

# Prevalence and Severity of Digital Eye Strain (DES) during the COVID-19 Pandemic Period amongst the University-Going Students of Jorhat, Assam: A Cross-Sectional Study

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## Abstract

**Aim:** The purpose was to determine the prevalence, the symptom frequency and severity and the associated risk factors of Digital Eye Strain (DES) among the university-going students attending and have attended online classes during the COVID-19 pandemic.

**Methods:** A total of 300 subjects from different university within the Jorhat region for a period of 4 months, from January to April, 2022 were enrolled in this cross sectional study. Questions about the habits of digital device usage, its severity and frequency were asked in the questionnaire. Data was collected and tabulated in MS Excel and further analyzed using SPSS software version 26.00. Associated risk factors of DES were analyzed by univariate and multivariate logistic regression with age, gender, device used, viewing distance and duration of screen use. A P value of  $\leq 0.005$  was considered statistically significant.

**Results:** Three hundred students responded to the questionnaire. The mean age of the student was found to be  $22.10 \pm 2.0$ . The mean duration of digital devices used during the COVID-19 pandemic was found to be  $3.22 \pm 0.98$  h which is more than the pre-COVID-19 pandemic ( $2.80 \pm 1.07$ ,  $P < 0.001$ ). Prevalence of DES in the cohort was 92% ( $n=276$ ). Of these 27% were mild, 37% moderate and 27.3% of severe grade. Multivariate analysis revealed that age 21 years ( $P=0.05$ ), female gender ( $P=0.0005$ ), smartphone use ( $P=0.004$ ) and duration of online class  $>4$  hr ( $P=0.0008$ ) as independent risk factors for DES in the student.

**Conclusion:** There is an increased prevalence of DES among the student in the COVID pandemic compared to before the COVID pandemic. Parents, teachers and eye care practitioners should be considerate about the usage of digital device to avoid DES and Optometrist should provide guidelines for the proper usage of the gadgets for abolishing the symptoms and sufferings due to DES.

**Key words:** Digital eye strain; Students; Online classes; COVID-19 pandemic

## Introduction

Digital eye strain, a growing public health concern, is a syndrome characterised by visual disruption and/or ocular pain caused by a variety of pressures on the ocular environment. It includes a variety of ocular and visual symptoms and estimates imply that it affects up to 50% of computer users. External symptoms associated with dry eye (grittiness, alien sensation, redness, watering and photophobia) and those associated with accommodative or binocular vision stress (eye discomfort, headache and difficulty focusing from one distance to another).

The pandemic of Coronavirus illness (COVID-19) has forced severe lifestyle changes, one of which is increasing exposure to digital devices. On March 25, 2020, India went into a countrywide lockdown. Lockdown was implemented early in the disease's development in India in an attempt to limit the infection, resulting in the shutdown of services such as schools, colleges and most workplaces. People are being compelled to work from home, and e-learning is the new standard for pupils. This has led to hazardous practises such as prolonged exposure to a digital gadget and a lack of outdoor recreational activities.

Because of the rising usage of technological devices, DES has become more popular among young adults in the contemporary context. DES is not a single entity, but rather a collection of symptoms such as ocular fatigue, dryness, abnormalities in accommodation and vergences and refractive error that, in the current scenario, are confined to the form of DES-based issues in a patient.

## Aim

To assess the prevalence and impact of lifestyle due to digital eye strain.

## Objective

To evaluate the digital eye strain and symptoms based on its risk factors among the population of 18-30 year's age group from different universities in the Jorhat region.

## Materials and Methods

A cross-sectional, random sampling questionnaire-based study is used to evaluate the prevalence and severity of DES among the university-going students attending online classes or have attended previously in Jorhat, Assam during the COVID-19 pandemic. During the 16 weeks of the cross-sectional study, a total of 300 responses were collected from different universities within Jorhat region. Individual respondent's interview was collected using a pre-validated questionnaire, and answers were collected from the respondents along with signed consent form [1]. The demographic data of the participants include age, gender, duration of digital device used, digital device used and distance of digital device from the eyes.

The queries were designed to assess the prevalence of DES and also to assess the DES for different risk factors.

### Place of study

- The Assam Kaziranga university, Jorhat
- Assam Women's university, Jorhat
- Assam Agriculture university, Jorhat

### Inclusion criteria

- Patient willing to participate in the study
- Age group between 18-30
- Patient scoring DES score of  $\geq 6$

### Exclusion criteria

- Suffering from any previous eye ailments
- From any kind of systemic diseases
- Any history of ocular trauma/surgery
- Undergoing any kind of treatment of ocular or systemic conditions

The questionnaire comprised of four sections: Demography of the subject, digital device information, DES symptoms questionnaire and good ocular health safety tips for subjects during digital device use.

A pre-validated computer vision syndrome questionnaire developed by Segui, et al. was used to measure the severity of DES symptoms. The CVS Q assessed the severity (moderate or severe) 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, coloured halos, vision worsening and headache [2]. The following frequency was recorded: Never=no symptoms; occasionally=scattered symptoms or once a week; often or always=2 or 3 times per week or virtually everyday. Moderate or severe intensity was reported. Following formula was applied to calculate the total.

$$DESscore = \sum_{i=1}^{16} (\text{frequency} \times \text{intensity})$$

Score: Where frequency: Never=0, occasionally=1, often or always=2 and intensity: Moderate=1, intense=2. DES score of  $\geq 6$  was indicative of DES.

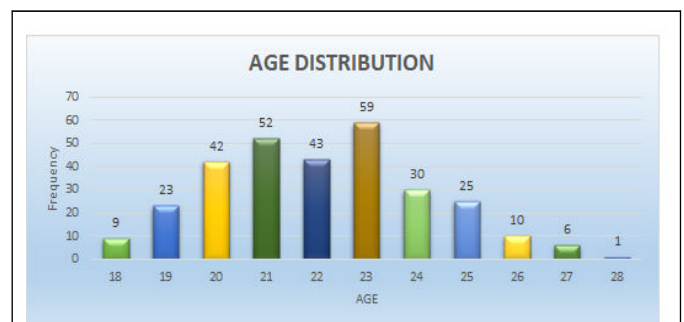
### Statistical analysis

The data collected from the respondents was exported as Microsoft Excel sheets via the Google drive link and the statistical analysis was performed using IBM SPSS version 26.00 Statistics software. Qualitative factors were provided as numbers and percentages, whereas quantitative variables were presented as mean standard deviation.

Univariate and multivariate logistic regression were used to examine the risk variables of DES in relation to age, gender, device utilised (smartphone, desktop, laptop/tab), viewing distance and length of screen use. The *chi-square* test was employed in the univariate analysis to evaluate the relationships between the qualitative variables [3]. Multiple logistic regression analysis was used in the multivariate analysis to identify the independent risk factors for DES by computing Odds Ratios (ORs) and their associated 95% CI. P values less than 0.05 were considered statistically significant.

## Results

A total of 300 responses were collected through both online and offline survey. The responses comprised of 87 (29%) males and 213 (71%) females. The age ranges from 18-28 years and the mean age of the individual was found to be  $22.10 \pm 2.10$  years (Range-10) with the majority of the individuals from the age group of 23 years (n=59) (Figure 1).



**Figure 1** Graphical representation of age distribution.

Out of the total 300 subjects included, following are the age distribution: 18 years (n=9, 3%), 19 years (n=23, 7.7%), 20 years (n=42, 14%), 21 years (n=52, 17.3%), 22 years (n=43, 14.3%), 23 years (n=59, 19.7%), 24 years (n=30, 10%), 25 years (n=8.3%), 26 years (n=10, 3.3%), 27 years (n=6, 2%) and 28 years (n=1, 0.3%) (Figure 1 and Table 1) [4].

**Table 1.** Demographic characteristics and details of digital device usage.

Demography	Numbers (%)
Mean age (years) $\pm$ SD	22.10 $\pm$ 2.10 (Range 10)
Male: Female	87: 213
Online class attended	278 (96%)
<b>Device used for online classes</b>	
Laptop	44 (14.7%)
Desktop	87 (29%)
Smartphone	160 (53.3)
Tablet	9 (3%)
<b>Duration of online classes</b>	
<1 hour	27 (9%)
1-2 hour	61 (20.3%)
3-4 hour	130 (43.3%)
>4 hour	82 (27.3%)
<b>Distance of digital device from eyes during online classes (n=300)</b>	
10-18 inches	69 (23%)
18-20 inches	104 (34.7%)
21-25 inches	89 (29.7%)
>25 inches	38 (12.7%)
<b>Duration of digital device usage (preCOVID era)</b>	
1 hour	46 (15.3%)
2 hour	72 (24%)
3 hour	79 (26.3%)
>3 hour	103 (34.3%)
<b>Duration of digital device usage (COVID era)</b>	
1 hour	15 (5%)
2 hour	58 (19.3%)
3 hour	74 (24.7%)
>3 hour	153 (51%)

### Frequency and severity of DES

The most common symptoms associated with DES in our study were itching (n=241, 80.3%), watering/tearing (n=234,

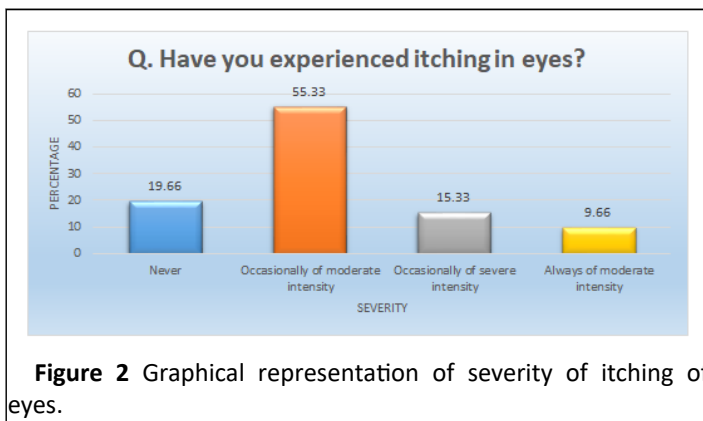
78%) and difficulty focusing near (n=234, 78%). Dryness (n=161, 53.7%) and excessive blinking (n=165, 55%) were the least common presenting symptoms.

### Burning sensation in the eyes

Out of 300 respondents, the result was: Never (n=79, 26.3%), occasionally of moderate intensity (n=150, 50%), occasionally of severe intensity (n=53, 17.7%), always of moderate intensity (n=17, 5.7%) and always of severe intensity (n=1, 0.3%).

### Itching in the eyes

Out of 300 respondents, the result was: Never (n=59, 19.7%), occasionally of moderate intensity (n=166, 55.3%), occasionally of severe intensity (n=46, 15.3%) and always of moderate intensity (n=29, 9.7%) (Figure 2).

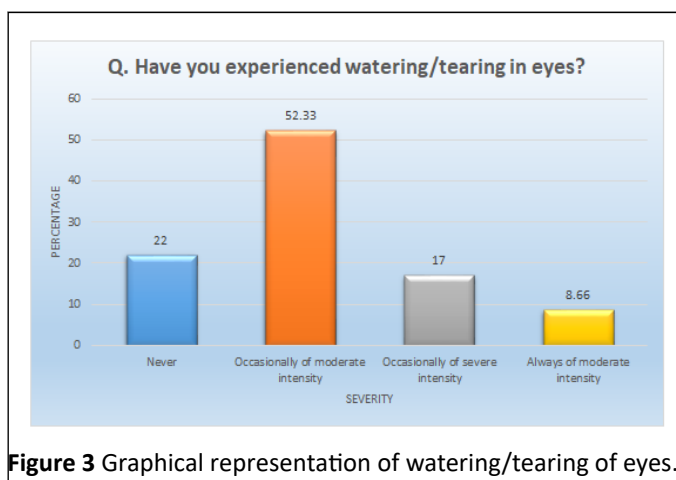


**Figure 2** Graphical representation of severity of itching of eyes.

**Foreign body sensation in the eyes:** Out of 300 respondents, the result was: Never (n=106, 35.3%), occasionally of moderate intensity (n=138, 46%), occasionally of severe intensity (n=40, 13.3%) and always of moderate intensity (n=15, 5%).

### Watering/tearing in the eyes

Out of 300 respondents, the result was: Never (n=66, 22%), occasionally of moderate intensity (n=157, 52.3%), occasionally of severe intensity (n=51, 17%) and always of moderate intensity (n=26, 8.7%) (Figure 3).



**Figure 3** Graphical representation of watering/tearing of eyes.

### Excessive blinking of eyes

Out of 300 respondents, the result was: Never (n=135, 45%), occasionally of moderate intensity (n=117, 39%), occasionally of severe intensity (n=32, 10.7%), always of moderate intensity (n=14, 4.7%) and always of severe intensity (n=1, 0.3%).

### Redness in eyes

Out of 300 respondents, the result was: Never (n=102, 34%), occasionally of moderate intensity (n=134, 44.7%), occasionally of severe intensity (n=49, 16.3%), always of moderate intensity (n=11, 3.7%) and always of severe intensity (n=2, 0.7%) [5].

### Pain in eyes

Out of 300 respondents, the result was: Never (n=98, 32.7%), occasionally of moderate intensity (n=138, 46%), occasionally of severe intensity (n=45, 15%), always of moderate intensity (n=18, 6%) and always of severe intensity (n=1, 0.3%).

### Heaviness in eyelids

Out of 300 respondents, the result was: Never (n=112, 37.3%), occasionally of moderate intensity (n=127, 42.3%), occasionally of severe intensity (n=45, 15%) and always of moderate intensity (n=16, 5.3%).

### Dryness in eye

Out of 300 respondents, the result was: Never (n=139, 46.3%), occasionally of moderate intensity (n=102, 34%), occasionally of severe intensity (n=45, 15%) and always of moderate intensity (n=14, 4.7%).

### Blurring of vision

Out of 300 respondents, the result was: Never (n=77, 25.7%), occasionally of moderate intensity (n=141, 47%), occasionally of severe intensity (n=46, 15.3%), always of moderate intensity (n=30, 10%) and always of moderate intensity (n=6, 2%).

### Increased sensitivity to light

Out of 300 respondents, the result was: Never (n=80, 26.7%), occasionally of moderate intensity (n=139, 46.3%), occasionally of severe intensity (n=55, 18.3%), always of moderate intensity (n=21, 7%) and always of severe intensity (n=5, 1.7%) [6].

### Worsening of eye sight

Out of 300 respondents, the result was: Never (n=72, 24%), occasionally of moderate intensity (n=129, 43%), occasionally of severe intensity (n=60, 20%), always of moderate intensity (n=25, 8.3%) and always of severe intensity (n=14, 4.7%).

### Headache

Out of 300 respondents, the result was: Never (n=77, 25.7%), occasionally of moderate intensity (n=141, 47%), occasionally of severe intensity (n=46, 15.3%), always of moderate intensity (n=30, 10%) and always of severe intensity (n=6, 2%).

### Halos around objects

Out of 300 respondents, the result was: Never (n=102, 34%), occasionally of moderate intensity (n=136, 45.3%), occasionally of severe intensity (n=49, 16.3%), always of moderate intensity (n=11, 3.7%) and always of severe intensity (n=2, 0.7%).

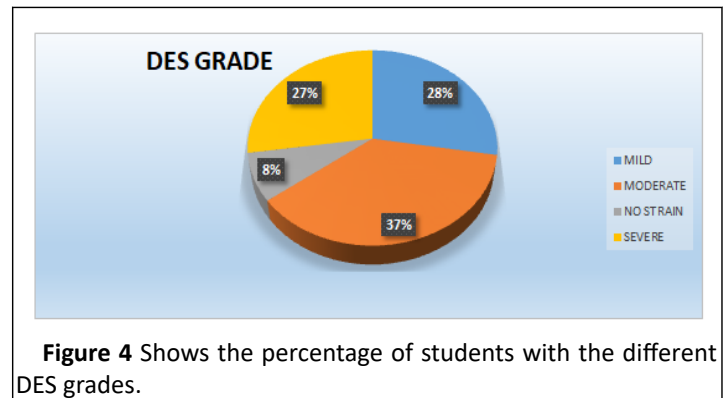
### Difficulty focusing near

Out of 300 respondents, the result was: Never (n=66, 22%), occasionally of moderate intensity (n=157, 52.3%), occasionally of severe intensity (n=51, 17%) and always of moderate intensity (n=26, 8.7%).

### Double vision

Out of 300 respondents, the result was: Never (n=81, 27%), occasionally of moderate intensity (n=140, 46.7%), occasionally of severe intensity (n=53, 17.7%), always of moderate intensity (n=21, 7%) and always of severe intensity (n=5, 1.7%). The prevalence of DES in the cohort was 92% (276/300). Of these, 27.7% were of mild grade (n=83), 37% of moderate grade (n=111) and 27.3% of severe grade (n=82) DES scores.

DES was significantly associated with female gender ( $P < 0.0001$ , odds ratio-1.56), smartphone use ( $P = 0.02$ , odds ratio-1.91), duration of online classes  $> 4$  hour ( $P < 0.0003$ , odds ratio-3.42) and digital device distance 18-20 inches ( $P = 0.07$ , odds ratio-1.71) in univariate analysis (Figure 4).



**Figure 4** Shows the percentage of students with the different DES grades.

As shown in Table 2 the multivariate analysis revealed that age 21 years ( $P = 0.05$ ), female gender ( $P = 0.0005$ ), smartphone preference over other digital devices ( $P = 0.004$ ), and duration of online classes 3-4 h ( $P = 0.008$ ), were independent risk factors for DES in the student.

**Table 2.** Multivariate logistic regression analysis of risk factors associated with digital eye strain.

Risk factor	OR	95% CI	P
Age 21 years	2.23	1.0-4.7	0.05
Female gender	4.5	2.1-9.6	0.0005
Smartphone preference	3.6	1.5-7.2	0.004
Digital device used	3.8	1.8-7.5	0.008
Distance of screen from eyes	0.9	0.5-1.9	0.71

## Discussion

Due to the widespread COVID-19 pandemic, various state/central governments took the drastic step of closing down various sectors of the country, including educational institutions, office workplaces and markets, in order to halt the virus's transmission, which has harmed the education of billions of schoolchildren and youths worldwide.

Closure of educational facilities shields kids from COVID-19, but it has a negative impact on their education. To avoid this, educational institutions around the world are transitioning from the traditional in-person class to the online teaching-e-learning method [7-9]. During the COVID-19 epidemic, digital learning has become a daily requirement, resulting in a significant increase in digital device use among pupils. In our analysis, 96% of the students took online classes. According to a European research, 68% of children used computers on a regular basis and 54% engaged in online activities.

The average time spent in front of digital devices in our study was 3.220.98 (range 3) h, which is comparable to a study done in the UK, in which the participant spent approximately 4 h per day on digital devices. According to a study conducted in rural western India, the average time spent in front of a screen among youngsters was roughly, 2.7 h, 1.7 h which is smaller than our

cohort. In our study, 36.9% of children spent more than 5 hours on digital devices, which is comparable to the pattern observed by Badri, et al., who found that students spent an average of 5.2 hours per day on digital devices [10-12].

Portello, et al. classified DES symptoms into two categories: Those associated to accommodation (blurred vision for close objects, headache and eyestrain) and those related to dryness (burning sensation, foreign body sensation, itching, wetness, sensitivity to light). We also examined the DES symptoms with the help of a validated questionnaire produced by Segu, et al. The self-administered CVS Q asks individuals to rate the severity and frequency of 16 symptoms they experienced while using a digital device, with a total score of six or above deemed diagnostic of DES. The CVS Q is a questionnaire that has been pretested, verified and validated for the diagnosis of DES. Itching (80.3% of instances), watering/tearing, and difficulty focusing near (78% of cases) were the most common symptoms reported in our study. The current study's multivariate analysis demonstrated that age 21 years, female sex, smartphone preference over other digital devices and duration of online classes 3-4 h were independent risk factors for DES in students [13-15]. In our analysis, the female sex appeared to be at higher risk ( $P = 0.0001$ , odds ratio 1.56), which is consistent with Shima,

et al 11's finding that visual symptom scores in digital device users were higher in females than males.

There were some limitations to the study. The study cannot define the DES status of a specific region due to a smaller sample size and the study being conducted in a tiny part of the region. Furthermore, the study was based on a symptom-based questionnaire, which requires respondents to describe the frequency and intensity of symptoms experienced while using digital devices, which is a subjective sense that differs from person to person and may be vulnerable to recall bias].

## Conclusion

The study emphasises the higher prevalence of Digital Eye Strain (DES) among students today compared to before the COVID-19 pandemic, as well as the effect of the e learning teaching style on students' ocular health. The report also emphasises a critical student ocular health issue in this era and encourages parents, teachers, and eye care providers to pursue evidence-based methods to avoid DES.

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