

Generation Z and Digital Eye Strain: A Narrative Review of Awareness Gaps and Preventive Strategies

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Abstract:

Generation Z, the first cohort to grow up in a fully digital environment, is increasingly reliant on smartphones, computers, tablets, and social media for education, communication, and entertainment. This review was conducted through a literature search of PubMed, Scopus, Web of Science, and Google Scholar to identify studies related to digital eye strain, screen use, awareness, and preventive strategies among Generation Z. This widespread and often prolonged digital engagement has led to increased screen exposure, which is strongly associated with a rising burden of visual symptoms collectively known as digital eye strain (DES), including eye fatigue, dryness, headaches, blurred vision, and general ocular discomfort. This narrative review synthesizes existing global and local literature to explore the impact of prolonged digital device use on visual health among Generation Z, with a particular focus on Pakistan. It also examines behavioral patterns related to digital usage, associated risk factors, and common ocular manifestations linked to excessive screen exposure. The evidence indicates high digital dependency among Generation Z, often with limited awareness of appropriate visual hygiene practices. Studies from international and local settings demonstrate a significant burden of DES symptoms in young populations, alongside moderate awareness of its causes and poor adoption of preventive strategies. In Pakistan, despite widespread digital device use among students, knowledge regarding DES and its preventive practices remains inadequate. This gap is further intensified by limited structured health education and absence of standardized awareness programs. Overall, this review highlights digital eye strain as an

emerging public health concern among Generation Z and emphasizes the urgent need for targeted awareness campaigns, integration of eye health education in academic settings, and implementation of preventive strategies to reduce screen-related visual morbidity.

Key Words: Generation Z, Digital Eye Strain, Screen Time, Visual Health, Health Education

Introduction

Generation Z, generally defined as individuals born between the mid-1990s and 2010, is the first cohort to grow up entirely in the digital era with widespread and continuous access to the internet, smartphones, and social media. This generation is closely connected with digital technology and frequently interacts through online platforms and virtual communication. Their daily routines, education, communication, and recreational activities are highly integrated with digital technologies. They are known for being highly active on social media, creative, dynamic, and strongly influenced by technological advancements in their everyday lives^(1, 9). The increasing reliance on digital devices such as smartphones, tablets, and computers for education and entertainment has led to a marked rise in screen exposure among adolescents and young adults. Prolonged use of these devices has been associated with a range of visual and ocular complaints, including eye strain, dryness, blurred vision, headaches, and musculoskeletal discomfort, commonly referred to as digital eye strain or computer vision syndrome. As screen time continues to rise globally, these symptoms are becoming an emerging public health concern, particularly among school and university students.⁽²⁾

The relationship between long-term exposure to digital screens and visual health is widely discussed, with growing attention to its effects on young people. With the increasing accessibility of smartphones, tablets, laptops, and other electronic devices, screen use has become common at a very early age, with reports showing high daily usage even among very young children. In modern society, these devices are widely used across this age group for education, communication, entertainment, and information, making digital exposure an unavoidable part of daily life and an important factor in understanding emerging visual health concerns.⁽³⁾

Beyond acute visual discomfort, excessive near work and prolonged digital screen use have also been implicated as environmental risk factors for the development and progression of myopia in children and adolescents. Reduced outdoor activity, increased academic screen dependence, and prolonged engagement with social media further contribute to sustained near focus behavior, which may exacerbate visual stress and refractive changes.⁽⁴⁾

Despite this growing burden, awareness regarding appropriate visual hygiene practices and preventive strategies remains limited among young individuals. In Pakistan, where digital device use is rapidly increasing across educational and social settings among Gen Z, the local evidence on screen-related visual health effects remains fragmented.

Therefore, this narrative review aims to synthesize existing literature on the impact of prolonged screen exposure on visual health among Generation Z, with a particular focus on Pakistan. It further explores associated risk factors, common visual symptoms, and gaps in awareness and preventive practices, to better understand this evolving public health concern and inform future preventive strategies.

Methodology

This study was conducted as a narrative review to provide an overview of the current evidence regarding digital eye strain (DES), digital behavior patterns, awareness gaps, and preventive strategies among Generation Z, with a particular focus on Pakistan. Relevant literature was identified through searches of PubMed, Scopus, Web of Science, and Google Scholar. The search focused on articles published between 2020 and 2026, corresponding to the period covered by the studies included in this review. The search was performed using combinations of the keywords: “Generation Z,” “digital eye strain,” “computer vision syndrome,” “screen time,” “visual health,” “digital behavior,” “social media,” “awareness,” “preventive

strategies,” and “Pakistan.” Studies were included if they were published in English and addressed digital device use, visual health, digital eye strain, awareness, behavioral patterns, or preventive measures among adolescents and young adults representative of Generation Z. Articles not relevant to the objectives of the review, duplicate records, and studies lacking information related to visual health or digital eye strain were excluded. The screening process involved reviewing titles, abstracts, and full texts of retrieved articles for relevance to the review objectives. Additional relevant studies were identified through reference list screening. The selected literature was then narratively synthesized and organized into thematic sections including digital eye strain, contributing factors, digital behavior patterns, evidence from global and local studies, awareness gaps in Pakistan, and preventive strategies.

Overview of Digital Eye Strain

Digital eye strain (DES) refers to a group of visual and ocular symptoms that occur due to prolonged use of digital electronic devices such as smartphones, computers, and tablets. It commonly presents with dry eyes, itching, foreign body sensation, watering, blurred vision, and headaches, along with non-ocular symptoms such as neck stiffness, general fatigue, and back or shoulder pain. According to the American Optometric Association, the usage of digital devices continuously for two hours is adequate to bring about digital eye strain. ⁽⁵⁾

According to the American Optometric Association, digital eye strain (DES) refers to a group of ocular and visual discomfort symptoms associated with prolonged use of digital devices such as computers, tablets, smartphones, and e-readers. These symptoms commonly include burning eyes, watering, redness, eye strain, headaches, dry eyes, and blurred vision. In addition, non-ocular symptoms such as neck and back pain may occur, often related to prolonged device use and poor posture. The Vision Council reports that a large proportion of adults experience at least one symptom of DES, highlighting its increasing prevalence as digital devices have become an essential part of daily life, with children and adolescents also being particularly affected due to early and frequent exposure. ⁽⁶⁾

Mechanisms and Contributing Factors

Digital Eyestrain (asthenopia) is classified into internal and external types. The internal type results from strain and ache inside the eye due to stress on the accommodative and convergence mechanisms, while the external type is associated with dryness and irritation on the ocular surface due to altered viewing conditions. These external symptoms resemble those seen in dry eye conditions. Under challenging viewing conditions, increased contraction of the orbicularis oculi muscle leads to squinting in an effort to improve vision, which subsequently reduces the normal blink rate. This reduction in blinking results in inadequate tear distribution and contributes to ocular surface dryness. Electromyography may be used as a sensitive method to measure orbicularis muscle activity and assess eyestrain. ⁽⁷⁾

Blue light emitted from digital devices has both beneficial and harmful effects on eye health. While it may support alertness and help regulate circadian rhythms, excessive exposure is associated with digital eye strain, sleep disturbances, and potential long-term retinal effects. These impacts are mainly related to prolonged screen exposure and continuous use of digital devices in daily activities. ⁽⁸⁾

Digital Behavior Patterns in Generation Z

Generation Z spends a large amount of time on social media platforms like WhatsApp, Instagram, YouTube, TikTok, and Facebook. Social media has become a major part of their daily life and affects their behavior. Some students become hyperactive, while others become quiet, moody, and emotionally dependent on social media. Excessive use also decreases face-to-face interaction, increases internet addiction, and causes anti social behavior and phubbing, where students focus more on phones than people around them. ⁽⁹⁾

Generation Z is strongly connected with the internet and digital technology and does not clearly separate real and virtual life. They prefer online communication, value self expression,

freedom, quick success, and fast access to information. They spend continuous time in cyberspace, follow online trends, and often show individualistic behavior. Some common digital behaviors include internet dependence, trolling, downloading pirated content, use of foul language, and difficulty in deep communication and information processing. ⁽¹⁰⁾ Generation Z shows strong internet-centered behavior, shaped by responsibility, individualism, collectivity, rational thinking, and digital communication styles. Their communication characteristics and behavioral models are highly influenced by continuous interaction with the online environment. ⁽¹⁰⁾

In Pakistan, these patterns are further reinforced by online learning environments and increased reliance on digital devices for academic purposes. As a result, screen exposure is often prolonged and lacks structured regulation.

Evidence from Global and Local Studies

Both global and local evidence show that Generation Z is highly connected with digital technology and social media, which strongly influences their communication style, behavior, values, and social interaction. Findings from Indonesia and Russia suggest that excessive internet and social media use may contribute to internet dependence, anti-social behavior, mood changes, online-centered communication, trolling, misuse of digital freedom, and possible eye strain due to prolonged screen exposure. At the same time, Generation Z values self expression, quick access to information, career success, and online interaction, showing how digitalization shapes their daily lives and personalities. ^(9, 10)

Evidence from studies in India shows that awareness of Digital Eye Strain is generally moderate, with better understanding of its basic concept and preventive measures such as taking screen breaks. However, significant gaps remain in recognizing specific symptoms, environmental risk factors, and consistent use of protective strategies. Research also highlights that awareness levels are influenced by socio demographic factors such as education and rural and urban residence. Overall, Indian studies indicate a clear need for improved health education and targeted awareness programs to bridge existing knowledge and practice gaps related to DES. ⁽¹¹⁾

Evidence from a local study conducted among medical students in Peshawar, Pakistan, with a mean age of approximately 22 years (representing Generation Z), reported a high prevalence of digital eye strain symptoms (74.1%). Headache was the most common symptom, and significant associations were observed between increased screen time and symptoms such as eye pain, redness, tearing, and itching. The findings indicate that prolonged digital device use is strongly linked with ocular discomfort among Generation Z young adults, highlighting the growing burden of screen-related visual problems in this population and emphasizing the need for preventive strategies and awareness in the context of increasing digital dependence. ⁽¹²⁾

Table 1: Summary of Included Studies

Author/Year	Country	Population	Main Findings
Mujiwati & Laili (2023)	Indonesia	Generation Z students	Social media associated with behavioral changes, internet addiction, and reduced face to face interaction
Tolstikova et al. (2020)	Russia	Generation Z university students	Strong internet-centered behavior and online communication patterns
Joshi et al. (2025)	India	Young individuals	Moderate awareness of DES but poor preventive practices
Haider et al. (2023)	Pakistan	Medical students	High prevalence of DES symptoms associated with increased screen time

Public Health and Awareness Gaps in Pakistan

Despite the increasing dependence of Generation Z in Pakistan on digital devices for education, communication, and entertainment, awareness regarding the ocular consequences of prolonged screen exposure remains limited. Although digital technologies are deeply integrated into academic and social life, structured understanding of digital eye strain (DES), its symptoms, and preventive practices is still inadequate among young individuals. Available literature indicates that while basic recognition of symptoms such as eye fatigue, redness, and headaches exists, awareness of underlying risk factors and long-term visual consequences remains weak. This highlights a persistent gap between high digital device use and appropriate eye health literacy.

In Pakistan, this situation is further complicated by limited and fragmented health education initiatives related to digital eye health. Evidence from local studies among Generation Z shows a high burden of DES symptoms, yet preventive behaviors and routine eye care practices remain poorly adopted. Contributing factors include lack of standardized awareness programs in educational institutions, limited access to structured visual health education, and uneven distribution of health awareness between different populations. Overall, these gaps emphasize the need for coordinated public health strategies to improve awareness, promote preventive behavior, and integrate digital eye health education into academic systems.

Preventive Strategies and Recommendations

Health Education and Visual Hygiene

Health education programs should be implemented to increase awareness regarding digital eye strain (DES) and its associated effects. Students should be encouraged to follow preventive practices such as the 20-20-20 rule and maintain proper ergonomic posture during digital device use. In addition, regular consultation with Optometrists is recommended for individuals experiencing persistent visual symptoms to ensure timely evaluation and management. ^(6, 12)

Blue Light Protection and Ergonomic Measures

Protective measures to reduce the harmful effects of blue light and prolonged digital device use include the use of blue light filters on screens and software applications that adjust display color temperature. Blue light-blocking glasses can also be used, especially during extended screen time. Many modern devices offer built-in settings such as night mode, warmer color tones, and reduced brightness or contrast to minimize exposure. In addition, proper screen positioning, keeping devices at an appropriate distance and below eye level, along with ensuring adequate and well-balanced lighting in both home and workplace environments, can help reduce glare and visual strain. ⁽⁸⁾

Educational and Behavioral Guidance

Teachers, Universities and Schools should guide students toward positive use of technology and social media. Social media platforms such as Gmail, YouTube, and Instagram can be used for educational activities and learning purposes. They should provide counseling services, enforce rules consistently, and encourage cooperation between teachers, parents, and the community to help students maintain balanced social behavior and reduce the negative effects of excessive social media use. ⁽⁹⁾ Generation Z should be guided toward socially constructive values and responsible internet behavior. Positive use of the digital environment, better communication skills, stronger ethical values, and balanced interaction between virtual and real life are important. Educational institutions and society should help reduce deviant online practices such as trolling, misuse of freedom, and harmful digital activities by promoting positive digital engagement. ⁽¹⁰⁾ Better understanding of Generation Z's online behavior and communication patterns can help develop effective guidance and promote responsible internet use, balanced social interaction, and healthy digital engagement. ⁽¹⁰⁾

Policy and Institutional Recommendations

National and local ophthalmology societies should develop and implement standardized guidelines for the effective management of digital eye strain (DES) to reduce its burden, particularly among Generation Z who are highly exposed to prolonged screen use. Ensuring proper ergonomic environments is also essential as a key preventive measure against DES, especially in academic and digital learning settings commonly used by Generation Z. In addition, individuals should be encouraged to adopt regular visual breaks and maintain appropriate screen positioning and lighting conditions to minimize ocular stress and improve overall visual comfort. ⁽¹²⁾

Table 2: Common Symptoms and Preventive Strategies of DES in Gen Z

Common DES Symptoms	Preventive Strategies
Eye strain	20-20-20 rule
Dry eyes	Frequent blinking
Headache	Screen breaks
Blurred vision	Proper screen distance
Neck/back pain	Ergonomic posture
Redness/watering	Blue light filters/night mode

Conclusion

This narrative review highlights that Generation Z in Pakistan is highly dependent on digital devices for education, communication, and social interaction, resulting in increased and often unregulated screen exposure. The literature consistently demonstrates a strong association between prolonged digital device use and a wide range of visual symptoms, including eye strain, dryness, headaches, and general ocular discomfort, reflecting a growing burden of digital eye strain in this population. Despite this, awareness regarding DES, its risk factors, and effective preventive practices remains insufficient, with notable gaps in both knowledge and behavior, particularly in the Pakistani context.

Overall, digital eye strain among Generation Z represents an emerging public health concern that requires urgent attention. Strengthening awareness through structured health education programs, integrating visual hygiene into academic curricula, and promoting responsible digital behavior are essential steps to reduce the burden of screen-related visual problems. Early adoption of preventive eye care practices at the student level will be crucial in protecting long-term visual health in this highly digitalized generation.

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