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Online classes in Indian schools during COVID 19 pandemic- Effect on ocular health

Taskin Khan^{1,*}, Hina Kauser¹, Gaurav Dubey²¹Dept. of Ophthalmology, Hamdard Institute of Medical Sciences & Research, Jamia Hamdard, New Delhi, India²Dept. of Optometry, Faculty of Paramedical Sciences UPUMS, Etawah, Uttar Pradesh, India

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ABSTRACT

Background: There is increased onscreen time and restricted outdoor activity of Indian school children during COVID19 pandemic lockdown. We investigated the effect of online classes on ocular health of school children and any associated risk factors.

Materials and Methods: Online questionnaire-based survey using Google forms on students of class 5-12 of schools of Delhi. 488 responses were included in the study. Questions based on demographic characteristics, class, type of devices and pattern of usage for online classes, spectacle use, ocular symptoms suggestive of computer vision syndrome (headache, ocular pain, blurred vision, redness, itching and burning of eyes) were asked and responses noted. Student suffering from any ocular disease except refractive error were excluded.

Statistical Analysis: Excel spread sheet was used for data analysis. The prevalence of ocular symptoms and type of device used were expressed as percentage. With the CI of 95% the significance level was considered as $P < 0.05$. The main outcome was symptoms of eyestrain arising due to online classes.

Results: 488 students from Class 5 to 12 responded (98.7% response rate). Mean age was 14years. Total prevalence of ocular symptoms was 64.34% (313 students, $P < 0.0001$). Smart phone was the commonest device used for online classes (78.27%). 247 out of 382 smartphone users (64.65%, $P < 0.0001$) had ocular symptoms. 163 students who had refractive errors 61.9% of them had significant symptoms.

Conclusions: Digitalization has helped in continuing school education during pandemic. However, it's effect on ocular health of children is a major challenge. Reforms are needed in the school curriculum to minimize the exposure and long-term collateral impact of COVID-19.

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1. Introduction

We are in a midst of pandemic caused by SARS-COV-2 since December 2019. COVID-19 disease, as it is called, is a new and highly infectious viral illness.¹ Considering that it gets transmitted from person to person through respiratory droplets when encountering an infected individual, the Indian government instructed for a nationwide lockdown to contain the transmission of infection on 24th March

2020.^{2,3} This meant closure of all educational institutes, offices and businesses.

In India, schools close for summer vacations from May till July. The lockdown due to COVID -19 meant that the rest of the studies would get affected; the government therefore gave directives to continue the studies through online classes. This was a new concept for school children as till now online studies were confined to a few assignments that the students can work at their own pace and usually given for the vacation period. These online classes also meant an increase in onscreen time for children and restricted

* Corresponding author.

E-mail address: taskinkhan_2010@rediffmail.com (T. Khan).

outdoor activity. There is enough evidence that suggest that the increased screen time causes symptoms of eye strain with the possibility of myopic shift.⁴⁻⁹ Notably, children although more susceptible to these problems may ignore these symptoms leading to more damage as compared to adults.

Several studies have been conducted on university students and computer workers regarding their ocular health due to excessive use of computers and smart phones. Prolong and continuous use of computers and smart phones has been found to have a profound effect on ocular health as well as causing learning disorders and decreased productivity.^{10,11}

Since prolong and continuous online classes in Indian schools is a new concept. To seek answers to the sudden surge in school children seeking ophthalmic consultation during the covid-19 pandemic, the present study was taken up to know the prevalence of symptoms of eye strain and any relation to the increased on-screen time. Besides also to find out any associated risk factors.

2. Materials and Methods

The study is an online survey conducted in May 2020, New Delhi, India, to assess the effect of online classes on ocular health of students in Indian schools and any associated risk factors. It was done by sending out questionnaire through Google forms to children through teachers and parents of four (two each) private and government schools of South Delhi. The questionnaire was validated and tested; any modifications suggested were incorporated before sending out to all the students.

After taking verbal consent, teachers and parents were briefed about the study before sharing the google form. Total 494 responses were received out of which six were found to be blank so were removed from the study. 488 responses (98.78%) were included in the study. The questionnaire included demographic characteristics, class in which the student studied, type of devices and pattern of usage for online classes (duration of online class, break in between classes), use of spectacles, ocular symptoms suggestive of eyestrain / computer vision syndrome (headache, ocular pain, blurred vision, redness, itching and burning of eyes) and any difficulty arising from online classes (internet connectivity, shared devices or any other). The exclusion criteria were student suffering from any ocular disease except refractive error.

Data analysis was done using Excel spread sheet. The prevalence of ocular symptoms and type of device used were expressed as percentage. With the CI of 95% the significance level was considered as $P < 0.05$. The main outcome was symptoms of eyestrain associated with the use of desktop computers, tablets, laptops, or smart phones. The study was approved by the Ethics committee of the Institute and adhered to the Declaration of Helsinki.

3. Results

A total of 494 students returned the form, six forms were blank and so were removed from the study. 488 (98.7% response rate) students were finally included in the study from four South Delhi schools, two each of government and private schools. All respondents were from middle, high and higher secondary school. Classes ranged from Class 5 to 12. The mean age of the respondents was 14 years, youngest being 8 year old and the oldest 19 years. Majority of respondents were girls with a total of 317 (64.75%) while 171 (35.2%) were boys.

Total prevalence of ocular symptoms seen was 64.34% (313 students, $P < 0.0001$). Out of 317 girls 217 (68.45%) and 97 out of 171 boys (56.72%) complained of ocular symptoms ($P = 0.009856$).

Type of devices and number of students using these for online classes along with prevalence of symptoms among use of different devices are given in Table 1. Smart phones alone, 382 (78.27%) or in combination, two or multiple devices {46 (9.42%) and 04 (0.8%) respectively} was the single most important device used by the students. This was the group with maximum number of students having ocular symptoms, 247 (64.65%) out of 382. It was followed by 30 students using laptop alone where 22 (73.33%) had ocular complaints.

With Odds Ratio (OR) of 1.8296, 95% confidence interval (CI) 1.4329 to 2.3363 and P value < 0.0001 ; Smart phone alone (78.27%) or in combination was the single most common device used for online classes followed by Laptop (6.1%, $P = 0.0155$). 64.65% of smartphone users had ocular complaints ($P < 0.0001$). Table 2 gives the significance levels of different digital devices causing ocular complaints among their users.

It may be seen in Figure 1, out of 313 respondents who had ocular complaints 159 (50.79%) respondents had combination of ocular symptoms of headache, redness, itching, blurring of vision, burning of eyes and/or ocular pain. Headache alone was found in 73 (23.32%), 42 (13.41%) had ocular pain, 15 (4.79%) had itching alone, 12 (3.83%) had burning of eyes while blurring of vision and redness only was seen in 10 (3.19%) and 02 (0.63%) respectively.

Since ocular symptoms were found to be significantly high in smartphone and laptop users, we compared the prevalence of ocular symptoms caused by only these two digital devices which statistically showed no significant difference among each other (247 and 22 respectively, $P = 0.7237$). Although, headache alone, eye pain alone, itching and burning of eyes was significantly more with smartphone usage as compared to laptop use as shown in Table 3.

Time spent by students on online classes on an average, for classes 5 to 8 it was 2 hours continuously with a break of 15 minutes while that of higher classes it was 3 hours continuously with a break of 15 minutes, however time at

Table 1: Number of students using different type of digital devices, incidence of ocular complaints and their relationship with the type of device used during online teaching.

Type of device used by student	Total number of students	Number of students with no ocular symptoms	Number of students with ocular symptoms
Smart Phone	382 (78.27%)	135 (35.34%)	247 (64.65%)
Laptop	30 (6.1%)	8 (26.66%)	22 (73.33%)
Tablet	12 (2.4%)	06 (50%)	06 (50%)
Desktop/PC	02 (0.4%)	Nil	02 (100%)
Smart TV	12(2.4%)	06 (50%)	06 (50%)
Dual device (Combination of two devices)	46(9.42%)	20 (43.47%)	26(56.52%)
Multiple device (Combination of three or more devices)	04 (0.8%)	Nil	04 (100%)

Table 2: Significance level of ocular symptoms with the digital devices used by students for online classes

Type of device	OR	95% CI	Z statistics	P value
Smart Phone	1.8296	1.4329 to 2.3363	4.844	<0.0001
Laptop	2.7500	1.2125 to 6.2369	2.421	0.0155
Tablet	1.0000	0.3203 to 3.1222	0.000	1.0000
Desktop	5.0000	0.2394 to 1.0.4226	1.038	0.2993
Smart TV	1.0000	0.3203 to 3.1222	0.000	1.0000
Dual devices	1.3000	0.7161 to 2.3600	0.862	0.3885
Triple devices	9.0000	0.4832 to 167.6218	1.473	0.1409

Table 3: Number of students, types of ocular symptoms observed and relationship with the device used for online classes

Type of device used by student n=no. of students affected	Combination of ocular symptoms	Total number of students having different types of ocular complaints (n=313)					
		Headache alone	Eye Pain alone	Redness	Itching	Burning of eyes	Blurring of vision
Smart Phone n=247	125 (50.60%)	61 (24.6%)	32(12.9%)	2(0.89%)	13(5.2%)	8(3.23%)	6(2.42%)
Laptop n=22	12(54.54%)	Nil	4(18.18%)	Nil	2(9.09%)	4(18.18%)	Nil
Tablet n=06	04(66.66%)	Nil	Nil	Nil	Nil	Nil	02(33.33%)
Desktop/PC n=02	Nil	02(100%)	Nil	Nil	Nil	Nil	Nil
Smart TV n=06	04(66.66%)	02(33.33%)	Nil	Nil	Nil	Nil	Nil
Dual device (Combination of two devices) n=26	12(46.15%)	06 (23.07%)	06(23.07%)	Nil	Nil	Nil	02(7.69%)
Triple device (Combination of three devices) n=04	02 (50%)	02 (50%)	Nil	Nil	Nil	Nil	Nil

which break was taken was not fixed.

In response to the question of improvement in ocular symptoms on taking rest; 238 (76%) said rest and break in class helped in relieving their symptoms.

Besides online classes, 353(72.3%) students used these devices at other times also making it an additional increase in on-screen time to an average of 3 hours; a total of 6hours.

The number of students using spectacles was 163 (33.4%), of these 101 (61.9%) of them complained of eyestrain during the online classes. It may be noted that

81% (82) of these students had undergone their regular eye checkup within a year.

On being asked about the problems faced during online teaching 284 (58.19%) students responded with an affirmation. 460 (94.2%) students said that internet connectivity was the major issue during the classes, 28 said they had to share their devices with others at home. Other problems included learning not being interactive, missing friends and school.

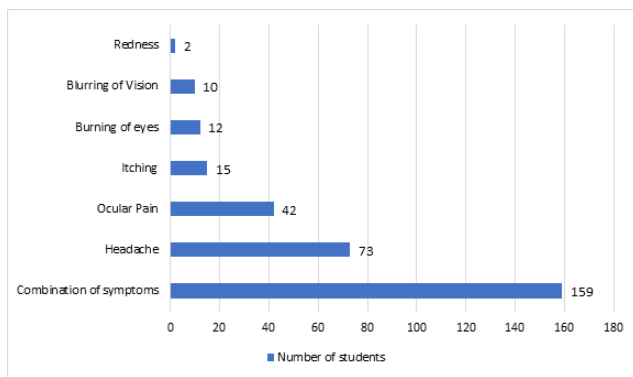


Fig. 1: Type and incidence of ocular complaints observed during online teaching

4. Discussion

Lockdown due to COVID-19 has made online classes for school children in India to be a new normal. The schools have shifted their curriculum to virtual classes. The hours spent at school earlier are now being spent in front of the digital screen with physical activity being almost nil. Use of smart phones, laptop, tablets, and smart TV has increased drastically. The increased screen time is playing havoc with the ocular health of our future generation. These are unprecedented times; this study is first of its kind that has been done on school going children in India to see the effect of increased screen time due to online classes.

In the present study out of 488 school children the overall prevalence of ocular symptoms was 64.34% (313 students, $P < 0.0001$). In a study conducted on 416 medical and engineering students the prevalence of Computer Vision Syndrome was 80.3%, while 68.1% was seen in another study done on University students in Malaysia.^{11,12} Variable results are seen in different studies, 72.1%, 59.5% notably all these studies have been done in adult patients using digital devices.^{13,14} Although prevalence rate of asthenopia in children and adolescents have been evaluated as 23.1%, 12.4- 26.4%, however none of these have studied the effect of digital devices on ocular symptoms.^{15,16}

The most common device used in the present study was smart phone, 78.27% (P value < 0.0001) which has also been seen in other studies conducted on 334 students, 78% and 576 adolescent students with 58.3% using smart phones.¹⁷ It was also the most common device in the present study to cause ocular complaints (64.65%, $P < 0.0001$) which is similar to another study where higher prevalence of symptoms were seen among adolescent smart phone users, $P = 0.005$.¹⁸ The use of smart phones and tablets increases eyestrain; headaches, ocular pain, itching, blurring of vision, and burning of eyes.^{4,5} Although more research is required to be done in children to know the effect of digital devices it has been shown in a recent meta-analysis that an overall 19.7% of asthenopia exists.¹⁶ The use of smart phone

in children causes ocular symptoms which may result from altered accommodation, convergence, and tear film abnormality.⁴

The most common ocular complaint observed in the present study was a combination of symptoms, followed by headache and ocular pain. Out of 313 respondents who had ocular complaints 159 (50.79%) respondents had combination of ocular symptoms of headache, redness, itching, blurring of vision, burning of eyes and/or ocular pain. This was also seen in another study done on adolescents where smartphone use was associated with a higher multiple ocular symptom (5-7 symptoms; $P = 0.005$).¹⁸

It has been shown that an hour spent on smart phone increases blurring of vision and eyestrain by as much as 5times.¹⁹ In separate studies done on 8-11years old and also on 18-23-year-old it was shown that increased hours of smart phone use per day increased the ocular symptoms and stopped when smart phone use was stopped; this is also seen in the present study where 76% of 313 respondents said that their symptoms improved after taking rest.^{4,11,20}

The relationship between ocular complaints and time spent on online classes could not be assessed in the present study as the school hours were almost same for all the four schools who participated in the study. Since the time spent in front of the screen was same for all schools not much significance was seen ($P = 0.7578$) although 75% of them said that when they used these devices other than school hours (average 2hrs) the ocular symptoms reappeared (49.1%) indicating digital device use as confounding factor in the development of ocular symptoms with increased on-screen time. This has also been reported in other studies, where > 2 hours daily and ≤ 2 hours continuously were associated with multiple ocular symptoms (OR 2.18, 95% CI 1.09-4.39).¹⁸

In the present study it may be noted that the single most common device used was smartphone. Since ocular symptoms were found to be significantly high in smartphone and laptop users, we compared the prevalence of ocular symptoms caused by only these two digital devices which statistically showed no significant difference among the two devices (247 and 22 respectively, $P = 0.7237$). However, headache alone (24.6%), eye pain alone (12.9%), itching (5.2%) and burning of eyes (3.23%) was significantly more with smartphone usage as has been seen in other studies where incidence of asthenopia was 26.4%.¹¹

In the present study, 50 students switched devices during their classes. The effect of use of multiple devices on young children (average age 14years) has not been studied however, it may be noted that in previous studies done on adults, ocular complaints were more common in multiple digital device users.¹⁹ In our study we noticed that 60% of the users who switched devices had symptoms. The significance of which needs to be further explored.

We also noticed in our study that 61.9% of students wearing refractive correction had ocular symptoms after attending online classes although there were no complaints otherwise. It may be noted that these students were using their spectacles during the class. 81% of those were having eyestrain has had the routine yearly eye checkup. It could be that patients with refractive errors are at higher risk of developing asthenopia or there are other factors that might be responsible for these symptoms; results consistent with other studies where it has been seen that refractive errors even after correction increases the risk of Computer Vision Syndrome. Moon JH et al., (2016) reported in their study that the students who wore spectacles and contact lenses (n = 176) showed a higher risk of developing headache (OR = 1.8, 95% CI = 1.2-2.6, P < 0.01) and blurred vision (OR = 2.1, 95% CI = 1.4-3.4, P < 0.001) which was statistically significant.⁴ It may also be noted that the use of smart phone increases the risk of myopic shift of refraction.^{20–22}

The other important finding which is unique to this study was that of poor internet connectivity encountered by the students (94.2%). This is an important finding which the decision makers must investigate as most of the teaching is going to be online for some time now.

There are certain limitations in the present study as the data was acquired through questionnaire, so it may be subject to recall bias as also the study is confined to students of urban schools, and therefore may not be representative of other populations. A larger population-based study is called for. Despite this our findings are an important contribution to the literature especially with increase in on screen time due to the present pandemic.

5. Conclusion

COVID-19 pandemic has affected every aspect of our lives. Children are the most vulnerable lot. As humanity tries to cope up with the impact of pandemic the governments are trying to make adjustments to allow normalcy to prevail. With the closure of schools, online education is going to be the new normal for some time. Although digital technology has been most beneficial in helping to continue school education; the impact of increasing use of digital devices on ocular health of children is a major challenge. A better approach would be looking into the present school education system in India and bringing about a change with less dependency on continuous lectures/ online classes to minimize the long-term collateral impact of COVID-19.

6. Source of Funding

None.

7. Conflict of Interest

The authors declare that there is no conflict of interest.

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Author biography

Taskin Khan, Associate Professor

Hina Kauser, Associate Professor

Gaurav Dubey, Optometry Faculty

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