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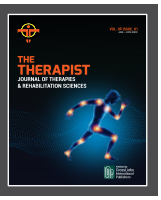

Original Article

Effect of Ergonomic Practices on Computer Vision Syndrome (CVS) symptoms among undergraduate and postgraduate IT students of University of Chakwal

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ABSTRACT

Computer Vision Syndrome (CVS) is common nowadays among students due to constant working on computer. In addition to various visual and ocular disorders, there is also periodic rise in their musculoskeletal problems. Objective: To determine the effect of visual ergonomics on CVS among IT university students of Chakwal. Methods: A cross-sectional descriptive study was done in IT department of the University of Chakwal from October-December 2021. About 65 undergraduate and postgraduate IT students studying in the University of Chakwal were enrolled through consecutive sampling. Students using computers and having symptoms of Computer Vision Syndrome (CVS), refractive error and convergence insufficiency were included. The data were gathered for visual effects in response to different ergonomics and was analysed by SPSS 25.0 and Microsoft Excel 2016. P≤0.05 was taken as significant. Results: Of the 65 students, most (72.3%) were undergraduate students. Almost 55.4% complained of severe neck / shoulder pain and dryness of eyes. 39% used to do computer work for 1-4 hours / day. Students working for 1-4 hours at home had less blinking and watering of eyes in addition to eyestrain (p< 0.05). There was significant association of mild headache (p<0.02) and minimal photophobia (p<0.05) with 1-4 hours computer work at home. Taking break up to 1 hour had significant association with mildness of eye burning, crossing and redness (p<0.05). Conclusions: IT students had moderate to severe dryness of eyes, neck and shoulder pain. Not spending more than four consecutive hours on computer work and taking at least one hour break is imperative to avoid severe symptoms.

INTRODUCTION

A complex of visual complaints associated with near work while working on computer are categorized as computer vision syndrome. It is becoming a public health problem of international concern [1]. It is considered as the common cause of idiopathic visual complaints nowadays. Visual fatigue and digital eye strain are other terms that are frequently in use for this syndrome [2]. Apart from ocular and visual disorders, computer vision syndrome is also accompanied with certain extra-ocular complaints like headache, backache, shoulder and neck pain [3, 4]. There has been reported the considerable use of digital devices including computers and laptops at workplaces both among developed and developing nations of the globe [5]. The use of laptops and other digital gadgets has become essential both in academic institutions as well as in different organizations for completing assignments and accomplishing the dispensed tasks [6]. This syndrome has also been identified as an occupational hazard with resultant diminished productivity and reduced job satisfaction rate [7]. Currently, no standard guidelines are

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available to facilitate Evidence Based Medicine (EBM) practice pertaining to computer vision syndrome by our ophthalmologists[8]. Approximately 70% of the computer users worldwide present with subsequent visual defects that are likely to be rectified by computer-based interventions [9]. An international study carried out by applying ergonomics among office workers at their workplace has illustrated significant improvement in reducing the severity of backache in addition to pain in neck, shoulder and wrist [10]. A study has been done by Shah ***et al.,*** among Peshawar bankers to determine the prevalence of computer vision syndrome among them and accompanying predisposing factors who frequently complained of resultant non-ocular problems. Female gender and uninterrupted computer use were the commonest risk factors [11]. Although ergonomics have been applied internationally for office workers in order to decrease the propensity of computer vision syndrome[12]; yet the studies in Pakistan are lacking ergonomics application for this problem.

The present study was deliberated to measure the frequency of undergraduate as well as postgraduate IT students who are specifically identified with visual problems suggestive of Computer Vision Syndrome (CVS) and their working with various computer specifications. This study would enable us to determine the magnitude of those who need improvement in ergonomics for avoidance of visual defects. Moreover, interventional studies can promptly be chalked out in future to measure the positive effects of various ergonomic applications in different academic institutes.

METHODS

A cross-sectional descriptive study was carried out in Information Technology (IT) department of the University of Chakwal from October-December 2021. This study is based on thesis that was composed in partial fulfilment of BSc (Hons) Optometry & Orthoptics requirement. It was ethically approved by Institutional Ethical Review Board of Munawar Memorial Hospital and College of Optometry Chakwal (Ref# MMH/IRB/012/2021) on 10th October 2021. The prevalence of computer vision syndrome on systematic analysis was found to be 66%[7]. In accordance with this prevalence, the sample size of 106 was calculated with WHO sample size calculator using 95% confidence level of 1.96 (z) and 9% margin of error (d). The formula used for calculation was $n = z^2 \times p(1-p) / d^2$. Data were collected by means of self-administered structured questionnaire from 65 students only keeping in view the eligibility criteria through consecutive non-probability sampling. Students identified with any ocular pathology or musculoskeletal disorders were considered ineligible for the study. Computer vision syndrome has been defined by American Optometric Association as composite of various visual disorders that are linked with prolonged use of computer and other digital handheld appliances [13]. Gross eye examination and Hirschberg test were performed with a pen torch. Cover eye test was performed to exclude squint. Convergence was assessed. Distant visual acuity was determined with Snellen eye chart. Ergonomic practices in our study are defined as subjection of the study participants to various font size, screen size, screen resolution in addition to the time spent on computer and breaks during computer work. The participants filled in the questionnaire regarding the visual effects observed by them while working on computer during the past four weeks, working hours, associated symptoms, and specifications of computer used, seating position and type of work done on the computer. Students detected with any visual disorder were later referred to optometry department of Munawar Memorial Hospital for detailed eye examination. The data analysis was done by using SPSS version 25.0 and Microsoft Excel 2016. Descriptive statistics were applied. Statistical association of diverse CVS symptoms with ergonomics was determined by logically applying chi-square test and Fisher' exact test. P ≤0.05 was considered significant.

RESULTS

Of the total 65 IT subjects enrolled in the study, 47 (72.3%) and 18 (27.7%) were undergraduate and postgraduate students respectively. There were about 60% males and 40% females among them. Of the various computer vision syndromes reported among our study subjects, neck pain, shoulder pain and dryness of eyes were frequently reported and almost in equal propensity (55.4%) among those presenting with moderate to severe problem as illustrated below in Table 1.

Table 1: Computer Vision Syndrome (CVS) associated symptoms among IT students

Computer Vision Syndrome (CVS)	None	Mild	Moderate	Severe
Blurring of vision	58.5%	35%	4.5%	2%
Burning of eyes	38.5%	36.9%	13.8%	10.8%
Headache	29.2%	33.8%	24.7%	12.3%
Double vision	64.6%	27.7%	6.2%	1.5%
Eye strain	44.6%	44.6%	10.9%	1.5%
Dryness of eyes	24.6%	20%	44.6%	10.8%
Neck pain	20%	24.6%	41.6%	13.8%
Shoulder pain	20%	24.6%	41.6%	13.8%
Watery eyes	21.5%	43.1%	23.1%	12.3%
Red eyes	49.3%	26.1%	13.8%	10.8%

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Responses pertinent to working hours, longest uninterrupted time while doing computer work, resolution of computer screen and refresh rate among IT students are revealed below in Figure 1a – 1d.

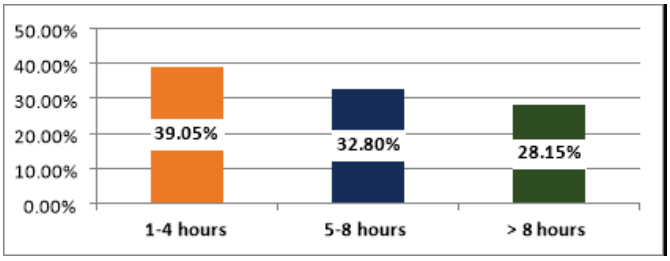

Figure 1a: Working hours of IT subjects

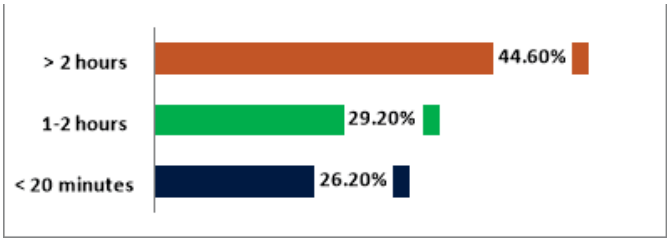

Figure 1b: Longest uninterrupted time while working on computer

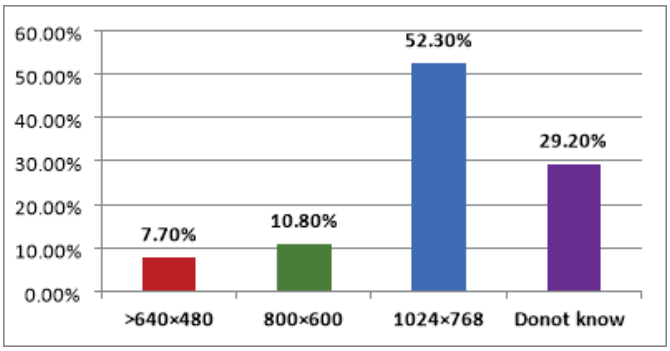

Figure 1c: Resolution of screen (pixel per inch)

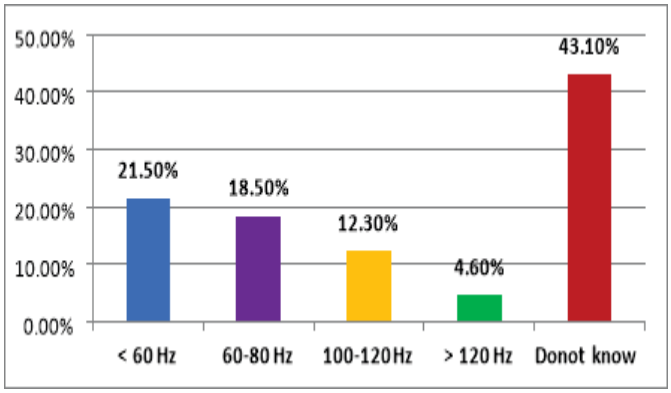

Figure 1d: Refresh Rate

Most (46.5%) of our respondents used to do computer work by keeping the computer monitor at their eye level while 29.2% and 24.3% of the IT students used to have their computer monitor below and above their eye level respectively. Majority (38.5%) of our IT students were using font size of 9-11 pt while doing computer work while 32.3% and 13.8% students used to work with 6-8 pt and <6 pt font size. Most (73.8%) of our IT students were taking break during their computer work and among them 33.8% were taking break every 20 minutes while 24.7% and 24.6% of the subjects were taking breaks every 60 minutes and every 2 hours respectively. Severity of watery eyes seemed to have statistically significant association with time spent on computer work and spending more time resulted in more blinking of eyes ($p<0.05$) as illustrated below in Table 2.

Table 2: Association of watering and blinking of eyes with duration of computer work

Variables	Watery eyes				p-value
	None	Mild	Moderate	Severe	
Breaks during computer work					(chi-square test applied) 0.20
Yes	12	20	11	05	
No	02	08	04	03	
Time spent on playing video games					(Fisher's exact test applied) >0.10
1-4 hours	14	23	14	06	
5-8 hours or more	0	05	01	02	
Time spent on playing video games					(X2 test applied) *< 0.05
1-4 hours	08	24	12	01	
5-8 hours	05	04	03	08	

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Variables	Blinking of eyes				p-value
	None	Mild	Moderate	Severe	
Breaks during computer work					(X^2 test applied) *< 0.05
Yes	21	20	05	02	
No	10	01	04	02	
Time spent on playing video games					(Fisher's exact test applied) >0.10
1-4 hours	25	19	07	03	
5-8 hours or more	03	06	01	01	
Time spent on computer at home					(Fisher's exact test applied) *<0.05
1-4 hours	22	19	05	0	
5-8 hours	09	02	04	04	

*-statistically significant association

Eyestrain seemed to be more among IT students who used to work for longer time on computer as shown below in Table 3.

Table 3: Association of eyestrain with various ergonomic practices

Computer work attributes	Eyestrain				p-value
	None	Mild	Moderate	Severe	
Font size					
6-10 pt	04	14	08	04	(X^2 test applied) >0.2
11-15 pt	09	16	04	05	
Time spent on computer at home					
1-4 hours	10	24	09	03	(X^2 test applied) *<0.05
5-8 hours or more	03	06	04	06	
Breaks during computer work					
Up to 1 hour	08	18	10	02	(X^2 test applied) >0.2
2 hours or more	05	12	03	07	
Size of screen					
14-15 inches	11	21	05	03	(Fisher's exact test applied) >0.10
17-21 inches	12	08	03	02	
Resolution of screen					
<640 × 480	04	04	04	0	(Fisher's exact test applied) >0.10
1024 × 768	15	27	07	4	

*-statistically significant association

Similarly statistical association of headache, dryness of eyes and photophobia with various ergonomic practices among our IT students is revealed below in Table 4.

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Table 4: Association of headache, dryness of eyes and photophobia with various ergonomic practices

Variables	Headache				p-value
	None	Mild	Moderate	Severe	
Breaks during computer work					
Up to 1 hour	11	13	12	02	(X^2 test applied) >0.2
2 hours or more	08	09	02	06	
Time spent on playing video games					
1-4 hours	18	19	16	04	(Fisher's exact test applied) >0.10
5-8 hours or more	01	03	0	04	
Time spent on computer at home					
1-4 hours	13	20	12	01	(X^2 test applied) *<0.02
5-8 hours	06	02	04	07	
Variables	**Dryness of eyes**				**p-value**
	None	**Mild**	**Moderate**	**Severe**	
Time spent on computer during job					
1-4 hours	10	16	06	03	(X^2 test applied) >0.2
5-8 hours	06	13	07	04	
Time spent on computer at home					
1-4 hours	11	21	12	02	(X^2 test applied) >0.2
5-8 hours	05	08	01	05	
Variables	**Photophobia**				**p-value**
	None	**Mild**	**Moderate**	**Severe**	
Time spent on computer during job					
1-4 hours	10	16	06	03	(X^2 test applied) *<0.005
5-8 hours	06	13	07	04	

*-statistically significant association

Statistical association of eye burning, redness and crossing with various ergonomic practices among our IT students is revealed below in Table 5.

Table 5: Association of eye burning, redness and crossing with ergonomic practices

Variables	Eye burning				p-value
	None	Mild	Moderate	Severe	
Size of screen					
14-15 inches	12	20	04	04	(X^2 test applied) >0.20
17-21 inches	13	04	05	03	
Longest uninterrupted time					
Up to 1 hour	18	10	06	02	(X^2 test applied) >0.20
2 hours or more	07	14	03	05	
Taking breaks during computer work					
Up to 1 hour	16	16	06	0	(X^2 test applied) *<0.05
2 hours or more	09	08	03	07	
Variables	**Redness of eyes**				**p-value**
	None	**Mild**	**Moderate**	**Severe**	
Breaks during computer work					
Upto 1 hour	24	11	01	02	(Fisher's exact test applied) *<0.05
2 hours or more	08	06	08	05	

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Time spent on playing video games					
1-4 hours	29	16	07	05	(Fisher's exact test applied) < 0.10
5-8 hours or more	03	01	02	02	
Refresh rate					
60-80 Hz	10	10	05	01	(X^2 test applied) >0.50
100-120 Hz and above	22	07	04	04	
Font size					
6-10 pt	17	07	04	02	(X^2 test applied) >0.25
11-15 pt	15	10	05	05	
Variables	**Crossing of eyes**				**p-value**
	None	**Mild**	**Moderate**	**Severe**	
Breaks during computer work					
Yes	28	15	04	01	(Fisher's exact test applied) *<0.05
No	07	04	04	02	
Type of computer work done					
Working on internet & Computer programming	30	11	05	03	(Fisher's exact test applied) >0.10
Word processing & Gaming	05	04	03	0	

*-statistically significant association

DISCUSSION

All presenting complaints suggestive of Computer Vision Syndrome (CVS) are secondary to prolonged use of diverse digital devices such as laptop, mobile phone or tablet. Experiencing multitude of visual and eye related disorders due to prolonged screen time is quite worrisome [14]. About 55.4% of the students in our study had moderate to severe neck and shoulder pain in addition to dryness of eyes. Approximately 35.4% and 24.6% complained of watery eyes and red eye problem respectively. A survey done in American Optometry clinics revealed that presenting complaints among 14.25% of the patients were attributed to computer use[15]. Apart from office workers, university students are also found busy in literature search that make them prone to eye strain and other associated problems. COVID-19 lockdown has been identified as one of the predisposing factors to prolonged screen time among all [16]. A similar study done by Lorusso *et al.*, among university students also illustrated that most (69%) of the students had neck pain secondary to computer usage for prolonged time without breaks in between [17]. Approximately 1-4 hours and 5-8 hours were utilized by our 39% and 32.8% of respondents respectively while working on computer. Moreover, longest uninterrupted time among majority (44.6%) of the students was greater than 2 hours. Likewise, a study among Ethiopian University instructors attributed the development of Computer vision syndrome associated symptoms to the long working hours on computers[18]. Prolonged screen time is also linked with

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dry eye, a clinical condition that is likely to reduce work productivity and impair mental health of the sufferers as well [19]. Linkage of dry eye with increased screen time is suggestive of the need for lessening the computer use that might prove beneficial in reversal of the presenting complaints. Eyestrain, watering and blinking of eyes had statistically significant association ($p<0.05$) with more time (5-8 hours) spent on computer among IT students (Table 2 & 3) in our study. Moderate to severe headache has also been reported among those who used to work about 5-8 hours or more on computer ($p<0.02$) as shown in Table 4. The students across the globe were subjected to online learning amidst COVID-19 that also led to worsening of the symptoms related to Computer Vision Syndrome (CVS). A study by Wang *et al.*, illustrated escalated frequency of eye dryness and headache due to online learning [20]. A similar study among Chinese students reported occurrence of CVS symptoms among 75% of the students amidst COVID-19 pandemic due to increased time spent on the screen for online education [21]. Taking breaks during computer work even for up to one hour seemed to be associated with mildness of burning, redness and crossing of eye among our students ($p<0.05$) as evident from Table 5 of our results. Rising incidence of CVS in developing regions of the world was also attributed to non- utilization of protective measures by majority in addition to very short period of break while working on computer [22]. No doubt, it is immensely necessary to work on computer for the students of any filed to make their assignments or presentations; however, awareness about the precautionary measures for getting rid of the resultant visual and ocular symptoms is of utmost importance for safety. Taking adequate break time, using eye drops and other respective personal protective equipment in addition to other ergonomic practices can prove quite beneficial. The students working for 1-4 hours on computer in current study were determined to have mild photophobia than those who used to do uninterrupted computer work for 5-8 hours ($p<0.005$) as evident from Table 4. According to National Institute of Occupational Safety & Health (NIOSH) survey, only 22% of the computer workers usually complain of various musculoskeletal disorders while majority of the computer users present with eyestrain, headache, blurring of vision, photophobia, dryness of eyes and blurred vision. Excessive computer use has been identified as the one the major contributors to photophobia by optometrists [23]. The resultant brain injuries also lead to diminished work productivity [24]. Comprehensive information pertaining to lifestyle and occupational health risks should adequately be disseminated to all workers as well as students of any institute for avoidance of grave consequences.

CONCLUSIONS

Most common symptoms among IT students were headache, neck and shoulder pain. Spending less time on computer work with at least on hour of break was associated with mildness of Computer Vision Syndrome (CVS) symptoms.

Authors Contribution

Conceptualization: IK
Methodology: SJ
Formal analysis: SJ, RS
Writing-review and editing: MK, SH, UJ
All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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