International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 1, January 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122
DOI: 10.69605/ijlbpr_14.1.2025.144

ORIGINAL RESEARCH

Observational Study on the Prevalence and Pattern of Refractive Errors in School-Aged Children

[1]Abhishek Ranjan, [2]Vivek Prasad, [3]Atul Kumar Anand, [4]Pradeep Karak

[1,2,3]Assistant Professor, [4]Associate Professor & HOD, Department of Ophthalmology, Nalanda Medical College & Hospital, Patna, Bihar, India

Corresponding Author
Atul Kumar Anand
Assistant Professor, Department of Ophthalmology, Nalanda Medical College & Hospital, Patna, Bihar, India

Received: 16 November, 2024 Accepted: 21 December, 2024 Published: 10 January, 2025

ABSTRACT
Aim: To assess the prevalence and pattern of refractive errors among school-aged children in the 6–16 years age group in an urban-rural population attending schools in the vicinity of Nalanda Medical College and Hospital, Patna.**Material and Methods:**This observational cross-sectional study was conducted over a one-year period from January 2021to December 2022. A total of 110 children aged 6–16 years were selected from nearby schools using multistage random sampling. After obtaining informed consent, participants underwent detailed ophthalmic examinations including visual acuity testing, pinhole test, torchlight examination, and cycloplegic refraction. Refractive errors were classified as myopia (≤ −0.50 D), hypermetropia (≥ +2.00 D), or astigmatism (≥ 0.50 D cylinder). Data were analyzed using descriptive statistics and logistic regression to identify predictors.**Results:**Among 110 children (59 males, 51 females), the overall prevalence of refractive errors was 52.73%. Myopia was the most common type (28.18%), followed by astigmatism (13.64%) and hypermetropia (10.91%). Prevalence increased with age from 40.91% in the 6–8 years group to 65.52% in the 15–16 years group. Most cases (81.03%) were bilateral. Logistic regression showed age (OR = 1.20, p = 0.004) and urban residence (OR = 2.32, p = 0.033) as significant predictors. Gender was not significantly associated with refractive error (p = 0.510).**Conclusion:**Refractive errors are highly prevalent in school-aged children, particularly myopia, and show a strong association with increasing age and urban residence. Regular school-based vision screening programs are essential for early detection and timely correction to prevent visual disability.

Keywords: Refractive error, Myopia, School children, Prevalence, Cycloplegic refraction

INTRODUCTION

Refractive errors are among the most common causes of visual impairment worldwide, particularly in children. These conditions, including myopia, hypermetropia, and astigmatism, are characterized by the eye’s inability to properly focus light on the retina, resulting in blurred vision. If not detected and corrected at an early stage, refractive errors in children can adversely impact academic performance, social interaction, and overall quality of life. Moreover, uncorrected refractive errors have been identified as one of the leading causes of avoidable visual disability across the globe.[1-5]

The prevalence of refractive errors varies considerably across regions, influenced by genetic, environmental, socioeconomic, and lifestyle factors. Studies have shown marked differences in prevalence between rural and urban populations, as well as among different age groups and genders. In India, a country with a vast and diverse population, school-going children represent a critical demographic in which early identification of refractive anomalies can prevent long-term visual and developmental consequences.[2,4]

Globally, the burden of uncorrected refractive errors is substantial. According to meta-analyses and global surveys, millions of children suffer from refractive anomalies that remain uncorrected due to lack of awareness, inadequate access to vision care services, or socio-economic barriers.[5,6]In low- and middle-income countries, these challenges are further compounded by the absence of systematic school-based screening programs. The World Health Organization and several national eye health initiatives have emphasized the need for integrating vision screening into school health programs as a cost-effective approach to reduce childhood visual impairment.[1]

DOI: 10.69605/ijlbpr_14.1.2025.144

India, in particular, faces a dual burden of refractive error prevalence: the incidence is rising in urban areas due to increasing screen exposure and academic pressures, while in rural settings, lack of awareness and access to eye care services result in poor detection rates.[7,8] Several regional studies have reported prevalence rates ranging from 5% to over 30% among school-aged children, depending on the population studied and methodology employed.[2,4,8]Despite these variations, a consistent trend points to a growing need for routine visual screening and corrective interventions at the primary care level.

Myopia has emerged as the most frequently reported refractive error in children, and its prevalence has shown a marked increase over the last two decades, particularly in urban and semi-urban populations.[3,5] Contributing factors include increased near work activities, reduced outdoor exposure, and prolonged screen use—all lifestyle changes that are becoming increasingly common among school-aged children. Hypermetropia and astigmatism, although less prevalent than myopia, also contribute significantly to the burden of uncorrected visual impairment, particularly when left undiagnosed in younger children.[6,7]

A major barrier in addressing refractive errors in children is the asymptomatic nature of the condition in many cases. Children rarely report visual problems, and many adapt by squinting or sitting closer to the board, often going unnoticed by parents or teachers. This underscores the importance of proactive school-based screening, which can serve as a practical, community-level intervention to identify and manage cases early.[1,7]

The use of spectacles remains the primary method of correction, and studies have shown that with proper prescription and compliance, significant improvements in visual acuity and functional performance can be achieved. However, cultural stigmas, aesthetic concerns, and poor access to affordable eyewear continue to limit acceptance and utilization of corrective devices in many parts of India.[6] In this context, pediatric ophthalmologists and public health experts advocate for child-friendly designs, subsidized distribution, and parent-teacher sensitization programs to improve compliance.[7]

In recent years, comprehensive population-based and school-based studies have attempted to quantify the magnitude of refractive errors among Indian children. For example, a multi-state investigation conducted in both urban and rural schools revealed varying patterns in prevalence and types of refractive errors, with urban children displaying higher rates of myopia, while astigmatism was more evenly distributed.[8] Additionally, a tertiary hospital-based study highlighted the clinical diversity and diagnostic challenges in detecting refractive anomalies in children, particularly among those with coexisting ocular or systemic disorders.[9]

Despite the growing body of literature, gaps remain in understanding the regional variability in refractive error distribution, the age-specific prevalence patterns, and the barriers to uptake of corrective services. Many existing studies are limited by small sample sizes, localized populations, or lack of follow-up data on compliance and outcomes. Moreover, few have examined the combined influence of demographic, environmental, and educational variables on refractive error patterns in the Indian school-going population.

This observational study aims to contribute to this evolving field by systematically assessing the prevalence and pattern of refractive errors in school-aged children across both urban and rural settings. By identifying age-wise and gender-wise distribution of refractive errors, the study also seeks to provide insights that can inform the development of targeted screening and intervention strategies. The data generated may serve as a useful reference for public health planners, educators, and vision care providers in formulating effective policies for early detection and management of refractive errors in children.

MATERIAL AND METHODS

This observational cross-sectional study was conducted at Nalanda Medical College and Hospital, Patna, over a period of one year, from January 2021 to December 2022. The primary objective was to assess the prevalence and types of refractive errors among school-aged children.

A total of 110 students aged between 6 -16 years were included in the study. Participants were selected from both urban and rural schools located within the vicinity of the hospital using a multistage random sampling technique. Prior to enrolment, necessary approvals were obtained from the Institutional Ethics Committee, and written informed consent was secured from parents or guardians, along with assent from the children wherever applicable.

Inclusion Criteria

- Children aged 6 to 16 years.
- Students present on the day of examination.
- Those who gave consent and showed willingness to undergo eye screening.

Exclusion Criteria

- Children with congenital or acquired ocular pathology other than refractive errors.
- History of previous ocular surgery.
- Children uncooperative or absent during vision testing.

Each child underwent a detailed ophthalmic examination at the school premises. The evaluation began with an assessment of visual acuity using a standard Snellen's chart for older children or age-appropriate optotypes for younger participants. To determine the potential for visual improvement, a pinhole test was subsequently performed. External ocular structures and the anterior segment of the eye

Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.1.2025.144

were examined under torchlight illumination to identify any gross abnormalities. Cycloplegic refraction was carried out to neutralize accommodation—1% cyclopentolate eye drops were used in children below 10 years of age, while 1% tropicamide was used in older children. Following adequate cycloplegia, retinoscopy and subjective refraction were performed by trained optometrists and the findings were verified by an ophthalmologist. When clinically indicated, posterior segment evaluation was conducted using a direct ophthalmoscope to rule out any underlying retinal pathology.

Refractive errors were classified based on the spherical equivalent or cylindrical power as follows: myopia was defined as a spherical equivalent of ≤ −0.50 diopters, hypermetropia as a spherical equivalent of ≥ +2.00 diopters, and astigmatism as the presence of a cylindrical error of ≥ 0.50 diopters.

The data collected was compiled and analyzed using descriptive statistics. Results were expressed in terms of frequencies and percentages. The prevalence of each refractive error type was calculated, and age- and gender-wise distributions were studied.

RESULTS

In the present study, a total of 110 school-aged children between 6 -16 years of age were examined to assess the prevalence and distribution of refractive errors. As shown in Table 1, the study population comprised 59 males (53.64%) and 51 females (46.36%). The majority of children belonged to the 12–14-year age group (29.09%), followed by 15–16 years (26.36%), 9–11 years (24.55%), and 6–8 years (20.00%). This distribution ensured balanced representation across early childhood to mid-adolescence.

Table 2 outlines the overall prevalence of refractive errors. Out of 110 children screened, 58 were found to have some form of refractive error, accounting for a prevalence of 52.73%. Among these, myopia was the most frequently encountered type, affecting 31 children (28.18%), followed by astigmatism in 15 children (13.64%) and hypermetropia in 12 children (10.91%). Notably, 47.27% of the total population had no detectable refractive errors, indicating that nearly half of the screened children had normal vision.

Table 3 presents the gender-wise distribution of refractive errors. Among the 59 males, 18 had myopia, 7 had hypermetropia, and 9 had astigmatism, totaling 34 males (57.63%) with some refractive error. Among the 51 females, 13 had myopia, 5 had hypermetropia, and 6 had astigmatism, totaling 24 females (47.06%) with refractive errors. Although a slightly higher prevalence of refractive errors was observed in males compared to females, the difference was not statistically significant. The distribution of each type of refractive error was relatively balanced across genders.

When stratified by age group as shown in Table 4, the prevalence of refractive errors increased with age. In the youngest group (6–8 years), 9 children (40.91%) were diagnosed with refractive errors. This increased to 13 children (48.15%) in the 9–11 years group, 17 children (53.13%) in the 12–14 years group, and 19 children (65.52%) in the oldest age group (15–16 years). Myopia was the predominant error in all age groups except 6–8 years, where hypermetropia was relatively more frequent. These findings suggest a trend of increasing refractive error prevalence with advancing age, possibly due to prolonged near work, increased screen exposure, or other environmental and developmental factors.

Table 5 analyzes the laterality of refractive errors among the 58 affected children. A large majority, 47 children (81.03%), had bilateral refractive errors, while 11 children (18.97%) had unilateral involvement. This highlights that most refractive errors in this population affected both eyes, underscoring the need for bilateral vision screening in school health programs.

To identify independent predictors of refractive error, a multiple logistic regression analysis was conducted, as shown in Table 6. The analysis revealed that age was a statistically significant predictor, with an odds ratio (OR) of 1.20 (95% CI: 1.06–1.37, p = 0.004), indicating that each additional year of age was associated with a 20% increase in the likelihood of having a refractive error. Urban residence was also significantly associated with refractive errors, with an OR of 2.32 (95% CI: 1.07–5.02, p = 0.033), suggesting children from urban areas were more than twice as likely to develop refractive errors compared to their rural counterparts, possibly due to increased exposure to digital devices and reduced outdoor activity. Gender, however, was not a significant predictor (p = 0.510), implying no substantial difference in refractive error prevalence between males and females.

Table 1: Age and Gender Distribution of Study Participants (n = 110)

Age Group (Years)	Male (n)	Female (n)	Total (n)	Percentage (%)
6–8	12	10	22	20.00%
9–11	14	13	27	24.55%
12–14	17	15	32	29.09%
15–16	16	13	29	26.36%
Total	**59**	**51**	**110**	**100.00%**

DOI: 10.69605/ijlbpr_14.1.2025.144

Table 2: Prevalence of Refractive Errors Among the Participants

Refractive Status	Number of Children (n)	Percentage (%)
Myopia	31	28.18%
Hypermetropia	12	10.91%
Astigmatism	15	13.64%
No Refractive Error	52	47.27%
Total	**110**	**100.00%**

Table 3: Gender-wise Distribution of Refractive Errors

Type of Refractive Error	Male (n = 59)	Female (n = 51)	Total (n)	Percentage (%)
Myopia	18	13	31	28.18%
Hypermetropia	7	5	12	10.91%
Astigmatism	9	6	15	13.64%
No Error	25	27	52	47.27%

Table 4: Age-wise Distribution of Refractive Errors

Age Group (Years)	Myopia (n)	Hypermetropia (n)	Astigmatism (n)	Total with RE (n)	Percentage (%)
6–8	3	4	2	9	40.91%
9–11	6	3	4	13	48.15%
12–14	10	2	5	17	53.13%
15–16	12	3	4	19	65.52%
Total	**31**	**12**	**15**	**58**	**52.73%**

Table 5: Laterality of Refractive Errors in Affected Children (n = 58)

Laterality	Number of Children	Percentage (%)
Bilateral	47	81.03%
Unilateral	11	18.97%
Total	**58**	**100.00%**

Table 6: Multiple Logistic Regression Analysis for Predictors of Refractive Error (n = 110)

Variable	β Coefficient	Standard Error	Odds Ratio (OR)	95% CI for OR	p-value
Age (years)	0.185	0.062	1.20	1.06 – 1.37	0.004
Gender (Male)	0.274	0.428	1.32	0.57 – 3.03	0.510
Urban residence	0.843	0.399	2.32	1.07 – 5.02	0.033

DISCUSSION

The demographic distribution in this study, as shown in Table 1, demonstrated balanced representation across age and gender groups, which adds to the generalizability of the results. The predominance of participants in the 12–14-year (29.09%) and 15–16-year (26.36%) age groups is consistent with the age range at which refractive errors are known to manifest more frequently due to academic pressure and prolonged near work. Similar age distributions were reported in studies by Pavithra et al. and Kerkar&Thombre, who focused on the 7–17 years age group and found increased error prevalence in older children due to environmental and behavioral factors like reduced outdoor activity and increased screen time.[10,11]

The overall prevalence of refractive errors in our study was 52.73% (Table 2), which is notably higher compared to other Indian studies. Hassan et al. reported a prevalence of 33.4% among schoolchildren in Kashmir[12] , while Pavithra et al. found a prevalence of 21.1% in Bangalore.[10] The higher prevalence in our study could be attributed to the urban-rural mix of schools, increased digital screen exposure post-COVID-19 lockdown, and differing diagnostic protocols such as cycloplegic refraction, which may yield more accurate detection. Notably, myopia was the most common refractive error (28.18%), followed by astigmatism (13.64%) and hypermetropia (10.91%). This aligns with global and national trends where myopia is increasingly emerging as a public health concern among school-aged children, as emphasized in the systematic review by Sheeladevi et al., which highlighted rising myopia rates in Indian children.[13]

Gender-wise analysis (Table 3) revealed that refractive errors were slightly more common in males (57.63%) compared to females (47.06%), although the difference was not statistically significant. This is consistent with findings from Czepita et al., who also observed a non-significant gender variation in the occurrence of refractive errors.[14] However, other studies like the one by Wadaani et al. in Saudi Arabia have reported a higher prevalence in females , indicating potential regional and lifestyle-based influences on gender trends.[15]

Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.1.2025.144

The age-wise distribution (Table 4) showed a progressive increase in refractive error prevalence with advancing age, from 40.91% in the 6–8 years group to 65.52% in the 15–16 years group. This trend was also reported in the studies by Dandona et al. in rural Andhra Pradesh and Padhye et al. in Maharashtra, where the prevalence of refractive errors increased with age due to higher academic load and more sustained near tasks.[16,17] Myopia, in particular, demonstrated a strong age correlation, suggesting its development is influenced by visual demands of education and environmental factors, a conclusion also supported by Pokharel et al. in their study from Nepal.[18]

The majority of refractive errors were bilateral (81.03%) as observed in Table 5, which is in agreement with studies from Nepal (Pant et al.) and Ethiopia (Yared et al.), where bilateral involvement was also predominant . This has important implications for school screening programs, as unilateral cases may be underdiagnosed if comprehensive binocular assessments are not employed. It also emphasizes the potential for undetected amblyopia if such refractive errors are not identified early.[19,20]

Table 6 presents the results of logistic regression analysis, identifying age and urban residence as significant predictors of refractive error. Each one-year increase in age increased the odds of having a refractive error by 20% ($p = 0.004$), consistent with our findings in Table 4 and corroborated by Ayub et al., who also noted an age-dependent rise in prevalence.[21] The association between urban residence and higher refractive error prevalence (OR = 2.32; $p = 0.033$) has been similarly observed in studies by Padhye et al. and Parmar et al., who reported that urban children are more likely to develop refractive errors than rural counterparts due to limited outdoor exposure and increased screen-based education.[17,22] Interestingly, gender did not emerge as a significant predictor ($p = 0.510$), further reinforcing the notion that refractive error development is more closely linked to environmental exposures and age-related factors than to biological sex.

CONCLUSION

This study highlights a high prevalence (52.73%) of refractive errors among school-aged children, with myopia being the most common type. The occurrence of refractive errors increased significantly with age and was more frequent among children from urban areas. Most cases were bilateral, emphasizing the importance of comprehensive screening. Although gender differences were not statistically significant, the findings underscore the need for early detection and regular school-based vision screening programs to prevent long-term visual impairment and academic hindrance.

REFERENCES

1. Baltussen R, Naus J, Limburg H. Cost-effectiveness of screening and correcting refractive errors in school children in Africa, Asia, America and Europe. Health Policy. 2009;89(2-3):201–15. doi:10.1016/j.healthpol.2008.06.003
2. Raju P, Ramesh SV, Arvind H, George R, Baskaran M, Paul PG, et al. Prevalence of refractive errors in a rural South Indian population. Invest Ophthalmol Vis Sci. 2004;45(13):4268–72. doi:10.1167/iovs.04-0221
3. Triveni C, Divya T, Devi PR, Chowdary NL, Sirisha G. Prevalence of refractive errors in school going children in rural and urban areas – a cross-sectional study. Trop J OphthalmolOtolaryngol. 2021;6(2):22–7. doi:10.17511/jooo.2021.i02.01
4. Joseph E, Ck M, Kumar R, Sinha S, Raj N, Sharma A, et al. Prevalence of refractive errors among school-going children in a multistate study in India. Br J Ophthalmol. 2023;108(1):143–51. doi:10.1136/bjo-2022-322123
5. Hashemi H, Fotouhi A, Yekta A, Pakzad R, Ostadimoghaddam H, Khabazkhoob M. Global and regional estimates of prevalence of refractive errors: systematic review and meta-analysis. J CurrOphthalmol. 2018;30(1):3–22. doi:10.1016/j.joco.2017.08.009
6. Sheeladevi S, Seelam B, Nukella PB, Borah RR, Ali R, Keay L. Prevalence of refractive errors, uncorrected refractive error, and presbyopia in adults in India: a systematic review. Indian J Ophthalmol. 2019;67(5):583–92. doi:10.4103/ijo.IJO_1235_18
7. Donahue SP. Prescribing spectacles in children: a pediatric ophthalmologist's approach. Optom Vis Sci. 2007;84(2):110–4. doi:10.1097/OPX.0b013e318031b09b
8. Srivastava T, Kumar A, Shukla E, Singh S, Sharma A, Yadav V, et al. Prevalence of refractive errors among school-going children in urban versus rural areas. Cureus. 2024 Apr 28;16(4):e59197. doi:10.7759/cureus.59197
9. Kalita P, Dutt I, Boro M. A clinical study to know the pattern of refractive error in children attending a tertiary care hospital. Int J Res Med Sci. 2023;11(8):2068–71.
10. Pavithra MB, Maheshwaran R, Rani Sujatha MA. A study on the prevalence of refractive errors among school children of 7–15 years of age group in the field practice areas of a medical college in Bangalore. Int J Med Sci Public Health. 2013;2(3):641–5.
11. Kerkar S, Thombre A. An observational study to evaluate the prevalence and pattern of refractive errors in children aged 3–17 years in Mumbai, India. Int J ContempPediatr. 2020;7(5):1028–32. doi:10.18203/2349-3291.ijcp20201632
12. Hassan S, Nabi S, Zahoor N, Khan S, Makayee AA, Wahab A. Prevalence and pattern of refractive errors among school-going children in district Baramulla, Kashmir: A cross-sectional study. Indian J Ophthalmol. 2023;71(12):3642–5. doi:10.4103/IJO.IJO_982_23. PMID: 37991297; PMCID: PMC10788752
13. Sheeladevi S, Seelam B, Nukella PB, Modi A, Ali R, Keay L. Prevalence of refractive errors in children in India: a systematic review. ClinExpOptom. 2018;101(4):495–503. doi:10.1111/cxo.12678
14. Czepita D, Mojsa A, Ustianowska M, Czepita M, Lachowicz E. Role of gender in the occurrence of

DOI: 10.69605/ijlbpr_14.1.2025.144

refractive errors. Ann Acad Med Stetin. 2007;53(2):5–7.
15. Wadaani FA, Amin TT, Ali A, Khan AR. Prevalence and pattern of refractive errors among primary school children in Al Hassa, Saudi Arabia. Glob J Health Sci. 2012;5(1):125–34.
16. Dandona R, Dandona L, Srinivas M, Sahare P, Narasaiah S, Munoz SR, et al. Refractive error in children in a rural population in India. Invest Ophthalmol Vis Sci. 2002;43(3):615–22.
17. Padhye AS, Khandekar R, Dharmadhikari S, Dole K, Gogate P, Deshpande M. Prevalence of uncorrected refractive error and other eye problems among urban and rural school children. Middle East Afr J Ophthalmol. 2009;16(2):69–74.
18. Pokharel GP, Negrel AD, Munoz SR, Ellwein LB. Refractive error study in children: results from Mechi Zone, Nepal. Am J Ophthalmol. 2000;129(4):436–44.
19. Pant BP, Ghising R, Awasthi S, Pant SR, Bhatta RC. Refractive status among the students presenting to Geta Eye Hospital, Kailali, Nepal. Nepal Med Coll J. 2010;12(2):95–9.
20. Yared AW, Belaynew WT, Destaye S, Ayanaw T, Zelalem E. Prevalence of refractive errors among school children in Gondar town, northwest Ethiopia. Middle East Afr J Ophthalmol. 2012;19(4):372–6.
21. Ayub Ali IA, Ayub S. Prevalence of undetected refractive errors among school children. Biomedica. 2007;23:96–101.
22. Parmar A, Kartha G, Baria M. A study on the prevalence of refractive errors among school children of 10–16 years in Surendranagar district, Gujarat. Int J Community Med Public Health. 2017;4(9):3376–80.