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ASSOCIATION OF SMART PHONE USAGE AND EYE PROBLEMS AMONG SCHOOL-GOING STUDENTS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background:

Smartphone ownership has expanded rapidly among children and adolescents, and daily screen time often exceeds international recommendations. Excessive and problematic use of smartphone may contribute to eye problems, with digital eye strain acting as a potential mediating factor.

Objective:

To assess the impact of smartphone usage on eye problems among school-going adolescents and to examine the mediating role of digital eye strain in the relationship between smartphone addiction and eye problems.

Methods:

A cross-sectional study was conducted among school-going adolescents using a structured self-administered questionnaire through pilot study. Smartphone addiction was considered the independent variable, eye problems as the dependent variable, and digital eye strain as the mediating variable. Data were analysed using descriptive statistics, correlation, and regression analyses to assess associations and mediation effects.

Results:

Descriptive demographic results shows that males were in majority i.e. 61% (183) as per concern the age majority of the students aged 15 years were reported as 36.7% (110), in context of class of study, class 10th students were reported in majority, with the frequency of 136 (45.3%). As the level of smart phone usage was studied, majority of the sample size reported smartphone duration as 1-2 hours of 47% (141). The purpose of smartphone usage was also studied as the most if the time spent on social media reported as 50.7% (152). Screen protection glasses were reported as 6% of the sample.

Conclusion:

Smartphone addiction is significantly associated with eye problems among adolescents, with digital eye strain playing a mediating role. Promoting healthy smartphone use and preventive strategies may help reduce ocular problems in this population.

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Keywords: *Smartphone addiction, Digital eye strain, Eye problems, Adolescents, Cross-sectional study*

Chapter 1
INTRODUCTION

1.1 Background of the Study

Smartphone proprietorship has expanded rapidly among children and adolescents, and daily screen time often exceeds international recommendations. Recent reviews estimated that digital eye strain now impose adverse effects on most young screen users and is driven by extended near work, short viewing distances, and limited blinking during device use (Kaur et al., 2022; Mataftsi et al., 2023). Children experienced further increases in screen time during and after the COVID-19 pandemic due to online schooling and entertainment, which has exaggerated concern about ocular symptoms such as headache, burning, redness, and blurred vision (Gupta et al., 2021).

Experiential studies in Asia and the Middle East have shown that high smartphone use is linked with dry eye, reduced blink rate, and myopic progression in school-age children (Mohan et al., 2021; Akib et al., 2021; Chidi-Egboka et al., 2023). A study from Saudi Arabia reported that two-thirds of university students experienced at least one ocular problem after smartphone use, most commonly eye pain and dryness (Issa et al., 2021). Narrative and systematic reviews have emphasised that digital eye strain in children is now a public health issue, but high-quality epidemiological data from low- and middle-income countries remain limited (Bozzola et al., 2024; Pucker & Tichenor, 2024). In Pakistan, a study done in 2025 stat that "the study concluded that a significant proportion of adolescents experienced moderate to severe internet addiction. These findings high- light the urgent need to make policies and interventions to promote healthy digital practices among adolescents. (Hyder et al., 2025)

In Pakistan, school students widely use smartphones, yet there is little school-based research on how smartphone addiction and digital eye strain interact to affect ocular health. Local health settings report growing appearances of eye redness, dryness, and complaints of "vision is getting worse" after online gaming and social media, but these observations have not been systematically quantified. Understanding this relationship in Islamabad schools is necessary to guide screening, counselling, and school-level health promotion. This research therefore, focuses on smartphone use, digital eye strain, and self-reported eye problems among students in classes 8–10.

1.2 Problem Statement

School-going adolescents in Islamabad progressively depend on smartphones for learning, communication, entertainment and any notifications and alert. International evidence indicates that such rigorous use is linked with digital eye strain and dry eye disease, which can impair comfort, concentration, and long-term visual health (Bozzola et al., 2024). However, there is no local evidence measuring smartphone addiction, digital eye strain, and ocular problems in Pakistani school students or examining how these concepts are related. Without such data, nurses, teachers, and parents cannot design screening programmes. This study addresses this gap through a school-based cross-sectional survey in Islamabad.

1.3 Purpose of the Study

The purpose of this study is to investigate how smartphone usage level is associated with digital eye strain and ocular problems among school-going adolescent students in Islamabad, and to test whether digital eye strain mediates the relationship between smartphone addiction and eye problems.

1.4 Objectives of the Study

- To determine the prevalence of smartphone addiction, digital eye strain, and ocular problems among students in classes 8–10 at public and private school in Islamabad.
- To examine the association between smartphone addiction scores and digital eye strain among school-going students.
- To assess the association between smartphone addiction and self-reported ocular problems.
- To test whether digital eye strain mediates the relationship between smartphone addiction and ocular problems.

1.5 Research Questions

1. What is the prevalence of smartphone addiction, digital eye strain, and ocular problems among students in classes 8–10 in the selected Islamabad schools?
2. How is smartphone addiction associated with digital eye strain among these students?
3. How is smartphone addiction associated with self-reported ocular problems among these students?
4. Does digital eye strain mediate the relationship between smartphone addiction and ocular problems?

1.6 Significance of the Study

This study was providing the first school-based investigation of smartphone addiction, digital eye strain, and ocular problems among Pakistani adolescents. Results can inform and support public policy makers about vision-screening protocols, school health policies, and parent education on safer smartphone use. The results will also contribute to the growing international evidence that near digital work is a developing determinant of children and adolescent eye health, particularly in rapidly urbanising contexts.

1.7 Operational Definitions

Smartphone addiction: A pattern of excessive, poorly controlled smartphone use that interferes with daily activities, assessed using an adapted short version of the Smartphone Addiction Scale (SAS-SV) scored on a five-point Likert scale (Desouky & Abu-Zaid, 2020).

Digital eye strain (DES): A cluster of ocular and visual symptoms such as headache, tired eyes, burning, dryness, and blurred vision occurring during or shortly after near digital device use, measured using items adapted from the paediatric Digital Eye Strain Questionnaire (Aguilar, 2024; Demirayak et al., 2022).

Ocular problems: Longer-lasting or recurrent eye complaints reported over the previous four weeks (for example, frequent redness, dryness, sensitivity to light or perceived worsening of vision), adapted from Issa et al. (2021) and paediatric DES questionnaires.

School-going students: Boys and girls enrolled in classes 8–10 in government and private secondary schools in Islamabad at the time of data collection.

Chapter 2
LITERATURE REVIEW

2.1 Smartphone Use and Addiction among Students

Smartphone use has widespread among adolescents, with many reporting daily use exceeding four hours (Bozzola et al., 2024). Studies applying the SAS-SV in young populations have shown high rates of problematic or addictive use, results in loss of control, withdrawal, and functional impairment (Desouky & Abu-Zaid, 2020). During the pandemic, online learning and social media increased these practices, particularly in school going students (Gupta et al., 2021). Excessive daily smartphone use has been linked with poor sleep, lack of physical activity and psychological distress, suggesting that it is both a behavioural and health risk.

2.2 Digital Eye Strain and Ocular Symptoms in Children

Digital eye strain is a visual problem and a set of eye symptoms that develop as a result of extended use of digital devices (Kaur et al., 2022). The typical symptoms of paediatrics are headache, pains in the eyes, burning, itching, redness, and heaviness of the eyelids (Demirayak et al., 2022). The COVID-19 pandemic prevalence estimates among school children who are in online learning were 50 to 70 percent (Gupta et al., 2021; Mohan et al., 2021). Among the risk factors, there are extended screen time, viewing screen spacing of 30-40 cm or shorter, lack of outdoor play and activities, and infrequent breaks (Mataftsi et al., 2023).

2.3 Smartphone Use, Dry Eye, and Myopia in Youth

Ocular problems are associated with tear film instability, decreased blinking frequency, and dry eye disease in children and adolescents due to smartphone use. Akib et al. (2021) discovered that junior high students who spent more than 2 hours daily using the smartphone were more likely to experience dry eye compared to those who spent less time on the phone. It was found that an hour of smartphone gaming significantly reduced the blink rate and produced the

symptoms of a dry eye in children (Chidi-Egboka et al., 2023). According to meta-analyses, there is also an indication that screen time is linked with the increased risk of myopia development when used together with reduced outdoor time (Li et al., 2025; Bozzola et al., 2024). Such eye changes support the importance of observing the visual performance of those who exceeds smartphones usage than recommended.

2.4 Smartphone Use, Technostress, and Child Health

Digital technologies can serve as stressors in addition to a direct impact on the eye. Al-Abdullatif et al. (2020) applied the person-technology fit model to demonstrate that too much mobile texting affected technostress and poor performance. Digital eye strain reviews also claim that demanding visual activities, constant distractions, and inability to manage online responsibilities have the potential to cause psychological stress and apparent eye fatigue (Kaur et al., 2022; Barata et al., 2025). In children, the pressures come in addition to developmental susceptibility, which casts a doubt on the growing effects on well-being. Bozzola et al. (2024) have highlighted that the use of paediatric media should be assessed in a more comprehensive health model with the inclusion of sleep, activity, mental health, and vision. On the whole, there is evidence to observe the symptoms of smartphones related to the eye as an extension of a broader stress and health profile.

2.5 Theoretical Framework

The individual directs this study-technology fit model, which hypothesises the impact of technology features that cause stressors that afterward lead to behavioural or health stressors (Al-Abdullatif et al., 2020). In this research, high levels of smartphone use and addiction represent the technology characteristics. Digital eye strain, occurs when frequent ocular symptoms during device use, was treated as a stress response. Persistent ocular problems, such as chronic dryness or perceived visual deterioration, are observed as the strain outcome. The model suggests that poor fit between students and their digital environment will increase stress responses, which, in turn, mediate the impact of exposure on health outcomes.

2.6 Conceptual Framework

The framework recommends that higher smartphone usage labelled as addiction, as scores increase digital eye strain symptoms, which in turn increase the possibility of ocular problems. A direct path from smartphone addiction to ocular problems is also expected.

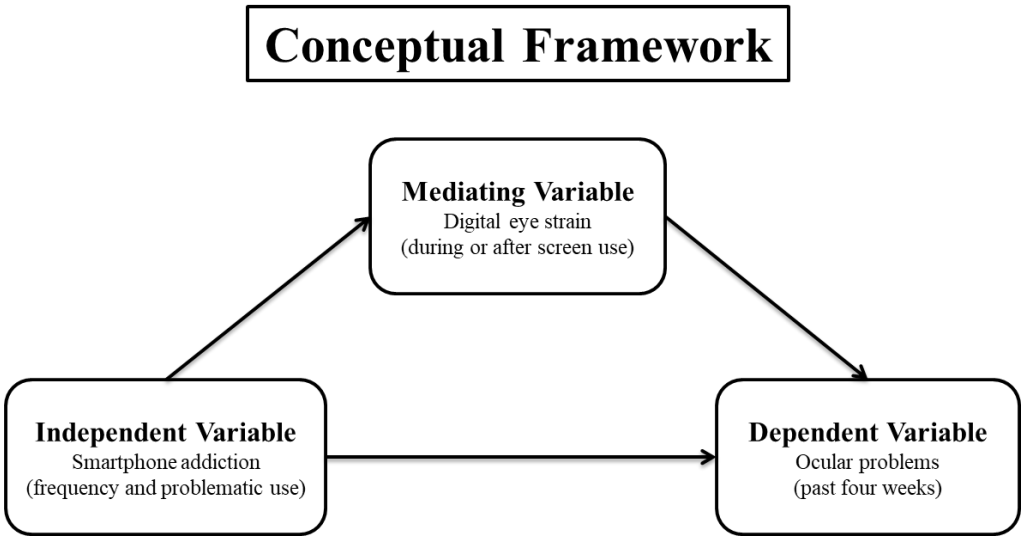

Figure 1: Conceptual Framework

2.7 Research Gap

Most existing research on smartphone use and ocular health has focused on university students or clinic-attending children in high-income countries (Demirayak et al., 2022). Systematic reviews identify limited data from low- and middle-income settings and few studies that integrate behavioural addiction measures with validated paediatric digital eye strain questionnaires (Mataftsi et al., 2023). No published studies were located that examine smartphone addiction, digital eye strain, and ocular problems together among Pakistani school students. This research addresses that gap by using self-structured instruments in a school-based survey of classes 8–10 students in Islamabad and by testing a mediation model grounded in the person–technology fit framework.

Chapter 3
METHODOLOGY

3.1 Research Design

A quantitative cross-sectional design was used to measure smartphone addiction, digital eye strain, and ocular problems at a single point in time among school-going adolescents. This design is appropriate for estimating prevalence and exploring associations between variables in a relatively large sample within limited resources (Gupta et al., 2021). The study was not establishing causality but will provide evidence for potential pathways that can be tested in longitudinal research.

3.2 Study Setting and Population

The study was conducted in Islamabad in government and private secondary schools selected from different sectors to reflect socio-economic diversity. The target population was students enrolled in classes 8–10 during the data-collection period.

Inclusion criteria

The inclusion criteria were to own or have a regular use of a smartphone and have the capacity to read Urdu or English.

Exclusion Criteria

All students who have a known severe ocular disease or neurological disorder with impair vision was excluded on the basis of school health records.

3.3 Sample Size and Sampling Technique

The number of students was a sample of 300, in line with the proposal brief. In a given school, there was classes 8-10, and where possible, classes were chosen at random. All students in selected classes who meet the inclusion criteria and provide consent/assent was invited to participate. This random sampling approach enhances feasibility while reducing selection bias and should provide adequate power for correlation and mediation analyses.

3.4 Pilot Study

A pilot study was conducted prior to the main study to test the feasibility and reliability of the data collection instrument. The pilot study was conducted on a sample of 10% of the total sample size, the sample of pilot study was collected from same population, but these participants were not included in the main study sample. The pilot study was conducted to assess and refine the structure, clarity, and relevance of the questionnaire, ensuring its suitability for the targeted population. A 0.897 Cronbach's alpha was obtained through the study for 30 participants, which ensures its reliability.

3.5 Research Instrument

Data was collected using a structured questionnaire with two parts:

Part I: Demographics

- Age, gender, class, school type (public and private), reported daily screen time of smartphone, purpose of using smartphone, use of any screen protecting glasses, if any eye problem appear is it checked to physician, if checked to physician, is the symptoms relieved with treatment.

Part II-Study variables

- **Smartphone addiction:** Five items adapted from the Smartphone Addiction Scale–Short Version (SAS-SV), covering compulsive use, withdrawal, tolerance, and functional impairment, rated on a five-point Likert scale from "strongly disagree" to "strongly agree" (Desouky & Abu-Zaid, 2020).
- **Digital eye strain:** Five items adapted from the paediatric Digital Eye Strain Questionnaire developed by Aguilar (2024),

including headaches, eye pain, tired eyes, burning, itching, tearing, and blurred vision during screen use, rated from "never" to "always".

- **Ocular problems:** Five items on recurrent eye redness, dryness, light sensitivity, foreign-body sensation, and perceived worsening of vision over the past four weeks, adapted from Issa et al. (2021).

3.5 Data Collection Procedure

After obtaining ethical approval and permissions from school authorities, the researcher briefed class teachers and students about the study's purpose and procedures. Parental consent and student assent was collected in advance as after principal consent was taken for data collection in schools and consent (yes/no) poll was establish in parents-teachers WhatsApp groups, the data was collected from the students after parental consent. Questionnaires were conducted in classes on specific days during a set time by the school administration and the researcher was in the classroom to clarify the questions without affecting the answers. The anonymous forms were self-administered, and students were taken around 15-20 minutes to complete the forms and place them in closed envelops. The permission or consent letter of the schools are attached with the file (Appendix A). Filled out questionnaires was validated on completeness, coded using some form of unique numbers, and stored safely in order to be entered and analysed.

3.6 Data Analysis Plan

The SPSS version 26 was used in entering and analysing the data. The means, standard deviations, frequencies, and percentages were calculated to be used to provide a summary of demographic variables and scale scores. The three scales were tested in terms of reliability (Cronbach alpha and the correlations of the items with the total) and thus with the help of Cronbach alpha and item-total correlation (Aguilar, 2024; Kaur et al., 2022). The Pearson correlation coefficients was employed to evaluate the bivariate associations between smartphone addiction, digital eye strain and ocular problems. To investigate the idea of smartphone addiction predicting ocular issues, multiple linear regression was used to consider the effect upon age, gender, and daily screen time. The digital eye strain was tested as a mediating variable between the smartphone addiction and ocular problems through the mediation analysis outcome with the help of the PROCESS macro (model 4). The p-value of less than 0.05 was held as statistically significant.

3.7 Ethical Considerations

Informed consent: Students was asked to participate in the study on a voluntary basis, and their parents and students was given their informed consent to participate in the study.

Anonymity and confidentiality: No names/roll numbers were gathered in the questionnaire. The data was coded and kept in a secured place.

Right to withdraw: Students were allowed to refuse or withdraw without academic penalties.

Risk management: It was described in information sheets that the survey is low-risk, students with bothersome eye symptoms will be referred to an eye clinic.

Ethical clearance: The institutional ethics committee and other educational authorities will be consulted by getting their approval.

3.8 Limitations of the Study

The cross-sectional design was restraining causal interpretation of the relationship between smart phone use and eye problems. There are also possibilities of self-report bias and social attraction especially in matters touching on the screen-time estimates. The research was targeted at schools in Islamabad therefore, the results might not be generalizable across other parts of Pakistan and school systems. The lack of objective ocular tests and electronic records of smartphone use was making it impossible to determine some relationships due to the lack of resources, as they may be underestimated or assigned to the wrong category.

Chapter 4
DATA ANALYSIS AND INTERPRETATION

4.1 Introduction

In this chapter, presents the demographics of the participants and eye care behaviours. As the study was related to school going students apart from age and gender the demographics include class of study and type of school, it also contains a question to get information about smartphone usage duration per day of the students. It

provides reliability and descriptive statistics of ocular problems, smartphone addiction, and digital eye strain, also Pearson correlations, regression and PROCESS Model 4 tests. Whether the illusion of ocular problems surrounds a mediation of digital eye strain.

Table 4.1: Demographics Profile

		Frequency	Percentage %
Gender	Male	183	61%
	Female	117	39 %
Age	13	9	2.7%
	14	85	28.3%
	15	110	36.7%
	16	82	27.3%
	17	14	4.7%
Type of School	Public	159	53 %
	Private	141	47%
Class Of Study	Class 8	58	19.3%
	class 9	106	35.3%
	class 10	136	45.3%
Hours Of Mobile Use	1-2	141	47%
	3-4	116	38.7%
	5-6	26	8.7%
	More than 6 hr	17	5.7%
Mobile Using Purpose	Social media	152	50.7%
	Chat gpt	44	14.7%
	Gaming	48	16%
	Academic purpose	56	18.7%
Total		300	100%

As indicated in Table 4.1, the sample was 300 students 183 males, or 61%, in majority and 117 females, or 39%. The majority (36.7 %) of the students were aged 15 years, and 28.3% aged 14 ears and 27.3% aged 16 years. Students incline to be in public schools slightly more 53% in comparison with those in the private schools 47%. The most significant percentage of students enrolled was 45.3% was in Class 10. Almost half of sample size spent 1-2 hours a day on smartphones 47%, and social media was the primary purpose 50% for using smartphone.

Table 4.2: Frequency Analysis

		Frequency	Percentage %
screen protection glasses	Yes	18	6%
	No	282	94%
physician consultation	Yes	48	16%
	No	252	84%
relived with medicine	Yes	32	67%
	No	16	33%

Table 4.2 indicates that the use of screen protection glasses was only reported by 18 students (6%), and 282 students (94%) did not use them. As the eye problems checked to a physician by 48 students (16%), as compared to 252 students (84%) who had not taken any consultation to a physician. 32 students (67%) were found to have relief with medicine, and 16 (33 %) students reported no relief. Such findings indicate weak preventive practice and care seeking, though later analyses showed the presence of reported symptoms.

4.2 Reliability Analysis

Table 4.3: Reliability Statistics

Cronbach's Alpha	N of Items
.897	30

The Cronbach's alpha obtained in Table 4.3 is 0.897 with 30 items through pilot study. This value is greater than the traditional value of 0.70, implying high internal consistency, which means that the items of the questionnaire measure their constructs in a stable and coherent way. A coefficient of 0.90 also means that there is a low likelihood of a random measurement error, so that the future correlation, regression, and mediation analysis using these scale scores can be considered credible. Nonetheless, a high alpha will not establish validity, and thus, content and construct alignment are significant.

4.3 Descriptive Analysis

Table 4.4: Descriptive Statistics

	N	Mean	Std. Deviation
Ocular Problems	300	3.8607	.78253
Smartphone Addiction	300	3.8333	1.01834
Digital Eye Strains	300	3.8027	.83885

Table 4.4 demonstrates that the mean Ocular Problems = 3.8607 (SD = 0.78253), mean Smartphone addiction = 3.8333 (SD = 1.01834), and mean digital eye strains = 3.8027 (SD = 0.83885), and the value of N = 300. All these means fall beyond the middle of a five-point scale, showing that students had moderate to high rates of ocular symptoms and digital eye strain. The variability of smartphone addictions is the greatest, which indicates that there is more variation among the students in terms of smartphone addiction than in Ocular Problems or digital eye strain.

4.4 Correlation Analysis

Table 4.5: Correlation Matrix

		Ocular Problems	Smartphone Addiction	digital eye strains
Ocular Problems	Pearson Correlation	1	.947**	.976**
	Sig. (2-tailed)		.000	.000
	N	300	300	300
Smartphone Addiction	Pearson Correlation	.947**	1	.936**
	Sig. (2-tailed)	.000		.000
	N	300	300	300
digital eye strains	Pearson Correlation	.976**	.936**	1
	Sig. (2-tailed)	.000	.000	
	N	300	300	300

. Correlation is significant at the 0.01 level (2-tailed).

It indicates that there are strong positive correlations between Ocular Problems and Smartphone addiction ($r = 0.947$, $p < 0.001$), Ocular Problems and digital eye strains ($r = 0.976$, $p < 0.001$), and Smartphone Addiction and digital eye strains ($r = 0.936$, $p < 0.001$), which were revealed in Table 4.5. These coefficients suggest that students who reported greater smartphone addiction also reported greater levels of digital eye strain and greater

Ocular Problems. This indicates a significant amount of shared variance, which adds to the argument in favour of a mediation model, but also raises the concern of concept overlap.

4.5 Regression Analysis

Table 4.6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.947[a]	.897	.897	.25109

a. Predictors: (Constant), smartphone addiction

In Table 4.6, it is demonstrated that smartphone addiction is a strong predictor of Ocular Problems, where R = 0.947 and R 2 = 0.897. The simple regression model can explain the Ocular Problems variance of about 89.7 percent by Ocular Problems. The value of the standard error of the estimate (0.25109) shows comparatively small prediction error around the regression line. The high R2 is in line with the high correlation mentioned above and indicates that smartphone addiction is a statistical predictor of ocular problems dominating in this sample.

Table 4.7 Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.070	.057		18.924	.000
	Smartphone Addiction	.728	.014	.947	51.051	.000

a. Dependent Variable: Ocular Problems

As can be seen in Table 4.7, the regression intercept is = 1.070 (SE = 0.057, t = 18.924, p < 0.001). The coefficient B of Smartphone Addiction is unstandardized = 0.728 (SE = 0.014), and the standardized beta = -0.947, and the t = 51.051, p = -0.001, is statistically significant. It means that, when the smartphone addiction score is increased by one unit, the Ocular Problems score is predicted to increase by 0.728 units, other things being constant, since there are no other predictors in the model. The effect size is great as indicated by the very high beta.

4.6 Mediation Analysis

Table 4.8: Mediator model (Outcome: Digital Eye Strain; Predictor: Smartphone Addiction)

Term	Coefficient (b)	SE	t	p	95% CI LL	95% CI UL
Constant	0.8478	0.0667	12.7054	<0.001	0.7165	0.9791
Smartphone Addiction	0.7708	0.0168	45.8163	<0.001	0.7377	0.8040

Table 4.8 demonstrates the mediator regression in which smartphone addiction is used to estimate Digital Eye Strain. The smartphone addiction coefficient = 0.7708 (SE = 0.0168, t = 45.8163, p < 0.001), and the lower and upper limits of the 95% interval are 0.7377 and 0.8040, respectively. This means that there is a positive relationship between smartphone addiction and Digital Eye Strain, such that students who are more smartphone addictive give higher scores on digital eye strain. The intercept is important as well, indicating a

minimum level of Digital Eye Strain even in low smartphone addiction. On the whole, this is a strong indicator of path a in the mediation model.

Table 4.9: Outcome model (Outcome: Ocular Problems; Predictors: Smartphone Addiction and Digital Eye Strain)

Term	Coefficient (b)	SE	t	p	95% CI LL	95% CI UL
Constant	0.5036	0.0432	11.6437	<0.001	0.4185	0.5887
Smartphone Addiction (direct effect, c′)	0.2127	0.0249	8.5406	<0.001	0.1637	0.2618
Digital Eye Strain (path b)	0.6684	0.0302	22.1021	<0.001	0.6089	0.7279

As depicted in Table 4.9, Smartphone Addiction and Digital Eye Strain have strong predictive qualities of Ocular Problems in combination. Smartphone Addiction is also an important effect (c' = 0.2127, SE = 0.0249, t = 8.5406, p < 0.001), and the confidence interval of the Smartphone Addiction (0.1637- 0.2618) is 95 percent. Digital Eye Strain also has a close correlation with Ocular Problems (b = 0.6684, SE = 0.0302, t = 22.1021, p < 0.001). The decrease in the Smartphone Addiction coefficient compared to the simple model means that it is partially mediated.

Table 4.10: Direct and indirect effects (PROCESS Model 4)

Effect type	Path	Effect	SE / BootSE	T	p	95% CI LL	95% CI UL
Direct effect	c′ (Smartphone Addiction → Ocular Problems)	0.2127	0.0249	8.5406	<0.001	0.1637	0.2618
Indirect effect (bootstrap, 5000)	a×b (Smartphone Addiction → Digital Eye Strain→ Ocular Problems)	0.5152	0.0434	—	—	0.4286	0.5987

Table 4.10 indicates that there was a statistically significant direct effect of Smartphone Addiction on Ocular Problems (effect = 0.2127, p < 0.001). It also demonstrates a statistically significant indirect effect with the help of Digital Eye Strain (effect = 0.5152, Boot SE = 0.0434) with a bootstrap confidence interval of 0.4286 to 0.5987. Since this period does not have a zero, the mediated effect is upheld. The direct effect is smaller than the indirect one, which implies that the majority of the correlation between Smartphone Addiction and Ocular Problems is explained by the pathway involving Digital Eye Strain.

4.7 Discussion

The results point towards common eye-related symptoms among students, and there is a lack of preventive practice. The mean score of Ocular Problems, Smartphone Addiction, and Digital Eye Strain was greater than the midpoint of the scale, which shows moderate and high levels of symptom burden. Screen protection glasses or physician consultation were only reported by in a small number, thus showing that there is a significant number of students who ignores the symptoms. Kaur et al. (2022) hypothesized that prolonged near-screen work may lead to low-blinking and leads to ocular discomfort, which is in line with the high levels of symptom scores noted in this case. The sample demonstrates a

high level of self-reported eye discomfort and a low level of protective or clinical support.

These tests indicate that Smartphone Addiction and Ocular Problems are very strongly correlated, and their correlation is validated by the correlation matrix and regression model. The model of smartphone addiction explained 89.7 percent of the variance of Ocular Problems and showed that the students who were more Smartphone Addictive were also more expected to report higher Ocular Problems. As much as this trend shows to the research hypothesis that more problematic or heavy smartphone use is associated with poor eye performance, the effect size is excessively large and should be interpreted with caution. Since the measures were all self-reported and assessed at a single occasion, there is a risk that shared method variance and item overlap content increased the coefficients. Demirayak et al. (2022) discovered that symptoms of digital eye strain in children co-occur and are conditioned by the patterns of screen exposure, which could produce closely interconnected patterns of symptom reporting in the same questionnaire.

Implication: Smartphone Addiction is a powerful statistical indicator of Ocular Problems, but the strength of association may be due to overlap in the measurements.

The mediation model offers evidence of a mechanism that exists between Smartphone Addiction and Ocular Problems via digital eye strain. The prediction of digital eye strain, Ocular Problems, and the indirect effect of sensations were strong, and the bootstrap confidence interval was not in the range of zero. The direct effect was also significant, and this means that it was partially mediated and not entirely mediated. The route is possible since near-screen activities can cause momentary strain symptoms that subsequently lead to irritation, including ocular problems. Chidi Egboka et al. (2023) demonstrated that gaming on a smartphone may decrease the rate of blinking and cause symptoms of dry eyes in children, which is why strain processes may result in symptom development. Paediatric media use was highlighted to be assessed in a framework of a wider health model by Bozzola et al. (2024), so nursing assessment was also reported to encompass sleep, breaks, and outdoor time as a part of the management of symptoms. Digital eye strain seems to be a critical issue, and it advocates for screening and preventive education in schools.

Chapter 5
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In the research, it is concluded that eye problems are prevalent in secondary school students in Islamabad and are significantly associated with smartphone addiction and digital eye strain. Descriptive findings suggest that moderate and high Ocular Problems, smartphone addiction, and digital eye strain were reported by the participant students, and preventive behaviours and clinical consultation were poor. The internal consistency of the instrument is high, and it is a reasonable assurance that the items measure a consistent body of symptoms. Correlation and regression analyses establish that smartphone addiction is correlated with ocular problems significantly, which means that the students who report higher levels of smartphone addiction also report higher levels of eye problems. The high coefficients are, however, unusual, hint at the measures could have content overlap, and the findings should be interpreted as indicators of association and not the exact effect size. The mediation model explains it better as it demonstrates that digital eye strain is a pathway between smartphone addiction and ocular Problems. There was a strong positive effect of smartphone addiction on the digital eye strain, a strong positive effect of digital eye strain on Ocular Problems, and an indirect effect was statistically supported. The findings provide responses to the research questions by establishing the existence of eye problems, establishing relationships between smartphone addiction and ocular problems, and establishing that digital eye strain can be used to explain such relationships. Overall, the results substantiate the opinion that the control of digital eye strain is the key to eliminating the feeling of eye discomfort among adolescent smartphone users.

5.2 Recommendations

Eye health education should be added into regular health programs in schools, the special

precautions for prolonged smartphone use may cause digital eye strain and ocular problems.

- Basic preventive measures, such as taking screen breaks every now and then, having a comfortable viewing distance, using larger fonts so that you do not need to strain your eyes, and blinking deliberately at the time of use, these guidelines should be taught to students.
- The school nurses and the class teachers ought to encourage the 20-20-20 rules during study times and take short breaks outside where possible.
- It is recommended that parents establish regular boundaries of recreational screen time by making an account as a parent and control screen time and content preferred to watch, particularly exercises in the late evening hours, and should also monitor the symptoms that continue to appear after the use of devices.
- In schools that have health programs, a short screening checklist or assessment can be implemented to detect students having frequent redness, pain, or blurred vision and to offer early counselling.
- Clinical eye examination should be referred to students who complain of frequent or intense symptoms to rule out refractive error or dry eye disease.

5.3 Implication in Future Research

Longitudinal research design in the future should be aimed to highlight on whether increased smartphone addiction predicts digital eye strain and whether Digital Eye strain is a predictor of ocular issues. Recall bias would be reduced by objective exposure measures (phone-based screen time logs, bright light or warm light cause digital eye strain and viewing distance monitoring), which might help in reducing the very high correlations found in the current study. Clinical examination, such as tear film examination, rate glance, and refraction examination, should be incorporated in order to differentiate temporary strain and underlying dry eye or refractive error. Generalizability and the ability to compare by school type and socioeconomic context would be enhanced by multi-site sampling of Islamabad and other provinces. The researchers are also expected to improve the models of measurement so that the overlaps in items could be reduced between smartphone addiction, digital eye strain, and ocular problems, as well as test other pathways, which consider sleep quality and outdoor time. These would enhance causal inference and inform the targeted prevention. Gender and class-stratified analyses could show those requiring more substantial assistance.

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