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A Study on the Relationship between Poor Visual Ergonomics and Digital Eye Strain in Prolonged Screen Users

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Abstract— The exponential growth of digital technology has led to unprecedented levels of screen exposure across occupational, educational, and personal contexts. Prolonged use of visual display terminals has been associated with a range of ocular and musculoskeletal symptoms collectively referred to as Digital Eye Strain (DES) or Computer Vision Syndrome (CVS). Poor visual ergonomics—encompassing improper screen positioning, inadequate lighting, prolonged viewing duration, and insufficient visual breaks—has been identified as a significant contributory factor to DES. This study examines the relationship between poor visual ergonomic practices and the prevalence and severity of digital eye strain among prolonged screen users. Drawing upon existing empirical research, ergonomic theory, and occupational health frameworks, the paper explores causal mechanisms, risk factors, symptom patterns, and preventive strategies. The findings underscore a strong association between suboptimal visual ergonomics and increased DES severity, emphasizing the need for ergonomic awareness, institutional interventions, and evidence-based policy measures to mitigate visual health risks in digitally intensive environments.

Keywords— Digital Eye Strain, Computer Vision Syndrome, Visual Ergonomics, Screen Exposure, Occupational Health, Human–Computer Interaction

Introduction

The integration of digital technologies into everyday life has transformed the nature of work, learning, and communication. Computers, laptops, tablets, and smartphones are now indispensable tools across sectors such as education, healthcare, information technology, finance, and governance. While these technologies enhance productivity and access to information, prolonged exposure to digital screens has introduced new health challenges, particularly concerning visual well-being.

Digital Eye Strain (DES), also referred to as Computer Vision Syndrome (CVS), has emerged as a widespread occupational and public health concern. Individuals who spend extended periods viewing digital screens frequently report symptoms such as eye fatigue, dryness, irritation, blurred vision,

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headaches, and neck or shoulder pain. Epidemiological studies suggest that between 60% and 90% of regular screen users experience at least one symptom of DES during or after prolonged screen use.

Source: https://www.eyesdefined.com/the-impact-of-digital-devices-on-blurry-vision/

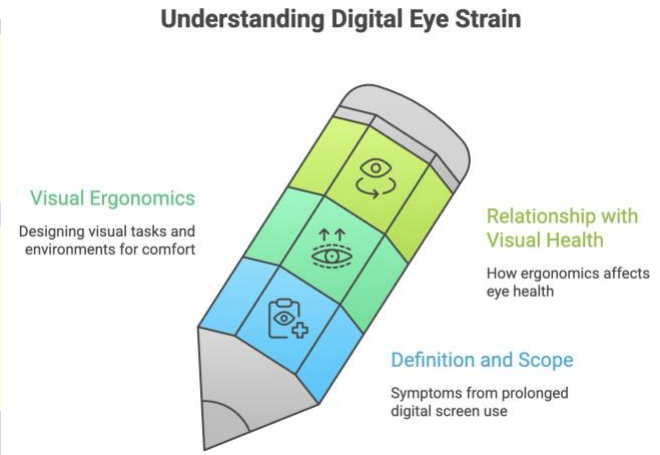
Among the numerous factors contributing to DES, poor visual ergonomics plays a central role. Visual ergonomics focuses on optimizing visual conditions to reduce strain and enhance comfort and efficiency during visual tasks. Inadequate screen height and distance, improper lighting, glare, extended uninterrupted screen time, and lack of ergonomic awareness collectively exacerbate visual discomfort.

This paper seeks to examine the relationship between poor visual ergonomics and digital eye strain in prolonged screen users. By synthesizing theoretical frameworks, empirical findings, and practical considerations, the study aims to contribute to a deeper understanding of how ergonomic deficiencies influence ocular health and how targeted interventions can mitigate adverse outcomes.

Conceptual Framework

1. Digital Eye Strain: Definition and Scope

Digital Eye Strain encompasses a range of ocular and extra-ocular symptoms resulting from prolonged digital screen use. Unlike printed text, digital displays present unique visual challenges, including pixelated images, reduced contrast, glare, and the need for sustained accommodation and convergence. These demands increase the workload on the visual system, particularly during extended viewing periods.



2. Visual Ergonomics

Visual ergonomics is a subfield of ergonomics concerned with designing visual tasks and environments that align with human visual capabilities and limitations. In the context of screen use, visual ergonomics includes:

- Screen height, distance, and angle
- Ambient lighting and glare control
- Font size, contrast, and display resolution
- Viewing duration and break frequency

Poor visual ergonomics arises when these factors are misaligned with physiological needs, leading to increased visual stress.

Vol. 08, Issue 06, June: 2020
ISSN(P) 2347-5404 ISSN(O)2320 771X

3. Relationship between Ergonomics and Visual Health

The relationship between visual ergonomics and eye health is grounded in human–computer interaction theory and occupational health research. Prolonged exposure to poorly designed visual environments results in sustained accommodative effort, reduced blink rate, tear film instability, and musculoskeletal strain, collectively contributing to DES.

Table 1: Key Components of Visual Ergonomics in Digital Screen Use

Ergonomic Component	Description	Visual Impact
Screen height	Monitor positioned at or slightly below eye level	Reduces ocular surface exposure and dryness
Viewing distance	Optimal distance of 50–70 cm	Minimizes accommodative stress
Screen angle	Slight downward tilt	Improves comfort and posture
Lighting	Balanced ambient illumination	Reduces glare and contrast stress
Break frequency	Regular visual breaks	Prevents cumulative visual fatigue

Review of Related Literature

1. Prevalence of Digital Eye Strain

Multiple studies across occupational groups indicate high DES prevalence among prolonged screen users. Office workers, students engaged in online learning, software professionals, and call center employees consistently report high symptom rates. Increased screen time during the COVID-19 pandemic further amplified DES prevalence due to remote work and online education.

2. Visual Ergonomic Risk Factors

Empirical research identifies several ergonomic risk factors associated with DES:

- Screens positioned too high or too close
- Excessive screen brightness or glare
- Poor ambient lighting
- Continuous screen use without breaks
- Inappropriate seating and posture

Studies demonstrate that individuals exposed to multiple risk factors simultaneously experience more severe and persistent symptoms.

3. Behavioral and Environmental Influences

Behavioral habits, such as infrequent blinking and poor posture, interact with environmental conditions to exacerbate DES. Research shows that blink rate can decrease by up to 60% during screen use, contributing to ocular dryness and irritation.

Methodological Approach

This study adopts a systematic narrative review and analytical framework to examine the relationship between poor visual ergonomics and digital eye strain.

1. Data Sources

Peer-reviewed studies published in academic journals were reviewed from databases including:

- PubMed

Vol. 08, Issue 06, June: 2020
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- Scopus
- Web of Science
- Google Scholar

2. Inclusion Criteria

Studies were included if they:

- Focused on adult or adolescent prolonged screen users
- Examined visual ergonomic factors
- Assessed DES symptoms or prevalence

3. Analytical Strategy

Findings were synthesized thematically, focusing on:

- Ergonomic deficiencies
- Symptom patterns
- Causal mechanisms
- Preventive strategies

Poor Visual Ergonomics and DES: Mechanisms of Association

1. Screen Position and Viewing Distance

Improper screen positioning increases accommodative and postural strain. Screens placed above eye level force sustained upward gaze, increasing ocular surface exposure and dryness. Inadequate viewing distance further intensifies accommodative effort.

2. Lighting and Glare

Poor lighting conditions, including excessive brightness or insufficient illumination, lead to contrast imbalance and glare. Glare forces continuous visual adaptation, contributing to eye fatigue and headaches.

3. Reduced Blink Rate

Prolonged screen engagement significantly reduces spontaneous blinking, disrupting tear film stability. Poor ergonomic setups exacerbate this effect by demanding sustained visual concentration.

Table 2: Common Symptoms of Digital Eye Strain and Associated Ergonomic Risk Factors

DES Symptom	Associated Ergonomic Risk Factor
Eye fatigue	Prolonged continuous screen viewing
Dryness	Reduced blink rate, upward gaze
Blurred vision	Excessive near focus, poor resolution
Headache	Glare, improper lighting
Neck/shoulder pain	Poor screen height and posture

4. Duration of Exposure

Extended uninterrupted screen use without visual breaks results in cumulative visual fatigue. Poor ergonomics accelerates symptom onset and prolongs recovery time.

Empirical Evidence of Association

1. Cross-Sectional Studies

Vol. 08, Issue 06, June: 2020
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Cross-sectional surveys consistently reveal higher DES prevalence among users with poor ergonomic practices. Participants reporting improper screen height, excessive glare, and long viewing durations show significantly higher symptom scores.

2. Experimental and Intervention Studies

Intervention studies demonstrate that ergonomic corrections—such as adjusting screen height, optimizing lighting, and enforcing breaks—lead to measurable reductions in DES symptoms. These findings support a causal relationship rather than mere correlation.

3. Occupational Studies

Workplace studies indicate that employees in ergonomically optimized environments report fewer visual complaints and higher productivity compared to those in poorly designed settings.

Individual and Organizational Factors

1. Individual Awareness and Behavior

Lack of ergonomic awareness contributes significantly to poor visual practices. Many prolonged screen users are unaware of optimal viewing distances, break schedules, or lighting requirements.

2. Organizational Responsibility

Organizations play a crucial role in shaping visual ergonomics through workstation design, training programs, and health policies. Absence of ergonomic guidelines increases DES risk.

Implications for Health, Productivity, and Quality of Life

Digital eye strain extends beyond discomfort, affecting:

- Work efficiency and accuracy
- Academic performance
- Mental well-being
- Long-term ocular health

Chronic exposure to poor visual ergonomics may contribute to persistent visual dysfunction and reduced quality of life.

Preventive and Corrective Strategies

1. Ergonomic Design Interventions

- Proper screen placement (50–70 cm distance, slightly below eye level)
- Adjustable seating and monitor stands
- Anti-glare screens

2. Behavioral Interventions

- Scheduled visual breaks (20-20-20 rule)
- Blink awareness training
- Limiting continuous screen exposure

3. Policy and Education

- Ergonomic training programs
- Inclusion of visual ergonomics in occupational health regulations
- Digital literacy initiatives in educational institutions

Limitations of Existing Research

Despite substantial evidence, limitations persist:

Vol. 08, Issue 06, June: 2020
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- Heavy reliance on self-reported symptoms
- Short-term intervention studies
- Limited longitudinal data
- Underrepresentation of low-resource settings

Future research must address these gaps through standardized methodologies.

Future Research Directions

Future studies should:

- Employ longitudinal designs
- Integrate objective clinical measures
- Explore technology-assisted ergonomic solutions
- Examine diverse demographic and occupational groups

Table 3: Preventive and Corrective Strategies for Digital Eye Strain

Intervention Type	**Strategy**	**Expected Outcome**
Ergonomic design	Screen repositioning	Reduced visual load
Environmental	Anti-glare lighting	Improved comfort
Behavioral	20-20-20 rule	Reduced fatigue
Educational	Ergonomic awareness	Sustainable habits
Policy-level	Workplace guidelines	Long-term prevention

Conclusion

This study establishes a strong and consistent relationship between poor visual ergonomics and the prevalence and severity of digital eye strain among prolonged screen users. Suboptimal ergonomic conditions significantly increase visual workload, disrupt ocular physiology, and exacerbate DES symptoms. Conversely, ergonomic improvements demonstrate substantial potential to reduce visual discomfort and enhance well-being.

As digital screen use continues to rise globally, addressing visual ergonomics is imperative for protecting ocular health, improving productivity, and promoting sustainable digital engagement. Coordinated efforts involving individuals, organizations, educators, and policymakers are essential to mitigate the growing burden of digital eye strain in modern society.

References

- ***American Optometric Association.*** *(2017). Computer Vision Syndrome (CVS). https://www.aoa.org/healthy-eyes/eye-and-vision-conditions/computer-vision-syndrome*
- ***Rosenfield, M.*** *(2011). Computer vision syndrome: A review of ocular causes and potential treatments. Ophthalmic and Physiological Optics, 31(5), 502–515. https://doi.org/10.1111/j.1475-1313.2011.00834.x*
- ***Sheppard, A. L., & Wolffsohn, J. S.*** *(2018). Digital eye strain: Prevalence, measurement and amelioration. BMJ Open*

Vol. 08, Issue 06, June: 2020
ISSN(P) 2347-5404 ISSN(O)2320 771X

Ophthalmology, 3(1), e000146. https://doi.org/10.1136/bmjophth-2018-000146

- ***Blehm, C., Vishnu, S., Khattak, A., Mitra, S., & Yee, R. W.*** *(2005). Computer vision syndrome: A review. Survey of Ophthalmology, 50(3), 253–262. https://doi.org/10.1016/j.survophthal.2005.02.008*
- ***Portello, J. K., Rosenfield, M., Bababekova, Y., Estrada, J. M., & Leon, A.*** *(2012). Computer-related visual symptoms in office workers. Ophthalmic and Physiological Optics, 32(5), 375–382. https://doi.org/10.1111/j.1475-1313.2012.00925.x*
- ***Coles-Brennan, C., Sulley, A., & Young, G.*** *(2019). Management of digital eye strain. Clinical and Experimental Optometry, 102(1), 18–29. https://doi.org/10.1111/cxo.12798*
- ***Anshel, J.*** *(2007). Visual ergonomics in the workplace. AAOHN Journal, 55(10), 414–420. https://doi.org/10.1177/216507990705501004*
- ***Chu, C. A., Rosenfield, M., & Portello, J. K.*** *(2014). Blink patterns: Reading from a computer screen versus hard copy. Optometry and Vision Science, 91(3), 297–302. https://doi.org/10.1097/OPX.0000000000000152*
- ***Gowrisankaran, S., & Sheedy, J. E.*** *(2015). Computer vision syndrome: A review. Work, 52(2), 303–314. https://doi.org/10.3233/WOR-152162*
- ***Tsubota, K., & Nakamori, K.*** *(1993). Dry eyes and video display terminals. New England Journal of Medicine, 328(8), 584. https://doi.org/10.1056/NEJM199302253280817*
- ***World Health Organization (WHO).*** *(2010). Healthy workplaces: A model for action. https://www.who.int/publications/i/item/healthy-workplaces-a-model-for-action*
- ***International Labour Organization (ILO).*** *(2019). Working on a computer: Preventing visual fatigue. https://www.ilo.org/global/topics/safety-and-health-at-work*
- ***European Agency for Safety and Health at Work (EU-OSHA).*** *(2018). Work-related eye strain and ergonomics. https://osha.europa.eu*
- ***Reddy, S. C., Low, C. K., Lim, Y. P., Low, L. L., Mardina, F., & Nursaleha, M. P.*** *(2013). Computer vision syndrome: A study of knowledge and practices in university students. Nepalese Journal of Ophthalmology, 5(2), 161–168. https://doi.org/10.3126/nepjoph.v5i2.8707*
- ***Logaraj, M., Madhupriya, V., & Hegde, S.*** *(2014). Computer vision syndrome and associated factors among medical and engineering students. Journal of Clinical and Diagnostic Research, 8(8), 1–4. https://doi.org/10.7860/JCDR/2014/10240.4711*
- ***Seguí, M. del M., Cabrero-García, J., Crespo, A., Verdú, J., & Ronda, E.*** *(2015). A reliable and valid questionnaire was developed to measure computer vision syndrome at the workplace. Journal of Clinical Epidemiology, 68(6), 662–673. https://doi.org/10.1016/j.jclinepi.2015.01.015*