Journal of Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/6481cj96

MAGNITUDE OF DIGITAL EYE STRAIN AMONG UNDER GRADUATE MEDICAL STUDENTS

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ABSTRACT

Aim: The present study aimed to assess the magnitude of digital eye strain and accommodation and convergence among under graduate medical students.

Materials and methods: A private hospital-based, cross-sectional descriptive study was conducted among undergraduate medical students aged >18 years from January 2023 to June 2025. A total of 300 students were enrolled using a self-administered questionnaire. A predesigned proforma collected data on socio-demographic details, health status, seating position, viewing distance, device-related factors, duration of device use, awareness of digital eye strain, and protective habits during VDT use. The prevalence and severity of digital eye strain were assessed using the validated DES-Q questionnaire, and convergence insufficiency was evaluated using an objective assessment method.

Results: In the present study, Digital eye strain (DES) was reported by 54% (162 out of 300) of participants. Most students were aged 19–21 years (59.3%), with females constituting a slightly higher proportion (56.3%) than males (43.7%). The majority belonged to the upper-middle socioeconomic class (81.7%). Regarding device-use practices, 57% maintained an appropriate seating position, while 43% did not, and 63.7% viewed screens at a distance of less than 50 cm. More than half of the participants had been using VDT devices for 6–10 years (54%), and daily device use was equally distributed between ≤4 hours and >4 hours. Use of VDT filters was reported by 50.7% of participants, while awareness regarding digital eye strain was low (37%). Most eye-related characteristics showed no significant association with DES; however, significant associations were noted with the level of the top of the computer screen ($p=0.024$), average daily VDT use ($p=0.015$), use of VDT filters ($p<0.001$). 77.8% of participants demonstrated abnormal accommodation levels, while 74.1% had normal convergence values

Conclusion: The study confirms a high prevalence of Digital Eye Strain among medical under graduates, highlighting the need for better ergonomic practices and increased awareness.

Keywords: Digital Eye Strain, Under Graduate Medical 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, smartphones, digital tablets, ebook readers, etc.[1] The ocular complaints experienced by computer/laptop/phone users typically include eyestrain, eye fatigue, burning sensations, irritation, redness, blurred vision, and dry eyes and extraocular symptoms include neck pain, back pain, and shoulder pain among others. Digital eye strain is the term used to describe the condition in which a person experiences one or more of these ocular and extraocular problems as a result of using a computer and staring at a computer display.[2]

According to Lema et al.'s meta-analysis of the literature on digital eye strain, the prevalence of computer vision syndrome is 66.0% globally, 87.3% in India, 97.0% in Pakistan, and 12.0% in Japan.[3] Nowadays, university students including medical students are spending more time staring at the screen for studying and for research work. DES is more common among computer users, particularly medical students, according to many research. According to the 2016 Digital Eye Strain research, which analyzed survey data from over 10,000 US individuals, the total prevalence of self-reported symptoms was 65.0%, with women more likely than men to experience them. DES was reported more frequently by individuals who used two or more devices simultaneously, compared with those using just one device at a time, with prevalence of 75.0% and 53.0%, respectively.[4]

Both subjective and objective techniques may be used to assess DES. Both pharmacological and non-pharmacological approaches are frequently used to treat it; pharmacological approaches include the use of artificial tears, while non-pharmacological approaches include proper ergonomics, maintaining regular blinking, using suitable lighting, carefully positioning the digital device, adjusting image parameters (resolution, text size, contrast, and luminance), and taking breaks.[5]

Intense use of digital displays, either for recreational purposes or for work/schooling context can cause ocular and extraocular symptoms,[6] digital eye strain is turning into a serious public health issue, due to less emphasis being given to it, particularly in developing countries. The majority of earlier research relied solely on subjective questionnaires administered through direct or online surveys; however, no one has identified the diagnostic criteria for digital eye strain, which is a significant problem. Surveys may overestimate the true prevalence of DES because they typically rely solely on the existence of one or more DES complaints to diagnose DES without connecting these complaints to the duration of screen time or the long-term frequency of these complaints over months[7] additionally, the objective criteria, which are the subject of this study, have not been investigated. As is well known, the harshness of visual display terminals rises in the age range above 18.

This is the first research on the impact of digital eye strain on under graduate medical students in a Northern Indian tertiary care facility. Very little research has been done on how long-term computer use affects Indian medical college students. Hence we designed a study to assess the magnitude of digital eye strain among medical students.

Materials and methods

The private hospital-based, cross-sectional and descriptive study was conducted in young age group of >18 years old, over the duration of January 2023 to June 2025, using a self-administered questionnaire. Total 300 medical students were enrolled for the study.

Pre design patient proforma was used for patients Socio-demographic information, Health status, Seating position, screen distance, and devicerelated factors, Duration of device use, Awareness about Digital eye strain, & Protective habits while using VDT devices. The study used the validated DES-Q questionnaire to measure the prevalence and severity of Digital eye strain. Convergence insufficiency was evaluated using an objective assessment method.

Inclusion Criteria

- Under graduate Medical student of private medical college.
- >18 years of age.

- Visual display terminals devices using computer/phones/laptops/tablets for more than 2 hours per day for at least since 1 year.

Exclusion criteria

- Students with history of any prior ocular disease/ any ocular surgery / refractory surgery/contact lens user.

Methodology

The validated DES-Q [8] questionnaire was used to assess the prevalence and symptoms of digital eye strain (DES). A detailed history regarding DES symptoms and duration of Visual Display Terminal (VDT) exposure was obtained. Objective assessment of convergence was performed using the Royal Air Force (RAF) rule, with the RAF box positioned at 36 cm. The measurement was recorded at the point of loss of binocular fixation, with normal convergence defined as 6–10 cm; values ≥10 cm indicated convergence insufficiency. Accommodation was assessed both monocularly and binocularly by moving the RAF box progressively closer from 36 cm until blur was reported. A normal accommodative response in young adults was ≤10 cm.

Method of Collection of Data

Undergraduate students were approached in small groups in their classrooms at the end of selected course sessions after obtaining instructor permission. On the scheduled day, willing participants were informed about the study purpose and risks, provided with consent forms, and asked to complete the questionnaire. The investigator remained present during completion, and questionnaires were collected immediately afterward. A study log recorded class details, attendance, eligibility, participation, and refusals to calculate the refusal rate.

In order to measure the prevalence and severity of DES and its symptoms—such as eye fatigue, headache, blurred vision, double vision, itching eyes, dryness, tearing, eye redness and pain, excessive blinking, feeling of a foreign body, burning or irritation, difficulty focusing for near vision, feeling of sight worsening, and sensitivity to light—the study used the validated DES Questionnaire, which was based on the literature review and validated by experts through discussion, pilot testing, and retesting.[8] The DES-Q, we score the symptoms as follows:

- 0 - no complaints.
- 1- Only one complaint.
- 2 - Two or more complaints

Then we calculate the total score, and based on the CVS smart total score, we categorize the cases as low probability (3-4), high probability (5-6), or confirmed cases (>7) of DES.

Statistical Analysis

The student investigator was entered and analyse the collected data in the SPSS (Statistical Package for the Social Sciences- Version 23.0). Single data entry was done. For data verification, 10% of collected data was chosen randomly and compared with the database entries, and range checks was done. Appropriate statistical data methods were applied. A descriptive analysis was done using means, SDs, and percentages. Continuous two independent groups were compared by parametric independent Student‘s t test. Discrete (categorical) groups were compared by chi-square ($\chi 2$) test was used. P values less than 0.05 ($p < 0.05$) was considered statistically significant.

Results and observations

In the present study, out of 300 individuals, 54.0% (162 people) reported experiencing Digital eye strain (DES). Majority of participants are aged 19-21 years (59.3%), with a smaller percentage aged 22-24 years (37.7%) and over 24 years (3.0%). Females make up a slightly larger portion of the sample (56.3%) compared to males (43.7%). The socio-economic status (SES) of the participants is predominantly upper middle class (81.7%), with few from the upper class (1.3%) and middle class (17.0%). (Table 1)

Most participants maintained an appropriate seating position relative to the screen (57%), while 43% did not. A majority viewed screens at distances <50 cm (63.7%). Over half had used VDT devices for 6–10 years (54%), and device use was evenly split between ≤4 hours and >4 hours per day (50% each). Most participants took breaks after 60 minutes (54.3%), whereas only 39% followed the 20-minute break practice. Use of VDT filters was almost equal (50.7% users), but awareness of digital eye strain was low, with only 37% reporting awareness. (Table 1)

The table explores the association between Digital eye strain and various eye related characteristics. Key findings indicate non-significant differences between DES and non-DES groups for most variables, as evidenced by p-values above 0.05. However, significant associations were found with level of top of computer screen (p=0.024), average hours/day spent on VDT devices (p=0.015), use of VDT filter (p<0.001). (Table 2)

The table compares various symptoms between participants with Digital eye strain and those without. It shows that burning of eyes is universally mild among all participants. For both DES and non-DES groups, the majority of symptoms, including as itching, tears, frequent blinking, eye discomfort, and foreign body feeling, are minor in intensity. There are non-significant differences between the DES and non-DES groups for any of the symptoms, as indicated by the p-values, all of which are above 0.05. (Table 3)

The following table shows that among those with normal accommodation (≤10), 22.2% have DES. Among those with abnormal accommodation (>10), 77.8% have DES. The Chi-square test value is 0.064, and the p-value is 0.800, indicating non-significant association between accommodation & presence of DES. The mean accommodation between DES and non-DES cases was statistically insignificant (p>0.05) by independent sample t test. (Table 4)

The below table shows that 22.2% of those with excess convergence (<5) have DES. For those with normal convergence (6-10), 74.1% have DES. Only a small percentage of participants have convergence insufficiency (>10), with 3.7% having DES. The Chi-square test value is 0.176, and the p-value is 0.916, indicating non-significant association between convergence & presence of DES. The mean convergence between DES and non-DES cases was statistically insignificant (p>0.05) by independent sample t test. (Table 5)

Table 1: Prevalence of DES, Demographic characteristics distribution and Profile of behavioral habit of study group

		Frequency (n=300)	Percentage
Digital eye strain (DES)	Yes	162	54.0%
	No	138	46.0%
Age (Years)	19-21	178	59.3%
	22-24	113	37.7%
	>24	9	3.0%
Sex	Male	131	43.7%
	Female	169	56.3%
SES	Upper	4	1.3%
	Upper Middle	245	81.7%
	Middle	51	17.0%
Behavioral habits			
Seating position at level of Screen	Yes	171	57.0%
	No	129	43.0%
Viewing distances	<50cm	191	63.7%
	>50cm	109	36.3%
Duration of VDT device used (Years)	1-5	62	20.7%
	6-10	162	54.0%
	>10	76	25.3%

Average hours/day spent on VDT devices	≤ 4 hours	150	50.0%
	>4 hours	150	50.0%
Break Frequency	After 20 min	117	39.0%
	After 60 min	163	54.3%
	After 120 min	20	6.7%
Use of VDT filter	Yes	152	50.7%
	No	148	49.3%
Aware of Digital eye strain	Yes	111	37.0%
	No	189	63.0%

Table 2: Association between DES and behavioral habit of study group

DES and behavioral habit of study group		**DES**		**Chi Square value**	**P value**
		Yes (n=162)	**No (n=138)**		
Seating position	Appropriate	87 (53.7%)	84 (60.9%)	1.561	0.211
	Inappropriate	75 (46.3%)	54 (39.1%)		
Viewing distances	<50cm	103 (63.6%)	88 (63.8%)	0.001	0.972
	>50cm	59 (36.4%)	50 (36.2%)		
Level of top of computer screen	Above the level of screen	19 (11.7%)	16 (11.6%)	**7.436**	**0.024**
	At level of eyes	80 (49.4%)	88 (63.8%)		
	Below the level of eyes	63 (38.9%)	34 (24.6%)		
Duration of VDT device used (Years)		5.01±2.37	4.29±2.02	**2.759**	**0.006**
Average hours/day spent on VDT devices		8.86±3.55	8.79±3.87	0.173	0.862
Break Frequency	After 20 min	63 (38.9%)	54 (39.1%)	0.750	0.687
	After 60 min	90 (55.6%)	73 (52.9%)		
	After 120 min	9 (5.6%)	11 (8.0%)		
No. of Devices usage at a time	1	64 (39.5)	62 (44.9)	0.498	0.129
	2	90 (55.6)	71 (51.4)		
	3	8 (4.9)	5 (3.6)		
The habit of adjusting the screen	Yes	137 (84.6%)	115 (83.3%)	0.085	0.771
	No	25 (15.4%)	23 (16.7%)		
Use of VDT filter	Yes	96 (59.3%)	56 (40.6%)	10.403	**<0.001**
	No	66 (40.7%)	82 (59.4%)		
Aware of CVS	Yes	58 (35.8%)	53 (8.4%)	0.217	0.642
	No	104 (64.2%)	85 (61.6%)		

Table 3: Intensity of symptoms associated with DES

Symptoms	DES						P value
	Yes (n=162)			No (n=138)			
	Mild (≤3)	Moderate (5-6)	Severe (>7)	Mild (≤3)	Moderate (5-6)	Severe (>7)	
Burning of eyes	162	0	0	138	0	0	--
Itching	159	2	1	137	1	0	0.590
Foreign body sensation	156	5	1	131	5	2	0.743
Tearing	158	3	1	137	1	0	0.453
Excessive blinking	158	2	2	136	2	0	0.420
Eye pain	160	2	0	136	2	0	0.872
Heavy eye lid	161	0	1	137	1	0	0.363
Dryness in eyes	156	6	0	134	3	1	0.415
Blurred vision	155	6	1	137	1	0	0.151
Double Vision	159	2	1	135	3	0	0.536
Difficulty in focusing for near vision	158	2	2	137	1	0	0.383
Increased sensitivity to light	159	1	2	138	0	0	0.275
Coloured Halos	160	2	0	135	2	1	0.547
Feeling that sight is worsening	161	1	0	135	1	2	0.304
Headache	160	2	0	134	4	0	0.305
Redness	160	2	0	138	0	0	0.190

Table 4: Association between DES and Accommodation

Accommodation Group	DES		Chi Square value	P value
	Yes (n=162)	No (n=138)		
Normal (≤10)	36 (22.2%)	29 (21.0%)	0.064	0.800
Abnormal (>10)	126 (77.8%)	109 (79.0%)		
Mean±SD	19.10±11.17	17.51±10.30	1.268	0.206

Table 5: Association between DES and Convergence

Convergence Group	DES		Chi Square value	P value
	Yes (n=162)	No (n=138)		
Excess Convergence (<5)	36 (22.2%)	32 (23.2%)	0.176	0.916
Normal (6-10)	120 (74.1%)	102 (73.9%)		
Convergence Insufficiency (>10)	6 (3.7%)	4 (2.9%)		
Mean±SD	5.84±3.20	5.86±2.76	0.065	0.948

Discussion

Digital eye strain (DES) has become a major concern as digital devices are becoming unavoidable in academic and professional environments. In our research among undergraduate medical students, 54.0% of the participants indicated DES symptoms, a percentage that is generally in line with high prevalence rates reported in the literature.

Our study population was largely composed of young adults, with the majority (59.3%) being between 19–21 years of age. Females accounted for 56.3% of the sample, and the majority of participants were from the upper-middle socioeconomic stratum (81.7%). These demographic factors are consistent with those found in other studies Sharma et al[9] and Venkateshvaran et al[10], examined medical students. Our results showed that neither age nor gender was found to have any statistically significant correlation with DES prevalence. Ali et al[11] reported a trend among female participants in some cohort studies; however, within our population, differences were nonsignificant. In our study, the prevalence of DES among students, regardless of age or gender, supports the contention that the pervasive use of digital devices results in a uniformly high risk, regardless of these factors.

Since 81.7% of the subjects were from the upper-middle-class segment, it is clear that higher SES could be associated with greater exposure to technology and more time spent on screens. While our statistical analysis showed SES to only border on significance ($p \approx 0.051$), this almost-significant trend is consistent with other research done by Garg et al[12] and Venkateshvaran et al[10], that has implicated greater exposure to digital devices, usually as a function of greater disposable income, with increasing the risk of DES.

We found that certain habits like extended daily screen time, use of devices without safe protective measures, and poor ergonomic usage had a profound impact on the prevalence of DES. More importantly, those with over four hours of daily use of digital devices tended to be symptomatic. Also, individuals who did not wear anti-glare filters and who kept the top of their screen below eye level had a greater prevalence of DES. These findings are in line with earlier research by Ali et al[11] and Garg et al[12], which reported that prolonged screen exposure and ergonomics expose individuals to ocular discomfort. In our research, the application of VDT (visual display terminal) filters was strongly related to lower DES prevalence. Students who utilized anti-glare or blue light filters experienced lower rates of symptoms, a conclusion that is aligned with the guidelines of numerous studies conducted by Ali et al[11] and Garg et al[12].

The most common symptoms were burning, itching, foreign body sensation, and tearing, with most of these symptoms rated as mild. While headaches and intermittent double vision did occur, the severity of these symptoms did not demonstrate statistically significant differences between the DES group and the non-DES group. Haider et al[13] reported that whereas a broad range of symptoms can be commonly listed by users of digital devices, the overall intensity is generally light, and the symptom profile only infrequently signifies serious ocular pathology. Garg et al[12] also found that even though symptoms were very prevalent, most patients characterized their eye discomfort as low-grade.

Moreover, although our study included a wide symptom questionnaire, it should be mentioned that self-reported outcomes may be subjectively biased. Anbesu et al[14] meta-analysis pointed out the difficulty of using subjective symptom reporting alone, a limitation that may account for heterogeneity between studies.

In addition, the wide range of symptoms registered, ranging from ocular surface abnormalities (such as dryness and irritation) to extraocular symptoms (including headache and neck pain), attests to the multisystemic effect of chronic digital use. Although the severe manifestations did not exist as observed in this study, repeating symptoms attest to the cumulative risk of screen utilization. To this end, our results support the literature, such as that of Sharma et al[9] and Venkateshvaran et al[10], which resonates with the view that repeated mild symptoms can still have a considerable effect on quality of life over extended periods.

An analysis of our data revealed that 77.8% of participants demonstrated abnormal accommodation levels, while 74.1% had normal convergence values. Notably, these measures did not show any statistically significant association with the presence of DES. These findings align with previous

research conducted by Yammouni R et al[15] and Tiwari et al[16], which likewise discovered that quantitative measures of binocular function did not prove to be good predictors of digital eye strain in young adults. This seeming discrepancy between self-reported DES symptoms and objective ocular findings is consistent with results in the general literature. Although most studies use subjective questionnaires to estimate DES prevalence, few have looked at clinical parameters like accommodation and convergence.

Tiwari et al[16] have suggested that in a group of comparatively young and fit subjects, adaptation processes may ensure ocular function even after extended near work. This is consistent with our finding of normal convergence in some three-quarters of our subjects, even when a very large majority complained of DES. While abnormal accommodation was seen in the majority of subjects, its absence of significant correlation with symptom occurrence indicates that abnormal accommodation might be an epiphenomenon and not the primary cause of DES in our population.

In addition, our use of both subjective and objective assessments in the study identifies key practical implications. Although objective ratings were not significantly different, they are a valuable adjunct to symptom self-reporting, affirming that students' discomfort is not necessarily followed by quantifiable convergence or accommodation deficits. These results are in agreement with the findings of Yammouni R et al[15], who found only weak correlation between subjective eye strain and objective measures of binocular vision. Our research confirms the hypothesis that digital eye strain, as it is perceived by medical students, is predominantly a matter of external (and modifiable) factors and not intrinsic ocular pathology.

Limitations

The study might have a limited sample size, which could impact generalizability of findings to the larger population of medical students. A larger, more diverse sample would provide more robust conclusions.

Conclusion

Our findings validate the high prevalence of Digital Eye Strain among medical undergraduates and emphasize the necessity of improved ergonomic practices and enhanced awareness campaigns. By identifying critical factors in demographic, behavioral, symptomatic, and clinical domains, this research supports a deeper understanding of DES, which in turn enables the implementation of targeted interventions for the maintenance of eye health in educational settings.

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