Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-9, Issue-4 | July- August 2023
DOI: 10.53339/aimdr.2023.9.4.9
Page no- 65-72 | Section- Research Article (Ophthalmology)

Effect of Excessive Use of Digital Devices on the Vision of Growing Children Between 5-20 Years of Age

Jahir Uddin Mahmud[1]*, Md Feroj Ali[2], Abu Bakar Siddique[3], Md Naiem Hossain[4]

*[1]Professor and Head, Department of Ophthalmology, Tairunnessa Memorial Medical College & Hospital, Gazipur, Bangladesh.
Email: golamshahnewaz@gmail.com
Orcid ID: 0009-0001-7824-4369
[2]Register, Department of Ophthalmology, Tairunnessa Memorial Medical College & Hospital, Gazipur, Bangladesh.
Email: ferojdr176@gmail.com
Orcid ID: 0009-0001-5508-6492
[3]Medical Officer, Department of Ophthalmology, Tairunnessa Memorial Medical College & Hospital, Gazipur, Bangladesh.
Email: absiddique60tm11@gmail.com
Orcid ID: 0009-0000-2210-4212
[4]Medical Officer, Department of Ophthalmology, Tairunnessa Memorial Medical College & Hospital, Gazipur, Bangladesh.
Email: naiem332733@gmail.com
Orcid ID: 0009-0007-1056-3201

*Corresponding author

Received: 24 March 2023
Revised: 10 April 2023
Accepted: 28 April 2023
Published: 30 June 2023

Abstract

Background: The widespread use of digital devices among children has raised concerns about the potential adverse effects on their vision. This study aimed to investigate the impact of digital devices on the vision of growing children in Bangladesh, focusing on the prevalence of various vision problems and the effect of a -0.50 D Spherical Concave Lens on these issues. **Material & Methods:** This cross-sectional study was conducted in a private chamber of Dhaka, Bangladesh, over 16 months (March 2021-July 2022). A total of 428 children aged 5-20 years were selected, and data was collected using a structured questionnaire through in-person interviews with participants and their legal guardians. Informed consent and ethical approval were obtained. Data analysis was conducted using SPSS V.25 software. **Results:** The study found a high prevalence of myopia (26.87%), asthenopia (10%), eye strain (8%), and mild astigmatism (5%) among the participants. Autorefraction measurements ranged from -2.00D to -10.00 Diopters, with minimal final correction required. The use of a -0.50 D Spherical Concave Lens demonstrated significant improvements in asthenopia, eye strain, and mild astigmatism. **Conclusion:** Our findings highlight the adverse effects of digital devices on the vision of growing children and the potential benefits of interventions, such as the use of a -0.50 D Spherical Concave Lens, in alleviating these issues. Further research and the development of public health policies and educational programs are needed to promote eye health and reduce the adverse effects of digital device use on children's vision.

Keywords:- Digital Device, Ocular, Myopia, Technology, Student

INTRODUCTION

The rapid advancement of technology has led to a significant increase in the use of digital devices among people of all age groups, particularly among children. Over the past few decades, there has been a remarkable shift in the way children engage with digital technology, as devices such as smartphones, tablets, and gaming consoles have become an integral part of their daily lives.[1] However, this widespread adoption of digital devices raises concerns about the potential negative impact on the physical and mental health of children, including their vision. The prevalence of myopia (nearsightedness) and asthenopia (eyestrain) has been associated with prolonged

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use of digital devices in children.[2,3] This study aims to investigate the effect of digital devices on the vision of growing children in Bangladesh, a developing country with a young and rapidly growing population. In Bangladesh, the accessibility and use of digital devices have been increasing exponentially, especially among the urban population. By the year 2020, about 25% of the population had access to the internet, with the majority of users being under the age of 25.[4] With the government's "Digital Bangladesh" initiative, there has been a push to increase digital literacy and access to digital devices across the country.[5,6] Consequently, it is vital to assess the impact of digital device use on the vision of children in Bangladesh to ensure their well-being and healthy development. Previous studies conducted in various countries have reported an association between digital device use and vision problems in children.[7,8,9] A systematic review by Lance et al. (2020) found that children who spent more time using digital devices had a higher prevalence of myopia, with the risk increasing by 2% for every additional hour of screen time per week.[10] Moreover, prolonged exposure to digital screens can also cause digital eye strain or computer vision syndrome, characterized by symptoms such as dryness, irritation, fatigue, and blurred vision.[11] It is essential to determine whether these findings are also applicable to the Bangladeshi context, given the country's unique socio-economic and cultural factors. In addition to the direct impact on vision, the use of digital devices may also contribute to the displacement of time spent on outdoor activities, which has been shown to be protective against myopia development.[12] A study conducted in Taiwan found that children who spent more time outdoors had a lower risk of myopia, even after adjusting for potential confounders, such as parental myopia and time spent on near work.[13] Investigating the balance between digital device use and outdoor activities in Bangladesh will provide valuable insights into the potential role of these factors in the development of vision problems among children. This study will contribute to the growing body of research on the impact of digital device use on children's vision by focusing on the Bangladeshi population. The findings will have significant implications for public health policies and interventions aimed at promoting healthy screen time habits and preventing vision problems in children. Furthermore, the study will also provide a basis for future research on the long-term effects of digital device use on vision and overall health in the Bangladeshi context.

MATERIAL AND METHODS

This observational cross-sectional study was conducted at a private chamber of Dhaka, Bangladesh, equipped with digital vision chart, slit lamp bio-microscope, auto refractometer, near vision chart, color vision chart, and Schirmer test strip. The study duration was 16 months, from March 2021 to July 2022. During this period, a total of 428 children visiting the chamber were selected following the inclusion and exclusion criteria. For inclusion of participants, growing children from pre-school to undergraduate level children within the age of 5-20 years were included. Any children under 5 years of age and adults over 20 years of age were excluded from the study. Data was collected through in-person interview with both the participants and their legal guardians using a structured questionnaire. Informed consent

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was obtained from the guardians prior to data collection, and ethical approval regarding the study was also obtained from the ethical review committee of the study hospital. Collected data was analyzed using SPSS V.25 software.

RESULTS

Of the total participants, 250 (58.40%) were female, while 178 (41.60%) were male. [Table 1]

Table 1: Gender distribution of the participants (n=428).

Gender	n	%
Male	178	41.60%
Female	250	58.40%

Table 2: Age distribution of the participants (n=428).

Age	n	%
5-12	159	37.15%
13-20	269	62.85%

The younger age group, ranging from 5 to 12 years, consisted of 159 participants, accounting for 37.15% of the total sample. The older age group, comprising individuals between 13 and 20 years old, was made up of 269 participants, representing 62.85% of the sample.

Table 3: Age distribution of the participants according to gender (n=428).

Age group	Gender			
	Male		Female	
	n	%	n	%
5-12 (n=159)	83	52.20%	76	47.80%
13-20 (n=269)	86	31.97%	183	68.03%

In the younger age group of 5-12 years (n=159), there were 83 male participants (52.20%) and 76 female participants (47.80%), indicating a relatively balanced distribution. However, in the older age group of 13-20 years (n=269), there was a notable disparity in gender distribution, with 86 male participants (31.97%) and 183 female participants (68.03%).

Table 4: Distribution of digital device usage purpose among the participants (n=428)

Purpose of Digital Device used	n	%
School Project	285	66.59%
Gaming	187	43.69%
Social Networking	152	35.51%
Reading eBooks	130	30.37%
Watching movies/videos	126	29.44%

The most common purpose for using digital devices was for school projects, with 285 participants (66.59%) reporting this use. Gaming was the second most common purpose, with 187 participants (43.69%) engaging in this activity. Social networking was reported by 152 participants (35.51%), while

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reading eBooks and watching movies/videos were reported by 130 (30.37%) and 126 (29.44%) participants, respectively.

Table 5: Distribution of participants by digital device usage habits (n=428)

Usage Habits	**n**	**%**
Time Spent on DD		
<2 hours	166	38.79%
2-4 hours	187	43.69%
4-6 hours	61	14.25%
>6 hours	14	3.27%
Time spent reading on DD		
<2 hours	147	34.35%
2-4 hours	203	47.43%
4-6 hours	56	13.08%
>6 hours	22	5.14%
Reading distance to device		
<25 cm	71	16.59%
25-40 cm	239	55.84%
>40 cm	119	27.80%

In terms of time spent on digital devices (DD), 166 participants (38.79%) reported using them for less than 2 hours per day, while 187 participants (43.69%) used them for 2-4 hours daily. A smaller percentage of participants, 61 (14.25%), reported 4-6 hours of daily usage, and only 14 participants (3.27%) used digital devices for more than 6 hours per day. Regarding time spent reading on digital devices, 147 participants (34.35%) spent less than 2 hours per day, while the majority, 203 participants (47.43%), spent 2-4 hours per day. A smaller group, 56 participants (13.08%), reported 4-6 hours of daily reading time, and 22 participants (5.14%) spent more than 6 hours per day reading on their devices. In terms of reading distance to the device, 71 participants (16.59%) reported reading at a distance of less than 25 cm, while the majority, 239 participants (55.84%), read at a distance between 25 and 40 cm. A smaller group of 119 participants (27.80%) reported reading at a distance greater than 40 cm.

Table 6: Prevalence of different vision problems among the participants (n=428)

Vision Problem	**n**	**%**
Myopia	115	26.87%
Asthenopia	43	10.00%
Eye Strain	34	8.00%
Mild Astigmatism	21	5.00%
Hyperopia	50	11.68%
Astigmatism	65	15.19%
Other vision problems	20	4.67%

Myopia had the highest prevalence rate, reported by 115 individuals (26.87%). Hyperopia and astigmatism were also common, with prevalence rates of 11.68% and 15.19%, respectively. Asthenopia,

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Page no- 65-72 | Section- Research Article (Ophthalmology)

eye strain, mild astigmatism, and other vision problems were less prevalent, with rates ranging from 4.67% to 10%.

Table 7: Autorefraction and Correction Measurements (n=428)

Measurement	Range	n	%
Autorefraction (High values)	-2.00D to -10.00D	80	18.69%
Final Correction (No previous refractive error)	-0.50 D Spherical Concave Lens	200	46.73%
Final Correction (Unknown refractive errors)	Myopia/Myopic Astigmatism - 0.50 to -0.75 D Spherical Concave Lens	148	34.58%

A notable number of participants, 80 (18.69%), exhibited high autorefraction values ranging from -2.00 to -10.00 Diopters. However, the final correction required was minimal. For participants without previous refractive errors, 200 (46.73%) required a -0.50 D Spherical Concave Lens for correction. Among those with unknown refractive errors, 148 participants (34.58%) needed correction for myopia or myopic astigmatism, in addition to the -0.50 D Spherical Concave Lens for final tuning.

Table 8: Prevalence of Vision Problems and the Effect of -0.50 D Spherical Concave Lens (n=428)

Vision Problem	n	%	Improvement After -0.50 D Spherical Concave Lens
Asthenopia	43	10.05%	Yes
Eye strain	34	7.94%	Yes
Mild astigmatism (Corrected by separate minus/concave cylinders)	21	4.91%	Yes

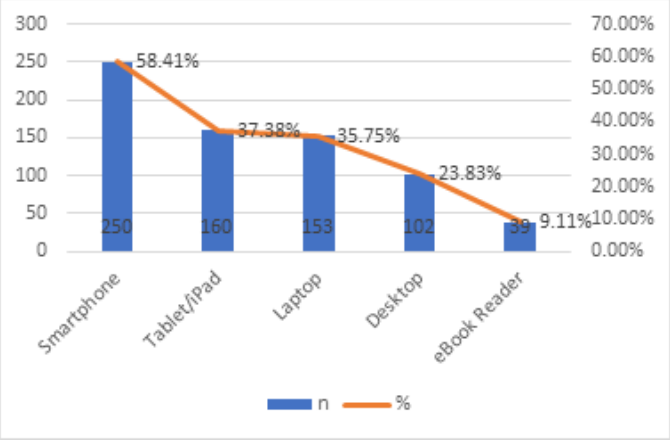

Figure 1: Distribution of digital device usage among the participants (n=428)

The most commonly used digital device was the smartphone, with 250 participants (58.41%) reporting its use. Tablets and iPads were used by 160 participants (37.38%), followed by laptops, which were used by 153 participants (35.75%). Desktop computers were utilized by 102 participants (23.83%), and the least commonly used device was the eBook reader, with only 39 participants (9.11%) reporting its use. [Figure 1]

Asthenopia was found in 43 participants (10%), eye strain in 34 participants (8%), and mild astigmatism in 21 participants (5%). Mild astigmatism was corrected by using separate concave cylinders ranging from 0.50D to .075. The use of the -0.50 D Spherical Concave Lens resulted in improvements for all these vision problems. These findings suggest that the -0.50

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D Spherical Concave Lens may have a significant positive impact on the vision of growing children who use digital devices, alleviating issues such as asthenopia, eye strain, and mild astigmatism. [Table 8]

DISCUSSION

In the present study, we investigated the effect of digital devices on the vision of growing children in Bangladesh, focusing on the prevalence of various vision problems and the impact of a -0.50 D Spherical Concave Lens on these issues. The gender distribution in our study population was fairly balanced, with 41.60% male and 58.40% female participants. Previous studies have reported similar gender distributions in studies assessing the impact of digital devices on children's vision.[8,10] The age distribution of the participants showed that the majority (62.85%) were aged between 13 and 20 years, while 37.15% were between 5 and 12 years. A study by Williams et al. (2015) found a comparable age distribution, with a higher prevalence of vision problems in older children due to increased exposure to digital devices.[14] Our study also revealed differences in age distribution according to gender, which may have implications for understanding how digital devices affect vision differently in males and females. Regarding digital device usage, smartphones were the most commonly used devices (58.41%), followed by tablets/iPads (37.38%), laptops (35.75%), desktops (23.83%), and eBook readers (9.11%). This finding aligns with a study by Jones et al. (2016), which reported a similar distribution of digital device usage in children and adolescents.[15] Our study found that digital devices were primarily used for school projects (66.59%), gaming (43.69%), social networking (35.51%), reading eBooks (30.37%), and watching movies/videos (29.44%) [Table 4]. This finding is consistent with previous research, which has shown that the use of digital devices for education, entertainment, and communication is widespread among children and adolescents, especially during the recent worldwide COVID-19 pandemic.[16,17] In terms of digital device usage habits, the majority of participants spent 2-4 hours per day on digital devices (43.69%) and reading on digital devices (47.43%). Studies have suggested that prolonged exposure to digital devices may contribute to the development of vision problems, such as myopia and asthenopia.[18] Our study found a high prevalence of myopia (26.87%), asthenopia (10%), eye strain (8%), and mild astigmatism (5%) among the participants. Autorefraction measurements in our study ranged from -2.00 to -10.00 D Diopters, but the final correction required was minimal. For participants without previous refractive errors, a -0.50 D Spherical Concave Lens was sufficient for correction. Similarly, participants with unknown refractive errors required correction for myopia or myopic astigmatism, in addition to the -0.50 D Spherical Concave Lens. The use of the -0.50 D Spherical Concave Lens resulted in significant improvements in asthenopia, eye strain, and mild astigmatism. This finding supports the hypothesis that interventions, such as the use of a -0.50 D Spherical Concave Lens, may mitigate the adverse effects of digital device usage on children's vision.[19] The use of a -0.50 D Spherical Concave Lens appears to have a positive impact on alleviating these issues. Further research is needed to better understand the long-term effects of digital device use on vision and the potential benefits of

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Page no- 65-72 | Section- Research Article (Ophthalmology)

interventions such as the -0.50 D Spherical Concave Lens.

Limitations of the Study

The study was conducted with a small sample size. So, the results may not represent the whole community.

CONCLUSIONS

In conclusion, our study highlights the significant impact of digital devices on the vision of growing children in Bangladesh. The findings reveal a high prevalence of vision problems, including myopia, asthenopia, eye strain, and mild astigmatism, among the participants. In addition, long-term use of digital devices can cause tear film instability and dry eye symptoms, like burning, irritation, sticky lids, heavy lids, frequent blinking etc. Asthenopia, eye strain and mild astigmatism may be the results of long-term use of digital devices, which is optically corrected by -0.50 D spherical lens in 90% cases. 5% cases of mild astigmatism require correction by separate minus cylinders (-0.50D ti 0.75D). Some other treatments include use of artificial tear, advice of not using devices continuously, rather with regular intervals of 30 minutes, and advice of ocular rest by closing eyes for 30 seconds. The use of a -0.50 D Spherical Concave Lens demonstrated a positive effect on alleviating these issues, suggesting the potential benefits of interventions in mitigating the adverse effects of digital device usage on children's vision.

Recommendation

Future research should focus on developing public health policies and educational programs aimed at raising awareness among parents, educators, and healthcare professionals about the potential risks associated with excessive digital device usage. Additionally, it is crucial to emphasize the importance of regular eye examinations for early detection and intervention.

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Source of Support: Nil, Conflict of Interest: None declare