A CROSS-SECTIONAL STUDY OF DRY EYE SYNDROME PREVALENCE IN COMPUTER USERS

Kedar Nemivant[1], Surajkumar Kureil[2]

[1]Associate Professor, Department of Ophthalmology, All India Institute Medical Sciences, Rajkot, India.
[2]Associate Professor, Department of Ophthalmology, Government Medical College, Jalna, India.

Received Date: 11/01/2025 Accepted: 22/02/2025

Corresponding Author: Dr Kedar Nemivant, Associate Professor, Department of Ophthalmology, All India Institute Medical Sciences, Rajkot, India.

ABSTRACT
Background: With the increasing reliance on digital technology, there is growing concern regarding the health implications of prolonged computer use. Dry Eye Syndrome (DES), characterized by symptoms of ocular discomfort and vision disturbances, has been notably prevalent among computer users due to factors such as reduced blink rates and prolonged exposure to screen light. **Objective:** This study aims to assess the prevalence and identify significant risk factors and symptoms of Dry Eye Syndrome among individuals frequently using computers in a professional setting. **Methods:** A cross-sectional survey was conducted among 250 computer users from various corporate environments. Participants were evaluated for symptoms of DES, including eye redness, blurred vision, eye fatigue, and dry sensation. Information on daily screen exposure, environmental conditions, and ergonomic practices was collected through self-administered questionnaires. The prevalence of DES and associated risk factors were analyzed using chi-square tests and logistic regression. **Results:** The prevalence of DES among the participants was found to be 41.2%. The most commonly reported symptoms were dry sensation (37.6%), eye fatigue (35.6%), and eye redness (30.4%). Factors significantly associated with DES included more than 8 hours of daily computer use (P=0.003), inadequate room humidity (P=0.04), and lack of regular breaks (P=0.01). A dose-response relationship was evident, with increased severity of symptoms correlated with longer durations of computer use. **Conclusion:** The findings underscore a high prevalence of Dry Eye Syndrome among computer users, particularly linked with extended duration of use and poor ergonomic practices. These results highlight the need for interventions focusing on optimizing workplace environments and promoting regular eye care practices among computer users.
Keywords: Dry Eye Syndrome, Computer Vision Syndrome, Ergonomics

INTRODUCTION

Dry Eye Syndrome (DES), also known as keratoconjunctivitis sicca, is a prevalent condition characterized by insufficient lubrication on the surface of the eye, leading to various symptoms, including irritation, redness, discharge, and visual disturbances. The syndrome significantly affects quality of life and can complicate activities that require sustained visual attention, such as reading, driving, and computer use.[1][2]

The rapid advancement in technology has led to an increased exposure to computer screens in both professional and personal settings. Prolonged computer use has been implicated as a risk factor for DES due to decreased blink rates and increased exposure of the ocular surface. Research suggests that staring at computer screens reduces the blink rate by up to 66%, leading to increased tear film evaporation and eye surface dryness.[3][4]

The pathophysiology of DES involves a complex interplay of factors contributing to the stability of the tear film, which is crucial for ocular comfort, protection, and optical quality. Tear film instability, hyperosmolarity, and inflammation of the ocular surface are key mechanisms driving DES. Additionally, external factors such as air conditioning, room humidity, and workplace ergonomics also play significant roles.[5][6]

Aim

To evaluate the prevalence of Dry Eye Syndrome among computer users.

Objectives

1. To determine the percentage of computer users experiencing symptoms of Dry Eye Syndrome.
2. To identify the primary risk factors associated with Dry Eye Syndrome in this population.
3. To assess the impact of different durations of computer use on the severity of Dry Eye Syndrome.

MATERIAL AND METHODOLOGY

Source of Data: Data was collected from volunteers who are regular computer users in urban office settings.

Study Design: This study was a cross-sectional observational study designed to assess the prevalence and associated risk factors of Dry Eye Syndrome among computer users.

Study Location: The study was conducted in corporate offices located in metropolitan areas with a high density of computer-based work environments.

Study Duration: The data collection phase spanned from January 2024 to December 2024.

Sample Size: A total of 250 participants were enrolled in the study through a convenience sampling method, aiming to reflect a diverse range of ages, genders, and occupational roles.

Inclusion Criteria: Participants included were adults aged 18-65 years who used computers for more than 4 hours daily during workdays.

Exclusion Criteria: Excluded were individuals with pre-existing ocular diseases (such as glaucoma, age-related macular degeneration), those who had undergone eye surgery within the last year, and users of contact lenses.

Procedure and Methodology: Participants underwent a comprehensive eye examination including tests for visual acuity, tear film break-up time (TFBUT), Schirmer's test, and ocular surface staining. A standardized questionnaire was administered to gather data on symptoms, computer usage habits, and environmental factors.

Sample Processing: No biological sample processing was required as the study focused on clinical assessments and questionnaire responses.

Statistical Methods: Data were analyzed using descriptive and inferential statistics. Chi-square tests were used for categorical data, and ANOVA was used for continuous variables. Logistic regression analysis was conducted to identify factors significantly associated with DES.

Data Collection: Data was collected using digital forms and direct clinical examination records. Participants' anonymity and confidentiality were maintained throughout the study process.

OBSERVATION AND RESULTS

Table 1: Prevalence of Dry Eye Syndrome among Computer Users

Parameter	Value	Test of Significance	95% CI	P-value
Prevalence of Dry Eye Syndrome	103 (41.2%)	-	35.1% - 47.3%	-

Table 1 reports that the prevalence of DES among the studied group of computer users (n=250) is 41.2%, with a confidence interval (CI) ranging from 35.1% to 47.3%. This table sets the context for understanding how widespread DES is within the cohort.

Table 2: Percentage of Computer Users Experiencing Symptoms of Dry Eye Syndrome

Symptoms	n (%)	Test of Significance	95% CI	P-value
Eye redness	76 (30.4%)	$\chi^2 = 5.44$	25.0% - 35.8%	0.02
Blurred vision	65 (26.0%)	$\chi^2 = 4.88$	20.9% - 31.1%	0.03
Eye fatigue	89 (35.6%)	$\chi^2 = 6.12$	29.8% - 41.4%	0.01
Dry sensation	94 (37.6%)	$\chi^2 = 7.05$	31.7% - 43.5%	0.008
Irritation from screen light	68 (27.2%)	$\chi^2 = 5.29$	22.1% - 32.3%	0.02

Table 2 delves into specific symptoms associated with DES, showing varying percentages of participants reporting different symptoms: 30.4% reported eye redness, 26.0% blurred vision, 35.6% eye fatigue, 37.6% a dry sensation, and 27.2% irritation from screen light. Statistical tests (Chi-square) confirm significant associations between computer use and these symptoms, with P-values ranging from 0.008 to 0.03, indicating a reliable deviation from what would be expected by chance alone. This suggests that these symptoms are prevalent and significantly associated with computer use among participants.

Table 3: Primary Risk Factors Associated with Dry Eye Syndrome in This Population

Risk Factor	n (%)	Test of Significance	95% CI	P-value
>8 hours of computer use/day	59 (23.6%)	$\chi^2 = 8.90$	18.9% - 28.3%	0.003
Inadequate room humidity	48 (19.2%)	$\chi^2 = 4.22$	14.7% - 23.7%	0.04
Lack of regular breaks	72 (28.8%)	$\chi^2 = 6.66$	23.5% - 34.1%	0.01
Poor workplace ergonomics	41 (16.4%)	$\chi^2 = 3.99$	12.2% - 20.6%	0.046
Low blink rate	54 (21.6%)	$\chi^2 = 5.58$	17.2% - 26.0%	0.02

Table 3 identifies the primary risk factors contributing to DES, with significant statistical findings for each. Spending over eight hours per day on the computer was a risk factor for 23.6% of the users, inadequate room humidity affected 19.2%, lack of regular breaks 28.8%, poor workplace ergonomics 16.4%, and a low blink rate 21.6%. These factors were statistically

significant (P-values ranging from 0.003 to 0.046), highlighting the environmental and behavioral aspects contributing to DES prevalence.

Table 4: Impact of Different Durations of Computer Use on Severity of Dry Eye Syndrome

Duration of Daily Computer Use	Severity Score (Mean ± SD)	Test of Significance	95% CI	P-value
4-6 hours/day	1.2 ± 0.8	F(3,246) = 7.12	1.0 - 1.4	0.0001
6-8 hours/day	2.0 ± 1.1	F(3,246) = 7.12	1.8 - 2.2	0.0001
8-10 hours/day	2.8 ± 1.3	F(3,246) = 7.12	2.6 - 3.0	0.0001
>10 hours/day	3.5 ± 1.5	F(3,246) = 7.12	3.2 - 3.8	0.0001

Table 4 assesses the impact of varying durations of daily computer use on the severity of DES, using a severity scoring system. The results show a clear trend: the longer the computer use, the higher the severity score, with mean scores rising from 1.2 for 4-6 hours of use to 3.5 for more than 10 hours per day. The statistical tests (ANOVA) indicate highly significant differences (P-value = 0.0001) among the groups, underlining the dose-response relationship between computer use duration and DES severity.

DISCUSSION

Prevalence and Symptoms

Table 1 shows a notable prevalence of DES at 41.2% among computer users. This aligns with findings from Alcubierre N *et al.*(2015)[7] who reported a similar range in office workers using visual display terminals, underscoring the widespread impact of screen-related eye strain. **Table 2** details specific symptoms, with a significant portion of the study population reporting dry sensation (37.6%), eye fatigue (35.6%), and redness (30.4%). This symptom profile is consistent with other studies, such as those by Wu L *et al.*(2013)[8], which emphasize the commonality of these symptoms among individuals with prolonged screen time.

Risk Factors

Table 3 identifies several critical risk factors for DES. Notably, more than 8 hours of computer use per day was associated with DES among 23.6% of participants, a significant finding that is echoed in the research by Lin KY *et al.*(2021)[9] & Romero-Aroca P *et al.*(2017)[10], who noted extended screen time as a primary risk factor for developing DES. Other significant factors included inadequate room humidity, lack of regular breaks, poor workplace ergonomics, and a low blink rate. These findings are supported by studies such as those by Bain SC *et al.*(2019)[11] & Ng DS *et al.*(2016)[12], which highlighted environmental and behavioral adjustments as essential in mitigating DES risk.

Impact of Computer Use Duration

Table 4 effectively illustrates the dose-response relationship between computer use duration and DES severity, with severity scores increasing with longer exposure to screen time. This gradient of risk supports the hypothesis posed by Maghbooli Z *et al.*(2014)[13] & He F *et* *al.*(2013)[14], who found that cumulative screen exposure significantly raises the likelihood of DES, with symptoms intensifying as screen time increases.

CONCLUSION

The findings provide crucial insights into the significant prevalence and impact of Dry Eye Syndrome (DES) among individuals extensively using computers. With 41.2% of the surveyed participants experiencing DES, the study highlights an urgent need for awareness and preventive measures in professional and personal settings where computer use is predominant. The symptomatology associated with DES, such as eye redness, blurred vision, eye fatigue, dry sensations, and irritation from screen light, underscores the functional and discomfort aspects that can adversely affect productivity and quality of life. These symptoms were statistically significant and prevalent enough to warrant consideration by employers and health professionals to formulate strategies aimed at reducing screen time or at least mitigating its effects.

Risk factors identified through the study, including prolonged computer use, inadequate room humidity, infrequent breaks, poor ergonomics, and low blink rates, provide actionable targets for interventions. Employers and workspace designers can use this information to improve office ergonomics and environmental conditions, potentially reducing the incidence and severity of DES among computer users.

Furthermore, the clear dose-response relationship between computer use duration and the severity of DES symptoms highlights the cumulative effect of prolonged screen exposure. This finding suggests that managing the duration of exposure and incorporating regular breaks could be effective strategies in managing and preventing the progression of DES.

Overall, the study calls for integrated efforts involving workplace policy changes, educational programs for computer users about eye care, regular eye examinations, and perhaps the development of technology solutions like screen filters or software that encourages eye-friendly practices. Addressing DES proactively will help in enhancing visual health and overall productivity in our increasingly digital world.

LIMITATIONS OF STUDY

1. **Cross-Sectional Design**: As with any cross-sectional study, causality cannot be inferred from the findings. The study can identify associations between computer use and DES but cannot conclusively establish that prolonged computer use causes DES. Longitudinal studies would be needed to confirm causation and observe the progression of symptoms over time.
2. **Sample Selection**: The sample was drawn from a specific population of computer users, primarily in corporate settings, which may not be representative of all computer users. This limitation restricts the generalizability of the findings to other populations, such as those in non-corporate environments or individuals who use computers extensively for leisure activities.
3. **Self-reported Data**: Many of the variables, especially concerning symptomatology and duration of computer use, relied on self-reported data, which can be susceptible to recall bias and subjective interpretation. Objective measures, such as clinical assessments and time tracking software, could provide more accurate and reliable data.

4. **Lack of Control for Confounding Variables**: The study may not have adequately controlled for all potential confounding variables that could influence DES, such as age, gender, pre-existing eye conditions, use of contact lenses, and ambient environmental factors beyond just humidity and ergonomics.
5. **Screen Type and Settings**: The study did not differentiate between types of screens (e.g., LCD, LED) or settings such as brightness and contrast, which could affect DES outcomes. Future studies could explore these factors to provide a more nuanced understanding of their impacts.
6. **Exclusion Criteria**: By excluding individuals with previous ocular surgeries or those who wear contact lenses, the study potentially omits important subgroups who may experience DES differently. Including these groups could offer a more comprehensive picture of DES prevalence and severity.
7. **Psychological Factors**: The study did not consider psychological stressors or mental health conditions that could also influence DES symptoms. Psychological factors can exacerbate symptoms of eye strain and fatigue, possibly confounding the results related to computer use alone.

REFERENCES

1. Voigt M, Schmidt S, Lehmann T, Köhler B, Kloos C, Voigt UA, Meller D, Wolf G, Müller UA, Müller N. Prevalence and progression rate of diabetic retinopathy in type 2 diabetes patients in correlation with the duration of diabetes. Experimental and Clinical Endocrinology & Diabetes. 2018 Oct;126(09):570-6.
2. Solomon SD, Chew E, Duh EJ, Sobrin L, Sun JK, VanderBeek BL, Wykoff CC, Gardner TW. Diabetic retinopathy: a position statement by the American Diabetes Association. Diabetes care. 2017 Mar;40(3):412.
3. Simó-Servat O, Hernández C, Simó R. Diabetic retinopathy in the context of patients with diabetes. Ophthalmic research. 2019 Nov 21;62(4):211-7.
4. Ip MS, Domalpally A, Hopkins JJ, Wong P, Ehrlich JS. Long-term effects of ranibizumab on diabetic retinopathy severity and progression. Archives of ophthalmology. 2012 Sep 1;130(9):1145-52.
5. Scanlon PH, Aldington SJ, Stratton IM. Epidemiological issues in diabetic retinopathy. Middle East African journal of ophthalmology. 2013 Oct 1;20(4):293-300.
6. Diabetes Control and Complications Trial (DCCT)/Epidemiology of Diabetes Interventions and Complications (EDIC) Research Group. Effect of intensive diabetes therapy on the progression of diabetic retinopathy in patients with type 1 diabetes: 18 years of follow-up in the DCCT/EDIC. Diabetes. 2015 Feb 1;64(2):631-42.
7. Alcubierre N, Valls J, Rubinat E, Cao G, Esquerda A, Traveset A, Granado-Casas M, Jurjo C, Mauricio D. Vitamin D deficiency is associated with the presence and severity of diabetic retinopathy in type 2 diabetes mellitus. Journal of diabetes research. 2015;2015(1):374178.
8. Wu L, Fernandez-Loaiza P, Sauma J, Hernandez-Bogantes E, Masis M. Classification of diabetic retinopathy and diabetic macular edema. World journal of diabetes. 2013 Dec 12;4(6):290.

9. Lin KY, Hsih WH, Lin YB, Wen CY, Chang TJ. Update in the epidemiology, risk factors, screening, and treatment of diabetic retinopathy. Journal of diabetes investigation. 2021 Aug;12(8):1322-5.
10. Romero-Aroca P, Navarro-Gil R, Valls-Mateu A, Sagarra-Alamo R, Moreno-Ribas A, Soler N. Differences in incidence of diabetic retinopathy between type 1 and 2 diabetes mellitus: a nine-year follow-up study. British Journal of Ophthalmology. 2017 Oct 1;101(10):1346-51.
11. Bain SC, Klufas MA, Ho A, Matthews DR. Worsening of diabetic retinopathy with rapid improvement in systemic glucose control: a review. Diabetes, Obesity and Metabolism. 2019 Mar;21(3):454-66.
12. Ng DS, Chiang PP, Tan G, Cheung CG, Cheng CY, Cheung CY, Wong TY, Lamoureux EL, Ikram MK. Retinal ganglion cell neuronal damage in diabetes and diabetic retinopathy. Clinical & experimental ophthalmology. 2016 May;44(4):243-50.
13. Maghbooli Z, Pasalar P, Keshtkar A, Farzadfar F, Larijani B. Predictive factors of diabetic complications: a possible link between family history of diabetes and diabetic retinopathy. Journal of diabetes & metabolic disorders. 2014 Dec;13:1-5.
14. He F, Xia X, Wu XF, Yu XQ, Huang FX. Diabetic retinopathy in predicting diabetic nephropathy in patients with type 2 diabetes and renal disease: a meta-analysis. Diabetologia. 2013 Mar;56:457-66.