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Original Article

Computer Vision Syndrome among Students of Undergraduate Level of Punjab University Lahore

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Abstract: Background: Computer Vision Syndrome is a common eye health issue among university students due to the use of digital gadgets resulting, symptoms of headache, eye strain and blurred vision. The study was conducted to assess this issue among undergraduate students of Punjab University Lahore. **Methods:** 283 participants were included in this cross-sectional study following a self-structured questionnaire introduced online to collect the data. Computer vision-related symptoms and other factors were asked and the survey was conducted during August 2021 and January 2022. Data was collected and analyzed by SPSS software version 26**. Results:** The mean age of all the participants involved in the study was 23.12 ±1.213 years and 162 (57.24%) were females and 121 (42.76%) were male. The frequency of CVS in this study was 63.95%. Ocular symptoms of computer user range from eye strain/fatigue 55.83% (158), difficulty in refocusing of eyes 28.90% (82), double vision 20.85% (59), dryness/blurred vision 11.66% (33). Extra-ocular symptoms include Headache 47.70% (135), neck/shoulder/back pain 20.14% (57). Headache and eye fatigue/eye strain, was significantly associated with electronic device usage time, illumination, and duration of break. **Conclusions:** This descriptive cross-sectional study may be helpful to establish a need of vision screening in educational institutes to prevent symptoms of computer vision syndrome (CVS), observed as a common issue and often ignored. We found in this study that 63.95% students had symptoms of computer vision syndrome. Headache, strain, fatigue, and focusing issues were found common in the survey. The causes were found, the lack of awareness and wrong practices of using computer screens.

Keywords: Computer vision syndrome, digital ocular issues, digital gadgets.

1. Introduction

Using modern technology, in the form of the digital gadgets became an important part of the life. University students use these digital devices for study, recreational and vocational purposes (Kenabova & Vetrova, 2019). The young generation especially students rely more on digital screens rather than printing materials. Undoubtedly, these devices make life easier but additionally have negative impact on general and eye health (Noreen et al., 2021; Al Tawil et al., 2020).

Recently, the number of individuals is increasing day by day, those use digital screens for daily tasks including, reading, typing, social media, and entertainment. Excessive use may result to experience many ocular and non-ocular problems associated with computer usage (Oishi & Dhanmondi, 2023). Eye strain has been proved due to improper regulatory compliance, while working on computer terminals, and typical symptoms of Computer Vision Syndrome (CVS) are blurred vision for distance and near work, and the most commonly observed oculo-motor nerve abnormalities with accommodation disorders (Bali, 2014).

CVS as a various eye and environmental disorders, occur when the visual demands of a task exceed the user's eyesight and, as a result, the computer image cannot be effectively focused. The eye cannot focus on the image that the pixel is creating on the computer screen, so it needs to be focused and refocused thousands of times a day. Eye aches due to using computer screen is not directly associated, but it can affect the quality of visual tasks to complete. Computers in almost every banker's lab, back room, and desk today allow you to write, create, calculate, and communicate faster than ever before. Knowledge of how to operate a computer and how to read a computer

screen is a major factor in the challenges associated with using a computer. The movement of the extra-ocular muscles, the mechanism of regulation, and the surface of the eye are all important aspects of the pathophysiology of computational visual syndrome (Assefa, 2017; Kokab & Khan, 2012).

Distance from the screen, viewing angle, age, gender, uncorrected refractive errors, sitting posture may be the direct causes of a CVS. As the computer technology changed our lifestyle, over last 30 years, and made our daily routine tasks easier and fast (Tugut, 2018; Dessie, 2018).

Visual impairment became a most likely threat in the modern workplace, and CVS has been proved as a major factor to reduce the performance of professional activities by 48%. This issue is proved as compromising the quality of life of the individual as well as students population. As many studies showed result, that 61.4% of computer-dependent individuals suffered from back-ache, shoulder and neck pain as well as eye strain in almost70.6% population (Akinbinu & Mashalla, 2013).

Considering, pathophysiology of CVS, the human eye perform different focusing mechanism while reading text material and on computer screen. Computer screen effects in a way, depending upon text type, distance, viewing angle, brightness, display type, configuration requirements, while reading. The VCD symbols consists of the pixels resulting from the light beam hitting the back of the phosphorescent coated screen, and the printed symbol consists of the well-defined symbols on the front, so each pixel is bright in the center and less bright outward. As a result, the human eye is unable to focus on pixel marks for extended periods of time. Instead, the focus system hangs on the computer screen. This is because computer users prefer to view the printed text vertically rather than read it. As a result, in dark illuminations rooms and quiet places, the eyes are always relaxed and always try to focus on the pixel characteristics (Arslan, 2016).

The mechanism of focusing and defocusing phenomenon of the eye, exerting more accommodation by the ciliary muscles causes eye strain and accommodative associated with CVD. In addition, computer work requires frequent impulsive eye movements (eye movements), coordination (continuous focus), and convergence. All of this requires constant relaxation and contraction of the eye muscles (Alemayehu & Alemayehu, 2019).

Clinically the specific cause of computer vision syndrome has specific characters and caused by a combination of variables such as excessive working hours, inadequate breaks, and continuous screen exposure. CVS symptoms may exist as eye Strain, brightness, contrast, screen flare, and screen refresh rate are believed to increase the visual load on the system and cause these symptoms.

Prolonged use of computer screens not only causes eye strain but dryness of eyes due to decreased blinking rate. This is because long-term use of visual indicators can destabilize the tear film, damage the corneal epithelium, causing eye pain. This has been established that using a computer for 45 minutes reduces the frequency of blinking by 57% and can cause dry eye issue. (Gowrisankaran & Sheedy, 2015).

Various factors such as display media, the appearance of the target background, and the wavelength of light can all affect visual performance. F blurred vision can all be environmental variables such as refractive error, improper eyeglasses, presbyopia, poor eye posture, excessive glare, and low screen resolution. Blurred vision can also be caused by abnormal tears production. Poor posture results to appear neck stiffness, shoulder pain, psychosocial stress, and back pain. Headaches are difficult to diagnose, but usually occur in the middle to late afternoon after long-term use of the computer. Symptoms of CVS. (Gowrisankaran & Sheedy, 2015).

Risk Factors also have a relationship between the symptoms and indicators of computer addiction and the time spent on computers intensively. The presence of glare is another important factor in developing the CVS. Fatigue and discomfort are also due to the low or high resolution of the computer screen. Periodic Eye Checks, History (component must contain the number of devices and type of devices to use), Viewing distance and angle, amount of light, brightness, and time spent are crucial to developing CVS. The size, contrast, and screen resolution are also important. Based on the history, physical examination should include refraction, binocular visual acuity assessment, and tear film assessment. Blink rate is also useful for diagnosing and treating CVS (Alemayehu & Alemayehu, 2019).

2. Materials and Methods

Data was collected from participants of this descriptive cross-sectional study, those using digital devices for the execution of their educational tasks. Screen type also was under consideration to collect the symptoms of CVS. Online survey was conducted by total 283 participants of students of undergraduate level of Punjab University Lahore. Initially the questionnaire developed to collect the data was validated by distributing among 15 students. Later on, the questioner was introduced

among the participants of the study via for demographic information along with questions regarding computer screen use.

The sample size was calculated by the Chochran's formula:

$$n = \frac{Z^2 \frac{\alpha}{2} pq}{\rho^2}$$

Here n=sample size, P=Prevalence, q=1-p, Z=1.96, P=0.81, (taken from parent article, published by Logaraj M; et. al 2014), q or occurrence of error was 0.05, = (1.96)2(0.81) (1-0.81) / (0.05)2

= (3.841) (0.81) (0.19) / 0.0025

= 0.5911 / 0.0025

= 236

The sample calculated was (n=236).

Attrition rate= 20%, the final sample size calculated as 283.

The detailed information were obtained from respondents by online using social media by convenient sampling method technique, The questions were asked to the participants about visual terminal use, including type of terminal, hours spend on digital screen, break during use of digital screen, average duration of break, distance between eyes and screen, level of illumination of screen, sitting position, use of monitor filters and symptoms related to the use of digital screen or visual terminals were also included in the questionnaire. The IRB approval was also obtained for the study protocol, and data was gathered in 6 Months duration. The informed consent was also received from all participants. The data was analyzed by using SPSS software (SPSS Statistics, Version 26) and statistical analyses were conducted to determine trends and correlations between variables by using Chi-Square test.

Data were received by visiting the university campus and distributed questionnaire as well using social media. The respondents those use digital gadgets for social contacts, educational tasks and entertainment were included in the study aged 19-25 years of undergraduate level. Students experiencing signs of headache, shoulder pain, eye pain, and neck pain or with another sign of Computer vision syndrome as study variables were noted, while any serious pathology of eye, any eye surgery, and individuals having any systemic health issue were excluded from the study.

3. Results

Total of 283 participants (university students) were included in this study, all the participants (university students) responded to the questionnaire completely (response rate was 100%). Regarding study variables. The formation of questions was designed in a simple way and most of the questions were asked in yes or no options that allows the participants (university students) to choose only one option of every given variable except the symptoms.

Table 1. Demographic Presentations of the Participants

Variable	Distribution	Frequency	Percentage
Gender	Males	121	42.76
	Females	162	57.24
	Total	**283**	**100**
Age	19	4	1.4
	20	6	2.1
	21	19	6.7
	22	34	12.0
	23	106	37.5
	24	87	30.7
	25	27	9.5
	Total	**283**	**100**

This table showed the gender and age wise distribution of the study participants, as males 121 (42.76%), and females 162 (57.24%). Furthermore, the mean age of the participants (university students) participants was noted as 23.12±1.213 years. and the mean age of the participants were 23.12 years.

Table 2. Types of the visual terminal and time consumed on digital device

Visual Terminal Type	Frequency	Percentage
Mobile Phone	136	48.06
Laptop	141	49.82
Desktop Computer	6	2.12

This table showed about the digital terminal use by the university students. 136(48.06%) participants were using mobile phones, 141(49.82%) were use laptops while only 6(2.12%) were using desktop computer.

Table 3. Use of digital gadgets

Use of Digital Screen	1-2 Hours	55	19.4
	4 Hours	92	32.2
	More than 4 Hours	136	48.1

Thie table showed the use of visual terminal used by the university students as 136 (48.06%) used mobile phones, 141 (49.82%) used laptops and only 6 (2.12%) were using desktop computers. A large number of participants were using mobile phones and laptops as compared to desktop computers. Here 55(19.4%) participants used digital screen 1-2 Hours, 92(32.2%) used digital screen 4 Hours, and 136(48.1%) respondents were using digital screen for more than 4 Hours.

Table 4. Ocular symptoms of Computer Vision syndrome

Symptoms	Response	Frequency	Percentage
Headaches	Yes	135	47.7
	No	148	52.29
Blurred Vision	Yes	59	20.84
	No	224	79.15
Focusing Problems	Yes	82	28.97
	No	201	70.27
Drye Eyes	Yes	33	11.66
	No	250	88.66
Fatique of Eyes	Yes	158	37.10
	No	125	44.16

The data in the table in responses by the participants showed that the presence of Headaches 135(47.7%), Blurred or Double vision 59(20.84%), Focusing problems 82(28.97%), Dry eyes 33(11.66%), and Fatigue of Eye 105(37.105) was noted by the study participants. Headaches were noted as a higher value than other symptoms.

Table 5. Awareness about following regular breaks during digital screen

Breaks	Frequency	Percentage
<1 hour	135	47.7
>1 hour	88	31.1
Every 20 minutes	60	21.2

This table showed that only 60(21.2%) university students followed the 20-20-20 rule, while other participants (135(47.7%) use digital screens for 1 hour and 88(31.1%) use digital devices for more than 1 hour.

Table 6. Association of Computer Vision Syndrome and Practices

Variables	Headache	Eye fatigue	Dryness	Difficulty in refocusing	Blurred vision	Back/neck/shoulder pain

	n	*p*	n	*p*	n	*p*	n	*p*	n	*p*	n	*p*
Hours spend on screen												
2 hours	27		33		8		11		15		11	
4 hours	40	0.610	27	0.508	7	0.327	35	0.044*	17	0.413	25	0.095
More	68		78		18		36		27		21	
Break												
Every 20 min	52		70		14		44		22		33	
After an hour	40	0.0001*	54	0.372	12	0.759	30	0.0001*	21	0.182	17	0.118
>hour	43		34		7		8		16		7	
Duration of break												
Upto 10 min	103		122		28		64		43		48	
Upto 20 min	2	0.0001*	12	0.564	3	0.335	9	0.489	6	0.777	3	0.279
>20 min	30		24		2		9		10		6	
Distance from screen												
<40 cm	9		10		3		5		1		4	
b/w 40-76 cm	48	0.046*	68	0.862	12	0.699	32	0.595	26	0.190	22	0.763
>76 cm	78		80		18		45		32		31	
Illumination of screen												
25-50%	11		12		3		8		4		5	
51-75%	0	0.205	1	0.414	0	0.818	2	0.340	0	0.675	0	0.675
76-100%	124		145		30		72		55		52	
Use of monitor filter												
Yes	92		141		32		73		46		49	
No	43	0.0001*	7	0.019*	1	0.038*	9	0.207	13	0.100	8	0.785

This table showed the facts that computers users practice and showing multiple behavior to use digital screens. The p-value for the study variables with symptoms of CVS was significant value showing as significant. Time duration, distance from the screen, illumination, use of blue light filter and regular breaks during computer work. The association of CVS with these factors mentioned in the table are statistically significant.

4. Discussion

As the students of University of the Punjab of undergraduate level were participated in the study including a total of 283 participants including 42.76% male and 57.24% female of age 19-25 and the mean age of 23.12 ±1.213 years, and all participants provided 100% response. This survey showed that students are at level of risk of computer vision syndrome because of using electronic devices but not at high level of risk because at this level the students have exposure of digital screen (like mobiles and Laptops) not for longer period of time as compare to office workers and post-graduate students. The results were previously found in a study, including 69% females and 31% males of mean age was 20.16±3.81 years, answered for the presence of at least one symptom of CVS. The prevalence of computer vision syndrome was found to be 63.95% in this study depending

upon the symptoms, usage time of screen and duration of break while using the digital screen. A study conducted among undergraduate students of medical education was reported as 78.6%. (Noreen et al., 2016). A similar study done in Nigeria explained the prevalence of CVS as 74%. Another study done in engineering students has shown that the prevalence of CVS was 81.9% and in medical students was 79%. In Ethiopia among bank workers. This prevalence is high as compared to this study. The increased percentages in their studies are because students use digital screens for a long period of time without taking breaks during their work but in this study the participants did not spend too much time on digital screen and does not experience severe symptoms as compare to older study. The maximum time consumed by the students on electronic devices is greater than 4 hours. 48.06% (136/283) spends more than 4 hours on their devices in other study 5% student used <1 hour, 9% students spend 01-02 hours, 21% of the participants worked 2-3 hours, 24% worked 3-4 hours, 27% of students worked 4-6 hours and 14% students spend >6 hours on their digital screens. No association found between time consumed on digital screen and symptoms recorded in present study.

A higher number of students participated in this study noted severe headache, difficulty in refocusing, back/shoulder/neck pain, double vision and eye strain/fatigue. All these symptoms which are observed during this study last for at-least one month. Headache was found one of the most commonly symptoms in respondents, reported by 47.70% of students. According to a similar study in India, 82.1% of participants reported symptoms of headache, while in Tokyo, Sen and Richardson found complaints of headache as 61%, among computer users. A similar study, in Egypt assumed, headache as 26% in students of medical field. In another study in Malaysia expressed the symptom of headache as a common symptom among college students and the prevalence was found as 19.7%. These reports suggest that unilateral, vision-related, cluster headache-type headaches, or tension-type headaches are common symptoms associated with frequent use of computers (Travers, Stanton, 1984). Another common symptom observed by the students was severe eye fatigue/eye strain, which is reported by 30% of students. A study on undergraduate medical students shows 15% eye fatigue and 48% irritation of eyes followed by students (Bali, 2007).

Time consumed on computer screen is very crucial and proved a direct linked with ocular symptoms, while for longer duration. But in this study headache and eye strain/fatigue is related to duration of computer usage. In this study, time spent at the computer on both mobile phones and laptops was not found to be directly related to symptoms of computer vision syndrome. Screen time of more than 4 hours was reported as directly linked with computer related symptoms. Headache and eye strain/eye fatigue sitting for longer duration on digital screen used for longer duration. Exceedingly more than 4 hours of computer usage is significantly associated with symptoms of CVS as documented in other study. Rehman and Sanip in their study suggested that the use of computer screen, more than 7 hours resulted CVS. Ocular symptoms including eye strain, eye fatigue, and focusing issues were found significant in India, in computer users for more than 4 hours. Another study conducted in India showed results in accordance with this study in which the ocular symptoms including eye strain/ eye fatigue and difficulty in refocusing are common in computer users for more than 4 hours (Stella et al.,) reported these symptoms of CVS using computer screen for more than 8 hours daily (Chiemeke, 2007). We found in our study, that taking some breaks during computer work the participants experienced fewer symptoms, and no association was found regarding duration of break and relief of ocular and non-ocular symptoms. Regular breaks do not significantly reduction in CVS (Ranasinghe, 2016). Previous study also documented that neck/shoulder/back pain gets aggravated by sitting posture. We also found that computer related symptoms were markedly present among the study population. In our study, the behavioral factors like maintained proper distance from the screen, illumination of the digital screen, and regular breaks during computer work proved crucial roles. In many studies these rules were established among younger generation. There should be a proper distance with proper gesture and correct sitting position is very important for computer users (Logaraj et al., 2013). Regular breaks during computer work or other digital gadgets are well established and must be maintained to relax the accommodation and minimize the CVS (Henning, Jacques et al., 1997; Heuvel & Thé K, 2003). This factor was remained significant in our study, and most of the students were unaware from the importance of taking regular breaks or following 20-20-20 rule, that explains that during computer work, this is necessary to take a break for 20 second after 20 minutes looking 20 feet away. This proved an effective method to minimize the eye strains and fatigue.

Awareness campaigns and training to use digital gadgets in a safer way should be planned in educational institutes. Use of blue light filters, proper distance from the screen, sufficient illumination, and possibly bigger screen must not be ignored. Following 20-20-20 rule, must be experienced during educational tasks. Book reading should be encouraged instead of digital screen, when possible. Vision screening once a year in educational institutes may be helpful to minimize the issues.

5. Conclusions

We found CVS in our study as a very common issue of the younger generation, especially students studying undergraduate level programs. Symptoms associated with CVS, found strong evidence of significance while using computer screen for longer duration of time. Blurred vision, focusing issues and neck and shoulder pain was also found as main issues due to use of digital devices. Results also showed that the undergraduate university students rely more on digital devices to complete the educational tasks. In our study 63.95% participants experienced CVS. Being a high ratio observed, the situation is alarming and not to be ignored, so need to be addressed. The symptoms of CVS may be minimized by changing the ways of using digital gadgets and following 20-20-20 rule. Enjoying outdoor games and activities can control the CVS symptoms.

Author Contributions:

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Conceptualization, Study design, data collection, manuscript writing, and final review

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Study design, Manuscript writing and Final review

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Study design, final review

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