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Digital Screen Use and Intraocular Pressure Dynamics:
Physiological Mechanisms, Evidence, and Clinical Implications

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Abstract

Digital screens have become an inseparable part of modern life, shaping how people learn, work, and communicate. In countries such as India, this transition has been particularly rapid, with increasing screen exposure across children, adolescents, working adults, and even the elderly. What was once occasional use has now evolved into prolonged and often uninterrupted daily engagement. While symptoms of digital eye strain are widely recognized, the deeper physiological effects of sustained screen use, particularly on intraocular pressure (IOP), remain less clearly understood.

Intraocular pressure is a finely regulated parameter determined by the balance between aqueous humor production and outflow, along with influences from episcleral venous pressure, autonomic activity, and circadian rhythms. Even subtle fluctuations in IOP, when repeated over time, may have important implications for individuals at risk of optic nerve damage, especially in a country like India where the burden of glaucoma is substantial and often underdiagnosed.

Digital screen use introduces a unique visual and physiological environment. Prolonged near work demands sustained accommodation and convergence, while intense visual attention reduces blink rate, affecting tear film stability. In addition, commonly adopted postures—such as forward head tilt and neck flexion—may increase episcleral venous pressure, thereby influencing aqueous humor drainage. Exposure to blue-enriched light and continuous cognitive engagement further interact with neurohormonal pathways, potentially altering circadian regulation of intraocular pressure.

Emerging human studies suggest that digital screen use can lead to modest but measurable increases in intraocular pressure, particularly during extended periods of continuous use. Although these changes are generally transient and well tolerated in healthy individuals, their cumulative effect over time remains uncertain, especially in vulnerable populations such as those with glaucoma, ocular hypertension, or high myopia.

Despite growing interest, current evidence remains limited by short study durations and controlled experimental settings. There is a need for long-term, real-world studies to better understand the true clinical significance of these findings.

This review brings together current insights into the physiological mechanisms, available evidence, and clinical implications of digital screen use on intraocular pressure, emphasizing the importance of awareness and simple behavioral modifications in an increasingly digital world.

INTRODUCTION

India has witnessed one of the fastest increases in digital screen adoption worldwide. More than 750 million Indians currently use smartphones and other digital devices, with usage particularly concentrated among adolescents, college students, and young working adults. Daily screen time has also risen significantly; surveys suggest that Indian youth spend 4 to 7 hours per day on digital screens for social media, online learning, entertainment, messaging, and gaming.[1,3] The COVID-19 pandemic amplified this shift, as digital platforms became primary modes of education and communication, making screen exposure frequent, prolonged, and often unavoidable.[3] Importantly, this trend is no longer restricted to the young population alone, but increasingly involves children and older adults, reflecting a widespread transformation in visual behaviour across all age groups.

Keywords: smartphone use, intraocular pressure, digital eye strain, glaucoma risk

Alongside these behavioural changes, concerns regarding ocular health have emerged. Indian ophthalmology clinics have reported increasing presentations of digital eye strain, headaches, blurred vision, and reduced blinking in frequent screen users.[1,3] Although these symptoms are widely recognized, the potential effect of digital screen use on intraocular pressure (IOP) is less well appreciated, particularly in a country with a significant burden of glaucoma. India accounts for nearly one-fifth of global glaucoma cases, many of which remain undiagnosed. Even small, repeated fluctuations in IOP may influence disease progression in susceptible individuals.[10]

Digital screen use differs from traditional near work because it typically involves shorter viewing distances (20–30 cm), higher accommodative demand, sustained cognitive engagement, and prolonged neck flexion. In addition, digital screens emit blue-enriched light and are often used continuously without adequate visual breaks. These factors create a distinct physiological environment that may contribute to transient elevations in intraocular pressure.[5,6,9] Reduced blink rate, increased convergence demand, and postural influences such as neck flexion may further alter episcleral venous pressure and aqueous humour dynamics.[4,7]

Understanding how digital screen use influences intraocular pressure is therefore highly relevant in the present era, particularly in the Indian context where screen exposure is rapidly increasing across diverse populations. Identifying these associations is important not only for improving awareness but also for guiding preventive strategies in individuals at risk of ocular hypertension and glaucoma.

This review explores the physiology of intraocular pressure, the mechanisms linking digital screen use and IOP fluctuations, the available evidence from human studies, and their clinical significance.

PHYSIOLOGY OF INTRAOCULAR PRESSURE

Nosophobia Intraocular pressure reflects the dynamic balance between aqueous humor production and its outflow. Aqueous humor is produced by the ciliary body through active ion transport and ultrafiltration. It flows from the posterior chamber to the anterior chamber and exits primarily through the trabecular meshwork into Schlemm's canal, ultimately draining into the episcleral veins. A smaller proportion exits via the uveoscleral pathway.

During accommodation, the ciliary muscle contracts, increasing lens curvature and influencing aqueous humor dynamics. This process may reduce uveoscleral outflow and thereby contribute to transient changes in intraocular pressure.[5] Episcleral venous pressure is another important determinant of IOP, as aqueous humor must drain against this pressure gradient. Any factor that increases venous pressure can therefore lead to elevation of intraocular pressure.[9]

Autonomic regulation also plays a significant role in IOP control. Sympathetic stimulation increases aqueous humor production, while parasympathetic activity facilitates trabecular outflow. These mechanisms highlight the complex physiological regulation of intraocular pressure and its susceptibility to both ocular and systemic influences.[12]

DIGITAL SCREEN–RELATED MECHANISMS AFFECTING INTRAOCULAR PRESSURE

Digital screen use engages several physiological mechanisms simultaneously, including accommodation, convergence, altered blinking patterns, postural changes such as neck flexion, blue light exposure, and autonomic nervous system responses. These mechanisms interact to influence intraocular pressure through changes in aqueous humor dynamics, episcleral venous pressure, and ocular blood flow.[5,6,7,9,12]

Prolonged near work increases accommodative demand and convergence effort, which may transiently alter intraocular pressure by affecting ciliary muscle activity and aqueous outflow.[5,6] Reduced blink rate during sustained visual attention contributes to tear film instability and ocular surface stress, indirectly influencing ocular physiology.[13] Postural factors, particularly neck flexion during screen use, can increase episcleral venous pressure and thereby reduce aqueous humor drainage.[7,9] In addition, blue light exposure from digital screens may suppress melatonin secretion, potentially affecting circadian regulation of intraocular pressure.[6,11] Cognitive and emotional engagement during screen use may further activate the autonomic nervous system, increasing aqueous humor production.[12]

The key mechanisms are summarized below (Table 1).

Mechanism	Explanation
Increased accommodation	Close viewing distance increases ciliary muscle activity reducing uveoscleral outflow[5]
Reduced blink rate	Concentration reduces blinking, affecting tear film stability[13]
Sympathetic activation	Digital screen use involves higher cognitive and emotional engagement (notifications, dynamic content), leading to increased sympathetic activity and aqueous humor production, whereas printed material induces relatively lower autonomic stimulation[12]
Convergence demand	Near tasks increase extraocular muscle load and intraorbital Pressure[6]
Neck flexion posture	Down-gaze elevates episcleral venous pressure[6,11]
Blue light exposure	Suppresses melatonin, reducing nocturnal IOP control[12]
Choroidal volume changes	Near focus may temporarily increase choroidal blood volume[7,8]

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DIGITAL SCREENS VERSUS PRINTED MATERIAL

Digital screen use differs significantly from traditional printed reading. Printed text is typically viewed at a comfortable distance (35–40 cm), under stable lighting conditions, and is associated with normal blink patterns and minimal postural strain. In contrast, digital screens are often viewed at shorter distances (20–30 cm), emit blue-enriched light, and encourage prolonged visual attention, reduced blinking, and sustained neck flexion.[4,6,7]

Furthermore, digital screen use is associated with higher cognitive engagement and continuous visual stimulation, which may increase accommodative demand and autonomic activation compared to printed materials. These differences create a distinct physiological environment that may contribute to greater fluctuations in intraocular pressure during digital screen exposure.[5,9]

Table 2: Comparison of printed text reading and smartphone viewing

Parameter	Printed Text	Smartphone
Viewing distance	35-40 cm	20-30 cm[5]
Light exposure	Ambient-reflected	Blue-enriched emitted[13]
Blink rate	Normal	Reduced[7]
Posture	Upright	Neck flexion[6]
Physiological load	Moderate	Higher[5,9]

EVIDENCE FROM HUMAN STUDIES

Several studies have examined the effect of digital screen use on intraocular pressure. Lee et al. reported a progressive rise in intraocular pressure over 30 minutes of continuous digital screen use in healthy adults.[5] Ha et al. demonstrated that digital screen–based reading produced greater IOP elevation compared to printed text, suggesting a device-related physiological effect.[2] Zainol et al. observed transient increases in intraocular pressure after as little as 20 minutes of screen exposure.[6]

Postural influences have also been highlighted. Norazman et al. showed that neck flexion and certain viewing positions during digital device use significantly increased intraocular pressure.[7] Similarly, Baskaran et al. demonstrated that posture plays a key role in modulating IOP, with dependent positions contributing to higher readings.[9]

Although these changes are generally modest in healthy individuals, they may be more pronounced in patients with glaucoma or ocular hypertension, indicating potential clinical relevance.[5,9]

Author/Year	Population	Exposure	Main Finding
Lee et al., 2019	Healthy adults	30 minutes Smartphone	Time-dependent rise in IOP
Ha et al., 2018	Healthy and Glaucoma	Reading tasks	Higher IOP rise with smartphone
Zainol et al., 2025	Healthy adults	20 minutes Smartphone	Small, transient IOP elevation
Norazman et al., 2024	Healthy adults	Multiple postures	Neck flexion; increased IOP

CLINICAL SIGNIFICANCE

In healthy individuals, brief elevations in intraocular pressure during digital screen use are unlikely to be clinically significant. However, repeated fluctuations throughout the day may be important in individuals with glaucoma, ocular hypertension, or risk factors such as high myopia.[5,9] Since IOP variability is known to contribute to glaucomatous progression, understanding modifiable behavioral factors is essential.[10]

Simple measures such as maintaining proper posture, reducing prolonged uninterrupted near work, positioning screens at eye level, and limiting excessive screen use—particularly at night—may help reduce IOP fluctuations and promote ocular health.[7,9]

RESEARCH GAPS AND FUTURE DIRECTIONS

Despite growing interest in the relationship between digital screen use and intraocular pressure, the current body of evidence remains limited in scope and depth. Most available studies are short-term, conducted under controlled conditions, and involve relatively small sample sizes, which restricts the generalizability of findings to real-world settings. The cumulative and long-term impact of repeated, transient intraocular pressure fluctuations associated with habitual digital screen use remains poorly understood.

A significant gap exists in the characterization of diurnal and cumulative IOP variability in relation to real-life digital behavior. Continuous monitoring using emerging technologies, such as wearable intraocular pressure sensors, may provide more accurate insights into dynamic fluctuations over extended periods.[10] Additionally, current literature does not adequately account for device heterogeneity (smartphones, tablets, computers) and differences in usage patterns, including duration, viewing distance, posture, and multitasking behaviors.

Another important limitation is the lack of data in high-risk and vulnerable populations, including individuals with glaucoma, ocular hypertension, high myopia, and paediatric age groups, where physiological responses and susceptibility to IOP fluctuations may differ significantly. The interaction between digital screen exposure and circadian regulation of intraocular pressure, particularly in the context of blue light–mediated melatonin suppression, also requires further exploration.[11]

Furthermore, there is a need for studies integrating behavioural, physiological, and environmental factors, including ergonomic practices, lighting conditions, and psychosocial stress, to better understand their combined effect on intraocular pressure dynamics. Future research should aim to establish clinically relevant thresholds of exposure and identify modifiable risk factors that can inform preventive strategies and public health guidelines.

CONCLUSION

Digital screen use has emerged as a significant and ubiquitous component of modern life, particularly in rapidly digitizing populations such as India. The available evidence suggests that digital screen exposure can induce transient increases in intraocular pressure through a combination of physiological mechanisms, including accommodative effort, convergence, reduced blink rate, postural influences, autonomic activation, and light-mediated neurohormonal effects.[5,6,7,9,11]

Although these changes are generally modest and well tolerated in healthy individuals, repeated and cumulative intraocular pressure fluctuations may have clinical implications in susceptible populations, including individuals with glaucoma, ocular hypertension, high myopia, and other optic nerve vulnerabilities.[5,9,10] In this context, digital screen use represents a potentially modifiable behavioural factor influencing ocular health.

Given the widespread and increasing reliance on digital devices across all age groups, there is a need for greater awareness regarding their potential impact on intraocular pressure. Simple behavioural and ergonomic modifications—such as maintaining appropriate viewing distance, minimizing prolonged uninterrupted screen exposure, optimizing posture, and reducing excessive night time use—may help mitigate these effects.

Further research is required to clarify long-term implications and establish evidence-based guidelines; however, current insights underscore the importance of integrating ocular health considerations into everyday digital practices.

REFERENCES

1. Lee J, Chen S, Park K, et al. Effect of digital screen use on intraocular pressure and ocular surface. Sci Rep. 2019;9:18714.
2. Ha A, Kim CY, Shim SR, et al. Changes in intraocular pressure associated with digital device use compared with print reading. PLoS One. 2018;13:e0206061.
3. Zainol N, Izhar NM, Azmi N. Effect of digital screen usage on intraocular pressure in healthy adults. Transl Neurosci Ophthalmol. 2025;7:11–18.
4. Norazman FN, Azmi SNH. Effects of different postures during electronic device use on intraocular pressure. J Health Sci Med Res. 2024;42:389–397.
5. Ambrosini G, et al. Accommodative demand and intraocular pressure: a systematic review and meta-analysis. Ophthalmic Physiol Opt. 2024;44:240–252.
6. Chang AM, Aeschbach D, Duffy JF, Czeisler CA. Evening use of light-emitting eReaders negatively affects sleep and circadian timing. Proc Natl Acad Sci USA. 2015;112:1232–1237.
7. Kwon M, et al. Effect of near work on choroidal thickness and intraocular pressure. Invest Ophthalmol Vis Sci. 2016;57:262–267.
8. Read SA, Collins MJ. The short-term influence of optical blur on accommodation, choroidal thickness, and axial length. Ophthalmic Physiol Opt. 2010;30:415–424.
9. Baskaran M, et al. Effects of posture on intraocular pressure in glaucoma patients and healthy controls. Ophthalmology. 2014;121:874–879.
10. Kumar RS, et al. Diurnal intraocular pressure fluctuation and its implications. J Glaucoma. 2016;25:390–397.
11. Choi J, Kim K. Melatonin and intraocular pressure regulation. J Ocul Pharmacol Ther. 2017;33:1–7.
12. Aihara M, Lindsey JD, Weinreb RN. Experimental sympathetic denervation increases aqueous humor production. Curr Eye Res. 2003;27:95–99.
13. Portello JK, Rosenfield M, Bababekova Y, Estrada JM, Leon A. Computer-related visual symptoms in office workers. Optom Vis Sci. 2012;89:1416–1424.