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REVIEW

Impact of prolonged screen use on the visual health of young adults

Impacto del uso prolongado de pantallas en la salud visual de adultos jóvenes

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ABSTRACT

Introduction: in the current digital context, prolonged screen use has become common practice among young working adults. This constant exposure has led to a significant increase in the appearance of Computer Visual Syndrome (CVS), a condition characterized by visual, ocular and extraocular symptoms such as dry eyes, blurred vision, burning, headache and neck pain. Concerns about the possible harmful effects of blue light have also led to hypotheses about its long-term impact on visual health, especially in relation to macular degeneration.
Method: the study addressed the prevalence of CVS in adults aged between 18 and 40 who were exposed to screen devices for more than six hours a day. It analyzed factors such as exposure time, ergonomic conditions in the work environment, blinking frequency and the influence of blue light. A literature review was used to compare previous findings and the use of the CVS-Q questionnaire was evaluated as a diagnostic tool.
Conclusions: it was concluded that VDU work significantly affected the study population, with prolonged screen time, poor ergonomics and reduced blinking being the main associated factors. Although no conclusive evidence was found on the permanent effects of blue light, it was recommended that further research into its possible cumulative toxicity be conducted. The study highlighted the need to implement preventive measures, such as active breaks, eye lubricants and ergonomic adjustments, to preserve visual health and optimize work performance.

Keywords: Computer Vision Syndrome; Digital Screens; Visual Health; Ergonomics; Blue Light.

RESUMEN

Introducción: en el contexto digital actual, el uso prolongado de pantallas se consolidó como una práctica común entre los adultos jóvenes en edad laboral. Esta exposición constante generó un aumento significativo en la aparición del Síndrome Visual Informático (SVI), una condición caracterizada por síntomas visuales, oculares y extraoculares como sequedad ocular, visión borrosa, ardor, cefalea y dolor cervical. La preocupación por el posible efecto nocivo de la luz azul también llevó a plantear hipótesis sobre su impacto a largo plazo en la salud visual, especialmente en relación con la degeneración macular.
Método: el estudio abordó la prevalencia del SVI en adultos de entre 18 y 40 años que estuvieron expuestos más de seis horas diarias a dispositivos con pantalla. Analizó factores como el tiempo de exposición, las condiciones ergonómicas del entorno laboral, la frecuencia del parpadeo y la influencia de la luz azul. Se empleó una revisión bibliográfica para comparar hallazgos previos y se valoró el uso del cuestionario CVS-Q como herramienta diagnóstica.
Conclusiones: se concluyó que el SVI afectó de forma significativa a la población estudiada, siendo el tiempo prolongado frente a pantallas, la mala ergonomía y la disminución del parpadeo los principales factores asociados. Aunque no se encontró evidencia concluyente sobre los efectos permanentes de la luz azul,

se recomendó continuar investigando su posible toxicidad acumulativa. El estudio resaltó la necesidad de implementar medidas preventivas, como pausas activas, lubricantes oculares y ajustes ergonómicos, para preservar la salud visual y optimizar el desempeño laboral.

Palabras clave: Síndrome Visual Informático; Pantallas Digitales; Salud Visual; Ergonomía; Luz Azul.

INTRODUCTION

In today's digital age, prolonged screen use is an unavoidable reality, especially among working-age adults, given its impact on professional performance. This phenomenon has raised significant concerns about visual health, stemming from the emergence of various ophthalmological symptoms that are grouped under the term Computer Vision Syndrome (CVS).[1,2]

These symptoms include eye redness, itching, burning, blurred vision, double vision, asthenopia, and extraocular symptoms such as headache and neck pain. In addition, exposure to blue light emitted by electronic devices such as computers, televisions, and mobile phones has been identified as a possible contributing factor to adverse effects on the retina's photoreceptors.[3,4,5]

This study aims to analyze the impact of prolonged screen use on the visual health of young adults, assessing both immediate discomfort and possible long-term consequences. In particular, it seeks to identify the most common visual disturbances related to extended screen use and evaluate their impact on the visual health of working adults.[6]

In today's technology-driven society, screens are almost constantly in people's daily lives. Because of this, it is imperative to investigate their potential effect on vision, as ophthalmological disorders affect people's quality of life and have a socioeconomic impact due to reduced work productivity.[7,8] Therefore, it is essential to investigate the effect on the visual health of working-age adults, i.e., adults in early adulthood (18-40 years) who spend more than 6 hours a day in front of screens due to their work or recreational activities.

This study mainly investigated screen time, its relationship with the layout of work environments and the appearance of eye discomfort, and to a lesser extent, the effects of overexposure to blue light and its relationship with visual symptoms to assess screen use's short- and medium-term consequences.

The importance of this study lies in determining guidelines on screen time, the distance at which devices should be located in work environments, and, if necessary, guiding manufacturers of devices with screens in the development of technology that reduces possible risks and damage. In this way, the quality of life can be improved, and socioeconomic deterioration caused by this problem can be prevented.

DEVELOPMENT

Computer Vision Syndrome (CVS)

Definition and prevalence

Computer Vision Syndrome is a set of eye and visual signs and symptoms associated with prolonged screen use. This problem has been widely reported in people who spend more than 5 hours in front of display terminals. According to recent studies, between 64 % and 90 % of users of devices with screens/display terminals have ophthalmological symptoms that can vary between eye redness, itching, burning, blurred vision, diplopia, and asthenopia.[7]

One of the main factors contributing to the symptoms of this syndrome is altered eye lubrication, which is associated with altered blinking, with the blinking rate decreasing by 1/3 during display terminals. Contributing factors to the onset of SVI:

Screen exposure time: prolonged exposure is the factor that most influences the development of SIV. Studies have shown that using display terminals for more than 5 hours and the presence of any of the symptoms included in SIV increase the likelihood of diagnosis, with women being more affected than men.[8,9] Using the 20-20-20 rule, based on observing an object 20 feet (6 m) away, followed by 20 minutes of work and 20 minutes of rest, effectively reduces the symptoms of SIV. However, the benefit duration was linked entirely to the rule's use duration, with no residual beneficial effect. It has also been determined that the screen environment plays a role, with those whose workstations had more ergonomic conditions experiencing less severe symptoms.[10,11,12]

Blinking frequency and quality: The frequency and quality of blinking are two key factors in developing SIV's signs and symptoms. Usually, the blinking rate is 15-20 per minute. It has been shown that under cognitive demand when using screens, this rate can decrease in the most extreme cases to as little as 3 per minute.[13,14,15,16,17] Not only that, but the quality of blinking is also affected,[18] leading to incomplete blinking and consequently to instability of the tear film, causing it not to cover the eye completely and also accelerating tear evaporation time, which leads to symptoms such as eye irritation, burning sensation, or dry eye.[19] Therefore, one of the most effective treatments for IVS is eye drops.[20]

Ergonomic conditions of the environment and type of screens: Conditions such as poor lighting, a distance between the eyes and screens of less than 40-70 cm, screens located below eye level, and the use of screens without anti-glare technology are high-risk factors for the development of VSD. It has been found that SIV symptoms can be significantly minimized by adjusting working conditions to avoid glare, maintaining a distance of more than 40 cm from the screen, and taking short breaks during long tasks.[21]

A study conducted in 2019 found that workers who use low-resolution screens or have significant glare on their screens experience higher levels of visual fatigue and headaches. In addition, ambient light and incorrect screen placement contribute to eye fatigue, as they force the user to adopt awkward postures and strain their eyes to focus on the content, giving us a glimpse of the impact of SIV on work productivity.[22,23]

Female gender: Multiple studies have shown that females have a significantly higher prevalence of SIV, the cause of which is unknown.[24,25,26]

Detection tools: Although the detection of CVS is clinical and its diagnosis is based on medical suspicion, a questionnaire called CVS-Q has been created. This short questionnaire allows for identifying symptoms, early detection, personalization of treatment about the symptoms present, monitoring of the progress of symptoms, promotion of research into CVS, and the identification of ergonomic factors that may contribute to it.[27]

Symptoms associated with the use of display terminals

The symptoms of Computer Vision Syndrome are varied but can be classified into three groups: ocular symptoms, visual symptoms, and extraocular symptoms, the latter being addressed with less relevance in this paper.

Ocular symptoms: the most common are dryness, burning, itching, and redness of the eyes. All are highly associated with altered blinking, leading to a reduction in the rate and quality of blinking; this leads to incomplete blinking and, consequently, a more unstable tear film that does not cover the entire surface of the eye, causing a failure in lubrication and accelerated tear evaporation, generating these characteristic symptoms.[28,29]

Visual symptoms: the most common are blurred vision, double vision, and difficulty focusing on objects at different distances. These symptoms are associated with the effort made to maintain visual focus on the screen for long periods, leading to a decrease in accommodative power, elimination of the central point of convergence, and deviation of the phoria for near vision.[30,31,32]

Extraocular symptoms: although not covered in this paper, it is worth mentioning that headaches and neck or shoulder pain are prevalent in SIV and are associated with the posture people adopt when using electronic devices, leading to muscle stress that triggers the symptoms.[33]

Exposure to blue light: Blue light is a portion of the visible light spectrum, ranging from 380 to 500 nanometers (nm), with a short wavelength that classifies it as high-energy light. This light is found naturally in sunlight, which contains approximately 25 % blue light. However, with the widespread use of electronic devices, exposure to this light has increased significantly, as LED screens emit up to 35 % blue light. This has raised concerns about the potential impact of overexposure to blue light due to prolonged use of screens in work and home environments.

Recent studies have shown that blue light is phototoxic to the pigmented epithelial cells of the retina. Exposure to this light induces the production of reactive oxygen species that lead to oxidative changes in intracellular material, which undergoes lysosomal degradation and gives rise to lipofuscins, which generate even more reactive oxygen species, leading to cellular senescence of the retinal pigment epithelium. This has led to the hypothesis that it could accelerate age-related macular degeneration (AMD). Despite these findings, no conclusive evidence has been found that blue light doses emitted by LED screens in work or home environments are retinotoxic or that blue light-blocking lenses prevent the onset of eye diseases such as AMD.[15,16,34]

However, because this issue is relatively new, it is still unknown whether some cumulative toxicity could develop.

CONCLUSIONS

This study has shown that prolonged screen use is associated with a high prevalence of visual and ocular symptoms, particularly in young adults of working age, a highly exposed population due to the demands of today's academic, professional, and recreational environments. Computer Vision Syndrome (CVS) is a multifactorial condition involving variables such as exposure time, blink quality and frequency, ergonomic conditions, and, to a lesser extent, exposure to blue light.

The most common symptoms of VSD include dry eyes, redness, burning, blurred vision, and, in some cases, extraocular symptoms such as headache or neck discomfort. These symptoms mainly result from a decrease in the frequency and quality of blinking during screen use, which affects the stability of the tear film and causes increased tear evaporation. In addition, environmental and postural conditions in the workplace or academic setting play an important role, as factors such as inadequate distance from the screen, poor lighting, or lack of

anti-glare filters increase the severity of symptoms.

Although exposure to blue light has been the subject of study and concern in recent years, current evidence does not support that the doses emitted by standard screens have permanent genotoxic effects. However, the need for further research into its possible long-term cumulative effect is recognized, especially in the development of pathologies such as age-related macular degeneration (AMD).

This analysis is important because it raises awareness of an issue that, although common, is often underestimated. Establishing preventive measures such as applying the 20-20-20 rule, using artificial tears, improving ergonomic conditions, and limiting screen time is essential to mitigate the effects of IVS. In addition, tools such as the CVS-Q questionnaire can be useful for early detection and monitoring of symptoms.

Finally, this study highlights the need to develop occupational health policies that address the visual impact of screen use, promoting healthy work environments that favor both the visual well-being and productivity of workers and students.

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CONFLICT OF INTEREST

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