

Original Research Report

SCREEN TIME AND DRY EYE DISEASE DURING DISTANCE LEARNING AMONG THE CLASS OF 2019 MEDICAL STUDENTS AT A UNIVERSITY IN JAKARTA, INDONESIA

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ABSTRACT

Dry eye disease (DED), also known as dry-eye syndrome, is commonly caused by a lack of tears or excessive evaporation. It affects 334 million people worldwide. According to global epidemiological research, the DED prevalence in adults and the elderly is roughly 5-50%. Research has revealed that DED prevalence and epidemiology are more typically connected to aging. However, extended exposure to digital screens is an external DED risk factor to be aware of, especially in this digital technology era and amidst the COVID-19 pandemic. These two situations are expected to increase the number of DED sufferers in the younger age groups, such as elementary, high school, and university students. The ongoing COVID-19 pandemic has compelled a shift in learning and teaching methods in order for education to proceed. However, the digitization era and the COVID-19 pandemic can double the DED risk, particularly among medical students. This study's objective was to determine how remote learning affected DED prevalence among the class of 2019 medical students at Universitas Tarumanagara, Jakarta, Indonesia, in the COVID-19 pandemic. Data were collected from 144 respondents using a Google Forms questionnaire. According to the statistical test results, there was a 2.4-fold increase in screen time during the COVID-19 pandemic compared to the pre-pandemic period. The results demonstrated a significant relationship between screen time and DED among the class of 2019 medical students at Universitas Tarumanagara. These findings are predicted to be of interest to academics and students, as their frequent engagement with computer displays and smartphones will continue to increase due to technological advancements. Furthermore, researchers may use the findings as a reference in conducting DED-related research.

Keywords: Dry eye disease (DED); technology; COVID-19; healthy eyes; human and health

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Highlights:

1. There is a correlation between screen time and dry eye disease among medical students due to distance learning during the pandemic.
2. This study's findings can lead researchers to conduct further studies to investigate and prevent DED.

INTRODUCTION

Dry eye disease (DED), often known as dry eye syndrome, is a condition caused by a lack of fluid in the eyes or excessive evaporation. This condition affects around 334 million people around the world (Favero et al. 2021, Agarwal et al. 2021). According to global epidemiological research, the DED prevalence among adults and the elderly ranges between 5% and 50% (Stapleton et al. 2017). In

the age of cutting-edge digital technology and the COVID-19 pandemic, prolonged exposure to digital screens is a risk factor that must be monitored in order to prevent DED. Internet connectivity, cellphones, tablets, and other similar technology have made life more convenient (Mehra & Galor 2020). The convenience offered by technology leads users to spend more time glued to their digital devices. It increases the DED prevalence in the younger generation, such as

school-aged children and college students (Yazdani et al. 2019, Kawashima et al. 2020, Naderi et al. 2020).

The present COVID-19 pandemic has forced changes to teaching and learning approaches in order to maintain the continuity of the educational process (Cartes et al. 2022). Face-to-face learning has been substituted for distance learning or fully online learning, which has its own set of mental and physical health consequences, such as digital eye strain from prolonged computer and smartphone use (Sheppard & Wolffsohn 2018, Khariri et al. 2022). A study found that studying in front of a computer screen for more than three hours increases the risk of developing DED (Thun-Hohenstein et al. 2021). Medical students are at a higher risk of exposure due to the heavy workload from online lectures, discussions, case discussions, paper writing, journal searches, and e-book learning (Albert 2020, Cartes et al. 2022). The digitization era, as well as the ongoing COVID-19 situation, can increase the double risk of DED, particularly among medical students (Usgaonkar et al. 2021, Ardyan et al. 2021). This study examined the association between distance learning and the risk of DED among students at the Faculty of Medicine, Universitas Tarumanagara, Jakarta, Indonesia. The findings of this study may be useful for academics and students, whose use of computer screens and smartphones continues to grow as technology advances. Future clinical investigations evaluating the relationship between DED and screen time are expected to support the findings of this study.

MATERIALS AND METHODS

This study employed a cross-sectional study design. A two-week online survey through Google Forms was provided, which included demographics, health conditions, medical history, the Ocular Surface Disease Index (OSDI), and screen time before and during the pandemic. The participants in this study were the class of 2019 students at the Faculty of Medicine, Universitas Tarumanagara, Jakarta, Indonesia. The sample size for this study was determined using a single sample proportion formula, and 123 students were necessary. Data were acquired from the students who were engaged in distance learning activities and willing to participate in this research by filling out the questionnaires. Exclusion criteria for this study were students from the class of 2019 at the Faculty of Medicine, Universitas Tarumanagara, who had been diagnosed with autoimmune diseases (such as Sjogren's syndrome, rheumatoid arthritis, sarcoidosis, Bell's palsy, diabetes, and thyroid disorders) or who were taking antihistamines, beta-blockers, decongestants, diuretics, selective

serotonin reuptake inhibitors (SSRIs), anxiolytics, tricyclic antidepressants, antipsychotics, and oral isotretinoin for more than three months.

The change in screen time for distance learning was the independent variable of this study, while DED was the dependent variable. The Shapiro-Wilk test was used to assess data normality with a significance value (p) of 0.05, and the Chi-square test was used to determine independence or correlation (Razali & Wah 2011, McHugh 2013). The class of 2019 students of the Faculty of Medicine, Universitas Tarumanagara, consented to the publication of this study.

RESULTS

In the span of two weeks, 154 medical students completed the questionnaires and agreed to be research respondents. At the data cleaning stage, there were 10 students who had regularly consumed drugs in the previous three months that could have interfered with the objectivity of the study, including 7 students (70%) consuming anti-histamines, a student (10%) consuming anti-depressants, a student (10%) consuming anti-histamines and anti-psychotics, and a student (10%) consuming anti-depressants and antipsychotics. After excluding the ten students, the number of participants who met the inclusion criteria was 144, with 70.8% being females (n=102) and 29.2% being males (n=42).

Table 1. Characteristics of respondents according to the completed questionnaires.

Characteristics	Frequency (n)	%
Sex		
Male	42	29.2
Female	102	70.8
Screen time before the pandemic		
<1 h	1	0.7
1-4 h	36	25.0
4-8 h	68	47.2
8-12 h	27	18.8
>12 h	12	8.3
Screen time after the pandemic		
<1 h	1	0.7
1-4 h	10	6.9
4-8 h	33	22.9
8-12 h	71	49.3
>12 h	29	20.1

As seen in Table 1, there had been an increase in the amount of screen time during the COVID-19 pandemic. Prior to the pandemic, the majority of respondents (47.2%) spent 4-8 hours in front of a screen, with the second majority (25%) spending 1-4 hours. During the pandemic, the majority of the

respondents increased their screen time from 4-8 hours (22.9%) to 8-12 hours (49.3%). The proportion of respondents with 8-12 hours of screen time surged 2.6 times, while the proportion with more than 12 hours of screen time increased 2.4 times. The distribution of less than an hour of screen time per day was only 0.7%, with a minimum ratio to other screen time groups.

Table 2. Categorization of dry eye severity among the respondents based on the screen time groups.

Characteristics	Category of dry eye severity n (%)				Total
	Normal	Mild	Moderate	Severe	
Sex					
Male	35 (83.3)	4 (9.5)	2 (4.8)	1 (2.4)	42
Female	66 (64.7)	29 (28.4)	5 (4.9)	2 (2.0)	102
Screen time before the pandemic					
1-4 h	29 (78.3)	7 (19.0)	0 (0.0)	1 (2.7)	37
4-8 h	51 (75.0)	11 (16.2)	4 (5.9)	2 (2.9)	68
8-12 h	16 (59.3)	9 (33.3)	2 (7.4)	0 (0.0)	27
>12 h	5 (41.7)	6 (50.0)	1 (8.3)	0 (0.0)	12
Screen time during the pandemic					
1-4 h	10 (91.0)	1 (9.0)	0 (0.0)	0 (0.0)	11
4-8 h	26 (78.8)	5 (15.2)	1 (3.0)	1 (3.0)	33
8-12 h	50 (70.4)	15 (21.1)	5 (7.0)	1 (1.4)	71
>12 h	15 (51.7)	12 (41.4)	1 (3.4)	1 (3.4)	29

Table 1 summarizes the characteristics of the respondents, while Table 2 categorizes the severity of dry eye based on the reported symptoms. The female respondents were more likely experience dry eyes (35.3%) than male respondents (16.7%). Furthermore, both before and during the COVID-19 pandemic, there was a propensity for increasing dry eye symptoms, which worsened with increased screen time.

Table 3. Data normality test of the OSDI scores based on the screentime groups.

Category	Screen time			
	Before the pandemic		After the pandemic	
	p-value	Conclusion	p-value	Conclusion
1-4 h	0.004	Abnormal	0.000	Abnormal
4-8 h	0.000	Abnormal	0.000	Abnormal
8-12 h	0.000	Abnormal	0.017	Abnormal
>12 h	0.048	Abnormal	0.050	Abnormal

p: Significance

The first analysis of the Ocular Surface Disease Index (OSDI) was performed to compare dry eye disease over various screen time groups. The OSDI score comparison started with a data normality test in each screen time. The Shapiro-Wilk normality

test (observation of <30 per group) revealed an abnormal distribution (p<0.05), as seen in Table 3. Finally, a comparative analysis using the Kruskal-Wallis test was performed and described in Table 4. There were significant differences in the mean and median OSDI scores (p<0.05) among the four screen time groups during the COVID-19 pandemic (Table 3). Conversely, there was no significant difference in the mean and median OSDI scores for the four screen time groups prior to the pandemic (p>0.05).

Table 4. Comparative test of the OSDI scores based on the screentime groups.

Category	Screen time			
	Before the pandemic*		During the pandemic**	
	Average±SD	Median	Average±SD	Median
1-4 h	7.3±8.4	5.0	4.3±5.1	3.0
4-8 h	9.0±8.1	7.0	7.6±8.8	6.0
8-12 h	10.4±8.2	7.0	9.7±8.8	8.0
>12 h	12.3±7.5	14.0	11.2±8.6	9.0

SD: Standard deviation; *p=0.11; **p=0.02; p: Significance; p=0.05

The second analysis included a Chi-square test of independence with categorical variables and a correlation test, as depicted in Table 5. This analysis was performed by reclassifying normal and dry eye conditions. The screen times were classified as <8 hours, 8-12 hours, and >12 hours groups due to some 0 observations in the other screen time group. Furthermore, the results of the correlation test revealed that screen time had a significant effect on the incidence of dry eye before and during the pandemic.

Table 5. Correlation of screen time with the respondents' eye conditions.

Screen time	Eye conditions based on the OSDI scores		p
	Normal n (%)	Dry n (%)	
Before the pandemic			
<8 h	80 (76.1)	25 (23.9)	0.04
8-12 h	16 (59.2)	11 (40.8)	
>12 h	5 (53.4)	7 (46.4)	
During the pandemic			
<8 h	36 (82.0)	8 (18.0)	0.02
8-12 h	20 (48.7)	21 (51.3)	
>12 h	15 (51.7)	14 (48.3)	

DISCUSSION

A study by Sheppard & Wolffsohn (2018) found that sitting in front of a computer screen for more than three hours raised the risk of DED considerably. The findings are also consistent with a study conducted by Cartes et al. (2022) on the

association between screen time and dry eye symptoms among 1,450 university students during the COVID-19 epidemic. They also mentioned a considerable rise in average screen time prior to and after the pandemic (9.8 hours vs. 15.9 hours, respectively). Most countries, including Indonesia, implemented widescale isolation, quarantine, and social restrictions when the World Health Organization (WHO) declared the COVID-19 pandemic (Bulut & Kato 2020, Adam et al. 2021). When lockdown policies were implemented in many countries, increased screen time and a lack of outdoor activity led to an increase in myopia prevalence (Savitri et al. 2022).

To boost productivity, several methods of working and studying at home have been proposed, including fully online or remote learning, lecturing, and working (Bahkir & Grandee 2020, Sievertsen & Burgess 2020, Adam et al. 2021). The implementation of these learning methods mostly involves video display terminals, which require extensive close-up work and may predispose to DED among workers and students (Hasanah et al. 2017, Bahkir & Grandee 2020, Loebis et al. 2021). Continuously using digital terminals for long periods of time, especially without intermittent breaks, has been demonstrated to impair eye health and induce discomfort by disrupting tear stability and creating mild inflammation (Latkany et al. 2014). Furthermore, excessive screen time can result in accommodative dysfunction and divergence responses (Yuan et al. 2021).

In this study, the prevalence of dry eyes was 29.8%. This number was quite low when compared to recent studies evaluating the OSDI scores. Condori et al. (2021) discovered that 70.6% of university students in Peru had symptomatic dry eyes. In comparison, Alkabbani et al. (2021) discovered a 62.6% prevalence of dry eyes among university students in Dubai. Another study on college students showed a high prevalence of computer vision syndrome, but it could improve with the administration of sodium hyaluronate (Zulkarnain et al. 2022). However, because DED is a complex disorder that includes environmental factors, differences in climate and humidity in each research region may have an effect (Madden et al. 2013, Tesón et al. 2013).

The results of this study suggested that the female respondents had a higher prevalence of dry eyes than the male respondents. Cartes et al (2022) and Supiyaphun et al (2021) also similarly argued that female students more typically experienced dry eye symptoms ($p < 0.05$). Several female-predominant factors, such as contact lens use, were identified in addition to hormonal factors that played a role in the development of dry eyes. The comparison and

correlation test results demonstrated that screen time was related to the occurrence of dry eye symptoms, particularly during the COVID-19 pandemic ($p < 0.05$).

These findings are consistent with the majority of studies on the association between screen time and dry eyes among college students. Cartes et al. (2022), Condori et al. (2021), Alkabbani et al. (2021), and Supiyaphun et al. (2021) were some of the researchers who discovered that screen time was related to the occurrence and severity of dry eyes. Tear hyperosmolarity, also known as tear film instability, significantly contributes to DED. A reduced blink reflex has been recognized as a risk factor for tear hyperosmolarity in computer users (Talens-Estarells et al. 2021). Sánchez-Valerio et al. (2020) emphasized that electronic devices do not cause organic damage but rather influence the emergence of exhaustion or asthenic symptoms when misused or utilized for an extended period of time. Prolonged use of electronic devices can also cause a decrease in blinking, lacrimal gland changes, sensorineural damage, and a hindered distribution of adequate tear film lipid layers. DED, ocular surface injury, and eyelid disruption may emerge as a result of these conditions.

Strength and limitations

This research could be beneficial to academics and students since it provides an observation on the occurrence of DED due to prolonged electronic device use during the pandemic. However, the sample size of this study was rather small compared to other studies that investigated a larger population. Future research can be conducted based on the findings of this study in order to investigate DED among college students on a larger scale and to prevent its prevalence.

CONCLUSION

During the pandemic, there was a higher propensity for medical students to spend more time in front of screens. Dry eye disease (DED) became prevalent among the class of 2019 students at the Faculty of Medicine, Universitas Tarumanagara, Jakarta, Indonesia, due to prolonged electronic device usage during distance learning. Screen time was found to be related to the occurrence of dry eyes among the students.

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Conflict of interest

None.

Ethical consideration

The study was ethically approved by the Research and Community Service Unit of the Faculty of Medicine, Universitas Tarumanagara, Jakarta, Indonesia, with the approval letter no. 170/KEPK/UPPM/FK UNTAR/XI/2021 on 29/11/2021.

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Author contribution

KB conceptualized the study and methodology, conducted the investigation and formal analysis, and drafted the initial manuscript. MR validated and supervised the study, reviewed and edited the manuscript, curated the data, provided resources, and managed the project administration.

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