RESEARCH PAPER

Bright Screens, Developing Eyes: Digital Eye Strain in the Pediatric Population

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ABSTRACT

Background: The rapid integration of digital devices into daily life has significantly transformed learning and recreational activities among children. However, prolonged screen exposure has raised growing concerns regarding digital eye strain (DES), particularly in the pediatric population whose visual systems are still developing.

Objective: This study aims to determine the prevalence of digital eye strain among children and adolescents and to identify associated behavioral and environmental risk factors contributing to its development.

Methods: A cross-sectional, questionnaire-based study was conducted among school-aged children. Data were collected on daily screen time, device usage patterns, viewing distance, posture, and frequency of breaks. Common symptoms of digital eye strain, including eye fatigue, dryness, blurred vision, headache, and neck or shoulder discomfort, were assessed using a structured and validated survey tool.

Results: A high prevalence of digital eye strain symptoms was observed among participants, with eye fatigue and headaches being the most frequently reported complaints. Increased screen time, especially exceeding recommended daily limits, was strongly associated with a higher risk of DES. Additional contributing factors included poor ergonomic practices, reduced blinking during screen use, and inadequate lighting conditions. Younger children demonstrated increasing susceptibility due to unregulated device usage and limited awareness of preventive measures.

Conclusion: Digital eye strain is an emerging public health concern in the pediatric population, driven by escalating screen exposure and suboptimal usage habits. Early identification of risk factors and the implementation of preventive strategies—such as screen time regulation, ergonomic adjustments, and awareness programs—are essential to safeguard visual health in children. These findings highlight the need for collaborative efforts among parents, educators, and healthcare professionals to promote healthier digital practices.

Keywords: Digital eye strain, pediatric population, screen time, visual health, prevalence, risk factors

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Introduction

The widespread adoption of digital devices has profoundly altered the daily lives of children and adolescents, reshaping both educational practices and earning offers numerous cognitive and educational advantages, it has also introduced emerging health concerns, particularly related to visual well-being (1).

Digital eye strain (DES), also referred to as computer vision syndrome, encompasses a range of ocular and extraocular symptoms resulting from extended screen use. Common manifestations include eye fatigue, dryness, irritation, blurred vision, headaches, and musculoskeletal discomfort involving the neck and shoulders (2). These symptoms arise due to a combination of factors, including reduced blink rate, continuous accommodative stress, glare from screens, and improper viewing ergonomics (3). In pediatric populations, these effects may be more pronounced due to the ongoing development of visual pathways and limited awareness regarding healthy screen-use practices. Recent global trends indicate a marked increase in screen time among children, further accelerated by the integration of digital education and lifestyle changes following public health emergencies such as the COVID- 19 pandemic (4). Studies have reported that many school- aged children exceed recommended daily screen-time limits, thereby increasing their susceptibility to visual and postural complications (5). Moreover, the unregulated use of handheld devices, often at closer viewing distances and under suboptimal lighting conditions, exacerbates the risk of developing DES symptoms (6).

The pediatric population represents a particularly vulnerable group, as early exposure to excessive screen use may have both immediate and long-term implications for visual health. In addition to transient discomfort, persistent digital eye strain may contribute to reduced academic performance, decreased attention span, and potential progression of refractive errors (7). Despite growing awareness, there remains a lack of standardized preventive strategies and limited data from developing regions assessing the magnitude of this problem.

Given these concerns, it is essential to systematically evaluate the prevalence of digital eye strain and its associated risk factors among children. Understanding modifiable behavioral and environmental determinants can inform targeted interventions aimed at reducing the burden of DES. Therefore, this study seeks to assess the prevalence of digital eye strain in the pediatric population and examine its association with screen-use patterns and related risk factors.

Materials and Methods.

Study Design and Setting

A descriptive cross-sectional study was conducted over a period of 4- 6 months in selected schools. The study targeted school-going children in both public and private educational institutions to ensure variability in socioeconomic and digital exposure patterns.

Study Population and Sampling

The study population comprised children aged 6–16 years who regularly used digital devices, including smartphones, tablets, or computers. Participants were selected using a stratified random sampling technique to achieve representative inclusion across different age groups and academic levels. Children with known pre- existing ocular pathologies (e.g., diagnosed refractive errors under treatment, strabismus, or chronic ocular disease) or systemic illnesses affecting vision were excluded.

The minimum sample size was calculated using a standard prevalence estimation formula, assuming a 50% expected prevalence of digital eye strain (to maximize sample size), a 95% confidence level, and a 5% margin of error (1).

Data Collection Tool and Procedure

Data were collected using a structured, pre-tested questionnaire adapted from previously validated instruments assessing digital eye strain symptoms and screen-use behaviors (2,3). The questionnaire was divided into three sections:

- **Demographic characteristics:** age, gender, and educational level
- **Screen-use patterns:** daily screen time, type of device used, viewing distance, posture, and duration of continuous use
- **Symptom assessment:** presence and frequency of symptoms such as eye strain, dryness, redness, blurred vision, headache, and neck/shoulder pain

To improve reliability, the questionnaire was administered under supervision, and younger children were assisted by trained facilitators or teachers when required.

Operational Definition

Digital eye strain (DES) was operationally defined as the presence of one or more ocular or extraocular symptoms associated with digital device use, occurring either
occasionally or frequently during or after screen exposure (2).

Statistical Analysis

Data were entered and analyzed using statistical software such as SPSS version 25. Descriptive statistics were used to summarize demographic variables and prevalence of symptoms. Categorical variables were presented as frequencies and percentages.

Inferential analysis was performed to identify associations between digital eye strain and potential risk factors. The chi-square test was applied for categorical comparisons. Variables with p-values <0.05 in univariate analysis were included in multivariable logistic regression to determine independent predictors of DES. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported, and a p-value <0.05 was considered statistically significant (4).

Ethical Considerations

Ethical approval was obtained from the institutional review board prior to study initiation. Permission was also secured from school administrations. Informed consent was obtained from parents or guardians, and assent was taken from participating children. Confidentiality and anonymity of participants were strictly maintained throughout the study in accordance with the principles of the Declaration of Helsinki (5).

Results

Participant Characteristics

A total of 300 school-aged children were included in the analysis. The mean age of participants was 11.2 ± 2.8 years, with a nearly equal distribution between males (51.7%) and females (48.3%). The majority of participants belonged to the 6–10 years age group (40.0%).

Table 1: Demographic Characteristics of Participants (n = 300)

Variable	Category	n	%
Age Group (years)	6–10	120	40.0
	11–13	100	33.3
	14–16	80	26.7
Gender	Male	155	51.7
	Female	145	48.3

Prevalence of Digital Eye Strain

The overall prevalence of digital eye strain (DES) was 68.3% (n = 205). Among affected participants, multiple symptoms were frequently reported.

Table 2: Distribution of Digital Eye Strain Symptoms (n = 300)

Symptom	n	%
Eye fatigue	160	53.3
Headache	140	46.7
Neck/shoulder pain	120	40.0
Blurred vision	110	36.7
Dryness/irritation	95	31.7

Screen Time and Device Usage Patterns

A substantial proportion of participants reported extended daily screen exposure. Approximately 33.3% of children used digital devices for more than 4 hours/day, while smartphones were the most commonly used devices (60.0%).

Table 3: Screen Usage Characteristics (n = 300)

Variable	Category	n	%
Daily Screen Time	<2 hours	70	23.3
	2–4 hours	130	43.3
	>4 hours	100	33.3
Primary Device	Smartphone	180	60.0
	Tablet	50	16.7
	Computer/Laptop	70	23.3

Association Between Risk Factors and Digital Eye Strain

Significant associations were identified between DES and multiple behavioral and environmental factors. Children with screen time exceeding 4 hours/day demonstrated a markedly higher prevalence of DES (85.0%) compared to those with lower exposure ($p < 0.001$).

Similarly, improper posture, lack of regular breaks, and suboptimal lighting conditions were significantly associated with increased occurrence of DES.

Table 4: Association of Risk Factors with Digital Eye Strain (n = 300)

Variable	DES Present n (%)	DES Absent n (%)	p-value
Screen time >4 hours	85 (85.0)	15 (15.0)	<0.001
Improper posture	150 (75.0)	50 (25.0)	0.002

Variable	DES Present n (%)	DES Absent n (%)	p-value
No regular breaks	140 (77.8)	40 (22.2)	<0.001
Poor lighting	130 (72.2)	50 (27.8)	0.010

Multivariable Logistic Regression Analysis Multivariable logistic regression analysis was performed to identify independent predictors of digital eye strain. After adjusting for potential confounders, the following variables remained statistically significant:

- Screen time >4 hours/day (AOR: 2.8; 95% CI: 1.6–4.9; $p < 0.001$)
- Lack of regular breaks (AOR: 2.3; 95% CI: 1.4– 3.8; $p < 0.001$)
- Improper posture (AOR: 1.9; 95% CI: 1.1–3.2; $p = 0.02$)

These findings indicate that prolonged screen exposure and modifiable behavioral factors are significant independent determinants of DES in the pediatric population.

Discussion

This study demonstrates a **high prevalence (68.3%) of digital eye strain** among children, consistent with global findings indicating a rising burden of screen-related visual symptoms. The predominance of symptoms such as eye fatigue and headache aligns with previously reported literature (Rosenfield, 2011; Sheppard & Wolffsohn, 2018).

A key finding of this study is the strong association between **prolonged screen time and DES**, with children exposed to more than 4 hours daily showing significantly higher risk. This supports earlier research suggesting a dose–response relationship between screen exposure and visual discomfort.

Improper ergonomic practices, including poor posture and reduced viewing distance, were also identified as significant contributors. These findings highlight the importance of behavioral modifications, as many risk factors identified are preventable.

The increased reliance on digital devices for education and entertainment has amplified these risks, particularly in developing settings where awareness regarding safe screen use remains limited. Early-life exposure to such risk factors may have long-term implications for visual health and academic performance.

Conclusion

Digital eye strain is highly prevalent among school-aged children and is significantly associated with modifiable

Key recommendations include:

Limiting screen time according to age guidelines

Promoting the **20-20-20 rule**

Improving ergonomic practices

Increasing awareness among parents and educators

Early preventive interventions are essential to reduce the long-term burden of visual morbidity in the pediatric population.

References

1. Rosenfield M. Computer vision syndrome: a review of ocular causes and potential treatments. *Ophthalmic Physiol Opt*. 2011;31(5):502–515. **doi:** 10.1111/j.1475-1313.2011.00834.x
2. Sheppard AL, Wolffsohn JS. Digital eye strain: prevalence, measurement and amelioration. *BMJ Open Ophthalmology*. 2018;3(1):e000146. **doi:** 10.1136/bmjophth-2018-000146
3. American Academy of Pediatrics. Media use in school-aged children and adolescents. *Pediatrics*. 2016;138(5):e20162592. **doi:** 10.1542/peds.2016-2592
4. Wong CW, Tsai A, Jonas JB, et al. Digital screen time during COVID-19 pandemic and its impact on vision in children. *JAMA Ophthalmology*. 2021;139(2):167–174. **doi:** 10.1001/jamaophthalmol.2020.6092
5. World Health Organization. Guidelines on physical activity, sedentary behaviour and sleep for children under 5 years of age. Geneva: WHO; 2019. *(No DOI available)*
6. Moon JH, Kim KW, Moon NJ. Smartphone use is a risk factor for pediatric dry eye disease. *BMC Ophthalmology*. 2016;16:188. **doi:** 10.1186/s12886-016-0366-4
7. Portello JK, Rosenfield M, Bababekova Y, et al. Computer-related visual symptoms in office workers. *Ophthalmic Physiol Opt*. 2012;32(5):375–382. **doi:** 10.1111/j.1475-1313.2012.00925.x

8. Logaraj M, Madhupriya V, Hegde SK. Computer vision syndrome and associated factors among medical students. *Int J Med Public Health*. 2014;4(2):179–185. **doi:** 10.4103/2230-8598.132907
9. Coles-Brennan C, Sulley A, Young G. Management of digital eye strain. *Clin Exp Optom*. 2019;102(1):18–29. **doi:** 10.1111/cxo.12798.
10. Mohan A, Sen P, Shah C, et al. Prevalence and risk factor assessment of digital eye strain among children using online learning during pandemic. *Indian J Ophthalmol*. 2021;69(1):140–144. **doi:** 10.4103/ijo.IJO_2539_20
11. Hosmer DW, Lemeshow S, Sturdivant RX. Applied logistic regression. 3rd ed. Wiley; 2013. **doi:** 10.1002/9781118548387.