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More Technology, Less Vision? Computer Vision Syndrome as a Silent Digital Epidemic

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Introduction

We live immersed in an unprecedented era of technological abundance. We study, work, entertain ourselves and communicate in front of screens for most of the day. Yet, have we truly considered what these demands of our vision? Would it have been imaginable, barely two decades ago, that we would spend more time looking at pixels than looking at each other?

This silent revolution digital convenience in exchange for visual effort has a name: **Computer Vision Syndrome (CVS)**. A cluster of visual, cognitive and musculoskeletal symptoms that already affects between **60% and 90%** of screen users [1,2]. Historically associated with the workplace, CVS now affects individuals of all ages: schoolchildren, university students, adults and older people.

From the perspective of Occupational Medicine, a worrying phenomenon emerges: many patients normalize these symptoms and consider them an inevitable toll of modern life. However, the evidence shows that CVS is a multifactorial, frequent condition with repercussions that extend far beyond ophthalmology.

CVS is an emerging public health challenge that requires a population-level response grounded in primary prevention, visual education and healthier digital environments. But is it truly inevitable, or are there population-wide interventions capable of changing its trajectory?

Physiological Foundations of CVs

Ocular physiology changes profoundly when we interact with screens. Blinking, which under normal conditions occurs **18 to 22 times per minute**, decreases to **7-10 times** with the use of visual display devices [3]. This reduction combined with incomplete blinking compromises tear film stability, promoting dryness, irritation and a gritty sensation.

Sustained near vision induces accommodative fatigue and **lag of accommodation**, a transient inability to shift focus between distances [4]. Blurry vision at the end of the day is a common symptom. In some cases, transient myopia appears, especially after prolonged computer sessions [5].

Environmental factors such as glare, reflections, poor lighting, low contrast and forced cervical postures increase both visual and musculoskeletal strain [6]. Thus, tension headaches, shoulder stiffness and mental fatigue often coexist with ocular symptoms. Finally, short-wavelength blue light inhibits melatonin synthesis, disrupts circadian rhythms and impairs sleep quality [7]. This deterioration in rest amplifies both visual and cognitive symptoms, creating a persistent cycle of fatigue.

Impact On Public Health

CVS shapes the way we learn, work and interact. Its impact is transversal and affects all stages of life. In **children and**

adolescents, visual fatigue diminishes attention, slows reading and compromises concentration and learning. A lack of natural light combined with intensive screen use is associated with myopic progression [8].

Among **university students**, CVS impairs reading efficiency, information retention and academic performance [2]. Digital load, insufficient sleep and academic pressure intensify symptoms. Digital multitasking, continuous videoconferencing and the absence of structured breaks reduce productivity, slow complex tasks and increase errors in **young adults and teleworkers** [5]. Mood, creativity and overall performance are also affected. **Older adults** face presbyopia, tear film instability and reduced contrast sensitivity, which worsen symptoms [6], hinder essential daily tasks and diminish autonomy and well-being.

Beyond ocular effects, sleep emerges as a critical element. Blue light–induced melatonin suppression delays sleep onset and fragments rest [7]. As a result, irritability, daytime fatigue, lower stress tolerance and poorer cognitive performance appear. Ultimately, a vicious cycle develops: the more tired we are, the more we rely on screens; and the more we rely on screens, the worse we sleep. CVS is therefore a profound modulator of emotional well-being, quality of life, productivity and social functioning. Its normalization constitutes a silent risk of population magnitude.

Public Health Implications and the Need for Prevention

Primary prevention is the most effective strategy to reduce the impact of CVS not only because of its low cost and scalability, but because it acts at the source of the problem, before symptoms appear or become chronic. Unlike clinical or corrective interventions, which are applied once damage is already established, prevention modifies behaviors, environments and habits in a sustained way, reducing cumulative visual load throughout the day.

In a context where digital exposure grows from childhood to older age and spans schools, universities, workplaces and homes, preventive strategies become a shared responsibility among individuals, institutions, technology companies and public health systems.

What can we do individually and collectively to protect our vision? The answer requires a combination of educational interventions, environmental modifications and health policies that promote safe digital practices from an early age. This includes integrating structured visual breaks, redesigning educational and work environments with ergonomic criteria, promoting healthier digital use and ensuring that technologies incorporate design elements that minimize visual fatigue.

Only through a holistic approach combining individual behaviors with population-level measures and appropriate regulation can we effectively protect visual health in a world increasingly mediated by screens.

Visual breaks: resting to see better

The **20-20-20 rule** (every 20 minutes, look at an object 20 feet away (10 meter) for 20 seconds) reduces ocular fatigue, stabilizes the tear film and decreases accommodative strain [9].

Digital ergonomics: adapting the environment

This is a simple and high-impact intervention. Basic ergonomic adjustments constitute a cost-effective preventive strategy that can be implemented in any digital environment. Maintaining a minimum distance of **50-70** cm between the eyes and the screen reduces accommodative demand and lowers the likelihood of end-of-day visual fatigue. Placing the screen slightly **below eye level** promotes a more physiological viewing angle, decreases palpebral aperture and reduces tear evaporation, preventing dryness and irritation. Uniform lighting and the absence of reflections on the device surface minimize glare and decrease the effort required for focus, improving both comfort and reading efficiency.

Finally, correct cervical and lumbar postures aligned with ergonomic principles reduce musculoskeletal strain associated with prolonged work, a frequently underestimated component of Computer Vision Syndrome [5]. Together, these interventions form a simple, reproducible and high-impact preventive package capable of improving ocular health, well-being and productivity in educational, occupational and domestic settings.

Natural light: an undervalued protector

Natural light is one of the most consistent yet underestimated protective factors in preventing visual alterations associated with intensive screen use. Evidence shows that regular outdoor light exposure reduces myopic progression in children and adolescents [8], likely through mechanisms involving retinal dopaminergic regulation, increased depth of field and reduced sustained accommodative tension during near-vision tasks.

From a population perspective, incorporating outdoor breaks between academic activities whether in schools, secondary education or universities is an especially attractive public health intervention: effective, low-cost and easy to implement. In **adults**, both in on-site work and teleworking contexts, daily exposure to natural light is associated with lower visual fatigue, better circadian regulation, increased vitality and more stable cognitive performance throughout the day, acting as a key modulator of workplace well-being in the digital era.

Beyond its visual benefits, natural light supports circadian rhythm regulation, enhances mood and promotes healthier habits. Systematically incorporating natural-light exposure into educational and workplace planning not only protects ocular health but contributes to a broader, holistic approach to well-being in an increasingly screen-mediated world.

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Visual education: understanding to prevent

The adoption of healthy visual habits requires not only practical recommendations but also education and understanding of the mechanisms that generate visual fatigue and of the most effective strategies to counteract it. **Visual literacy** still underdeveloped in most educational and occupational systems thus becomes a fundamental pillar of CVS prevention.

Key protective behaviors include alternating focal distances to avoid sustained accommodative tension; avoiding "digital marathons" by incorporating structured breaks that allow visual recovery; and reducing nighttime brightness, both for visual comfort and due to the influence of blue light on sleep architecture. Conscious blinking helps stabilize the tear film, reducing dryness and irritation, especially during high-concentration tasks. Early recognition of transient blurry vision, stinging, headache or increased reading effort is essential to intervene before a chronic fatigue pattern becomes established.

In low-humidity environments, common in closed offices or heated spaces, regular ocular lubrication with artificial tears may be beneficial a safe, accessible and clinically supported measure to improve comfort and reduce tear evaporation. Altogether, these actions constitute a comprehensive educational strategy that empowers individuals, enhances self-regulation and complements organizational interventions in digital health.

Technology as an ally

Far from being only a source of overload or distraction, technology can become a strategic ally in preventing harm associated with telework. Applications now exist that remind users to take active breaks, correct sustained postures or detect behavioral patterns that increase musculoskeletal risk. Likewise, intelligent lighting and climate systems can automatically adjust the work environment to optimal ergonomic parameters, reducing visual fatigue and enhancing comfort. These tools, easily scalable to large populations (workplaces, care facilities, schools, universities…), offer a feasible way to integrate prevention into daily routines without additional effort [10].

However, this preventive potential is not exempt from challenges. Relying exclusively on technological solutions to correct the adverse effects of the digital ecosystem introduces a relevant paradox: we risk medicalizing everyday life and shifting responsibility to individuals without addressing the structural causes of the problem. Moreover, the increasing sophistication of these tools demands reflection on the quality of the algorithms behind their recommendations, the validity of their metrics and the responsible use of collected data.

For this reason, incorporating regulatory frameworks and **healthy-design standards** ensuring minimum criteria for digital ergonomics, data protection, algorithmic transparency and well-being promotion is essential to prevent prevention from being subordinated to market logic. Designing digital environments that reduce visual strain should not depend solely on auxiliary applications, but be integrated from the outset into the architecture of devices, platforms and workspaces.

Furthermore, the emergence of new technologies from next-generation wearables to real-time data-analysis platforms opens the door to more precise and personalized prevention. The ability of mobile devices to monitor physiological variables, sleep patterns or stress indicators across distributed work settings allows early identification of problems before they manifest clinically. In this way, technology becomes not only a reminder or alert mechanism but also a core component of evidence-based public health strategies capable of generating virtuous cycles of self-care, well-being and sustainable productivity.

Conclusion

Computer Vision Syndrome represents an emerging intergenerational challenge whose impact extends far beyond ocular discomfort. Its influence on vision, sleep quality, cognitive performance, learning, emotional well-being and overall quality of life positions it as a growing public health concern. Crucially, CVS is not an inevitable trade-off of living in a digital environment; it is a preventable condition that requires awareness, structured interventions and coordinated action at individual, occupational and societal levels.

Primary prevention remains the most effective and equitable strategy. Regular visual breaks, evidence-based ergonomic adjustments, exposure to natural light, visual health education and intelligent technologies that facilitate healthier digital behavior constitute low-cost, high-impact interventions. The digital transformation has enabled extraordinary advances in productivity, communication and access to information, but such progress should not come at the expense of visual and cognitive health.

As digital exposure continues to rise across all age groups and socioeconomic contexts, public health systems face an urgent question: **will we allow preventable visual strain to become a structural burden of the digital era, or will we commit to safeguarding visual health as an essential component of modern well-being?** The answer will shape not only how we work and learn but also how we design the digital environments that increasingly define our daily lives.

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