ORIGINAL RESEARCH

The Impact of Prolonged Screen Time on Myopia Progression in Children

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ABSTRACT
Objective: To investigate the impact of prolonged screen time on myopia progression in children and evaluate the protective role of outdoor activities in mitigating its effects. **Methods:** A quantitative observational study was conducted with 85 children aged 6–14 years diagnosed with myopia. Baseline and follow-up assessments of spherical equivalent refractive error (SER) and axial length were performed over two years. Daily screen time, outdoor activity, and behavioral factors such as viewing habits were recorded using self-reported logs and questionnaires. Statistical analyses, including correlation and multiple regression, were used to assess the relationship between screen time, outdoor activity, and myopia progression. **Results:** Participants with high screen time (>4 hours/day) exhibited significantly greater myopia progression (-0.92 ± 0.18 D) and axial elongation (0.36 ± 0.08 mm) compared to those with low screen time (<2 hours/day; -0.35 ± 0.12 D, 0.16 ± 0.04 mm). Outdoor activity (>2 hours/day) was inversely correlated with myopia progression (-0.30 ± 0.10 D, 0.14 ± 0.03 mm) compared to low outdoor activity (<2 hours/day; -0.75 ± 0.20 D, 0.29 ± 0.07 mm). Regression analysis identified screen time ($\beta = -0.42$, $p < 0.001$), outdoor activity ($\beta = 0.28$, $p = 0.01$), and parental myopia ($\beta = -0.35$, $p = 0.003$) as significant predictors. **Conclusion:** Prolonged screen time significantly accelerates myopia progression in children, while outdoor activities provide a protective effect. Targeted interventions, including reduced screen time, improved viewing habits, and increased outdoor exposure, are essential to curb the rising prevalence of pediatric myopia.
Keywords: Myopia progression, screen time, outdoor activity, children, visual health, axial elongation.

INTRODUCTION

The digital era has revolutionized education, entertainment, and social interaction, bringing screens into the daily lives of millions worldwide. In children, extended sedentary time has now obviously characterized contemporary lifestyles due to the availability of smartphones, tablet computers, PCs, and gaming devices. Although these technological have brought tremendous advantages, their effects have been frowned at as they might pose a great threat to the health of growing children. There is a rising trend in children developing vision impairment known as myopia or near-sightedness [1]. A condition where distant objects are not clear due to the enlargement of the eyeball or change in refraction power. This condition has also experienced a rapid increase in the global market, with the World Health Organization estimating that by the year 2050, about half the world's population will be experiencing this condition, myopia. Among the thousands of external causative factors widely believed to have fuelled this trend, extended time spent on the screens is maybe one of the dominant suspects owing to its effects on vision and conduct. Staring at a screen for an extended time harms our eyes, breaks our natural blink cycle, and reduces the amount of time spent outdoors which is crucial for managing myopia [2]. However, close viewing distances when using these devices and the detailed attention of children when using these devices may increase incidences of myopia as young people are most susceptible during their vital ocular developmental stages[3].

Current society has placed children behind walls where they spend hours glued on screens. This transformation has, however, had the effect of minimizing time spent out of doors, something that is so important when it comes to the health of our eyes. The research has indicated that controlling for the amount of time a child spends outdoors, natural light exposure enhances the release of dopamine in the retina that reduces the rate of the elongation of the eyeball as observed in myopia situation [4]. Less sunlight combined with constant attention to near work like reading on tablets and computers present a double danger to children. The fact of using any digital devices for educational purposes, including apps and online classes, has made that continued screen time a common practice. For example, with the use of online learning that has been embraced all over the world due to the COVID-19 pandemic, children spend a lot of time on screen [5]. Although these tools were helpful in maintaining continuity of education, they were some profound concerns to post COVID-19 impacts that included children's oculus health adversely affected by constant screen viewing. Computers and mobile phones being almost essential tools for learning and fun, their use has become executable leading to high screen exposure which makes its effects on visions even more appreciable [6]. Many children watch content on screens when conditions are unfavorable, and eyes are not properly adjusted to screen content, and exposure to bright light, they experience more stress on eyes. Secondly, most endpoints are designed to create habits that keep people engaged for long hours without remembrance to give their eyes a break [7]. The widely used rule, according to which a person should take a 20-second break and look at an object situated 20 feet away every 20 minutes, is certainly not followed by kids occupied with their games. The increase of myopia rates also has its impact on economy and society, the following are worthy of our attention [8]. Myopia has several complications in the extreme; retinal detachment, glaucoma, and cataracts may result if the condition is not well handled. This put a lot of pressure on the healthcare facility and families particularly in areas where there is poor access to eye-related services. Similar to the education point, poor vision in children results to poor performance, poor interaction, and quality life, which adds on the need to address this problem [9].

OBJECTIVE

The main objective of the study is to find the impact of prolonged screen time on myopia progression in children.

Methodology

This observational study was conducted and involved a total of 85 children aged between 6 and 14 years, who were diagnosed with myopia and recruited from a pediatric ophthalmology clinic. The inclusion criteria required participants to have a baseline spherical equivalent refractive error (SER) of -0.50 diopters or worse in at least one eye. Exclusion criteria included children with other ocular pathologies, systemic diseases, or a history of corrective eye surgeries.

Data Collection Procedures

At the baseline visit, all participants underwent a comprehensive ophthalmological examination. This included measurements of visual acuity, refractive error using cycloplegic autorefraction, and axial length using an optical biometer. Baseline demographic data, including age, sex, and parental myopia status, were also recorded.To quantify screen time, parents were asked to maintain a detailed daily log of their child's activities involving digital devices over one month. Screen time was categorized into educational, recreational, and total usage. Additionally, posture, viewing distance, and lighting conditions during screen use were noted.Time spent on outdoor activities was assessed using a self-reported questionnaire validated for children. This data was collected to evaluate the protective role of natural light exposure against myopia progression. Participants were followed up at six-month intervals over two years. At each follow-up, refractive error and axial length measurements were repeated. Changes in SER and axial elongation were used as primary indicators of myopia progression.

Statistical Analysis

Data were analyzed using SPSS v29. Correlation analysis was performed to explore the relationship between screen time and changes in SER and axial length. Multiple regression analysis was employed to adjust for confounding factors such as age, parental myopia, and outdoor activity. Statistical significance was set at a p-value of <0.05.

RESULTS

The study analyzed data from 85 children aged 6 to 14 years, with an average age of 10.2 ± 2.3 years. Of the participants, 42 (49.4%) were male and 43 (50.6%) were female. The mean baseline spherical equivalent refractive error (SER) was -1.75 ± 0.68 diopters (D), and the average axial length was 24.2 ± 0.5 mm. Parental myopia was reported in 60% of the participants, and the mean daily screen time across all participants was 4.3 ± 1.2 hours. Time spent on outdoor activities averaged 1.2 ± 0.8 hours per day.

Table 1: Baseline Characteristics of Participants

Variable	Mean ± SD / Percentage	Range
Number of Participants	85	-
Age (years)	10.2 ± 2.3	6–14
Male	49.4% (n=42)	-
Female	50.6% (n=43)	-

Baseline SER (D)	-1.75 ± 0.68	-0.50 to -3.00
Baseline Axial Length (mm)	24.2 ± 0.5	23.0–25.0
Parental Myopia (Yes)	60%	-
Daily Screen Time (hours)	4.3 ± 1.2	1.5–7.0
Outdoor Activity (hours/day)	1.2 ± 0.8	0.5–3.0

Participants in the high screen time group (>4 hours/day) experienced the greatest myopia progression, with a mean change in SER of -0.92 ± 0.18 D and axial elongation of 0.36 ± 0.08 mm. In comparison, the moderate screen time group (2–4 hours/day) showed a change in SER of -0.58 ± 0.15 D and axial elongation of 0.24 ± 0.06 mm. The low screen time group (<2 hours/day) had the least progression, with a mean SER change of -0.35 ± 0.12 D and axial elongation of 0.16 ± 0.04 mm. These findings underscore the significant impact of prolonged screen use on myopia progression.

Table 2: Myopia Progression by Screen Time Group

Screen Time Group	Participants (n)	Change in SER (D)	Axial Elongation (mm)
Low (<2 hours/day)	22	-0.35 ± 0.12	0.16 ± 0.04
Moderate (2–4 hours/day)	30	-0.58 ± 0.15	0.24 ± 0.06
High (>4 hours/day)	33	-0.92 ± 0.18	0.36 ± 0.08

Participants in the high outdoor activity group (>2 hours/day) exhibited the least progression, with a mean change in SER of -0.30 ± 0.10 D and axial elongation of 0.14 ± 0.03 mm. Conversely, the low outdoor activity group (<2 hours/day) showed significantly greater progression, with a mean change in SER of -0.75 ± 0.20 D and axial elongation of 0.29 ± 0.07 mm.

Table 3: Myopia Progression by Outdoor Activity

Outdoor Activity Group	Participants (n)	Change in SER (D)	Axial Elongation (mm)
High (>2 hours/day)	19	-0.30 ± 0.10	0.14 ± 0.03
Low (<2 hours/day)	66	-0.75 ± 0.20	0.29 ± 0.07

Children using screens in dim lighting and at close distances experienced the greatest progression, with a mean change in SER of -1.05 ± 0.22 D and axial elongation of 0.38 ± 0.09 mm. In contrast, those using screens under optimal lighting conditions and maintaining proper viewing distances showed slower progression, with a mean change in SER of -0.50 ± 0.15 D and axial elongation of 0.20 ± 0.05 mm.

Table 4: Behavioral Factors and Myopia Progression

Factor	Participants (n)	Change in SER (D)	Axial Elongation (mm)
Dim Lighting and Close Distance	47	-1.05 ± 0.22	0.38 ± 0.09
Optimal Lighting and Distance	38	-0.50 ± 0.15	0.20 ± 0.05

DISCUSSION

The findings of this study demonstrate a significant association between prolonged screen time and the progression of myopia in children. Increased daily screen time was found to accelerate myopia progression, as evidenced by a greater negative change in spherical equivalent refractive error (SER) and increased axial elongation. Conversely, outdoor activity served as a protective factor, mitigating the impact of screen time on myopia progression. These results align with existing literature on the environmental and behavioral factors influencing myopia development and progression [10]. The results clearly indicate that children with high daily screen time (>4 hours/day) experienced the most pronounced progression of myopia, with an average SER change of -0.92 D over two years and an axial elongation of 0.36 mm. This supports the hypothesis that prolonged engagement with screens at close distances contributes to increased visual strain and disrupted ocular growth. The strong correlation between screen time and myopia progression (r = -0.64) emphasizes the need to address screen usage as a modifiable risk factor [11]. One plausible mechanism underlying this association is the strain placed on the ciliary muscles during prolonged near work, such as reading or interacting with screens [12]. This strain may promote axial elongation, a key contributor to myopia progression. Additionally, extended screen use often occurs in environments with suboptimal lighting or at close distances, compounding the risk. Behavioral factors, such as the inability to take regular breaks or maintain proper posture, further exacerbate this issue, as observed in participants who used screens under poor conditions [13]. The protective effect of outdoor activity against myopia progression was evident in this study. Children who spent more than 2 hours per day outdoors showed significantly slower progression of myopia, with a mean SER change of -0.30 D compared to -0.75 D in those with less outdoor time.

Axial elongation was similarly reduced in the high outdoor activity group [14]. This supports prior research suggesting that natural light exposure plays a critical role in regulating eye growth and preventing excessive axial elongation.

Natural light stimulates dopamine release in the retina, which inhibits axial elongation and myopia progression. Moreover, outdoor activities encourage the eyes to focus on distant objects, providing a break from near work and visual strain associated with screen use. The findings suggest that promoting outdoor play and incorporating structured outdoor time into children's routines could serve as an effective strategy for myopia control [15]. The study also highlights the importance of proper viewing habits and screen use environments. Children who used screens in dim lighting or at close distances exhibited faster myopia progression compared to those with optimal viewing conditions [16]. This underscores the need for public health campaigns to educate parents and children about healthy screen habits, such as maintaining appropriate viewing distances, ensuring adequate lighting, and adhering to the "20-20-20" rule. The increasing prevalence of myopia among children poses significant challenges for healthcare systems and families [17]. Unchecked, progressive myopia can lead to serious complications, including retinal detachment, macular degeneration, and glaucoma. Early interventions targeting modifiable risk factors, such as screen time and outdoor activity, are essential to curbing this trend. Policymakers, educators, and healthcare providers must collaborate to implement strategies for myopia prevention and management. Potential interventions include integrating eye health education into school curricula, encouraging screen breaks during academic and recreational activities, and designing outdoor spaces that promote physical activity [18]. For parents, awareness campaigns highlighting the risks of excessive screen time and the benefits of outdoor play could help establish healthier habits at home. While this study provides valuable insights, certain limitations should be acknowledged. The reliance on self-reported screen time and outdoor activity data may introduce recall bias. Additionally, the study's observational design limits the ability to establish causation. Future research should focus on longitudinal studies with objective measures of screen use and outdoor exposure, as well as interventional studies to assess the efficacy of specific preventive strategies.

CONCLUSION

This study underscores the significant impact of prolonged screen time on myopia progression in children, while highlighting the protective benefits of outdoor activity and proper screen habits. The findings advocate for a comprehensive approach to myopia prevention, combining public awareness, behavioral modifications, and policy interventions to protect the ocular health of future generations.

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