

## DIGITAL EYE STRAIN – A PUBLIC HEALTH PROBLEM? A CROSS-SECTIONAL STUDY ON DIGITAL EYE STRAIN & SCREEN USAGE AMONG UNDERGRADUATE MEDICAL STUDENTS IN MADURAI, SOUTH INDIA

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### Abstract

**Background:** Digital eye strain (DES) consists of a range of eye problems that result from prolonged use digital screens. Although, the harmful effect of overuse is known, students are increasingly dependent on these for education & entertainment. Therefore, we conducted this study to estimate the prevalence of Digital eye strain among undergraduate medical students. **Materials and Methods:** A Cross-sectional study was conducted among 310 medical students in Madurai city. A pretested semi-structured questionnaire was used to collect data. Data entered in MS excel and analysis done using SPSS. **Result:** The overall prevalence of digital eye strain among undergraduate medical students was found to be 11%. 39.4% of the study subjects had one or more of the symptoms related to DES. The most common symptom reported was Headache (42.5%) followed by Eye Strain (37%) & Neck/shoulder/back pain (37%). Smart phones were the predominant primary device, More than half have been using mobiles for more than 10 years & 54.2% of the students spent a significant amount of screen time at night time. Both higher years of usage & more hours spent on screen were influenced by increased age and urban location of family. There was a significant association noted between the duration of exposure to digital screens, night time usage and the DES. 61.9% had a refractive error & was significantly associated with prevalence of digital eye strain. **Conclusion:** Though the prevalence of Digital eye strain was found to be lower than in similar studies done in the country, around 40% had at least 1 symptom that might be related to it. Also, prolonged usage, nighttime usage, existing refractive error is shown to be associated with Digital Eye Strain. With the introduction of CBME, digitization & internet usage in medical education has become essential. Hence preventive measures against DES should be made mandatory for college students.

## INTRODUCTION

Digital eye strain (DES), also known as computer vision syndrome (CVS) consists of a range of ocular and visual problems that results from prolonged use of devices with a screen like computers, smart phones, digital tablets, ebook readers, etc.<sup>[1]</sup> A couple of decades back the use of computers was confined specific section of the workforce and thus this comparatively small segment of the population in India was at risk of developing this problem. But India is one of the fastest countries in terms of

digital adoption & this is driven largely by smart phones. More than 65% of young Indians (average age of 21 years) own a smart phone,<sup>[2]</sup> & connect to the internet and the time people spend in front of a screen particularly smart phones has increased drastically. The harmful effect of overuse of these devices is known and parents, teachers & others in authority tried to restrict screen time.<sup>[3]</sup> But with the era of lockdowns associated with Covid 19 society as a whole has become increasingly dependent on these devices specifically for education & entertainment. Consequently, Digital eye strain (DES) can be considered to be an emerging public

health threat.<sup>[4]</sup> Hence, we expect the prevalence of DES to have increased significantly. Therefore we conducted this study to estimate the prevalence of Digital eye strain among undergraduate medical students in Madurai.

### Objectives

- To estimate the prevalence of Digital eye strain among students of Madurai district.
- To evaluate the pattern of Digital screen usage among the students.
- To identify factors associated with Digital eye strain.

## MATERIALS AND METHODS

Study design, setting, and study participants:

A Cross-sectional study was conducted from August 2022 to November 2022 among medical students. In our study area, there is one public and one private medical college. Both these colleges were included in our study.

### Sample Size Calculation

The sample size was calculated by the following assumption: 95% confidence interval, a margin of error of 5%, and a prevalence of DES of 55.8% among medical college students from a previous study by Khan et al.<sup>[5]</sup> The sample size was calculated to be 289. 10 % was added up and finally, we took 310 samples.

### Inclusion and Exclusion Criteria

All the medical college students within the age group 17-25 years without any systemic complications like diabetes, hypertension, and tuberculosis were included in the study. Students who were taking medications like steroids or immune suppressants were excluded and those who do not give informed written consent were also excluded from the study.

### Data Collection Tools and Methods

By using the non-probability method (convenience sampling) all the eligible students were included in the study.

A semi-structured questionnaire developed by Segui M et al,<sup>[6]</sup> was used to assess the prevalence of DES. Sociodemographic data were collected from the participants. The questionnaire had 2 parts.

Part A contains information about the frequency of digital screen usage, hours spent on a digital screen, usage in a dark place, illumination, and symptoms.

Part B contains information about the frequency and intensity of 16 common symptoms leading to DES like headache, burning, itching, tearing, heavy eyelid, etc.

### Statistical Methods

Data was entered in MS excel and analysis was done using PSPP version 1.6.2 software. Results are expressed in mean, Standard deviation & percentages. The Chi-square test was applied to test the association. For statistical purposes, p-value <0.05 were considered to be statistically significant.

### Ethical Consideration

Clearance from the institutional Ethical committee was obtained before the start of the study & informed written consent was obtained from the study subjects.

## RESULTS

### Characteristics of the Study Population

A total of 310 undergraduate medical students participated in the study. The minimum age of the students was 18 years and the maximum age was 25 years and the Mean age was 20±1.45. Among the total sample population, 65.5% (203) were female 34.5% (107) were male. 53.9% of the students belong to urban areas, 30% to semi-urban areas, and the rest 16.1% to rural areas. 64.5% were hostellers and the rest 35.5% were day scholars.

### Digital Eye Strain

The overall prevalence of digital eye strain among undergraduate medical students was found to be 11%. Almost all of them had mild DES. 39.4% of the study subjects had one or more of the symptoms related to DES. The most common symptom reported was Headache (42.5%) followed by Eye Strain (37%) & Neck/shoulder/back pain(37%) [Figure 1].

There was no association between age, gender, native place & place of stay, and the presence of DES (p>0.05) [Table 1].

### Profile of Digital Screen Usage

All the students were regularly using devices with digital screens. Among them 78.7% uses android mobiles, 13.5% uses iPhone, 2.6% uses laptop, 1% uses desktop and 4.2% uses tablets/Ipad/Notepad as their primary device (based on the comparative duration of use in a normal day). Based on the years of screen usage 17.7% were using less than 5 years, 24.5% were using for 7 years rest 57.7% were using for more than 10 years.

Both years of usage & hours spent on screen were influenced by the increasing age of the student (p-value < 0.001) and the area where the family is located (p-value = 0.047). i.e students from urban areas reported longer years of usage & more screen time per day.

There was a significant association noted between the duration of exposure to digital screens (hours per day) and the DES (P<0.05) [Table 2].

The type of gadget or years of screen usage did not have any significant association with Digital eye strain (P>0.05).

Concerning the illumination level of the screen while in use, 55.8% used their screens at less than 25% of illumination, 32.3% at 26-50%, 10% used 51-75% and only 1.9% used more than 76%. But there was no association between the illumination level of the screen & DES (p > 0.05).

More than half of the students (54.2%) spent a significant amount of screen time (more than 2/3) with their devices during night time. There was

significant association between the habit of using the phone during dark hours and DES ( $p < 0.05$ ) [Table 2].

#### Attitude

The majority i.e. 81.6% of the students feel that usage of gadgets is affecting their lifestyles & 84.2% are willing to change their behaviour towards gadgets.

#### Eye Health

In our student population, 61.9% had a refractive error and they were wearing glasses. 8.7% of students are using lubricating eye drops daily. 1.9% of students had operated on their eyes previously. Mostly they have operated for Lasik. There was a statistically significant association between eye drops usage ( $x^2 -6.77$ ,  $p$ -value = 0.009), and the prevalence of digital eye strain. Similarly, a statistically significant association was noted between the eye refractive error ( $x^2 -3.87$ ,  $p$  value-0.049) and the prevalence of digital eye strain.

During prolonged screen usage 20.6% were complaining of blurring of vision and 8.1% were complaining of haziness. This was significantly associated with the DES ( $x^2 -21.07$ ,  $p$  value-0.000) [Table 3]

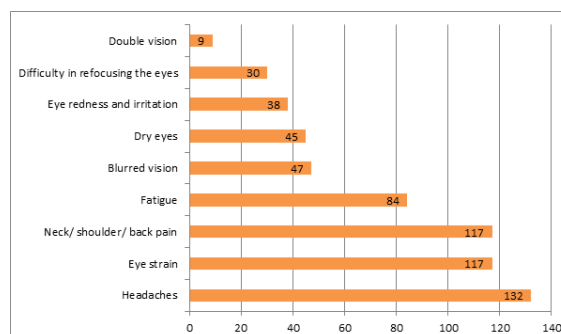


Figure 1: Common symptoms reported by study participants

Table 1: Relationship between DES and socio-demographic characters

Sociodemographic characters		Digital eye strain		X <sup>2</sup> value (p value)
		Absent	Present	
Age	Less than 20 years	118	11	1.34 (0.273)
	More than 20 years	158	23	
Gender	Female	183	20	0.749 (0.445)
	Male	93	14	
Area	Rural	125	18	0.438 (0.507)
	Urban	151	16	
Present stay	Day scholar	100	10	0.615 (0.433)
	Hosteler	176	24	

Table 2: Relationship between DES and a) Duration of screen usage & b) usage of a digital screen in dark hours

	Screen time	Digital eye strain		X <sup>2</sup> value (P value)
		Absent	Present	
a) Duration of screen usage	Less than 2hr	37	2	11.55 (0.0209)
	2-3hr	69	4	
	3-4hr	68	14	
	4-6hr	72	6	
	More than 6 hrs	30	8	
b)usage of a digital screen in dark hours	Less than 2hr	216	23	10.368 (0.0346)
	2-3hr	29	5	
	3-4hr	19	1	
	4-6hr	6	4	
	More than 6 hrs	6	1	

Table 3: Relationship between DES and vision after prolonged hours on digital screen

Vision after long hours of usage of digital screen	Digital eye strain		X <sup>2</sup> value (P value)
	Absent	Present	
Blurred	50	14	21.077 (<0.001)
Hazy	18	7	
Clear	208	13	

## DISCUSSION

The overall prevalence of digital eye strain among undergraduate medical students was found to be 11%. This was found to be significantly lower than similar studies done in India. A similar study by Karmacharya et al,<sup>[7]</sup> reported a prevalence of around 68.1% though done in COVID pandemic time where screen time is supposed to be higher due to increased online classes. A study by Mohan A et al. among school students reported around 50%

prevalence.<sup>[4]</sup> The Mohan et al. study was done while the school students were educated primarily through e-learning during the COVID pandemic. However, pandemic & online classes cannot explain this difference as a study by Khan et al,<sup>[5]</sup> done before the pandemic also reported a higher prevalence of 55.8%.

Most studies on DES looked at the proportion of students reporting at least one symptom of DES. 39.4% of our study subjects had one or more of the symptoms associated with DES. Studies by

Mohammed et al,<sup>[9]</sup> & Logaraj et al,<sup>[10]</sup> reported that the proportion of their study subjects experiencing one or more symptoms of DES was 59% & 78% respectively. Noreen et al. reported that 67.2% of medical students had symptoms related to DES.<sup>[11]</sup> This was far better than what was reported by Iqbal et al,<sup>[12]</sup> who found that 86% of Egyptian medical students reported one or more symptoms, Sanodiya et al,<sup>[13]</sup> who found 89.5% & Chwala et al,<sup>[14]</sup> who found more than 90% of medical undergraduates who participated in the study complaining of at least one symptom. The difference might be due to differences in usage patterns between the groups.

The most common symptoms reported were Headache, Eye strain & Neck/ shoulder/ back pain. Different studies found different symptoms as the most common being reported. Mohammed et al,<sup>[9]</sup> reported Neck pain, headache, and watering of the eyes as the most common, Karmacharya et al,<sup>[7]</sup> burning sensation, worsening eyesight, and eye pain as the most common, Sharma & Kumar,<sup>[15]</sup> reported headache, pain in the neck and shoulder & blurring of vision as most common & Warad et al,<sup>[16]</sup> reporting eye strain, headache & frequent rubbing of eyes as the most common symptoms. Thus there is no prominent symptom that is pathognomonic of DES and any of these symptoms should lead to the suspicion of Digital Eye Strain.

Our study did not find any statistically significant association between DES and age, gender, native place & place of stay. In most studies sex of students was found to influence the prevalence of Digital Eye Strain or the presence of symptoms suggestive of DES. Khan et al,<sup>[5]</sup> reported a higher prevalence of DES among females. Sharma & Kumar,<sup>[15]</sup> & Chwala et al,<sup>[14]</sup> reported a higher prevalence of symptoms of DES among females. Mohan et al. (8) reported males are more vulnerable to symptoms of DES. However, Logaraj et al,<sup>[10]</sup> found that males & females have different sets of predominant symptoms.

All the students were regularly using devices with digital screens. 92.2% used Mobile phones as their primary device. This was similar to reports by Khan et al,<sup>[5]</sup> (94.16%), Iqbal et al,<sup>[12]</sup> 88% & Chawla et al (88%).<sup>[14]</sup>

Our study showed that students from urban areas reported longer years of usage & more screen time per day. This may indirectly denote that families in urban areas give their children access to devices at an earlier age.

There was a significant association noted between the duration of exposure to a digital screen (per day) and Digital Eye Strain or the presence of at least one symptom related to it. This finding is similar to the finding of many other similar studies like Mohammed et al,<sup>[9]</sup> Mohan et al,<sup>[8]</sup> & Warad et al.<sup>[16]</sup> More than half of the students spent a significant amount of screen time (more than 2/3) with their devices at night. Similar behavior was reported by Mohammed et al,<sup>[9]</sup> among 68% of students,

Gammoh et al,<sup>[17]</sup> among 53% of students & Iqbal et al,<sup>[12]</sup> among 87% of students.

Our study found a significant association between the habit of using phones during dark hours and Digital Eye strain. This was similar to Shantakumari et al,<sup>[18]</sup> who found that habit of using a screen in the dark can lead to Eye Strain.

In our student population, 61.9% had a refractive error and they were wearing glasses. There was a statistically significant association noted between refractive error with the prevalence of digital eye strain ( $\chi^2 = -3.87$ ,  $p$  value-0.049). A similar association was reported by Warad et al. (16), Mohammed et al,<sup>[9]</sup> Sharma & Kumar,<sup>[15]</sup> & Ali et al.<sup>[19]</sup> However, Sanodiya et al,<sup>[13]</sup> did not find a statistically significant association between the two. Among our study population, 8.7% of students are using lubricating eye drops daily. Warad et al,<sup>[16]</sup> reported 16% using lubricating eye drops, while Karmacharya et al,<sup>[7]</sup> reported around 20% using eye drops for this purpose. The higher rates are consistent with the higher prevalence reported by both these studies.

During prolonged screen usage 20.6% were complaining of blurring of vision and 8.1% were complaining of haziness. A study by Iqbal et al,<sup>[12]</sup> reported 33% with similar complaints after prolonged use while Mohammed et al,<sup>[9]</sup> reported 26% having blurring of vision after prolonged screen usage.

## CONCLUSION

Though the prevalence of Digital eye strain was found to be lower than in similar studies done in the country, one-tenth is still a significant number. Also, prolonged usage is shown to cause Digital Eye Strain. With the introduction of CBME i.e. Competency Based medical education, there is a plethora of teaching methodology that is student-driven like flipped classroom, Self-directed learning, simulated dissection, etc.<sup>[20]</sup> It is felt by both faculty & students that digitization & internet usage is essential for the successful application of such modern teaching-learning methods.<sup>[21]</sup> Thus the screen time for Medical students is going to increase, not taking into account the increased utilization of social media by the younger generation. Hence preventive measures against DES need to be taken up by the students.

### Recommendations

More research is needed into the minutiae of screen viewing among college students to understand when & where they impact their eyes & vision & at what point we can intervene effectively. Regular Health education sessions on ways to avoid Digital eye strain should be made mandatory for these college students. The health education should focus on non-pharmacological management including the use of appropriate lighting in the room, the appropriate positioning of devices, adjusting screen parameters,

correct ergonomic practices, maintaining normal blinking, etc.

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