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Research Article

EFFECTS OF COMPUTER VISION SYNDROME ON TEAR FILM QUALITY OF INDIVIDUALS ACROSS VARIOUS AGE GROUPS AND OCCUPATIONS

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ABSTRACT

Objective:: Computers become a part of everyday life because it has to a greater extent, revolutionized most professions and their work performance. Spending uninterrupted and excessive time in computers and other display devices without taking precautions and prevention leads to significant ocular problems, which are being grouped together as - computer vision syndrome (CVS). The present study was conducted in a tertiary care center to evaluate the effects of CVS on tear film quality in individuals across various age groups and occupations.

Methods: A cross-sectional study was conducted at a teaching institute from August 2021 to September 2022, in which 600 patients who worked on computers or digital devices for at least 3 h daily were included in this study. In all patients, a complete ocular examination was performed, including visual acuity, refraction, Schirmer's test 1, tear film breakup, slit-lamp examination, intraocular pressure, and fundus examination by indirect ophthalmoscopy.

Results: In the present study, most of the participants in this study belonged to 21–30 years of age. Among study participants with CVS and screen time of more than 8 h, 88% had moderate and severe dry eyes. On comparison of mean values of the Schirmer's test between participants with CVS, it was observed that mean Schimers (4.5 mm in the right eye and 5 mm in the left eye) and tear film breakup time (4.9) were much lower among study participants with CVS whose screen usage time was more than 8 h.

Conclusion: The present study found that computer vision conditions are very common. In addition, the likelihood of developing the same was higher among IT employees and engineering students.

Keywords: Computer vision syndrome, Digital devices, Computer use, Schirmer's test, Tear film breakup time.

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INTRODUCTION

Computers become a part of everyday life because it has to a greater extent, revolutionized most professions and their work performance. IT professionals, accountants, bankers, engineers, doctors, journalists, academicians, students, and others are highly engaged with computers for their work. Computer use has no doubt made life easier and also increased the work output tremendously, but at the same time, it has also produced many ocular problems due to improper use of computers and, most importantly, insufficient knowledge about safe computer usage techniques and practices. Spending uninterrupted and excessive time on computers and other display devices without taking precautions and prevention leads to significant ocular problems, which are being grouped together as computer vision syndrome (CVS). In India, the computer-using population is more than 40 million, and about 80% of the population have discomfort due to CVS. and 60% adult population in India uses visual display terminal for more than or equal to 6 h/day compared with 37% in the adolescent group [1].

CVS is caused by a number of different factors linked to the excessive use of digital devices. Some of these factors include the length of duration spent, the working distance between digital device and eyes, number of digital devices used at the same time, and light intensity in the surrounding working environment. In a study (Uchino *et al*., 2013), it was shown that the use of visual display devices (VDD) is an important risk factor for digital eye disease. VDD reduces blink rates and tear film breakup time, which leave the ocular surface more exposed [2]. The breakup of the tear film usually triggers reflexive blinking, leading to a restored tear film [3]. However, VDD use suppresses reflexive blinking, inhibiting this response and causing longer intervals with an unprotected ocular surface [4]. The present study was conducted in a tertiary care center to evaluate the effects of CVS on tear film quality in individuals across various age groups and occupations.

METHODS

A cross-sectional study was conducted at a teaching institute from August 2021 to September 2022, in which 600 patients who worked on computers or digital devices for at least 3 h daily were included in this study. Prior permission was obtained from the institutional ethics committee. After obtaining informed consent and explaining the purpose of the study, data were collected in a structured pro forma. In all patients, a complete ocular examination was performed, including visual acuity, refraction, Schirmer's test 1, tear film breakup, slit-lamp examination, intraocular pressure, and fundus examination by indirect ophthalmoscopy. The diagnosis of dry eye was made based on ocular surface disease index (OSDI) score, Schirmer's test value <10 mm, tear film breakup time (TBUT) value <10 s, fluorescein staining, and meibomian gland dysfunction. Schirmer's test 1 was performed without anesthesia. What man 41 filter paper strip is kept in the lower fornix at the junction of the medial two-third and lateral one-third. After 5 min of wetting the filter paper, a value >15 mm was considered normal, a value 5–10 mm was suggestive of moderate to mild dry eye, and a value <5 mm was considered severe dry eye. TBUT is defined as the interval between the last complete blink and the first randomly distributed dry spot on the cornea. About 2% fluorescein sodium dye was instilled in the conjunctival sac and examined under the cobalt blue light of a slit lamp. The value of 30 s was considered normal, <10 s was considered abnormal tear film, and <5 s was considered dry eye.

Statistical analysis

Data were collected and entered simultaneously in the statistical package for social sciences, version 23, and coded appropriately. The data were analyzed keeping in view the aims and objectives of the study. Descriptive statistics were calculated to summarize the sample characteristics in terms of frequency and percentage. Graphs and Charts were made. Analytical and inferential analysis was applied between dependent variables and other independent variables. Significance was set at 0.05.

RESULTS

In the present study, most of the participants belonged to the 21–30 age group, followed by the 11–20 age group, (48.85% and 33.5%, respectively). 22.57±7.22 years was the mean age of the participants. Most of the participants were female (55.7%). 20.2% were engineering students, 16.75 were IT workers, 18% were medical students, 18.55 were school-going children, 15.5% were bankers, and 11.2% were nursing students. The highest mean usage time was observed for IT workers (6.47 h), followed by engineering students (5.88 h), medical students (5.63 h), bankers (5.44 h), Nursing students (4.67 h), and schoolchildren (4.09 h). This difference in mean usage time depending on different occupations was found to be statistically significant. On comparison of mean values of the Schirmer's test between participants with CVS, it was observed that mean Schirmer's (4.5 mm in the right eye and 5 mm in the left eye) and TBUT (4.9) were much lower among study participants with CVS whose screen usage time was more than 8 h. Among study participants with CVS and screen usage time between 5 and 7 h, 64.8% had mild dry eyes and 4.2% had moderate dry eyes. Among study participants with CVS and screen time of more than 8 h, 88% had moderate and severe dry eyes. The lowest mean TBUT was observed for IT workers (8.3±3.1), followed by engineering students (9.4±1.8), medical students (9.9±2), bankers (10.2±1.9), Nursing students (10.3±1.9), and schoolchildren (11.5±1.4). Among engineering students, 69% had TBUT <10 s, followed by IT workers with 67%, medical students with 58%, bankers (57%), Nursing students (41%), and schoolchildren (21.6%). The lowest mean Schirmer's were observed for IT workers (7.8±3.1), followed by engineering students (9.2±1.7), medical students (9.4±1.6), bankers (9.6±1.8), Nursing students (10.2±1.5), and schoolchildren (10.8±1.4). Among its workers, 41% had Schirmer's <5 s, followed by bankers (3.2%), medical students (2.8%), and engineering students (2.5%). Among bankers, 51% have mild dry eyes. Among engineering, medical, and nursing students, 65%, 55%, and 22% had mild dry eyes, respectively. Among IT workers, 39% had moderate dry eyes, followed by 28% with mild dry eyes and 1% with severe dry eyes. Among schoolchildren, only mild dry eyes were seen in 3.6% of the study participants. Among engineering students, 0.8% had severe dry eyes.

DISCUSSION

The majority of the study participants in the present study were in the age group of 21–30 (48.8%) years of age, followed by 11–20 years (33.5%), with a mean age of study participants was 22.57±7.22 years. Most of the participants were female (55.7%), and 44.3% were male. The majority of the study participants belonged to the adult group, followed by children, which could be due to the COVID-19 pandemic situation in country. During that period, most of the work study was done from home through online classes. In accordance with our findings, Ranganatha and Jailkhani [5] reported female preponderance in their study, and study participants ranged between 19 and 22 years. Dry eye is a multifactorial disease of the tears and ocular surface that results in symptoms of discomfort, visual disturbance, and tear film instability with potential damage to the ocular surface. On comparison of mean values of the Schirmer's test, it was observed that mean values were significantly lower among study participants with CVS as compared to those who do not have CVS. Furthermore, TBUT was low in study participants with CVS (9.5). On comparison of mean values of the Schirmer's test between participants with CVS, it was observed that mean Schimers (4.5 mm in the right eye and 5 mm in the left eye) and TBUT (4.9) were much lower among study participants with CVS whose screen usage time was more than 8 h. This indicates that evaporative dry eye is more common in subjects with CVS. Sánchez-Valerio *et al*. [6] in their study also reported that the mean Schirmer was comparatively lower among study participants with CVS (12.97±7.6) as compared to those without CVS (17.7±9.7), and this difference in mean was statistically significant. The authors also observed that the mean TBUT was much lower among study participants with CVS (5.69±1.9). According to Shrestha *et al*. [7], Schirmer's test showed a dry eye in 25.7% and a lower tear film break-up time in 32.9%. In the present study, OSDI scores were found to be a significantly higher among study participants with CVS. It was observed that among study participants with CVS, significant higher number of cases of dry eyes were seen as compared to those without CVS. Among study participants with CVS and screen usage time between 5 and 7 h, 64.8% had mild dry eyes and 4.2% had moderate dry eyes. Among study participants with CVS and screen time of more than 8 h, 88% had moderate and severe dry eyes. This observation emphasizes the fact that more than 8 h of screen time is a risk factor for severe dry eyes. IT workers and Bankers who had not been taking breaks within 20 min suffered from CVS more significantly because the eyes normally cannot remain focused on the pixel-generated image on a computer screen for a long time. As such, the eyes must focus and refocus thousands of times by taking frequent breaks while viewing the screen, and if the refresh rate is too slow, it causes a high flickering screen, which leads to symptoms of CVS. Shenoy and Madan *et al*. [8] reported in their study that mild, moderate, and severe dry eye were present in 25.4%, 36.5%, and 23.8% of the study participants, respectively. Furthermore mean OSDI scores were 46.06±22.05 among those with dry eye as compared to 11.32±4.49 among those without dry eye. According to Gupta *et al.* [9] the OSDI score was also significantly higher among the study participants with DED. The relationship between the TBUT and Schirmer's values and the OSDI scores was found to be inverse. This suggests that DED in a patient is related to comparatively inferior vision quality and that there is also a significant decline in vision quality with worsening DED test results. In the present study, 20.2% were engineering students, 16.75 were

Table 1: Distribution of participants according to demographic profile (n=600)

Demographic profile	n (%)
Age group (years)	
5–10	33 (5.5)
11–20	201 (33.5)
21–30	293 (48.8)
31–40	71 (11.8)
41–50	2 (0.3)
Gender	
Male	266 (44.3)
Female	334 (55.7)
Occupation	
Banker	93 (15.5)
Engineering student	121 (20.2)
IT worker	100 (16.7)
Medical student	108 (18.0)
Nursing student	67 (11.2)
School going children	111 (18.5)

Table 2: Occupation and their mean screen usage timing

Occupation	Usage timing (h), mean±SD	p-value
Banker	5.44±1.40	0.00*
IT worker	6.47±2.04	
School going children	4.09±0.73	
Engineering students	5.88±1.29	
Medical students	5.63±1.20	
Nursing students	4.76±0.94	

SD: Standard deviation, Significant (p value <0.05)

Table 3: Dry eye test and computer vision syndrome

Dry eye test	CVS present (n=405) usage timing (h)			p-value
	5–7 h (n=355)	>8 h (n=50)	Absent (n=195)	
Schirmer test right eye (mm)	9 (1.2)	4.5 (0.3)	11.5 (0.9)	0.00*
Schirmer test left eye (mm)	8.9 (1.6)	5 (0.3)	11.99 (0.6)	0.00*
TBUT	9.5 (1.5)	4.9 (0.6)	12 (0.8)	0.00*
OSDI 0–12 normal eye	110 (0.3)	1	194 (1.)	0.00*
OSDI 13–22 mild dry eye	230 (0.6)	3 (0.1)	1	
OSDI 23–33 moderate dry eye	15	44 (0.9)	0	
OSDI>33 Severe dry eye	0	2 (.)	0	

CVS: Computer vision syndrome, TBUT: Tear film breakup time, OSDI: Ocular surface disease index, Significant (p value <0.05)

Table 4: Comparison of patients according to tear film breakup time and occupation

TBUT	Occupation					
	Engineering student, n (%)	Medical student, n (%)	Nursing student, n (%)	School children, n (%)	IT worker, n (%)	Banker, n (%)
≥10 s	37 (0.3)	45 (0.4)	39 (0.6)	87 (0.8)	33 (0.3)	40 (0.4)
<10 s	84 (0.7)	63 (0.6)	28 (0.4)	24 (0.2)	67 (0.7)	53 (0.6)
Mean	9.4±1.8	9.9±2	10.3±1.9	11.5±1.4	8.3±3.1	10.2±1.9

TBUT: Tear film breakup time

Table 5: Comparison of patients according to Schirmer's test eye and occupation

Schirmer test	Occupation					
	Engineering student, n (%)	Medical student, n (%)	Nursing student, n (%)	School children, n (%)	IT worker, n (%)	Banker, n (%)
≥15	0	0	0	0	0	0
5–10	118 (1.)	105 (1.)	67 (1.)	111 (1.)	59 (0.6)	90 (1.)
<5	3	3	0	0	41 (0.4)	3
Mean	9.2±1.7	9.4±1.6	10.2±1.5	10.8±1.4	7.8±3.1	9.6±1.8

Table 6: Comparison of patients according to ocular surface disease index score and occupation

OSDI score	Occupation					
	Engineering student, n (%)	Medical student, n (%)	Nursing student, n (%)	School children, n (%)	IT worker, n (%)	Banker, n (%)
0–12	36 (0.4)	36 (0.3)	32 (0.3)	42 (0.4)	52 (0.8)	107 (1.)
13–22	48 (0.5)	79 (0.7)	28 (0.3)	60 (0.6)	15 (0.2)	4
23–33	9 (0.1)	5	39 (0.4)	6 (0.1)	0	0
>33	0	1	1	0	0	0

OSDI: Ocular surface disease index

IT workers, and 18% were medical students. The highest mean usage time was observed for IT workers (6.47 h), followed by engineering students (5.88 h), medical students (5.63 h), and bankers (5.44 h). This difference in mean usage time depending on different occupations was found to be statistically significant. Parameters pertaining to the quality of tear film were compared according to different occupations. In the present study, the lowest mean TBUT was observed for IT workers (8.3±3.1) (p=0.05) followed by engineering students (9.4±1.8), medical students (9.9±2), bankers (10.2±1.9), Nursing students (10.3±1.9), and schoolchildren (11.5±1.4). According to Das *et al*. [10], the value of TBUT between engineering and nursing was found to be statistically significant. Among engineering students, 69% had TBUT <10 seconds, followed by IT workers with 67%, medical students with 58%, bankers (57%), Nursing students (41%), and schoolchildren (21.6%). The lowest mean Schirmers were observed for IT workers (7.8±3.1), followed by engineering students (9.2±1.7), medical students (9.4±1.6), bankers (9.6 ± 1.6), Nursing students (10.2±1.5), and schoolchildren (10.8±1.4). Among IT workers, 41% had Schirmers <5 s, followed by bankers (3.2%), medical students (2.8%), and engineering students (2.5%). Among engineering, medical, and nursing students, 65%, 55%, and 22% had mild dry eyes, respectively. Among IT workers, 39% had moderate dry eyes, followed by 28% with mild dry eyes and 1% with severe dry eyes. Among schoolchildren, only mild dry eyes were seen in 3.6% of the study participants. Among engineering students, 0.8% had severe dry eyes. IT workers, engineering students, and medical students have the lowest mean TBUT and Schirmer's scores as well as the highest frequency of dry eye disease; this indicates that they have lesser tear film stability. This might be as a result of their using computers, smartphones, or tablets for longer periods of time, which results in a decrease in blink rate and dry eyes. According to Das *et al*. [10], of 108 engineering students, 74.07% had mild dry eye and 11.11% had moderate dry eye. Of 139 nursing students, 59.71% had mild dry eye, 14.38% had moderate dry eyes, and 0.71% had severe dry eye.

CONCLUSION

The present study found that computer vision conditions are very common. In addition, the likelihood of developing the same was higher among IT employees and engineering students. We can conclude that prolonged computer use affects the stability and quality of the tear film, resulting in dry eye syndrome. To lessen the symptoms of dry

eye syndrome and avoid major problems, patients should be educated about the condition. Computer ergonomics should also be considered, including screen height, chair position, blinking exercises, glare protection, and the use of artificial tears.

Limitations and scope

Sample size was an obvious limitation, also few dropouts in the initial few months due to the COVID-19 pandemic. Furthermore, details such as viewing distance and working time were self-reported and were less reliable; the study did not examine participants activities while they were actually using computers.

Recommendations

Health education can be used to raise awareness among computer users about how to use computers safely, including the recommended amount of work time, proper workspace design and lighting control, work positions, related health and eye problems, good preventive vision care habits, regular professional eye care, and some training to help users with common issues. The rule of 20/20/20 is another suggestion for easing computer vision issues. The 20/20/20 rule advises giving your eyes the break they need every 20 min while using a computer by focusing for 20 s on an item that is 20 feet (6 meters) away.

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CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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ETHICAL APPROVAL

Approved.

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