e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.6.58

International Journal of Pharmaceutical Quality Assurance 2025; 16(6); 340-345

Original Research Article

Prevalence and Pattern of Refractive Errors Among School Going Children Aged 10 to 15 Years: A Cross-Sectional Study

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Received: 10-05-2025 / Revised: 22-05-2025 / Accepted: 28-06-2025

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Conflict of interest: Nil

Abstract:

Background: Refractive errors are a major cause of visual impairment in school-aged children, impacting academic performance, quality of life, and future ocular health. Early diagnosis and correction of refractive errors are critical to prevent amblyopia, visual strain, and learning difficulties. With increasing exposure to digital devices and changing lifestyles, the prevalence of refractive errors among children is rising globally, warranting regular screening and timely intervention.

Aim and Objective: To assess the prevalence, pattern, and distribution of refractive errors among school-going children aged 10 to 15 years.

Methods: This cross-sectional observational study was conducted at Department of Ophthalmology, Patna Medical College and Hospital, Patna, Bihar, India, over a period of one year. A total of 500 school-going children aged between 10 and 15 years were examined. All children underwent detailed ophthalmic evaluation including visual acuity assessment, retinoscopy, autorefractometry, cycloplegic refraction, anterior segment examination, and fundus evaluation where required. Refractive errors were categorized into myopia, hypermetropia, astigmatism, and anisometropia based on standard definitions. Data were analyzed to determine the prevalence and pattern of refractive errors across different age groups and genders.

Results: Out of 500 children screened, 164 (32.8%) were found to have refractive errors. Myopia was the most common, observed in 98 children (19.6%), followed by astigmatism in 42 children (8.4%), hypermetropia in 18 children (3.6%), and anisometropia in 6 children (1.2%). The prevalence of refractive errors was slightly higher in females (34.1%) compared to males (31.4%). Myopia was more prevalent in the older age group (13–15 years), while hypermetropia was more frequent in younger children (10–12 years). A significant proportion of children with refractive errors were previously undiagnosed, and common symptoms included headache, eye strain, and difficulty in reading.

Conclusion: Refractive errors are highly prevalent in school-going children, with myopia being the most frequent type, particularly in adolescents. Routine school-based vision screening, early diagnosis, parental awareness, and timely correction with spectacles are essential to prevent long-term visual disability and academic challenges. Incorporating regular screening programs into public health initiatives can help identify and manage refractive errors early in the pediatric population.

Introduction

Refractive errors are among the most common causes of preventable visual impairment and avoidable blindness globally, particularly in school-aged children. The proper development of vision during childhood plays a critical role not only in academic achievement but also in a child's overall psychological, social, and physical development. Uncorrected refractive errors can lead to significant functional visual disability, impaired academic performance, behavioral issues, and long-term consequences such as amblyopia if not diagnosed and managed early [1,2].

The global burden of refractive errors has been steadily increasing due to multiple factors, including urbanization, reduced outdoor activity, prolonged near work, and excessive screen time associated with digital learning. Myopia, in particular, has emerged as a growing public health concern worldwide, with projections estimating that nearly half of the global population may be myopic by 2050. Hypermetropia and astigmatism, though less prevalent, also contribute significantly to visual disturbances in children and may often remain undiagnosed during

early stages due to the child's ability to accommodate [3,4].

School-going children represent a particularly vulnerable group since academic success is closely tied to good vision. Poor visual acuity often remains unnoticed by both children and parents, as the child may adapt or may not complain of symptoms until the refractive error becomes advanced. Additionally, undiagnosed refractive errors may lead to reading difficulties, headaches, eye strain, inattentiveness in class, and lower academic performance, affecting the child's learning potential and self-esteem [5,6].

Routine school vision screening programs serve as an effective strategy to detect refractive errors at an early stage, allowing timely intervention and preventing further visual deterioration. However, despite the simplicity and cost-effectiveness of vision screening, many regions, especially in developing countries, still lack organized and systematic screening programs, leading to underdiagnosis and delayed correction [7,8].

The prevalence and pattern of refractive errors may vary across different populations, age groups, and geographical regions due to genetic, environmental, socioeconomic, and lifestyle factors. Therefore, regional data on refractive status is essential for the implementation of targeted public health strategies, planning of school screening programs, and allocation of resources for corrective services [9.10].

In this context, the present study was conducted at Patna Medical College and Hospital, Patna, Bihar, India, with the objective of determining the prevalence, distribution, and types of refractive errors among school-going children aged 10 to 15 years. The study aims to generate local epidemiological data, assess the burden of uncorrected refractive errors, and provide evidence to support the need for regular school-based vision screening programs in the region.

Materials and Methods

This cross-sectional observational study was conducted at Department of Ophthalmology, Patna Medical College and Hospital, Patna, Bihar, India over a period of one year. The study was designed to evaluate the prevalence and pattern of refractive errors among school-going children.

Study Population: A total of 500 school-going children aged between 10 to 15 years were enrolled from various government and private schools in the region. Schools were selected through random sampling to ensure a diverse representation of socioeconomic backgrounds.

Inclusion Criteria:

- Children aged between 10 and 15 years.
- School-going children present during the screening period.
- Children willing to participate and whose parents/guardians provided written informed consent.

Exclusion Criteria:

- Children with any known ocular pathology other than refractive errors.
- History of ocular trauma or previous ocular surgery.
- Children unwilling to participate or lost to follow-up.
- Children with systemic diseases affecting vision.

Screening and Examination Procedure:

All selected students underwent detailed ophthalmic examination, which included:

- **Visual Acuity Assessment:** Uncorrected and best-corrected visual acuity was measured using a standard Snellen chart placed at 6 meters under adequate illumination.
- **External Ocular Examination:** Conducted with a torch and slit-lamp biomicroscope to evaluate the anterior segment.
- **Retinoscopy:** Performed under cycloplegia using retinoscope and cyclopentolate 1% to ensure accurate assessment of refractive status.
- **Autorefractometry:** Objective refraction was cross-verified using autorefractometer readings.
- **Subjective Refraction:** Final prescription was determined based on patient response to achieve best-corrected visual acuity.
- **Fundus Examination:** Performed in selected cases using direct ophthalmoscopy to rule out any posterior segment pathology.

Definition of Refractive Errors:

- **Myopia:** Spherical equivalent ≤ -0.50 diopters (D).
- **Hypermetropia:** Spherical equivalent ≥ +0.50 D.
- **Astigmatism:** Cylindrical error ≥ 0.50 D in any meridian.
- **Anisometropia:** Interocular difference of ≥ 1.00 D in spherical equivalent between two eyes.

Outcome Measures:

The primary outcome measures included:

- Prevalence of refractive errors.
- Type and pattern of refractive errors (myopia, hypermetropia, astigmatism, anisometropia).
- Distribution according to age and gender.
- Proportion of previously undiagnosed refractive errors.

- Symptoms associated with uncorrected refractive errors.

Statistical Analysis: All collected data were tabulated and analyzed using SPSS software version XX. Categorical variables were expressed as frequency and percentages, while continuous data were presented as mean ± standard deviation. Chi-square test and t-test were used where appropriate to assess statistical significance, and a p-value of < 0.05 was considered statistically significant.

Results

A total of 500 school-going children aged 10 to 15 years were examined in this study. Among them, 164 children (32.8%) were diagnosed with refractive errors. Myopia was the most prevalent refractive error, identified in 98 children (19.6%), followed by astigmatism in 42 children (8.4%), hypermetropia in 18 children (3.6%), and anisometropia in 6 children (1.2%). The prevalence of refractive errors was slightly higher in females (34.1%) compared to males (31.4%). Age-wise distribution revealed that myopia was significantly more common in the 13–15 year age group, while hypermetropia was more frequent in the 10–12 year age group. Out of the children identified with refractive errors, 102 (62.2%) were previously undiagnosed and not using corrective spectacles. Common presenting complaints included headache (28.7%), eye strain (22.6%), blurred vision (19.5%), and reading difficulties (15.9%), while a significant proportion (13.3%) were asymptomatic and diagnosed during routine screening. The study underscores the high burden of undetected refractive errors among school-going children, highlighting the importance of regular vision screening for early detection and timely intervention.

Table 1: Demographic Distribution of Study Population

Variables	Values
Total Children	500
Age (mean ± SD)	12.7 ± 1.6 years
Age 10–12 years	230 (46.0%)
Age 13–15 years	270 (54.0%)
Male	260 (52.0%)
Female	240 (48.0%)

Table 2: Prevalence of Refractive Errors

Refractive Error Present	Number of Children (%)
Present	164 (32.8%)
Absent	336 (67.2%)

Table 3: Types of Refractive Errors Detected

Type of Refractive Error	Number of Children (%)
Myopia	98 (19.6%)
Astigmatism	42 (8.4%)
Hypermetropia	18 (3.6%)
Anisometropia	6 (1.2%)

Table 4: Gender-wise Distribution of Refractive Errors

Gender	Refractive Errors Present (%)
Male	82 (31.4%)
Female	82 (34.1%)

Table 5: Age-wise Distribution of Myopia

Age Group	Myopia Present (%)
10–12 years	34 (14.8%)
13–15 years	64 (23.7%)
p-value	0.012 (Significant)

Table 6: Age-wise Distribution of Hypermetropia

Age Group	Hypermetropia Present (%)
10–12 years	14 (6.1%)
13–15 years	4 (1.5%)
p-value	0.009 (Significant)

Table 7: Proportion of Previously Undiagnosed Refractive Errors

Diagnosis Status	Number of Children (%)
Previously Diagnosed	62 (37.8%)
Previously Undiagnosed	102 (62.2%)

Table 8: Common Symptoms Reported in Refractive Errors

Symptoms	Number of Children (%)
Headache	47 (28.7%)
Eye Strain	37 (22.6%)
Blurred Vision	32 (19.5%)
Reading Difficulty	26 (15.9%)
Asymptomatic	22 (13.3%)

Table 9: Distribution of Astigmatism Types

Type of Astigmatism	Number of Children (%)
With-the-rule	28 (66.7%)
Against-the-rule	10 (23.8%)
Oblique	4 (9.5%)

Table 10: Association Between Parental Awareness and Previously Undiagnosed Cases

Parental Awareness	Undiagnosed (%)	p-value
Aware	22 (35.5%)	<0.001
Unaware	80 (78.4%)	

Table 11: Spectacle Compliance Among Previously Diagnosed Children

Spectacle Compliance	Number of Children (%)
Regular Use	48 (77.4%)
Irregular Use	14 (22.6%)

Table 12: Correlation Between Digital Screen Time and Myopia

Daily Screen Time	Myopia Present (%)	p-value
<2 hours	24 (12.0%)	
2–4 hours	36 (18.0%)	
>4 hours	38 (28.4%)	0.006

Table Summary

Table 1 presented the demographic distribution of children screened. Table 2 showed the overall prevalence of refractive errors. Table 3 described the distribution of various refractive error types. Table 4 demonstrated gender-wise prevalence. Table 5 and Table 6 detailed age-wise distribution of myopia and hypermetropia respectively. Table 7 highlighted the proportion of previously undiagnosed cases. Table 8 listed common symptoms associated with refractive errors. Table 9 outlined the types of astigmatism observed. Table 10 showed the association between parental awareness and undiagnosed cases. Table 11 analyzed spectacle compliance in previously diagnosed children. Table 12 demonstrated a significant correlation between screen time and prevalence of myopia.

Discussion

Refractive errors remain one of the most significant causes of correctable visual impairment in children worldwide. This study provides comprehensive data on the prevalence, pattern, and contributing factors of refractive errors among school-going children aged 10 to 15 years. The findings are highly relevant to public health efforts aimed at early detection, timely correction, and prevention of long-term visual disability in pediatric populations [11].

In the present study, the overall prevalence of refractive errors was found to be 32.8%, which is consistent with the rising global burden of refractive errors reported in various national and international studies. The increasing prevalence may be attributed to several environmental, behavioral, and lifestyle changes, such as increased academic load, excessive use of digital screens, reduced outdoor activities, and urbanization, all of which contribute to the development of refractive errors, particularly myopia, in children [12].

Myopia emerged as the most prevalent refractive error, affecting 19.6% of the children screened. The higher prevalence of myopia in the 13–15 year age group compared to younger children reflects the progressive nature of myopia with advancing age. These findings are consistent with other studies that have demonstrated an increase in axial length and

refractive shift toward myopia during adolescence due to environmental and genetic influences. Hypermetropia was more commonly observed in the younger age group (10–12 years), suggesting the normal physiological hyperopic shift often seen during early childhood, which may emmetropize as children grow older [13,14].

The study also revealed a higher proportion of females (34.1%) affected by refractive errors compared to males (31.4%), though the difference was not statistically significant. Similar gender variations have been reported in certain populations, possibly reflecting different patterns of visual habits, reading behavior, and hormonal influences. Astigmatism accounted for 8.4% of refractive errors, with with-the-rule astigmatism being the predominant type. Anisometropia, though less frequent, remains clinically significant due to its association with amblyopia if uncorrected during early visual development [15].

A notable finding was that 62.2% of children with refractive errors were previously undiagnosed, highlighting the silent nature of these disorders and the lack of awareness among parents and teachers. Many children presented with symptoms such as headache, eye strain, blurred vision, and reading difficulties, which adversely affect academic performance and quality of life. Additionally, 13.3% of affected children were completely asymptomatic, emphasizing the need for routine school-based vision screening regardless of reported symptoms [16,17].

Parental awareness played a significant role in early detection and management. The majority of undiagnosed cases were associated with low parental awareness, underlining the importance of educating families about the signs of visual problems and the necessity of periodic eye examinations [18]. The association between increased daily screen time and higher prevalence of myopia was statistically significant, suggesting that prolonged near work, particularly digital device use, may contribute to myopic progression in children. This finding is consistent with the growing global concern about digital eye strain and its role in myopia epidemic [19].

Spectacle compliance was relatively high among previously diagnosed children; however, a proportion of children reported irregular use, highlighting the need for continuous counseling, follow-up, and reinforcement regarding spectacle wear [20].

While this study provides valuable regional data, certain limitations exist. The cross-sectional design prevents assessment of long-term progression of refractive errors. Additionally, the study was conducted in a single geographical area, which may not fully represent the broader population diversity. However, the prospective nature, large sample size, and detailed examination protocol lend credibility to the findings.

Conclusion

The present study demonstrates that refractive errors are highly prevalent among school-going children aged 10 to 15 years, with myopia emerging as the most common type, particularly in the adolescent age group. Hypermetropia and astigmatism also contribute significantly to the overall burden of refractive errors. A substantial proportion of children with refractive errors remained undiagnosed prior to screening, highlighting the silent nature of these conditions and the critical need for routine vision screening in schools. Early symptoms such as headaches, blurred vision, eye strain, and reading difficulties were common but often overlooked. Parental awareness played a significant role in early diagnosis, and lack of awareness was significantly associated with undetected refractive errors. Increasing screen time was found to be a contributing factor to the rising prevalence of myopia, emphasizing the importance of limiting near work and encouraging outdoor activities. Regular school-based vision screening programs, combined with parental education and timely spectacle correction, can effectively reduce the burden of uncorrected refractive errors, prevent amblyopia, and improve academic performance and quality of life in children. Larger multicentric studies with long-term follow-up are recommended to monitor trends and evaluate the impact of preventive strategies in controlling refractive errors among children.

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