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Impact of Digital Devices on Eye Health and Role of Diet

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The widespread use of digital devices such as smartphones, computers, and tablets has led to increased screen exposure, raising significant concerns about eye health. Prolonged screen use is associated with digital eye strain (DES), characterized by symptoms such as dry eye, eye fatigue (asthenopia), blurred vision, headaches, and the risk of myopia progression. These effects are primarily attributed to reduced blink rate, incomplete blinking, and continuous near-vision tasks. In addition, exposure to blue light from digital screens can induce oxidative stress, contributing to retinal damage and visual discomfort. Environmental factors, including poor lighting, improper viewing distance, and extended screen time without breaks, further aggravate these conditions. Preventive strategies such as maintaining proper screen ergonomics, adopting the 20-20-20 rule, and reducing screen exposure are essential for minimizing ocular strain. Furthermore, nutrition plays a vital role in supporting eye health. Diets rich in antioxidants, vitamins A, C, and E, carotenoids (lutein and zeaxanthin), and omega-3 fatty acids help protect against oxidative damage, improve tear film stability, and support overall visual function. Thus, integrating healthy screen habits with proper nutrition is crucial for maintaining ocular health in the digital era.

Introduction

Digital devices such as smartphones, computers, and tablets have become an integral part of modern life, with widespread use in education, work, and communication, leading to a significant increase in screen time. This shift in life style has resulted in prolonged visual engagement and sustained near work, placing increased demand on the visual system. Factors such as screen characteristics, lighting conditions, and viewing habits influence visual comfort during extended use. Consequently, individuals commonly experience visual disturbances including digital eye strain, dryness, blurred vision, and headaches. With the growing dependence on digital devices, understanding their impact on eye health is essential for developing effective preventive strategies, including lifestyle modifications and nutritional prevention, to maintain optimal ocular health. (Skobolina *et al.*, 2020).

Impact of Digital Device on Eye Health

Prolonged use of digital devices increases visual stress and reduces ocular comfort. It is commonly associated with conditions such as Digital Eye Strain (DES), Dry Eye Disease (DED), and asthenopia, resulting in symptoms like eye strain, dryness, blurred vision, and headaches. Continuous near work and reduced blinking are major contributing factors. Long-term exposure is also linked to the development of myopia. In addition, environmental factors such as glare and poor lighting further aggravate these effects (Gajewski *et al.* 2025).

Contributing Factors

- ✓ Prolonged screen exposure increases visual stress. (Pavel *et al.* 2023)
- ✓ Reduced blink rate leads to tear film instability and dryness.

- ✓ Continuous near work increases accommodative demand.
- ✓ Blue light exposure contributes to ocular discomfort.
- ✓ Poor lighting and glare increase visual strain.
- ✓ Improper viewing distance and posture affect comfort.
- ✓ Lack of breaks and excessive screen time worsen symptoms.

Among these, blue light exposure from digital devices plays a significant role in affecting ocular health.

Blue Light: Blue light is a high-energy visible light emitted from digital devices such as smartphones, computers, and tablets. Prolonged exposure to blue light can penetrate deeper into the eye and contribute to ocular discomfort. It induces oxidative stress by generating reactive oxygen species, which may affect ocular tissues and visual function. Furthermore, excessive blue light exposure can disrupt circadian rhythm and negatively impact sleep patterns. (Hipolito and Coelho,2023).

Ocular Problems Associated with Digital Device Usage

Management and Prevention Strategies

Digital Eye Strain (DES): Digital Eye Strain (DES), also known as computer vision syndrome, refers to a group of visual and ocular symptoms associated with prolonged use of digital devices. It is one of the most common ocular complaints, affecting nearly 50–90% of users. DES is primarily caused by reduced blink rate, continuous near work, and increased visual demand during screen use. Environmental factors such as glare, poor lighting, and improper viewing habits further aggravate the condition. Common symptoms include headache, blurred vision, difficulty in focusing, eye strain, dryness, burning and itching sensation, redness, watering (tearing), diplopia, and irritation. (Kaur *et al.*, 2022).

Dry Eye Disease (DED): Dry Eye Disease (DED) is a common ocular condition characterized by tear film instability and inadequate lubrication of the ocular surface. It is frequently associated with prolonged digital device use due to reduced blink rate, leading to increased tear evaporation. This results in symptoms such as dryness, irritation, burning sensation, redness, and watering. If left unmanaged, DED can affect visual comfort and performance. Environmental factors such as air conditioning, screen glare, and poor lighting further aggravate the condition (Mohtasebet *et al.* 2021).

Asthenopia: Asthenopia, also known as visual fatigue, refers to eye discomfort caused by prolonged visual tasks such as continuous use of digital devices. It is primarily due to increased accommodative and convergence demand during sustained near work. Common symptoms include eye strain, headache, blurred vision, and difficulty in focusing. Poor lighting, screen glare, and improper viewing posture further aggravate the condition, which may affect visual efficiency. (Song *et al.* 2026)

Headache: Headache is a common symptom associated with prolonged use of digital devices. It is primarily caused by continuous visual effort, sustained accommodation, and increased screen exposure. Poor posture, screen glare, and improper lighting further contribute to its development. It is often associated with eye strain and visual fatigue, and may affect concentration Falkenberg *et al.*2020.

Myopia: Myopia, or short-sightedness, is a refractive error in which distant objects appear blurred while near vision remains clear. It is mainly caused by prolonged near work, excessive use of digital devices, and reduced outdoor activities, leading to increased accommodative stress and elongation of the eyeball. Common symptoms include blurred distance vision, eye strain, and headaches. Continuous screen exposure may further contribute to its progression, particularly among children and young adults. (Gomes *et al.* 2020)

Ergonomic Interventions: Ergonomic interventions play a key role in reducing visual strain associated with digital device use. Proper adjustment of screen distance (20–28 inches), height (15–20° below eye level), and viewing angle helps maintain optimal posture. Adequate ambient lighting and reduction of screen glare further improve visual comfort. Optimizing screen settings, including brightness (60–70%), contrast (3:1 to 10:1), and

resolution, along with increasing text size (≥ 12 -point font), helps reduce accommodative stress. Additionally, the use of computer-specific spectacles designed for intermediate viewing distances can enhance visual efficiency and reduce eye strain. (Coles-Brennan *et al.* 2019)

Behavioural Strategies: Behavioural strategies play an important role in preventing digital device-related ocular problems. Practices such as regular blinking exercise, periodic eye rest, and controlled screen usage (≤ 4 hours per day) help reduce visual strain. Blinking exercise improves tear film stability and reduces dry eye symptoms. In addition, the 20-20-20 rule—looking 20 feet away for 20 seconds every 20 minutes—is an effective method to reduce visual fatigue and maintain ocular comfort during prolonged screen use. (Mohtaset *et al.*, 2021).

Lifestyle Modifications: Lifestyle modifications play a key role in maintaining ocular health and preventing digital device-related visual problems. Increased outdoor activity (2–3 hours per day) helps reduce the risk of myopia. Adequate sleep (6–8 hours) is essential for normal visual function and overall well-being. In addition, reducing prolonged near work and limiting excessive screen time help decrease visual strain. Adopting a balanced lifestyle that integrates these practices is important for promoting long-term eye health (Baird *et al.*, 2020)

Medical Management: Medical management plays an important role in treating digital device-related ocular conditions, particularly dry eye disease. Lubricating eye drops are the primary approach to improve tear film stability and reduce dryness. Omega-3 fatty acid supplements may further enhance tear quality and support ocular surface health. For contact lens users, appropriate lens selection, use of rewetting drops, and environmental adjustments are essential to minimize discomfort and maintain ocular health. Coles-Brennan *et al.* 2019.

Nutritional Prevention: Chronic exposure to digital devices induces oxidative stress, contributing to ocular damage and visual disorders. Therefore, dietary strategies that reduce oxidative burden are essential for maintaining ocular health. Regular consumption of antioxidant-rich foods such as fruits, green leafy vegetables, and fish helps protect against oxidative damage and supports visual function. Omega-3 fatty acids improve tear film stability, enhance tear production, and reduce dryness associated with dry eye disease and digital eye strain. Anthocyanins act as potent antioxidants that protect ocular tissues and reduce visual fatigue. Lutein and zeaxanthin play a key role in retinal protection by filtering blue light and neutralizing free radicals, thereby improving visual performance. Vitamins A, C, D, and E support retinal function, reduce oxidative stress, and maintain ocular surface integrity, while zinc aids vitamin A metabolism and strengthens antioxidant defence mechanisms. (Lem *et al.* 2022)

Conclusion

The increasing dependence on digital devices has emerged as a significant risk factor for various ocular disorders, including digital eye strain, dry eye disease, asthenopia, and myopia. These conditions are largely attributed to prolonged near-vision activities, decreased blink rate, and continuous visual demand, which collectively disrupt normal ocular physiology. Furthermore, external factors such as suboptimal lighting conditions, screen glare, and improper viewing posture can intensify visual discomfort and fatigue.

Addressing these challenges requires a comprehensive approach involving ergonomic corrections, behavioral strategies such as periodic breaks, and overall lifestyle modifications to reduce visual stress. In this context, nutrition serves as an important supportive factor in ocular health management. The intake of antioxidant-rich foods, along with essential vitamins (A, C, and E), carotenoids like lutein and zeaxanthin, and omega-3 fatty acids, has been shown to alleviate oxidative stress, support retinal integrity, and improve tear film stability. Therefore, a synergistic combination of preventive practices and nutritional interventions is essential for mitigating the adverse effects of prolonged digital exposure and promoting long-term visual health.

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