

Computer Vision Syndrome among Computer Operators Working at a Tertiary Care Hospital - A Study of Prevalence, Knowledge, Ergonomics and Other Associated Factors

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ABSTRACT

BACKGROUND

Computer is an integral part of modern life. Millions of persons directly use computer by looking into VDTs (Video Display Terminals) for long time continuously which has been the cause of complex eye and vision problems which are experienced during or related to computer use called "Computer Vision Syndrome" (CVS).¹ Prolonged computer use causes extreme discomfort while using of VDTs which in turn leads to low work productivity. Hence, it is very necessary to reduce computer use and find preventive measures for this emerging problem. The present study was designed to determine the prevalence and knowledge about CVS among computer operators of a tertiary care center and educate them about preventive measures and workplace ergonomics.

METHODS

The study was performed among 50 computer operators working at a tertiary care hospital. Detailed information about demographic profile, computer use, and questionnaire-based assessment of knowledge about CVS, workstation ergonomics and reassessing of knowledge after educating each study subject about CVS was done followed by comprehensive ocular examination of each study subject.

RESULTS

CVS was found to be present among 78 % of computer operators. Most disturbing symptom in both male and female was sore/tired eyes (70 %) followed by neck and shoulder pain (64 %). CVS had resulted in eye problems in adverse environmental condition & limitation of activity involving visual task in computer operators. There is high prevalence of CVS, in computer operators of BMHRC which might be due to poor knowledge of ergonomics, >10 years of computer use for 7 to 8 hours per day, and improper/not using of spectacles in workplace. There might be slight exaggeration of self-reported symptoms due to computer use by computer operators as it was questionnaire-based study.

CONCLUSIONS

The high prevalence of CVS and poor knowledge about workstation ergonomics in computer operators indicates the need for creating awareness about CVS, providing ocular health education, regular scheduled screening, and proper ergonomically designed workstation for computer operators and their regular comprehensive eye examination.

KEY WORDS

Computer Vision Syndrome, Ergonomics, Computer Professionals

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BACKGROUND

Computers have brought the biggest technological revolution in 21st century because of their high efficiency and varied applications and contributions in different fields like online classes, recreation facilities etc at homes and workplaces.^{1,2} Despite these contributions excessive use of computers resulted in prolonged and continuous staring at Video Display Terminal (VDT) commonly known as computer screen which has resulted in complex disorder called "Computer Vision Syndrome" (CVS).³ Computer vision syndrome (CVS) is defined as a complex of eye and vision problems related to near vision tasks which occurs during and/or after the use of computers and prolonged viewing of the video display terminals (VDT) by American Optometric Association.⁴

CVS symptoms can be classified as ocular and non-ocular respectively. Ocular symptoms can further be classified as ocular surface abnormalities & accommodative spasm. Ocular surface abnormalities resulted in symptoms of redness, dryness and irritation in eyes, burning sensation in eyes, watering, ocular strain/fatigue, blurring of vision, glare, extreme sensitivity to light and contact lens intolerance. Accommodative spasm related to computer use is the cause of ocular strain/fatigue, blurring of vision, transient diplopia, headache & slowness in changing focus. Neck & shoulder pain and backache is because of extra ocular aetiology. It has been evident from different studies that in the same environment persons who use VDT have more problems and ocular complaints as compared to non-users.⁵ The most commonly reported health problem because of VDT use is vision-related problems which are multifactorial and occurs in over 70 % of computer workers.⁶ Many researchers have found that visual symptoms related to computer use increases with continuous extended exposure to computer screens although there is no strong evidence about its causation.^{7,8,9,10}

Talwar et al & Parihar et al in their studies found that refractive error & presbyopia which are uncorrected, and binocular vision abnormalities are additional factors causing visual symptoms related to computer use.^{4,6} Other factors that contributed to the development of complaints and symptoms related to computer use are environmental factors, poor computer workstation design, and workplace ergonomics. Rosenfield in his study enumerated improper lighting, imbalance between computer screen and surrounding illumination, age and sex of computer user, and some systemic diseases as additional environmental or external risk factors for CVS.¹¹

The arrangement of equipment and furniture in work place for users to work more efficiently and comfortably is referred to as workplace ergonomics.¹² Proper positioning of keyboard, monitor, mouse, chairs, desks, document folders, seat height, width, depth, material, backrest, armrest, thickness of work surface, document holder and so on which facilitate comfortable and efficient working on computer in work place is referred to as visual or computer ergonomics.^{7,13,14} S. C. Reddy et al in their study reported that users with their computer screens set below the eye level had significantly lower CVS case than those who viewed the screen at or above the eye level.¹⁵ Study done by Mashige et al on Nonpresbyopic University staff in South Africa found that they had poor ergonomic set up at workstations and were ignorant of ergonomic standards for computer use.¹⁶

Various previous studies have reported measures to alleviate the symptoms of CVS which include frequent blinking (12–18/minute), short-time breaks after every 20 minutes to look at distant object at least 20 feet away for 20 seconds (20–20–20 rule), adjustment of workstation, good sitting posture, appropriate lighting and screen brightness, and regular stretching of arms, leg, back, neck, and shoulders.^{4,13,17}

The present study was designed to determine the prevalence of CVS, pre- and post-education assessment of knowledge of CVS, identification of associated risk factors for CVS among computer operators working in Tertiary care hospital in Central India.

METHODS

The study was done on 50 computer operators working in a Tertiary Care Hospital who consent to participate in study after prior permission from Institutional Ethical Committee. The study was a descriptive cross-sectional study in which computer operators had to undergo three phases under supervision of trained personnel. In first phase, each computer operator had answered a validated computer vision syndrome questionnaire (CVS-Q).

The questionnaire required computer operator to fill details about demographics that include age, gender, the educational qualification, the electronic device used, assessment of knowledge of CVS, symptoms pertaining to CVS, computer working hours, breaks taken while computer use, computer screen position, use of antiglare filter over computer screen, eye glass / contact lens use and work place ergonomics. The computer operators were asked regarding the frequency of symptoms as; never, rarely, often, or most of the time. They were also asked regarding appearance of symptoms along with frequency while doing specific visual task and in specific environmental conditions as sometime, half of the time, most of the time. On the basis of CVS symptoms in CVS-Q¹⁸ questionnaire the participants were divided into CVS (≥ 6 SCORE) and Non-CVS (< 6 SCORE).

Second phase, each study participants underwent comprehensive ophthalmic evaluation by Ophthalmologist that includes refraction, slit lamp examination and fundus examination (if required).

Third phase the participants were educated about CVS and their preventive measures through a power point presentation followed by reassessing their knowledge by asking them predesigned questions.

Statistical Analysis

SPSS version 22 programme was used for statistical analysis. P value was calculated by Chi square test.

RESULTS

The study was done on 50 computer operators (64 % were male and 36 % were females) working at Tertiary Care Hospital. Male to female ratio was 16:9. The mean age of study participants were 37.2 ± 7.39 years with majority of participants (24 %) were 31 -35 yrs. age group. Among all

participants youngest was 24 years and eldest was 59 years old. Maximum number of participants was postgraduates (54 %) and rest of them was undergraduates (46 %). [Table I]

Sl. No.	Parameters	Details	
1	Average age	Mean ± SD	37.32 ± 7.39
2	Sex		
	Male	Number	32
		Percentage	64 %
	Female	Number	18
		Percentage	36 %
3	Education		
	Graduation	Number	23
		Percentage	46%
	Masters	Number	27
		Percentage	54%
4	Computer use		
	Average number of hours	Mean ± SD	7.56 hours ± 1.23
	Average number of years	Mean ± SD	13.38 years ± 5.72
5	Assessment of knowledge (% of correct answers)		
	Pre education score		34.4 %
	Post education score		64.66 %

Table I. General Details of Participants

Average number of years of computer use by participants is 13.38 ± 5.72 years. Majority of participants (34 %) were using computer since 11-15 years. Average number of hours of computer use by participants is 7.56 ± 1.23 hours. 100 % of participants were using desktop with overhead fluorescent lightening in work area. 50 % (26 % laptop & 24 % desktop) participants use computer at home. Average time spent on computer by participants at work is 7.36 hours, at home is 0.83 hours and on smart phone is 1.58 hours.

The average viewing distance (in inches) of eye to computer screen is 28.62 (29.87 inches in males & 26.38 inches in females), to keyboard is 20.9 and to reference material is 20.84 inches. Level of computer screen was above eye level in 12 % of participants (8 % males & 4 % females), at eye level in 68 % (38 % males & 30 % females) and below eye level in 20 % participants (18 % males and 2 % females). 18% of participants use printed reference material at eye level and 82 % below eye level.

Poor knowledge and awareness about workstation ergonomics and computer vision syndrome were found in computer operators as evident by percentage of correct answers assessed by questionnaire which was 34.4 % and improved to 64.66 % after educating computer operators regarding computer vision syndrome and ergonomics [Table II].

94 % of participants had symptoms/complaints suggestive of CVS. 100 % of female and 90.62 % of male participants suffer from one or more symptoms of CVS. 76 % participants believe that these symptoms are related to computer use, 16 % think there might be some other reason for them and 2 % did not have any idea about the cause of their symptoms. The prevalence of CVS on the basis of CVS Q questionnaire score ≥ 6 was found to be 76 %. Most disturbing symptom in both male and female was sore/tired eyes (70 %) followed by neck & shoulder pain (64 %). 12 % of participants do not take any measure to get relief from symptoms. 88 % take measures which includes take break and move around (42 %), take

break and remain seated (36 %), close eyes (40 %), blink more frequently (6 %). 26 % take more than one measure to get relief from their symptoms. [Table III] [Table IV].

38 % participants were using glasses (16 % for distance, 16 % both for distance and near, 6 % for near), out of which 14 % were given new spectacle correction as they were using wrong correction.

A Average Time Spent on Computer (in Hours)		
	At work	7.36 hours ± 1.04
	At home	0.83 hours ± 1.36
	On smart phone	1.58 hours ± 1.89
B Computer use at work		
	Desktop	100 %
	Laptop	0
C Computer use at home		
	Desktop	24 %
	Laptop	26 %
D Use of glasses while computer use		
	Yes	38 %
	No	62 %
E Use of contact lenses while computer use		
	Yes	0
	No	100
F Use of reference matter while computer use		
	Yes	86 %
	No	14 %
G Average viewing distance(in inches) from eye to		
	Computer screen	28.62 ± 8.64 inches
	Keyboard	20.9 ± 9.64 inches
	Reference material	20.84 ± 9.48 inches
H Level of computer screen as compare to eye		
	Above	12 %
	Equal	68 %
	Below	20 %
I Level of Reference material as compare to eye		
	Above	0
	Equal	18 %
	Below	82 %
J Limitation of activity involving visual task because of computer use		
	Reading	30 %
	Driving at night	32 %
	Working with computer	44 %
	Watching television	42 %
	None	36 %
K Eye problems in adverse environmental conditions		
	Windy areas	40 %
	Dry areas	28 %
	Air conditioned areas	22 %
	None	42 %

Table II. Details Related to Computer Use

S. No.	Symptoms	Male		Female		Total Participants	
		Participants		Participants		No	%
		No.	%	No	%		
A	Redness and itching	11	22 %	11	22 %	22	44 %
B	Sandy or gritty sensation	6	12 %	10	20 %	16	32 %
C	Glare (light) sensitivity	11	22 %	6	12 %	17	34 %
D	Sore / tired eyes	20	40 %	15	30 %	35	70 %
E	Dry / watery eyes	16	32 %	10	20 %	26	52 %
F	Fluctuation / blurred vision	16	32 %	4	8 %	20	40 %
G	Double vision	9	18 %	3	6 %	12	24 %
H	Headache	15	30 %	10	20 %	25	50 %
I	Back pain	17	34 %	13	26 %	30	60 %
J	Neck & shoulder pain	18	36 %	14	28 %	32	64 %

Table III. Distribution According to Symptoms Related to CVS with Average Severity Score

Sl. No.	Measures Taken	Participants	
		Number	Percentage
1	Blink more frequently	6	12 %
2	Close eyes	20	40 %
3	Take break and move around	21	42 %
4	Take break and remain seated	18	36 %
5	None	6	12 %

Table IV. Measures Taken to Get Relieved from Symptoms Due to Computer Use

Out of 62 % participants who were not using glasses 24 % need spectacle correction which was given to them and 38% did not require any spectacle correction. 100 % participants do not use contact lenses while using computer.

64 % of participants (38 % males, 26 % females) have limitation of activity (reading 30 %, VAD use 44 %, watching television 42 %, driving at night 32 %) because of their eye problems. More number of participants who had limitation of daily activity because of eye problems were in age group 36 – 40 years (females > males in this group). 48 % of participants (24 % male, 24 % female) have eye problems in adverse environmental conditions (19 % windy, 15 % dry area, 11 % air-conditioned areas). More number of participants and having eye problems in adverse environmental condition were in age group 26 – 30 yrs. (males > females in this age group). [Table V]. 48 % of the participants were found to have either refractive error or ocular surface disorder for which appropriate treatment was given.

S. No	Sex	Activity Limitation because of Eye Problems				Eye Problems in Adverse Environmental Conditions			
		Yes		No		Yes		No	
		Number	%	Number	%	Number	Percentage	Number	Percent age
1	Male	19	38 %	13	26 %	12	24 %	20	40 %
2	Female	13	26 %	5	10 %	12	24 %	6	12 %
Total		32	64 %	18	36 %	24	48 %	26	52 %

Table V. Sex Distribution of Problems in Daily Life because of CVS

DISCUSSION

This study was done on computer operators of Tertiary Care Hospital to estimate the occurrence of Computer Vision Syndrome (CVS) and also to find possible association of CVS symptoms with various ergonomic factors. CVS symptoms were found in 78 % of our study participants, the results were comparable to observations made by different investigators.¹⁹

The mean age of study participants were 37.2 with majority of participants (24 %) were 31 -35 yrs. age group.

The reason for increased prevalence of CVS in our study participants might be due to all the study participants were working on computer on an average of 7-8 hours per day for about >10 years. 100 % of female and 90.62 % of male participants suffer from one or more symptoms of CVS and hence it can be concluded that females as compared to males were more prone to develop CVS symptoms, similar observation was reported by Shantakumari et al who also found higher CVS symptoms in females.⁶

Most disturbing symptom in both male and female was sore/tired eyes (70 %) followed by pain in neck & shoulder (64 %), the findings are comparable to study done by Shantakumari et al & Akinbinu and Mashalla who reported eye

soreness as the commonest symptom and most disturbing symptom.^{6,20} The reason for sore / tired eyes resulting in headache might be as the eyes have to adjust constantly due to constant refocusing of eyes while viewing computer screen and reference material, condition become worse if eye glasses without correct prescription were used. There is difference in response of eyes and brain while reading character on computer screen and to printed character. Eyes are much comfortable in focusing printed material as compared to computer screen, as center character (pixels) on computer screen are brighter as compared to character at the edges of the screen as intensity diminishes from center towards their edges making it very difficult for eyes to remain fixed and maintain focus.

The most common non ocular symptoms were neck and shoulder pain followed by back pain, this might be due to awkward unnatural posture adopted by computer operators. Many reporters have reported positive significant association between eye strain & neck shoulder symptoms.^{19,21} The study done by Sheedy et al.²² suggested that ocular CVS symptoms can change the posture while computer use resulting in increased time taken to complete a task and decreased work productivity as compared to someone without symptoms. The possible pathophysiology for this can be prolong viewing of computer screen results in lower blinking rate causing eye moisture to evaporate leading to dryness. In an attempt to relieve CVS symptoms many people can assume awkward, unnatural postures thus causing sore back, stiff neck and hurting shoulders. They may arch their foreheads in effort to see better, thus causing headaches.

38 % of participants were given proper spectacle correction (14 % using wrong correction & 24 % were not using any spectacles). Uncorrected refractive errors can lead to increase mental stress, reduced effective working hour, increase risk of errors and frequent absence from work leading to reduced productivity.

The average viewing distance from the display screen among study participants were 28.62 inches which is different from viewing distance less than 25 inches among 26.2 % subject reported by Stella C et al.²³ Increased viewing distance by study participants might be in an anticipation to decrease CVS symptoms and eye strain as increased viewing distance may allow the eyes to relax.²⁴

The study participants were found to be having poor knowledge regarding workstation ergonomics and computer vision syndrome as evident by pre-education score 34.4 % which improved to 64.66 % after educating computer operators regarding computer vision syndrome and ergonomics. This might be the significant predictors of complaints related to computer use hence implementation of worksite ergonomics & awareness programs may be cost effective preventive measure to reduce work related complaints, medical expenses and to improve work productivity.^{25,26}

Majority of participants having limitation of activity involving visual task due to eye problems were in age group 36 – 40 yrs. (female > male) can be attributed to female gender and decreasing ciliary body muscle contractibility. Majority of participants having eye problems in adverse environmental condition (windy/dry/air-conditioned areas) were males in age group 26 – 30 years, this might be attributed to these persons more involved in outdoor activities.

CONCLUSIONS

In our study, increased prevalence of CVS was found among computer operators working in a Tertiary Care Hospital. It might be due to their poor knowledge about workstation ergonomics, >10 years of computer use for 7 to 8 hours per day & improper/not use of spectacles in workplace. Majority of them (64 %) have limitation of activity involving visual task due to eye problems, 48% have eye problems in adverse environmental conditions (windy / dry / air-conditioned areas).

The limitation of our study was small sample size, the participants may under or over report their CVS symptoms depending upon their mood and personality as it is a questionnaire-based study and involves subjective assessment of CVS symptoms and workstation ergonomics.

Computer use which is high visual demanding task has become an integral part of modern life that resulted in a new era of professional risk among computer users of computer vision syndrome (CVS). As most of the computer professionals are ignorant of this evolving occupational hazard called Computer Vision Syndrome, it remains an undiagnosed, ill-defined and underrated problem at workplace despite its wide prevalence. Depending on severity and persistence of disorder, CVS can cause deterioration in performance, abstinence from work leading to decrease in work productivity and increased medical expenses.

Successful management of CVS requires a multidirectional approach. Abstinence from the cause must have been an ideal solution but in case of CVS it is not possible practically because of excessive use of computers in day-to-day life. Hence prevention is the key for managing CVS that can be done by creating awareness and providing health education to computer operators, modification of workstation ergonomics; regular screening programmes that can be questionnaire based for early identification of CVS symptoms. Modification of workstation ergonomics like level of computer screen below eye level, proper viewing distance from the screen and reference material, proper height of workstation chair, properly tilted copy stands for reference material, position of AC, appropriate brightness of the screen & surrounding, use of anti-glare filters on screen, correct prescription eyeglasses with anti-glare coating, regular breaks, etc can be done to prevent CVS. Computer operators should undergo scheduled regular comprehensive eye examination along with appropriate ocular therapy.

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

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