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A Study on Computer Vision Syndrome among Undergraduate Medical Students in Medical College at Jamnagar, Gujarat

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A B S T R A C T

***Introduction*:** The development of technology in education made a noticeable transformation in the methods of teaching, presenting information, and sources for studying. However, this convenient lifestyle still raised a health-related concern. Among the health-related aspects is a condition known as computer vision syndrome (CVS). CVS symptoms occur when there is a need to increase the visual demand to the extent it exceeds the person's visual ability. Dry eyes have been proved to play as a major contributor to CVS symptoms. ***Aim and Objective*:** Aim of this study is to study computer vision syndrome in medical students. ***Material and Method*:** An observational, cross-sectional study of 250 Undergraduate medical students in government medical college, Jamnagar between December 2021 to June 2022. Questionnaire was used to record asthenopic symptoms and daily exposure to electronic screens. ***Result*:** 170 boys and 80 girls who were examined by only one ophthalmologist. Sample comprised of Control Group (Students whose overall screen time is less than 4 hours) of 75 students and Case Group (Students whose overall screen time is more than 4 hour every day) of 175 students. ***Conclusion*:** As the use of computer had become universal in higher education institutions, the subject of the prevention of CVS and associated discomfort should be made part of the curriculum in higher institutions. The application of lubricant eye drops constitutes basic therapeutic approach in combating most of the symptoms of CVS. Hence, it can be implemented in all the areas of computer utility as it is economical and easily accessible.

Keywords: Computer vision syndrome, Asthenopic CVS, ocular surface CVS, visual CVS, extraocular CVS.

INTRODUCTION

In this current scenario, the use of computers became an essential tool to perform everyday tasks at work and at home. This holds true regardless of the user's profession or occupation. The development of technology in education made a noticeable transformation in the methods of teaching, presenting information, and sources for studying. Though, this convenient lifestyle still raised a health-related concern. Many individuals who spend long periods of time in front of computers report a combination of eye and vision issues. According to the American Optometric Association, computer vision syndrome is "the complex of eye and vision problems related to near work which are experienced during or related to computer use [1]." These symptoms are not exclusively connected to work-related task, but can affect individuals of all ages due to the widespread use of computers in everyday life [2]. Almost 75% of a person's daily activities include computer usage [3]. Globally, around 60 million computer workers experience discomfort from CVS [4]. Nearly 45 million workers use computers by staring at the screen for hours continuously [5]. A survey study among American optometrists found that 14.25% of patients who visited optometry clinic were suffering primarily from symptoms associated with computation in the methods of teaching, presenting information and sources of studying [6]. There have been several studies reporting an increased prevalence of computer vision syndrome among computer students especially medical students [7, 8]. Electronic devices can provide many sources that are not available in traditional studying

methods (eg. Access to electronic books, 3D imaging and simulation). However, many students seem to ignore issues arising from visual distress most likely due to the adaptability and plasticity of their visual system [9]. If you frequently use digital Devices, there's a good chance you've experienced computer vision syndrome also known as digital eye strain. This is a type of eye strain that's caused by prolonged use of digital screens. Among other symptoms, computer vision syndrome can cause: eye fatigue, dry eyes, headaches. Experiencing computer vision syndrome doesn't mean you need to completely give up your screen time, though. The way you view a digital screen can make a big difference [10]. CVS symptoms occur when there is a need to increase the visual demand to the extent it exceeds the person's visual ability. The image on the screen is produced by thousands of pixels combined to form an image, in which the margins are not sharp and is dependent on the resolution, the contrast of the background, and glare or reflection from the screen. These factors in contrary to printed documents increase the visual demand in order to perceive good images. In addition, CVS can also be explained by decreased blinking reflex while staring at the screen, leading to exaggerating dry eyes. Dry eyes have been proved to play as a major contributor to CVS symptoms. The underlying cause of dryness needs to be diagnosed and treated accordingly. Users who are known to have dry eyes are recommended to use lubricating eye drops to minimize the symptoms of CVS. Other factors such as the duration of usage, taking breaks, distance from the screen, screen brightness, and sitting posture were discussed in previous studies and were considered as known risk factors of CVS [6]. A suitable resolution to eyestrain is to specify a reasonable duration of time for using electronic devices along with occasional breaks. These breaks will help the person stay focused by relieving the muscle strain acquired from long reading sessions with electronic devices. Another way to decrease the eye strain is to balance hardcopy studying with electronic methods. This will lead to more efficacies and less harmful exposure to the eyes. Time consumption and effort will be reduced, resulting in more productivity because our eye is simply like a muscle that can be exhausted after extended activities without interruption, so breaks will simply relax the eye to return more energetic. It will also decrease the tension that can lead to ache and feeling bored. The CVS represents a public health problem, mainly in medical students, due to their high frequency of use of computer devices, even more so in the current context of the COVID-19 pandemic, where they have increased their use for virtual education. Health profession students need to spend a great deal of time in studying and education. However, many cannot achieve their study goals due to CVS and other symptoms that follow long hours of studying, which made it a great issue that requires investigation and, lastly, a solution to limit this phenomenon [11]. Digital devices need to be held at a distance between distant and near vision, effectively straining the visual system, as it is designed for comfortable near and distant vision [12, 13]. More specifically, printed texts and texts on digital screens are different in terms of gaze angles, viewing distances, appearance, blinking rates, movement of the palpebral fissure, and accommodative demands. While digital texts comprise, pixels created from electronic beams striking a phosphor-coated screen surface, the printed text comprises clearly defined and stable characters throughout its surface. As individual pixels are brighter at the centre than at their periphery, human eyes cannot sustain focus on characters created by pixels. Focussing tends to lag behind computer screens because of the vertical gaze position [14]. Consequently, the eyes repeatedly struggle to gain and maintain a focus of the pixels, which action of the ciliary body fatigues the eyes, causing the accommodative problems associated with CVS. Prolonged use of digital devices not only strains the visual system, but it also induces musculoskeletal strain and circadian disturbances [15, 16]. The syndrome presents with headaches, itching, eye strain/asthenopia, blurred vision, dry eyes, and shoulder/neck pains. External symptoms of ache, headache, and strain are primarily associated with binocular and/or accommodative vision stress [12, 17-19]. The available evidence suggests that as little as two hours of sustained digital device usage a day is likely to develop a range of vision-related problems [20-23]. CVS is categorized into four strains: asthenopic CVS (manifests as eye strain, eye dryness, soreness, headache, and fatigue), ocular surface CVS (dryness, grittiness, irritation, redness, burning sensation, and heaviness often due to environmental factors, blinking rates, and use of lenses/glasses), visual CVS (double or blurred vision, presbyopia, and slow focus change), and extraocular CVS (musculoskeletal pain). You may be able to reduce or prevent eye strain by changing the way you use digital screens. Here are some tips that may help protect your eyes from strain and discomfort.

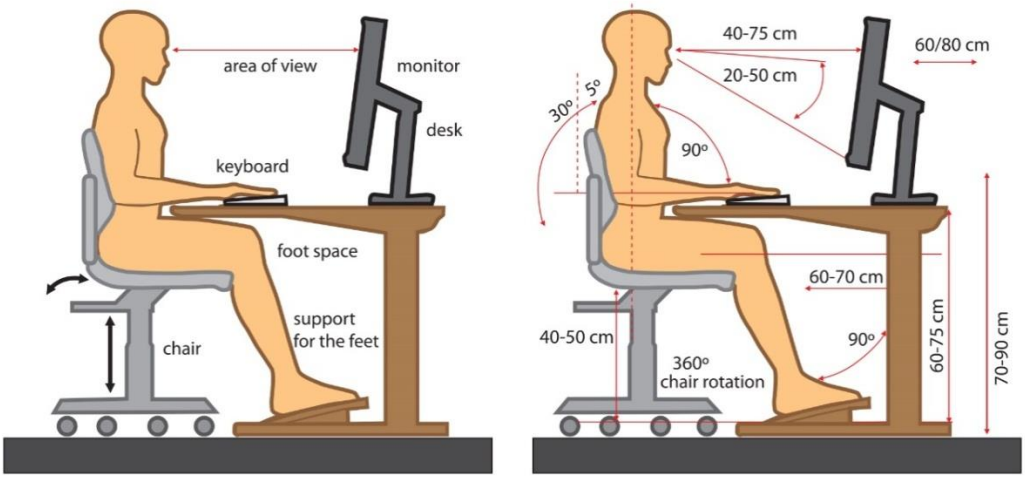


Figure 1: Proper posture

Figure 2: Prevent eye strain

AIM & OBJECTIVES

Aim of this study is to study computer vision syndrome in medical students, to study the relationship between duration of exposure to computer and severity of eye symptoms in medical students and to be able to provide required treatment and preventive measures as early as possible and help the needful patients.

MATERIAL & METHODS

An observational, cross-sectional study of 250 Undergraduate medical students in government medical college, Jamnagar between December 2021 to June 2022. Questionnaire was used to record asthenopic symptoms and daily exposure to electronic screens.

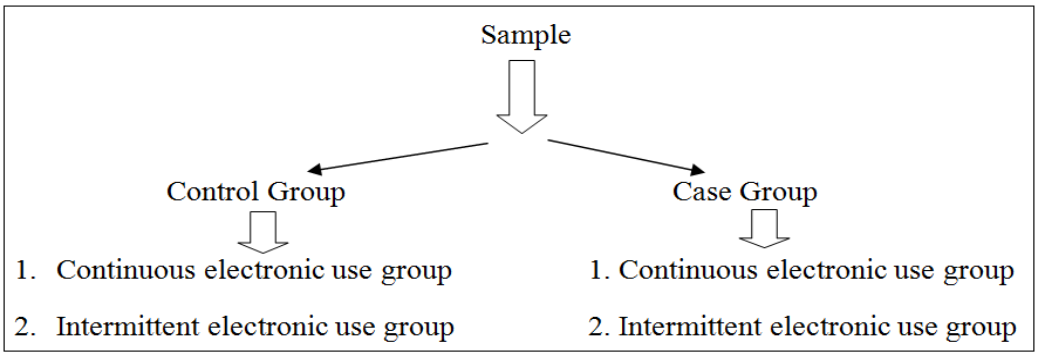
Inclusion Criteria: Medical students studying in medical college Jamnagar who are giving consent for participating in the study.

Exclusion Criteria: Students having eye symptom due to other ocular pathology, Students not giving consent for participation in the study.

After taking into consideration the inclusion and exclusion criteria, ophthalmological examination included anterior segment examination by slit lamp, refractive error correction and identification of the dominant eye using the Dolman method done in all students in Department of Ophthalmology, M. P. Shah medical college, Jamnagar.

Detailed history about each asthenopic symptom is taken to differentiate Headache from other causes of headache like Migraine, Tension-Type headache, Cluster headache. Eye Strain, Eye ache and Burning differentiated from other causes such as lack of sleep and incorrect eyeglass prescription. Other causes of Dizziness like anxiety disorders, anaemia, hypoglycaemia, ear infection should be rule out. For Ocular dryness detailed slit lamp examination and Schirmer test should be performed. Other causes of tearing like foreign body, Conjunctivitis, Keratitis should be rule out.

Two groups of students were examined according to the average amount of time spent on screen: students whose overall screen time is less than 4 hours (control group) and students whose overall screen time is more than 4 hour every day (case group). Both groups were then divided into two subgroups: students using electronic screens in continuous pattern (eg, televisions, computers, tablets, and smartphones) for 2 hours (continuous electronic use subgroup) and students using electronic screens in breaking pattern (intermittent electronic use subgroup). Refractive error examination was done of these students using auto refractometer and cycloplegic dilatation. Cycloplegic refraction was used to relax the ciliary muscle mainly to differentiate students having true myopia and spurious myopia. The same students were re-examined after 6 months to analyze the change in refractive error. The Frequencies procedure provides statistics and graphical displays that are useful for describing many types of variables. For a first look at your data, the Frequencies procedure is a good place to start looking at your data.



RESULTS

All 250 (170 boys, 80 girls) sample was taken from undergraduate medical students as average screen time among them was 4-5 hours as most commonly used method of study among them is learning through online lectures nowadays. Sample comprised of Control Group (Students whose overall screen time is less than 4 hours) of 75 students and Case Group (Students whose overall screen time is more than 4 hour every day) of 175 students. Continuous electronic use and Intermittent electronic use subgroup is students using electronic screens in continuous pattern for 2 hours and in breaking pattern respectively. 62.40% (18 in the control group and 138 in the case group) reported at least one symptom of asthenopia. Of these, 37.45% (100 patients) suffered from headaches, 13.85% (37 Patient) suffered from burning and 3.37% suffered from transient diplopia. Highest prevalence of Asthenopic symptoms is seen in subgroup with continuous screen usage among case group (93.5%), whereas lowest prevalence of Asthenopic symptoms is seen in subgroup with intermittent screen usage of control group (91.3%). The case group had a higher prevalence of ametropic patients compared to the control group (66.37% vs 56.52% of patients respectively; which remained when the low and high electronic use subgroups were considered. Case group had a higher prevalence of Myopia (82 %) than the control group (81%) of patient. In Case group continuous electronic use subgroup showed a higher prevalence of myopia compared to intermittent electronic use subgroup. Prevalence of Low myopia is Higher in Case group (71%) than Control group (28.8%). For Moderate myopia and High Myopia not much difference in Case group and Control group and Prevalence of Low Hypermetropia is Higher in Control group (80.00%) than Case group (59.08%). For Moderate Hypermetropia and High Hypermetropia not much difference in Case group and Control group. 87.2% (218 Patient) has Right Eye and 12.8% (32 Patient) has Left Eye Dominant Eye. Prevalence of Myopia for Dominant eye and non-dominant eye in Control Group is almost same but in Case group High prevalence of Myopia is seen in Dominant eye (80.57%) than non-dominant eye (65.71%). It was observed that 2.86% of the students experienced Pseudo myopia due to continuous use of screen for prolonged hours which caused intermittent blurring of vision.

Table 1: Prevalence of Study Population in Case Group and Control Group

Patient Distribution	Continuous Electronic Use	Intermittent Electronic Use
Control Group		
Boys	18 (24%)	30 (40%)
Girls	11 (14.6%)	16 (21.33%)
Total no. of patient	29(38.66%)	46(61.33%)
Case Group		
Boys	44(25.14%)	78(44.57%)
Girls	18 (17.72%)	35 (10.28%)
Total no. of patient	62 (42.86%)	113(54.85%)

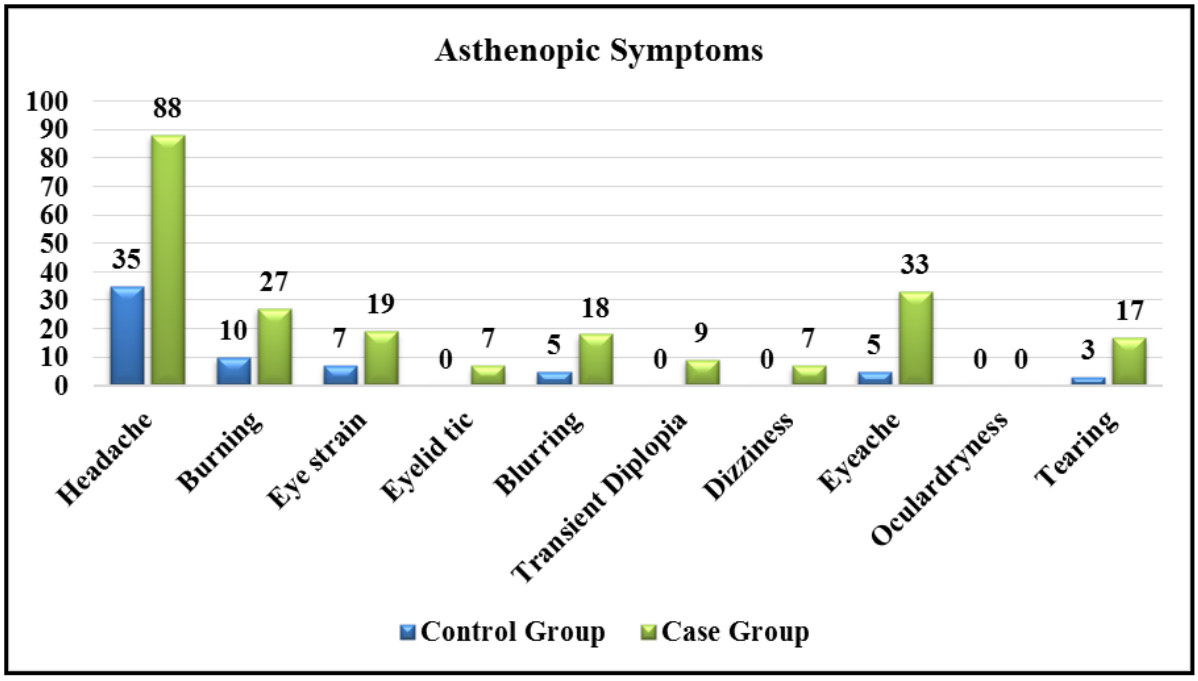


Figure 3: Prevalence of Asthenopic Symptoms in Case Group and Control Group

Table 2: Prevalence of Relation between Time Spent on Electronic Screens and Asthenopia in Case Group and Control Group

Presence of at least one symptom of Asthenopia	Continuous Electronic Use	Intermittent Electronic Use	Total
Control Group	27 (11.53%)	42 (17.94%)	69 (29.48%)
Case Group	58 (24.78%)	107 (45.72%)	165 (70.51%)

Table 3: Prevalence of Emmetropia and Ametropiain Case Group and Control Group

Refraction	Control Group		Case Group		TOTAL
	Continuous Electronic Use	Intermittent Electronic Use	Continuous Electronic Use	Intermittent Electronic Use	
Emmetropia	10 (47.20%)	20 (52.60%)	15 (6.85%)	38 (2.85%)	83 (27.66%)
Ametropia	19 (22.40%)	26 (24.8%)	47 (33.71%)	75 (56.57%)	167 (72.34%)
Total	75		175		250

Table 4: Prevalence of Ametropia in Case Group and Control Group

Ametropia	Control Group		Case Group		Total
	CEU	IEU	CEU	IEU	
Myopia	17 (37.77%)	23 (51.11%)	39 (31.96%)	61 (50%)	140
Hypermetropia	2 (4.44%)	3 (6.66%)	8 (6.55%)	14 (11.47%)	27
Total	45		122		167

(CEU: Continuous Electronic Use, IEU: Intermittent Electronic Use)

Table 5: Prevalence of Myopia and Hypermetropia in Case Group and Control Group

Power	Control Group		Case Group		Total
	CEU	IEU	CEU	IEU	
MYOPIA					
Low (< -3D)	15 (37.5%)	17 (42.5%)	31 (31%)	48 (48%)	111
Moderate (-3D to -6D)	2 (5%)	5(12.5%)	5 (5%)	11 (11%)	23
High (> -6D)	0(0%)	1(2.5%)	3(3%)	2(2%)	6
Total	40		100		140
HYPERMETROPIA					

Low (< +2D)	2 (40%)	2 (40%)	5 (22.72%)	8 (36.36%)	17 (62.96%)
Moderate (+2D to +5D)	0 (0%)	1 (20%)	2 (9.09%)	4 (18.18%)	7 (25.92%)
High (> +5D)	0 (0.00%)	0 (0%)	1 (4.54%)	2 (9.09%)	3 (11.11%)
Total	5		22		27

(CEU: Continuous Electronic Use, IEU: Intermittent Electronic Use)

Table 6: Prevalence of Dominant Eye in Case Group and Control Group

Dominant Eye	Control Group		Case Group		Total
	Continuous Electronic Use	Intermittent Electronic Use	Continuous Electronic Use	Intermittent Electronic Use	
Right	22 (29.33%)	41 (54.66%)	53 (30.28%)	102 (58.28%)	218
Left	7 (9.33%)	5 (6.66%)	9 (5.14%)	11 (6.28%)	32
Total	75		175		250

Table 7: Prevalence of Refraction in Dominant Eye and Non-Dominant eyein Case Group and Control Group

Refraction	Continuous Electronic Use	Intermittent Electronic Use	Total
Control Group			
Dominant Eye	**29**	**46**	**75**
Emmetropia	10(13.33%)	20(26.66%)	30(40%)
Myopia	17(22.66%)	23(30.66%)	40(53.33%)
Hypermetropia	2(2.66%)	3(4.00%)	5(6.66%)
Non-Dominant Eye	**29**	**46**	**75**
Emmetropia	9(12%)	18(24%)	27(36%)
Myopia	18(24%)	25(33.33%)	43(57.33%)
Hypermetropia	2(2.66%)	3(4%)	5(6.66%)
Case Group			
Dominant Eye	**62**	**113**	**175**
Emmetropia	15(8.50%)	33(18.85%)	48(27.42%)
Myopia	39(22.28%)	65(37.14%)	104(59.42%)
Hypermetropia	8(4.57%)	15(8.57%)	23(13.14%)
Non-Dominant Eye	**62**	**113**	**175**
Emmetropia	14(8%)	38(33.62%)	52(29.71%)
Myopia	39(22.28%)	61(34.85%)	100(57.14%)
Hypermetropia	9(5.14%)	14(8%)	23(13.14%)

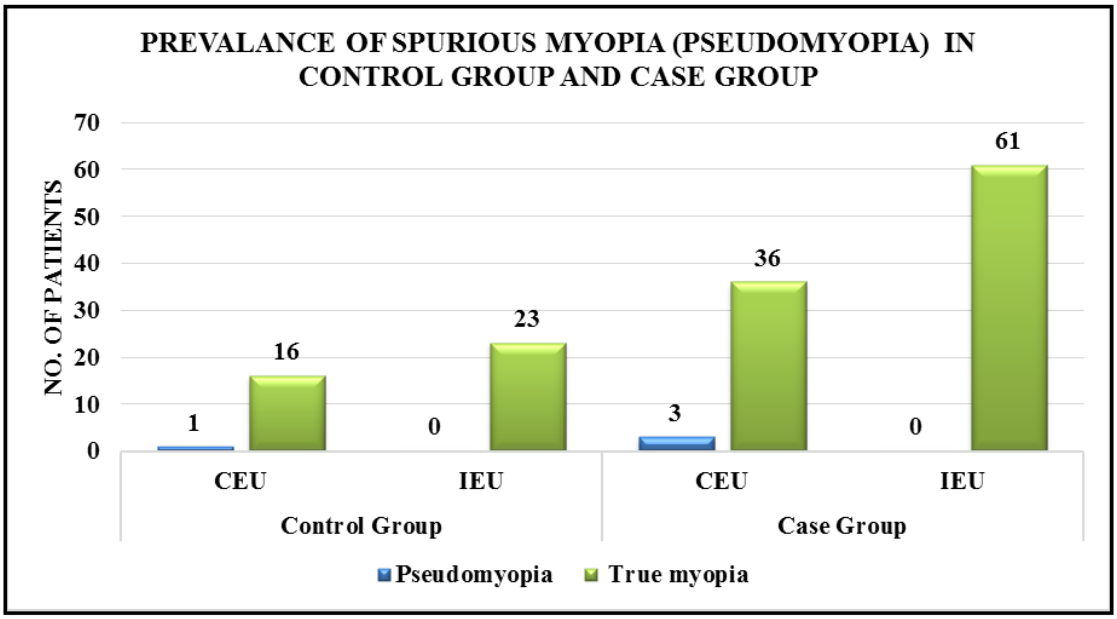


Figure 4: Prevalence of Myopia and Hypermetropia in Case Group and Control Group

DISCUSSION

Recently, there has been a sharp increase in the number of students spending long periods of time using various electronic screens. The number of hours spent on screen and the possibility of using laptops, large television screens, or smaller devices such as tablets or pocket-size smartphones has never been as great as it is today and these gadgets have become accessible to almost every person in modern societies. The study population was taken as medical students as screen usage has significantly increased among them as the most important and commonly used study technique among them is learning through online lectures thus, they tend to spend high amount of time in front of screen which makes them highly prone to computer vision syndrome. Studies in Sri Lanka, India, and United Arab Emirates support the significantly high CVS prevalence among female computer workers, with significantly higher headache and blurred vision incidence. In contrast, males were found to have higher risk of redness, burning sensation, blurred vision, and dry eyes among medical and engineering students in India. Students in this study were relatively young, with a mean age of 21.65 years. No significant associations were found between the year of medical school and the age with CVS. Students in this study were relatively young, with a mean age of 21.65 years. No significant associations were found between the year of medical school and the age with CVS. According to the study conducted by M. Rosenfield and another study conducted by P. Ranasinghe, refractive errors including myopia and hyperopia showed no significant association with CVS [24, 25]. However, astigmatism was associated significantly with CVS symptoms. Previous experimental studies showed a significant increase in symptoms in individuals with uncorrected residual astigmatism. If refractive errors are uncorrected including myopia, hyperopia, and astigmatism, they contribute to the symptoms of CVS [24, 25]. Also in our study it was observed that there was no significant association of prevalence of ammetropia with CVS but there was increase in myopic refractive error and decrease in hypermetropic error in our study when reexamined after 6 months. Students who were known to have dry eye disease were associated significantly with CVS. This is explained by the reduced blinking reflex while seated in front of the screen for a long time, which contributes to improper tear production, thus exaggerating dry eye disease. The most frequently reported ocular symptoms were specifically and significantly among students using higher screen brightness and higher level of the screen from the eyes. Change in colour perception and double vision were correlated significantly with improper room lightning and not using screen filters. Among the extraocular symptoms, headache (42.4%) was the most common symptom observed among students. It was associated significantly with short distance from the screen. Headache is explained in CVS patients by the constant need to adjust the eyes by contracting the extraocular muscles and ciliary muscles to maintain the lens in the accommodating phase. It is noteworthy that extraocular symptoms like headache were reported more frequently than ocular symptoms in our study. This is in line with a study performed by Logaraj*et al*., in which neck and shoulder pain and headache were more frequently reported than ocular symptoms. Furthermore, Noreen *et al*., and Logaraj*et al*., and Reddy *et al*., reported that students who spent more than four hours and two hours respectively were at significantly at higher risk of CVS. In contrast, Hassan *et al*., found that taking short breaks every 30 minutes every hour decreases visual discomfort [26]. The recommended viewing distance was suggested to be 20–28 inches by the American Optometric Association. A study carried out by Straker*et al*., found that musculoskeletal complaint gets worse by sitting posture [27]. Improper viewing angles are reported as a risk factor for CVS in previous studies. It is recommended to place the screen 10–20° below the level of the eyes. Higher gaze angles expose more area of the cornea and conjunctiva, resulting in more ocular surface-related symptoms with an increased tear evaporation rate. Strengthening the fact, Reddy *et al*., found significant reduction in CVS symptoms when the screen is viewed below the eye level. Limitations of this study is that it was conducted in a single center and CVS was diagnosed based on self-reported symptoms.

CONCLUSION

Computer has become an important part of education system all over the world. As computer use is such a high visual demanding task, vision problems and symptoms have become very common among students. This study has shown that the development of CVS is associated significantly with the more umber of risk factors. Computer users are invariably exposed to the risk of developing CVS leading to marked deterioration in performance owing to severity and persistence of disorders. So, abstinence from cause is the ideal solution but it is far from practicality in the case of CVS. The most significant preventive measure taken by students was applying the 20-20-20 rule followed by proper location of the screen. Although there is no risk of permanent visual damage, it has been proved that CVS-related symptoms reduce the productivity of work. Health and Education professionals have suggested the need for teachers and students to be ergonomically conscious when using computers. As the use of computer had become universal in higher education institutions, the subject of the prevention of CVS and associated discomfort should be made part of the curriculum in higher institutions. Universities continuously develop their educational methods, there is a need to raise awareness among students regarding health effects related to prolonged computer use for studying and explain preventive measures in order to reduce CVS symptoms.

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