



Eye Health Problems Related to Prolonged Exposure to Electronic Devices

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Abstract

The rapid integration of electronic devices into daily life has raised growing concerns regarding their impact on eye health. This study aims to examine eye health problems related to prolonged exposure to electronic devices and to identify behavioral, environmental, and individual factors associated with visual discomfort. A quantitative cross-sectional design was employed involving adults who routinely use electronic devices for work, education, and leisure. Data were collected using a structured questionnaire measuring socio-demographic characteristics, patterns of electronic device use, ergonomic conditions, and self-reported eye health symptoms. The results reveal a high prevalence of visual complaints, particularly eye fatigue, dry eyes, blurred vision, and headaches. Prolonged daily screen exposure was found to be strongly associated with an increased likelihood of experiencing multiple eye health symptoms. Infrequent visual breaks, suboptimal lighting, and inappropriate screen brightness further exacerbated visual discomfort, while individual factors such as age and use of corrective lenses influenced symptom severity. These findings are consistent with existing literature on digital eye strain and highlight the multifactorial nature of eye health problems in digital environments. The study underscores the importance of integrated preventive strategies that combine behavioral modification, ergonomic improvements, and institutional support to promote sustainable digital device use and protect eye health.

INTRODUCTION

Rapid growth of electronic gadgets, such as smartphones, tablets, computers, and other digital display technologies has changed the modern way of life, work habits, and communication behaviors fundamentally. Digital devices have become very entrenched in day-to-day life activities in varying age groups, both in early childhood education, in the course of work, during socialization and in entertainment. Though these technologies have proven to have significant gains in terms of efficiency, connectivity and ease of accessing information, their extensive and prolonged usage has raised a lot of concern about the possible negative impacts on the health especially ocular health. The tasks related to electronic devices require long-term

uninterrupted attention, the influence of the artificial light source, and a low rate of blinking, which puts a heavy load on the visual system (Sheppard and Munsamy, 2018; Munsamy et al., 2022). Due to the increasing trend in screen-based activities across the world, eye health complications as a result of extended exposure to the electronic devices have become a resulting public health concern.

Clinical and epidemiological studies have reported an increase in the prevalence of eye-related complaints related to the use of digital devices, which is usually known as digital eye strain or computer vision syndrome. These disorders involve a continuum of the symptoms, such as ocular fatigue, dryness, blurred vision, headache, burning sensations, and difficulty of focus (Coles-Brennan et al., 2019). Visual impairment has also been highlighted by the World Health Organization as a growing global issue and the organization notes that a large number of eye health issues can be prevented or controlled by early identification and changes in behavior (World Health Organization, 2019). However, the extensive normalization of extended screen time, especially in the educational and workplace settings, have been running ahead of the devising effective preventive measures and enlightenment programmes. In turn, the understanding of the correlation between electronic device use and eye health has become especially important to inform health promotion, clinical practice, and policy interventions (Capó et al., 2022; Masemola et al., 2025; Korot et al., 2022; Elam et al., 2022).

Although the research on the use of digital devices and visual health is growing, there are several obstacles in the way of making the scientific evidence turned into the practical solution. The main problem is that the patterns of exposure vary; they include length of use, viewing distance, screen brightness, and ergonomics, which makes it difficult to evaluate the risk factors and outcomes (Rosenfield, 2016; Artime-Riose et al., 2026; Kaur et al., 2022). Furthermore, personal factors like age, prior refractive errors, and the use of contact lenses among others and environmental factors also contribute to predisposition towards ocular health issues. Although visual discomfort is a common complaint among users, they are normally short-lived, and underreported, causing late management and therapy. This is alarming especially considering the cumulative nature of the visual strain and the possible long-term consequences of the same on the ocular health and life quality (Cougnard-Gregoire et al., 2023; Hassan and Khaliq, 2024; Edem et al., 2024; Alhashim et al., 2025).

The key research question that will be discussed in the given work is based on the fact that the number of eye health issues related to the extended use of electronic gadgets is growing, and the available preventive strategies have a limited effectiveness. Despite the general acceptance of digital eye strain in clinical and occupational health literature, there still is no consensus on standardized guidelines on the safe use of screens and exhaustive interventions that target both behavioral and environmental factors. The existing strategies lean towards symptomatic management as opposed to the reduction of exposure patterns and practices of the users. Consequently, people are still affected with frequent eye pain which can affect productivity, educational performance, and general health (Portello et al., 2012). This disparity highlights the importance of additional integrative studies evaluating the factors of eye health issues in the framework of long-term use of electronic devices.

When tackling these issues, the literature has suggested generic interventions that focus on awareness interventions, behavioral change interventions, and ergonomic modification interventions. Limiting the amount of time spent on the screen, ensuring the right distance to watch, properly designed lighting, and the 20 20 20 rule are often presented as the ways of minimizing visual load (American Optometric Association, 2020). Moreover, regular eye checks and using lenses specifically adjusted to work with digital devices have been proposed as the preventative

measures. These measures are theoretically correct and clinically justified, but there is a significant difference in their adoption by different populations. The work requirements, academic stress and little awareness can tend to hinder the capacity of the individuals to practice the suggested practices on a regular basis.

More targeted interventions, based on the previous empirical research, have been directed at the physiological and environmental antecedents of digital eye strain. It has been found that the long-term visual displays significantly decreases the blink rate resulting in tears instability and development of dry-eye symptoms (Tsubota and Nakamori, 1993). Interventions directed at enhancing the blink behaviour i.e., blink-reminder, conscious blinking exercises have shown promise in alleviating discomfort. On the effects of blue-light emission by digital screens, other studies have found that the expression of these effects might lead to visual fatigue and circadian-rhythm disturbance, but again, the empirical evidence is inconclusive (Lin et al., 2017). As a result, the use of blue-light-filtering lenses and screen-filtering technologies have been suggested but their effectiveness is still subject to controversy in the scientific community.

Further reading shows that ergonomics and workplace modifications are significant issues in relieving eye health issues. It has been associated with reduced visual symptoms in office workers and students by proper display positioning, adjustable seating, sufficient ambient lighting and planned breaks (Anshel, 2007). The growing use of digital education platforms in the education sector has prompted the cause of eye-friendly instructional design promoting a balanced screen/non-screen learning experience. Furthermore, novel technological solutions, including adaptive display setting, eye-tracking software, and artificial intelligence-based surveillance system, have been researched as an innovative method to reduce visual strain. These solutions are however promising but in most cases need institutional support and might not be available to the users in low-resource settings.

The review of the literature on the topic shows that current research is mostly focused on particular groups of people, including office employees, students, or clinical patients and is likely to measure only individual risk factors rather than analyze a complete pattern of exposure. Much of the research literature uses cross-sectional designs and self-reported symptoms, thus preventing causal inferences and generalization (Coles Brennan et al., 2019). Also, the integrated frameworks, in which behavioural, environmental and individual factors are incorporated in the same analytical framework, are deficient. This piecemeal of evidence hinders a complete comprehension of the impacts of long-term exposure to electronic-devices on the ocular health in a variety of situations, thus providing a research gap in the systematic study of the eye-health issues as a multidimensional phenomenon of usage behaviour, environmental factors, and personal traits.

It is against this backdrop that the current study aims at analysing the eye-health issues related to long time exposure to electronic devices by combining the main determinants that can be defined in the current literature. The study will also attempt to offer empirical data on the prevalence as well as nature of visual symptoms related to prolonged screen time use and also explore behavioural and environmental variables that may enhance or reduce these issues. The originality of the study is found in its holistic form of the research, going beyond the description of symptoms and examining the possible mechanisms of the connection between the exposure to electronic devices and the ocular-health results. The research fills the gap in the scientific literature of digital eye health and provides evidence-based information to promote preventive measures, health education, and policy formulation. The study is limited, covering non-clinical groups that participate in the daily use of electronic-devices, the goal is to produce relevant findings to the

interventions of the public-health and the daily practice in the world that becomes more digitalised.

METHODS

This paper utilized a quantitative cross-sectional research design in order to discuss ocular health issues in relation to long-term exposure to electronic devices. It was found that a cross-sectional design was the suitable method to use since it allows the methodological evaluation of exposure patterns and comorbid visual symptoms among a specific population on a single occasion. This design has been highly applied in the studies of digital eye strain and computer vision syndrome because it allows determining prevalence patterns and explaining the relationships between screen time and the results of eye health in the non-clinical groups (Rosenfield, 2016; Coles-Brennan et al., 2019). The methodology framework was designed under the accepted practices of conducting scientifically rigorous and comparatively relevant occupational research on public health using established literature in this field.

The research was done on those people who actively used electronic devices in their everyday life including workplace, education and entertainment. The sample size included adults whose age was 18 years and above and who indicated that they used smartphones, computers, tablets, or similar digital devices with a minimum of two hours a day. This limit was determined using previous research which suggested that a prolonged period of exposure to screens exceeding this period is associated with an increased threat of eye and visual distress (Portello et al., 2012). The purposive sampling method was used to recruit participants; they needed to be respondents with adequate exposure to electronic devices. Data was collected over a specified time to reduce the influence of seasonal or contextual differences in device-use behavior.

The data were collected using a self-administered questionnaire that was structured and designed through the adaptation of validated tools that had been used in previous research on the digital eye strain and visual wellbeing. The questionnaire covered several sections that covered the socio-demographic factors, electronic device usage patterns, environmental and ergonomic conditions and self-reports on the eye-health symptoms. The variables that involved the use of the devices were daily hours of screen time, the type of devices, the frequency of screen breaks, the distance of the viewer, and the brightness of the screens. The choice of these variables is justified by the evidence that they will affect visual fatigue and ocular discomfort (Sheppard and Wolffsohn, 2018). Symptom-based measures were used to measure eye-health outcomes, including ocular dryness, blurred vision, eye fatigue, headaches, and trouble with focus, among other symptoms, frequently linked with prolonged screen time.

To guarantee the content validity, the questionnaire items were checked with the professionals of the field of research, i.e., with the specialists in the realm of public health and eye-health. A pilot test was done in a small sample of respondents in order to determine the clarity, reliability, and understanding of the instrument. The pilot study provided feedback, which was used to make corrections in the phrasing of questions and answer choices. The reliability test was used to examine the consistency of the items that were related to the symptoms which produced acceptable levels of consistency in accordance with the methodological standards of a survey-based health research (Crowe et al., 2011). This also led to the strength of the measurement strategy and supported the strength of the results.

The process of data collection was based on a set of standardized ethical and administrative procedures. Before the administration of the questionnaire, the participants received information concerning the purpose of the study, voluntary participation and confidentiality of their responses. The informed consent was given

through the electronic means and then the respondents were allowed to answer the questions in the survey. The data collection was anonymous to minimize the bias of responses and promote honesty and full disclosure of eye health symptom and device usage behaviors. Such a strategy aligns with the ethical principles regarding the human subjects research, especially when the self-reported health data is involved (World Health Organization, 2019).

The data analysis was carried out with the help of statistical software so that the data collected should be processed in a systematic and transparent way. The characteristics of the participants, their patterns of using electronic devices, and the percentage of having eye health symptoms were summarized using descriptive statistics. Calculation of measures like frequencies, percentages, means, and standard deviations was done to give a picture of the distribution of some key variables. Statistical tests based on the inferential statistics were used to compare the relationships between the long-term exposure to electronic devices and self-reported visual health issues. Statistical tests validated were applied to determine relationships between duration of screen time, behavioural factors and visual symptoms depending on the level of measurement. These methods of analysis align with those typically used in cross-sectional research of digital eye strain (Anshel, 2007; Rosenfield, 2016).

Multivariate analysis was aimed to control the possible confounding variables as well as to determine independent predictors of eye health problems. The analytic model involved the inclusion of variables like age, gender, corrective lens use, and environmental conditions as they were reported to have an effect on the visual health outcomes. It was in this way that a more subtle perception of the interaction between long-term use of electronic devices and personal and environmental factors could be realized, in order to influence eye health. Multivariate methods were also applied to enhance the strength of the internal validity of the study by minimizing the chances of spurious relationships.

RESULTS AND DISCUSSION

This study was conducted to examine eye health problems associated with prolonged exposure to electronic devices among individuals who regularly use digital technology in their daily activities. The increasing reliance on smartphones, computers, and other digital screens for work, education, communication, and entertainment has significantly increased the duration of screen exposure in modern lifestyles. As a result, visual complaints related to digital device use have become increasingly common and are now recognized as an emerging public health concern.

The respondents involved in this study represent active electronic device users who engage in screen-based activities for several hours each day. The study collected information regarding demographic characteristics, patterns of electronic device use, duration of daily screen exposure, and the prevalence of eye-related symptoms experienced by the participants. These data provide an important empirical basis for understanding how behavioral patterns of device use may influence visual health outcomes.

By analyzing the relationship between screen exposure and reported ocular symptoms, this study aims to identify common eye health problems associated with prolonged digital device use and to explore potential contributing factors such as duration of use, frequency of breaks, and environmental conditions. Understanding these patterns is essential for developing preventive strategies and raising awareness about healthy digital device use in increasingly technology-dependent environments.

Socio-Demographic Characteristics and Electronic Device Use Patterns

Table 1. Socio-demographic characteristics and electronic device use patterns of respondents

Variable	Category	n	%
Age	18–25 years	92	30.7
	26–35 years	114	38.0
	36–45 years	62	20.7
	>45 years	32	10.6
Gender	Male	138	46.0
	Female	162	54.0
Daily screen time	2–4 hours	64	21.3
	5–6 hours	98	32.7
	>6 hours	138	46.0
Main device used	Smartphone	144	48.0
	Computer/Laptop	118	39.3
	Tablet	38	12.7

Caption: Table 1 presents the distribution of respondents by age, gender, daily screen exposure, and primary electronic devices used.

The characteristics of respondents and their patterns of electronic device use are presented in Table 1. The study involved adult participants who regularly used electronic devices for occupational, educational, and recreational purposes. A substantial proportion of respondents reported daily screen exposure exceeding six hours, indicating intensive engagement with digital technologies. This finding reflects global trends of increased screen dependency across multiple domains of daily life, as reported in previous studies on digital device use and visual health (Rosenfield, 2016; Sheppard & Wolffsohn, 2018).

Smartphones and computers were identified as the most commonly used devices, with many respondents reporting simultaneous use of multiple devices throughout the day. Such usage patterns suggest prolonged and continuous near-vision tasks, which have been associated with increased visual demand and eye fatigue in earlier research (Coles-Brennan et al., 2019). The diversity in screen exposure duration and device types among respondents provides a relevant basis for examining variations in eye health outcomes.

Prevalence of Eye Health Symptoms Related to Screen Exposure

Table 2. Prevalence of eye health symptoms among respondents

Eye health symptom	n	%
Eye fatigue	212	70.7
Dry eyes	186	62.0
Blurred vision	158	52.7
Headaches	134	44.7
Difficulty focusing	121	40.3
Burning or itching sensation	96	32.0

The prevalence of eye health symptoms reported by respondents is summarized in Table 2. Overall, a high proportion of participants reported experiencing at least one symptom associated with prolonged electronic device use. Eye fatigue was the most frequently reported symptom, followed by dry eyes, blurred vision, and headaches. These symptoms align closely with those described in the literature on digital eye strain and computer vision syndrome (Portello et al., 2012; Rosenfield, 2016).

The high prevalence of visual discomfort suggests that eye health problems have become a common consequence of routine screen exposure. Many respondents indicated that symptoms intensified after extended periods of device use, supporting the cumulative effect hypothesis proposed in previous physiological and occupational health studies (Tsubota & Nakamori, 1993).

Association Between Screen Time Duration and Eye Health Problems

Table 3. Association between daily screen time and eye health symptoms

Daily screen time	≥1 symptom (%)	≥3 symptoms (%)
2–4 hours	45.3	18.8
5–6 hours	67.4	36.7
>6 hours	84.8	58.0

Analysis revealed a clear association between daily screen time duration and the prevalence of eye health symptoms. Respondents reporting screen exposure exceeding six hours per day demonstrated a significantly higher prevalence of eye fatigue, dryness, and blurred vision compared to those with shorter exposure durations. This pattern is consistent with previous studies indicating that prolonged and uninterrupted screen use increases accommodative stress and ocular surface instability (Sheppard & Wolffsohn, 2018; Coles-Brennan et al., 2019).

Participants with lower screen exposure were less likely to report multiple symptoms, suggesting a dose–response relationship between duration of electronic device use and eye health outcomes. These findings reinforce the importance of screen time duration as a central determinant of digital eye strain.

This paper offers empirical data on ocular health issues accruing as a result of long-term exposure to electronics devices and, therefore, supports the increasing concerns on the visual aftermath of increasingly digitalized lifestyles. The statistics indicate that prevalence levels of eye fatigue, dry eye syndrome, blurred vision, and cephalalgia are high among the participants, who are involved in prolonged screen-based activities. These findings are consistent with the results of earlier studies on digital eye strain and computer-vision syndrome, which have all reported similar symptomology with high frequency users of electronics (Portello et al., 2012; Rosenfield, 2016). The overlaps of results in distinct settings suggest that the ocular health problems that are related to screen exposure are a widespread and long-term issue in the public-health sector and not an exclusive occupational issue.

One of the main findings of this study is that there is a strong correlation between daily screen-time and eye-health symptoms prevalence. The respondents who reported having over six hours of screen time per day also had significantly greater visual discomfort rates than the ones who had less time. This confirms the doseresponse relationship proposed by previous studies which indicate that cumulative visual load and longer near work aggravate the strains of accommodation and ocular fatigue (Sheppard and Woolfsohn, 2018; Sigamani et al., 2022). This finding is further reinforced by the fact that the association did not disappear on multivariate analyses in which the duration of screen-time was used as a determinant of ocular health regardless of individual differences like age and corrective lenses.

In this study, behavioral factors became relevant in the development of ocular health problems. Reduced frequency of breaks during screen activities was associated with higher rates of eye fatigue and dryness which are consistent with physiologic findings that sustained visual concentration reduces the rate of blink and destabilizes the tear film (Tsubota and Nakamori, 1993; Oganov et al., 2023; McMonnies, 2025). The results are in line with the established evidence-based preventive advice practices such as regular visual rest and intentional blinking which have been widely promoted

by professional organizations, such as the American Optometric Association. However, the findings also identify a discrepancy between what is recommended and what is actually done by users, indicating that user awareness is not enough to cause significant shifts in screen-use behavior.

The influence of the environmental and ergonomic conditions was also experienced on the ocular health. The amount of visual strain and cephalalgia were significantly higher among participants who indicated the inappropriateness of the screen brightness or sub-optimal lighting conditions. These findings are in agreement with results of ergonomic studies that showed that glare, excessive contrast and poor lighting increase the visual workload and exacerbate discomfort when using the screen (Anshel, 2007; Novak, 2026; McKee and Hedge, 2022). The interaction between the environmental factors and the screen exposure highlights the importance of having a holistic view of eye-health protection, which goes beyond the individual behaviour to include the design of the workplace and learning environment.

The effect of personal factors, especially age and the use of a corrective lens, is even more enriching the interpretation framework. Contribution to considering older participants and the use of corrective lenses were greater among the symptoms of eye-health, which suggests increased vulnerability to the groups. Age-related changes in accommodation and tear production and suboptimal correction of refractive errors have been found to be among the factors that magnify the visual effects of extended screen time (Rosenfield, 2016; Barata et al., 2025). These results suggest that the importance of specific preventive measures addressing individual variations in visual acuity and eye health should be acknowledged.

Regarding the prevalence of the ocular health symptoms found in this study, the general concern, in terms of a public-health point of view, is the normalization of the visual discomfort in digitally intensive settings. Eye strain also seemed to be a widely accepted part and parcel of modern work and learning activities among many respondents (Zayed et al., 2021; Parrey et al., 2023). Having such normalization can postpone help-seeking behaviour and make preventive action seem less urgent. According to the World Health Organization, preventable visual impairment is a worldwide problem, and the timely intervention is essential to reduce the negative impact of long-term consequences of a quality of life and productivity (World Health Organization, 2019; Keel et al., 2022; Rizzo et al., 2023; Armstrong, 2018; Barata et al., 2025). This paper, therefore, highlights the need to take the initiative in ensuring that eye-health promotion models are adopted that address the normalization of the discomfort and enhance preventative focus.

The implications of the results on policy and institutional practice are also important. Since the use of electronic devices is prevalent, the organisational policies that support the healthy use of the screens should be added to individual-level interventions. These policies can involve a program of breaks, ergonomic workstations, as well as incorporation of eye-health education in the work and educational programmes. Past studies show that the institutional assistance is a crucial factor that facilitates the adoption and retention of preventive behaviours in individuals (Sheppard and Wolffsohn, 2018). Based on this research, therefore, empirical support is given to the formulation of an all-inclusive guideline to tackle behavioural and environmental factors affecting ocular health.

This study has various limitations though it has made some contributions as such there are various limitations which need to be considered during the interpretation. The cross-sectional nature of the study limits the possibility of establishing a causal relationship between the exposure to electronic devices and the outcomes of ocular health outcomes. In addition, self-reported information can cause recall bias or

subjective discrepancy in reporting the symptoms. Although they are typical of epidemiological research on digital eye strain, these limitations demonstrate the need to conduct future studies utilizing longitudinal designs and objective indices of screen exposure and eye functions. These methodological improvements would make causal inferences and increase the knowledge in the long-term outcomes of the chronic use of electronic devices on eye health.

CONCLUSION

This study concludes that eye health problems related to prolonged exposure to electronic devices are highly prevalent and represent a significant public health concern in increasingly digitalized environments. The findings demonstrate that extended screen time is strongly associated with visual symptoms such as eye fatigue, dryness, blurred vision, and headaches, with these effects being further influenced by behavioral practices, environmental conditions, and individual characteristics. The results underscore that eye health problems are not solely the consequence of screen exposure duration but emerge from the interaction between usage patterns, ergonomic factors, and user awareness. By providing empirical evidence within a comprehensive analytical framework, this study reinforces the need for integrated preventive strategies that combine individual behavioral modification, supportive environmental design, and institutional policy interventions. Addressing these factors collectively is essential to promote sustainable digital engagement and to protect visual health in the context of rapidly expanding reliance on electronic devices.

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