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Original Article

Dry eye disease survey among schoolteachers and children using visual display terminals during COVID-19 lockdown-CODE study (Covid and *dry eye* study)

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ABSTRACT

Background: Lockdown during COVID-19 led to teachers and children shifting to online classes, using visual display terminals (VDTs) for education, resulting in increased screen time. The present study was done to assess and understand the nature and magnitude of the problem and to suggest preventive or remedial measures.

Methods: A questionnaire-based cross-sectional study was conducted. The questionnaire was prepared for an online survey (using Google Forms) and circulated among school children belonging to different schools across India using multiple groups on social media.

Results: A total of 3327 participants from 46 schools across India participated in the survey. We found a marked rise in cumulative screen time for both teachers and students before and during the lockdown. There was a threefold increase in the number of participants with a cumulative screen time 6 h or more compared to the pre-COVID era. Teachers (older participants) had worse symptom scores than students. Larger screens, like televisions, were better VDTs compared to smartphones, tablets, or laptops.

Conclusions: School administrators and policymakers should pay due attention to institutionalizing the guidelines about class duration, appropriate screens, and stipulating break duration during online classes, which will continue to remain the predominant mode of education for teachers and students alike, at least in the near future.

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Introduction

Dry eye disease is a growing health problem and is one of the most frequent diagnoses among patients attending the ophthalmic outpatient department. It has multifactorial etiology, which includes congenital, endocrine, autoimmune, inflammatory, and nutritional disorders.[1–8] Some environmental factors like low humidity, use of air conditioners, dry heat, and visual display terminals (VDTs) also have an important role to play in the causation of dry eye disease as has been published in various studies earlier.[9–13] Use of VDTs for long hours reduces blink rate and can lead to dry eye disease. Lockdown during COVID-19 led to the shutdown of schools, and schoolchildren shifted to online classes using VDTs for education, which led to a marked increase in screen time. It has also led to decreased outdoor activity time for children. Both these factors have been reported to lead to pediatric dry eye disease. Schooling continued to be online as part of the nationwide COVID response. Prolonged exposure to VDTs has become unavoidable in the present scenario. In the prevailing circumstances, VDT-induced dry eye disease, may assume a massive public health problem. This is further compounded by challenges in obtaining a nonemergency Ophthalmology consultation owing to COVID prevention protocols. This study was carried out through an online survey questionnaire to find out dry eye disease-related symptoms among school children of different age groups and teachers. The aim of this study is to assess and understand the nature and magnitude of the problem and to suggest preventive or remedial measures.

Materials and methods

This study adheres to the tenets of the Declaration of Helsinki, and approval of the Institutional ethical committee was obtained. It was a cross-sectional study. A questionnaire was prepared for an online survey (using Google Forms) and circulated among school children and teachers belonging to different schools across India using multiple groups on social media like WhatsApp and Telegram. Informed consent was taken from all participants before attempting the questionnaire. The survey consisted of 16 questions and was open for one week. Table 1 The questionnaire can be accessed at https://docs.google.com/forms/d/1PSOCnC4b6LKKUVeK0WbrTltFkjcmq7Ea0NUvjn-vZ3A/printform. Respondents had an option of adding their names and email addresses; however, this was not mandatory. Association between categorical variables was assessed using Fischer exact test and Chi-square test. P value < 0.05 was considered to be statistically significant. All statistical analyses were performed using SPSS 25 statistical software.

Results

A total of 3327 participants responded to the questionnaire, of which 3096 (96%) were students and 130 (4%) were teachers. The remaining did not reveal their profession. They were from 46 schools located in different parts of India; 1675 (52.5%) were males and 1520 (47.5%) were females, and rest did not reveal their gender.

Of the total, 1465 (45.4%) students were in the age group 7–12 yrs, 1604 (49.7%) students were between 13 and 18 yrs, while 157 (4.9%) participants were older than 18 years. Before March 2020 (before lockdown), 1306 (40.5%) participants had cumulative daily screen time of less than 02 h, 1143 (35.4%) participants had screen exposure of 02–04 h, 560 (17.4%) participants had exposure between 04 and 06 h, while 217 (6.7%) participants had exposure of more than 06 h. Cumulative daily screen time during lockdown was less than 02 h for 349 (10.8%) participants, between 02 and 04 h for 1042 (32.3%) participants, between 04 and 06 h for 1093 (33.9%) participants, while it was more than 06 h for 742 (23%) participants. There was a significant increase (from 17.4% to 33.9%) in the screen exposure time for participants with 4–6 h, and (from 6.7% to 23%) more than 06 h groups, while a marked decrease (from 35.4% to 10.8%) was noted in the percentage for participants having screen time of less than 02 h (Fig. 1).

Among the participants, 64.5% were using smartphones, 23.7% laptops, 23.7% tablets, while 5.5% were using television as preferential (i.e., more than 50% of cumulative screen time) VDT. Among teachers, 40% used laptops compared to 23% of students, 59.2% used smartphones compared to 64.8% of students, and 0.8% of teachers and 5.7% of students were using television as the preferred modality for more than 50% of cumulative screen time (Fig. 2).

Activity-wise, the screen time was very high for online classes averaging 2–4 h, whereas it was less than 1 h for social media, gaming, and video calls (Fig. 3); 39.3% of participants were asymptomatic, 37.9% had mild symptoms, 19.3% had moderate, whereas 3.5% had severe symptoms of dry eye disease (Fig. 4); 31.6% of participants were taking 02–05 min break every 30 min, while 20.2% were taking longer than 05 min break every 30 min. Approximately half of the participants were not following any fixed schedule of long or short breaks (Fig. 5); 8.6% of participants were using artificial tear drops with or without prescription. There was a statistically significant difference among the types of device used and overall symptom score of 0, 1, and 2. Those who used television as most viewed screen, overall score of 0 (asymptomatic) was seen in 62.1% compared to smartphones 40.5%, laptops 32.7%, and tablets 31.5% of viewers (Chi-square test, p value < 0.001). Overall symptom score of 1 (mild symptoms) was seen in 49.3% of participants using tablets, smartphones users 37.3%, laptops users 40.2%, and television viewers 22% (Chi-square test, p value < 0.001). Overall symptom score of 2 (moderate symptoms) was seen in 23.3% of laptop users, 18.6% of smartphone users, 16.7% of tablet users and 12.4% of television viewers (Chi-square test, p value $= 0.002$). Values for overall score of 0, 1, and 2 were statistically significant. There was no statistically significant difference among the type of devices used and overall symptom score of 3 (severe) among laptop, tablet, smartphone and television users, Chi-square test, p value $= 0.835$.

Overall symptom score of 0 was seen in 40.6% of students and 8.5% of teachers (z score, p value < 0.001), score of 1 in 38% of students and 34.6% of teachers (z score, p value $= 0.434$), 2

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Table-1 – Questionnaire for online survey .

1. Name 2. Gender 3. School
4. Profession Teacher / Student
5. Age a. 7-12 yrs. b. 13-18 yrs. c. More than 18 yrs
6. Average daily cumulative screen time- prior to Mar 2020
   a. Less than 02 hours b. 02-04 hours c. 04-06 hours d. More than 06 hours
7. Average daily cumulative screen time- at present
   a. Less than 02 hours b. 02-04 hours c. 04-06 hours d. More than 06 hours
8. Screen viewed most of the time (more than 50% of cumulative screen time)
   a. Smart phone b. Tablet c. Laptop/ PC d. TV
9. Activity wise screen time- Classes
   a. Less than 01 hour b. 01-02 hours c. 02-04 hours d. 04-06 hours
   e. More than 06 hours
10. Activity wise screen time- Social media
   a. Less than 01 hour b. 01-02 hours c. 02-04 hours d. 04-06 hours
   e. More than 06 hours
11. Activity wise screen time- Gaming
   a. Less than 01 hour b. 01-02 hours c. 02-04 hours d. 04-06 hours
   e. More than 06 hours
12. Activity wise screen time- Video calls
   a. Less than 01 hour b. 01-02 hours c. 02-04 hours d. 04-06 hours
   e. More than 06 hours
13. Frequency of breaks 2-5 minutes long
   a. Every 30 mins b. Hourly c. 02 hourly d. Not fixed
14. Frequency of breaks longer than 5 mins
   a. Every 30 mins b. Hourly c. 02 hourly d. Not fixed
15. Nature of symptoms- how would you describe your symptoms
   a. Burning sensation Persistent/ occasional/ Never
   b. Itching Persistent/ occasional/ Never
   c. Foreign body sensation Persistent/ occasional/ Never
   d. Eyes are watery Persistent/ occasional/ Never
   e. Eyes feel sore and fatigued. Persistent/ occasional/ Never
   f. Head ache Persistent/ occasional/ Never
   g. Wake up with eyes feeling sore Persistent/ occasional/ Never
   h. Find it difficult to fall asleep because of discomfort in the eyes Persistent/ occasional/ Never
16. Overall symptom score (as you perceive)
   a. 0- no symptoms b. 1- mild symptoms c. 2- moderate (need to do something about it)
   d. 3- Severe (can't carry on like this anymore)
17. Do you wear glasses, prescription or otherwise while looking at various screen **Yes/no**
18. Are you instilling any lubricant eye drops with or without a prescription **Yes/no**

in 18% of students and 49.2% of teachers (z score, p value < 0.001) and overall score of 3 was seen in 3.4% of students and 7.7% of teachers (z score, p value < 0.010). Overall teachers had worse overall symptom scores compared to students.

Among 07–12 yrs age group, 50.6% of participants were asymptomatic, 35.8% had mild symptoms, 11.5% had moderate, and 2.1% had severe symptoms of dry eye. Among 13–18 yrs age group, 32.1% of participants were asymptomatic, 39.7% had mild symptoms, 23.7% moderate, and 2.1% had severe symptoms of dry eye (Fig. 4).

Discussion

The COVID-19 pandemic has led to marked changes in teaching-learning methods the world over, shifting focus to online classes by using various VDTs. VDTs have been associated with dry eye disease, but prevalence is widely underestimated. The strength of our study is the large number of participants, both students and teachers, from 46 different schools all over the country. The percentage of participants with cumulative screen time of 4–6 h and 06 h or more, prior

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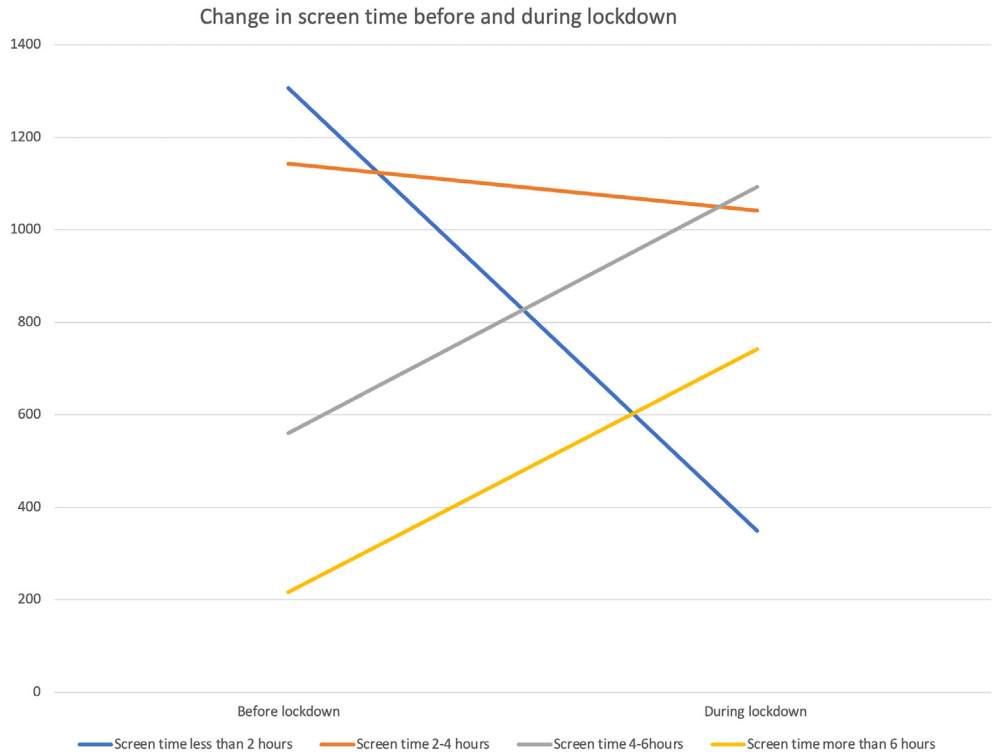

Figure-1 – Shows changes in screen time of participants before and during lockdown.

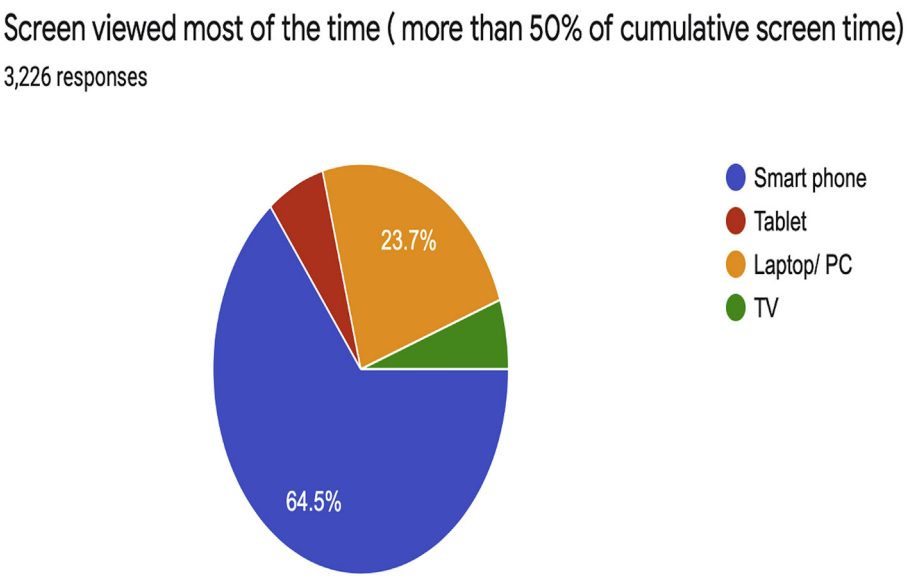

Figure-2 – Shows predominant device use for online classes by the participants.

to March 2020 was 17.4% and 6.7%, respectively. This rose to 33.9% (double) and 23% (triple) during the lockdown months. On the other hand, the percentage of participants with cumulative screen time of less than 2 h dropped from 35.4% to 10.8% during this period. The VDT-induced dry eye, prior to March 2020, was seen mostly among software professionals, banking professionals, etc. The use of smartphones and other screens for recreational purposes, social networking, and academic purposes was limited, in the student-teacher community, in the pre- COVID era. The prevailing circumstances,

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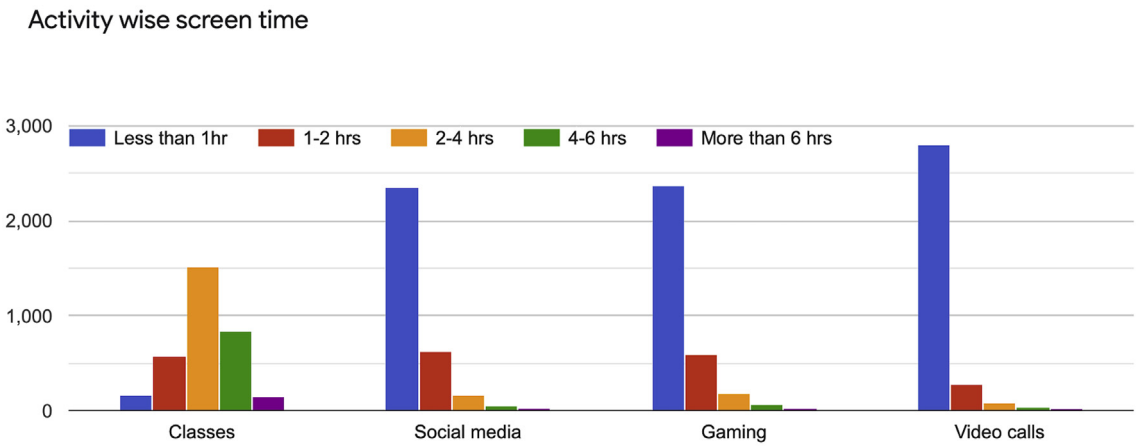

Figure-3 – Shows activity wise screen time of the participants.

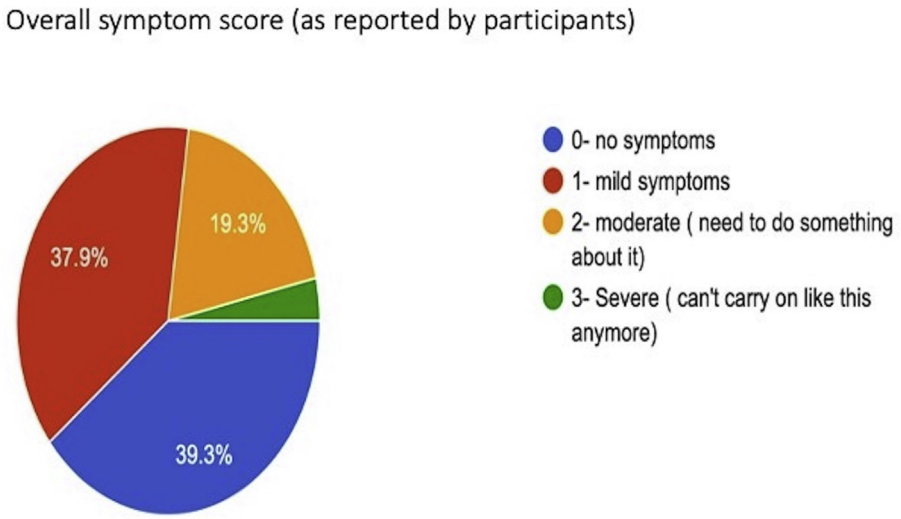

Figure-4 – Shows overall symptom score of the participants.

as evident from this study, have forced 2–4 h of additional screen time in most of the cases in the student-teacher community. These additional numbers, considering the student population of over 250 million and a teacher population of 9.68 million in India, would make VDT-induced dry eye a serious public health concern in the times to come. Teachers (older participants) had worse symptom scores than students. Age, comorbidities, and other lifestyle-related factors are probably the contributory factors.

For overcoming VDT-induced dry eye, various VDT break time guidelines have been published and recommended in different countries. *Anshel et al* proposed the "20-20-20 rule" in the 1990s, which suggested taking 20 s break every 20 min by looking 20 feet away for preventing and relieving digital eye strain.[14] The American Academy of Ophthalmology, as well as the American Optometric Association have recommended it for prevention of eye strain in 2018.[15] The Ministry of Health, Labour and Welfare, Japan, have suggested that continuous VDT time must not exceed 01 h and a break *of* 10–15 min must be established before subsequent continuous operation. In addition, one or two "short breaks" of 01–02 min must be established during 1-h continuous VDT operation time.[16] Similar guidelines have been suggested in various other countries, including the United Kingdom. *Fujita et al* have suggested the concept of "blind working (BW) time" among VDT users in 2019.[17] They concluded in their study that in VDT users engaged in "BW," the interblink interval was shorter immediately after BW and had improved subjective symptoms. They found BW to be effective in the management of VDT working time.

High cumulative screen time and uninterrupted viewing of VDTs, be it for recreational purposes or academic activity, are significant risk factors for symptomatic dry eye disease among school teachers and school students, as reaffirmed by this study.

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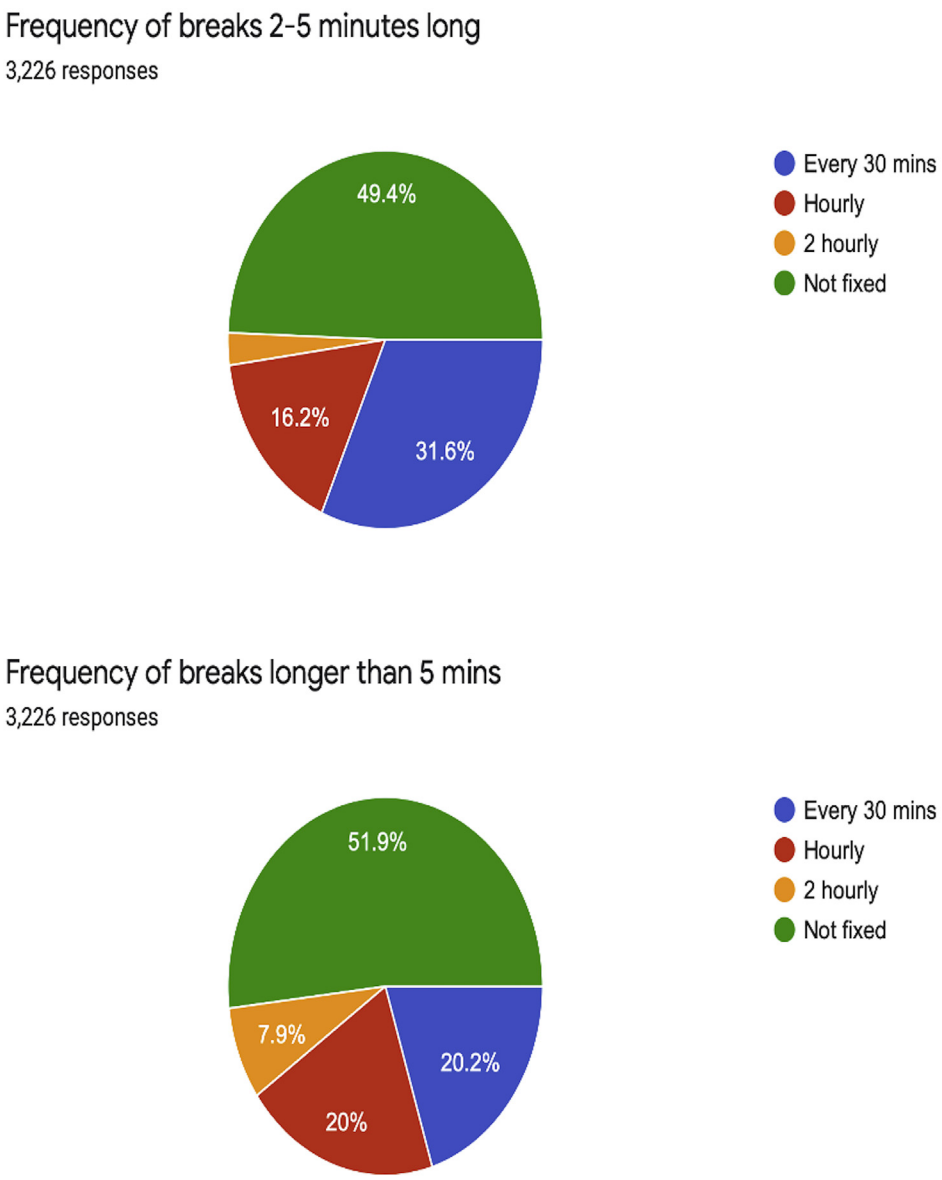

Figure-5 – Distribution of frequency of breaks during online classes by the participants.

Recommendations

High cumulative screen time and uninterrupted viewing of VDTs, be it for recreational purposes or academic activity, are significant risk factors for symptomatic dry eye disease among school teachers and school students, as reaffirmed by this study. The COVID 19 pandemic has established a new normal in all spheres of life. Work from home and online teaching-learning are here to stay in some measure. Therefore, it is imperative that all stakeholders, viz., students, parents, teachers, school administrators, and policymakers, pay due attention to this aspect. Concerned authorities ought to institutionalize guidelines by prescribing and providing appropriate screens for this purpose and stipulating class duration and break duration accordingly.

Discloser of competing interest

The authors have none to declare.

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