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Impact Of Digital Device Use On Dry Eye Syndrome And Myopia Progression: A Review Of Current Evidence

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Abstract

The rapid increase in daily screen exposure has led to a rising prevalence of visual disorders, including dry eye syndrome (DES) and myopia. This review summarizes current evidence regarding the mechanisms by which digital device use affects tear film stability, accommodation, and myopia progression. Recent studies indicate that reduced blink rate, increased accommodative demand, and circadian rhythm disturbances contribute significantly to both DES and myopization. Diagnostic strategies and potential preventive measures are discussed with consideration of age-related differences in clinical presentation.

Keywords: Digital load; dry eye syndrome; myopia; accommodation; tear film; screen time.

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1. Introduction

In today's world, the use of digital devices—smartphones, tablets, and computers—is increasing in both children and adults. This trend is associated with an increase in dry eye complaints and a rising prevalence of myopia. Recent studies indicate that prolonged screen time may not only worsen the ocular surface but also contribute to structural changes in the eye, such as myopia progression. In recent years, digital stress has become an integral part of life for both children and adults. With the increased use of smartphones, tablets, and computers, ophthalmologists have noted an increase in complaints of dry eye, burning sensations, decreased visual comfort, and a growing number of patients with progressive myopia. Research shows that prolonged screen time can alter blinking mechanisms, accelerate tear film evaporation, and contribute to accommodative strain, which in turn increases the risk of ophthalmological disorders. In recent years, several major studies, including systematic reviews and meta-analyses, have been published, allowing for a more objective assessment of this problem.

The aim of this review is to summarize the latest scientific evidence on the impact of screen time on the

ocular surface and refraction, as well as to outline clinical and preventive recommendations.

Mechanisms Of Digital Exposure

1. Decreased Blink Rate and Tear Film Disruption

Digital device use is associated with decreased blink rate and a longer interval between blinks. These changes lead to tear film evaporation and instability—the primary pathophysiological mechanisms of dry eye syndrome. Research shows that smartphone users' blink rate can be reduced by more than half, and the time to tear film breakdown decreases proportionally with the duration of visual exposure.

2. Accommodation load and ciliary muscle strain

Working at close range requires active accommodation. Prolonged strain is associated with accommodative spasm, asthenopia, and potential elongation of the eyeball, which is considered a mechanism contributing to myopia progression in children and adolescents.

3. Reducing time spent outdoors

Available data convincingly demonstrate the protective effect of exposure to natural daylight. Children with high screen time spend fewer hours outdoors, which may contribute to myopia progression regardless of visual load at close range.

4. Impact on circadian rhythms

Evening use of digital devices suppresses melatonin production and impairs sleep quality. Sleep disruption can contribute to increased visual fatigue and worsen subjective dry eye symptoms.

Epidemiological Data And Clinical Trials

1. Myopia and Screen Time

In 2025, one of the most significant meta-analyses, including 45 studies and 335,524 participants, was published. It demonstrated a dose-response relationship between screen time and the risk of myopia. Each additional hour of screen time was associated with a 21% increase in the odds of myopia (OR = 1.21, 95% CI: 1.13–1.30).

In a nonlinear analysis, the most rapid increase in risk was observed with an increase in screen time from 1 to 4 hours per day:

- OR at 1 hour: 1.05
- OR at 4 hours: 1.97

After 4 hours, the increase in risk persisted but slowed, forming an S-shaped curve.

2. Digital Use and Dry Eye Syndrome

Research over the past decade confirms significant changes in tear film parameters with prolonged screen time.

- Children with screen time >3–3.5 hours/day demonstrate a higher incidence of dry eye, a decrease in TBUT, and increased symptom severity.
- In a population of young adults with high screen time (≈40–45 hours/week), up to

90% of participants had dry eye symptoms (DEQ-5 ≥ 6).

- Studies also show significant correlations between screen time and a decrease in blink rate, TBUT, and the development of inflammatory changes.

Table 1

Table 1. Effect of digital workload on blink and tear film parameters

Parameter	Normal	With prolonged use of screens	Clinical consequences
Blink rate	15–20/min	4–8/min	Tear film evaporation, dryness
Interblink interval	2–3 sec	Increase to 5–7 sec	Accelerated tear film breakdown

TBUT	Stable tear film	Decrease <10 sec	Dry eye symptoms
Symptoms (OSDI/DEQ-5)	Low values	Significant increase	Discomfort, eye fatigue

Table 2
Dose-response relationship between screen time and the risk of myopia

Screen time per day	Odds ratio (OR)	Interpretation
1 hour	1.05	Slightly increased risk
4 hours	1.97	Sharp increase in risk
>4 hours	>2.0, with a slowing increase	Saturation effect, but the risk remains high

2. Discussion

Current data suggest a significant association between screen time, ocular surface disorders, and the risk of myopia progression. Mechanisms linking digital exposure and ophthalmic disorders include decreased blink rate, tear film instability, increased accommodative load, decreased time spent outdoors, and effects on circadian rhythms. However, it is important to emphasize that most of the data are based on observational studies, limiting the ability to establish causal relationships. Despite this, the body of evidence demonstrating a dose-response relationship is constantly growing, increasing the credibility of the findings.

Causal relationships are not fully proven—most data are based on observational studies. For example, in a review by Ha et al., the authors point to high heterogeneity and insufficient evidence of causality. Furthermore, confounding factors are possible: children who spend a lot of time on screens may be less likely to go outdoors, which in itself is a risk factor for myopia.

On the other hand, strong correlations between screen time and dry eye symptoms support the idea that chronic use of digital devices may have a direct adverse effect on the lacrimal system: decreased blinking, reduced TBUT, and inflammatory changes.

Factors such as age, device type (smartphone, computer), duration of use, and the quality of breaks may modify the risk. For example, children with daily screen time >3–3.5 hours had a significantly higher risk of moderate and severe dry eye.

Clinical Recommendations And Prevention

1. Screen Time Limitation: Based on the analysis by Ha et al., it may be appropriate to aim for less than 1 hour of screen time per day, especially in children, although this threshold requires caution due to the nature of the data. jamanetwork.com

2. Educational Interventions: Parents and children should be taught the rules of "healthy digital hygiene"—regular breaks, blinking, proper lighting, and the 20-20-20 rule.

3. Eye Health Monitoring: Ophthalmologists should consider screen time as a risk factor when examining patients with dry eye and myopia; regular TBUT measurement, blink assessment, and referral for correction (if needed) are recommended.

4. Myopia prevention: In addition to optical and pharmacological methods, it is important to pay attention to lifestyle—increasing time outdoors and reducing "near work," especially on digital devices.

3. Conclusion

Digital strain is a significant risk factor for both dry eye syndrome and progressive myopia. Evidence from a larger number of studies indicates dose-response relationships between screen time and these ophthalmic

conditions. Clinical practice should consider patients' digital lifestyles, implement preventive and educational measures, and actively explore further mechanisms and intervention strategies.

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