reported by 37 (29.13%) affected children and was not significantly associated with refractive error ($p = 0.411$). Similarly, computer use duration was not statistically significant ($p = 0.169$). Video-game use itself was not significantly associated with refractive error ($p = 0.261$); however, duration of video-game use was significantly associated ($\chi^2 = 6.545$, $p = 0.005$). Reading books and reading duration were not significantly associated with refractive error ($p = 0.249$ and $p = 0.261$, respectively). Television viewing was significantly associated with refractive error ($\chi^2 = 4.660$, $p = 0.015$). Among affected children, 85 (66.93%) reported watching television. Television viewing duration was also significantly associated with refractive error ($\chi^2 = 4.177$, $p = 0.021$) (Table 3).

Table 3. Association of Behavioral and Environmental Factors with Refractive Error Among School-Going Children in Peshawar (n = 400)

Variable	Category	Refractive error, n (%)	No refractive error, n (%)	Total, n (%)	χ^2	p-value
Parental positive family history	Yes	48 (37.80)	51 (18.68)	99 (24.75)	5.213	0.011
	No	79 (62.20)	222 (81.32)	301 (75.25)		
Outdoor activities	Yes	54 (42.52)	194 (71.06)	248 (62.00)	5.862	0.008
	No	73 (57.48)	79 (28.94)	152 (38.00)		
Duration of outdoor activities	<1 hour/day	52 (40.94)	103 (37.73)	155 (38.75)	5.723	0.008
	>1 hour/day	22 (17.32)	71 (26.01)	93 (23.25)		
Computer use	Yes	37 (29.13)	75 (27.47)	112 (28.00)	0.051	0.411
	No	90 (70.87)	198 (72.53)	288 (72.00)		
Computer use duration	<2 hours/day	21 (16.54)	51 (18.68)	72 (18.00)	0.918	0.169
	>2 hours/day	16 (12.60)	24 (8.79)	40 (10.00)		
Video-game use	Yes	54 (42.52)	127 (46.52)	181 (45.25)	0.410	0.261
	No	73 (57.48)	146 (53.48)	219 (54.75)		
Video-game duration	<2 hours/day	17 (13.39)	68 (24.91)	85 (21.25)	6.545	0.005
	>2 hours/day	37 (29.13)	59 (21.61)	96 (24.00)		
Reading books	Yes	93 (73.23)	210 (76.92)	303 (75.75)	0.459	0.249
	No	34 (26.77)	63 (23.08)	97 (24.25)		
Reading duration	<2 hours/day	61 (48.03)	128 (46.89)	189 (47.25)	0.410	0.261
	>2 hours/day	32 (25.20)	82 (30.04)	114 (28.50)		
Television viewing	Yes	85 (66.93)	108 (39.56)	193 (48.25)	4.660	0.015
	No	42 (33.07)	165 (60.44)	207 (51.75)		
Television viewing duration	<2 hours/day	53 (41.73)	51 (18.68)	104 (26.00)	4.177	0.021

>2 hours/day	31 (24.41)	57 (20.88)	88 (22.00)
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Values are presented as frequency (percentage). χ^2 , cChi-square test statistic. A p-value < 0.05 was considered statistically significant.

Discussion

This study assessed the prevalence and pattern of refractive error and its association with selected demographic, socioeconomic, familial, and behavioral determinants among school-going children in Peshawar. Of all the children, 31.75% (127/400) had refractive error. In children with refractive errors, hyperopia was the least frequent (18.11%), followed by astigmatism. (37.01%) and myopia (44.88%). The results suggest a significant problem with refractive errors in school-going children and highlight the need for early detection and proper eye assessment. The prevalence found in the present study was greater than reported by Alem and Gebru in elementary school children in Ethiopia [11]. Gurung and Gupta, however, found a prevalence of 34.9% in children attending a tertiary eye-care center, similar to our results [14]. The prevalence was also reported to be lower (17.43%) for school-going children by Srivastava et al. [24]. These differences may reflect differences in study populations and age groups, geographical settings, sampling methods, and detection methods for refractive error. In the present study, myopia was the highest percentage of refractive error, with 44.88% of children affected, followed by astigmatism and hyperopia. Several studies have reported significant differences in the distribution of children by type of refractive error. Gurung and Gupta [14] reported a significant burden of refractive error among children visiting an eye-care center in a tertiary care center, and Hassan et al. [22] reported a varying pattern of refractive errors among school-going children in Kashmir. These disparities may reflect differences in demographic characteristics, educational setting, near-work activity, outdoor exposure, and other population-specific factors. In the present study, sex was significantly associated with refractive error ($p=0.002$), with girls making up 55.91% of children with refractive error. Similarly, Sharma et al. found a significant association between sex and refractive error in school children [15]. However, other papers have not found any significant relationship between sex and refractive error [8]. These differences suggest that the sex-refractive error association may vary across populations and should be considered in light of a population's demographic and behavioral factors. In the present study, Age was not significantly associated with refractive error ($p=0.152$). Most children with refractive error were under 8 years, but age groups did not differ significantly in distribution. Ahmad et al. reached the same conclusion, finding no significant relationship between age and refractive error [8]. Refractive error was also not significantly related to class grade ($p=0.119$), similar to previous school-based studies [8,11]. Educational attainment was strongly associated with refractive error among parents. In the present study, father's education ($p=0.008$) and mother's education ($p=0.007$) were significantly associated with refractive error. Previous reports also show correlations between parental education level and child refractive error [11]. Parental education level can affect awareness of eye health, diagnosis of visual problems, seeking care, and children's educational and environmental exposure. The father's employment status was significantly associated with refractive error ($p=0.006$), but the mother's was not ($p=0.283$). Household monthly income was also significantly related to refractive error ($p=0.013$). This suggests that socioeconomic factors may affect children's eye health. Other studies have also investigated socioeconomic factors as potential risk factors for refractive error [7,15,17]. However, these associations should not be interpreted as causal because this is a cross-sectional study. Refractive error was significantly related to school type ($p=0.010$). Sixty-six. 93% of children with refractive error attended public schools, and 33.07% attended private schools. Previous studies have reported similar differences by school setting [11,12]. Differences in educational background, socio-economic status, access to eye-care services, and awareness may explain differences between school populations. In the present study, a positive family history of refractive error among parents was significantly associated with refractive error ($p=0.011$). This is similar to previous findings that family may play a role in the development of refractive abnormalities in children [23]. The current results, however, suggest not only a genetic link but also a shared environment and/or behavior among family members. Refractive error was significantly associated with outdoor activity ($p=0.008$). More children with refractive error reported not doing outdoor activities. Previous research has explored the link between outdoor exposure and childhood refractive error, and has linked lower levels of outdoor activity to myopia in certain populations [19,25,26]. The results from the present study thus reinforce the need to explore

children's outdoor behavior as a relevant factor. Computer use itself was not significantly associated with RE ($p=0.411$), and duration of computer use was not statistically significant ($p=0.169$). Likewise, video game use was not significantly correlated with refractive error ($p=0.261$). In contrast, we found a significant association between the duration of video game use and scores ($p=0.005$). Previous studies have reported links between prolonged exposure to digital screens and refractive abnormalities, especially myopia and astigmatism [23,25,26]. The results suggest that the amount of time spent on screens may matter more than screen time itself. Television viewing was significantly associated with refractive error ($p=0.015$), and television-viewing duration ($p=0.021$). This is supported by previous research exploring long-term screen time and refractive abnormalities in childhood [23,25,26]. Nevertheless, screen-related behaviors may be correlated with other factors, including reduced outdoor activity and increased sedentary or near-work behavior. Therefore, interpret these associations cautiously. Reading books was not significantly associated with refractive error ($p=0.249$), and reading duration was also not statistically significant ($p=0.261$). This finding is broadly consistent with research indicating that the relationship between near-work activities and refractive error may depend on the type, duration, and intensity of the activity rather than reading alone [19]. Overall, the findings show a substantial prevalence of refractive error among school-going children in Peshawar, with myopia as the most common refractive-error pattern. Several demographic, socioeconomic, familial, and behavioral variables showed statistically significant associations. These findings support the importance of school-based vision screening, early ophthalmic assessment, parental awareness, and appropriate referral services for children with suspected visual impairment.

Ethical Approval

The Institutional Ethics Committee of MTI Lady Reading Hospital, Peshawar, Pakistan, approved this study (Approval No. 278/LRH/MTI/2024) before it began. We conducted the study in accordance with the ethical principles of the Declaration of Helsinki.

Informed Consent: We obtained written informed consent from participants before enrollment. We informed participants and their parents/guardians about the study's purpose and procedures, and participation was voluntary.

Funding: This study received no external funding.

Conflict of Interest: The authors declare that they have no competing interests or conflicts of interest related to this study.

Authors' Contributions

Natasha Junaid: Conceptualization, study design, data collection, interpretation of findings, manuscript drafting, critical revision of the manuscript, final approval of the version to be published, and accountability for all aspects of the work.

Syed Noor: Study design, data collection, data curation, literature review, interpretation of data, manuscript revision, final approval of the version to be published, and accountability for all aspects of the work.

Irfan Ullah Shah : Conceptualization, study supervision, clinical assessment, interpretation of findings, critical revision of the manuscript for important intellectual content, final approval of the version to be published, and accountability for all aspects of the work.

Muhammad Junaid Sethi: Data collection, clinical assessment, data curation, literature review, manuscript revision, final approval of the version to be published, and accountability for all aspects of the work.

Muhammad Ishtiaq: Data analysis, data interpretation, manuscript drafting and revision, critical review of the manuscript for important intellectual content, final approval of the version to be published, and accountability for all aspects of the work.

Sadaf Bilal: Data collection, literature review, data curation, manuscript revision, final approval of the version to be published, and accountability for all aspects of the work.

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