Original Article

The Impact of Electronic Digital Device on Vision in Children

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Abstract

Background: Overuse of electronic digital device (EDD) can be considered one of the risk factors of visual damage, one of the most common problems is visual fatigue (asthenopia), and this when affect children may cause a lot of problems in school performance. **Objective:** This study aimed to evaluate asthenopia due to digital device among children, aged 5–16 years. **Materials and Methods:** The study included 300 children. Their (EDD) usage and its visual effect were surveyed, and we used organized and self-administered questionnaire. Communication with the target group was by sending invitations through social media. **Results:** Three hundred children aged 5–16 years, male 65% and female 35%, were using EDD daily. A total of 52.3% have been using these devices for 5–10 years. Majority of patients (N = 92, 30.7%) spend more than 6 h on phone daily, and those using device at bedtime with switching off light represent N = 165 (55.0%), using of program in mobile against blue light was positive in N = 114 (38.0%). Severe headache was positive in N = 68 (22.7%). Severe eye pain and eye fatigue were positive in N = 60 (20.0%). There was significant relation between eye strain symptoms and (duration of mobile use (years), daily time spent on mobile, and program against blue light, P values were less than 0.001. **Conclusions:** Digital eyestrain at a young age is a new concern brought on by adolescents' growing use of digital devices. Our study details the ways in which school-aged children use electronic devices, assesses risk factors for eyestrain, and underlines the need for more research into these problems.

Keywords: Asthenopia, EDD, eyestrain, visual fatigue

Introduction

Asthenopia is the term for the subjective experience of eyestrain or visual tiredness. Extraocular muscle imbalance, uncorrected refractive errors, accommodative dysfunction, and poor illumination are all contributing factors.[1] Watery eyes, double vision, blurry vision, itching, sore eyes, headaches, a dry eye sensation, and redness are common symptoms of asthenopia in patients.[2]

The severity of the symptoms and signs may impair everyday activities and hasten the onset of age-related eye disorders.[3] Asthenopia is a result from excessive accommodation and vergence processes like those who spend a lot of time staring at "video display units (VDU)." Although children are increasingly using new technology tools like smartphones, computers, and videogames, the prevalence of asthenopia in youngsters is unknown.[4-8] When asthenopia affects children, this visual fatigue may cause a lot of problems in attention, reading, writing, memory, and hence performance at the school.[8]

A recent study revealed that the frequency of asthenopia in children is around 19.7%.[9] Those who use their phones and other gadgets for longer periods of time experience severe accommodation problems, extraocular muscle strains, and frequently exhibit asthenopia.[10] With the coronavirus outbreak, people are increasingly relying on their "electronic digital devices (EDD)" to do their work and learn in class. All age groups will experience a gradual loss in ocular health as a result of this.[11] People are more susceptible to asthenopic symptoms due to prolonged eye exposure to computer screens, cell phones, and social media use because of their scholastic duties and lengthy study sessions.[12] There are not many researches that compare the prevalence of asthenopia to other ocular

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disorders and diseases. But still, the prevalence rates ranged from 12.4% to 32.2% for those under the age of 18 years, to 57% for those under the age of 30 years.[13] The symptoms of EDD are divided into four groups: ocular surface-related, extraocular, visual, and asthenopia. Blehm *et al.*[14] increased the incidence of asthenopia, which is linked to wide use of electronic learning that conducted on the Internet, where students can administer their learning materials online at any time and place with long sessions without proper breaks[15] It is advised to take frequent breaks and look away from the computer at a faraway object at least twice an hour to prevent the symptoms.[16] Now, day children are differing from adults concerning the use of mobile phone, iPad, and tablet for longer time exposure when they become older. Although, little is known about the contemporary incidence of EDD using in children in Iraq. The majority of the information now available on EDD usage and its detrimental effects comes from adult studies and earlier research.

Materials and Methods

A cross-sectional study was performed over the period from October 2020 to April 2021, on 300 children, aged 5–16 years.

Study design

In this cross-sectional study surveyed, asthenopia in children who used EDD in Babylon governate in Iraq close to the coronavirus disease 2019 (COVID-19) pandemic. The study population was randomly selected. A questionnaire was designed by the researcher. Because of the difficulty of understanding the eyestrain, the word "asthenopia" and its symptoms, which include eye pain, blurriness, itchiness, moist eyes, and headaches, were explained to the kids before the questionnaire was administered. Children were questioned regarding the EDD they used (iPad, smartphone, and tablet), the average number of hours they spent using them each day, and how long they had been using EDD annually.

Further data on elements that may influence eye symptoms, such as the usage of glasses and the use of electronics at night with the lights out, was also obtained. Since EDD usage is more likely to begin in children between the ages of 5 and 16 years old, we restricted our target sample to those in this age range. The decision to only interview guardians for this survey was primarily motivated by the ethical worry that youngsters might not completely understand the study's validity. Three sections make up the questionnaire. The first component of the questionnaire asked for sociodemographic information. In the second section, questions about visual clinical manifestations such as headache, eye pain and weariness, itching, redness, and weeping were used to evaluate asthenopia. For each question, there were four possible answers, each worth one to four points (1 = never, 2 = mild, 3 = moderate, and 4 = severe). The third section dealt with the EDD that the sample population used, the average daily usage time, and other variables that may have an impact on visual symptoms, such as the use of eyeglasses and using EDD at night when the lights are off. Due to restrictions brought on by the COVID-19 epidemic, data were gathered utilizing a self-administered Arabic questionnaire that was posted online.

Data analysis

To do the statistical analysis, the Statistical Package for the Social Sciences (SPSS) version 27.0 (SPSS, IBM Company, Chicago, IL, USA) was used. Frequencies and percentages were used to present categorical variables. Means and standard deviations were used to present continuous variables. To determine the relationship between categorical variables, the Pearson Chi-square test was performed. The means of the four groups were compared using the analysis of variance test. *P* values under 0.05 were regarded as significant.

Ethical approval

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients verbal and analytical approval before sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee according to the document number 676 (including the number and the date on 11/08/2020) to get this approval.

Results

Table 1 and Figure 1 display the distribution of patients by sociodemographic details, such as (age and gender). Patients' average ages ranged from 8.32 to 2.36, with the oldest patient being 16 years old and the youngest being 5 years. The majority of patients (N = 195, 65.0%) were males.

Figure 2 displays the distribution of studied subjects according to the duration of mobile use (years) including (<5, 5–10 and ≥10 years). The mean duration of mobile use was (5.20 ± 2.34) with a maximum duration was 12 years and a minimum duration was 1 year. Patients using mobile for less than 5 years represent N = 119 (39.7%), patients using mobile for 5–10 years represent N = 157 (52.3%),

Table 1: The patients' distribution by sociodemographic traits (N = 300)

Sociodemographic characteristics		
Age (years)	8.32 ± 2.36	5–16
Gender	Number	Percent
Female	105	35.0
Male	195	65.0
Total	300	100

and patients using mobile for ≥10 years represent $N = 24$ (8.0%).

Figure 3 displays patients' distribution according to occupation of mother including (housewife and employee). Housewives represent $N = 183$ (61.0%) and employee mothers represent $N = 117$ (39.0%).

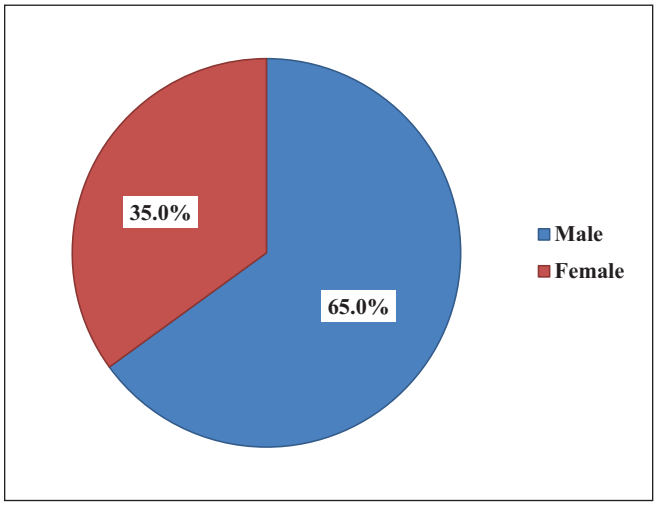

Figure 1: The distribution of patients according to gender ($N = 300$)

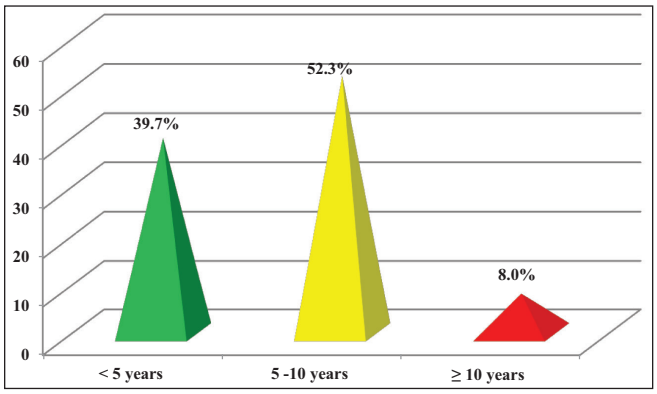

Figure 2: Patient distribution based on number of years of mobile use ($N = 300$)

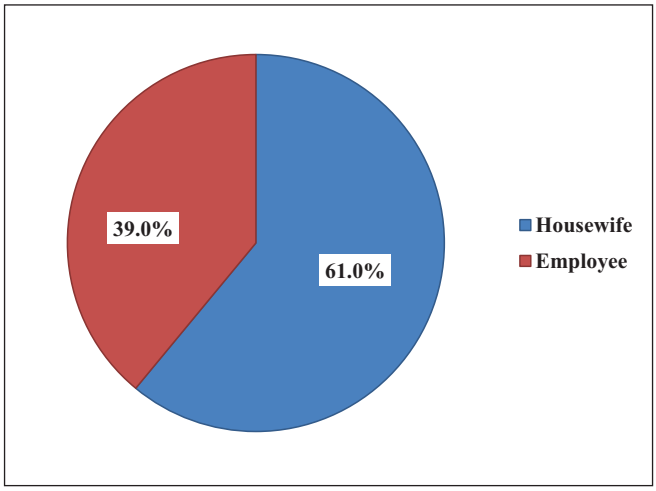

Figure 3: Patients' distribution based on mother's profession ($N = 300$)

Table 2 shows patients' distribution according to study variables including (type of digital device, daily time spent on phone, eyeglasses wearing, using the device at bedtime with switching off light, using phone owner and program in mobile against blue light). Majority of patients ($N = 178$, 59.3%) use mobile, majority of patients ($N = 92$, 30.7%) spend more than 6 h on phone daily. Only $N = 65$ (21.7%) wear eyeglasses, using device at bedtime with switching off light represent $N = 165$ (55.0%), child owner for device used represent $N = 115$ (38.3%), using of program in mobile against blue light was positive in $N = 114$ (38.0%).

Table 3 and Figures 4-6 the prevalence of eye strain symptoms (including headache, redness, itching and tearing, and eye pain and eye fatigue) among study patients. Prevalence of headache was 65.7%. Prevalence of redness, itching and tearing was 42.0%. Prevalence of eye pain and eye fatigue was 52.0%.

Table 4 shows distribution of patients according to eye strain symptoms including (headache, redness, itching and tearing, and eye pain and eye fatigue). Severe headache

Table 2: Patients distribution of according to study variables ($N = 300$)

Study variables	Number	%
Type of digital device		
Mobile	178	59.3%
I pad	67	22.3%
Tablet	55	18.4%
Total	300	100.0%
Daily time spent on phone		
<1 h	57	19.0%
<4 h	82	27.3%
<6 h	69	23.0%
>6 h	92	30.7%
Total	300	100.0%
Eyeglasses wearing		
Yes	65	21.7%
No	235	78.3%
Total	300	100.0%
Using device at bedtime with switching off light		
Yes	165	55.0%
No	135	45.0%
Total	300	100.0%
Using phone owner		
Child	115	38.3%
Family	185	61.7%
Total	300	100.0%
Program in mobile against blue light		
Yes	114	38.0%
No	186	62.0%
Total	300	100.0%

Table 3: Prevalence of eye strain symptoms among study patients ($N = 300$)

Eye strain symptoms	Number	%
Headache		
Positive	197	65.7%
Negative	103	34.3%
Total	300	100.0%
Redness, itching, and tearing		
Positive	126	42.0%
Negative	174	58.0%
Total	300	100.0%
Eye pain and eye fatigue		
Positive	156	52.0%
Negative	144	48.0%
Total	300	100.0%

Table 4: Distribution of patients based on eye strain symptoms ($N = 300$)

Eye strain symptoms	Number	%
Headache		
Never	103	34.3%
Mild	63	21.0%
Moderate	66	22.0%
Severe	68	22.7%
Total	300	100.0%
Redness, itching, and tearing		
Never	174	58.0%
Mild	37	12.3%
Moderate	47	15.7%
Severe	42	14.0%
Total	300	100.0%
Eye pain and eye fatigue		
Never	144	48.0%
Mild	55	18.3%
Moderate	41	13.7%
Severe	60	20.0%
Total	300	100.0%

was positive in $N = 68$ (22.7%). Severe redness, itching, and tearing were positive in $N = 42$ (14.0%). Severe eye pain and eye fatigue were positive in $N = 60$ (20.0%).

Table 5 revealed the mean variations of age/years according to eye strain symptoms. There were significant variations between means of age (years) according to eye strain symptoms (including headache and eye pain and eye fatigue).

Table 6 , Figures 7 and 8 the mean differences of duration of mobile use (years) according to eye strain symptoms (including headache, redness, itching and tearing, and eye pain and eye fatigue). Significant variations between means of duration of mobile use (years) according to eye strain symptoms were observed.

Tables 7–9 show the association between eye strain symptoms (including headache, redness, itching and tearing, and eye pain and eye fatigue) and study variables (including gender, occupation of mother, type of digital device, daily time spent on phone, eyeglasses wearing, using device at bedtime with switching off light, using phone owner and program in mobile against blue light).

Table 10 displayed the mean variations of age/year according to time spent on phone (hours) including (<1 h, <4 h, <6 h, and >6 h). There were significant variations between means of age/year according to time spent on phone (hours).

Discussion

Our study findings were difficult to compare with other reviews owing to the small sample involved in the study, and many definitions of asthenopia could be considered, also we found a lower prevalence of asthenopia in small children due to the problems in understanding the inquiries used in questioner. In our study, prevalence of headache was 65.7%; redness, itching, and tearing was 42.0%; and eye pain and eye fatigue were 52.0%. Children frequently experience eyestrain, according to other studies, similar to the Ip *et al*.[17] study, which examined 1448 children aged 6 and estimated that 12.6% of the sample had asthenopia. A total of 82% of the kids who showed up with the typical eye fatigue symptoms had normal eye exams.[17] In research by Abdi,[18] which examined 216 kids between the ages of 6 and 16, asthenopia was present in 23.1% of the kids. Another study examined 72 children between the ages of 5 and 9 and found that the prevalence of asthenopia was estimated to be 26.4%.[19] Following that, Vilela *et al*.[20] found that among 964 Brazilian adolescents, asthenopia was present 24.7% of the time. Because our study covered a large age range, we observed a high prevalence.

Based on the presence of at least one symptom, research in Kazerun, south of Iran, found that 71% of students over the age of 18 have asthenopia.[13] Another study with a mean participant age of 21 years revealed that asthenopia affected 57% of Chinese students.[3]

In our study, we found that 30% were using mobile more than 6 h and daily time spent on EDD increased with age, there were substantial variations between means of age (years) according to time spent on phone (hours); P value was 0.001. Therefore, it should be decreasing time for adolescents, but this difficult to be practice because most of the student homework depends on EDD. Previous research suggests that teenagers spend between 80 and 840 min per week working on computers.[21-27] Several reasons, like as the excessive use of devices in classrooms as teaching aids and the usage of social networking while playing video games and watching movies, may contribute to an increase in screen time exposure.

Table 5: Mean variations of age (years) according to eye strain symptoms

Eye strain symptoms	*N*	Mean ± SD	F test	*P* value
Headache				
Never	103	7.60 ± 1.96	**9.945**	**<0.001***
Mild	63	8.03 ± 2.08		
Moderate	66	8.50 ± 2.55		
Severe	68	9.49 ± 2.54		
Redness, itching, and tearing				
Never	174	8.16 ± 2.34	0.997	0.395
Mild	37	8.19 ± 2.34		
Moderate	47	8.74 ± 2.45		
Severe	42	8.60 ± 2.39		
Eye pain and eye fatigue				
Never	144	7.95 ± 2.20	**4.186**	**0.006***
Mild	55	8.33 ± 2.24		
Moderate	41	8.27 ± 2.61		
Severe	60	9.22 ± 2.48		

SD = standard deviation

*P value < 0.05 is significant

Table 6: The mean differences of duration of mobile use (years) according to eye strain symptoms

Eye strain symptoms	*N*	Mean ± SD	F test	*P* value
Headache				
Never	103	4.60 ± 2.05	**7.134**	**<0.001***
Mild	63	4.86 ± 2.24		
Moderate	66	5.52 ± 2.16		
Severe	68	6.13 ± 2.69		
Redness, itching, and tearing				
Never	174	5.11 ± 2.27	0.408	0.747
Mild	37	5.14 ± 2.32		
Moderate	47	5.32 ± 2.36		
Severe	42	5.52 ± 2.65		
Eye pain and eye fatigue				
Never	144	4.96 ± 2.24	**3.584**	**0.014***
Mild	55	4.93 ± 2.02		
Moderate	41	5.15 ± 2.53		
Severe	60	6.07 ± 2.56		

SD = standard deviation

*P value < 0.05 is significant

According to a study done in North India, people who use EDD for more than 2 h/day are more likely to develop cell phone vision syndrome than people who use it for less than 9 h/day. Research done during COVID-19 among schoolchildren revealed a higher prevalence of asthenopia with longer EDD screen exposure and online learning.[28,29]

In our study, we found asthenopia (headache, eye pain, and eye fatigue) increased with age ($P < 0.001$ and $P = 0.006$) subsequently. Asthenopia, particularly dry eyes, over-accommodation, and imbalances in the convergence are common in school-age children.[13] In Taiwan, 63.2% of 11–15-year-old children routinely used mobile programs,, and the incidence of use raised with age.[30]

In our study, although half of participants were normal regarding eye symptoms during using EDD, the severity of symptoms was nearly equal percent (mild, moderate, and sever). According to research conducted by Abuallut *et al.*,[31] mild symptoms included headaches (64.7%), eyestrain from work (70.5%), and eye fatigue (75.3%). The majority of participants in the study on Kim *et al.*[32] experienced mild-to-severe asthenopia, with symptoms including dry eyes and eye strain. Eye strain, headaches, and impaired vision were the most prevalent complaints, prior investigations by Gupta *et al.*[33] showed.

Table 7: Association between eye strain symptoms (headache) and study variables (*N* = 300)

Study variables	Headache				*P* value
	Never	Mild	Moderate	Severe	
Gender					0.519
Male	63 (61.2)	44 (69.8)	46 (69.7)	42 (61.8)	
Female	40 (38.8)	19 (30.2)	20 (30.3)	26 (38.2)	
Total	103 (100.0)	63 (100.0)	66 (100.0)	68 (100.0)	
Mother occupation					0.971
Housewife	64 (62.1)	37 (58.7)	41 (62.1)	41 (60.3)	
Employee	39 (37.9)	26 (41.3)	25 (37.9)	27 (39.7)	
Total	103 (100.0)	63 (100.0)	66 (100.0)	68 (100.0)	
Type of digital device					0.42
Mobile	61 (59.2)	43 (68.2)	38 (57.6)	36 (52.9)	
I pad	23 (22.3)	10 (15.9)	13 (19.7)	21 (30.9)	
Tablet	19 (18.5)	10 (15.9)	15 (22.7)	11 (16.2)	
Total	103 (100.0)	63 (100.0)	66 (100.0)	68 (100.0)	
Daily time spends on phone					**<0.001***
<1 h	39 (37.9)	11 (17.5)	6 (9.1)	1 (1.5)	
<4 h	41 (39.8)	13 (20.6)	14 (21.2)	14 (20.6)	
<6 h	13 (12.6)	17 (27.0)	18 (27.3)	21 (30.8)	
>6 h	10 (9.7)	22 (34.9)	28 (42.4)	32 (47.1)	
Total	103 (100.0)	63 (100.0)	66 (100.0)	68 (100.0)	
Eye glasses wearing					0.631
Yes	18 (17.5)	15 (23.8)	15 (22.7)	17 (25.0)	
No	85 (82.5)	48 (76.2)	51 (77.3)	51 (75.0)	
Total	103 (100.0)	63 (100.0)	66 (100.0)	68 (100.0)	
Using device at bedtime with switching off light					0.079
Yes	46 (44.7)	38 (60.3)	40 (60.6)	41 (60.3)	
No	57 (55.3)	25 (39.7)	26 (39.4)	27 (39.7)	
Total	103 (100.0)	63 (100.0)	66 (100.0)	68 (100.0)	
Using phone owner					**0.01***
Child	28 (27.2)	23 (36.5)	34 (51.5)	30 (44.1)	
Family	75 (72.8)	40 (63.5)	32 (48.5)	38 (55.9)	
Total	103 (100.0)	63 (100.0)	66 (100.0)	68 (100.0)	
Program in mobile against blue light					**<0.001***
Yes	71 (68.9)	25 (39.7)	9 (13.6)	9 (13.2)	
No	32 (31.1)	38 (60.3)	57 (86.4)	59 (86.8)	
Total	103 (100.0)	63 (100.0)	66 (100.0)	68 (100.0)	

*P value < 0.05 is significant

Digital screens emit blue light, also known as high-energy visible light wavelengths. The eye is vulnerable to blue light exposure, and over time the cumulative harm may worsen eye conditions (such as age-related macular degeneration).[34] In this study, the results found that there is a very strong relationship between using a program in EDD to protect eyes from blue light in decreasing all eye symptoms (headache, eye pain, fatigue, redness, itching, and tearing, P value (<0.001) for all symptoms. Most of the sample population (90.1%) used smartphones at bedtime or after turning off the lights, while a small group (9.9%) did not, with (P = 0.028).[31] According to a different study by Antona *et al*.,[35] reading an EDD for an extended period of time can increase asthenopic symptoms compared with reading a book in a comparable setting. When using a gadget in low light, symptoms could get worse. In our study, about half of 55% (165) using EDD at bedtime with switching off light and there is no significant relation with all asthenopia symptoms according to the P value, whereas according to research by Ichhpujani *et al*.,[36] 19.3% (111) of people used their smartphones while in bed with the lights off. It was noticed to get bigger with age.[36]

In our study, about 178 (59.3%) of participants using smartphone, but there is no significant relation with eye symptoms according to P value, which is agree with the result of Abuallut *et al*.[31] study.

Table 8: Association between eye strain symptoms (redness, itching, and tearing) and study variables (*N* = 300)

Study variables	Redness, itching and tearing				*P* value
	Never	Mild	Moderate	Severe	
Gender					0.644
Male	109 (62.6)	26 (70.3)	30 (63.8)	30 (71.4)	
Female	65 (37.4)	11 (29.7)	17 (36.2)	12 (28.6)	
Total	174 (100.0)	37 (100.0)	47 (100.0)	42 (100.0)	
Mother occupation					0.763
Housewife	102 (58.6)	23 (62.2)	30 (63.8)	28 (66.7)	
Employee	72 (41.4)	14 (37.8)	17 (36.2)	14 (33.3)	
Total	174 (100.0)	37 (100.0)	47 (100.0)	42 (100.0)	
Type of digital device					0.746
Mobile	105 (60.4)	25 (67.6)	23 (48.9)	25 (59.6)	
I pad	38 (21.8)	6 (16.2)	14 (29.8)	9 (21.4)	
Tablet	31 (17.8)	6 (16.2)	10 (21.3)	8 (19.0)	
Total	174 (100.0)	37 (100.0)	47 (100.0)	42 (100.0)	
Daily time spent on phone					0.096
<1 h	42 (24.2)	5 (13.5)	3 (6.4)	7 (16.7)	
<4 h	51 (29.3)	7 (18.9)	15 (31.9)	9 (21.4)	
<6 h	34 (19.5)	12 (32.5)	14 (29.8)	9 (21.4)	
>6 h	47 (27.0)	13 (35.1)	15 (31.9)	17 (40.5)	
Total	174 (100.0)	37 (100.0)	47 (100.0)	42 (100.0)	
Eye glasses wearing					0.466
Yes	35 (20.1)	7 (18.9)	10 (21.3)	13 (31.0)	
No	139 (79.9)	30 (81.1)	37 (78.7)	29 (69.0)	
Total	174 (100.0)	37 (100.0)	47 (100.0)	42 (100.0)	
Using device at bedtime with switching off light					0.752
Yes	94 (54.0)	23 (62.2)	24 (51.1)	24 (57.1)	
No	80 (46.0)	14 (37.8)	23 (48.9)	18 (42.9)	
Total	174 (100.0)	37 (100.0)	47 (100.0)	42 (100.0)	
Using phone owner					0.484
Child	63 (36.2)	17 (45.9)	16 (34.0)	19 (45.2)	
Family	111 (63.8)	20 (54.1)	31 (66.0)	23 (54.8)	
Total	174 (100.0)	37 (100.0)	47 (100.0)	42 (100.0)	
Program in mobile against blue light					**<0.001***
Yes	91 (52.3)	10 (27.0)	8 (17.0)	5 (11.9)	
No	83 (47.7)	27 (73.0)	39 (83.0)	37 (88.1)	
Total	174 (100.0)	37 (100.0)	47 (100.0)	42 (100.0)	

**P* value < 0.05 is significant

Smaller EDD, such as mobile devices, may be held 20–30 cm away from the eyes, creating the ideal environment for digital eyestrain. A recent research, Long *et al*.[37] study found that nearer distances are associated with severe eyestrain symptoms.

Aziz and Bakir's[38] study showed that text neck syndrome is a risk factor for eye symptoms. Children with neck pain had a strained eye. In contrast, patients with dry eyes were impacted by text neck syndrome, and they felt pain when they closed or opened their eyes. Most patients with eye symptoms spend more than 3 h of playing games, watching TV, and using smartphones daily. Therefore, this affects their eyes immediately.[38]

Our analysis has certain limitations. The first one is that participants in the included studies primarily provided information about their visual function using questionnaires. Due to participants' biased recall or erroneous reporting, the questionnaires themselves may contain errors. EDD use time should be measured using objective tools in future study, and visual acuity testing should be used to assess visual function. The second drawback is the tiny sample size. Our final restriction is that, despite our best efforts to keep those with impaired vision and refractive error out of the study, recent visual issues may have increased the prevalence of eyestrain in the population. However, objective measurement of asthenopia is not possible in any way.

Table 9: Association between eye strain symptoms (eye pain and eye fatigue) and study variables (*N* = 300)

Study variables	Eye pain and eye fatigue				*P* value
	Never	Mild	Moderate	Severe	
Gender					0.266
Male	92 (63.9)	39 (70.9)	30 (73.2)	34 (56.7)	
Female	52 (36.1)	16 (29.1)	11 (26.8)	26 (43.3)	
Total	144 (100.0)	55 (100.0)	41 (100.0)	60 (100.0)	
Mother occupation					0.69
Housewife	88 (61.1)	36 (65.5)	26 (63.4)	33 (55.0)	
Employee	56 (38.9)	19 (34.5)	15 (36.6)	27 (45.0)	
Total	144 (100.0)	55 (100.0)	41 (100.0)	60 (100.0)	
Type of digital device					0.823
Mobile	86 (59.7)	35 (63.6)	25 (61.0)	32 (53.3)	
I pad	31 (21.5)	10 (18.2)	8 (19.5)	18 (30.0)	
Tablet	27 (18.8)	10 (18.2)	8 (19.5)	10 (16.7)	
Total	144 (100.0)	55 (100.0)	41 (100.0)	60 (100.0)	
Daily time spent on phone					**0.002***
<1 h	42 (29.2)	7 (12.7)	4 (9.8)	4 (6.7)	
<4 h	41 (28.5)	13 (23.6)	15 (36.6)	13 (21.7)	
<6 h	25 (17.3)	17 (30.9)	9 (22.0)	18 (30.0)	
>6 h	36 (25.0)	18 (32.8)	13 (31.6)	25 (41.6)	
Total	144 (100.0)	55 (100.0)	41 (100.0)	60 (100.0)	
Eyeglasses wearing					0.206
Yes	27 (18.8)	11 (20.0)	14 (34.1)	13 (21.7)	
No	117 (81.2)	44 (80.0)	27 (65.9)	47 (78.3)	
Total	144 (100.0)	55 (100.0)	41 (100.0)	60 (100.0)	
Using device at bedtime with switching off light					0.691
Yes	78 (54.2)	32 (58.2)	25 (61.0)	30 (50.0)	
No	66 (45.8)	23 (41.8)	16 (39.0)	30 (50.0)	
Total	144 (100.0)	55 (100.0)	41 (100.0)	60 (100.0)	
Using phone owner					0.526
Child	49 (34.0)	23 (41.8)	18 (43.9)	25 (41.7)	
Family	95 (66.0)	32 (58.2)	23 (56.1)	35 (58.3)	
Total	144 (100.0)	55 (100.0)	41 (100.0)	60 (100.0)	
Program in mobile against blue light					**<0.001***
Yes	74 (51.4)	18 (32.7)	5 (12.2)	17 (28.3)	
No	70 (48.6)	37 (67.3)	36 (87.8)	43 (71.7)	
Total	144 (100.0)	55 (100.0)	41 (100.0)	60 (100.0)	

*P value < 0.05 is significant

Table 10: Mean differences of age/year according to time spent on phone (hours)

Study variable	Time spends on phone	*N*	Mean ± SD	F test	*P* value
Age (years)	<1 h	57	7.68 ± 1.83	**6.08**	**0.001***
	<4 h	82	7.93 ± 2.02		
	<6 h	69	8.22 ± 2.41		
	>6 h	92	9.13 ± 2.69		

SD = standard deviation

*P value < 0.05 is significant

Conclusion

Digital eyestrain at a young age is a new concern brought on by adolescents' growing use of digital devices. Our study details the ways in which school-aged children use electronic devices, assesses risk factors for eyestrain, and underlines the need for more research into these problems.

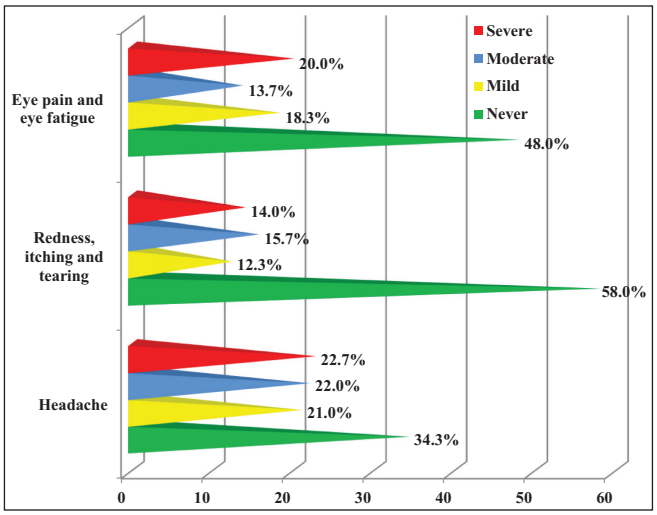

Figure 4: Distribution of patients according to eye strain symptoms ($N = 300$)

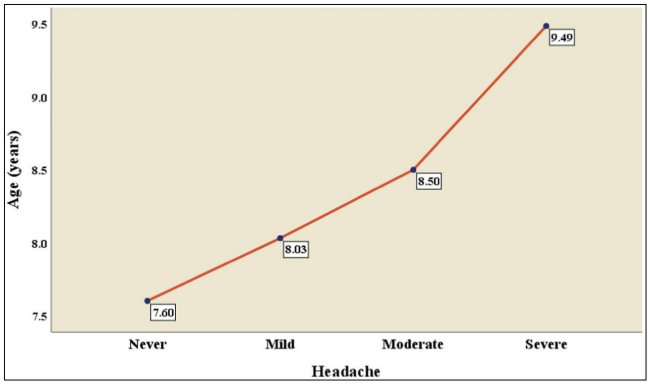

Figure 5: The mean differences of age/years according to eye strain symptoms (headache)

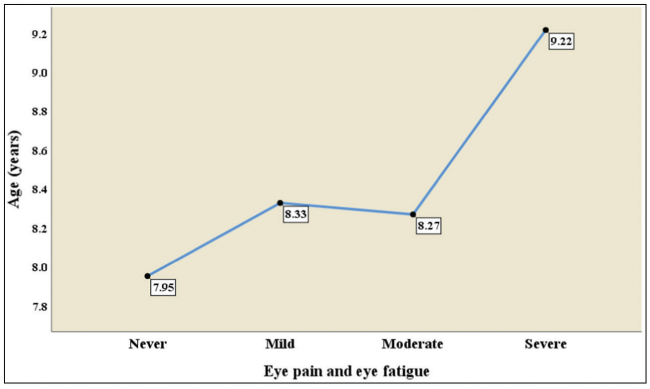

Figure 6: The mean variations of age/years according to eye strain symptoms (eye pain and eye fatigue)

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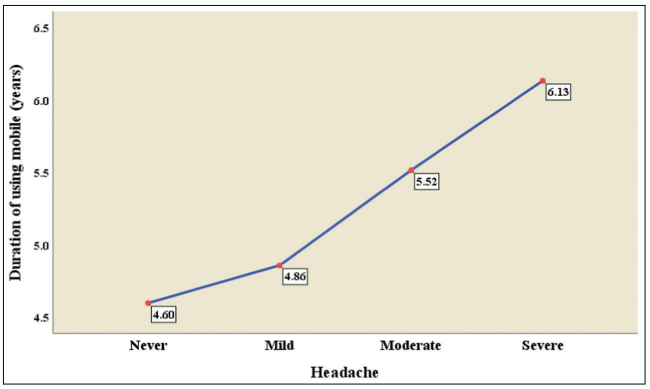

Figure 7: The mean differences of duration of mobile use (years) according to eye strain symptoms (headache)

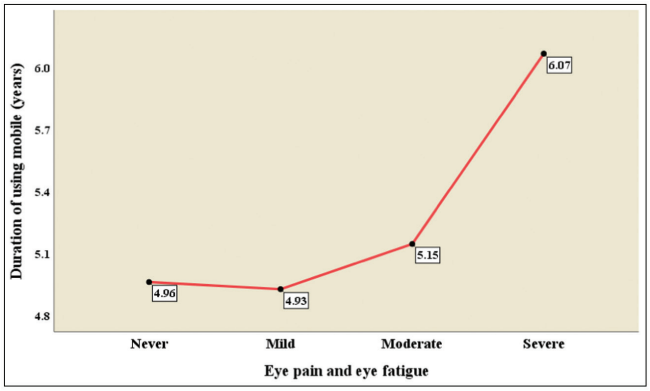

Figure 8: The mean differences of duration of mobile use (years) according to eye strain symptoms (eye pain and eye fatigue)

Conflicts of interest
There are no conflicts of interest.

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