

Computer Vision Syndrome in Medical Students during a Period of Exclusive Online Lecture Classes in Durgapur, West Bengal - A Cross-Sectional Study

Shantanu Bhattacharjee¹, Ipshita Aparajita Nanda²

^{1, 2} Department of Ophthalmology, IQ City Medical College, Durgapur, West Bengal, India.

ABSTRACT

BACKGROUND

Computer has become an indispensable tool in the modern system of education and training. Health hazard viz. computer vision syndrome (CVS) associated with overuse of computer has been widely studied by different authors. Few studies have underscored the high prevalence of this condition among medical students. Present study has been conducted to find the prevalence of CVS, associated risk factors and to understand the level of awareness about the condition among undergraduate medical students during a period of exclusive online computer-based lecture classes.

METHODS

A descriptive cross-sectional study was conducted with 310 respondents among undergraduate medical students at IQ City Medical College, Durgapur, West Bengal from June 2020 to September 2020. The students were surveyed with pretested and structured questionnaire for various CVS related symptoms and ergonomic principles adopted by them. Data was collected and analysed. Chi-square test was performed to assess the statistical significance.

RESULTS

Prevalence of CVS in the study was found to be 58.38 %. Majority of students affected were females (69.5 %). Those using the computer for 2 – 4 hours a day were affected the most (66.5 %). The ergonomic factors that were found to have strong association with CVS were viz. prolonged and continuous use of digital screen, viewing distance, level of the digital screen with respect to eyes and chair support to lower back. The most disturbing symptom following continuous computer use was found to be headache (18.38 %), followed by eye strain (13.87 %).

CONCLUSIONS

The present study was conducted at a period when computer dependency among the students was high. Though some of the earlier studies have reported much higher prevalence of CVS among students, the present study has revealed a prevalence of 58.38 %. This was possibly due to high level of awareness (78.06 %) among medical students as revealed by the study. The study has also showed statistical significance between various ergonomic factors and development of CVS.

KEYWORDS

Computer Vision Syndrome, Ergonomics, Undergraduate Medical Students, Awareness

Corresponding Author:

*Dr. Shantanu Bhattacharjee,
6 Michael Faraday Road,
Sail Cooperative Area,
City Centre, Durgapur - 713216,
West Bengal, India.
E-mail: bhatshantanu9@gmail.com*

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BACKGROUND

With the advent of revolution in Information technology, computers have become indispensable tools in modern system of education. This has led to a new group of health disorders with ocular and extraocular symptoms directly or indirectly related to the computer use. This condition has been referred to as computer vision syndrome also known as digital eye strain. It has been estimated that nearly 60 million people worldwide are suffering from computer vision syndrome and approximately one million new cases are added every year.^{1,2}

American Optometric Association has defined CVS as a group of eye and vision related problems that result from prolonged computer, tablet, e-reader and cell phone use. It has been postulated that symptoms of CVS appear when the visual demands of the task exceed the visual abilities of the individual to comfortably perform them.³ Blehm et al. have divided the symptoms of CVS according to three basic pathophysiologic mechanism. 1. Extraocular mechanism causes symptoms like neck pain, headache, backache and shoulder pain. This has been attributed to incorrect placement of computer screen leading to muscle sprain. 2. Accommodative mechanism causes blurred vision, slowness of focus change, double vision and changes in colour perception. 3. Ocular surface mechanism causes symptoms like redness, gritty sensation and burning sensation after prolonged usage. Causes are thought to be multifactorial viz. decreased blinking rate, greater corneal surface area exposure due to horizontal gaze, contact lens use, chronic topical medications etc.⁴ It has been postulated that the risk of developing CVS is directly proportional to the number of hours of continuous computer use. A continuous use of computers for two or more hours per day poses significant risk for developing CVS.³

The visual work on a computer is different from that required when reading a print. Reading from a digital screen requires constant saccadic eye movements, change of accommodation and constant alignment of eyes. The characters on a digital screen are called pixels which are formed as a result of electron beam striking the phosphor coated rear surface of digital screen. The pixels are quite different from the normal print letters in that its centre is brightly illuminated in contrast to its edges which are blurry. This feature makes it difficult for the eyes to maintain constant focus on the pixel characters. The eyes, unable to maintain sustained focus on the plane of the computer screen, relaxes on to focus at a point beyond the screen. This point is referred to as resting point of accommodation (RPA). The eyes are therefore, constantly relaxing to RPA and straining to refocus on to the screen thereby leading to eyestrain and fatigue.⁵

Most frequently accepted diagnostic criterion for CVS has been presence of symptoms related to CVS^{6,1} occurring at least two to three times a week.⁷ Several studies have reported high prevalence of CVS among professional students but only a few of those were conducted on medical students.² As CVS is largely a preventable disease,⁸ awareness and knowledge are the key to its early prevention. Several preventive measures have been

suggested. Some of the preventive measures recommended by the American Optometric Association are - location of the computer screen should optimally be 20 – 28 inches away and 15 – 20° below the eye level. Lighting from overhead lamps and windows should not produce glare. Use of anti-glare screens should be encouraged. Seating chairs should be comfortably padded and conforming to the lower back, height should be adjusted so that the feet rest flat on the floor. The 20-20-20 rule for rest breaks has been proved to be beneficial where after every 20 minutes of computer use, one should take a break of 20 Sec and look at a distant object 20 feet away. Voluntarily increasing the blinking rate when working on visual display terminal (VDT)s is another important step.³

The present study was conducted during a period of national lockdown (June – September 2020) when the lecture classes were conducted exclusively on an online platform. This extraordinary socio-political situation has provided us with an opportunity to assess any shift in prevalence from previously reported studies.

Objectives

1. To find the prevalence of CVS among the medical students.
2. To study the association between various risk factors and CVS.
3. To find the level of awareness about CVS among the participants.

METHODS

The present study was conducted at IQ City Medical College, Durgapur, West Bengal, from June 2020 to September 2020. All undergraduate medical students were invited to participate in the study. A descriptive cross-sectional study was conducted with 310 respondents among undergraduate medical students. A self-administered, pretested and structured questionnaire was presented to evaluate various symptoms experienced by the students after continuous use of computers and assess the ergonomic principles adopted by them. All the students who have been using computers or smart phones for online classes for at least 2 hours a day for last 4 months (June – September 2020) and who were willing to participate in this study have been included. All the students who were diagnosed with dry eye disease or other corneal diseases were excluded. Informed consent was taken from each participant. Ethical approval was taken from the Institutional Ethics Committee prior to administering the questionnaire.

The questionnaire included information on sociodemographic profile, any experience of symptoms like redness of eyes, eye strain, watering of eyes, transient blurring of vision, headache, backache etc. and information on various ergonomic factors like sitting postures of the students, room lighting condition, hours of computer use etc.

The risk factors that were studied are viz. distance from the VDT screen, level of the VDT screen with respect to the

eyes, screen brightness, using glare filter on the screen and presence of chair support to the lower back.

Awareness of CVS among the respondents was tested by directly asking whether they have heard about CVS. A positive response was regarded as 'awareness' and having some understanding of CVS was defined as 'knowledge'.⁹ Knowledge was assessed by presenting a set of nine dichotomous questions in the questionnaire, related to the prevention of CVS. A score of 1 was assigned to each positive answer. A total score of 3 or less was rated as 'poor', that between 4 and 6 was rated as 'average' and a total score of 7 or above was rated as 'good' knowledge.⁹

1	Do you know that Computer Vision Syndrome (CVS) is also known as Digital Eye Strain?
2	Do you go to Ophthalmologist for a periodic eye check-up?
3	Do you know that CVS can result from continuously working on digital screens without breaks?
4	Do you know that watching digital screen from a distance can reduce CVS?
5	Do you know that glare from digital screen can cause CVS?
6	Do you know that blinking more often while working on digital screen can reduce CVS?
7	Have you heard about ergonomic principles of computer work station?
8	Do you feel that digital screen affects your life style and eye health?
9	Are you willing to decrease your screen time to guard against CVS?
Questionnaire Used for Scoring 'Knowledge'	

The diagnostic criterion for computer vision syndrome was considered as any of the CVS related symptoms that the students experienced while using the digital screen like redness of eyes, burning sensation of eyes, blurring of vision, dry eyes, headache, back ache and neck or shoulder pain.¹⁰ As it was expected many of the respondents would complain of multiple symptoms, they were asked to identify and report the most disturbing symptom.

Data was collected and compiled in MS Excel sheet and analysed by statistical software. Chi square test was performed to calculate P value. A value of $P < 0.05$ was taken as statistically significant.

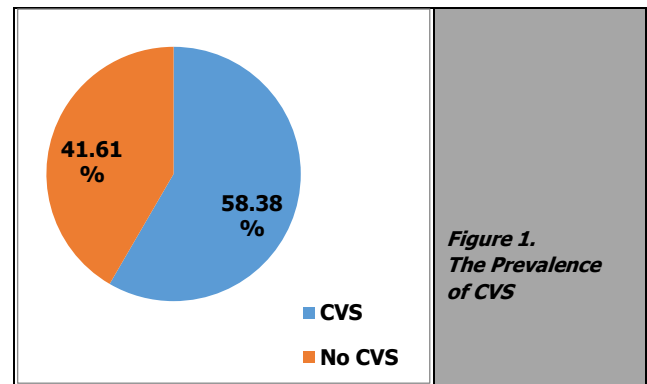
RESULTS

A total of 310 undergraduate students were enrolled in the study. Out of them 195 (62.9 %) were male and 115 (37.09 %) were female. The age of the participants ranged from 19 years to 24 years. The mean age of subjects was 21.129 years. A total of 181 students were diagnosed with CVS depending upon having either single or the most disturbing symptom in case of multiple symptoms of CVS. The prevalence of the CVS in the present study has been found to be 58.38 % (Fig.1). 51.8 % of the male students and 69.5 % of the female students were found to be suffering from CVS ($P < 0.05$).

	CVS (N=181)	No CVS (N = 129)	Total	P- Value
Males	101 (51.79 %)	94 (48.2 %)	195	0.002
Females	80 (69.56 %)	35 (30.43 %)	115	
Table 1. Gender Distribution and CVS				

Majority of the participants (51.93 %) prefer working on the digital screen for 2 to 4 hours a day. This group also has highest number of individuals affected with CVS (66.45 %); a correlation found to be statistically significant at $P < 0.05$ (Table 2).

Daily Computer Uses (Hours/Day)	CVS, N=181		Total, N (%)	P – Value
Up to 2 hours	26 (59.09 %)	1 8(40.9 %)	44 (100 %)	0.003
2 - 4 hours	107 (66.45 %)	54 (33.54 %)	161 (100 %)	
4 hours	48 (45.71 %)	57 (54.28 %)	105 (100 %)	
Use without breaks	Yes	64 (76.19 %)	20 (23.8 %)	<0.001
	No	117 (51.76 %)	109 (48.23 %)	
Table 2. Pattern of Computer Use in the Two Groups				



A total of 114 students (70.8 %) in the '2 - 4 hours' group preferred using the VDTs with breaks, while a total of 101 students (96.19 %) in the '4 hours and above' group preferred using with breaks. Only 25 % of students in the '2 hours and less' group were using the VDTs with breaks. This study has also revealed that students who are habituated in using the digital screen at a stretch, without breaks, are more prone to develop symptoms related to CVS. Out of total 84 students in the continuous usage group, 64 students (76.19 %) were diagnosed with CVS ($P < 0.001$).

The most disturbing extraocular symptom revealed in this study, was headache (18.38 %) and eye strain was the most disturbing ocular symptom (13.87 %), followed by blurring of vision (7.74 %) Table - 3.

Sl. No.	Symptoms	No. of Subjects(N)	Percentage
1	Headache	57	18.38 %
2	Eye strain	43	13.87 %
3	Blurring of vision	24	7.74 %
4	Dry Eyes	17	5.48 %
5	Visual fatigue	15	4.83 %
6	Neck/Shoulder/Back pain	11	3.54 %
7	Tearry eyes	9	2.90 %
8	Red eye	4	1.29 %
9	Double vision	1	0.32 %
10	No symptoms	129	41.61 %
Total		310	100 %

Table 3. Most Disturbing Symptom Reported Following Computer Usage

In the present study we have also studied the association between the presence of refractive error and the vulnerability to CVS. However, no statistically significant association was found.

Presence of Refractive Error	CVS		Total	P Value
	Yes (%)	No (%)		
Yes	108 (57.14 %)	81 (42.85 %)	189 (100 %)	0.78
No	49 (59.03 %)	34 (40.96 %)	83 (100 %)	
Don't know	24 (63.15 %)	14 (36.84 %)	38 (100 %)	
Table 4. Presence of Refractive Error and CVS				

The ergonomic practices that were found to have significant association with the risk of developing CVS were viz. distance from the digital screen, level of the digital screen with respect to the subject's eyes, brightness of the

screen, and chair design to support the lower back (Table 5).

Ergonomic Variables	Groups	CVS		Total N	P Value
		Yes N (%)	No N (%)		
Distance from the screen	≥ one arm length (40 cm)	43 (39.44)	66 (60.55)	109	P<0.001
	< 40 cm	138 (68.65)	63 (31.34)	201	
Monitor screen level	At eye level	53 (69.73)	23 (30.26)	76	P=0.008
	Below eye level	118 (53.15)	104 (46.84)	222	
	Above eye level	10 (83.33)	2 (16.66)	12	
	< 25 %	55 (76.38)	17 (23.61)	72	
Brightness of screen	26 - 50 %	98 (50.25)	97 (49.74)	195	P<0.001
	> 50 %	28 (65.11)	15 (34.88)	43	
	> 50 %	28 (65.11)	15 (34.88)	43	
Using glare filter	Yes	62 (55.85)	49 (44.14)	111	P=0.49
	No	119 (59.79)	80 (40.2)	199	
Source of room light	Overhead light	98 (62.02)	60 (37.97)	158	P=0.185
	Table lamps, open windows	83 (54.6)	69 (45.39)	152	
Chair support to lower back	Yes	92 (51.68)	86 (48.31)	178	P=0.005
	No	89 (67.42)	43 (32.57)	132	

Table 5. Working Environment and CVS

With respect to the awareness about CVS, 78.06 % of respondents were aware about the disease entity. Majority of the students (68.38 %) showed 'average' knowledge of CVS and expressed their willingness to modify the risk factors including decreasing the screen time. 21.93 % had 'poor' knowledge and 9.67 % had 'good' knowledge of CVS. It was also encouraging to note that majority of the participants in the study chose to adopt correct ergonomic practices like- correct screen level (71.6 %), proper screen brightness (62.9 %), having chair support to lower back (57.4 %), [Table 5.] and preferred not to use computers at a stretch (72.9 %) [Table 2.]

DISCUSSION

The prevalence of CVS in our study is 58.38 %. Similar studies evaluating CVS have reflected wide variations in prevalence. While the reported prevalence of CVS in a study by Subratty and Korumtolee was 59.5 % among keyboard users,¹¹ Seshadhri et al. 2014 reported a prevalence of 69.3 % among information technology professionals in Chennai¹² whereas Logaraj et al. in Chennai found a prevalence of 81.9 % among engineering students and 78.6 % among medical students.² These variations of prevalence in different studies are thought to be primarily due to varying level of knowledge and awareness about CVS and different practice pattern with respect to computer ergonomics.¹³

The higher prevalence of CVS in female students revealed in our study was similar to that reported by Shanta Kumari et al.¹⁴ The present study has revealed a direct relationship between total hours of computer use daily and development of CVS. Several studies have reported significant association between the CVS and total hours of computer use daily. Shrivastava and Bobhate report found that visual symptoms increased with the increase in working hours on computer.¹³ Rahman and Sanip, in their study reported that those respondents who used computer for more than 5 hours per day were at higher risk of developing CVS.¹⁵ Another factor that has been stressed upon as a risk factor is continuous use of VDTs without breaks.² Our study has also revealed findings consistent with this. Majority of the study subjects (51.9 %) were using computer between

2 – 4 hours per day and this group reported highest prevalence of 66.5 %, though the prevalence came down to 45.7 % in users of more than 4 hours per day as this group had higher number of students (96.1 %) who were using computer with periodic breaks. Several studies have shown the efficacy of taking frequent breaks of about 5 minutes or so in an hour in decreasing CVS related symptoms while not compromising productivity.¹³

The most disturbing extraocular symptom reported in our study was headache (18.38 %) and most disturbing ocular symptom was eye strain (13.87 %). This is in agreement with the study by Shantakumari et al. who also reported eye soreness (53.3 %) as the common symptom.¹⁴ Akinbinu and Mashalla had also reported eyestrain (30.9 %) and headache (30.9 %) as most disturbing complaints.¹⁶

The present study has also revealed statistically significant association between several ergonomic practices and development of CVS viz. distance from the display screen, monitor screen level with respect to eyes, brightness of the screen and chair support to the lower back. This is consistent with numerous previous studies like Stella et al. 2007,¹⁷ Bhandari et al. 2008;¹⁸ The present study has also observed significant reduction of symptoms when the computer was viewed at a distance of 40 cm or more and slightly below the eye level.

Glare from the screen has been a recognised factor in the development of CVS. In our study, majority (64 %) did not have a glare filter in place. However, we did not find any significant association between presence of glare and CVS in our study. This is similar to the findings by Reddy et al.¹⁹ However contrary to this, Ranasinghe et al.²⁰ found higher CVS symptoms in those not using glare filter. Anti-glare filters have been attributed to less frequent and less intense severity of symptoms in some studies.²¹

The respondents showed high level of awareness of CVS (78.06 %) in this study and with regard to the knowledge of CVS related to its prevention, 68.38 % scored in the 'average' category. In a similar study, 87 % of all participating students from colleges of different universities of Malaysia were aware of bad effects of prolonged use of computer on eyes.¹⁹ However contrary to this, an earlier study found awareness of CVS among students of faculty of medical science to be only 26.4 %.²²

CONCLUSIONS

In spite of the fact that the present study has been conducted during a period of national lockdown, when exclusive online lecture classes were being conducted and when the dependency on the digital screen was considered higher than usual, the prevalence of CVS was found to be only 58.38 % as compared to higher prevalence reported in other similar studies. This could probably be explained by the high level of awareness about CVS among the participants and the correct ergonomic factors adopted by them to prevent it. This study has showed statistically significant association between development of CVS and practice of ergonomic factors like distance from the VDT, level of digital screen with respect to eyes, intensity of

screen brightness, presence of chair support to lower back and continuous use of computers at a stretch. Preventive measures must include both personal eye care as well as proper ergonomic practices. Ergonomically designed furniture and adopting correct sitting posture are important steps in this direction. However, much is still needed to be done to promote awareness and knowledge of prevention of CVS among the student community and the general population as a whole.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

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