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ORIGINAL ARTICLE

Prevalence of Refractive Errors and their Association with Screen Time in School-Going Children: A Cross-Sectional Study

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ABSTRACT

Background: Refractive errors are a leading cause of visual impairment in children worldwide. With the increasing use of digital devices among school-aged children, concerns have emerged regarding the impact of prolonged screen time on eye health.

Objective: To determine the prevalence of refractive errors in school-aged children and evaluate the association between screen time duration and the occurrence of these visual impairments.

Methodology: A descriptive cross-sectional study was conducted at Sahiwal Teaching Hospital, Sahiwal, from 1st May 2023 to 1st October 2023. A total of 455 children aged 6 to 16 years from public and private schools were included using a non-probability consecutive sampling technique. Visual acuity was assessed using the Snellen chart, and children with subnormal acuity underwent further ophthalmologic evaluation.

Results: Out of the 455 students examined, 162 (35.6%) were found to have refractive errors. Myopia was the most prevalent (19.6%), followed by hyperopia (9.5%) and astigmatism (6.6%). A statistically significant association was found between increased screen time and refractive errors ($p < 0.001$), with 50.9% of children having refractive errors in the >4 hours/day group compared to 22.6% in the <2 hours/day group. Refractive errors were more prevalent in private school students (42.4%) than in public school students (28.4%) ($p = 0.002$). No significant gender difference was observed ($p = 0.64$).

Conclusion: Refractive errors are highly prevalent among school-going children and are significantly associated with prolonged screen time. The findings emphasize the need for regular vision screening, parental awareness, and promotion of healthy screen habits to mitigate visual health risks in children.

Keywords: Refractive errors, myopia, screen time, visual impairment, digital eye strain.

INTRODUCTION

Refractive errors are optical imperfections that prevent the eye from properly focusing light, resulting in blurred vision. The most common types include myopia (nearsightedness), hyperopia (farsightedness), and astigmatism. Among these, myopia has emerged as a rapidly growing global public health issue, particularly in younger populations. According to the World Health Organization (WHO), uncorrected refractive errors remain a leading cause of visual impairment worldwide, affecting an estimated 12 million children aged 5 to 15 years globally[1]. If refractive errors go unnoticed and uncorrected, they can reduce a child's academic advancement, negatively affect their self-esteem and have a lasting bad impact on their life[2]. In recent times, there has been a major increase in the number of refractive errors and it has become more common among urban and school-aged children. Various reasons have been linked to this trend and environmental ones like being outside less and working more closely are among the key ones[3]. People are spending much more time in front of screens than ever before. Kids are using digital devices more and more for education as well as for fun. Because of the pandemic, people, including pre-schoolers, depended more on technology and learned online, thereby facing more risks from the internet[4].

Watching the screen too much can cause various eye problems called digital eye strain or computer vision syndrome. Sometimes these symptoms are dry eyes, blurred vision, tired eyes and headaches. It has also been found that kids can develop or get worse myopia because of spending too much time in front of screens[5]. Mechanistically, sustained near work and limited exposure to natural light have been proposed as key contributors to these visual changes. As children spend more time indoors and on screens, they may be more vulnerable to refractive changes, particularly if preventive measures such as outdoor breaks and appropriate screen ergonomics are not in place[6]. Despite growing concern, there is a lack of comprehensive, region-specific data regarding the prevalence of refractive errors and their potential link with digital screen usage, particularly in South Asian countries like Pakistan. While global data suggest an escalating burden, regional studies are necessary to understand the unique sociocultural, environmental, and technological factors that may influence this relationship[7]. Most existing studies from developed countries may not reflect the same dynamics seen in countries with different healthcare infrastructure, access to eye care, patterns of technology use, and outdoor activity norms[8].

In Pakistan, limited public awareness about pediatric eye health, the scarcity of school-based vision screening programs, and minimal access to pediatric optometric services pose significant challenges to early diagnosis and management of refractive errors. In many cases, children with poor vision may remain undiagnosed for years, as symptoms are often attributed to inattentiveness or academic difficulty rather than underlying visual impairment[9]. As a result, the impact of uncorrected refractive errors becomes amplified in the school setting, leading to compromised learning and psychosocial development[10]. Given the increasing screen time and its potential implications on visual health, there is an urgent need to explore and quantify this association within the Pakistani context. Investigating the relationship between screen time and refractive error prevalence in school-going children will not only help determine the scale of the issue but also guide public health interventions aimed at prevention and early correction. Incorporating findings from such studies into school health programs, parent education, and national eye care policies could yield substantial long-term benefits[11].

Objective: To determine the prevalence of refractive errors in school-aged children and evaluate the association between screen time duration and the occurrence of these visual impairments.

METHODOLOGY

This descriptive, cross-sectional study was conducted at Sahiwal Teaching Hospital, Sahiwal, from 1st May 2023 to 1st October 2023. The target population consisted of school-going children aged 6 to 16 years, enrolled in grades 1 to 10. Both male and female students from a range of socioeconomic backgrounds were included to ensure representativeness. A total of 455 students

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were included in the study using a non-probability consecutive sampling technique.

Inclusion Criteria:

- Children aged 6–16 years
- Enrolled in selected schools in the Sahiwal region
- Willing to participate with informed consent from parents/guardians

Exclusion Criteria:

- Children with known congenital eye disorders or previous ocular trauma
- Children with systemic illnesses affecting vision (e.g., diabetes)
- Students under treatment for any neurological or ophthalmologic condition affecting visual acuity

Data Collection

After obtaining ethical approval from the Institutional Review Board and necessary permissions from school authorities, trained optometrists conducted on-site visual acuity screening using the Snellen chart under standardized lighting conditions. A pinhole test was administered to differentiate refractive causes of visual reduction. Students with visual acuity less than 6/9 in either eye were referred to the ophthalmology department at Sahiwal Teaching Hospital for further evaluation including cycloplegic refraction. To assess screen time, a structured, pre-validated questionnaire was distributed to parents/guardians. It collected detailed information regarding the child's daily screen usage, including duration spent on smartphones, tablets, computers, televisions, and gaming consoles. Based on the reported data, students were categorized into three screen time groups:

- Low screen time (<2 hours/day)
- Moderate screen time (2–4 hours/day)
- High screen time (>4 hours/day)

Data Analysis: Data were entered and analyzed using SPSS v17. Descriptive statistics including means, standard deviations, frequencies, and percentages were calculated for demographic and clinical variables. The association between screen time and the presence of refractive errors was analyzed using the Chi-square test. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 455 school-going children aged between 6 to 16 years participated in the study. Among them, 243 (53.4%) were males and 212 (46.6%) were females. The mean age of participants was 11.2 ± 2.7 years. Refractive errors were present in 35.6% of the participants, with myopia being the most common (19.6%), followed by hyperopia (9.5%) and astigmatism (6.6%), while 64.4% had no refractive error. In terms of screen time exposure, 34.1% of children reported less than 2 hours of screen time per day, 40.9% had 2 to 4 hours, and 25.0% reported more than 4 hours daily, indicating a considerable proportion of students exceeding recommended screen usage.

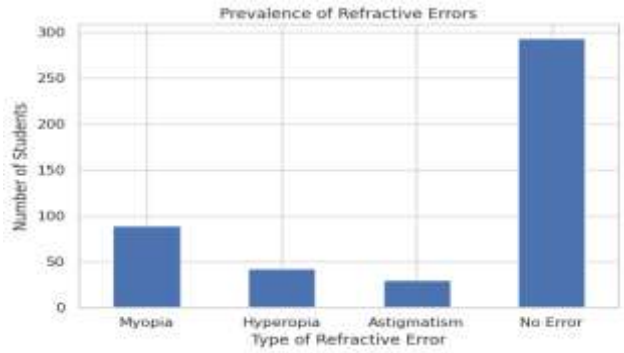


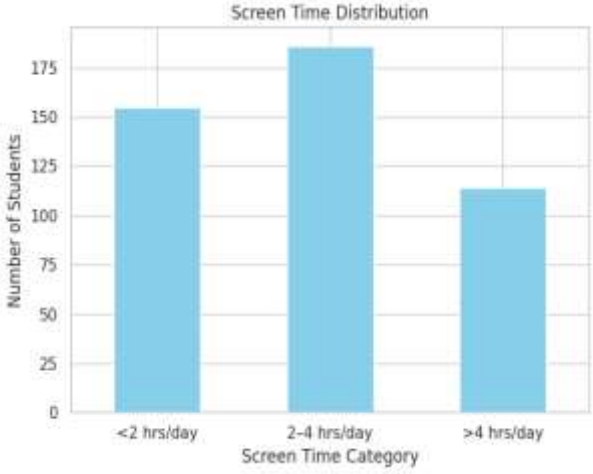
Table 1: Demographic Characteristics of Participants (n=455)

Variable	Frequency (n)	Percentage (%)
Gender		
Male	243	53.4%
Female	212	46.6%
Age Group (years)		
6–10	178	39.1%
11–13	157	34.5%
14–16	120	26.4%
Refractive Error Type		
Myopia	89	19.6%
Hyperopia	43	9.5%
Astigmatism	30	6.6%
No Refractive Error	293	64.4%
Screen Time Category		
<2 hours/day	155	34.1%
2–4 hours/day	186	40.9%
>4 hours/day	114	25.0%

A statistically significant association was observed between screen time and the presence of refractive errors ($p < 0.001$). Children with more than 4 hours of daily screen time had the highest prevalence of refractive errors (50.9%), compared to 37.1% in those with 2–4 hours and only 22.6% in those with less than 2 hours. Similarly, type of school showed a significant association ($p = 0.002$), with higher refractive error prevalence in private school students (42.4%) than in public school students (28.4%), while no cases were reported from madrassas.

Table 2: Association Between Screen Time and Refractive Errors

Screen Time Category	Refractive Errors Present	Refractive Errors Absent	p-value
<2 hours/day	35 (22.6%)	120 (77.4%)	<0.001
2–4 hours/day	69 (37.1%)	117 (62.9%)	
>4 hours/day	58 (50.9%)	56 (49.1%)	
Type of School			
Public School	58 (28.4%)	146 (71.6%)	0.002
Private School	104 (42.4%)	141 (57.6%)	
Madrassa/Other	0 (0%)	6 (100%)	
Gender			
Male	89 (36.6%)	154 (63.4%)	
Female	73 (34.4%)	139 (65.6%)	0.64



DISCUSSION

The findings of this study demonstrate a notable prevalence of refractive errors (35.6%) among school-going children in the Sahiwal region, with myopia (19.6%) being the most common, followed by hyperopia (9.5%) and astigmatism (6.6%). This trend is in line with multiple regional and global studies, reflecting a growing burden of childhood visual impairment. The increasing incidence of myopia, in particular, has been attributed to changes

in lifestyle, notably reduced outdoor activity and increased engagement with screens and near-work tasks[12]. One of the key findings of this study is the strong association between prolonged screen time and the occurrence of refractive errors. Children who reported screen time exceeding four hours per day had a significantly higher prevalence of refractive errors (50.9%) compared to those with less than two hours per day (22.6%)[13]. This association was statistically significant ($p < 0.001$). These results are consistent with prior studies suggesting that increased near-work activity especially through smartphones, tablets, and computers can lead to accommodative stress and axial elongation, contributing to the development of myopia[14]. A meta-analysis by Huang et al. in 2015 found similar evidence of this connection between screen use and refractive error progression in children. Interestingly, children from private schools had a significantly higher prevalence of refractive errors (42.4%) compared to those attending public schools (28.4%)[15]. This could be attributed to increased academic pressure, more homework, and greater access to digital learning tools and gadgets in private institutions. These children are often exposed to screens at an earlier age and for longer durations, thereby increasing their risk of developing myopia[16]. This finding is consistent with reports from studies in urban India and Southeast Asia, where students from academically rigorous environments demonstrated higher visual morbidity[17]. Refractive errors occurred just as often in males (36.6%) as in females (34.4%) and this was not statistically significant ($p = 0.64$). It means that what you eat, how you live and external factors are the main reasons behind refractive errors, not your gender. Past studies have sometimes found that females are more likely to experience near work vision problems which was not discovered when we followed the same group of participants[18]. Despite the fact that most participants were 6 to 10 years old, the amount of refractive errors grew as the ages of the participants increased. This agrees with the idea that repeatedly using near work and digital devices for a long time increases the chance of getting visual problems. Given that a child's eyes develop fastest in early childhood, these results suggest that early detection and swift management are very important[19].

While the study gives us much information, it also has some weaknesses. Since screen time information came from parents' memory, the data may be biased. Besides, since the study was done in one center in a semi-urban area, its results might not be applicable to people living in rural communities or in other parts of the country. What's more, this study was cross-sectional and so it could only show relationships but not prove they are direct causes. To find out which way the relationship works between screen time and refractive error, researchers should use longitudinal studies. In spite of the limitations, the study is credible due to its use of a big sample, objective way to check visual acuity and comparison between screen time groups. These statistics call for establishing vision screening in schools, spreading safe use tips for screens and letting parents, educators and health professionals know more about the risks.

CONCLUSION

It is concluded that refractive errors are a significant and prevalent public health issue among school-going children, with a total prevalence of 35.6% observed in this study. Myopia emerged as the most common type of refractive error, followed by hyperopia and astigmatism. The study established a statistically significant association between increased screen time and the presence of refractive errors, with children exposed to more than four hours of screen time per day being at considerably higher risk.

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