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A cross sectional study on digital eye strain among undergraduate medical students in a medical college in South India

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***Abstract*---**Background: Digital eye strain has been a matter of serious concern since the usage of digital devices has increased exponentially in the last few years. Several individuals suffer from physical discomfort, vague pain in the eyes, neck, head & shoulders, dryness, blurring & watering of eyes after screen use for longer than two hours at a time. The collection of these symptoms are referred to as digital eye strain. Purpose: To evaluate the prevalence, symptoms

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and associated risk factors of digital eye strain among undergraduate medical students in a medical college in South India. Material & Methods: This was a cross sectional study conducted among undergraduate medical students of a medical college located in south India using structured questionnaire administered through online social media. Results: 596 students responded to this questionnaire. Out of these 596 respondents, 351 students(58.89%) reported experiencing the symptoms of DES. Eye strain (34.10%),frequent headache(28.9%),rubbing of eyes (26.0%),watering (21.3%), burning sensation in eye(17.4%), redness (11.4%)were the symptoms reported by the subjects. Prolonged Use of digital devices, presence of refractive errors and inadequate use of photochromic spectacles and dependence on social media for academic and recreational purposes were the important causes for development of DES. Conclusion: Digital devices have become an inevitable part of today's life. DES is common among medical students, significant risk factors need to be assessed to reduce the symptoms & to ensure a better productivity of work. It is of utmost importance to create awareness among medical students regarding digital eye strain.

***Keywords*---**digital devices, screen time, digital eye strain (DES), questionnaire, usage, undergraduate medical students.

Introduction

Digital eye strain has been a matter of serious concern since the usage of digital devices has increased exponentially in the last few years. Several individuals suffer from physical discomfort, vague pain in the eyes, neck, head & shoulders, dryness, blurring & watering of eyes after screen use for longer than two hours at a time. The collection of these symptoms are referred to as digital eye strain. The American Optometric Association defined computer vision syndrome "as a complex of eye and vision problems related to near work experienced during computer use".[1] Also the development of technology in education has brought in a noticeable transformation in the methods of teaching, presenting information and sources for studying. Students prefer to use laptop, tablets, cell phones not just for recreational purpose but also for their academic activities so that they can avoid the burden of carrying heavy books.

However, this convenient lifestyle still raised a health related concern. Undergraduate medical students hailing from different parts of the world stay at hostel away from their home for a long period at a tender age, they inevitably embrace digital devices to communicate with family, to socialize with peers, to play games to beat stress and also for their academic activities like preparing for seminars, symposiums and to keep updated with recent advances in the medical field. It is estimated that globally around 60 million people suffer from this syndrome[2]. Almost 75% of a person's daily activities include computer usage [3]. So the present study aims to assess the prevalence, symptoms, and risk factors of digital eye strain particularly among undergraduate medical students.

Materials and Methods

A cross sectional study was conducted for a period of 1 month from 16th March to 17th April 2022 among undergraduate medical students in a renowned medical college located in South India. An online survey was conducted through a structured questionnaire circulated through social media platform among undergraduate medical students to assess the prevalence, symptoms and associated risk factors of digital eye strain. Predesigned, Structured, Self-assessment based questionnaire forms were circulated among 800 students out of which 596 students took active participation in the study. Those who were not willing to be part of the study were excluded. Also students with corneal dystrophies/ degeneration, keratoconus, diabetes, hypertension were excluded from the study. Ethical clearance for the study was taken by the Institutional Ethics Committee on human subject research (Ref: MDC/DOME/341). The filled questionnaire was collected and Data is analysed using statistical software R version 4.1.1 and Microsoft excel. Continuous variables were represented by mean$\pm$ SD and categorical variables represented by frequency. Chi-square test is used to check the dependency between two categorical variables. P value$\leq$0.05 indicates statistical significance.

Results

A total no of 596 participants responses were analysed. Mean age of the total participants was 21.04+/-SD 1.65 (ranging from 18 to 26 years of age). The male to female ratio was 0.83 Total 272(45.64%) male students & 324 (54.36%) female students took part in the study. Majority of the students who took part in the study were from first year MBBS i.e. 220(36.91%) followed by third year MBBS students 207(34.73%), followed by second year students 67(11.24%), followed by final year & house surgeons each category accounting for 8.56% (51 students from each category). Fig 1, 2 and 3 shows distribution of subjects with respect to age, gender and year of study.

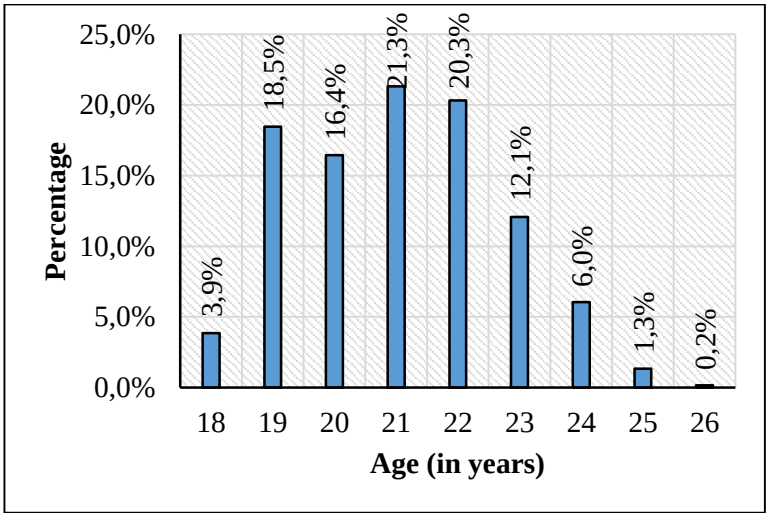

Figure 1. Distribution of subjects by age

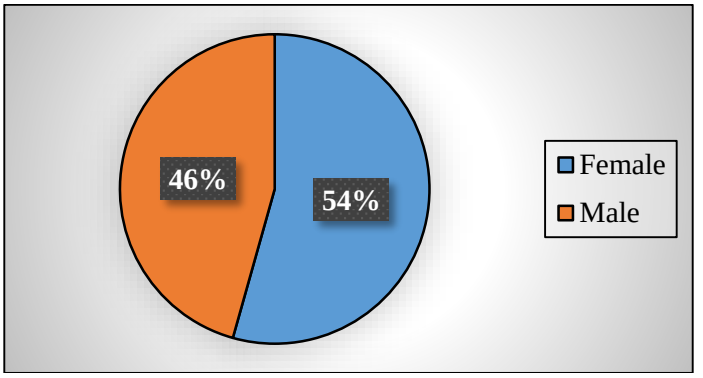

Figure 2. Distribution of subjects by gender.

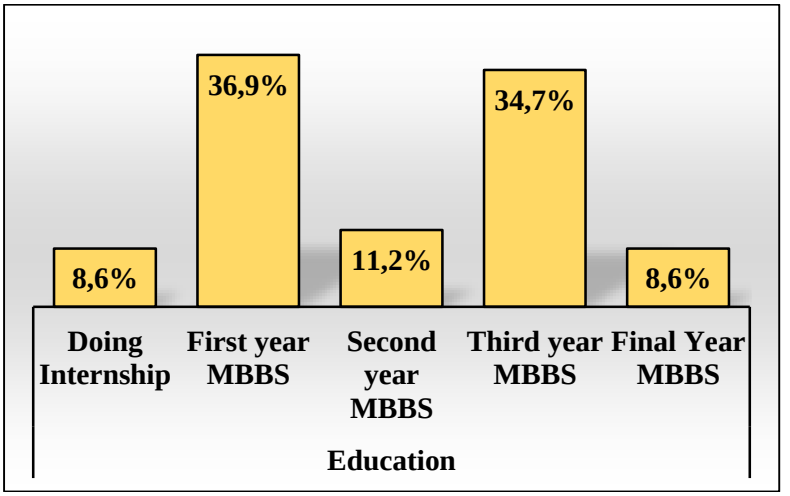

Figure 3. Distribution of subjects by education status

Duration of digital exposure for academic purpose

Out of 596 students,188 (31.54%) students spent 0 to 3 hours on digital devices and 281 students(47.14%) spent 3 to 6 hours on digital devices and 96 (16.10%) students spent 6 to 9 hours on screen & 31 students (5.20%) spent more than 9 hours on screen for academic purposes . The graphical representation of this data is shown in detail in Fig 4.

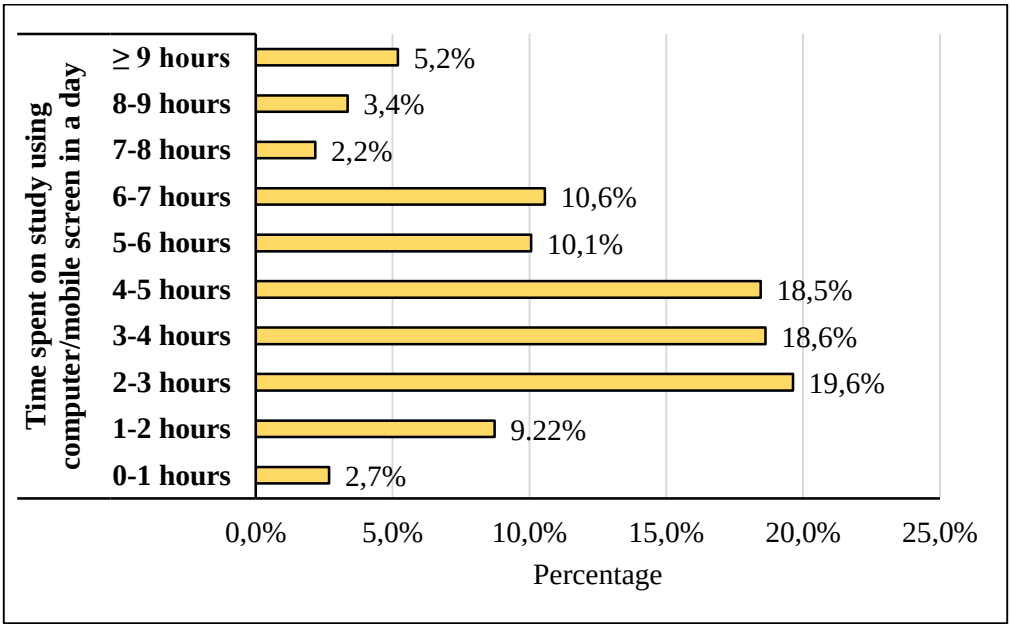

Figure 4. Distribution of subjects based on time spent on digital devices for academic purpose

Symptoms of DES

Out of 596 students, most common symptom was eye strain accounting for 34.01%(203 rsponses), followed by frequent headache accounting for 28.9% (171 responses), frequent rubbing of eyes 26.0% (155 responses) & watering from eyes 21.3% (127 responses), frequent burning sensation in the eyes 17.45% (104 responses), redness 11.41% (68 responses) and 245 students(41.11%) did not have any of the symptoms. The data is depicted graphically in figure 5.

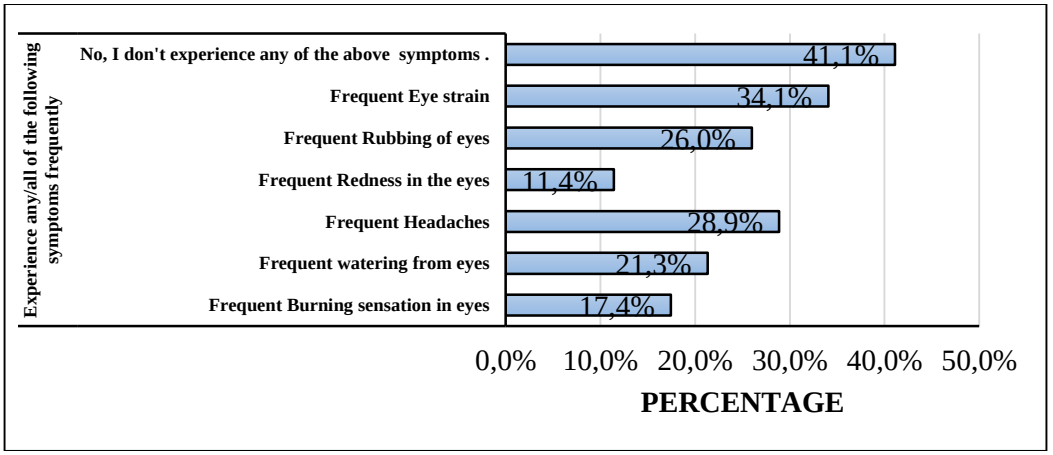

Figure 5. Distribution of subjects based on symptoms

Consultation with Ophthalmologist

Out of 351 students Who had symptoms of DES, 89 students(14.93%) were visiting ophthalmologist due to symptoms, remaining 507 students who were part of the study(85.07%) are not visiting ophthalmologist with respect to symptoms of DES. Graphical representation of the data is shown in figure 6.

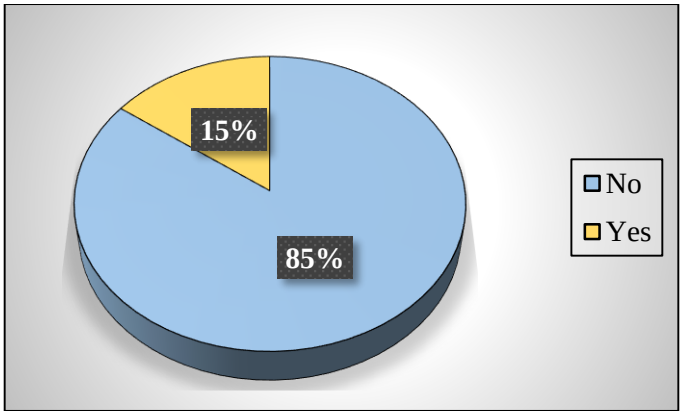

Figure 6. Distribution of subjects consulting ophthalmologist for the symptoms of DES

Usage of photochromic spectacles

Out of 596 students, 195 students (32.72%) use photochromic spectacles as a precautionary measure while working on screen & remaining 401 students(67.28%) do not use photochromic glasses while working on the screen. The graphical representation is shown in figure 7.

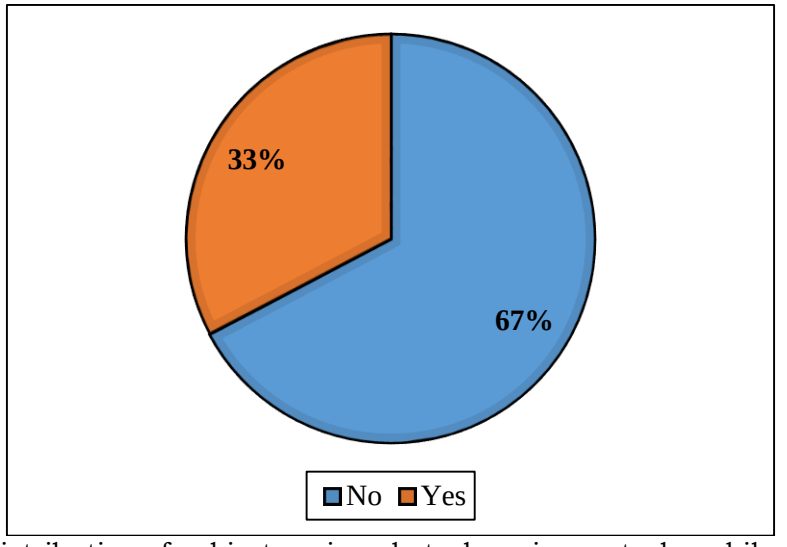

Figure 7. Distribution of subjects using photochromic spectacles while working on screens

Digital device usage for recreational purpose

out of 596 students, 184 (30.87) are active on social media for only 15 to 30 minutes in a day and 313 students (52.52%) were using social media for 2 to 4 hours a day, 77 students (12.92%)were found to be using social media for 4 to 6 hours /day and 22 students accounting for 3.69% are not using social media at all. The graphical representation is depicted in figure 8.

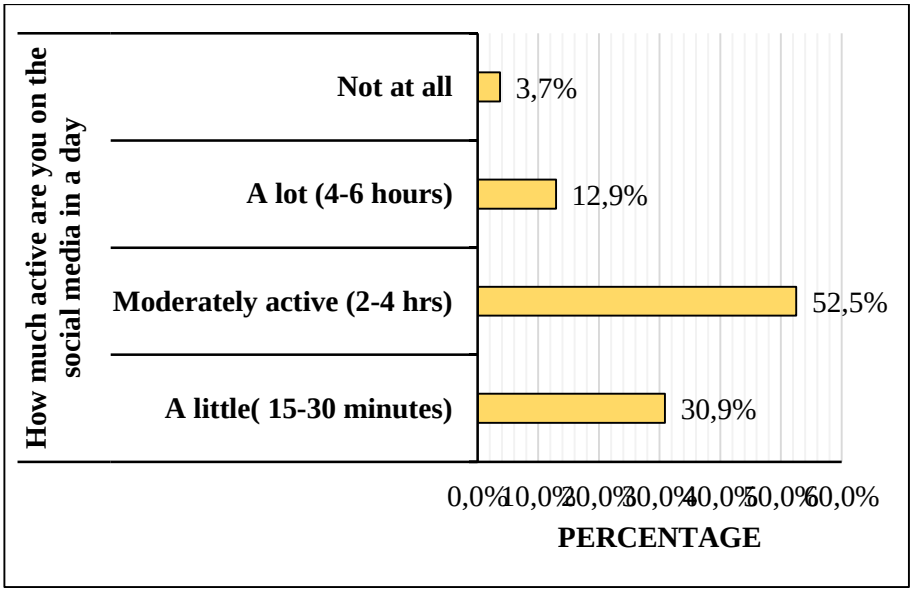

Figure 8. Distribution of subjects on the basis of activity on social media

Addiction to usage of gadgets

Out of 596 students, 273(45.81%) students are found to be addicted to gadgets mainly cell phones for entertainment purpose. The graphical representation is depicted in figure 9.

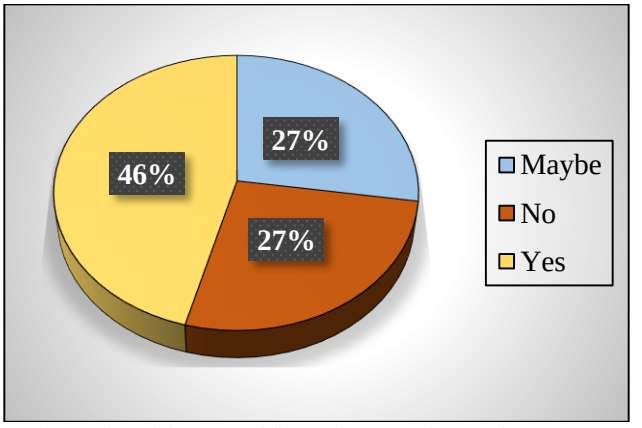

Figure 9. Distribution of subjects addicted to gadgets for entertainment purpose

Usage of lubricating eye drops

Out of 351 students who had symptoms of DES, we found 98 subjects (16.44%) are using lubricating eye drops and 498 students (83.56%) are not using any lubricating drops. Graphical representation of the data is shown in Fig.10

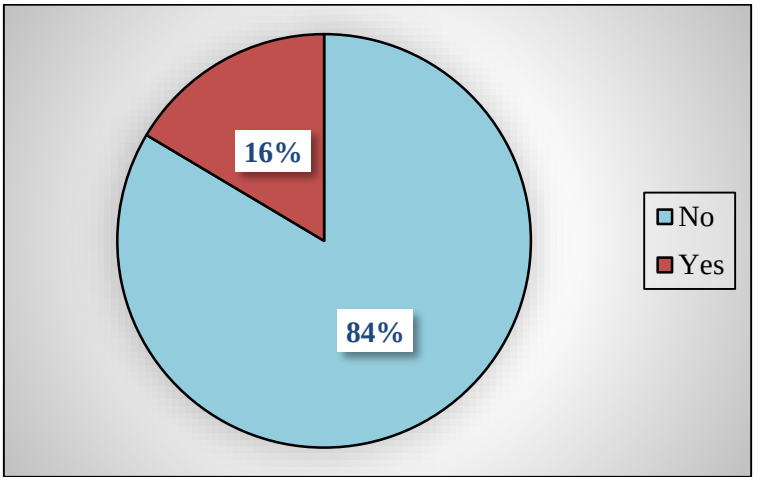

Fig 10. Distribution of subjects on the basis of using lubricating eye drops

Refractive errors among subjects

In the present study we found 331 (55.54%) students are diagnosed with myopia, 30 (5.03%) students are diagnosed with hypermetropia, 38 students (6.38%) are diagnosed with astigmatism. Graphical representation is shown in figure 11.

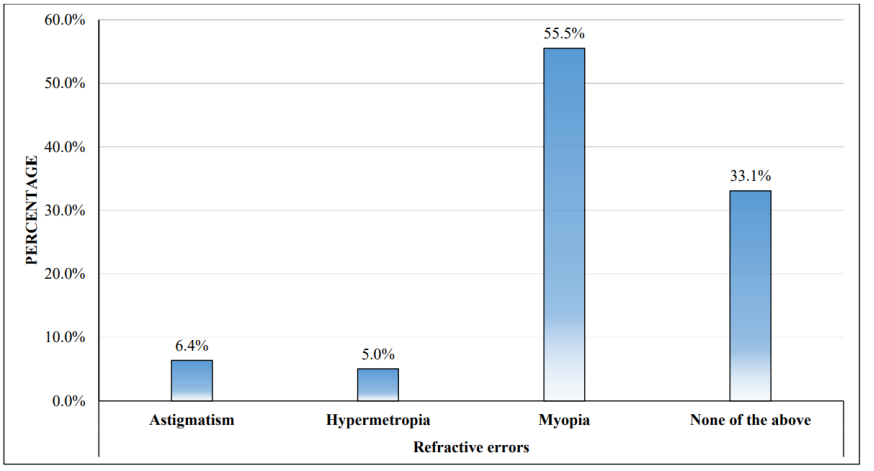

Figure 10: Distribution of subjects by experience of refractive errors.

Variable		Number of subjects (%)
Age (in years)	18	23 (3.86%)
	19	110 (18.46%)
	20	98 (16.44%)
	21	127 (21.31%)
	22	121 (20.3%)
	23	72 (12.08%)
	24	36 (6.04%)
	25	8 (1.34%)
	26	1 (0.17%)
Age (in years)		21.04±1.65
Gender	Female	324 (54.36%)
	Male	272 (45.64%)
Education	Doing Internship	51 (8.56%)
	First year MBBS	220 (36.91%)
	Second year MBBS	67 (11.24%)
	Third year MBBS	207 (34.73%)
	Final Year MBBS	51 (8.56%)
Time spent on study using computer/mobile screen in a day	0-1 hours	16(2.68%)
	1-2 hours	52 (8.72%)55(9.22%)
	2-3 hours	117 (19.63%)
	3-4 hours	11 (18.62%)
	4-5 hours	110 (18.46%)
	5-6 hours	60 (10.07%)
	6-7 hours	63 (10.57%)
	7-8 hours	13 (2.18%)
	8-9 hours	20 (3.36%)
	≥ 9 hours	31 (5.2%)
Experience any/all of the following symptoms frequently	Frequent Burning sensation in eyes	104 (17.45%)
	Frequent watering from eyes	127 (21.31%)
	Frequent Headaches	172 (28.86%)
	Frequent Redness in the eyes	68 (11.41%)
	Frequent Rubbing of eyes	155 (26.01%)
	Frequent Eye strain	203 (34.06%)
	No, I don't experience any of the above symptoms .	245 (41.11%)
Visiting ophthalmologists often due to complaints	No	507 (85.07%)
	Yes	89 (14.93%)
Do you use photochromic	No	401 (67.28%)
	Yes	195 (32.72%)

spectacles while working on the screens?		
How much active are you on the social media in a day?	A little(15-30 minutes)	184 (30.87%)
	Moderately active (2-4 hours)	313 (52.52%)
	A lot (4-6 hours)	77 (12.92%)
	Not at all	22 (3.69%)
Do you find yourself addicted to using the mobile phones for entertainment purposes?	Maybe	163 (27.35%)
	No	160 (26.85%)
	Yes	273 (45.81%)
Do you have any of the following refractive errors?	Astigmatism	38 (6.38%)
	Hypermetropia	30 (5.03%)
	Myopia	331 (55.54%)
	None of the above	197 (33.05%)
Do you use any lubricating eye drops ?	No	498 (83.56%)
	Yes	98 (16.44%)

Below table gives the association between demographic and other variables with refractive errors.

Table 2
Relationship of variables over refractive errors

		Refractive errors				p-value
		Astigmatism	Hypermetropia	Myopia	None	
Age (in years)	< 20	7 (18.42%)	10 (34.48%)	70 (21.15%)	46 (23.59%)	0.03998* MC
	20-22	23 (60.53%)	5 (17.24%)	123 (37.16%)	74 (37.95%)	
	22-24	6 (15.79%)	13 (44.83%)	115 (34.74%)	59 (30.26%)	
	24-26	2 (5.26%)	2 (6.9%)	23 (6.95%)	18 (9.23%)	
Gender	Female	25 (65.79%)	23 (79.31%)	177 (53.47%)	99 (50.77%)	0.02375*
	Male	13 (34.21%)	7 (24.14%)	154 (46.53%)	98 (50.26%)	
Education	Doing Internship	3 (7.89%)	4 (13.79%)	28 (8.46%)	16 (8.21%)	0.6912MC
	First year	16 (42.11%)	9 (31.03%)	114 (34.44%)	81 (41.54%)	
	Second year	5 (13.16%)	4 (13.79%)	36 (10.88%)	22 (11.28%)	
	Third year	13 (34.21%)	10 (34.48%)	127 (38.37%)	57 (29.23%)	
	Final Year	1 (2.63%)	3 (10.34%)	26 (7.85%)	21 (10.77%)	
Time spent	< 5	17 (44.74%)	24 (82.76%)	241	124	0.00050*

for academic purpose using computer/mobile screen in a day	hours			(72.81%)	(63.59%)	
	≥ 5 hours	21 (55.26%)	5 (17.24%)	90 (27.19%)	71 (36.41%)	
Visiting ophthalmologists often due to complaints	No	27 (71.05%)	26 (89.66%)	275 (83.08%)	179 (91.79%)	0.006497 *MC
	Yes	11 (28.95%)	4 (13.79%)	56 (16.92%)	18 (9.23%)	
Do you use photochromic spectacles while working on the screens?	No	19 (50%)	19 (65.52%)	196 (59.21%)	167 (85.64%)	<0.00001 *
	Yes	19 (50%)	11 (37.93%)	135 (40.79%)	30 (15.38%)	
How much active are you on the social media in a day?	A little(15-30 minutes)	12 (31.58%)	4 (13.79%)	119 (35.95%)	49 (25.13%)	0.06647
	Moderately active (2-4 hours)	16 (42.11%)	21 (72.41%)	163 (49.24%)	113 (57.95%)	
	A lot (4-6 hours)	7 (18.42%)	4 (13.79%)	38 (11.48%)	28 (14.36%)	
	Not at all	3 (7.89%)	1 (3.45%)	11 (3.32%)	7 (3.59%)	
Do you find yourself addicted to using the mobile phones for entertainment purposes?	Maybe	6 (15.79%)	9 (31.03%)	91 (27.49%)	57 (29.23%)	0.3824
	No	12 (31.58%)	6 (20.69%)	82 (24.77%)	60 (30.77%)	
	Yes	20 (52.63%)	15 (51.72%)	158 (47.73%)	80 (41.03%)	
Do you use any lubricating eye drops while working on screen?	No	26 (68.42%)	28 (96.55%)	271 (81.87%)	173 (88.72%)	0.01099* MC
	Yes	12 (31.58%)	2 (6.9%)	60 (18.13%)	24 (12.31%)	

Abbreviations: MC: Monte-Carlo's simulation used in chi-square test

By Chi-square test, it is observed that, there is significant difference in the distribution of age and gender over refractive errors. Furthermore, there is significant association present between time spent on study using computer/mobile screen in a day, visiting ophthalmologists often due to complaints, using photochromic spectacles while working on the screens, using lubricating eye drops while working on screen.

Discussion

The present study on DES used a predesigned, structured, self assessment based questionnaire that investigates screen time of the students and symptoms related to DES experienced by them. The current study showed that out of 596 students, 351 students (58.89%) (p value <0.0001) reported experiencing symptoms for DES. The observation was on par with the results obtained by other Indian community based studies on computer operators.[4] Prevalence of DES according to a study done by Ferzana Mohammed et. al. among Under graduate medical students during covid 19 pandemic was 89.9% [5] , which is much higher compared to our study conducted when students started attending offline classes proving that emergence of online lectures and clinical scenario which replaced conventional teaching techniques in the clinics and wards during pandemic led to sudden surge in number of students experiencing DES symptoms.

This clearly cautions us to be aware of the ophthalmologic problems that may occur because of unmitigated usage of digital devices. Our study showed out of 596 subjects, 188 subjects (31.54%) used digital devices for more than 3 hours per day. Majority of the students (281) used digital devices between 3 to 6 hours (47.14%) and 96 students (16.10%) spent 6 to 9 hours on screen 31 students accounting for 5.20% spent more than 9 hours on screen for academic activities. This sends a strong message to teachers of medical school to create awareness regarding DES and make an effort to keep a check and reduce screen time. Our results are similar to the results found in studies done by Ferzana mohammed et. al. and Rupali Maheshgaori et al on DES [6]. According to the US National Institute for occupational Safety and Health, Computer vision syndrome affects about 90% of the people who spend 3 hours or more a day at a computer. [7]

Among 596 students who participated in the survey eye strain was the commonest complaint accounting for 34.06% (203 responses) followed by headache accounting for 28.86%(171 responses) followed by frequent rubbing of eyes constituting 26.01 % (155 responses) , frequent watering of eyes 21.31% (127 responses), frequent burning sensation in eyes 17.45% (104 responses) redness 68(11.41%), where as 41.11% accounting for 245 students did not have any of the DES symptoms. These results co-related well with studies done by chawla et al among UG medical students at RIO, PGIMS, Rhotak .[8] and with the study done by Aiman Ahmed khan et. al among UG medical students done at Yenopoya medical college, Mangalore[9]. We also found in our study that 15% of students (89) who fall in the age group b/w 18 to 26 years Were visiting ophthalmologist due to symptoms of DES . This proves to be matter of concern sending a strong message for the youth to involve in extracurricular activities replacing digital devices for recreational activity and use conventional reading materials rather than routinely using digital devices for study purpose since the studies have proven that we tend to blink less frequently while using digital screen causing dry eyes, blurring of vision periodically while working.

In our study 195(32.72%) students were found to be using photochromic spectacles as a precautionary while working on the screen whereas rest 401(67.28%)did not use any photochromic spectacles. This alerts us to create awareness among students regarding the benefits of using photochromic

spectacles while working on screen. Since, blue light from LED and flouroscent lighting ,as well as monitors, tablets and mobile devices can negatively affect vision over the long term. Special lens tints and coatings can reduce the harmful impact of blue light.[1] Out of 596 students, 273 students have done self assessment stating that they are addicted to gadgets like mobile phone for entertainment purpose, which clearly sends a strong message to parents & medical school teachers to mould them in a better way by correcting their habits.
we also found that out of 596 students 331 (55.54%) students are diagnosed myopic and 30 students(5.03%) diagnosed as hypermetropic and 38 students (6.38%) are diagnosed with astigmatism. Further proving that myopia is more common among individuals who do more of near vision based activities. Also we found, Out of 351 students reporting symptoms of DES 98 students (16.44%) were using lubricating eye drops for DES.

So, The students should be made to understand that our eyes have little problem focusing on most of the printed materials, which is characterized by dense black characters with well defined edges. Healthy eyes can easily maintain focus on the printed page. These characters (pixels) are brightest at the centre and diminish in intensity towards the edges. This makes it very difficult for our eyes to maintain focus and remain fixed onto these images. Instead our eyes drift out to a point called the "Resting point of accommodation" or RPA. Our eyes involuntarily move to the RPA, and then strain to regain focus on the screen. This continuous flexing of eyes focusing muscles creates fatigue and the burning, tired eyes, feeling that is common after long hours at the computer.[10] Increasing the risk of developing DES . SO it is not advicable to replace conventional reading techniques with digital devices almost always .

Conclusion

A significant number of undergraduate medical students suffer from symptoms of DES. It still remains a poorly defined issue relative to its magnitude.In our study we found high Prevalence of DES among undergraduate medical students making it imperative to medical school teachers to imbibe adequate knowlegde & apropriate practices among students which will surely help them.

Limitations of the study

This study was a self assessment based, anonymous survey. Ophthalmic examination of the subjects could not be done and the accuracy of the information submitted could not be verified and it was confined to only undergraduate medical students of a single Institute.

Financial support and sponsorship
Nil
Conflicts of Interest : There are no conflicts of interest.

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