



THE IMPACT OF DIGITAL SCREEN EXPOSURE ON THE DEVELOPMENT OF DRY EYE SYNDROME AMONG YOUNG ADULTS

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Annotation: *This study investigates the influence of prolonged digital screen exposure on the development of dry eye syndrome (DES) in young adults, a rapidly increasing public health concern linked to modern lifestyle changes. Dry eye syndrome is characterized by ocular surface inflammation, tear film instability, and discomfort, leading to impaired visual function and reduced quality of life. The research examines the correlation between daily screen time, screen type, and ocular surface parameters, emphasizing tear film breakup time, Schirmer's test values, and ocular surface staining. The study incorporates both subjective symptom assessment via standardized questionnaires and objective clinical measurements, providing a comprehensive overview of the impact of digital device use on ocular health. Results indicate that extended screen exposure significantly increases the prevalence and severity of dry eye symptoms, suggesting the necessity for preventive strategies, awareness campaigns, and evidence-based ergonomic guidelines. This research highlights the importance of early diagnosis, patient education, and tailored interventions to mitigate DES in young adult populations heavily engaged in digital environments.*

Keywords: *dry eye syndrome, digital screen exposure, tear film, visual display units, ocular surface, young adults, blink rate, computer vision syndrome, Schirmer's test, ocular discomfort.*

Introduction

Dry eye syndrome (DES) has emerged as a significant ocular condition affecting young adults, primarily driven by increased exposure to digital devices including computers, smartphones, tablets, and e-readers. Modern lifestyles often involve prolonged near-vision tasks, reduced blink frequency, and sustained screen focus, leading to evaporative dry eye, ocular surface stress, and visual fatigue. Epidemiological data suggest that the prevalence of DES among young adults ranges between 15% and 30%, with higher rates in populations exposed to extended digital



screen time. The pathophysiology of DES involves multifactorial mechanisms, including tear film instability, meibomian gland dysfunction, hyperosmolarity, inflammation of the ocular surface, and neurosensory abnormalities. Digital screen exposure exacerbates these factors by decreasing spontaneous blink rate, increasing incomplete blinks, and promoting prolonged ocular surface exposure. Clinical manifestations include dryness, burning sensation, foreign body sensation, fluctuating vision, and photophobia, all of which compromise quality of life, productivity, and academic or occupational performance. Despite growing concern, awareness of DES and its preventive measures among young adults remains limited, necessitating comprehensive studies to assess the relationship between digital screen exposure and ocular surface health. This study aims to analyze both subjective and objective indicators of DES in young adults with varying daily digital screen usage and identify modifiable risk factors for targeted interventions.

Materials and Methods

A cross-sectional study was conducted on 250 young adults aged 18–30 years attending university clinics from January 2023 to December 2023. Participants were grouped according to daily screen exposure: low (<4 hours/day), moderate (4–8 hours/day), and high (>8 hours/day). Inclusion criteria comprised healthy individuals without previous ocular surgery or systemic conditions affecting tear production. Exclusion criteria included contact lens use, ocular surface disease unrelated to DES, and current use of topical ocular medications. Subjective assessment utilized the Ocular Surface Disease Index (OSDI) questionnaire to quantify symptom severity. Objective clinical evaluation included tear film breakup time (TBUT), Schirmer's test, and fluorescein ocular surface staining. Blink rate and completeness during digital tasks were recorded using high-speed video capture. Data analysis employed SPSS version 26, with chi-square tests for categorical variables, ANOVA for intergroup comparisons, and Pearson correlation to determine associations between screen exposure, blink parameters, and DES severity. Significance was defined at $p < 0.05$.

Results

Among 250 participants, 72 (28.8%) were in the low-exposure group, 104 (41.6%) in the moderate group, and 74 (29.6%) in the high-exposure group. OSDI scores increased significantly with screen time: low exposure mean score 12.4 ± 3.1 , moderate exposure 22.8 ± 4.6 , and high exposure 35.6 ± 5.2 ($p < 0.001$). Tear film breakup time decreased progressively with screen duration: low 11.2 ± 2.1 seconds, moderate 7.8 ± 1.9 seconds, and high 4.9 ± 1.5 seconds ($p < 0.001$). Schirmer's test values followed a



similar trend, with mean values of 18.5 ± 3.4 mm in low exposure, 12.7 ± 2.8 mm in moderate exposure, and 8.3 ± 2.5 mm in high exposure ($p < 0.001$). Incomplete blink frequency correlated positively with screen time ($r = 0.68$, $p < 0.01$). Fluorescein ocular surface staining revealed mild punctate keratopathy in 15% of low-exposure participants, 34% of moderate-exposure participants, and 57% of high-exposure participants. Regression analysis identified daily screen time greater than six hours and reduced blink rate as significant predictors of DES severity. No significant differences were observed between device type after adjusting for exposure duration.

Discussion

The findings demonstrate a clear association between prolonged digital screen exposure and the development of dry eye syndrome in young adults. Extended screen use contributes to evaporative tear loss, ocular surface desiccation, and reduced tear film stability, consistent with prior literature on computer vision syndrome and digital eye strain. High OSDI scores, reduced TBUT, decreased Schirmer values, and increased ocular surface staining in the high-exposure group highlight the cumulative impact of sustained screen engagement. Blink rate reduction during digital tasks emerges as a critical modifiable factor; incomplete or infrequent blinking exacerbates ocular surface dehydration. These results reinforce the necessity for preventive strategies, including regular breaks using the 20-20-20 rule, conscious blinking exercises, ergonomic adjustments, and the use of artificial tear substitutes. Early identification of symptomatic individuals via OSDI screening and clinical evaluation facilitates timely intervention, mitigating long-term ocular surface damage and improving visual comfort. Furthermore, awareness campaigns targeting students and young professionals can promote adherence to preventive measures. This study underscores the importance of integrating both subjective symptom reporting and objective clinical metrics to comprehensively evaluate DES risk associated with modern digital behaviors. Future research should focus on longitudinal monitoring, evaluation of innovative blink-training devices, and assessment of blue light-filtering technologies on ocular surface health.

Conclusion

Prolonged digital screen exposure significantly contributes to the onset and severity of dry eye syndrome in young adults by reducing tear film stability, decreasing blink rate, and increasing ocular surface stress. Objective clinical assessments and subjective symptom questionnaires demonstrate a dose-dependent relationship between screen time and DES. Implementation of preventive strategies, ergonomic



modifications, patient education, and early therapeutic interventions are essential to reduce the prevalence of DES and protect ocular health in digitally engaged populations. Continued research is needed to develop evidence-based guidelines for safe screen use and optimal ocular surface maintenance.

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