



The Correlation Between Mobile Screen Exposure and Children's Ocular Symptoms: A Survey-Based Analysis

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العلاقة بين التعرض لشاشات الهواتف المحمولة والأعراض العينية لدى الأطفال: تحليل قائم على استبيان

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Abstract:

Background: Due to the widespread use of mobile phones by children, it has become important to look at the effect of screen exposure on the development of ocular health in children. Even though previous research shows that prolonged exposure to screens leads to myopia and digital eye strain, the effect of using a mobile phone needs to be further researched.

Objective: This study aims to investigate the relationship between mobile phone usage and ocular symptoms among children aged 4-12 years. **Methodology:** The current study was a descriptive study of a cross-sectional design that used a survey form for data collection among 126 participants from Wasit governorate. The survey was used to collect information regarding the demographic profile of the sample, their mobile phone usage profile in terms of hours per day and years of use, and the presence of any ocular symptoms, including eye strain. Analysis was done to find any significant associations. **Results:** The analysis revealed mainly weak associations between mobile phone exposure and ocular symptoms. Age had a significant association with hours per day and years of exposure, but an inverse association was observed between years of exposure and eye strain. **Conclusion:** Unlike previous studies, this study only found a very weak association between the use of mobile phones and subjective eye complaints among children. Such results may indicate adaptive behavior on the part of the subjects or bias. However, considering the risk factors that have been found in other studies, moderation in the use of mobile phones is highly recommended.

Keywords: Screen exposure, blue-light, eye strain, symptoms, electromagnetic wave.

المخلص

الخلفية: نظراً للانتشار الواسع لاستخدام الهواتف المحمولة بين الأطفال، أصبح التحقيق في تأثير التعرض للشاشات على صحة العين لدى الأطفال أمراً بالغ الأهمية. وفي حين تربط الأبحاث السابقة بشكل متكرر بين وقت الشاشة المطول وقصر النظر وإجهاد العين الرقمي، فإن الآثار الاعراضية المحددة لاستخدام الهاتف المحمول تستدعي فحصاً إضافياً دقيقاً. **الهدف:** تهدف هذه الدراسة إلى تقصي العلاقة بين أنماط استخدام الهاتف المحمول والأعراض البصرية بين الأطفال تتراوح أعمارهم بين 4 و12 عاماً. **المنهجية:** أجريت دراسة وصفية ذات تصميم مقطعي باستخدام استبيان طبق على 126 مشاركاً من محافظة واسط. جمع الاستبيان البيانات الديموغرافية، وملفات استخدام الهاتف المحمول (ساعات الاستخدام اليومية والسنوات التراكمية)، والأعراض البصرية المبلغ عنها، بما في ذلك إجهاد العين. وأجريت التحليلات الإحصائية لتقييم الارتباطات المحتملة. **النتائج:** كشفت النتائج عن ارتباطات ضعيفة في الغالب بين التعرض للهاتف المحمول والأعراض البصرية الذاتية. وأظهر العمر ارتباطاً معنوياً بكل من ساعات الاستخدام اليومي والسنوات التراكمية للتعرض. ومع ذلك، لوحظ ارتباط عكسي غير متوقع بين سنوات التعرض التراكمية وتكرار إجهاد العين. **الاستنتاج:** خلافاً للنتائج التقليدية، حددت هذه الدراسة ارتباطات ضعيفة للغاية فقط بين استخدام الهاتف المحمول وشكاوى العين الذاتية لدى الأطفال. قد تعكس هذه النتائج أنماط سلوكية تكيفية أو تحيزات في الإبلاغ المنهجي. ومع ذلك، وبالنظر إلى المخاطر المثبتة والموثقة في الأدبيات الأوسع نطاقاً، يظل الاعتدال في استخدام الأجهزة المحمولة للأطفال موصى به بقوة.

الكلمات المفتاحية: التعرض للشاشات، الضوء الأزرق، إجهاد العين، طب عيون الأطفال، إجهاد العين الرقمي.

1. Introduction

In view of developments in mechanics and technology, exposure to electromagnetic fields has steadily risen, resulting in an enhanced level of exposure to electromagnetic waves for humans. The significant increase in the number of mobile phone and tablet users causes concern about possible damage from radiofrequency (RF) waves to people exposed to them [1].

Mobile telephones produce radiation in the radiofrequency region of the electromagnetic spectrum. Mobile telephones (2G, 3G, and 4G) produce RF radiation in the range of 0.7-2.7 GHz. Mobile phones of the fifth generation (5G) will be used in the radiofrequency range of up to 80 GHz [2]. Photochemical reaction is initiated by absorption of photon energy and its further loss as heat in the wavelength region of 390 nm to 480 nm, as shown in Figure 1. Thermal damage may result from excessive exposure to light, such as photokeratitis in skiers [3, 4].

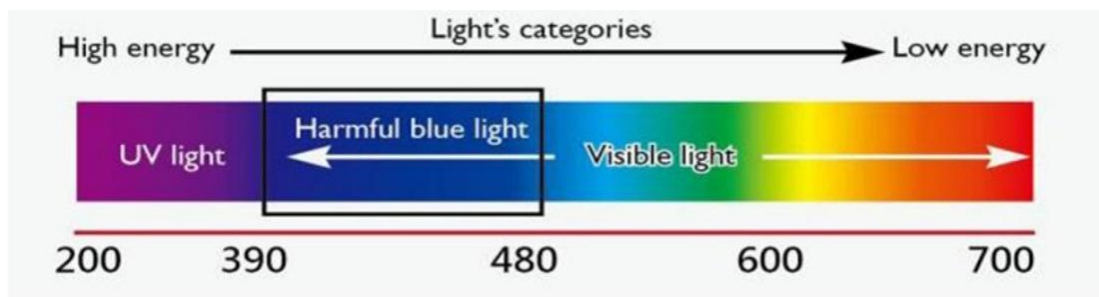


Figure 1: Distribution of blue light in terms of wavelength (λ)

The cornea absorbs ultraviolet light with wavelengths shorter than 300 nm, while the crystalline lens filters the light in the 300–400 nm range, especially the light in the 300–360 nm range, as

shown in Figure 2. As we grow older, there is comparatively more filtering of blue light along with the physiological yellowing of the crystalline lens. The aged crystalline lens has better filtering of blue light. “Blue light hazard is caused by exposure to visible light in the 400–500 nm wavelength range.” [4, 5].

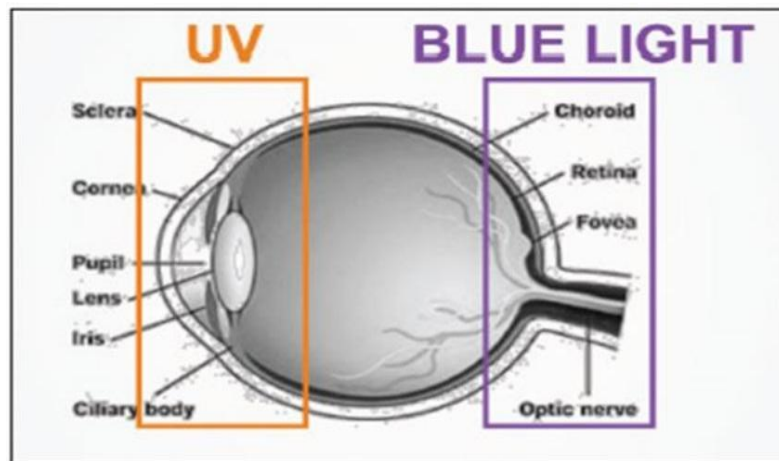


Figure 2: Hazards of light for the retina. The effects of ultraviolet (UV) light are felt by the anterior eye part, while blue light influences the posterior eye part.

Visible rays only can influence the retina, since the cornea and the lens absorb ultraviolet radiation. Therefore, ultraviolet (UV) radiation is considered the main risk factor for age-related macular degeneration [6]. As far as blue light is concerned, it means visible light with wavelengths less than about 440–450 nm and is known as the most intensive radiation of the visible spectrum for the human eye. No scientific data exist on how harmful blue light produced by gadgets is to our eyes. In case some users experience discomfort while using gadgets, it is caused by visual fatigue due to decreased blinking frequency and long-term gazing, which may result in fatigue and dryness of the eyes. However, scientific research shows that blue light affects the circadian rhythm of our body but not ocular health [7–9].

Improper use and overexposure to technology may lead to adverse effects. Current literature on science from around the world has advanced to include possible risks that screens may pose to the eyes of the pediatric population in relation to cell phones and computer screens [10,11]. In some cases, there is lack of recognition regarding the possible damage that could occur to the eyes of a child, which may be seen in behavior patterns like forced blinking, eye pain, rubbing, or tearing [12]. Increased use of mobile phones by certain children has led to disparities in eye health ($p = 0.002$), particularly in terms of the tear film parameters (TBUT and S1T) and corneal thickness. Thus, any effects of radiation and heat that may be generated from mobile phones will affect the eyes and the various parts that constitute it. Some individuals experience more blurriness of vision ($p < 0.05$) because of using cell phones [13–15].

2. Materials and Methods

Many researchers apply surveys to collect data about demographics, background information, knowledge, behavior, and attitude among peers, students, and patients. Proper surveys make it easier to complete, help collect accurate and uniform data, and produce data

ready to be analyzed and answer the research questions [16, 17]. Hence, the current study has been carried out as an observational study in the governorate of Wasit. A total number of 126 subjects have been sampled in this study database. The key parameters of the survey considered in the current study are

1. Sex
2. Age
3. Purpose of using the mobile phone
4. Average daily period of time using the mobile phone
5. Lighting in the room
6. Appearance of any ocular symptoms in the child following the use of mobile phones
7. Frequency of the complaint of eye strains by the child
8. Overall period of using mobile phones
9. Effect of using a mobile phone on a child's vision

All participants have given their consent before answering the survey. Data analysis has been done by using XLStat software, and Table 1 shows the results for each parameter.

3. Result and Discussion

The current research explored the effects of visible radiation mobile phone usage on ocular health parameters among children aged between 4 and 12 years, as shown in Table 1 below.

Table 1: Coding of age in terms of 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

All in all, the correlations between the use of the mobile phones and self-reported eye problems were minimal. The correlation between age and hours of daily usage was moderately high with a p-value of 0.0159, as represented in figure (a-3). This is also evident in figure (b-3), which displays the frequency of eye strain against daily usage. On the other hand, years of usage correlated higher than the daily usage, with a p-value of 0.00144, as presented in figure (a-4). As anticipated, years of exposure to mobile phones correlate positively with frequency of reported eye strain with a p-value of 0.00144, as represented in figure (b-4). The correlation, however, was negative, implying that more years of exposure did not necessarily mean more frequency of eye strain. The majority of the other correlations were insignificant.

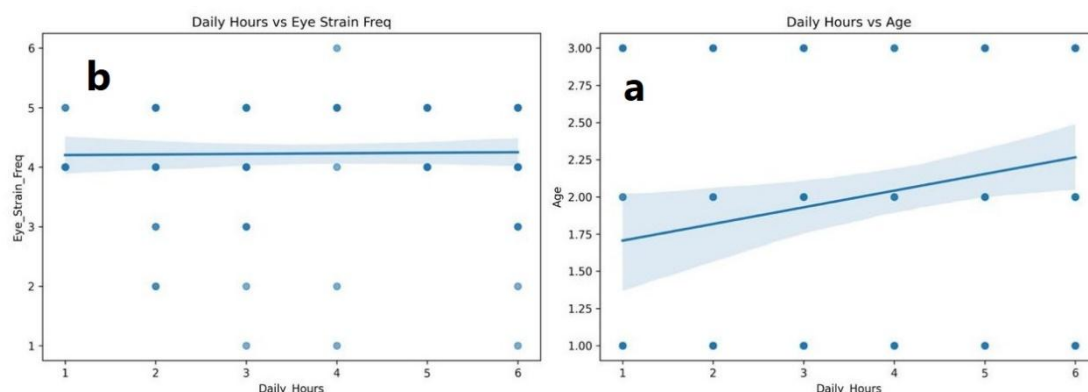


Figure (3): Relationship between (a) age with daily use, (b) eye-strain with daily use.

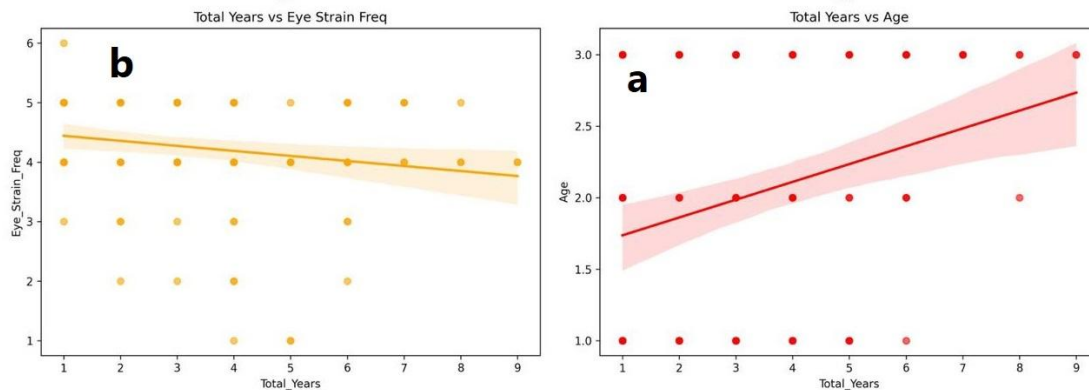


Figure (4): The relationship between (a) age and total use, (b) eye strain and total use

The results of our study differ from many studies that can be found in literature, which commonly describe the existence of a stronger correlation between screen exposure and negative ocular outcomes. For example, a series of meta-analyses concluded that an increasing amount of daily screen time increases the likelihood of developing myopia in children. One particular study showed that the odds ratio of developing myopia was 21% higher for every extra hour of screen use on a daily basis [18]. Huang et al., in turn, confirmed in their large-scale systematic review, which included more than 300,000 participants, that screen use is significantly associated with myopia progression, especially in children who spend little time outside [19]. On the contrary, our study found only weak associations with symptom-based outcomes, like eye strain.

Figure (5) describes the prevalence of symptoms in the survey for this study, as researchers can see the differences among children's eyes and their symptoms.

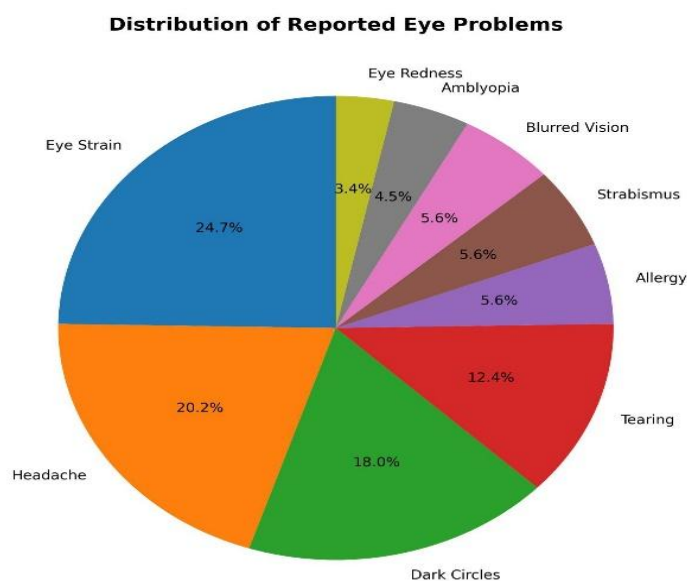


Figure (5): The percentage of prevalence of symptoms.

On the other hand, when compared with different research on DES conducted on children that indicated a high occurrence of symptoms, the study by Mohan et al. [20], which studied pediatric subjects during the COVID-19 pandemic, revealed that more than 60% had headaches, blurry vision, or eye problems, with longer screen time and fewer frequent breaks being very strongly associated with symptoms. Similarly, Alabdulkader [21] indicated that 70% of school-aged children had DES when they spent more than five hours a day using gadgets. Conversely, the weaker associations in this study could be due to shorter mean exposure time or lack of continuous remote schooling and adaptive behaviour.

The other factor is the cross-sectional study design, which makes causality impossible. It is possible that children who have more pain will consciously limit their use of the devices, which leads to the inverse relationship found between the total number of years exposed and eye strain. Another factor that could influence the results of the study is parent reporting; young children may not experience the pain as much as older children.

However, despite such limitations, the results have real-world applications. Despite a lack of strong correlations between the use of devices and eyestrain, previous research has shown that there is indeed a link between screen time and the development of myopia as well as digital eyestrain, thus making it necessary to take precautionary steps to prevent any problems in the future [22].

This study's strengths lie in the restriction of age range and in the use of several exposure measures in addition to time use (both daily hours and cumulative years). Among the limitations are the subjective nature of data collection, the lack of any objective eye examination, and the cross-sectional design.

Further research will need to employ longitudinal designs that utilize objective outcomes, like refraction and ocular surface evaluation, instead of symptoms. This could potentially allow for clarification of any causative relationship and whether long device usage has any cumulative effect on the eyes.

4. Conclusion

Despite age being a factor that correlates positively with mobile phone usage in children, this study shows that there is no significant correlation between mobile phone usage and ocular complaints such as eye strain. This result goes against what previous studies have found on the connection between mobile phone usage and either myopia or digital eye strain. In other words, this study shows that the ocular burden of mobile phones cannot be determined by relying solely on symptom-based measures.

Considering that many scientific studies have already demonstrated the risk posed by screen usage regarding refraction and eye complaints, it is necessary to maintain preventive approaches such as reducing near work activities, engaging in outdoor activities, and following the 20-20-20 rule. Further studies will be needed in order to determine the mechanisms involved in this process and to quantify the risks.

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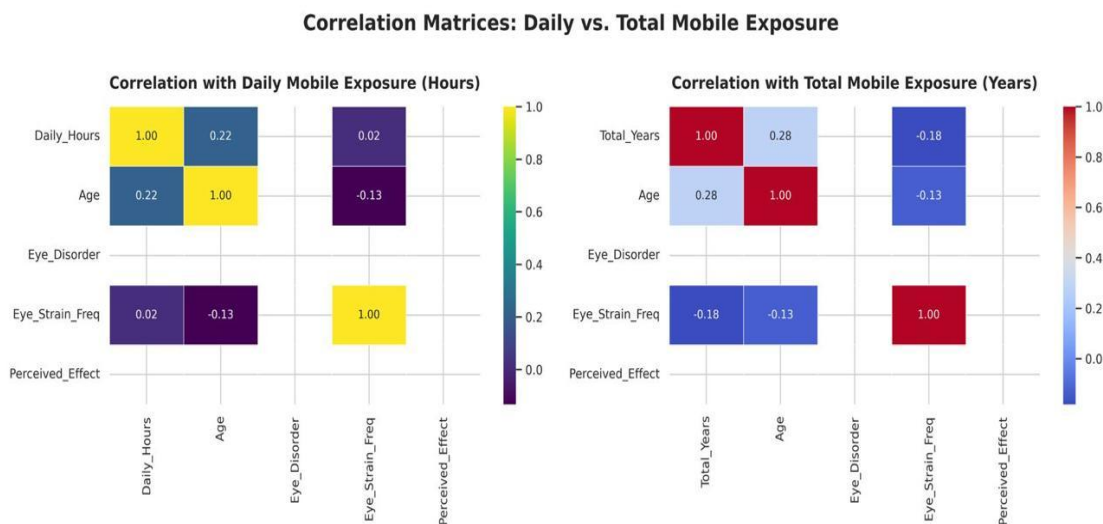
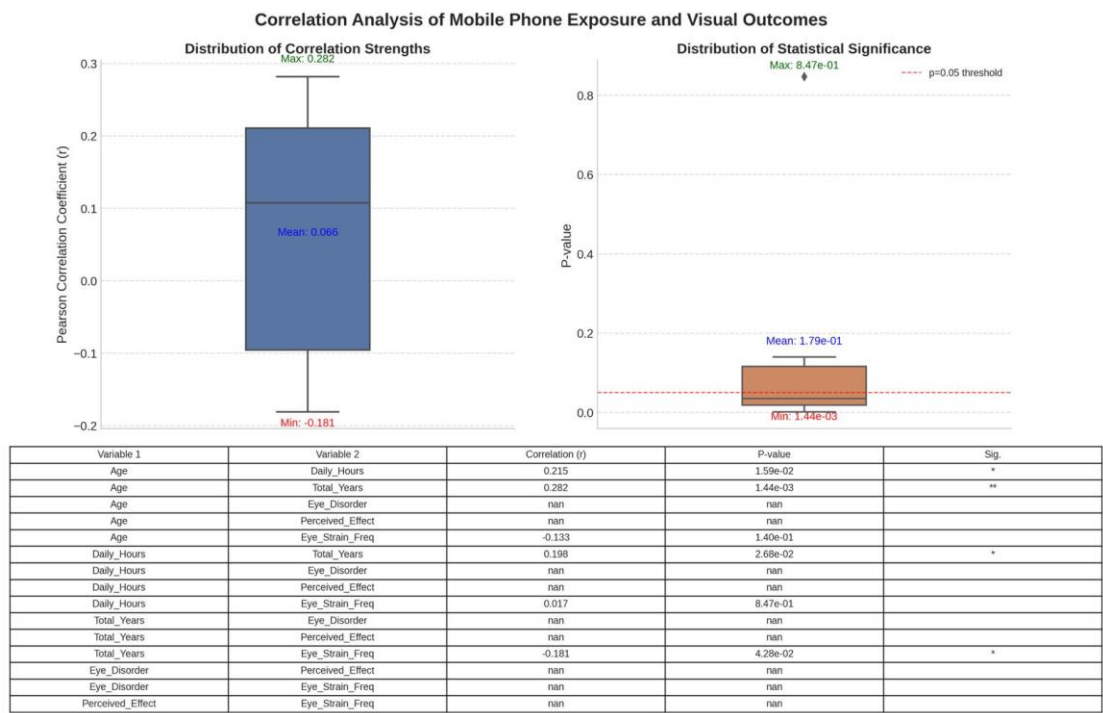
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For more details, the two figures was attached.



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