Computer Vision Syndrome among Children Using Online E-Learning during the COVID-19 Pandemic

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Abstract

Background: Since the declaration of the lockdown due to COVID-19, the usage of digital devices has gone up across the globe, resulting in a challenge for the visual systems of all ages. The aim of this study was to determine frequency, symptoms frequency and associated risk factors of Computer Vision Syndrome (CVS) among children attending online classes during COVID-19 pandemic.

Materials and methods: The online electronic survey form was prepared on the Google app. Children/parents were asked to indicate the total duration of digital device use before and during COVID era. The symptoms of CVS, its severity and frequency were recorded and measured with the Computer Vision Syndrome Questionnaire.

Results: One hundred and sixty four parents responded to the questionnaire, of these 124 were complete. Mean age of children was 14±3.01 years. Mean duration of digital device used during COVID era was 34.11±2.08 hours which was more than pre COVID era (0.98±0.24 hours). 36.29% used digital devices >5 hours in COVID era as compared to 0% before COVID era. The most common digital device used was smartphones (62.1%). Sixty seven children (54.03%) were attending online classes for >2 hours per day. 50% of the children had CVS. Of these 25% were mild, 12.9% moderate and 12.1% of severe grade. Most common symptoms were itching and headache. Multivariate analysis revealed age >14 years, male gender, smartphone use, use of device >5 hours and mobile games >1 h/day as independent risk factors for CVS in children.

Conclusion: There is an increased prevalence of CVS among children in COVID era. Awareness about prevention of CVS should be stressed and going forward, measures to bring these adverse effects to a minimum should be explored.

Key words: Computer vision syndrome; COVID-19; Children; Digital eye strain; e learning; Online class.

Introduction

Computer Vision Syndrome (CVS) also known as Digital Eye Strain (DES) and Visual Fatigue (VF) is characterized by a range of eye and vision-related symptoms and has been a recognized health problem for over 20 years.[1] Given the massive growth in digital device usage in recent years, many millions of individuals of all ages are at risk of CVS.[2] According to the American Optometric Association, as little as two hours of continuous digital device usage per day is enough to bring about the development of CVS.[3] Prolonged usage of these devices is not only a stressor on the visual system but also causes musculoskeletal strain and circadian disturbances.[4,5] The most common symptoms associated with CVS are eyestrain, headaches, blurred vision, dry eyes and pain in the neck and shoulders.[3] The emergence of the COVID-19 pandemic and the worldwide lockdown was immediately followed by a drastic increase in the amount of time spent on different digital devices. The lockdown has led to an increase in screen time and its influence on the wellbeing of users is a concern to healthcare practitioners. CVS is one of these health concerns.[6]

Although the ocular complications of digital device use have been extensively studied in young adults, only a few studies have addressed CVS in children.[7,8] Ocular symptoms and CVS related to the excessive use of digital devices due to the increased duration of online classes in this COVID era have been discussed extensively in the media, but have not been properly studied and reported in the literature. This study aimed to determine the prevalence, symptom frequency, and associated risk factors of CVS among children of secondary and higher secondary schools who use digital devices to attend online classes during the COVID-19 pandemic.

Materials and methods

This questionnaire-based cross-sectional study included the parents of higher secondary school children who were attending online classes during the COVID-19 pandemic. Participants were informed about the purpose, length and anonymity of the study. The parents were also informed that their data would be used for research purposes,

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but without disclosing the identity of the participants. The study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board. Incompletely returned forms were excluded from the analysis.

An online survey questionnaire was developed by the authors, which comprised of 4 sections: demography of the children, digital device information, CVS symptoms questionnaire and good ocular health safety tips for children during digital device use. The children or their parents were asked to indicate the average time in hours per day spent on each of the following activities: computer/PAD use, smartphone use, online classes, watching TV and playing of video games during the COVID era as well as the total duration of digital device use before and during the COVID era. CVS symptoms and their severity and frequency were recorded. The online electronic survey form was prepared on the Google survey forms app. The survey was circulated as a Google link among social media groups of parents and was open to responses for one week in July after the lockdown in Bangladesh.

The CVS symptoms and its severity were measured using the Computer Vision Syndrome Questionnaire (CVS-Q) developed by Segui et al.[9] The CVS-Q evaluated the intensity (Moderate or intense) and frequency (Never, occasionally, or always/often) of 16 eye strain-related symptoms, including burning sensation, itching in the eyes, foreign body sensation, watering, excessive blinking, redness, eye pain, heaviness in the eyelids, dryness, blurring of vision, double vision, difficulty in near vision, intolerance to light, colored halos, worsening of vision, and headache. If the total score was ≥6 points, the child was considered to be suffering from CVS. CVS scores were further categorized as mild (CVS score = 6-12) moderate (CVS score = 13-18) and severe (CVS score = 19-32).[9,10]

All the data that was collected from the respondents were exported as Microsoft Excel sheets from the Google drive link and statistical analysis was performed using the IBM SPSS Statistics software version 23. Quantitative variables were presented as mean ± standard deviation, while qualitative variables were presented as numbers and percentages. The associated risk factors of CVS were analyzed by univariate and multivariate logistic regression with age, gender, device used (Smartphone, desktop, laptop/tab) viewing distance, and duration of screen use. In the univariate analysis, the Chi-square or Fisher's exact test was used to investigate the associations between the qualitative variables. In the multivariate analysis, multiple logistic regression analysis was performed to identify the independent risk factors for CVS by calculating the Odds Ratios (ORs) and their corresponding 95% Confidence Interval (CI). A p value <0.05 was considered statistically significant. Before initiate the study the necessary permission was taken from the proper authority.

Results

A total of 164 parents/guardians responded to the questionnaire within the set time frame. Of these, we included 124 participants in our study analysis who provided complete responses to the survey. The mean age of the children was 14±3.01 years, of whom 60 (48.38%) were males. Of the respondents, 59.68% were students in class VI to VIII. In addition, 97.58% of the children were attending online classes. The mean duration of digital device use during the COVID era was 4.11±2.08 hours, which was longer than that in the pre-COVID era (0.98±0.24 hours). Furthermore, none of the children were using digital devices for >5 hours in the pre-COVID era as compared to 36.29% of children in COVID era. The most common digital devices used were smartphones (62.1%) and 54.03% children were attending online classes for >2 hours per day. In total, 64.52% of children used digital devices at < 18 inches from the eyes during the online classes. Table I shows the demographic and digital device use details as per the responses submitted by the parents.

Table I : Demographic characteristics and details of digital device usage (n=124)

Variables		Frequency (%)*
Age, years	Mean ±SD (Range)	14±3.01 (range 10-18)
Male: Female		60:64
Class		
	Class VI-VIII	74 (59.68)
	Class IX- X	26 (20.97)
	Class XI-XII	24 (19.35)
Duration of digital devise usage (Pre- COVID era) hours		
	Mean ±SD (Range)	0.98±0.24 (Range 1-2)
	<5 hours	124 (100.00)
	>5 hours	0 (0)

Duration of digital devise usage (COVID era) hours	
Mean ±SD (Range)	4.11±2.08 (Range 1-8)
<5 hours	79 (63.71)
>5 hours	45 (36.29)
Online classes attended	121 (97.58)
Device used for online class	
Smart phone	77 (62.10)
Laptop	53 (42.74)
Desktop	14 (11.29)
Tablet	9 (7.29)
Duration of online class	
<1 h/day	9 (7.26)
1-2 hour/day	48 (38.71)
>2 hour/day	67 (54.03)
Other uses of digital devices	
Watching TV	120 (96.77)
Playing games	100 (80.65)
Distance of digital device from eyes during online classes	
<18 inches	80 (64.52)
>18 inches	44 (35.42)

*Data are expressed as Frequency (%) if not mentioned otherwise.

The most common symptoms associated with CVS in our study were itching (53%) headache (52%) and excessive blinking. Double vision (5%) and difficulty in focusing near target (19%) were the least common presenting symptoms. In total, 49% of parents thought that their children's eyesight worsened because of the online classes. Figure 1 shows the number of children affected by the different CVS-Q symptoms with the proportion.

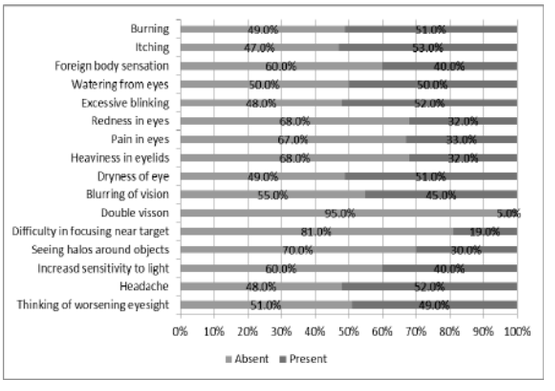

Fig 1 : Proportion of children affected by different symptoms of DSE

The prevalence of CVS in our cohort was 50%. Of these, 25% were of mild grade, 12.9% of moderate grade, and 12.1% of severe grade CVS scores. Figure 2 shows the percentage of children with the different CVS grades.

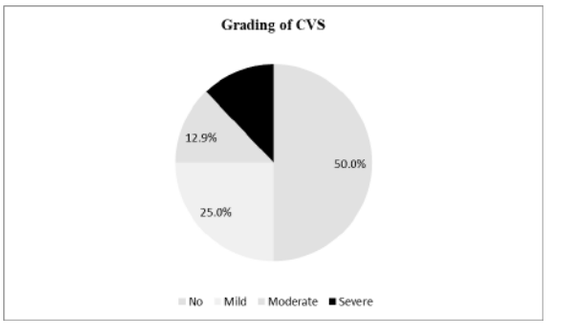

Fig 2 : Shows the percentage of children with the different CVS grades

CVS was significantly associated with age >15 years, male gender, preference of smartphone as digital device, digital device distance <18 inches from eyes, screen time >5 hours/day and playing mobile game >1 hour/day in univariate analysis. As shown in Table II, the multivariate analysis revealed that all these associations remained significant except distance of screen from eyes <18 inches.

Table II: Univarite and multivariate logistic regression analysis of risk factors associated with CVS

Risk factors	Univariate OR (95% CI for OR)	p value	Multivariate OR (95% CI for OR)	p value
Age >15 years	2.09 (1.11-3.22)	<0.001	1.15 (1.01-2.04)	0.014
Male sex	1.45 (1.00-5.21)	<0.001	1.23 (1.02-4.32)	0.024
Digital device preference	3.56 (1.51-46.21)	<0.001	2.41 (1.11-6.01)	<0.001
Screen time >5 hours/day	3.87 (1.24-8.32)	<0.001	3.22 (1.05-7.01)	0.001
Distance of screen from eye <18 inches	2.01 (1.01-5.02)	<0.001	1.15 (0.90-2.10)	0.068
Mobile game >1 hour/day	4.52 (1.25-10.23)	<0.001	3.45 (1.13-8.52)	<0.001

OR: Odds Ratio, CI: Confidence Interval.

Discussion

Many countries including Bangladesh have decided to close schools in order to maintain social distancing, as means of mitigating COVID-19 pandemic. Thirty five percent of population of Bangladesh is under age 18 (59.3 million) and 20.8% of total population is between 10-19 years. The current study addressed this major age group and demonstrated that, the prevalence of CVS was 50%. However, a recent meta-analysis reported that the pooled prevalence of CVS is 19.7% in children.[11,12] The increased prevalence of CVS in the current study was probably due to the increased visual demand of digital device use in our cohort because of the online classes in this COVID era. There was a significant increase in the

mean duration of digital device use during the COVID era (34.11±2.08 hours) compared to the pre-COVID era (0.98±0.24 hours). This is probably the main reason for the increased prevalence of CVS in the current survey.

In this study, 97.58% of children were attending online classes, out of which 54.3% of them were attending online classes for >2 hours per day. In a study conducted in India during the COVID era, only 48.9% of children were using smart phones for online classes spent >2 hours per day on digital devices.[10] In addition, 64.52% of children were using digital devices at a distance of >18 inches, which is similar to the study carried out by Ichapujani et al in which 56% were maintaining an ideal distance for digital device use.[13]

CVS symptoms were analyzed in this study using a validated questionnaire (Self-administered CVS-Q).[9] Headache, burning sensation and tired eyes are common visual-related problems associated with CVS. The most common symptoms reported in this study were itching and headache. The most common symptoms reported by Mohan et al among school children using digital devices were headache and burning sensation in 53.3% and 54.8% of cases, respectively.[12]

CVS symptoms were reported to be more common in females, however, in our study, the male sex appeared to be at higher risk. The results of our study indicated that male children were involved in multitasks on digital devices, making them to be at increased risk. An advancing age of >14 years was also found to be a higher risk factor for CVS in our study. Moon et al also reported that similarly and children of a higher age were spending more hours on smart phone use, which may lead to a higher CVS prevalence in older children.[14] Duration in front of a screen of >5 hours was found to be a significant risk factor for higher CVS scores in our study, which is a well-known factor for asthenopia among digital device users. A study reported that the prevalence of CVS was significantly higher in individuals who spent >4 hours per day on digital devices.[13] Similar results were found in another study, which reported that the duration in front of a screen was directly proportional to the CVS symptoms.[15]

In our study, the use of mobile games for >1 hour per day was a significant risk factor for CVS among children in multivariate analysis. The prolonged and constant use of smart phone-based video games in children may have an adverse effect on their visual system and cause CVS.[17] Ashorter screen distance has been associated with a higher risk of CVS in children in some studies.[16,17] Other than screen time, screen distance from eye was another issue which was revealed a significant factor in univariate analysis in the current study. Bilton described the one-two-ten (1,2,10) rule for the distances for digital devices: mobile phones at a distance of one foot, desktops and laptops at a distance of two feet and television at a distance of 10 feet.[18] The American Academy of Ophthalmology recommends a minimum distance of approximately 25 inches (About an arm's length) from the screen when using a computer.[19]

Limitations

Present study had a few limitations. Although this survey was circulated in parents'social media groups, we were unable to identify whether all the responders were parents/guardians of school-going children. In addition, study was designed on a symptom-based questionnaire that requires responders to indicate the frequency and intensity of symptoms experienced during digital device use, which is a subjective feeling and varies from person to person and may have recall bias. Refractive error of children was not considered in this study as it was not the part of our questionnaire.

Conclusions

Present study highlighted the higher prevalence of CVS among children in the present scenario of the COVID pandemic and the effect of the e-learning teaching model on children's ocular health. These findings are important for making the parents, teachers and eye care providers to be considerate about evidence-based measures to avoid CVS in children.

Recommendations

Guardians as well as the children should be aware about the good ocular health habits and tips in order to avoid CVS. Future studies should analyze the impact of good ocular health habits on CVS scores.

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Contribution of author
Sole study conducted by the author himself.

Disclosures
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