ORIGINAL ARTICLE

Examining The Correlation Between Screen Time, Mental Health, and Dry Eye Syndrome Among Undergraduate Students at KAHS

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ABSTRACT

Background: Prolonged screen time among university students has been linked to dry eye syndrome (DES) and mental health challenges. This study examined the correlations between screen time, depression, and DES among undergraduate students at the Kuliyyah of Allied Health Sciences (KAHS), International Islamic University Malaysia (IIUM). **Methods:** A cross-sectional study of 90 students (aged 19–24 years) used validated instruments, the Screen Time Questionnaire (STQ), Patient Health Questionnaire-9 (PHQ-9), and Dry Eye-related Quality of Life Score (DEQS). **Results:** Median daily screen time was 4.2 hours, with moderate depressive symptoms (median PHQ-9 = 6) and DES impact (median DEQS = 21). Depression and DES showed a strong positive correlation (r = 0.508, $p < 0.001$), while screen time (STQ) did not correlate significantly with either. **Conclusion:** Depressive symptoms were strongly related to DES severity, suggesting psychological health should be considered in managing ocular surface complaints among students.

Keywords:
Screen time; mental health; dry eye syndrome; undergraduate students

INTRODUCTION

Prolonged screen time has been increasingly associated with adverse physical and mental health outcomes, including stress, anxiety, and depression (Twenge & Campbell, 2018). Among university students, excessive digital device use can lead to emotional distress, cognitive fatigue, and reduced physical activity (Rosenfield et al., 2011). Moreover, disturbed sleep patterns and social isolation contribute to poor psychological well-being (Rosenfield et al., 2011; Nakshine et al., 2022)

Beyond mental health implications, extended screen exposure is a well-established risk factor for dry eye syndrome (DES), a multifactorial ocular surface disorder characterised by tear film instability and discomfort (Sheppard & Wolffsohn, 2018). Digital eye strain, a common condition among heavy screen users, often coexists with DES symptoms (Coles-Brennan et al., 2018). University students are particularly vulnerable because their learning activities heavily depend on digital platforms.

Given the increased digital dependence in higher education, there is a pressing need to understand how screen time affects both mental and ocular health. This study aimed to investigate the relationships between screen time, depressive symptoms, and DES among KAHS undergraduate students at IIUM. The findings aim to provide evidence to guide preventive and management strategies for students in digital-intensive environments.

MATERIALS AND METHODS

Study Design

This cross-sectional study adhered to the Declaration of Helsinki and received ethical approval from the IIUM Research Ethics Committee (IREC 2023-KAHS/DOVS3). It

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investigated the relationship between screen time, mental health, and DES among undergraduate students at KAHS, IIUM. Data was collected at the IIUM Optometry Clinic to ensure standardised assessments.

The sample size was determined using GPower (version 3.1.9.2) (Faul et al., 2009), with an estimated effect size derived from prior DES prevalence studies ($\alpha = 0.05$, power = 0.80). The analysis indicated that this study required 84 participants; to account for attrition, 90 students (13 males, 77 females) were enrolled. All participants provided written informed consent after a comprehensive study briefing.

The participant cohort was recruited through convenience sampling (Golzar et al., 2022), a strategy deemed appropriate given the study's exploratory and correlational design, the accessibility of the target KAHS student population, and the practical constraints of time and resources. This methodological alignment is consistent with precedents in similar health science research (Etikan, Musa, & Alkassim, 2016). To promote sample homogeneity and mitigate confounding variables, stringent inclusion and exclusion criteria were implemented. A recognised limitation of this sampling method is its inherent vulnerability to selection bias, as volunteers may systematically differ from non-participants in characteristics such as motivation, screen-time behaviours, or health awareness. Therefore, the findings should be interpreted with caution, and their generalisability is likely confined to student populations with comparable demographics. Inclusion criteria mandated that participants be KAHS undergraduates aged 19–24 years in good systemic health, with no history of refractive surgery and visual acuity of 6/6 or better. Exclusion criteria eliminated individuals outside the specified age range, non-KAHS students, those with active systemic or ocular conditions, users of medications affecting ocular or mental health (e.g., antihistamines or antidepressants), and individuals with a history of refractive surgery or visual acuity worse than 6/6. The age restriction was controlled for developmental variability in DES susceptibility, while excluding post-refractive surgery patients minimised confounding effects on tear film stability. Visual acuity requirements ensured participants could engage with digital screens without visual-related strain, thereby isolating screen time effects more precisely.

Data Collection

All 90 participants were informed about the study and provided written consent prior to their participation. They were then asked a series of questions to gather background information and ensure they met the inclusion criteria. Objective refraction using dry retinoscopy and subjective refraction was performed to determine each participant's refractive error. Data collection employed standardised instruments to ensure reliability and validity. These included the 18-item Screen Time Questionnaire (STQ) (Carson et al., 2016; Vizcaino et al., 2019), the Patient Health Questionnaire-9 (PHQ-9) (Kroenke, Spitzer, & Williams, 2001), and the Dry Eye-Related Quality of Life Questionnaire (DEQS) (Uchino et al., 2013).

The 18-item STQ was selected to evaluate screen use across various digital devices, including smartphones, tablets, computers, and TVs. It captures both duration and context of use (academic, recreational, or social), considering weekday and weekend patterns. The STQ has demonstrated strong psychometric properties, including construct validity, test-retest reliability, and internal consistency (Carson et al., 2016). It has been validated among children, adolescents, and adults, making it suitable for use across all age groups. The questionnaire's multidimensional design was used to identify trends linked to visual symptoms, sleep disturbances, and overall well-being. Test-retest reliability has been demonstrated with ICCs ranging from 0.67 to 0.88 (Carson et al., 2016). The STQ improves on older tools by including device-specific and contextual data, enhancing the ecological validity of digital behaviour measurement (Carson et al., 2016). Using a validated tool like the STQ ensures systematic and comparable data collection. Its relevance to contemporary screen habits makes it appropriate for studies examining the health impact of digital behaviour.

The PHQ-9 was selected for this study due to its strong psychometric properties, including high validity and reliability in assessing depressive symptoms (Kroenke, Spitzer, & Williams, 2001). Developed as part of the PRIME-MD diagnostic tool, it includes nine items reflecting DSM-IV criteria for major depressive disorder, scored based on symptom frequency over the past two weeks. The PHQ-9 has demonstrated excellent internal consistency (Cronbach's alpha 0.86–0.89) and strong test-retest reliability. Sensitivity and specificity exceed 85% at the standard cutoff score of 10, supporting the clinical and research utility of this measure. Its brief, self-administered format makes it practical for mental health screening in diverse populations. The PHQ-9's minimal burden, strong psychometric performance, and sensitivity to meaningful changes make it suitable for detecting at-risk individuals and monitoring mental health status in academic or clinical settings.

The DEQS questionnaire was chosen for this study due to its established reliability, validity, and sensitivity in

evaluating the impact of dry eye symptoms on quality of life (Uchino et al., 2013; Sakane et al., 2013). Developed specifically for dry eye patients, the DEQS assesses both symptom frequency and the resulting functional and emotional burden using a 15-item scale. Validation studies have demonstrated strong internal consistency (Cronbach's alpha = 0.88) and high test-retest reliability (ICC = 0.91), as well as good convergent validity with other dry eye symptom questionnaires and clinical indicators (Uchino et al., 2013). The DEQS also avoids significant floor and ceiling effects, supporting its suitability across varying levels of dry eye severity. The questionnaire's design allows for a single summary score ranging from 0 (no impact) to 100 (maximum impact), enabling clinicians and researchers to quantify subjective symptom burden with precision. Its ease of use, brief format, and robust psychometric profile make the DEQS particularly valuable for identifying individuals at risk and evaluating the effects of treatment or environmental factors on ocular surface-related quality of life.

Statistical Analysis

Data were analysed using SPSS software (Version 29; IBM Corp., Chicago, IL, USA). The Shapiro-Wilk test revealed non-normal distributions for all key variables, consistent with Ghasemi (2012) recommendations for small sample sizes, where the Shapiro-Wilk test is more powerful than the Kolmogorov-Smirnov test for detecting non-normality in small-to-moderate samples ($n < 200$), making it the preferred choice when sample sizes are below 100. Consequently, as suggested by Puth et al. (2015), Spearman's rank-order correlation (ρ) was employed to examine three primary relationships: (i) screen time (STQ) versus mental health (PHQ-9), (ii) screen time (STQ) versus dry eye syndrome (DEQS), and (iii) mental health (PHQ-9) versus dry eye syndrome (DEQS). Effect sizes were interpreted using Cohen (1988) criteria (0.1-0.3 = weak, 0.3-0.5 = moderate, >0.5 = strong), with statistical significance set at $p < 0.05$.

RESULTS

Demographic Information

A total of 90 participants were enrolled (females: n = 77; males: n = 13). The median age of participants was 21.0 years (IQR: 20.0–21.0; range: 19–24). When analyzed by gender, males had a median age of 20.0 years (IQR: 19.0–21.0), and females had a median age of 21.0 years (IQR: 20.0–21.0). Refractive error comparisons between right and left eyes also revealed no statistically significant differences (Wilcoxon signed-rank test, $p > 0.05$), thus, only right eye data were used for further analysis.

Table 1 provides the median (Q1, Q3) values for key parameters assessed in the study, both for the total sample (n = 90) and separately by gender (female: n = 77; male: n = 13).

Table 1: Median and interquartile range (IQR) of the investigated parameters for the participants and by gender

Parameters	Median (Q1, Q3)		
	Male (n=13)	Female (n=77)	Total (n=90)
Degree of Myopia, Spherical Equivalent (D)	−1.75 (−3.31, −0.18)	−1.38 (−2.50, −0.25)	−1.50 (−2.75, −0.25)
STQ (Total Score)	4.15 (3.25, 5.05)	4.25 (3.42, 5.07)	4.22 (3.37, 5.08)
PHQ-9 (Total Score)	5.50 (3.38, 7.63)	6.00 (3.25, 8.75)	6.00 (3.38, 8.63)
DEQS (%)	22.10 (14.45, 29.75)	20.84 (6.34, 35.34)	20.84 (6.47, 35.22)

Relationship between STQ and PHQ-9

Analysis revealed a weak, non-statistically significant positive correlation between STQ and PHQ-9 scores, r (88) = 0.116, p = 0.276, (Figure 1).

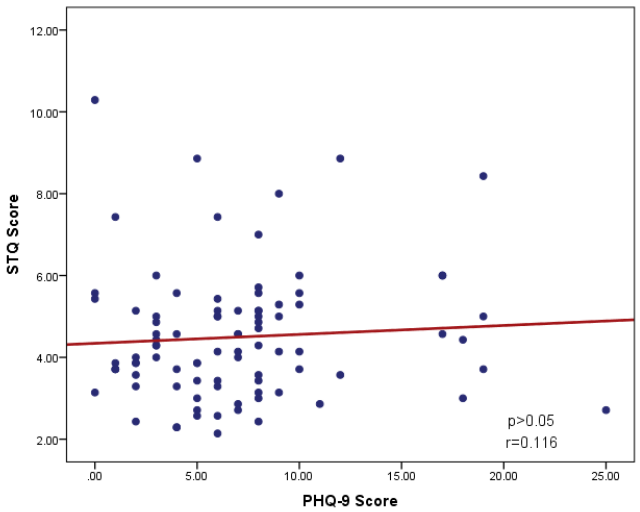

Figure 1: Scatter plot showing the correlation between STQ Score and PHQ-9 Score

Relationship between STQ and DEQS

There was a weak, non-statistically significant, positive correlation between STQ and DEQS scores, r (88) = 0.182, p = 0.085, (Figure 2).

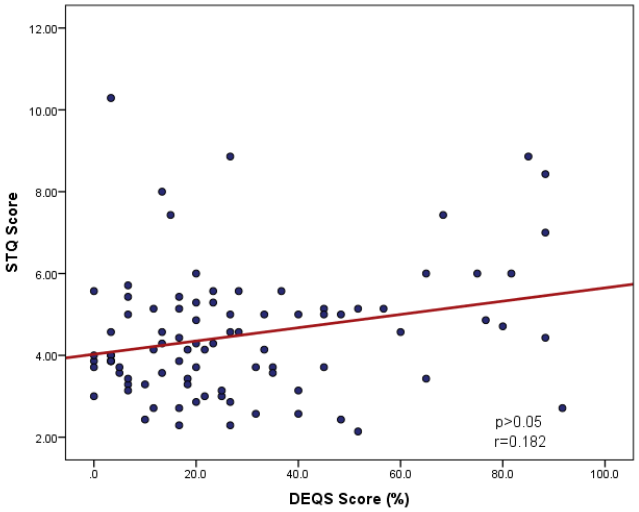

Figure 2: Scatter plot showing the correlation between STQ Score and DEQS Score (%)

Relationship between PHQ-9 and DEQS

A strong, statistically significant positive correlation was found between PHQ-9 and DEQS scores (r = 0.508, p < 0.001) (Figure 3). This indicates that higher depression scores were strongly associated with more severe dry eye symptoms. The effect size (r = 0.508) represents a strong and meaningful relationship, suggesting that depressive symptoms substantially contribute to the perceived impact of DES on quality of life, rather than this association being merely statistically significant (Cohen, 1988).

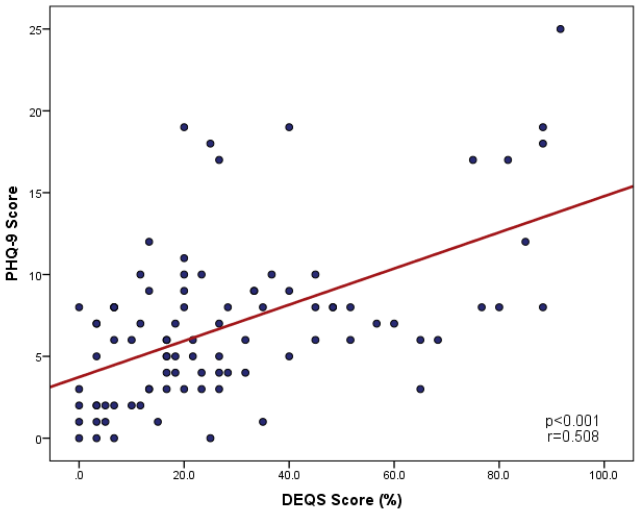

Figure 3: Scatter plot showing the correlation between PHQ-9 Score and DEQS Score (%)

DISCUSSION

This study examined the correlations between screen time (STQ), mental health (PHQ-9), and dry eye syndrome (DEQS) among undergraduate students at KAHS. The findings revealed several important relationships that contribute to our understanding of how digital device usage, psychological well-being, and ocular health interact in academic populations. Results showed no statistically significant correlation between the STQ and PHQ-9 (Figure 1) or between the STQ and DEQS (Figure 2). However, a statistically significant correlation was found between the PHQ-9 and DEQS (Figure 3). These results provided valuable insights while also raising questions about the complex interactions between these factors.

The absence of a significant correlation between screen time (STQ) and depressive symptoms (PHQ-9) contrasts with findings from previous studies that reported stronger associations between screen exposure and poor psychological well-being. For instance, Tang et al. (2021) and Wu et al., (2016) conducted a systematic review of longitudinal studies and found that higher recreational screen use was consistently linked with increased risks of depression among young people. Similarly, Twenge and Campbell (2018) observed that excessive screen time predicted lower psychological well-being in adolescents from population-based data. The divergence between those findings and the present study may be explained by contextual differences in screen-use behaviour. The current participants, who were health science students, predominantly used screens for academic rather than leisure purposes, which may involve more structured and purposeful engagement. Academic screen use has been associated with less emotional burden compared with passive or entertainment-based use (Lissak, 2018). Therefore, the educational nature of screen activity and heightened awareness of eye and mental health among KAHS students may have mitigated the adverse effects reported in general populations.

Similarly, the weak correlation between screen time and DES symptoms was somewhat surprising given the established literature on digital eye strain. Several factors may account for this finding. First, all participants had normal or corrected-to-normal visual acuity (6/6 or better), which may have provided some protection against screen-related ocular strain. Second, the average daily reported screen time (median, 4.22 hours; Table 1) was below the threshold associated with more severe DES symptoms reported in other studies. For example, Li et al. (2012) found a notable increase in DED symptoms in adults using digital devices for 6 hours or more daily. It is possible that health science students, being more aware of ocular

health, may unconsciously employ protective behaviours such as more frequent blinking or taking regular breaks from screens. Environmental factors not measured in this study, such as room lighting and humidity levels, might also have influenced these results.

The most significant finding was the strong positive correlation between depressive symptoms and DES (Figure 3). This aligns with growing evidence suggesting bidirectional relationships between mental health and ocular surface disorders. From a physiological perspective, stress and depression may affect tear production and ocular surface health through neurohormonal pathways (Zhang et al., 2019). Psychologically, the discomfort and visual disturbances associated with DES may contribute to increased stress and reduced quality of life, potentially exacerbating depressive symptoms (Ayaki et al., 2015). The moderate impact of DES on quality of life, as observed in our study with a median DEQS score of 20.84 (Table 1), supports this interpretation. These findings highlight the importance of considering psychological factors in the assessment and management of DES, particularly in student populations where academic pressures may compound these effects.

STUDY LIMITATIONS

This study had several limitations that should be carefully considered when interpreting the findings and applying them to broader contexts. First, the cross-sectional design limits the ability to establish causality between screen time, mental health, and dry eye syndrome. While associations can be observed, the temporal direction of these relationships remains unclear. Longitudinal studies or randomised controlled trials would be more appropriate for identifying temporal sequences and causal links (Levin, 2007).

Second, the use of self-reported instruments, namely the STQ, PHQ-9, and DEQS, introduced potential sources of information bias, such as recall bias and social desirability bias. Participants may have under- or overestimated their screen usage or symptoms either intentionally or unintentionally (Althubaiti, 2016). In addition, screen time data were not verified with objective digital tracking tools, which could have improved accuracy. Environmental and contextual factors, such as lighting conditions, air quality, and screen ergonomics, were also not assessed, although they are known to influence both mental health and ocular discomfort.

Another limitation is the relatively homogeneous demographic composition of the study sample, which consisted of undergraduate students from a single institution. Although participants came from a range of health science programs including optometry, dietetics, physiotherapy, radiology, audiology, speech therapy, and biomedical sciences, they shared somewhat similar academic pressures, age range, and institutional environment. This limited variability may reduce the external validity and generalizability of the findings to broader populations, such as those from different educational backgrounds, age groups, or individuals in varied occupational settings with diverse screen time behaviours and baseline health statuses (Bornstein et al., 2013).

Another demographic limitation was the gender imbalance among participants, with only 13 males and 77 females. Although gender was not a variable investigated in this study, this disproportion may affect the representativeness of the findings and should be considered in future research designs.

Additionally, this study relied solely on questionnaire-based screening tools without incorporating actual, measurable clinical diagnostics. Although the PHQ-9 and DEQS are widely validated and used in research and screening settings, they do not replace structured clinical interviews or comprehensive eye examinations, which can yield a more accurate diagnosis of depression or dry eye disease (Kroenke et al., 2001; Uchino et al., 2013; Okumura et al., 2020). The absence of such clinical evaluations limits the precision of symptom classification.

RECOMMENDATIONS FOR FUTURE RESEARCH

Future research should consider adopting a longitudinal design to establish causal relationships between screen time, mental health, and dry eye syndrome. Tracking participants over time would provide valuable insight into the direction and persistence of these associations. Expanding the study population to include students from multiple institutions and diverse academic disciplines would also enhance the generalisability of the findings. In addition, future studies could address current methodological limitations through practical improvements. The use of objective digital tracking applications on smartphones or computers could provide more accurate measures of screen exposure, thereby reducing recall bias that is often associated with self-reported questionnaires (Lin et al., 2016). Incorporating clinical eye examinations, such as Schirmer's test, tear breakup time, and ocular surface staining, would allow researchers to confirm questionnaire-based findings and strengthen the diagnostic validity of dry eye assessments (Stapleton et al., 2017). Finally, recruiting larger and more diverse samples would increase statistical power and allow

meaningful subgroup analyses, thereby advancing understanding of how digital behaviour influences ocular and psychological health.

CONCLUSION

In conclusion, depressive symptoms were strongly associated with the severity of dry eye symptoms, whereas screen time alone did not show a significant relationship with either variable. These findings highlight the close interaction between psychological and ocular health among students. Eye care professionals should consider screening for stress or depression when treating students with dry eye complaints, as addressing underlying mental health factors may improve overall management outcomes. Educators can play a preventive role by encouraging students to take regular screen breaks and practise good visual ergonomics during prolonged digital tasks. Together, these approaches can help protect both ocular comfort and mental well-being in academic environments that demand extensive screen use.

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