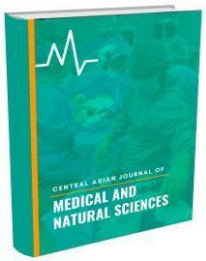

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Article

The Effects of Mobile Phones Use (Light Exposure) on The Eyes of Children Aged 4-12 Years

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Abstract: The widespread use of mobile devices among children has prompted concerns about the effects of screen exposure on pediatric ocular health. While existing literature links prolonged screen time to digital eye strain and myopia, the specific impact of mobile phones warrants further investigation. This study aimed to assess the correlation between mobile phone use and self-reported ocular complaints in children aged 4 to 12 years. An observational, cross-sectional study was conducted using a survey distributed to 126 participants in Wasit governorate. The survey collected data on demographics, mobile phone usage patterns (daily hours and cumulative years), and the prevalence of ocular symptoms like eye strain. Statistical analysis was performed to identify significant associations. The analysis revealed only weak correlations between mobile phone exposure and self-reported eye complaints. While age was significantly correlated with daily usage and total years of use, a notable negative correlation was found between cumulative years of use and reported eye strain. This suggests children with longer exposure did not report more symptoms. Most other associations were non-significant. Contrary to previous studies, this research found weak direct links between mobile phone use and subjective ocular complaints in children. This may indicate adaptive behaviors or reporting biases. Nonetheless, given established risks from other studies, preventive strategies like moderated use and regular breaks remain a prudent recommendation for safeguarding children's eye health.

Keywords: Screen Exposure, Blue-Light, Eye Strain, Symptoms, Electromagnetic Wave

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1. Introduction

Due to advancements in mechanics and technology, the use of electromagnetic fields progressively increases, hence exposing persons to these EM waves to a greater level. Significantly increasing the number of cell phone and tablets users raises serious concerns due to the potential harm caused by RF waves to exposed individuals [1].

Cell phones generate radiation within the radiofrequency segment of the EM spectrum. Second-, third-, and fourth-generation cell phones (2G, 3G, 4G) produce radiofrequency within the frequency range of 0.7–2.7 GHz. Fifth-generation (5G) mobile phones are expected to utilize the frequency band up to 80 GHz [2]. A photochemical reaction transpires when photon energy is absorbed and subsequently released as heat within the radiation spectrum of 390 nm to 480 nm, as seen in figure (1). Prolonged exposure to intense light can result in thermal injury, "photokeratitis in skiers" [3.4]

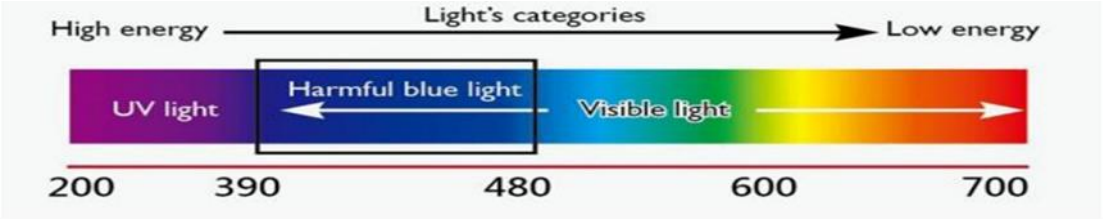

Figure 1. Location of the blue light according to wavelength (λ)

The cornea absorbs UV light below 300 nm, while the crystalline lens predominantly attenuates wavelengths between 300 and 400 nm, especially those up to 360 nm as shown in figure (2). With advancing age, there is a relatively increased reduction of blue light transmission and a corresponding physiological yellowing of the crystalline lens.The old crystalline lens demonstrates blue-light filtration.The characteristics of the "blue-light threat" arise from retinal exposure to shorter-wavelength visible light (400 to 500 nm) [5, 4].

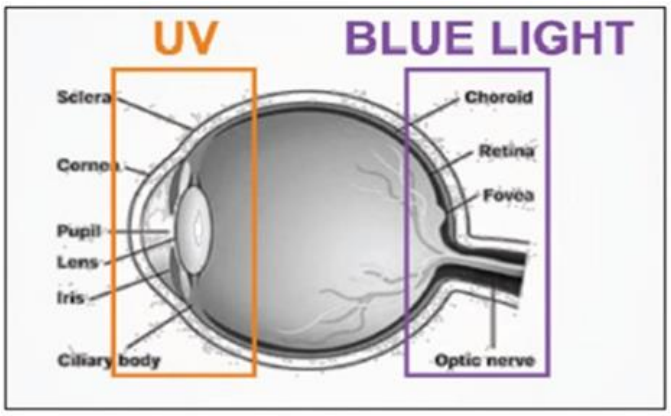

Figure 2. Dangers of light to the eyes. UV light affects the front of the eye; blue light affects the back of the eye.

Only visible light can penetrate the eye and reach the retina, whereas the cornea or lens primarily blocks ultraviolet radiation. So, ultraviolet (UV) light exposure regards the primary risk factor for age-related macular degeneration [6]. With regard to blue light, which is characterized by wavelengths shorter than 440–450 nm and recognized as the most intense radiation within the visible spectrum for the human eye, there is yet no scientific evidence substantiating that this light emitted from electronic devices is detrimental to ocular health. The discomfort experienced by certain individuals when utilizing a screen is attributable to visual fatigue due to tending to blink less frequently while gazing at a screen, resulting in fatigue and ocular dryness. However, the scientific research indicated that blue light influences our body's circadian rhythm rather than our eyes, natural alertness, and sleep cycle [7-9].

Incorrect use of technology, as well as overuse, may lead to serious consequences, and there is revised scientific international literature to describe the potential eye risks correlated to screen viewing time in the pediatric age, either mobile phone or computer screens [10,11]. Occasionally, there is no idea about potential harm to a child's eyes, which often begins as certain manifest mannerisms, such as forced blinking or complaints of transient episodic eye pain, rubbing, or epiphora [12]. The rampant utilization of mobile phones among certain young individuals has resulted in notable disparities in eye health ($p = 0.002$), impacting the dynamics of tear fluid, particularly TBUT and S1T, along with corneal thickness.Consequently, any radiation or heat impacts, or both, emitted by mobile

phones may impact the eye and its structures. Certain individuals indicated a rise in visual blurriness ($p < 0.05$) attributed to mobile phone usage [13-15].

2. Materials and Methods

In the holidays, the use of mobile increases; for that, the surveys were made for this study in summer holiday (July and August) to collect data from children and students regarding their demographics, personal histories, knowledge, behaviors, and attitudes. Well-crafted surveys facilitate ease of completion for respondents, provide accurate and consistent information collection, and yield data amenable to analysis for addressing research inquiries [16,17]. From this point, this research was made as a observational study performed in Wasit governorate. A total of 126 cases were collected for the database. The main parameters taken in survey form for the study are:

1. Sex
2. Age
3. Reason of mobile using
4. Daily average of using
5. Room lighting
6. Are there any symptoms in your child's eyes after using a mobile?
7. How many times did your child complain about eye strain?
8. The total period of mobile use.
9. Do you think using a phone affects a child's eyesight?

Agreement was obtained from all cases before conducting this survey. XLStac software was used to do the statistical analysis, and Table 1 displays the results for each parameter.

3. Results and Discussion

This study explored the effects of visible radiation mobile phone exposure usage on ocular health outcomes among children aged 4–12 years, where the details are shown in table 1.

Table 1. Description of the coding of ages for daily exposure

Ages	Code	Usage	Code
4-6	1	1 > h = 2	2
7-9	2	2 > h = 4	4
8-12	3	4 > h > 5	6

Overall, the correlations between mobile phone exposure and self-reported ocular complaints were weak according to the statistical analysis that is recorded in table 2 and figure 3. Age was modestly correlated with daily usage hours, where the p-value=0.0159, as figure (a-4) shows this relationship, and it is small but statistically significant, as figure (b-4) shows, the reported frequency of eye strain vs daily use. Additionally, there was a stronger correlation with total years of use, indicated by a p-value of 0.00144, as shown in figure (a-5), which reflects the expected increase in exposure with age. Interestingly, a small but statistically significant negative correlation was observed between cumulative years of use, as figure (b-5) shows this relationship between total use and reported frequency of eye strain. This suggests that children with longer exposure did not necessarily report more symptoms. Most other associations, including those between usage and reported eye disorders, were non-significant.

Table 2. The correlation of statistical analysis of mobile phone use and exposure

Variable 1	Variable 2	Correlation(r)	P-value	Sig.
Age	Daily-Hours	0.215	1.59e-02	*
Age	Total-Years	0.282	1.44e-03	**
Age	Eye-Disorder	Nan	Nan	
Age	Percerved-Effect	Nan	Nan	
Age	Eye-Strain-Freq.	-0.133	1.40e-01	
Daily-Hours	Total-Years	0.198	2.68e-02	*
Daily-Hours	Eye-Disorder	Nan	Nan	
Daily-Hours	Percerved-Effect	Nan	Nan	
Daily-Hours	Eye-Strain-Freq.	0.017	8.28e-01	
Total-Years	Eye-Disorder	Nan	Nan	
Total-Years	Percerved-Effect	Nan	Nan	
Total-Years	Eye-Strain-Freq.	-0.181	4.28e-02	*
Eye-Disorder	Percerved-Effect	Nan	Nan	
Eye-Disorder	Eye-Strain-Freq.	Nan	Nan	
Percerved-Effect	Eye-Strain-Freq.	Nan	Nan	

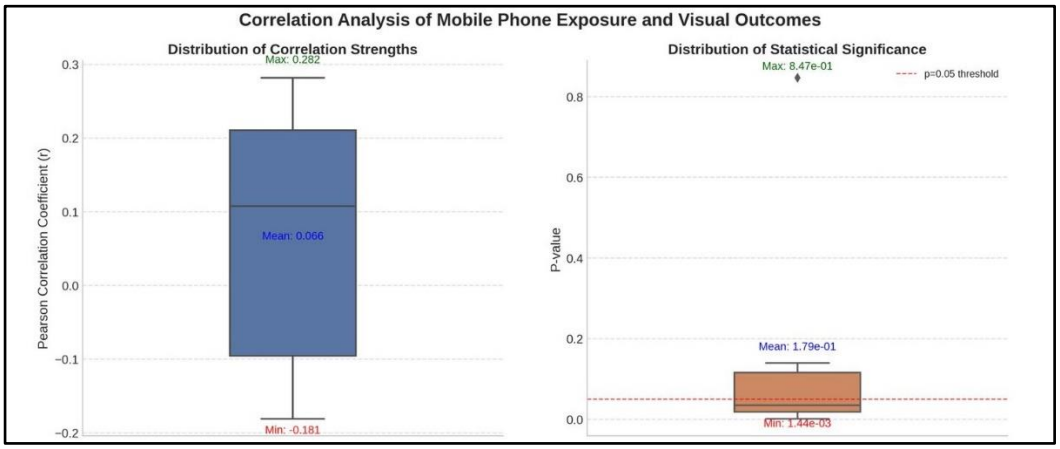

Figure 3. The statistical analysis of mobile phone use and exposure

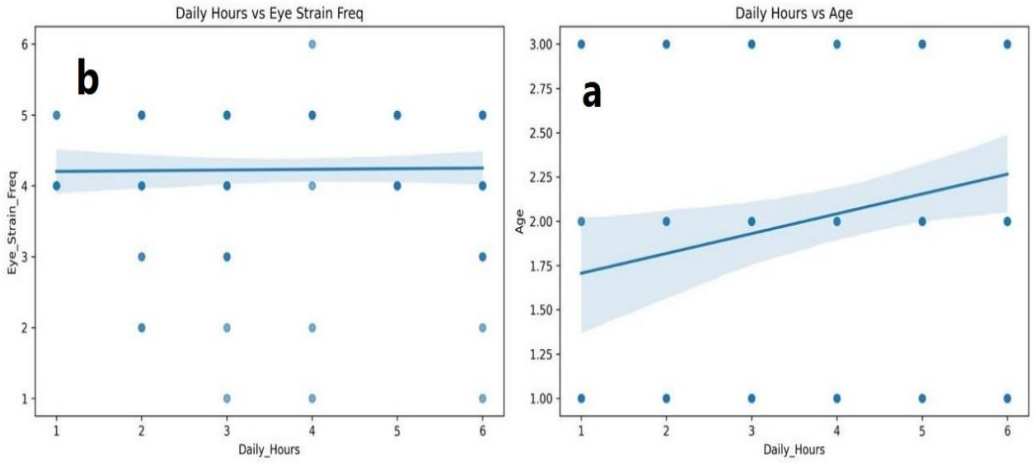

Figure 4. Relationship between (a) age with daily use, (b) eye-strain with daily use

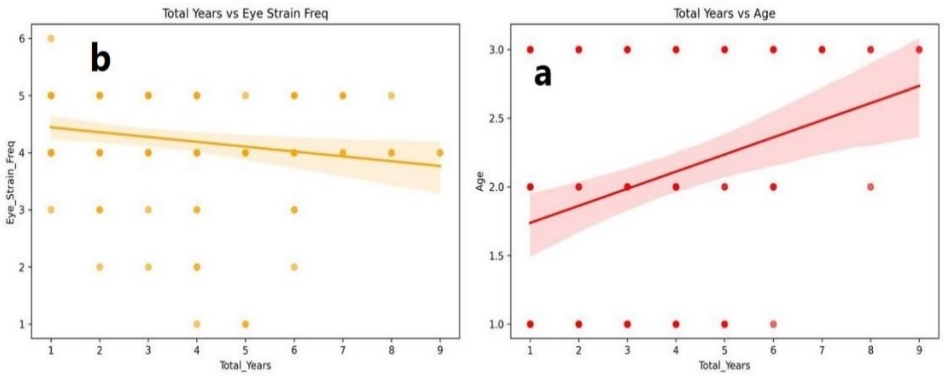

Figure 5. Relationship between (a) age with total use, (b) eye-strain with total use

Our findings differ from much of the existing literature, which generally indicates a stronger association between screen exposure and adverse ocular outcomes. For example, meta-analyses have demonstrated that increased daily screen time is associated with a higher risk of myopia development in children, with one study reporting a 21% increase in odds of myopia for each additional hour of daily screen time [18]. Similarly, Huang et al. confirmed in a large systematic review of over 300,000 participants that screen use contributes significantly to myopia progression, especially in children with limited outdoor activity [19]. In contrast, our study found only weak correlations with symptomatic outcomes such as eye strain, which may reflect differences in outcome measures. While refractive error and axial length represent objective endpoints, subjective symptom reporting may be influenced by awareness, recall bias, and variability in children's ability to articulate discomfort.

Figure (6) describes the prevalence of symptoms in the survey for this study, as researchers can see the differences among children's eyes and their symptoms.

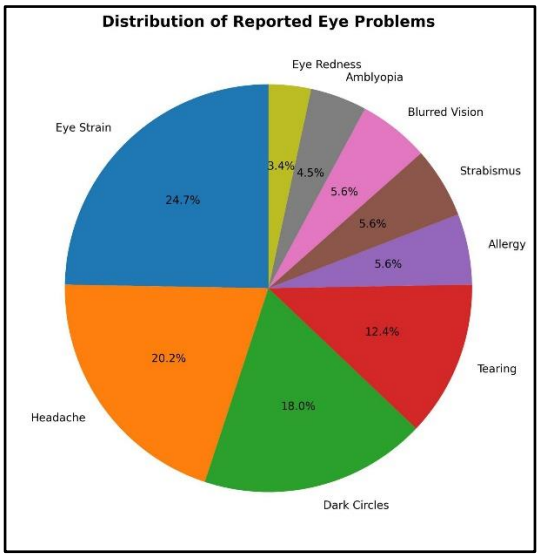

Figure 6. The percentage of prevalence of symptoms

As a comparison with another papers, which was found to have studies focusing specifically on digital eye strain (DES) in children, it reported a higher prevalence of symptoms. Mohan et al. [20], studying children during the COVID-19 pandemic, found that more than 60% reported headaches, blurred vision, or ocular discomfort, with longer screen time and fewer breaks strongly associated with symptoms. Similarly, Alabdulkader [21] reported a 70% prevalence of DES among schoolchildren using devices for more than five hours daily. In contrast, the weaker associations in our sample may be attributable to

lower average exposure times, the absence of continuous online schooling contexts, or adaptation behaviours such as taking breaks, adjusting brightness, or increasing blinking frequency.

Another important consideration is the cross-sectional design of our study, which precludes causal inference. It is possible that children who experience more pronounced discomfort may consciously reduce their device use, resulting in the inverse association we observed between cumulative years of exposure and eye strain. Furthermore, parental reporting may introduce bias; younger children's symptoms may be under-recognized or under-reported compared with older children, contributing to variability in the observed associations.

Despite these limitations, the findings carry practical implications. Although we did not observe strong positive associations between device use and eye strain, prior evidence linking screen exposure with myopia and digital eye strain underscores the need for preventive strategies. Professional guidelines from the American Academy of Ophthalmology and the World Health Organization emphasize moderation, adequate outdoor activity, and regular breaks from near work as essential strategies to mitigate potential long-term risks [22].

Strengths of this study include its focus on a narrow pediatric age group and the use of multiple measures of exposure (daily hours and cumulative years). Limitations include reliance on subjective reports, lack of objective ophthalmic assessments, and the cross-sectional design.

Future research should incorporate longitudinal designs with objective endpoints such as refraction, accommodation, and ocular surface assessment. This would allow clearer delineation of causal relationships and may clarify whether long-term device use exerts subtle but cumulative effects not captured by symptom reporting alone.

4. Conclusion

This study found that while mobile phone use increases with age among children, its direct association with self-reported ocular complaints such as eye strain was weak. In contrast to previous studies demonstrating strong links between prolonged screen exposure and myopia progression or digital eye strain, our findings suggest that symptom-based measures alone may underestimate the true ocular burden of mobile device use. The negative association observed between cumulative years of use and reported eye strain may reflect adaptive behaviors, reporting bias, or reverse causality.

Given the established evidence from other studies linking screen time to refractive development and ocular discomfort, preventive strategies—including limiting near work, encouraging outdoor activity, and adopting the 20-20-20 rule—remain important. Future longitudinal research with objective ophthalmic assessments is needed to clarify causal pathways and quantify long-term risks. Until such data are available, cautious moderation of mobile phone use in children should be recommended as a prudent public health measure.

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