



## ASSESSMENT OF PREVALENCE OF DIGITAL EYE STRAIN AMONG DIGITAL SCREEN USERS IN SETTING OF COVID-19 PANDEMIC.

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### ABSTRACT

**AIMS AND OBJECTIVES:** To assess the impact of the increased digital device usage and its ocular surface health implications along with circadian rhythm abnormalities related to digital eye strain during COVID-19 pandemic. **METHODS:** A validated questionnaire was provided to all the participants and various symptoms people experienced were analyzed. Dry eye tests were performed in all the study subjects. **RESULTS:** A total of 256 participants were included of which 88.3% of subjects reported an increase in their screen time since the onset of pandemic. The average increase in digital device usage was calculated at about  $4.4 \pm 1.9$  h per day. The total usage per day was found to be  $7.85 \pm 3.63$  hours. Sleep disturbances have been reported by 59.8% of participants. Typically, 93% of respondents had experienced at least one symptom related to digital device usage, and 66.4% said that the frequency and intensity of these symptoms increased since the pandemic started. Dry eye diagnosed clinically by Schirmer's test was present in 18.8 % of participants. **CONCLUSION:** The study highlights the increase in usage of digital devices after the onset of the COVID-19 pandemic leading to increase in digital eye strain across all age groups.

**KEYWORDS :** COVID-19, Digital eye strain, Pandemic

### INTRODUCTION

Digital eye strain (DES) includes a cluster of ocular, vision related and musculoskeletal symptoms caused by the repeated use of digital devices. Digital devices include electronic hardware such as cell phones, desktop computers, laptops, tablets, virtual reality viewers, 3D displays, smart wristwatches and e-readers, among others. The emergence of the COVID-19 pandemic and the worldwide lockdown lead to a further drastic increase in the hours spent on these devices for various purposes such as online classes, meetings, work from home and for entertainment.

As little as two hours of continuous digital device usage per day is enough to put the user at a great risk of developing DES due to decreased and incomplete blink rate leading to ocular surface compromise and asthenopic symptoms caused by a visual system in a constant state of accommodation and convergence<sup>1</sup>. Digital device usage causes the blink rate to fall significantly<sup>2,3</sup>, and because of this, the meibomian glands are not mechanically stimulated as often to release a proper lipid layer, and there is a fall in the rate of replenishment of the tear film. While working on computers, the gaze angle tends to be higher<sup>4</sup> than what normal near work usually demands, the palpebral aperture is vertically larger, leading to faster evaporation and incomplete blinking. Incomplete blinking fails to distribute the tear film properly, resulting in an unstable tear film<sup>5</sup>, which, coupled with an inadequate lipid layer, presents with dryness of eyes, grittiness or foreign body sensation, burning, and itching of eyes. The other component is the strain on the ocular muscles, both internal and external. Unlike printed pages, letters on *digital displays are not sharply outlined, with lower letters contrast to the background, as well as the effect of glare and reflection, rendering viewing more difficult.* Furthermore, given the various distances and angles of viewing, the eye movement and focusing demands are substantially higher than those needed when writing on or reading from paper. This is particularly evident in people with

uncorrected refractive errors<sup>6</sup>, contact lens wearers<sup>7</sup>, people with a history of ocular illnesses<sup>8</sup>, diabetics<sup>9</sup>, female gender<sup>9</sup>, and with autoimmune diseases. The majority of people develop DES when the visual demands of performing tasks overcome their visual capability to do so.

This study has been conducted to evaluate the impact of increased digital device usage due to lockdown and various restrictions on opening of schools, offices, markets and other recreational sources on ocular surface health and circadian rhythm in covid 19 era. The studies so far on this subject have dealt with the student population, or targeted working professionals through online questionnaire. This is the first hospital based study of its kind that includes people in all walks of life, since digital device usage is not restricted to any particular epidemiological profile.

### METHODS

The present study targeted digital screen users above 10 years of age attending ophthalmic opd with various ocular complaints. People on treatment for glaucoma<sup>10</sup>, contact lens wearers<sup>11</sup>, post LASIK or other ocular surgeries patients and Smokers were excluded. A validated questionnaire was provided to all the study participants after obtaining informed consent for patients above 18 years and informant consent of parents along with informant assent of children between 10-18 years of age. The validation of questionnaire was done with a pilot study using 25 other study participants. The questionnaire included multiple choice questions about demographics, the amount of time spent on digital devices pre Covid 19 pandemic and during Covid 19 pandemic and DES symptoms such as blurring of vision, burning sensation, redness, watering, heaviness of eyelids, foreign body sensation, double vision, eye ache, headaches, among others. The questionnaire also included any difficulty in falling asleep at night. All participants were next subjected to dry eye tests, namely, Schirmer's test I and 2.

**Schirmer's test**

The study has a descriptive cross sectional design. We enrolled 256 consecutive patients attending ophthalmic OPD of a tertiary medical centre between march 2021 to may 2021 fulfilling inclusion criteria.

The study was done in a room with ambient conditions. After explaining the procedure properly, Schirmer's I test done, with the help of commercially available test strip. The test strip is placed in lower fornix at junction of medial 2/3rd and lateral 1/3rd with initial 5mm of strip folded at the notch. Test results were noted by measuring the wetting on test strip after 5 min. Test was done simultaneously for both eyes. Schirmer's I test reflects both reflex and basal secretion.

Study subjects were then explained about Schirmer's II test. One drop of proparacaine was instilled in both eyes prior to test and After 5 min, Wet area of tear strip was noted. This reflected basal secretion of lacrimal gland. Schirmer's test values of < 10 mm was taken as dry eye.

**RESULTS**

Out of 256 patients, 77.3% (198) were male and 22.7% (58) were females. Of the respondents, a majority of 62.1% (159) belonged to the age group 18–25, 17.6 % (45) belonged to 10-17 years, 14.5% (37) belonged to 26–33 years, 5.5% (14) were between 34 and 41 years of age, and 0.04% (1) were in the 42 years and above group. Majority (59% that is 151) belonged to students population; 11.7% (30) were medical professionals; 24.1% (62) were nonmedical working professionals; and the rest, 5.1% (13) included housewives and temporarily unemployed people because of the pandemic. Of the study population, 46.9% (120) people were already aware of an entity called computer vision syndrome or digital eye strain (figure 1). Among the people claiming to have prior knowledge of computer vision syndrome, only 16.7% (20) were aware that breaks need to be taken every 20 minutes while working on digital devices.

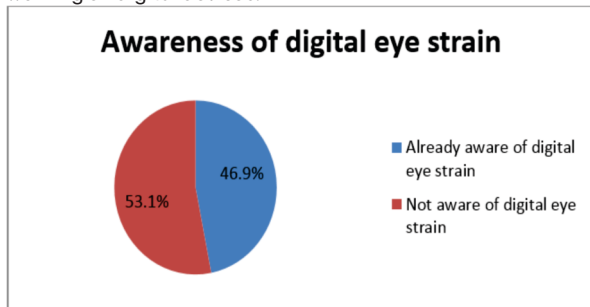


Figure 1: Awareness of digital eye strain among study population

It was noted that 88.3% (226) of participants had an increase in their digital device usage after the onset of COVID 19 pandemic. An average of  $4.43 \pm 1.9$  hours of increase in usage per day was noted. This led to the total amount of screen time per day  $7.85 \pm 3.63$  hours. It is noted that overall digital device usage increased from pre pandemic usage by 5 hours or more among 50.8% (130) of subjects, of which 59.2% (77) were students. The student population have logged an average increase in usage of  $5.16 \pm 2.73$  hours per day, bringing their daily usage to  $8.2 \pm 3.33$  hours. In total, 59.8% (153) people said that digital device usage prevented them from going to sleep at an optimal time. The working professionals in the nonmedical field are most affected in this regard, with 56.5% (35) reporting an inability to fall asleep on time. This is followed by the student population, where 33.8% (51) suffered from sleep disturbances. A small fraction of people, 8.2% (21), reported no change in their screen time during pandemic. Among these, the majority, 42.9% (9) belonged to homemakers and recently unemployed people.

Dry eye diagnosed clinically by Schirmer's test was present in 18.8 % (48) of participants. Symptoms related to digital eye strain like redness of eyes, watering, burning sensation, dryness of eyes, increased sensitivity to light, itching, excessive blinking, difficulty in focusing printed text, blurring of vision, feeling that sight is worsening, feeling of a foreign body or grittiness of eyelids, double vision, colored rings around bright objects, headache, eye pain, heavy eyelids were included in the questionnaire.

Males reported an average of  $2.71 \pm 2.34$  symptoms, while females reported  $2.5 \pm 2.78$  symptoms. The correlation between increase in screen time and number of symptoms was found to be statistically significant ( $P = 0.001$ ). As the screen time increased, there was a statistically significant increase (figure 2) in both frequency of symptoms ( $P = 0.03$ ) and intensity of symptoms ( $P = 0.05$ ). Sleep disturbances were increasingly reported by people with a higher screen time, this was also found to be statistically significant ( $P = 0.005$ ). In total, 93% (238) of respondents have experienced at least one symptom related to digital device usage, and 66.4% (170) said that the frequency and intensity of these symptoms have increased since the lockdown was declared. The mean usage among this population was  $9.3 \pm 3.5$  hours; and it predominantly consisted of the student community 65.3% (111).

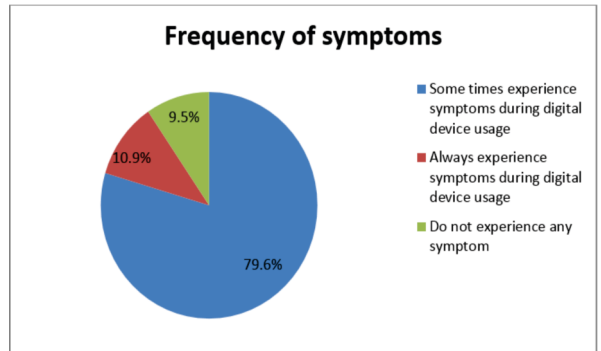


Figure 2: frequency of symptoms of digital eye strain experienced by the study Population

**DISCUSSION**

The sudden increase in the overall number of hours of screen time per day have been due to a shift of professional and social activities to an online platform after the advent of the pandemic. This included online meetings, webinars, online classes, assignments done on digital devices, work from home, personal and professional video calls, online shopping, leisure, and entertainment. In total, 93% of the subjects experienced at least one symptom associated with digital device usage. This is higher than the prevalence reported in previous studies<sup>12,13</sup>. In 2014, a study conducted in Chennai by Logaraj et al<sup>13</sup> reported a prevalence of 81.9% among engineering students and 78.6% among medical college students. The significant shift can be explained by the increase in duration of digital device usage among the participants of the study. Their study reported less than four hours of screen time per day for 85% of medical students and 46% of engineering students, while the student population in our study have logged an average of  $8.2 \pm 3.33$  hours of usage per day. The student population was considerably more symptomatic, and this can be attributed to the abrupt increase in screen time of students, who are previously unaccustomed to spending long consecutive hours on digital devices. In our study, the most common symptom was, eye pain affecting 47.3% (121) of the participants which can be explained by the undue strain on the intrinsic muscles of accommodation, which cannot fully relax under the viewing distances of digital devices. This is at par with 47.63% prevalence reported by Dessie et al.<sup>14</sup>, Headache was present in 33.2% subjects which could be a presentation of eye strain, undiagnosed refractive errors, or simply a result of exposure to continuous bright light for prolonged periods of time. This is on par with the

occurrence of headache reported by the study conducted in Ethiopia (33.7 %) in 2018<sup>14</sup> and significantly lower than the prevalence reported in Chennai (43.3% medical and 45% of engineering students) in 2014<sup>13</sup>, Blurring of vision has been reported by 17.2% of the population, and this is more than the occurrence reported by Talwar et al., at 13.2%. On the other hand, the study by Logaraj et al<sup>13</sup> saw 16.4% of medical students and 31.6% of engineering students experiencing this symptom. In total, 18.8% (48) of people said that they experienced heavy eyelids. Dry eye diagnosed clinically by Schirmer's test was present in 18.8 % (48) of participants which was much lower than the dry eye reported (45%) in Kharei and Khatri study<sup>15</sup>. This could be due to very recent increase in screen time during current pandemic. Sleep pattern disruption was more frequent in individuals who reported a longer screen time, as reported by numerous other studies<sup>16,17</sup>.

### Limitations

The study did not include current status of refractive errors. Also it does not handle musculoskeletal issues that arise from poor posture that goes hand in hand with these issues. The children in the study have not been followed up for the possible development of myopia resulting from prolonged hours of near work<sup>18</sup>.

### CONCLUSION

Our study highlights the increase in use of digital devices after the onset of the COVID19 pandemic leading to the slow deterioration of ocular health across all age groups. Measures are warranted to spread awareness about the prevention of digital eye strain and minimize the adverse effects.

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**Conflicts of interest - There are no conflicts of interest.**

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