

# Online survey to assess computer vision syndrome in professionals and health care workers due to excessive screen exposure during the COVID-19 pandemic

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## Abstract

**Purpose:** During the COVID-19 pandemic lockdown, the normal daily routine activities of people were restricted as a result of the need to stay indoors. Consequently, health-care professionals, IT professionals, teachers, and other workers were forced to continue their routine work-related activities from home. Due to the subsequently increased screen exposure, these professionals have started to complain about symptoms related to dry eye syndrome (DES) or computer vision syndrome (CVS).

**Objective:** The objective of the study was to screen for the presence of CVS symptoms, such as blurring of vision, headache, and watery eyes in these professionals due to increased screen time during the lockdown period of COVID-19 pandemic.

**Materials and Methods:** This was a non-randomized, questionnaire-based study conducted by the ophthalmology department of a tertiary care pediatric hospital in North India. The inclusion criteria were that participants had to work in professions of different fields such as health care workers/teachers/engineers/lawyers/bankers/MBA. They were interviewed through a Google Forms after completing the online consent in English. On receiving the link, participants were redirected to a consent form. Once they had given their consent, they could proceed to the Google survey questions. The questionnaire consisted of 22 questions related to the personal data and lifestyle habits of participants, such as screen use (daily screen hours) to describe the number of hours they spent every day on their computer or smartphone screens, as well as the presence of any CVS symptoms.

**Results:** A total of 230 professionals, including 159 (69.1%) females and 71 (30.9%) males, participated in the study. There was a significant increase in the symptoms of DES in study participants that had used a screen for more than 6 h with 3.6 times of odds ratio (95% CI 1.4–9.1) ( $P < 0.001$ ).

**Conclusion:** Increased exposure to screen during the lockdown period of COVID pandemic has a strong association with the development of symptoms related to CVS.

## Introduction

Coronavirus disease 2019 (COVID-19) has been one of the largest global pandemics to date, which has affected nearly 3 million people from 213 countries across the globe.<sup>[1,2]</sup> As a precautionary measure, strict norms of wearing a face mask, social distancing, and lockdown-like strategies were implemented. The

current pandemic has affected the normal movement of persons of all age groups. Since March 2020, not only schools but various offices have also imposed online work from home for their employees in different sectors of work, including information technology professionals working in the field of engineering, chartered accountants, and architects. Further groups that have been affected include teachers of various institutions due to

the closure of schools to deliver online classes to children, and health care workers watching conferences on medical education to update their knowledge on the latest COVID developments and dispatch reports of investigations. This “work from home” scheme involves the use of digital technology in the form of laptops, mobile phones, and television. All of these devices account for increased screen exposure, thus predisposing users to the development of “Computer Vision Syndrome” symptoms (CVS).<sup>[3-6]</sup> This syndrome is defined by the American Optometric Association (AOA) as a complex of eye and vision problems related to activities that stress the near vision and that are experienced in relation to or during the use of computers.<sup>[7]</sup> The AOA also suggests that a period of at least 2 h of exposure to such digital devices is sufficient enough to lead to DES. Indeed, several studies have enumerated the contribution of increased screen activity to the development of dry eye syndrome (DES) or CVS. The latter is an umbrella of conditions related to vision stress from device usage with internet access along with the involvement of the musculoskeletal system and circadian disturbance.<sup>[8-10]</sup> DES has been recognized as a growing public health concern and is one of the most frequent causes of ophthalmic consultation. According to the International Dry Eye Workshop (DEWS)<sup>[5]</sup> 2007, DES is defined as a multifactorial disease of the tears and ocular surface resulting in symptoms of tear film instability, visual discomfort along with increased tear film osmolarity, and ocular surface inflammation. DES has influenced the quality of life of nearly 10–20% of people in the population. The severity of signs and symptoms of DES is related to the number of hours spent in front of a digital device, which may range from 2 to 4 h/day. Although the previous studies on DES have included the student population and adult population of similar professions,<sup>[7-10]</sup> the present study is the first of its kind where professionals from different fields were enrolled, such as health care workers/teachers/engineers/lawyers/bankers/MBA. We aimed to determine the dry eye symptoms due to increased screen time during the lockdown period of COVID-19 pandemic and also to establish whether these symptoms were related to number of hours of screen exposure during this period.

## Materials and Methods

This was a non-randomized, questionnaire-based study conducted from July 2020 to August 2020 by the ophthalmology department of a tertiary care hospital in North India. Prior clearance was obtained from the Institutional Ethical Committee. Based on the research conducted by Castellanos-González *et al.* involving surgery residents to assess symptoms of dry eye during surgery, a cohort of 200 health care workers was among the enrolled participants.

## Procedure

An online survey (Google Forms) based on questions from the DEWS guidelines – CVS scale,<sup>[9]</sup> was circulated among health care workers (HCW = doctors/nurses/technicians), professionals of the IT department, and school teachers

during the pandemic period. All study subjects were invited to participate through the distribution of a Google Forms through multiple groups on social media, namely, WhatsApp and email. On receiving the link, participants were redirected to the consent form. Once the participant gave their consent, they could proceed to the Google survey, which consisted of 22 questions. After answering the questions, the participant could submit the form to the investigator by clicking on the submit link.

The questionnaire form included questions related to the personal data and lifestyle habits of participants. To facilitate the recording and interpretation of results, questions related to screen use (daily screen hours) were included to describe the number of hours the participant spent every day in front of their computer or smartphone screens.

## Statistical methods

Data were analyzed using the Statistical Package for the Social Sciences (SPSS v20) software. Descriptive data were presented as percentages. The dependent variable in this study was the presence of dry eye disease. The significance of associations was tested using Chi-square/Fisher’s exact test for categorical variables and Wilcoxon rank sum/Kruskal–Wallis test for continuous variables. Univariate and multivariable regression analyses were carried out to find an independent factor associated with the increase of DES symptoms.  $P < 0.05$  was considered as indicative of statistical significance.

## Results

A total of 230 professionals participated in the study with 159 (69.1%) females and 71 (30.9%) males. The mean age of the participants was  $30 \pm 11.4$  years. The most common activity for digital device usage pertained to requirements of professional work in 111 (48.2%) participants followed by COVID-related research in 55 (24%) professionals [Tables 1 and 2]. When categorizing the participants according to profession, 94 (40.8%) worked in the area of health care as doctors/nurses/technicians. A total of 136 were non-medical professionals and included 83 (36.1%) teachers, 11 (4.8%) IT professionals, and the remaining 42 (18.3%) belonged to miscellaneous professions such as lawyers, bankers, or housemakers [Table 3].

**Table 1:** Demographic distribution of study participants

Age	n (%)
20–30	33 (14.3)
31–40	72 (31.3)
41–50	92 (40.0)
51–60	33 (14.4)
Gender	
Female	159 (69.1)
Male	71 (30.9)
Total	230 (100.0)

**Table 2:** Distribution of screen time among the study participants

Laptop/computer	n (%)
<1 h	4 (1.7)
Up to 2 h	31 (13.5)
Up to 4 h	60 (26.1)
Up to 6 h	75 (32.6)
>6 h	60 (26.1)
Mobile phone usage	
<1 h	4 (1.7)
Up to 2 h	65 (28.3)
Up to 4 h	28 (12.2)
Up to 6 h	11 (4.8)
>6 h	122 (53.0)
Number of activities involving screen use	
Professional work	111 (48.2)
Research/journal reading	55 (24.0)
Academics	31 (13.4)
Telemedicine	25 (10.9)
Entertainment	8 (3.5)
Number of hours of activity increase in the previous three months	
<1 h	32 (13.9)
1–2 h	64 (27.8)
2–3 h	45 (19.5)
3–4 h	50 (21.7)
>4 h	39 (17.0)
Number of symptoms	
None	72 (31.3)
1 symptom	89 (38.7)
2 symptoms	42 (18.3)
3 symptoms	20 (8.7)
4 symptoms	7 (3.0)
Were these symptoms present before COVID?	
No	163 (70.8)
Yes	38 (16.5)
The above symptoms have increased since the start of lockdown period	29 (12.7)
Total	230 (100.0)

### Symptoms of DES due to digital device exposure

The most common symptom related to DES was headache (40%), difficulty to refocus (38.7%), followed by foreign body sensation (22.6%), and light sensitivity and blurring of vision (20.8%). The screen exposure had increased to the range of <1 h in 32 (13.9%), 1–2 h in 64 (27.8%), 2–3 h in 45 (19.5%), 3–4 h in 50 (21.7%), and more than 4 h in 39 (17.0%)

participants compared to the pre-pandemic period ( $P < 0.005$ ) [Tables 1 and 2, Figures 1 and 2].

Around 53% of participants had started using online digital devices for more than 6 h/day in the preceding 6 months [Figure 3]. A total of 163 participants (70.9%) reported that none of the above symptoms had been present before the increased screen exposure related to online work occurred during the COVID-19 pandemic ( $P = 0.041$ ) [Table 3]. There was a significant rise in the prevalence of DES symptoms in study participants using a screen for online work for over 6 h, with an OR of 3.6 times (95% CI 1.4–9.1) ( $P < 0.001$ ).

Based on classifying the symptoms according to exposure as per the assumed requirements of a specific profession, most of the participants experienced an average of one symptom related to digital devices. The largest number of symptoms along with their increased intensity was reported by teachers and IT professionals, as the mean usage of digital devices in these people ranged between  $8.5 \pm 3.6$  h. Furthermore, these DES symptoms were more frequent in participants with increased screen usage for professionals such as teachers and IT professionals, with OR of 2.4 (95% CI 2.1–6.3) ( $P < 0.05$ ) and 3.9 (95% CI 1.4–6.1) ( $P = 0.04$ ), respectively. Stress due to COVID 19 was reported by 176 (76.4%) participants, 124 (53.9%) had already worn glasses, and the remaining 98 (42.6%) had not got their refractive status checked [Table 4].

### Discussion

CVS, also known as DES, is usually related to watching the screens of computers or other devices that make near work for the eye more difficult.<sup>[4,11]</sup> Attention for demanding visual tasks makes any computer user susceptible to developing VCS or DES. The increase of screen time during the lockdown period of COVID-19 pandemic has also raised the intensity of symptoms related to dry eye disease. The prevalence of CVS ranges from 64% to 90% among computer users.<sup>[12-15]</sup> It has been reported that computer usage even for 3 h/day leads to the development of CVS symptoms, backache, and psychosocial stress. Numerous studies have focused on symptoms of dry eyes, such as the questionnaire-based study conducted by Gangamma and Rajagopala.<sup>[8]</sup> Therein, the questions related to the presence of pain in and around the eyes, headache, blurred near vision, blurred distant vision, dry eyes, sore/irritated eyes, red eyes, excessive tearing, double vision, twitching of eyelids, and changes in visualizing colors were all regarded as symptoms of dry eyes.

In our study, the most common symptom related to DES was headache (40%), followed by difficulty refocusing (38.7%), foreign body sensation (22.6%), light sensitivity, and blurring of vision (20.8%). These findings were similar to those of the study conducted in Chennai in 2014 on DES during the pandemic period by Bahkir *et al.*<sup>[10]</sup> and Logaraj *et al.*<sup>[11]</sup> The occurrence of headache could be attributed to undiagnosed refractive errors, the continuous use of ocular muscles, and exposure to the bright light of these digital devices for prolonged hours.

**Table 3:** Distribution of study participants according to profession and age

Age	HCW	Teachers	IT professionals	Others (bankers/lawyers)	Total
20–30	12 (12.8)	9 (10.8)	2 (18.2)	10 (23.8)	33 (14.3)
31–40	29 (30.8)	24 (29.0)	6 (54.5)	13 (30.9)	72 (31.3)
41–50	51 (54.2)	33 (39.7)	2 (18.2)	6 (14.3)	92 (40.0)
51–60	2 (2.1)	17 (20.5)	1 (9.1)	13 (30.9)	33 (14.4)
<b>Gender</b>					
Female	52 (55.3)	73 (87.9)	49 (36.6)	30 (71.4)	159 (69.1)
Male	42 (44.8)	10 (12.0)	7 (63.6)	12 (28.6)	71 (30.9)
Total	94 (40.8)	83 (36.1)	11 (4.8)	42 (18.3)	230

**Table 4 :** Distribution of symptoms according to activities in different professional categories

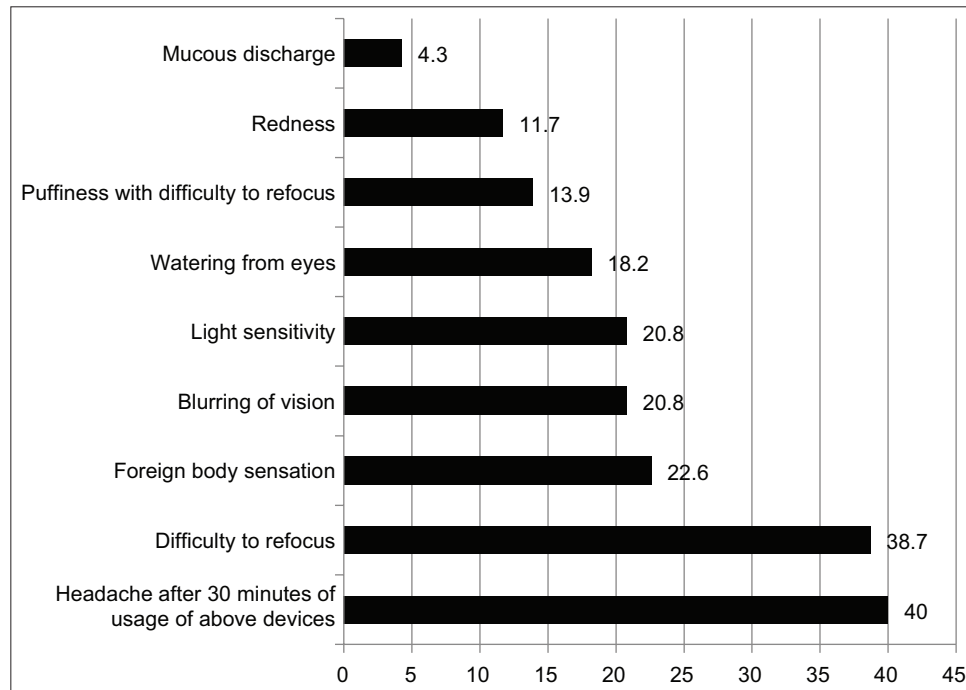
Parameters	HCW (n=94)	Teachers (n=83)	IT professionals (n=11)	Others (bankers/lawyers) (n=42)	Total (n=230)	P-value
<b>Duration of exposure to laptop/computer/mobile phone</b>						
Up to 1 h	1 (1.06)	1 (1.2)	0 (0.0)	2 (94.7)	4 (1.7)	<0.005
Up to 2 h	15 (16.0)	8 (9.6)	0 (0.0)	8 (19.0)	31 (13.5)	
Up to 4 h	27 (28.7)	23 (27.7)	0 (0.0)	10 (23.8)	60 (26.1)	
Up to 6 h	32 (34.0)	31 (37.4)	4 (36.4)	8 (19.0)	75 (32.5)	
>6 h	19 (20.2)	20 (24.1)	7 (63.6)	14 (33.3)	60 (26.9)	
<b>Increased duration of exposure to digital devices</b>						
Up to 1 h	18 (19.1)	7 (8.4)	1 (9.0)	6 (14.3)	32 (13.9)	<0.001
Up to 2 h	31 (32.9)	12 (14.5)	3 (27.3)	18 (42.8)	64 (27.8)	
Up to 4 h	21 (22.3)	15 (18.0)	1 (9.1)	8 (19.1)	45 (19.5)	
Up to 6 h	17 (18.1)	28 (33.7)	2 (18.1)	3 (7.1)	50 (21.7)	
>6 h	7 (7.5)	21 (25.3)	4 (36.4)	7 (16.6)	39 (16.9)	
<b>The above symptoms of DES were present before the pandemic</b>						
No	64 (68.0)	63 (75.9)	8 (72.7)	28 (66.7)	163 (70.9)	0.006
Yes	16 (17.0)	13 (15.6)	1 (9.0)	8 (19.0)	38 (16.5)	
<b>The above symptoms of DES have increased since the start of pandemic</b>						
Yes	14 (15.0)	7 (8.5)	2 (18.2)	6 (14.3)	29 (12.6)	0.041
No	80 (85.0)	76 (91.5)	9 (81.7)	36 (85.7)	201 (87.4)	
<b>Change in power of prescription in the past 6 months</b>						
6/6 unaided	42 (44.6)	36 (43.3)	3 (37.2)	17 (40.4)	98 (42.6)	0.005
No	55 (58.5)	37 (44.5)	5 (45.5)	16 (38.1)	113 (49.1)	
Not checked	27 (28.7)	29 (34.9)	4 (36.6)	14 (33.3)	74 (32.2)	
Yes	2 (2.1)	4 (4.8)	1 (9.0)	3 (7.1)	10 (4.3)	

DES: Dry eye syndrome, HCW: Health care worker

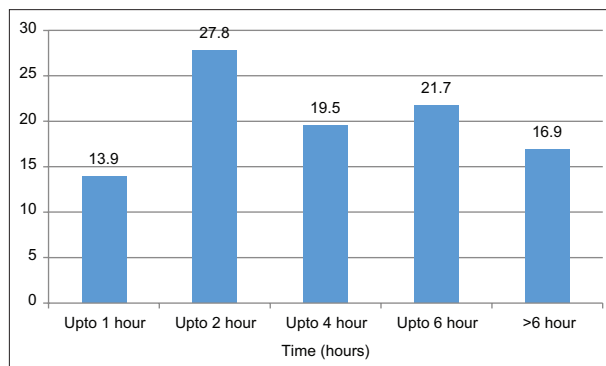
A total of 163 (70.9%) participants reported that none of the above symptoms had been present before the increased screen exposure due to online work during the COVID-19 pandemic ( $P = 0.041$ ). This result is similar to the 72.1% prevalence of DES in office workers as reported by Iwakiri *et al.*,<sup>[16]</sup> is higher than the 59.5% prevalence of DES as reported

by Subratty and Korumtolee *et al.*,<sup>[12]</sup> in a study conducted among keyboard users, and is lower than the prevalence of DES reported by Bahkir *et al.*,<sup>[10]</sup> and Lograj *et al.*,<sup>[11]</sup> at 90.4% and 81.9%, respectively.

Difficulty refocusing was experienced by 89 (38.7%) of the surveyed professionals, which could be attributed to the paucity

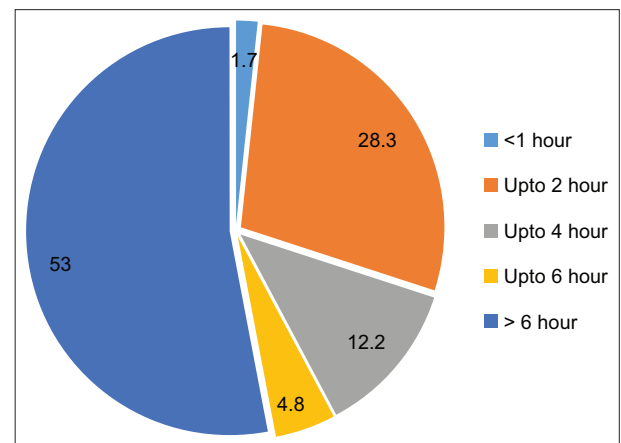


**Figure 1:** Distribution of dry eye syndrome symptoms experienced by study participants



**Figure 2:** Distribution of participants according to increased duration of online activity in the past 3 months

of breaks while using digital devices. In the present study, it was observed that participants using digital devices for <1 h/day had minimal or no DES symptoms as compared to participants using these devices for more than 6 h. Similar findings were reported by Rahman and Sanip<sup>[15]</sup> in their study on CVS, wherein they concluded that respondents that had used digital devices for more than 5 h/day developed more symptoms of CVS. Shrivastava and Bhobate<sup>[17]</sup> also indicated a significant association between the development of CVS symptoms in persons using digital devices for prolonged durations. Blurring of vision was reported by 48 (20.8%) of the participants of our study, which is similar to the prevalence reported by Bahkir *et al.*<sup>[10]</sup> and Logaraj *et al.*<sup>[11]</sup> at 16.4%. Around 10% of the enrolled professionals were using lubricating eye drops on a routine basis.



**Figure 3:** Distribution of study participants according to timings of digital device usage

### Limitations

One of the most important limitations of our study arises from its nature of an online study, where detailed ocular examinations, such as Schirmer's test and fluorescein dye disappearance test to quantify the degree of dry eyes, could not be performed. Besides, the slit-lamp examination would also help to rule out vitamin deficiency associated ocular surface disorders. Nonetheless, as the study period coincided with the pandemic, the social distancing norms had to be followed, thus an online study was the only possible alternative. Furthermore, a study similar to this type is warranted in children to determine the effect of increased

online exposure to digital screens and its potential negative effects on their eye health.

### Prevention

The CVS can be easily controlled by lifestyle changes and using proper ergonomics.<sup>[17-19]</sup> The most comfortable measure a screen user can take to reduce sore eye and headache related to DES is frequent blinking that leads to regular squeezing of the meibomian glands and therefore spreading the lipid layer across the ocular surface. In addition, one can use dedicated applications or software that reminds the user to blink more frequently.

Another preventive method is to employ plain blue filter, yellow-tinted glasses, or inbuilt blue filter in digital devices to prevent the harmful side effects of blue rays. One can also adopt the 20-20-20 rule, which entails that a person is advised to look at a distant object at least 20 feet away for 20 s every 20 min. The American Academy of Ophthalmology and the World Health Organization recommend that, besides refraction and routine ophthalmic examinations, certain eye exercises that include up-and-down and side-to-side eye tracking movements should also be carried out.

### Conclusion

The present study evidenced the increased exposure to digital screens related to online work during the lockdown period of COVID pandemic by means of an online survey aimed at various professionals. The results strongly support the suggestion of decreasing the number of hours of screen exposure during online work, taking regular breaks, and doing eye exercises.

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