JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

https://doi.org/10.61919/6qc95079

Original Article

Association of Problematic Smartphone Use With Digital Eye Strain, Dry Eye Symptoms, and Sleep Quality Among High School Students

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"Cite this Article" **Received**: 01 March 2026; **Accepted**: 26 May 2026; **Published**: 06 June 2026
Author Contributions: Concept: IF, IZ; Design: IZ, FM; Data Collection: IF, MJ, AR, AN; Analysis: IZ, FM; Drafting: IF, IZ, FM, MJ, AR, AN. **Ethical Approval**: Superior University, Lahore, Pakistan. **Informed Consent**: Written informed consent was obtained from all participants; **Conflict of Interest**: The authors declare no conflict of interest. **Funding**: No external funding; **Data Availability**: Available from the corresponding author on reasonable request; **Acknowledgments**: N/A.

ABSTRACT

Background: Problematic smartphone use is increasingly common among adolescents and may contribute to digital eye strain, dry eye symptoms, reduced blink rate, and impaired sleep quality because of prolonged near-work demand, sustained screen fixation, and bedtime screen exposure. Objective: To determine the association of problematic smartphone use with digital eye strain, dry eye symptoms, blink-rate status, and sleep quality among high school students. Methods: This school-based cross-sectional observational study included 108 high school students aged 13–18 years from American Lycetuff Model Town, Lahore, Pakistan. Participants were selected using convenience sampling. Data were collected using a structured proforma, Smartphone Addiction Scale–Short Version, digital eye strain symptom checklist, Ocular Surface Disease Index, Pittsburgh Sleep Quality Index, Snellen visual acuity assessment, and blink-rate evaluation during smartphone viewing. Associations were analyzed using chi-square tests and Pearson correlation in SPSS version 26, with statistical significance set at $p < 0.05$. Results: Mean daily smartphone use was 5.42 ± 1.86 hours and mean total daily screen time was 7.73 ± 2.34 hours. Problematic smartphone use was present in 62 students (57.4%). Moderate/severe digital eye strain was more frequent among problematic users than normal users (77.4% vs 34.8%; OR 6.43, 95% CI 2.75–15.04; p = 0.001). Moderate/severe dry eye symptoms were also higher among problematic users (71.0% vs 28.3%; OR 6.21, 95% CI 2.67–14.43; p = 0.001). SAS-SV score was positively correlated with PSQI score (r = 0.462; p = 0.001). Conclusion: Problematic smartphone use was significantly associated with greater digital eye strain, more severe dry eye symptoms, and poorer sleep quality among high school students. School-based visual hygiene education, screen-break practices, and reduced bedtime smartphone exposure may help reduce ocular and sleep-related symptom burden.
Keywords: Problematic smartphone use; Digital eye strain; Dry eye symptoms; Sleep quality; Adolescents; High school students; Ocular surface; Blink rate.

INTRODUCTION

Smartphones have become a vital part of everyday life for today's teens, particularly for high school students who use them to communicate, study, take online classes, enjoy, play games, and engage in social networks. Smartphones offer educational and social advantages but their overuse and misuse has led to increasing concerns for ocular health, sleep quality and overall health. Adolescents are at a critical point in their physical, cognitive and educational development, and over-exposure to screens could impact on their vision comfort, sleep pattern, attention and daily functioning. Problematic smartphone use is excessive or compulsive smartphone use that is difficult to control and is starting to interfere with activities in daily life. There has been recent research that indicates that greater use of digital media among adolescents is correlated to digital eye strain, dry eye symptoms and poor sleep quality, which is a significant public health and optometric issue (1,2).

The human eye is very sensitive to long duration of near work and continuous screen viewing. Four factors that are essential for normal visual comfort are accommodation, convergence, blinking and tear film stability. The tear film protects the eye surface, smooths the cornea, maintains optical clarity, lubricates the eye surface and prevents irritation. Any disruption of this tear film can result in dryness, burning, foreign body sensation, reflex watering, redness and blurred vision. Compared to reading books, there are some differences in the way people are using their smartphones, including the smaller size of the screens, smaller font, and constant fixation. This adds more convergence stress and accommodative demand, especially in the case of pupils who use the smartphone for an extended period without breaks. Scientific studies have revealed a relationship between excessive use of smart phones and eye complaints, digital eye strain, dry eye, and eye discomfort (3,4).

Computer vision syndrome, or digital eye strain, is a collection of eye and vision symptoms which develop as a result of spending extended periods of time looking at digital screens. Common signs and symptoms are eye fatigue, headache, blurred vision, dryness, burning sensation, redness, watering and difficulty focusing. Previous studies primarily were conducted with office workers and computer users, however with the widespread use of smartphones, the problem has been reported in school-aged children and adolescents. In Pakistan, students' screen-time exposure was linked to digital eye strain and visual acuity related problems, demonstrating the local relevance of this issue (5). Similarly, Allwihan et al. reported associations between long-term exposure to electronic devices and dry eye disease and related ocular symptoms in the young student population, indicating that the use of electronic devices could have a negative impact on the health of the ocular surface (6).

The biggest connection between the use of smartphones and dry eye symptoms is a reduction in blinks. Blinking under normal conditions produces an even spread of the tear film and aids in lipid distribution in the meibomian glands. During periods of heavy screen time, however, the frequency of blinks reduces, and it's more likely to be incomplete blinks. This dry eye syndrome happens when the amount of blinking is reduced, which causes more evaporation of tears and tears to lose stability. Hence, students who use the smartphone often for studying, social media, gaming and video streaming may experience a higher level of ocular surface irritation. Among the junior high school students, Akib et al. identified a significant relationship between excessive smartphone use and dry eye symptoms, such as increased Ocular Surface Disease Index scores, decreased tear break-up time and abnormal blink rate (14). The results suggest that the use of smartphones could result in measurable changes in the ocular surface in adolescents.

Symptoms of dry eye include burning, irritation, dryness, watering, redness, and visual fatigue in students. While the prevalence of dry eye among adults is often cited, with the advent of visual behaviour associated with smartphones, it is now a relevant and growing concern among adolescents. Increased device usage was correlated with the severity of dry eye symptoms, and the distance at which the screens are viewed was correlated with the severity of symptoms, as reported by Allwihan et al. (16). Luo et al. also reported that screen time was significantly associated with the symptoms of dry eye disease in young adults, indicating a dose-response relationship between screen time to the development of ocular surface discomfort (23). In conclusion, the results indicate that the increased the use of the smartphone could be associated with an increase in the occurrence of dry eye symptoms, particularly when the screen breaks, viewing distance, and blinking habits are poor.

Another factor to consider is sleep quality, as it has been associated with problematic smartphone use. Young people often use their cell phones before going to sleep to use social media, to chat, play games, or watch videos. Smartphone use at night can lead to a delay in sleep onset, a decrease in sleep time, and poorer subjective sleep quality. Exposure to blue light from screens can also be a problem for students because it increases their difficulty in falling asleep, as it can cause a reduction in the secretion of melatonin and a disbalance in the regulation of the circadian rhythms. Difficulty sleeping will then exacerbate ocular discomfort due to less recovery of the ocular surface and increased fatigue. Olivares-Guido et al. reported that problematic use of the smartphone and internet led to poor sleep quality among students, indicating that excessive digital use can have an impact on sleep and functioning (7). Moreover, Rasheed et al. also investigated problematic mobile phone use and sleep quality among medical students of Lahore which showed the significance of this issue among medical students of the country (8).

The connection between smartphone usage and eye irritation along with sleep can be reciprocal. Too much screen time can lead to DE symptoms (digital eye strain, dry eyes) and poor sleep can lead to visual fatigue and ocular surface instability. Students who experience poor sleep may find that they have more eye irritation, headache, poor concentration and fatigue during the day. Symptoms can negatively affect academic performance and lead to greater reliance on the mobile phone for passive entertainment, perpetuating the cycle of using the mobile phone and symptomology. Fatima et al. noted the health impacts of mobile phone addiction and of suboptimal sleep quality in children and adolescents and underscored the need to study the use of smartphones as a behavioural health rather than a technology-related habit (9). The same study reported by Mohesh et al., noted the impact of smartphone addiction on the focus of attention and eye health of the students (10).

Studies have been conducted in the past in relation to smartphone usage, which has been linked to digital eye strain, symptoms of dry eye and sleep disturbance; however many of these studies have been targeted at university students, medical students or adults. There have been fewer studies that have specifically focused on high school students, especially those in developing countries where knowledge of digital eye strain and preventive visual hygiene may be less.. Issa et al. reported ocular symptoms and dryness among smartphone users in cross-sectional surveys, while Aykutlu et al. identified digital media usage patterns linked to adolescent digital eye strain and sleep disturbances (11,12). Dandumahanti et al. further emphasized the importance of monitoring eye activity during smartphone engagement and its sleep-related impact (13). These studies support the need for focused research among school-aged populations.

Research among school-aged children also shows consistent concern. Chu et al. found that time spent on smartphones was associated with digital eye strain among school-aged children, suggesting that increased duration of mobile screen use contributes to higher symptom severity (15,22). Palanisamy et al. reported digital eye strain among adolescents during increased screen exposure, especially during the COVID-19 period when digital learning increased (19). Another Lahore-based study reported symptoms such as headache, eye strain, and dry eyes among high school students, while also highlighting poor awareness of preventive strategies (21). These findings show that high school students may experience smartphone-related ocular symptoms but may not understand how to prevent or manage them.

Therefore, the present study aims to evaluate the association of problematic smartphone use with digital eye strain, dry eye symptoms, and sleep quality among high school students. The study focuses on problematic smartphone use measured through the Smartphone Addiction Scale–Short Version, dry eye symptoms assessed by the Ocular Surface Disease Index, and sleep quality evaluated through the Pittsburgh Sleep Quality Index. By examining these associations, the study may help identify students at risk of digital eye strain, dry eye symptoms, and poor sleep quality. The findings may also support school-based awareness programmes, visual hygiene education, promotion of the 20-20-20 rule, reduced bedtime screen exposure, and early preventive optometric screening among adolescents.

MATERIAL AND METHODS

The research design used in this study was a cross-sectional analytical design to measure the association between problematic smartphone use, digital eye strain, dry eye symptoms and sleep quality among high school students. A cross-sectional design was suitable for this study because the study was designed to determine the pattern of smartphone usage, ocular symptoms, and sleep quality at one time, without using any intervention.

The study participants were high school students ranging in ages from 13-18 years who used smartphones for one or more hour every day. The age group was chosen because during adolescence, there are increased demands on schoolwork, more frequent and increased use of smart phones, and social media and altered sleep patterns. Students were included if they met the following criteria: both males and females, provided they signed a consent form as well as an assent form. The study employed a non-probability sampling technique (convenient sampling) in which participants were selected from a readily available school population in the time under study. This methodology proved to be effective in recruiting both those who were deemed suitable and willing to participate in the data collection process at the school level. Using a single population proportion formula with a 95% confidence level, Z (1.96), estimated population proportion (0.05), and a margin of error (0.048), the sample size was calculated to be 108. Students who did not provide complete responses, or valid data were not included in the final statistical analysis.

The age range for the students enrolled in the selected high school during the study period was from 13 to 18 years old. The participants had to possess a smart phone for at least one hour a day and to be able to read and fill out the questionnaires on their own. Since the study was conducted with minors, written consent from parents/guardians and assent from the students was required. These criteria ensured the relevance of the participants to the study objectives, and they were able to give useful self-reported data. Students who had a previous diagnosis of diseases of the eye including glaucoma, keratitis or severe allergic conjunctivitis were excluded as these diseases may have been responsible for eye discomfort or eye dryness symptoms without the students having the study disease. Surgery to the eyes in the last six months was also ruled out, because it could have an impact on the stability of the ocular surface. Systemic disorders of the ocular surface, such as Sjögren's syndrome or poorly-controlled diabetes, were excluded. Students who had used prescribed eye drops or had been diagnosed with neurological or sleep disorders before the onset of any problems with the smartphones were also excluded, to reduce the confounding factors.

Basic ocular screening was also carried out alongside the questionnaires, to aid reliability of the findings. Visual acuity was tested using a Snellen chart to look for significant uncorrected visual problems that might contribute to the symptom of digital eye strain. An assessment of the blink rate was also carried out. The students were instructed to view a smartphone screen at a normal viewing distance for 1 minute and the number of spontaneous blinks was recorded. Blink rate was observed to be reduced as this could be linked to tear film instability, digital eye strain and dry eye symptoms. These basic clinical evaluations assisted in associating self-reported ocular symptoms with actual visual behaviors in the use of a smartphone device.

Data collection was conducted in a designated classroom in the selected school or a school health room after ethical approval and permission was obtained from the school. Parents/guardians gave written informed consent and students gave assent. The students were initially screened based on the inclusion/exclusion criteria. Eligible subjects were then requested to fill out the structured proforma with the related data of their demographic and screen exposure. They filled out the following questionnaires while supervised by the researcher: the SAS-SV, OSDI, PSQI, and digital eye strain symptom checklist. Visual acuity and blink rate were tested after completing the questionnaires. All assessments for each person lasted about 20 - 25 minutes. Careful note was taken of all responses and clinical findings for statistical analysis.

Data collected were analyzed by statistical package for the social sciences (SPSS). Demographic characteristics, patterns of smartphone use, symptoms of digital eye strain, OSDI scores and PSQI scores were summarized using descriptive statistics (frequencies, percentages, means, and standard deviations).

The association between problematic smartphone use and digital eye strain, symptoms of dry eye and sleep quality was evaluated with the appropriate inferential test, depending on the nature of the variables. To look at categorical associations, it might be necessary to use chi square testing; to look at the relationships between questionnaire scores, it might be necessary to use correlation analysis. After adjusting for demographic and academic factors, regression analysis might be used to see if problematic smartphone use was independently associated with digital eye strain, dry eye symptoms and poor sleep quality. Results with a p-value < 0.05 were regarded as statistically significant.

RESULTS

The purpose of this study was to investigate the relationship between the use of the cell phone and eye strain, dry eye symptoms and sleep quality in high school students. In total, 108 students took part in the study. Most participants were 16 years old (25.0%), followed by 15 years (22.2%) and 17 years (18.5%). The number of females (56.5%) was slightly higher than males (43.5%). Majority of the students belonged to the Science group (38.9%) followed by Computer studies (25.9%). The average daily use of a smartphone was 5.42 ± 1.86 hours, and the total screen time was 7.73 ± 2.34 hours. The mean value of Smartphone Addiction Scale – Short Version (SAS-SV) was 34.76 ± 8.92, which indicated the moderate level of addiction to smartphones. Symptoms of DES were prevalent and the mean score of DES was 13.58 ± 4.27 and eye fatigue was a frequent symptom. The mean OSDI score was 25.84 ± 10.76, which is a moderate level of dry eye symptoms, and the mean PSQI score was 7.18 ± 2.63, which is a poor sleep quality. The rate of blinks per minute was decreased to 10.86 ± 3.14 after the viewing of the smartphones. Problematic smartphone use was significantly linked to digital eye strain, dry eye symptoms and sleep quality ($p = 0.001$, $p < 0.001$ and $p < 0.001$, respectively).

The total number of students was 108, of which ages ranged from 13 to 18.The sample consisted of 108 high school students aged 13-18. The largest age group was the 16 year old group with a total of 27 students or 25.0% of the total number of students. This was followed by 15-year old students with a total of 24 participants (22.2%) and 17-year old students with a total of 20 participants (18.5%). Fewer students were observed at 14 (14.8%) and 18 (10.2%) years and even fewer students were observed at 13 (9.3%) years. The distribution of the gender presented that females are slightly more represented at 61 students (56.5%) and males at 47 students (43.5%). The academic and ocular background characteristics of the participants are shown in table 1. The majority of the students were from the Science group, 42 (38.9%), followed by Computer, 28 (25.9%), Arts, 22 (20.4%) and Home Economics, 16 (14.8%). As far as the use of corrective lenses was concerned, 57 students (52.8%) did not wear corrective lenses, 47 students (43.5%) wore spectacles and only 4 students (3.7%) wore contact lenses. Diagnosed refractive error revealed that 38.9% of students reported no refractive error, and the most common reported refractive error was myopia (33.3%). Other screen time was also high, 46 students reported using 5-8 hours of the screen daily, 30 students reported using 2-4 hours of the screen daily and 24 students reported using 1-2 hours of the screen daily.

Table 1: Frequency Distribution of Demographic Variables

Variable	Category	Frequency (n)	Percentage (%)
Age	13 years	10	9.3
	14 years	16	14.8
	15 years	24	22.2
	16 years	27	25.0
	17 years	20	18.5
	18 years	11	10.2
	Total	108	100.0
Gender	Male	47	43.5
	Female	61	56.5
	Total	108	100.0
Program/Subject	Science	42	38.9
	Computer	28	25.9
	Arts	22	20.4
	Home Economics	16	14.8

Variable	Category	Frequency (n)	Percentage (%)
	Total	108	100.0
Corrective Lens Use	No corrective lenses	57	52.8
	Spectacles	47	43.5
	Contact lenses	4	3.7
	Total	108	100.0
Diagnosed Refractive Error	No refractive error	42	38.9
	Myopia	36	33.3
	Hyperopia	9	8.3
	Astigmatism	14	13.0
	Not sure	7	6.5
	Total	108	100.0
Daily Screen Time	Less than 2 hours	11	10.2
	2–4 hours	30	27.8
	5–8 hours	46	42.6
	More than 8 hours	21	19.4
	Total	108	100.0

Academic and Smartphone Use Characteristics

The academic and smartphone use characteristics revealed that students had significant digital screen exposure in their daily activities. Overall, the mean, median and mode of the daily smartphone use were 5.42, 5.50 and 6.00 hours, respectively (see Table 2). This means that many students spent 5-6 hours a day using a smartphone. The standard deviation of 1.86 hours indicates a range of smartphone use, with some students indicating that they used the device for a relatively moderate time and others for a longer period of use. Daily computer or laptop use was less with a mean of 2.31 hours, a median of 2.00 hours and a mode of 2.00 hours.

This difference suggests that smartphones were the main digital device used by participants. Table 2 further indicates that the total daily screen time was also high among the participants. The mean total screen time was 7.73 hours, with a median and mode of 8.00 hours, meaning that students used a lot of digital devices in a day. The average time of 2.34 hours indicates a level of digital use, although the standard deviation shows that there was some variation in the amount of time spent on screens. The mean score for the use of smartphone before sleep was 2.84, while the median and mode scores were 3.00 indicating that many of the students used their smartphones near the bedtime at least sometimes or often.

Table 2: Descriptive Statistics of Academic and Smartphone Use Characteristics

Descriptive Statistic	Daily Smartphone Use Hours	Daily Computer/Laptop Use Hours	Total Daily Screen Time Hours	Smartphone Use Before Sleep Score
Mean	5.42	2.31	7.73	2.84
Median	5.50	2.00	8.00	3.00
Mode	6.00	2.00	8.00	3.00
Standard Deviation	1.86	1.12	2.34	0.91
Variance	3.46	1.25	5.48	0.83

Prevalence of Problematic Smartphone Use

Smartphone Addiction Scale–Short Version (SAS-SV) was used to identify problematic behavior with smartphones. As shown in Table 3, the mean SAS-SV score was 34.76, with a median of 35.00 and mode of 36.00. The mean was 11.92, with a standard deviation of 8.92, indicating a considerable range of dependency on smartphones among the participants. This means that many students exhibited more dependency tendencies while some had normal smartphone usage patterns.

The overall mean score indicates a moderate level of dependency with the smartphone among the studied HS students. As shown in Table 3, 62 students, who accounted for 57.4% of the sample, were considered as having problematic smartphone use, and 46 students, who accounted for 42.6%, were considered as normal smartphone users. This translates to over half of the participants using their smartphone in a problematic way. The discovery is a crucial step on which further analyses will be based, since the purpose of this study was to investigate the relationship between problematic smartphone use and digital eye strain, dry eye symptoms, and sleep quality.

Table 3: Prevalence and Descriptive Statistics of Problematic Smartphone Use

Variable	Category / Statistic	Frequency / Value	Percentage / SD
Smartphone Use Category	Normal smartphone use	46	42.6%
	Problematic smartphone use	62	57.4%
	Total	108	100.0%
SAS-SV Score	Mean	34.76	SD = 8.92
	Median	35.00	
	Mode	36.00	
	Variance	79.57	

Digital Eye Strain and Dry Eye Symptoms among Participants

High school pupils studied included a significant number with Digital Eye Strain (DES). Table 4 shows that the mean digital eye strain score was 13.58 ± 4.27, which was a significant level of discomfort with screens as participants experienced digital eye strain. Severity-wise, 13.9% students had minimal or none digital eye strain and 26.9% had mild digital eye strain. More students had moderate (41, 38.0%) and severe (23, 21.3%) symptoms of digital eye strain. The participants also reported suffering from dry eye. Table 4 shows that the mean OSDI score was 25.84 ± 10.76, which falls within the moderate dry eye symptom range. Of the 26 students with normal scores, 24.1% had normal scores based on the OSDI classification and 25 students (23.1%) had mild dry eye symptoms. Thirty two students (29.6%) had moderate dry eye and 25 students (23.1%) had severe dry eye. In all, 82 students (75.9%) reported having any level of dry eye symptoms and 57 students (52.8%) reported moderate to severe symptoms. Most common complaints to the eye surface were watery eyes (53 students), dryness or irritation (51 students), burning sensation (50 students), redness (39 students) and foreign body sensation (38 students).

Table 4: Combined Results of Digital Eye Strain and Dry Eye Symptoms

Variable	Category / Measure	Frequency (n)	Percentage (%)
Digital Eye Strain Score	Overall DES score	—	—
Digital Eye Strain Severity	Minimal / No DES	15	13.9
	Mild DES	29	26.9
	Moderate DES	41	38.0
	Severe DES	23	21.3
	Moderate to severe DES	64	59.2
Dry Eye Symptoms	Overall OSDI score	—	—
OSDI Severity	Normal	26	24.1
	Mild	25	23.1
	Moderate	32	29.6
	Severe	25	23.1
	Any dry eye symptoms	82	75.9
	Moderate to severe dry eye symptoms	57	52.8
Frequent Ocular Surface Complaints	Burning often/always	50	46.3
	Redness often/always	39	36.1
	Watering often/always	53	49.1
	Dryness/irritation often/always	51	47.2
	Foreign body sensation often/always	38	35.2

Sleep Quality Status among High School Students

The Pittsburgh Sleep Quality Index (PSQI) was used to evaluate sleep quality, and a score more than 5 was set to mean poor quality sleep. The mean score of the PSQI was 7.18 ± 2.63, median 7.00 and mode 8.00 as seen in Table 5. This finding was an indication of the quality of sleep experienced by high school students in this study. Because the mean score was above the PSQI cut-off value, the results indicate that many students struggled to fall asleep, had poor sleep or may have even had daytime fatigue.

As can be seen from Table 5, the mean sleep duration of students in high school was 6.14 ± 1.21 hours, suggesting relatively short sleep duration for high school students. The mean score showing sleep disturbance was 2.42, indicating that a large number of participants had some degree of sleep disturbance or poor subjective sleep quality. Furthermore, the mean was 10.86 ± 3.14 blinks per minute after watching the smartphone and reduced blink rate was seen in 71 students (65.7%) of the sample. Here, the blink rate is an ocular parameter, but it is relevant because high exposure to smartphones can have a negative impact on sleep quality as well as on ocular comfort.

Table 5: Sleep Quality and Blink Rate Status among Participants

Variable	Measure / Category	Value / Frequency	Percentage / SD
PSQI Score	Mean	7.18	SD = 2.63
	Median	7.00	—
	Mode	8.00	—
Sleep Quality Interpretation	PSQI > 5 indicates poor sleep quality	Mean score above cut-off	—
Sleep Duration	Mean sleep duration	6.14 hours	SD = 1.21
Sleep Disturbance Score	Mean score	2.42	—
Blink Rate After Smartphone Viewing	Mean blink rate	10.86 blinks/minute	SD = 3.14
Reduced Blink Rate	Present	71	65.7%

Association between Problematic Smartphone Use and Digital Eye Strain

The first hypothesis was designed to determine if there existed a significant association between problematic smartphone use and digital eye strain in the sample of high school students.The first hypothesis was tested to determine if there was a significant association between problematic smartphone use and digital eye strain in the sample of high school students. The null hypothesis was Ho: There is no statistically significant association between digital eye strain and problematic smartphone use and the alternative hypothesis is Ha: There is a statistically significant association between digital eye strain and problematic smartphone use. The variables were both categorical, so a Chi-square test of association was used. Problematic smartphone use was dichotomized into normal smartphone use and problematic smartphone use and digital eye strain was dichotomized into minimal/mild and moderate/severe categories. This test was appropriate as it explored the difference in the severity of digital eye strain between groups who used smartphones.

Table 6: Cross-tabulation between Problematic Smartphone Use and Digital Eye Strain

Crosstab				
Count				
		Digital Eye Strain		Total
		Minimal/Mild DES	Moderate/Severe DES	
Problematic Smartphone Use	Normal smartphone use	30	16	46
	Problematic smartphone use	14	48	62
Total		44	64	108

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	19.452a	1	.001
Likelihood Ratio	17.965	1	.001
Fisher's Exact Test	20.112		.001
Linear-by-Linear Association	19.272	1	.002
N of Valid Cases	108		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.84.

The results showed a statistically significant association between problematic smartphone use and digital eye strain. When the students were divided into those who used phones normally, 30 of them were found to have minimal or mild symptoms of digital eye strain; however, 16 students were found to have moderate or severe symptoms. On the other hand, although there were 14 students with minimal or mild symptoms, 48 students showed moderate or severe symptoms of digital eye strain in problematic smartphone users. The Pearson Chi-square value was 19.452 and the degree of freedom was 1, which gave a p value of 0.001. A p-value of less than 0.05 was obtained, which means that the null hypothesis is rejected in favor of the alternative hypothesis. This means that problematic smartphone use had a high risk score for digital eye strain severity. The results indicated that pupils with problematic smartphone-use patterns had a higher risk of experiencing moderate or severe symptoms of eye fatigue, headache, blurred vision and other vision-related discomfort symptoms associated with screens.

Association between Problematic Smartphone Use and Dry Eye Symptoms

The second hypothesis was to see if problematic smartphone use was significantly associated with dry eye symptoms among high school students. The null hypothesis was that there was no significant association between problematic smartphone use and dry eye symptoms, and the alternative hypothesis was that there was a significant association between problematic smartphone use and dry eye symptoms. Both of these variables were categorical, so a Chi-square test of association was used. Smartphone use was categorized as normal use vs. problematic use, and dry eye symptoms were categorized based on the OSDI as normal/mild and moderate/severe. This test was suitable as it examined whether there was a significant difference between the two groups of smartphone users in terms of dry eye symptom severity.

Table 7: Cross-tabulation between Problematic Smartphone Use and Dry Eye Symptoms

Crosstab				
Count				
		Dry Eye Symptoms Normal/Mild Dry Eye Symptoms	Moderate/Severe Dry Eye Symptoms	Total
Problematic Smartphone Use	Normal smartphone use	33	13	46
	Problematic smartphone use	18	44	62
Total		51	57	108

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	19.012a	1	.001
Likelihood Ratio	17.523		.001
Fisher's Exact Test	19.657	1	.001
Linear-by-Linear Association	18.836	1	.002
N of Valid Cases	108	1	

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.84.

The results revealed a significant relationship between smartphone use problems and symptoms of dry eye. Forty-two of the normal smartphone users had normal or mild symptoms of dry eye, and 13 participants were classified as having moderate or severe symptoms. But for the 44 respondents with moderate or severe dry eye symptoms, only 18 had normal or mild symptoms, while the other 44 were problematic smartphone users. The Pearson Chi-square value was 19.012 with 1 degree of freedom and the p-value was 0.001. The null hypothesis was rejected because the p value was less than 0.05, thus the alternative hypothesis was accepted. This indicates that there was a significant relationship between problematic smartphone use and symptom severity of dry eye.

Association between Problematic Smartphone Use and Sleep Quality

The third hypothesis was that the problematic smartphone use significantly correlated with sleep quality among high school students. The null hypothesis was that there is no statistically significant relationship between problematic smartphone use and sleep quality whereas the alternative hypothesis was that there is a significant relationship. Pearson correlation was used due to the both variables being continuous scores. Smartphone Addiction Scale – Short Version (SAS-SV) was used to assess problematic use of a smartphone and the Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality. This test was appropriate, as it measured the strength and direction of the correlation between smartphone dependency and sleep quality scores.

Table 8: Descriptive Statistics for SAS-SV and PSQI Scores

Variable	N	Mean	Standard Deviation
SAS-SV Score	108	34.76	8.92
PSQI Score	108	7.18	2.63

Table 9: Correlation between Problematic Smartphone Use and Sleep Quality

Correlations

		Placing Natural Honey	Antibiotics Mandatory
Placing natural honey	Pearson Correlation	1	-.219
	Sig. (2-tailed)		.029
	N	100	100
Antibiotics Mandatory	Pearson Correlation	-.219	1
	Sig. (2-tailed)	.029	
	N	100	100

. Correlation is significant at the 0.05 level (2-tailed).

Problematic smartphone use was moderately positively correlated with sleep quality and significantly correlated ($r=0.41$, $p<0.001$). The mean SAS-SV score was 34.76 ± 8.92, while the mean PSQI score was 7.18 ± 2.63. Pearson correlation showed $r = 0.462$ with $p = 0.001$. The p value was less than 0.05, which means that the null hypothesis is rejected and the alternative hypothesis is accepted. The correlation was positive: the more smartphones were used, the higher the PSQI scores were. According to the result, the more problematic the use of smart phone was, the lower the PSQI score was, which means that students who had higher problematic smartphone use had poor sleep quality. This could relate to late night-use of smartphones, exposure to blue light, night time difficulties falling asleep, a shorter duration of sleep and daytime fatigue. In general, the results indicate that the use of the smartphone seems to have a negative impact on ocular health, as well as sleep-related well-being of high school students.

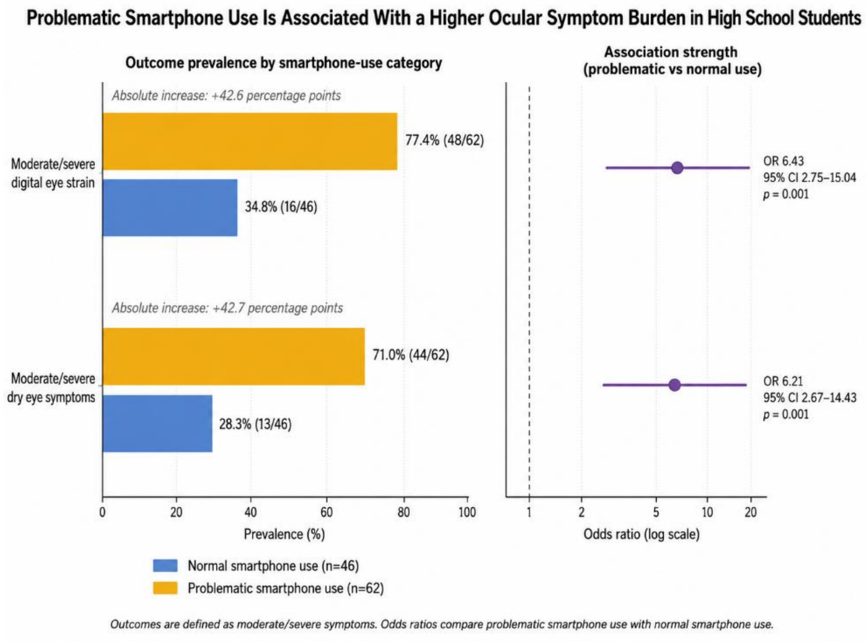

Figure 1 problematic smartphone use is strongly associated with higher ocular symptom burden among high school students

This figure shows that problematic smartphone use is strongly associated with higher ocular symptom burden among high school students.

The left panel compares the prevalence of moderate/severe symptoms between students with normal smartphone use and those with problematic smartphone use. Moderate/severe digital eye strain was present in 77.4% of problematic smartphone users compared with 34.8% of normal smartphone users, an absolute increase of 42.6 percentage points. Moderate/severe dry eye symptoms showed a similar pattern, affecting 71.0% of problematic smartphone users compared with 28.3% of normal users, an absolute increase of 42.7 percentage points.

The right panel displays the strength of these associations using odds ratios. Students with problematic smartphone use had 6.43 times higher odds of moderate/severe digital eye strain, with a 95% confidence interval of 2.75–15.04 and p = 0.001. They also had 6.21 times higher odds of moderate/severe dry eye symptoms, with a 95% confidence interval of 2.67–14.43 and p = 0.001. Since both confidence intervals are entirely above 1, the associations are statistically significant and clinically meaningful.

DISCUSSION

The purpose of the present study was to examine the relationship between problematic smartphone use with digital eye strain, dry eye symptoms, and sleep quality in high school students. 108 participants were selected for the study as a proper sample size for investigating the relationship between the use of a smartphone and eye and sleep problems among adolescents. Demographic results indicated that the majority of participants were from the middle adolescent age group (16 years, 25.0%; 15 years, 22.2% and 17 years, 18.5%). This age group is significant because high school students are usually using their smartphones during school for such tasks as studying, talking on the phone, watching videos for entertainment, playing games, and communicating with others online. Students were evenly distributed across gender with 61 female students (56.5%) and 47 male students (43.5%). The largest group of students were from the Science group (42, 38.9%) followed by the Computer group (28, 25.9%), which might be due to screening requirements that are higher in these groups. The study included the following inclusion criteria: smartphone usage for at least one hour per day and age between 13 and 18 years.The age range of the students (13 to 18 years) and the smartphone use (at least 1 hour per day) were appropriate for the assessment of visual and sleep problems associated with smartphones.

There was also a sample that exhibited problematic smartphone use. The mean SAS-SV score was 34.76 ± 8.92, with a median score of 35.00 and mode of 36.00. The figures suggest that a considerable number of the respondents were moderately dependent on their smartphones. This large variation in the standard deviation indicates that the students' use of the smartphone varied in terms of normal or problematic use patterns. This is significant not just because of its focus on screen time, but because of its focus on the problematic aspects of smartphone usage. Problematic use involves problems controlling the use of the device, excessive checking, using before bed, and continuing to use despite discomfort. These behaviours can prolong exposure time and limit recovery time for the eyes.

Almost everyone in the sample experienced digital eye strain. The average score for digital eye strain was 13.58 ± 4.27, indicating a significant level of visual discomfort associated with digital screens. Fatigue of the eyes was also a common symptom as 64 students said that they felt eye fatigue often or always. Headaches due to screen use was also prevalent, with 56 students saying they had it often or always. Other common symptoms were watering of the eyes in 53 students, burning sensation in 45 students and blurred vision in 50 students. The results suggest that the symptoms of digital eye strain were not limited to one symptom but were experienced as a constellation of visual and ocular complaints. It was also found that 41 students (38.0%) had moderate digital eye strain and 23 students (21.2%) had severe digital eye strain in the severity analysis. If moderate and severe categories were added together, 64 students (59.2%) would have clinically significant digital eye strain. This means that over 50% of all the participants had a significant visual discomfort from digital devices.

The sample also exhibited strong symptoms of dry eye. The mean OSDI score was 25.84 ± 10.76, and this score was in the moderate range of dry eye symptoms. Among many students that use a smartphone, the symptoms of burning, irritation, and redness represent ocular surface stress.

The analysis of blink rates further confirmed the ocular interpretation. A mean blink rate was 10.86 ± 3.14 blinks per minute after the smartphone viewing, suggesting that individuals blink fewer times when on a smartphone screen. For the blink rate assessment, 34.3% (37 students) had a normal blink rate, 39.8% (43 students) had a mild reduction in blink rate and 25.9% (28 students) had a marked reduction in blink rate. In total, 71 students (65.7%) had decreased the blink rate when looking at the smartphone screen. Clinically significant because blinking is important to spread the tear film across the ocular surface. A decrease in blink rate will lead to an increase in tear evaporation and decrease the stability of the tear film. This may cause watering, burning, redness and dryness. This blink rate result thus may be a partial reason for the high scores on OSDI and frequent complaints about the eye surface. It also backs up the theory that the use of the smartphone can have an impact on the eye's comfort, not just with regards to visual strain, but also the way people blink.

The results of the inferential analysis support the presence of significant relationships between problematic smartphone use and eye outcomes. The Pearson chi-square test of association between problematic smartphone use and digital eye strain was statistically significant ($\chi^2 = 19.452$, df = 1, p = 0.001). The students who used their smartphones normally had 30 with minimal or mild digital eye strain and 16 with moderate or severe symptoms. Of those students who had problems with their smartphones, 48 showed some moderate or severe digital eye strain and 14 showed minimal or mild. This definitely shows that students who had problematic smartphone use had higher rates of digital eye strain. Likewise, the relationship between problematic smartphone use and symptoms of dry eye was also statistically significant: $\chi^2 = 19.012$, df = 1, p = 0.001. Sixteen of the 13 people who used a smartphone normally had moderate or severe dry eye symptoms compared to 44 of the 78 problematic smartphone users. In this study, it has been demonstrated that the association between problematic smartphone use and digital eye strain (DES) was significant, and so was the association between DES and the severity of dry eye symptoms.

The findings on sleep quality indicated a significant association with the use of a smartphone. The mean PSQI score was 7.18 ± 2.63, most of whom had a PSQI score above the sleep disturbance cut-off score of

5, thus pointing to poor sleep quality in the majority of participants. The mean sleep duration was 6.14 ± 1.21 hours, which indicates a relatively short sleep duration for high school students. There was a moderate positive correlation between the score on SAS-SV and PSQI, $r = 0.462$, $p = 0.001$. This suggests that those who reported more problematic smartphone use also reported a worse sleep quality score on the PSQI, indicating poorer sleep quality. The relationship was statistically significant with the p-value being less than 0.05. The significance of this finding is that, poor sleep can exacerbate ocular discomfort due to decreased recovery time for the ocular surface and fatigue. Simultaneously, the use of a smart phone at bedtime could have a negative effect on sleep latency and daytime sleepiness.

CONCLUSION

The results of this study confirmed that high school students who suffered from problematic smartphone use exhibited significantly higher rates of digital eye strain, dry eye symptoms and sleep problems. In total, 108 participants were included and results revealed high daily digital exposure, with a mean of 5.42 ± 1.86 hours spent on the smartphone, and a mean of 7.73 ± 2.34 hours of overall screen time. The mean SAS-SV score was 34.76 ± 8.92 indicating moderate dependency on smartphone. Results of the ocular health assessment revealed that digital eye strain was a problem, with 64 students (59.2%) reporting a moderate to severe level of digital eye strain. Also common were dry eye symptoms: The mean OSDI score was 25.84 ± 10.76, and 82 students (75.9%) experienced some level of dry eye symptoms. In 71 students (65.7%), blink rate was decreased while viewing the smartphone, reflecting ocular surface stress. Quality of sleep was also impaired (PSQI = 7.18 ± 2.63). Results of statistical analysis revealed that there were significant correlations between problematic smartphone use and digital eye strain ($\chi^2 = 19.452$, $p = 0.001$), dry eye symptoms ($\chi^2 = 19.012$, $p = 0.001$), and sleep quality ($r = 0.462$, $p = 0.001$). Thus, limiting excessive screen time and screen habits could positively impact students' eye health and sleep quality.

REFERENCES

1. Aykutlu MŞ, Aykutlu HC, Özveren M, Garip R. Digital media use and its effects on digital eye strain and sleep quality in adolescents: a cross-sectional study. PLoS One. 2024;19(12):e0314390.

2. Bouazza S, Abbouyi S, Zarrouq B. Moderated mediation model of the association between problematic smartphone use and dry eye disease within Moroccan adolescents. Sci Rep. 2025;15:25334.

3. Shahnawaz G. Effects of smartphone overuse on eye and behavior: digital eye strain, dry eyes and ocular complaints. J Clin Community Ophthalmol. 2024;1(1):59–67.

4. Solanki MV, et al. Prevalence and determinants of smartphone-induced ocular strain in medical college students. Int J Health Sci. 2025;13(2):2524.

5. Haider I, Iqbal M, et al. Impact of screen time on digital eye strain and visual acuity among medical students in Peshawar, Pakistan. Khyber Med Univ J. 2023;15(4):229–234.

6. Allwihan R, Alhamiyani A, Mohan A, et al. The impact of electronic device use on dry eye disease and related symptoms in health science students. Open Ophthalmol J. 2024;18:74–83.

7. Olivares-Guido CM, et al. Problematic smartphone and internet use associated with poor sleep quality among students in Mexico City. Int J Environ Res Public Health. 2024;21(9):1177.

8. Rasheed R, Navied U, Mirza H, et al. Problematic mobile phone use and sleep quality in medical students: a cross-sectional study. J Shalamar Med Dent Coll. 2025;6(2):83–89.

9. Fatima G, et al. Mobile phone addiction and sleep quality among children and adolescents: unraveling the health consequences. Cureus. 2026;14(2):e353972.

10. Mohesh MI, et al. Impact of smartphone addiction on attention focus and eye health among students. Dermatol Med & Med Sci. 2025;14:10000.

11. Issa LF, et al. Smartphone use and its impact on ocular symptoms and dryness: evidence from cross-sectional surveys. Clin Ophthalmol. 2021;15:2879–2887.

12. Aykutlu MŞ, Özveren M, Garip R. Digital media usage patterns linked to adolescent digital eye strain and sleep disturbances during and after pandemic lockdowns. Ocul Surf. 2025;23:101243.

13. Dandumahanti BP, Chittoor PK, Subramaniyam M. Digital eye strain monitoring during smartphone engagement: eye activity measures and sleep impacts. J Eye Mov Res. 2025;18(4):34.

14. Akib MN, Pirade SR, Syawal SR, Fauzan MM, Eka H, Seweng A. Association between prolonged use of smartphone and incidence of dry eye among junior high school students. Clin Epidemiol Glob Health. 2021;11:100761.

15. Chu GCH, et al. Association between time spent on smartphones and digital eye strain among school-aged children. PLoS One. 2023;6(1):99.

16. Allwihan R, Alhamiyani A, Mohan A, et al. Electronic device use and dry eye disease symptoms in students. Open Ophthalmol J. 2024;18:74–83.

17. Rasheed R, Navied U, Mirza H, et al. Problematic mobile phone use and sleep quality among medical students in Lahore. J Shalamar Med Dent Coll. 2025;6(2):83–89.

18. Allwihan R, et al. The impact of electronic device use on computer vision syndrome symptoms. Open Ophthalmol J. 2024;11:100761.

19. Palanisamy K, et al. Prevalence of digital eye strain during COVID-19 among adolescents. Cureus. 2025;22:439428.

20. Olivares-Guido CM, et al. PSU and sleep quality in Mexican youths. Int J Environ Res Public Health. 2024;21(9):1177.

21. Anonymous. Awareness of digital eye strain among high school students in Lahore. Int J Health Promot. 2025;23:101243.

22. Chu GCH, school-aged children DES analysis. PLoS One. 2023;6(1):99.

23. Luo CK, Tan QQ, Tea Y, et al. Prevalence of DED symptoms and association with screen time in young adults. Ophthalmic Physiol Opt. 2025;45:1195–1200