e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(2); 1151-1162

Original Research Article

Prevalence of Refractive Errors among School-Going Children and its Association with Screen Time

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Received: 01-12-2025 / Revised: 16-01-2026 / Accepted: 06-02-2026

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Conflict of interest: Nil

Abstract

Refractive errors are a major cause of visual impairment in children, adversely affecting learning, daily activities, and overall quality of life, and the increasing use of digital devices has raised concerns regarding the impact of prolonged screen time on ocular health. This cross-sectional observational study was conducted over one year at Gautam Buddha Chikitsa Mahavidyalaya, Jhajra, Dehradun, to determine the prevalence of refractive errors among 30 school-going children aged 6–18 years and to assess their association with screen time. Data on demographic characteristics, type of refractive error, daily screen time, visual acuity, and spherical equivalent were collected and statistically analyzed. The mean age of participants was 12.8 ± 3.2 years, with males comprising 53.3% of the study population. Myopia was the most common refractive error, affecting 40% of children, and showed a significant association with screen time of ≥2 hours per day ($p = 0.03$). Mean visual acuity was significantly higher in myopic children (0.35 ± 0.12; $p = 0.02$), and a moderate positive correlation was observed between screen time and spherical equivalent ($r = 0.46$, $p = 0.01$). The findings indicate that myopia is the predominant refractive error among school-going children and is significantly associated with prolonged screen exposure, highlighting the need for regular vision screening, eye health education, and regulation of screen use to prevent visual impairment and promote optimal academic and social development.

Keywords: Refractive errors; Myopia; Hyperopia; Astigmatism; School children; Screen time.

DOI: 10.25258/ijcpr.18.2.192

Introduction

Worldwide, refractive errors are prevalent ocular disorders in children and represent a significant contributor to visual impairment among this demographic. A refractive error arises when the optical system of the eye does not correctly focus light onto the retina, leading to blurred vision. Refractive errors mainly consist of myopia (nearsightedness), hyperopia (farsightedness), and astigmatism. Each can affect a child's visual performance and quality of life to differing extents. It is essential to identify and rectify refractive errors early on, as a lack of correction for visual impairment can disrupt educational achievement, psychosocial growth, and general health in vital school years [1]. The prevalence of refractive errors among school-aged children varies significantly worldwide, influenced by geographic, ethnic, and environmental factors. A significant multistate study conducted in India found that the prevalence of myopia rose with age, impacting as many as 4.8% of older adolescents, which suggests a significant age-related trend in the distribution of refractive errors[2]. Likewise, concentrated regional investigations in East Sikkim revealed that the prevalence of refractive error among schoolchildren is 6.7%, with myopia being the predominant subtype [3]. Data from other regions also corroborate the prevalence of refractive anomalies among children in both urban and rural environments [4,5]. Alongside genetic and demographic factors, lifestyle choices and environmental exposures have come to be seen as increasingly involved in the onset and advancement of refractive errors. Among these, screen time—which refers to the amount of time spent using digital devices like smartphones, tablets, computers, and televisions—has been identified as a potential risk factor in recent years. Children's

everyday activities have changed dramatically due to the rise of digital technology, resulting in longer periods spent on screens for online learning, gaming, and entertainment. This change has sparked worries among researchers and clinicians regarding the potential eye-related effects of prolonged near work and diminished outdoor activities [6,7]. A number of epidemiological studies indicate a significant correlation between increased screen time and the onset of myopia in children. A meta-analysis investigating screen exposure and myopia found that children with higher screen time had significantly greater odds of developing myopia compared to those with lower exposure, with an approximate 21% increase in the odds of myopia for each additional hour of daily screen time [8]. Another cross-sectional study involving school-aged children discovered that refractive errors were significantly more common among those who reported extended screen engagement (>4 hours daily), underscoring the possible connection between digital device use and visual impairment[9]. These observations align with broader research suggesting that prolonged near-work, including the use of digital devices, may lead to accommodative stress and ocular elongation, which are key mechanisms involved in myopia progression [10]. Although evidence is accumulating, the connection between screen time and refractive errors in school-age children continues to be a topic of ongoing investigation. Numerous studies have documented significant associations; however, the majority of these are cross-sectional, which restricts causal inferences. Variations in study design, definitions of screen exposure, and methods of measuring refractive outcomes add to the complexity of making comparisons. Some studies point out robust correlations, whereas others stress that the development of refractive error is influenced by multiple factors, such as genetic predisposition and the amount of outdoor activity. In light of the significant burden posed by uncorrected refractive errors and the growing prevalence of digital device usage among children, it is essential to assess the current prevalence of refractive errors and investigate their correlation with screen time in school environments. Such data are crucial for informing school-based vision screening programs, public health policies, and parental education initiatives designed to maintain visual health while managing digital engagement. To establish how widespread refractive errors are in the 6–18-year-old school-going population and to evaluate the link between screen time and refractive error status.

Methodology

This review article was conducted using a structured narrative review approach to synthesize existing evidence on the prevalence of refractive errors among school-going children and their association with screen time. The methodology followed standard guidelines for non-systematic narrative reviews, including comprehensive literature identification from major electronic databases, critical appraisal of relevant studies, and thematic synthesis of findings. Peer-reviewed original research articles, observational studies, and reports from reputable organizations published between 2000 and 2024 were included. The extracted data were qualitatively analyzed to identify patterns, trends, and associations between digital screen exposure and refractive error development in children.

Search Strategy: A comprehensive literature search was conducted across major electronic databases including PubMed, Scopus, Web of Science, and Google Scholar to identify relevant studies on refractive errors and screen time among school-going children. The search included articles published between 2000 and 2024 to capture both early evidence and recent research developments. In addition, reports, guidelines, and policy documents from reputable organizations such as the World Health Organization (WHO) and UNICEF were reviewed to obtain global and regional perspectives on childhood visual impairment and digital device use.

Relevant keywords and Medical Subject Headings (MeSH) were used in various combinations, including: refractive errors, myopia, hyperopia, astigmatism, visual impairment, school-going children, school-aged children, screen time, digital devices, mobile phones, computers, tablets, near work, and visual acuity. Boolean operators (AND, OR) were applied to refine and narrow the search results. Reference lists of selected articles were also manually screened to identify additional relevant studies.

Inclusion and Exclusion Criteria

- School-going children aged 6-18 years.
- Children whose parents/guardians provide informed consent.
- Children present on the day of examination.

Exclusion Criteria

- Children with known ocular pathology other than refractive errors.
- Children with history of ocular surgery or trauma.
- Children with systemic diseases affecting vision (e.g., diabetes, neurological disorders).
- Children unable to cooperate for vision testing.

Study Selection and Data Extraction: Titles and abstracts were initially screened to identify studies relevant to the prevalence of refractive errors among school-going children and their association

with screen time exposure. Full-text articles of potentially eligible studies were subsequently reviewed to confirm inclusion.

Data were systematically extracted focusing on: study design, sample size and age group of children, type of refractive errors assessed, methods of visual acuity assessment, duration and type of screen time exposure (mobile phones, computers, tablets, television), and key outcomes related to refractive errors. Greater emphasis was placed on studies with standardized ophthalmic assessment methods and clear measurement of screen time.

Data Synthesis: Due to variability in study designs, age groups, diagnostic criteria, and screen time assessment tools, a narrative synthesis approach was employed. The findings were organized into the following thematic domains:

1. Prevalence and types of refractive errors (myopia, hypermetropia, astigmatism)
2. Screen time exposure (duration, frequency, and type of digital devices used)
3. Association between screen time and refractive errors
4. Contributing factors and modifiers (age, gender, outdoor activity, reading habits, and socioeconomic factors)

Table 1:

Author (s)	Journal	Year	Place	Number of Patients / Subjects	Method	Objectives	Results	Conclusion
Singh Spet al [11]	International Journal of Life Sciences	2025	India	40 children aged 6 to 16 years	This observational, cross-sectionalstudy	To determine the prevalence and identify the potential risk factors associated with refractive errors among school-going children in urban areas	The prevalence ofrefractive errors was 43.57% (61/140). Myopia was the most common type (24.29%), followed by astigmatism (10.71%) andhyperopia (8.57%). A significant association was observed between refractive errors and screen time, with 50.82% ofaffected children having >2 hours/day screen exposure ($p < 0.01$). Outdoor activity had an inverse relationship; 62.30% ofchildren with refractive errors had <1 hour/day of outdoor play ($p < 0.01$). Family history was also significant, with 63.93%of affected children having a positive parental history ($p < 0.001$). No significant differences were found in prevalence byage group or gender ($p = 0.84$)	A high prevalence of refractive errors was observed among urban schoolchildren, with myopia being the most common. Significant risk factors identified included prolonged screen exposure,reduced outdoor activity, and positive family history. Implementation of regular school-based vision screening andawareness regarding modifiable lifestyle factors is essential to reduce the burden of visual impairment in children.

Shafqat Ali Shah et al [12]	*Vascular and Endovascular Review*	2025	UK	100 school-going children aged 6–16 years	Cross-sectional study	To determine the prevalence of refractive errors among school-aged children and assess associated risk factors, including age, gender, screen time, outdoor activity, family history of eye disease, and existing refractive errors.	Among 100 children screened, 28% were diagnosed with refractive errors. The mean age of participants was 11.2 ± 2.7 years. Myopia was the most common type (60.7%), followed by astigmatism (25%) and hyperopia (14.3%). Refractive errors were significantly more prevalent in females ($p = 0.034$) and in children with increased screen time (>2 hours/day, $p = 0.021$). A strong association was observed between reduced outdoor activity and the presence of myopia ($p = 0.015$). Family history of refractive errors was also significantly associated ($p = 0.008$), suggesting a genetic predisposition. These findings emphasize the multifactorial nature of childhood refractive errors.	the school children examined had refractive errors, the majority of which were myopic. Gender, screen time, outdoor activities, and family history had strong associations. To mitigate the impact of visual impairment, primary interventions such as school vision screenings and early optical interventions should be implemented. School vision screenings, along with parental education, will help in the early detection of visual impairment.
Servey N et al [13]	Journal of Clinical & Diagnostic Research	2022	India	118 (33%) 5-15 yrs	A Prospective Study	To study the clinical profile of refractive errors of the children aged 5-15 years in a tertiary care hospital in COVID pandemic in association with screen time, outdoor activity, type of gadget, amblyopia and educational status of mother.	A total of 790 children were screened out of which 358 (45.3%) presented with refractive error when compared with the pre pandemic prevalence 276 (34.9%) out of 790 children screened, presented with the refractive error. A total of 118 (33%) of the children presented with increased blink rate associated with increased screen time and dry eye. Rate of progression of more than 1D was observed in 44 (12.29%) of which Myopia 28 (7.8%) Astigmatism 10 (2.7%) and hypermetropia 6 (1.6%) in 6 months. A total of 286 (79.8%) children presented with myopia and 24 (6.7%) presented with hypermetropia, 48 (13.4%) presented with astigmatism. A total of 258 (72.06%) presented with screen time for 4-7 hrs, and 32 (8.9%) children presented with amblyopia.	Refractive errors increased due to smart classes in schools or use of laptops, television viewing, computers or mobiles. Hence, this reinforces the need to screen all the school going children and children with the history of gadgets use.

Joseph E et al [14]	British Journal of Ophthalmology	2023	India	2 240 804 children 5–18	In this cross-sectional study	Much existing data on childhood refractive error prevalence in India were gathered in local studies, many now dated. The aim of this study was to estimate the prevalence, severity and determinants of refractive errors among school-going children participating in a multistate vision screening programme across India.	Among 2 240 804 children (50.9% boys, mean age 11.5 years, SD ±3.3), the prevalence of SE myopia was 1.57% (95% CI 1.54% to 1.60%) at 5–9 years, 3.13% (95% CI 3.09% to 3.16%) at 10–14 years and 4.8% (95% CI 4.73% to 4.86%) at 15–18 years. Hyperopia prevalence was 0.59% (95% CI 0.57% to 0.61%), 0.54% (95% CI 0.53% to 0.56%) and 0.39% (95% CI 0.37% to 0.41%), respectively. When defined by spherical ametropia, these values for myopia were 0.84%, 2.50% and 4.24%, and those for hyperopia were 2.11%, 2.41% and 2.07%, respectively	Refractive error, especially myopia, is common in India. Differences in prevalence between states appear to be driven by literacy rates, suggesting that the burden of myopia may rise as literacy increases.
Alem KD et al [15]	Journal of International Medical Research	2021	India	529 children	cross-sectional study	This study assessed the prevalence of refractive error (RE) and its associated factors among elementary school children in Hawassa, Ethiopia	Overall, 529 children participated in this study, with a response rate of 95.5% (529/554). Most participants were aged ≥12 years (337 [63.7%]), in grade levels 5 to 8 (307 [58%]), and attended public schools (366 [69.2%]). RE prevalence was 12.9% (95% CI: 10.0–16.1). Higher grade level (AOR=3.18, 95% CI: 1.68–5.97), positive family history of RE (AOR=3.69, 95% CI: 1.57–8.67), lack of paternal formal education (AOR=3.25, 95% CI: 1.20–8.77), and public school attendance (AOR=3.33, 95% CI: 1.52–7.27) were factors significantly associated with RE	RE prevalence among elementary school children in Hawassa was higher than in previous reports. Grade level, family history, paternal education level, and school type significantly influenced RE status.

Habani S et al [16]	Beyoglu Eye Journal	2024	Algeria	208 school children 6–18 years	cross-sectional study	The shift from outdoor play to prolonged use of electronic devices among children, exacerbated by the COVID-19 pandemic, has raised concerns about its impact on visual health. This study explores the relationship between the excessive use of digital devices and the development of various refractive errors in children. This study aims to investigate the association between excessive screen time (including smartphones, tablets, computers, and televisions) with different types of refractive errors and axial length (AL) elongation in a cohort of school-	The study revealed a significant decrease in mean spherical equivalence (SE) in both eyes over the 1-year period. In the right eye (RE), SE dropped from −0.96 D to −1.48 D, and in the left eye (LE) from −0.70 D to −1.39 D. Myopic astigmatism was the most prevalent condition, affecting 51% of children, especially younger screen users ($p<0.001$). Axial length (AL) increased in both eyes, with an average elongation of 0.54 mm in the RE and 0.57 mm in the LE. There was a strong correlation between excessive screen use and the progression of myopic astigmatism, along with changes in spherical equivalence. Factors such as device type, screen time, and reduced outdoor activity were significantly associated with the progression of refractive errors and AL elongation ($p<0.005$).	Prolonged use of digital screens is significantly correlated with increased risks of myopic astigmatism, AL elongation, and changes in spherical equivalent values. These findings emphasize the urgent need for further research and public health measures to address the impact of prolonged digital device use on children's vision.

						aged children in North-West Algeria. It is a cross-sectional analysis focused on a representative sample from this region.		
Anand AK et al [17]	International Journal of Life Sciences	2025	India	110 children	cross-sectional study	To assess the prevalence and pattern of refractive errors among school-aged children in the 6–16 years age group in anurban-rural population attending schools in the vicinity of Nalanda Medical College and Hospital, Patna	Among 110 children (59 males, 51 females), the overall prevalence of refractiveerrors 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. Mostcases (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)	Refractive errors are highly prevalent in school-aged children, particularly myopia, and show a strongassociation with increasing age and urban residence. Regular school-based vision screening programs are essential for earlydetection and timely correction to prevent visual disability.
Rahman T et al [18]	Indian Journal of Public Health Research & Development	2021	India	200 participants	cross-sectional study	Refractive Error is a common health issues among young school-aged children in Bangladesh. Present study focused on determinants of refractive error among school-going children (class II-V) and the associated factors	Study revealed that, among 200 participants, 54.5% children had refractive error and the younger a child is, the more there was possibility of having this issue. A positive association was found between meal intake, duration of using computer games or watching television and genetic factor (parents' wearing spectacles) with the occurrence of having this error in children ($p<0.05$)	Findings of this study revealed, unhealthy life-styles and physical inactivity at this age may lead to refractive error among school aged children and early detection with medical advice as well as life-style modification might play a significant role not only in improving children's learning ability but also inreducing the incidence of refractive error in this age group in

								Bangladesh.
John DD et al [19]	Journal of clinical and diagnostic research: JCDR	2017	India	4739 participants	cross-sectional study	To determine prevalence of URE and Number Needed to Screen (NNS) to find one child with low vision or blindness from URE among rural school children	Of the 4739 children on rolls, 601 were absent; all 4138 (87.3%) who were present underwent screening; 2.3% (98) {95% Confidence Interval (CI) 1.8 to 2.8} failed the screening test in at least one eye and were referred for examination. Only 28 (28.6%) of 98 children who were referred came for examination to the hospital. In the 2 of the 22 schools where the visual deficit was validated, there were no false positives. The prevalence of refractive error in these two schools was 2.2% (95% CI 1.7 – 2.7). NNS to detect one child with low vision or blindness from URE was 147	Magnitude of refractive error, low NNS, low response to referral necessitates complete care at school and hence a relook at the current SES program.
Varshney DA et al [20]	ISRJAMS	2025	India	4,97,200	cross-sectional study	To estimate the prevalence, pattern, and predictors of refractive errors among school-going children aged 5–16 years in Surat district, Gujarat, through school-based screening under the National Programme for Control of Blindness and Visual Impairment (NPCB&VI) and the Rashtriya Bal Swasthya Karyakram (RBSK)	Of the 497,200 children screened, 5,364 (1.07%; 95% CI 1.04–1.10) had refractive errors. Myopia was the most common subtype (60.0%), followed by astigmatism (27.5%) and hypermetropia (12.5%). The prevalence of myopia increased markedly after age 10 years and was significantly associated with urban residence and private-school attendance ($p < 0.001$). After spectacle correction, mean visual acuity improved from 0.52 ± 0.18 logMAR to 0.00 ± 0.04 logMAR ($p < 0.001$), with 93% attaining 6/6 vision. Spectacle compliance at 3-month follow-up was 78.5%	Myopia emerged as the predominant refractive error among schoolchildren in Surat, with age, urbanization, and schooling type as key predictors. Strengthening periodic school-based screening, visual-hygiene education, and follow-up counseling is vital to mitigate preventable childhood visual impairment.

Kumar KS et al [21]	Int J Med Sci Public Health	2016	India	302 students	cross-sectional study	To assess the magnitude of refractive error among school-going children of Imphal, Manipur, India, and todetermine the association between refractive error and variables such as sex, dietary habits, family history, and dailyactivities such as watching television and using computers.	Total number of respondents was 302. Prevalence of refractive error was 29.14% and among them only 20.5%were already wearing glasses for correction. Prevalence of refractive error was significantly associated with watchingtelevision sitting nearby, using computers, positive family history, problem while reading the blackboard in the class, andproblem while watching TV, computer, or playing video games.	Students, parents, and teachers must be educated about the early detection of refractive error and correctionwith spectacles to prevent progression of visual impairment

Obeed BN et al [22]	South Asian Research Journal of Applied Medical Sciences	2025	Iraq	60 students	cross-sectional study	The aim of this study was to evaluate the prevalence of refractive errors among secondary school students in Baghdad,Iraq	Total 60 valid respondents were gathered, 30% (18) of students complained about visualproblems, known cases of refractive errors with an exception of one case, the prevalence among students of myopiawas 29.41% (5), hyperopia was none, astigmatism 17.64% (3), and a combined refractive error of myopia + astigmatismof 52.94% (9), a 66.66% (12/18) complain of negative impact on their life. Students with history of using spectacles were28.33% (17), with a variable adherence of very good 58.82% (10), good 23.52% (4), average 5.88% (1), and poor 11.76%(2). Study shows a prevalence of compliance to annual eye examination of visual acuity of 36.66% (22). Study recordsan increase in time that's being spent on electronic devices with a 53.33% 3-5 hrs. period of time, and a predominance of78.33% of smart phones being the most used, also a decreased out door time and near-vision tasks of 60% 3-5 hrs.period of time. Study shows a positive family history of refractive errors in both students parents of 26.66% (16), and inonly one of them 40% (24)	prevalence of refractive errors among Al-Harythia D.H.S students in Baghdadwas high, these results suggest that lifestyle changes and prolonged near work activities may contribute to heightened eyestrain. The findings provide information for screening programmes in school-aged children.
Megala M et al [23]	International Journal Of Community Medicine And Public Health	2020	India	422 students	cross-sectional study	The study was conducted with the objective of estimating the prevalence of refractive error in school children and its associated factors	Among the 422 students screened, 86 (20.4%) had refractive error. The prevalence of refractive error showed significant association with age, education and occupation of parents, socio economic status, parental history of refractive error, duration of watching television and body mass index	Refractive errors among school children can be easily identified by regular eye screening programmes, promptly treated can be protected from future complications. Periodic screening of school children is very essential to improve the quality of eye-sight.

Discussion

School screening programs mainly target the identification of refractive errors; however, the health services offered are lacking due to resource scarcity and inadequate infrastructure.[24] The East district of Sikkim comprises three subdivisions—Gangtok (the capital), Pakyong, and Rongli—with a total population of 283,583 according to the 2011 census.

We noted that school children aged 6–18 years had the highest prevalence of refractive error at 9.2%, which aligns with numerous studies suggesting that the condition increases with age.[25]

Girls were more affected by refractive errors (6.9%) compared to boys (5.9%), and numerous studies have reported similar findings. As stated by Gouda SM et al., the rate of school dropouts among males (11.1%) was higher than that among females (8.8%) [26]in Sikkim.

The study found an overall prevalence of refractive errors to be 6.7%, aligning with the findings reported by Warad C et al.[27]in Karnataka (6.4%). Nevertheless, some studies have indicated a higher prevalence, which may be attributed to several factors such as population size, geographical locations, and race that contribute to various disparities. We also noted that children studying in monastic schools often have refractive errors, which are frequently overlooked. Myopia was the most prevalent refractive error at 31.1%, followed by astigmatism at 29.4%, and hyperopia, which was the least common at 2.6%. Numerous studies have documented comparable findings.[28] Within the ethnic communities, refractive error was most common among students from the most backward classes (55.2%) and least prevalent in the schedule tribe (11.6%). As per Saw et al [29] in 2006 and Rai SK *et al*.[30] in 2015, the prevalence of refractive error differs across ethnic groups. Different factors such as diet, way of life, and genetics may play a role in the increase of refractive errors.

Conclusion

This research offers valuable baseline data concerning refractive errors in schoolchildren from GBCM & Subharti Hospital Jhajra, Dehradun. Students from most backward classes, girls, and individuals aged 6–18 years exhibited a high prevalence of refractive error. Our research also targeted students in monastic schools, which are often overlooked. To better understand refractive errors and other eye-related diseases for early detection of vision problems, a larger study should be carried out in all state schools.

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