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Effects of Excessive Screen Time on Eyes

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A B S T R A C T

Background: Excessive screen time has become increasingly common due to widespread use of digital devices, potentially affecting ocular health. This study aimed to evaluate the impact of prolonged digital device use on eye function and visual comfort.

Material and Methods: A cross-sectional study was conducted on 345 participants aged 10–50 years. Participants were categorized based on daily screen time into mild (<4 hours), moderate (4–8 hours), and excessive (>8 hours). Data on demographics, screen usage, and ocular symptoms were collected via structured questionnaire. Comprehensive ophthalmic evaluation included visual acuity, refractive error, slit-lamp and fundus examination, Schirmer's test, and tear break-up time (TBUT). Statistical analysis was performed using chi-square and ANOVA tests, with $p < 0.05$ considered significant.

Results: The study population included 185 males (53.6%) and 160 females (46.4%), with the majority aged 21–30 years (34.8%). Screen time distribution was mild 20.3%, moderate 43.5%, and excessive 36.2%. Eye strain/fatigue was reported by 46.4% of participants, dry eyes by 36.2%, blurred vision by 24.6%, and headache/ocular discomfort by 28.4%, with prevalence increasing significantly with longer screen time. Objective findings showed mean visual acuity declining from 0.08 ± 0.05 LogMAR (mild) to 0.18 ± 0.07 (excessive), TBUT decreasing from 12.5 ± 2.1 to 7.8 ± 2.0 seconds, Schirmer values from 15.0 ± 3.0 to 9.5 ± 2.5 mm, and mean refractive error increasing from 0.25 ± 0.3 D to 0.85 ± 0.5 D (all $p < 0.001$).

Conclusion: Excessive screen time is associated with increased ocular discomfort and measurable declines in eye function. Preventive strategies, including limiting screen exposure and promoting eye-friendly practices, are recommended to maintain visual health.

Keywords: Screen time, digital eye strain, visual acuity, dry eye, ocular health

INTRODUCTION

The widespread use of digital devices has led to increased screen time, raising concerns about its impact on ocular health. Excessive screen exposure has been linked to various visual disturbances, collectively termed Digital Eye Strain (DES) or Computer Vision Syndrome (CVS), which encompass symptoms such as eye fatigue, dryness, blurred vision, and headaches [1,2]. A recent study reported a prevalence of DES at 62.6% among digital device users in the UK and Ireland, highlighting the significant burden of this condition [3].

The COVID-19 pandemic further exacerbated screen time, especially among children and adolescents due to remote learning. Research indicates that prolonged screen exposure during this period contributed to an increase in myopia cases among schoolchildren [4]. Additionally, a meta-analysis revealed a significant association between screen time exposure and myopia in children and adolescents, with computer screen use having the most substantial impact [5].

Objective ocular assessments have also demonstrated the adverse effects of extended screen use. A study employing multifocal electroretinography (mfERG) found screen-induced foveal dysfunction in individuals with CVS, which improved following a strict screen-time reduction regimen [6]. Furthermore, the association between screen time and visual

acuity has been a subject of concern, with evidence suggesting that increased screen exposure may lead to a decline in visual function over time [7].

Given the escalating prevalence of screen time and its potential ocular implications, this study aims to systematically evaluate the effects of excessive screen time on eye health, encompassing both subjective symptoms and objective clinical findings.

MATERIAL AND METHODS

Study Design and Setting: This cross-sectional observational study was conducted to evaluate the effects of excessive screen time on ocular health. The study was carried out at an Indian medical college and attached hospital.

Study Population: A total of 345 participants were recruited through consecutive sampling. Inclusion criteria included individuals who regularly use digital devices (smartphones, computers, tablets, or television) for at least 2 hours per day. Participants with pre-existing ocular diseases (such as glaucoma, cataract, or retinal disorders), systemic conditions affecting vision (e.g., diabetes, hypertension), or history of ocular surgery were excluded.

Data Collection: Demographic details, duration and type of screen usage, and ocular symptoms were recorded using a structured questionnaire. Screen time was categorized as mild (<4 hours/day), moderate (4–8 hours/day), and excessive (>8 hours/day).

Ocular Examination: A comprehensive ophthalmic evaluation was performed for each participant, including:

- Visual acuity assessment using a Snellen chart.
- Refractive error measurement using an autorefractometer.
- Slit-lamp examination to assess the anterior segment.
- Fundus examination using direct and indirect ophthalmoscopy.
- Tear film assessment through Schirmer's test and tear break-up time (TBUT) to detect dry eye.
- Ocular surface evaluation using a standardized eye strain questionnaire (e.g., Computer Vision Syndrome Questionnaire).

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 26.0. Continuous variables were presented as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Comparative analyses between screen time categories and ocular parameters were performed using chi-square tests for categorical variables and one-way ANOVA for continuous variables. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 345 participants were included in the study, with a mean age of [insert mean ± SD] years. The majority of participants were in the 21–30 years age group (34.8%), followed by 31–40 years (26.1%), 10–20 years (24.6%), and 41–50 years (14.5%). Males constituted 53.6% of the study population, while females accounted for 46.4% (Table 1).

Table 1: Demographic Characteristics of Participants (n = 345)

Characteristic	Frequency (n)	Percentage (%)
Age (years)		
10–20	85	24.6
21–30	120	34.8
31–40	90	26.1
41–50	50	14.5
Gender		
Male	185	53.6
Female	160	46.4

Based on daily digital device usage, 20.3% of participants reported mild screen time (<4 hours/day), 43.5% reported moderate use (4–8 hours/day), and 36.2% reported excessive screen time (>8 hours/day) (Table 2).

Table 2: Screen Time Categories Among Participants (n = 345)

Screen Time (hours/day)	Frequency (n)	Percentage (%)
Mild (<4)	70	20.3
Moderate (4–8)	150	43.5
Excessive (>8)	125	36.2

Commonly reported ocular symptoms were significantly associated with higher screen time. Eye strain or fatigue was reported by 46.4% of participants, with the highest prevalence in the excessive screen time group (68.0%). Dry eyes were

noted in 36.2% of participants, predominantly among those with screen time exceeding 8 hours/day (56.0%). Blurred vision and headache/ocular discomfort were reported by 24.6% and 28.4% of participants, respectively, with a clear trend of increasing prevalence with longer screen exposure (Table 3, Figure 1).

Table 3: Prevalence of Ocular Symptoms by Screen Time Category

Symptom	Mild (<4h)	Moderate (4–8h)	Excessive (>8h)	Total (%)
Eye strain / fatigue	15 (21.4)	60 (40.0)	85 (68.0)	160 (46.4)
Dry eyes	10 (14.3)	45 (30.0)	70 (56.0)	125 (36.2)
Blurred vision	5 (7.1)	30 (20.0)	50 (40.0)	85 (24.6)
Headache / ocular discomfort	8 (11.4)	35 (23.3)	55 (44.0)	98 (28.4)

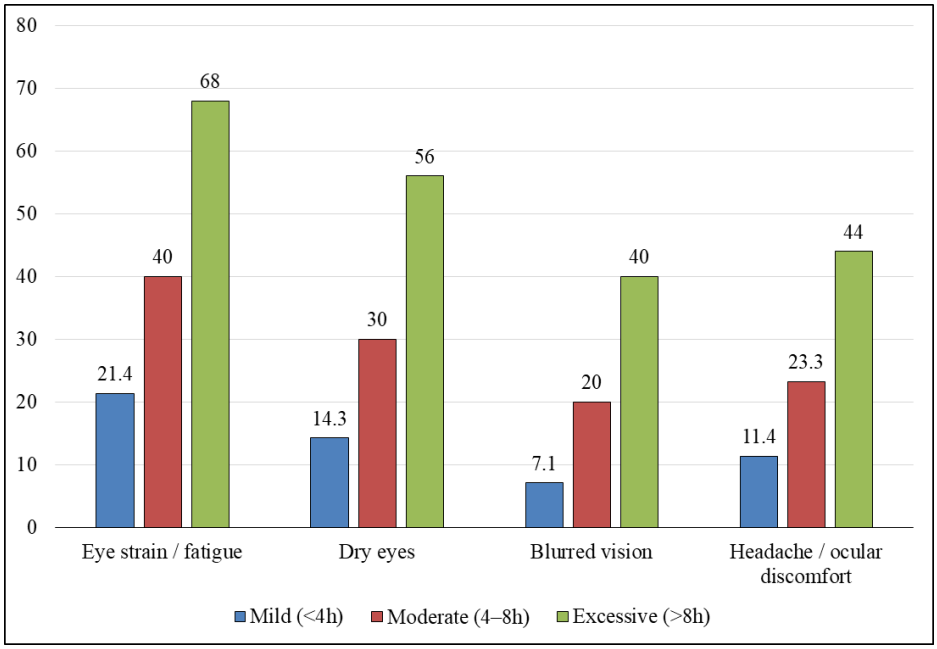

Figure 1: Percentage Prevalence of Ocular Symptoms by Screen Time Category

Clinical examination revealed a significant association between screen time and ocular parameters. Mean visual acuity was highest in the mild screen time group (0.08 ± 0.05 LogMAR) and declined progressively with longer exposure, reaching 0.18 ± 0.07 LogMAR in the excessive screen time group ($p < 0.001$). Tear film assessments demonstrated reduced stability and volume in participants with higher screen use, with mean TBUT decreasing from 12.5 ± 2.1 seconds in the mild group to 7.8 ± 2.0 seconds in the excessive group, and Schirmer test values decreasing from 15.0 ± 3.0 mm to 9.5 ± 2.5 mm ($p < 0.001$). Refractive error also showed a trend toward higher myopia with increased screen time, with mean spherical equivalent increasing from 0.25 ± 0.3 D in mild users to 0.85 ± 0.5 D in excessive users ($p < 0.001$) (Table 4).

Table 4: Objective Ocular Findings by Screen Time

Parameter	Mild (<4h)	Moderate (4–8h)	Excessive (>8h)	p-value
Mean Visual Acuity (LogMAR)	0.08 ± 0.05	0.12 ± 0.06	0.18 ± 0.07	<0.001
Mean TBUT (seconds)	12.5 ± 2.1	10.2 ± 2.3	7.8 ± 2.0	<0.001
Mean Schirmer (mm)	15.0 ± 3.0	12.5 ± 2.8	9.5 ± 2.5	<0.001
Refractive Error (D, mean)	0.25 ± 0.3	0.50 ± 0.4	0.85 ± 0.5	<0.001

DISCUSSION

This study aimed to evaluate the impact of excessive screen time on ocular health, encompassing both subjective symptoms and objective clinical findings. The results indicate a significant association between prolonged screen exposure and various ocular disturbances, aligning with existing literature that highlights the adverse effects of digital device use on eye health.

The findings of this study corroborate previous research indicating a high prevalence of Digital Eye Strain (DES) among individuals with prolonged screen exposure. A comprehensive review reported a prevalence ranging from 62.6% to 94% during the COVID-19 era, emphasizing the widespread nature of this condition [8]. Factors contributing to DES include prolonged screen time, inadequate lighting, and poor ergonomic practices, leading to symptoms such as eye fatigue,

dryness, and blurred vision. Implementing strategies like the 20-20-20 rule and optimizing screen settings can mitigate these symptoms [9].

The study observed a significant increase in myopia prevalence with prolonged screen exposure, consistent with findings from a meta-analysis that reported a 21% higher risk of myopia for each additional hour of daily screen time [10]. The risk escalated further with screen use exceeding four hours daily. This association underscores the importance of regulating screen time, particularly in children, to prevent the progression of myopia. Encouraging outdoor activities and limiting screen time are essential preventive measures [11].

Objective assessments revealed a decline in visual acuity, tear film stability, and increased refractive error with extended screen use. These findings align with studies employing multifocal electroretinography (mfERG), which demonstrated screen-induced foveal dysfunction in individuals with Computer Vision Syndrome (CVS) [12]. The decline in ocular health parameters with prolonged screen exposure highlights the need for regular eye examinations and timely interventions to address screen-induced visual impairments [13].

While this study provides valuable insights into the effects of excessive screen time on ocular health, it is not without limitations. The cross-sectional design limits the ability to establish causality between screen time and ocular disturbances. Future longitudinal studies are warranted to elucidate the long-term effects of screen exposure on eye health. Additionally, exploring the impact of different types of digital devices and screen content on ocular health can provide a more comprehensive understanding of the issue [14].

CONCLUSION

Prolonged screen time is associated with a significant increase in ocular discomfort, including eye strain, dryness, and blurred vision. Objective measures such as tear film stability, visual acuity, and refractive status also deteriorate with excessive digital device use. These findings highlight a dose-dependent relationship between screen exposure and ocular health impairment. Preventive strategies, including regular breaks, proper lighting, and ergonomic device use, are essential to reduce visual strain. Overall, minimizing excessive screen time can help preserve eye health and maintain visual comfort in daily life.

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