Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Effect of Digital Screen Use on Dry-Eye Disease among Adults Attending a Tertiary-Care Eye Hospital in Karachi, Pakistan

Hina Qazi[1]
Aga Khan University Hospital
Khadijah Abid[1]
Aga Khan University Hospital
Dania Memon[1]
Aga Khan University Hospital
Shaukat Chhipa
Shaukat.chhipa@aku.edu
Aga Khan University Hospital

Research Article

Keywords: Dry Eye Disease, Visual Display Terminal Devices, Tear Film Break-Up Time

Posted Date: August 5th, 2025

DOI: https://doi.org/10.21203/rs.3.rs-6962269/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Dry eye disease (DED) is a multifactorial ocular condition characterized by tear film instability and inflammation. Prolonged use of visual display terminals (VDTs), including computers and smartphones, is an emerging modifiable risk factor for DED, especially in digitally connected regions like Pakistan. Despite increasing complaints of digital eye strain, population-level data on DED prevalence and screen time are limited in South Asia.

Objective

To determine the frequency of DED and its association with digital screen exposure among adults attending ophthalmology clinics in Karachi, Pakistan.

Methods

A descriptive cross-sectional study was conducted at Aga Khan University Hospital from December 2023 to May 2024. Consecutive adults (n = 146) reporting ≥ 4 hours/day of habitual screen use were evaluated. DED was diagnosed using OSDI ≥ 13 with either TBUT < 10s or Oxford staining ≥ 1. Participants self-reported screen time across devices. Logistic regression was used to assess associations between screen time and DED.

Results

DED was diagnosed in 30.8% (n = 45) of participants. Median screen time was significantly higher in the DED group (7 vs. 6 hours/day; p = 0.001). DED patients also reported greater computer (6 vs. 4 hours/day; p = 0.001) and smartphone use (2 vs. 1 hour/day; p = 0.002). Total screen time was independently associated with DED (aOR = 1.538; p = 0.001).

Conclusion

DED is prevalent among urban adults with prolonged screen exposure in Pakistan. Computer and smartphone use were key risk factors. These findings support the need for public health interventions promoting safe screen practices to reduce DED burden.

Introduction

Dryeye disease (DED) is a multifactorial disorder of the ocular surface characterised by loss of tearfilm homeostasis, tear-film instability and hyperosmolarity, ocular-surface inflammation and damage, and neurosensory abnormalities.[1] Globally, DED affects an estimated 5–50% of population, with prevalence varying by diagnostic criteria, geographical setting, and demographics.[2] Symptoms such as foreignbody sensation, burning, fluctuating vision, and ocular fatigue impair quality of life and impose a substantial economic burden through reduced workplace productivity and increased healthcare utilization.[1, 3]

Rapid expansion of digital technology has introduced a ubiquitous environmental stressor for the ocular surface.[4] Visual display terminal (VDT) use including computers, tablets, smartphones, and other screens leads to reduced blink frequency and increased incomplete blinks, and promotes tearfilm evaporation.[5] A study show that individuals who engage in more than 6–8 h of daily screen time have increased prevalence of DED compared with lowexposure groups.[6] The biological plausibility of this association is reinforced by experimental evidence demonstrating immediate tearfilm thinning, increased ocularsurface temperature, and inflammatory cytokine release after intensive VDT use.[7]

South Asia is experiencing one of the fastest rises in digital connectivity worldwide. In Pakistan, smartphone penetration exceeded 51% in 2020, and computerized employment and elearning have surged after the COVID-19 pandemic.[8, 9] Concomitantly, ophthalmic clinics in urban centres report a surge of patients with symptoms compatible with digital eye strain, yet robust epidemiological data from Pakistan remain limited to student or occupational subgroups and seldom quantify screen exposure with sufficient precision.[3, 6, 10, 11] Consequently, the frequency of DED and its relation to VDT use in Pakistani adults is still uncertain.

The present study therefore measured the frequency of DED among adults attending the ophthalmology clinics of Aga Khan University Hospital, Karachi, and evaluated its association with VDT use. The findings of the study will help eye care professionals provide evidence-based guidance on safe screen usage and implement timely interventions (such as work breaks or environmental modifications) to reduce the burden of DED in the community.

Material and methods

A descriptive cross-sectional study was conducted in the ophthalmology outpatient clinics of Aga Khan University Hospital (AKUH), Karachi, from 1 December 2023 to 31 May 2024. The protocol adhered to the tenets of the Declaration of Helsinki and received approval from the AKUH Ethical Review Committee (ERC 2023-8398-25644). All participants provided written informed consent before enrolment.

A minimum sample size of 146 was derived from the singleproportion formula $n = z^2\, p\, (1-p)/d^2$, assuming a DED prevalence of 18.7% in Pakistani adults[12], a twosided α of 0·05, and a precision of 6.4% points. Consecutive adults aged 18–70 years attending AKUH for routine eye examination were screened. Eligibility required habitual visual-display terminal (VDT) use ≥ 4 h/day i.e. summed across computers, laptops, smartphones, and televisions during the preceding three months. The exclusion

criteria were ocular surgery within six months; current topical ocular medication; active ocular infection or inflammation; corneal or conjunctival pathology capable of altering the tear film; and contact-lens wear.

All examinations were performed by a fellowship-trained consultant ophthalmologist (> 5 years' experience) who was masked to each participant's reported screen habits. Best-corrected visual acuity (BCVA) was measured with an Early Treatment Diabetic Retinopathy Study chart at 4 m. Tear-film break-up time (TBUT) was measured twice per eye after instilling 2 µL of 2% sodium fluorescein; the lower value was retained. Corneo-conjunctival staining was graded on the five-point Oxford scale. Participants completed the Ocular Surface Disease Index (OSDI) questionnaire before any ocular instillation.

Dry-eye disease was diagnosed when OSDI ≥ 13 was accompanied by either TBUT < 10 s (in at least one eye) or an Oxford staining grade ≥ 1. Ten percent of examinations were repeated by a second masked ophthalmologist, yielding a Cohen κ of 0.83 for the DED classification.

After the clinical assessment, trained interviewers administered a structured questionnaire capturing age; gender; place of residence (urban/rural); highest educational attainment; monthly household income (proxy for socioeconomic status); occupation (deskbased vs nondesk); systemic comorbidities; current ocular treatment; and detailed screen exposure. Participants estimated average daily hours spent on computers, smartphones, and television during a typical working week. Totals were summed to create total screen time.

Data were analyzed with R Studio v2024.03. Continuous variables were tested for normality with the Shapiro–Wilk test and all were skewed; therefore, they are presented as median (interquartile range). Categorical variables are summarized as frequency (percentage). Univariate comparisons between DED and nonDED groups employed the χ^2 test (or Fisher's exact test when expected counts < 5) for categorical variables and the Wilcoxon Signed Rank test for nonnormal continuous variables. Univariate logistic regression analysis was applied to see the association socio-demographic factors and total screen time with DED; crude odds ratio (OR) along with 95% CI were estimated. Variables associated with DED at $p < 0.20$ in univariate analyses, were entered into a multivariable logisticregression model to estimate adjusted odds ratios (aOR) and 95% confidence intervals were estimated. Twosided $p < 0.05$ was considered statistically significant.

Results

The cohort was relatively young to middle-aged (median 37 years) with a male predominance (64%). Nearly seven in ten participants held a graduate degree, reflecting a well-educated urban participant; only 11% resided in rural areas. All of the participants belong from middle income group (100%). Almost half the sample were engaged in desk-based occupations, a further third in non-desk jobs, and one in five were unemployed. Systemic comorbidities were infrequent, each affecting fewer than 10% of participants. (Table 1)

Among the 146 adults examined, 45 individuals met the diagnostic criteria for DED, corresponding to a prevalence of 30.8%. The median computer usage among individuals with DED was 6 hours/day (IQR: 4–7), compared to 4 hours/day (IQR: 0–6) in those without DED, demonstrating a statistically significant difference (p = 0.001). Similarly, smartphone use was higher in the DED group, with a median of 2 hours/day (IQR: 1–3), versus 1 hour/day (IQR: 1–3) in non-DED participants (p = 0.002). In contrast, television usage did not differ significantly between groups (median 0 hours/day in both; p = 0.652). (Fig. 1) Furthermore, the median total screen time among individuals with DED was 7 hours/day (IQR: 6–8), versus 6 hours/day (IQR: 5–7) in those without DED (p = 0.001). (Fig. 2)

In univariate analysis, total screen time was significantly associated with dry eye disease (DED), with each additional hour of screen exposure increasing the odds of DED by 52.8% (OR: 1.528; 95% CI: 1.221–1.912; p = 0.001). Working status also showed a marginal association (p = 0.101), with employed individuals having higher unadjusted odds of DED compared to unemployed participants (OR: 2.454; 95% CI: 0.840–7.168). In the adjusted model, total screen time remained independently associated with DED (aOR: 1.538; p = 0.001), indicating that each additional hour of daily screen time increased the odds of DED by approximately 54%, independent of employment status. However, the association between working status and DED was not statistically significant after adjustment (aOR for employed: 0.967; 95% CI: 0.289–3.238; p = 0.956; student: aOR: 1.090; p = 0.893). (Table 2)

Table 1
Baseline characteristics of the study population (n = 146)

Characteristics	Median (IQR) or n (%)
Age (years)	37 (24–50)
Gender	
Male	94 (64.4)
Female	52 (35.6)
Education	
Primary	3 (2.1)
Middle school	41 (28.1)
Graduate	101 (69.2)
Postgraduate	1 (0.7)
Residential status	
Urban	130 (89)
Rural	16 (11)
Job type	
Employed	81 (55.5)
Student	38 (26)
Unemployed	27 (18.5)
Comorbid‡	
DM	11 (7.5)
HTN	13 (8.9)
Hep C	1 (0.7)
Thyroid	1 (0.7)
‡ Categories are not mutually exclusive; a participant could report more than one systemic condition.	

Table 2
Univariate and multivariate analysis of factors associated with DED

Variables	OR (95% CI)	p-value	AOR (95% CI)	p-value
Total screen time (hours/day)	1.528 (1.221–1.912)	0.001**	1.538 (1.198)	0.001*
Age (years)	1.009 (0.986–1.031)	0.453		
Gender				
Male	Ref			
Female	1.145 (0.552–2.373)	0.716		
Education				
Primary	Ref			
Secondary	0.563 (0.046–6.934)	0.653		
Graduate or Postgraduate	1.045 (0.092–11.927)	0.972		
Residence				
Rural	Ref			
Urban	1.382 (0.420–4.545)	0.594		
Working status				
Unemployed	Ref		Ref	
Employed	2.454 (0.840–7.168)	0.101**	0.967 (0.289–3.238)	0.956
Student	1.793 (0.541–5.938)	0.339	1.090 (0.311–3.813)	0.893

***Meeting the threshold p < 0.20 for multivariate regression*

**Significant at 5% level of significance*

Discussion

This study contributes to the growing body of literature linking prolonged VDT use with DED, particularly in underrepresented urban South Asian populations. With 30.8% of participants meeting the diagnostic criteria for DED, this prevalence underscores a substantial ocular health burden in digitally active adults residing in urban Pakistan.The finding parallels recent reports that emphasize rising DED prevalence among screen-exposed populations globally[13–15], and confirms this trend within a rapidly digitalizing middle-income country context.

The most prominent and statistically robust finding was the association between total screen time and DED. A clear dose-response pattern was identified, with each additional hour of daily screen exposure increasing the odds of DED by approximately 54% (aOR: 1.538; p = 0.001). This aligns with results from the JPHC-NEXT study in Japan, which reported an OR of 1.18 per hour of screen use, and the OSAKA study that found an OR of 1.94 among office workers with > 8 hours/day of screen exposure.[16, 17] Furthermore, a meta-analysis highlighted that the prevalence of DED among screen users can range widely from 9.5–87.5%, depending on exposure duration and population characteristics.[13] Variations in prevalence across regions may also reflect differences in environmental conditions, such as humidity and air quality, which are typically more controlled in high-income countries compared to settings like Pakistan.[18] Collectively, these findings affirm that DED is a growing public health concern globally, especially in the context of widespread and increasing digital screen use.

Our study also demonstrated significantly higher daily computer use in DED participants (median 6 vs. 4 hours; p = 0.001), with a similar association observed for smartphone use (median 2 vs. 1 hour; p = 0.002). Conversely, television viewing time did not significantly differ between groups, highlighting that not all forms of screen engagement carry equivalent DED risk. These distinctions likely reflect cognitive demand and blink dynamics as computer and smartphone use typically involve greater attentional focus and reduced blink frequency or completeness, thereby exacerbating tear film instability.[19, 20]

Interestingly, working status showed a marginal univariate association with DED (p = 0.101), but lost significance after adjusting for screen time, suggesting that occupational role is a surrogate marker of screen exposure rather than an independent risk factor. This reinforces the need for more nuanced exposure metrics in future research, rather than relying on job categories alone. While prior studies have flagged desk-based employment as a high-risk condition for DED[18], our data indicate that the true mediator may be screen time intensity within those roles.

Notably, demographic variables such as age, gender, and residence were not significantly associated with DED in this study. The absence of an age effect may reflect homogeneity in screen exposure across the sample, which was largely composed of young to middle-aged adults. Previous studies have established increasing age as a DED risk factor due to tear film and glandular changes[10, 21], but these effects may have been attenuated here due to limited representation of elderly individuals. Similarly, although prior studies attribute higher DED prevalence to hormonal changes in women[22], our male-dominant sample i.e. characterized by high VDT engagement showed no gender difference.

All participants belonged to the middle-income group, which limited our ability to assess socioeconomic differentials. However, DED prevalence did not significantly vary by education or urban versus rural residence. While urban dwellers exhibited higher odds of DED (OR: 1.38), the association was not statistically significant (p = 0.594). Nonetheless, urban lifestyles are commonly characterized by intensive digital engagement and environmental exposures (e.g., pollution, low humidity, artificial lighting), which are known contributors to ocular surface instability.[23, 24]

The implications of DED extend beyond ocular symptoms. Chronic DED can impair work productivity, mental health, and quality of life. With rising dependence on digital platforms for professional, academic, and recreational purposes, targeted preventive strategies are essential.[25, 26] Evidence-based measures such as the 20-20-20 rule, environmental adjustments (e.g., humidifiers, screen positioning), and behavioral interventions (e.g., blink training) have demonstrated effectiveness in reducing screen-related eye strain.[1, 14, 15, 27] Educational campaigns tailored to high-risk groups, particularly employed adults in digital professions could mitigate the long-term burden of DED.

This study has several limitations. First, the cross-sectional design precludes causal inferences. Although a strong association was observed between screen time and DED, temporality cannot be established. Second, the study was conducted in a single urban tertiary hospital, with all participants belonging to the middle-income bracket. This homogeneity limits generalizability to rural, low-income, or non-hospital-based populations. Third, screen time was self-reported, which may introduce recall bias. Future studies should consider using device-logged screen data or ecological momentary assessment for higher accuracy. Fourth, environmental and ergonomic factors such as screen distance, lighting, and humidity were not captured, despite their known influence on DED risk. Lastly, the use of non-probability consecutive sampling may contribute to selection bias.

Conclusion

In conclusion, this study demonstrates a high prevalence of DED among urban adults with prolonged digital screen use, with computer and smartphone use emerging as independent risk factors. Total screen time showed a strong dose-response relationship with DED, reinforcing the ocular implications of modern digital lifestyles. These findings underscore the need for preventive interventions at the individual, occupational, and policy levels to mitigate the growing burden of screen-related dry eye disease. Future longitudinal research with diverse and representative samples is warranted to confirm causality and develop targeted prevention strategies.

Abbreviations

BCVA: Best-Corrected Visual Acuity

DED: Dry Eye Disease

OSDI: Ocular Surface Disease Index

TBUT: Tear Break-Up Time

VDT: Visual Display Terminal

Declarations

Ethics approval and consent to participate: This study was conducted in accordance with the Declaration of Helsinki. The study protocol was approved by the Ethical Review Committee of Aga Khan University Hospital Karachi (ERC 2023-8398-25644). Written informed consent was obtained from all study participants prior to data collection.

Consent for publication: Not applicable.

Availability of data and materials: The data generated and analyzed from this study are available from the corresponding author on request.

Competing interest: None to declare.

Funding: None to declare.

Authors Contribution: H.Q. and S.C. conceived and designed the study. H.Q. conducted data collection and coordinated ethical approvals. drafted the initial manuscript. K.A assisted with data analysis, contributed to manuscript writing and revisions. D.M. supported data entry, literature review, and formatting. S.C. provided clinical supervision, validated diagnostic criteria, and critically reviewed the manuscript for important intellectual content. All authors reviewed and approved the final version of the manuscript.

Acknowledgement: We would like to thank Ms. Fariha Ali (Research Associate) for her assistance with the final formatting and submission of the manuscript. We also extend our thanks to Dr. Syeda Mahnoor Zehra for her input during the initial drafting of the manuscript.

References

1. Golden MI, Meyer JJ, Zeppieri M, Patel BC. Dry Eye Syndrome. StatPearls: StatPearls Publishing Copyright © 2025, StatPearls Publishing LLC.; 2025.
2. Yang W, Wang H, Li J, Chen Y, Zhang Y, Niu X, et al. Demographic and lifestyle factors associated with dry eye disease in China: A cross-sectional multi-center study. The Ocular Surface. 2024;34:146-55. DOI: https://doi.org/10.1016/j.jtos.2024.07.007.
3. Arif SA, Khan MI, Abid MS, Babar A, Arif MA, Jahanzaib HM, et al. Frequency and impact of individual symptoms on quality of life in dry eye disease in patients presenting to a tertiary care hospital. J. Pak. Med. Assoc. 2021;71(4):1063-8.
4. Wolffsohn JS, Lingham G, Downie LE, Huntjens B, Inomata T, Jivraj S, et al. TFOS Lifestyle: Impact of the digital environment on the ocular surface. The Ocular Surface. 2023;28:213-52. DOI: https://doi.org/10.1016/j.jtos.2023.04.004.
5. Kamøy B, Magno M, Nøland ST, Moe MC, Petrovski G, Vehof J, et al. Video display terminal use and dry eye: preventive measures and future perspectives. Acta Ophthalmol. 2022;100(7):723-39. DOI: 10.1111/aos.15105.

6. Sharma D, Shrestha S. Dry Eyes among Visual Display Terminal Users Visiting the Outpatient Department of Ophthalmology of a Tertiary Care Centre. JNMA J. Nepal Med. Assoc. 2023;61(266):803.
7. Casemore RK, Wolffsohn JS, Utheim TP, Reppe S, Aass HCD, Dutta D. A prospective, longitudinal study to assess progression of ocular surface signs, tear cytokines and protein profiles in young adults. Ocul Surf. 2025;37:57-67. DOI: 10.1016/j.jtos.2025.02.011.
8. Ejaz W, Altay S, Naeem G. Smartphone use and well-being in Pakistan: Comparing the effect of self-reported and actual smartphone use. Digital health. 2023;9:20552076231186075. DOI: 10.1177/20552076231186075.
9. Jamil S, Muschert G. The COVID-19 Pandemic and E-Learning: The Digital Divide and Educational Crises in Pakistan's Universities. Am. Behav. Sci. 2023;68:000276422311567. DOI: 10.1177/00027642231156779.
10. Abbott K, Hanson KS, Lally J. Prevalence of dry eye disease in the low vision population at the University of Colorado. Journal of Optometry. 2024;17(2):100501.
11. Li M, Zeng L, Mi S, Li Y, Liu Z, Yu K, et al. A multicenter study of the prevalence of dry eye disease in Chinese refractive surgery candidates. Ophthalmic Res. 2021;64(2):224-9.
12. Ayub A, Akhtar FM, Saleem N, Ali MH, Ayub MH, Butt NH. Frequency and Risk Factors of Dry Eye Disease in Pakistani Population, A Hospital Based Study. Pak J Ophthalmol [Internet]. 2017 Dec. 1 [cited 2025 May 13];33(4). Available from: https://pjo.org.pk/index.php/pjo/article/view/26.
13. Courtin R, Pereira B, Naughton G, Chamoux A, Chiambaretta F, Lanhers C, et al. Prevalence of dry eye disease in visual display terminal workers: a systematic review and meta-analysis. BMJ open. 2016;6(1):e009675. DOI: 10.1136/bmjopen-2015-009675.
14. Jaiswal S, Asper L, Long J, Lee A, Harrison K, Golebiowski B. Ocular and visual discomfort associated with smartphones, tablets and computers: what we do and do not know. Clin. Exp. Optom. 2019;102(5):463-77. DOI: 10.1111/cxo.12851.
15. Portello JK, Rosenfield M, Bababekova Y, Estrada JM, Leon A. Computer-related visual symptoms in office workers. Ophthalmic Physiol. Opt. 2012;32(5):375-82. DOI: 10.1111/j.1475-1313.2012.00925.x.
16. Hanyuda A, Sawada N, Uchino M, Kawashima M, Yuki K, Tsubota K, et al. Physical inactivity, prolonged sedentary behaviors, and use of visual display terminals as potential risk factors for dry eye disease: JPHC-NEXT study. Ocul Surf. 2020;18(1):56-63. DOI: 10.1016/j.jtos.2019.09.007.
17. Uchino M, Yokoi N, Uchino Y, Dogru M, Kawashima M, Komuro A, et al. Prevalence of dry eye disease and its risk factors in visual display terminal users: the Osaka study. Am. J. Ophthalmol. 2013;156(4):759-66. DOI: 10.1016/j.ajo.2013.05.040.
18. Wolffsohn JS, Lingham G, Downie LE, Huntjens B, Inomata T, Jivraj S, et al. TFOS Lifestyle: Impact of the digital environment on the ocular surface. The ocular surface. 2023;28:213-52.
19. Al-Mohtaseb Z, Schachter S, Shen Lee B, Garlich J, Trattler W. The Relationship Between Dry Eye Disease and Digital Screen Use. Clin. Ophthalmol. 2021;15:3811-20. DOI: 10.2147/opth.S321591.

20. Muppalla SK, Vuppalapati S, Reddy Pulliahgaru A, Sreenivasulu H. Effects of Excessive Screen Time on Child Development: An Updated Review and Strategies for Management. Cureus. 2023;15(6):e40608. DOI: 10.7759/cureus.40608.
21. Wang MT, Muntz A, Lim J, Kim JS, Lacerda L, Arora A, et al. Ageing and the natural history of dry eye disease: A prospective registry-based cross-sectional study. The ocular surface. 2020;18(4):736-41.
22. Kim H, An Y, Hwang WJ. Gender differences in dry eye disease symptoms associated with psychological health indicators among adults using mobile mental health apps. PLoS One. 2023;18(1):e0278921.
23. Onua A, Chukwuka I. Prevalence of dry eye disease in a rural niger delta community, southern Nigeria. Open Journal of Ophthalmology. 2017;7(02):95-102.
24. Abdulmannan DM, Naser AY, Ibrahim Ok, Mahmood AS, Alyoussef Alkrad J, Sweiss K, et al. Visual health and prevalence of dry eye syndrome among university students in Iraq and Jordan. BMC Ophthalmol. 2022;22(1):265. DOI: 10.1186/s12886-022-02485-w.
25. Chan C, Ziai S, Myageri V, Burns JG, Prokopich CL. Economic burden and loss of quality of life from dry eye disease in Canada. BMJ open ophthalmology. 2021;6(1):e000709. DOI: 10.1136/bmjophth-2021-000709.
26. Morthen MK, Magno MS, Utheim TP, Hammond CJ, Vehof J. The work-related burden of dry eye. The Ocular Surface. 2023;28:30-6. DOI: https://doi.org/10.1016/j.jtos.2023.01.006.
27. Kahal F, Al Darra A, Torbey A. Computer vision syndrome: a comprehensive literature review. Future science OA. 2025;11(1):2476923. DOI: 10.1080/20565623.2025.2476923.

Figures

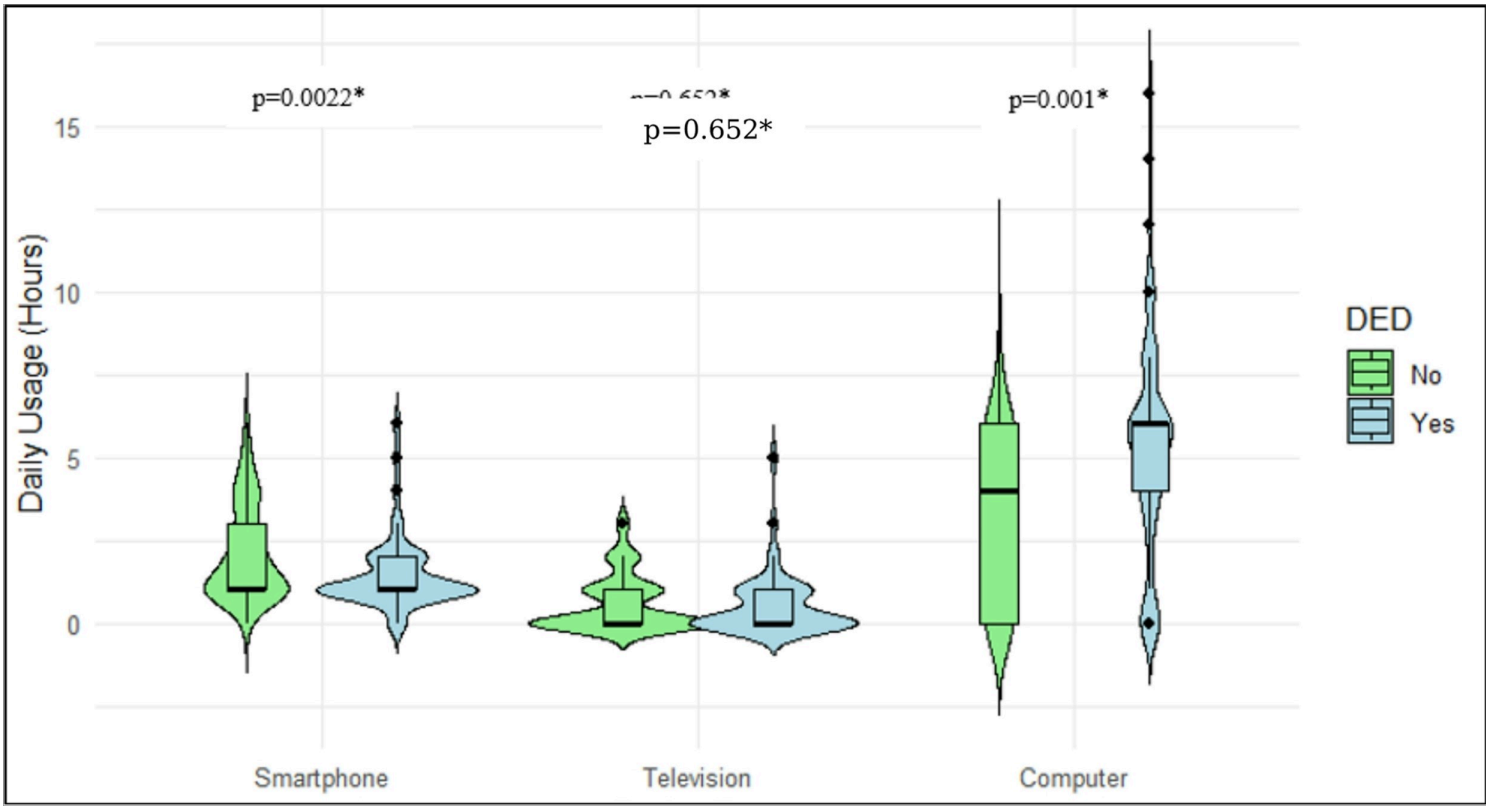


Figure 1

Different type screen use comparison with DED

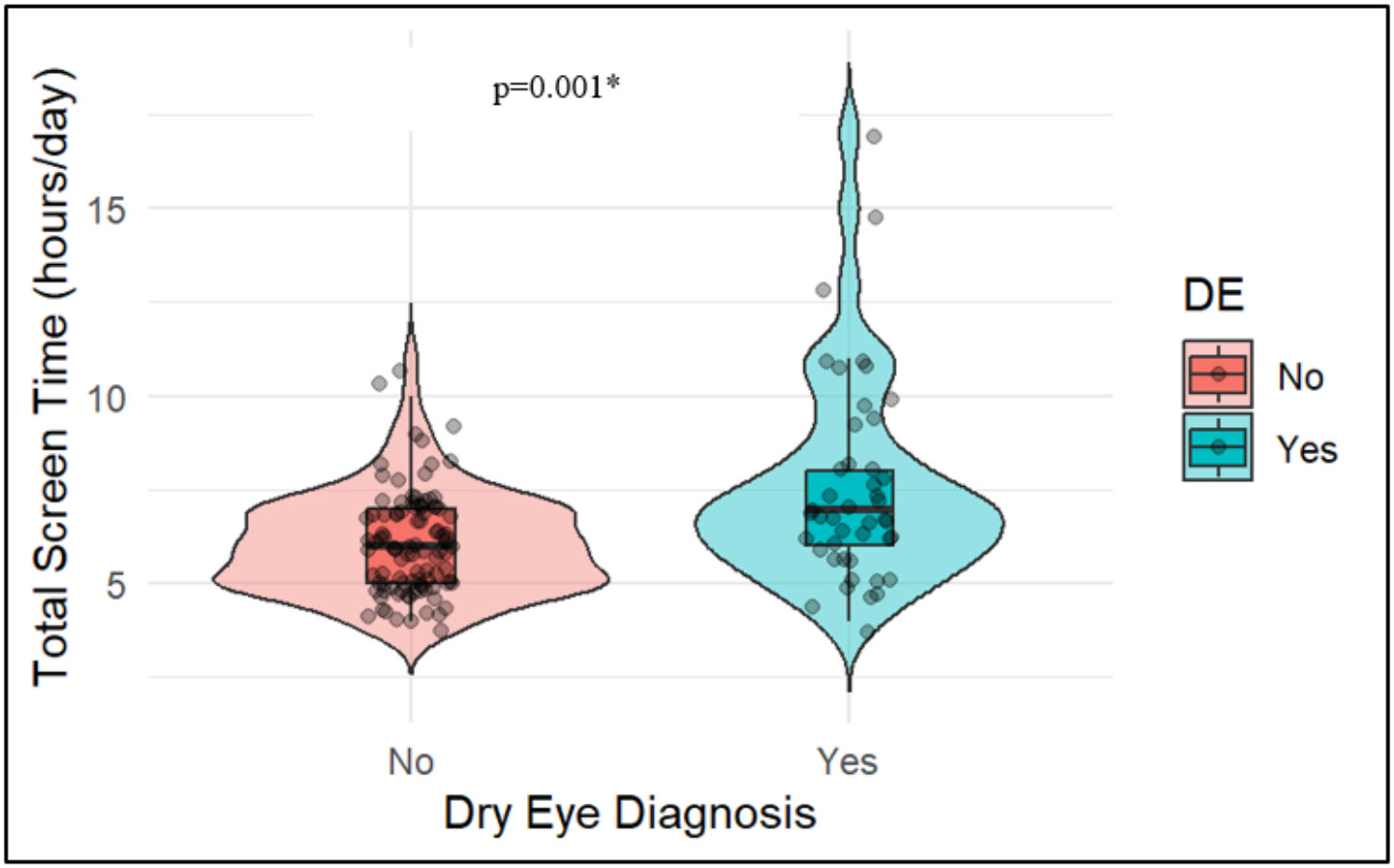


Figure 2

Total Screen Time Distribution by DED