



Original Article

Computer vision syndrome: prevalence and predictors among students

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Abstract

Background: Globally around 60 million people are suffering from Computer vision syndrome (CVS). A well-known eye and vision-related problem resulting from prolonged computer, tablet, e-reader and cell phone use. Viewing a digital screen often increases the visual load therefore the aim of this study was to explore the prevalence of CVS among students.

Methodology: This cross-sectional study was conducted from 1st September 2018 to 31st May 2019 on a sample of 320 students from diverse physiotherapy institutes of Karachi. Participants of both genders between the age of 18-24 years were included in the study. Data regarding demographics, CVS assessment, associated symptoms, intensity of symptoms and daily vision routine was recorded. CVS was assessed using a standardized CVS questionnaire (CVS-Q) and analyzed using SPSS version 21.

Results: A total of 320 physiotherapy students with a mean age of 21.04±0.8 years were enrolled in the study, majority of them were females 245(76.6%). Out of these, 186 students were diagnosed with CVS as they scored ≥6 on Segui and Colleagues CVS questionnaire with headache being the most prevalent symptom (63.1%) followed by itching (52.8%), increased sensitivity to light (43.6%), eye pain (42.6%) and feeling of foreign body (39.5%). Among the activities involved in daily vision routine, optical use and sitting posture were significantly associated with CVS.

Conclusion: It can be concluded from the study results that CVS is highly prevalent among physiotherapy students, one of the reasons for this might be the increased digital screens usage for academic purpose and clinical decision making.

Keywords

Computer Vision Syndrome (CVS), Digital Eye Strain, Physiotherapy, Daily Vision Routine, CVS Symptoms



Introduction

With the recent advancement of technology, the use of computer and other electronic devices especially smart phones and tablets, has widely increased not only for professional but also for academic purposes in colleges and universities. Both positive and negative impacts are associated with these technological modifications¹. On one hand, use of these gadgets provides us easy communication, e-learning, improved and appropriate time management whereas prolong exposure results in various visual and ergonomic disorders. Using these technologies for 3 hours/day increases the health risk promoting CVS, low-back pain (LBP), headaches and psychosocial stress etc^{1,2}.

CVS is a complex condition involving a group of vision-related problems which are common among people who spend most of the time working on computers, tablets, cell phones and e-books³. Viewing a digital screen for prolonged time duration leads to eye strain and vision-related problems mainly due to poor lighting, glare on digital screen, improper viewing distance, poor sitting posture and uncorrected vision problems¹, which are usually neglected by the technological users³. In addition to the above-mentioned errors, dry eye is also a major contributor of CVS, which leads to decreased lubrication and nourishment of eyes due to insufficient tears production. Its effects by decreasing the rate of blinking which in turn results in prolonged and continuous exposure during digital operations⁴. Proper adjustment of these settings and appropriate use of screen filters to minimize glare and ocular discomfort are considered as the most effective measures for prevention of CVS.

Pakistan is quickly becoming digitalized; it is now among the countries with highest mobile phone use, currently, there are almost 59 million smart phone users in Pakistan⁵. Since 2016, there has been an approximate increase of 47% among the smart phone users,

20% among internet users, 35% in social media users. While the use of desktops and laptops for web browsing has decreased to 22%⁶. Based on the local and international literature eye problems and headache are the significant symptoms associated with CVS resulting from prolonged technological use⁷. In relation to this, a study conducted in Lahore indicated high frequency of CVS among computer engineering students i.e. 72.4% (123/170)⁸ which is also supported by a prevalence study conducted in Peshawar i.e. 90.5% of the enrolled students were diagnosed with CVS⁹.

In the light of mounting evidence regarding high CVS prevalence in young generation, the study was designed to explore the frequency of CVS among students and to identify the daily vision routine factors promoting its risk.

Methodology

This cross-sectional study was conducted between 1st September 2018 to 31st May 2019 over 320 students of diverse physiotherapy institutes of Karachi including Liaquat National School of Physiotherapy, Ziauddin College of Rehabilitation Sciences, Jinnah Postgraduate Medical College and Baqai Medical University. Subjects were selected through convenient sampling technique, irrespective of gender and involved in daily technological use from at least 1 year or more were included in the study. While those who underwent eye surgery, having eye infection, taking any topical medication or eye drops were excluded from the study. Written informed consent was taken from each participant and their voluntary participation was assured, participant confidentiality was maintained.

For assessment, a semi-structured questionnaire was used which comprised of two parts. First part included daily vision related routine of individuals i.e. distance of screen during digital device use, duration of watching digital screen, sleep duration, eye

hygiene, viewing position in classroom and breaks during prolong use of digital device. In second part a standardized CVS-Q developed by Segui and colleagues¹⁰ was used for estimating the CVS frequency⁹. The questionnaire focused on the frequency and intensity of total 16 CVS associated symptoms including burning, itching, feeling of foreign body, tearing, excessive blinking, eye redness, eye pain, heavy eyelids, eye dryness, blurred vision, double vision, difficulty focusing for near vision, increased sensitivity to light, colored halos around object, feeling that sight is worsening and headache.

The occurrence of CVS symptoms was indicated via numeric codes i.e. from 0 to 2 (0-Never, 1-Occasionally, 2-Often or Always), while intensity of symptoms was marked from 1 to 2 (1= Moderate and 2+= Intense). The frequency and intensity of each

symptom was multiplied in order to get the total score for each symptom. As per the criteria, score of each symptom was recoded as 0=0, 1 or 2=1 and 4=2. If the sum of all recoded score was ≥ 6 , the participant was considered to be suffering from CVS. The recorded data was analyzed using SPSS version 21. Chi-square test was used to evaluate associations between categorical variables.

Result

Out of total 320 enrolled participants, there was female majority i.e. 245 females and 75 males only with a mean age of 21.04 ± 0.8 years. The diagnosis for CVS was made using CVS-Q scoring, around 58% participants were diagnosed with CVS. The baseline characteristics were recorded for all study subjects as shown in table 1.

Table 1: Demographic characteristics of the study population

Variables	Total participants (n=320)	Computer Vision Syndrome (n=186)
Mean Age (Years)	21.04±0.8	22.45±0.73
Gender	Male	75(23.3)
	Female	245(76.6)
Marital status	Married	9(2.8)
	Unmarried	311(97.2)
Educational status (DPT)	1 st Year	60(18.8)
	2 nd Year	58(18)
	3 rd Year	60(18.8)
	4 th Year	65(20.3)
	5 th Year	77(24.1)

*Values are given as n(%) or mean \pm SD

*DPT-Department of Physiotherapy

Headache was the major complaint reported by participants diagnosed with CVS i.e. 63.1% followed by itching (52.8%), increased sensitivity to light (43.6%), while other infrequent symptoms of CVS are mentioned below in table 2.

Table 2: Major symptoms among study subjects diagnosed with CVS

Symptoms	n(%)
Headache	117(63.1)
Itching	98(52.8)
Increased sensitivity to light	81(43.6)

Eye pain	79(42.6)
Feeling of foreign body	73(39.5)
Tearing	69(37.4)
Burning	66(35.9)
Blurred vision	64(34.4)
Heavy eyelids	55(29.7)
Eye redness	51(27.2)
Feeling that sight is worsening	51(27.2)
Colored halos around object	46(24.6)
Difficulty focusing for near vision	42(22.6)
Excessive blinking	38(20.5)
Eye dryness	33(17.9)
Double vision	25(13.3)

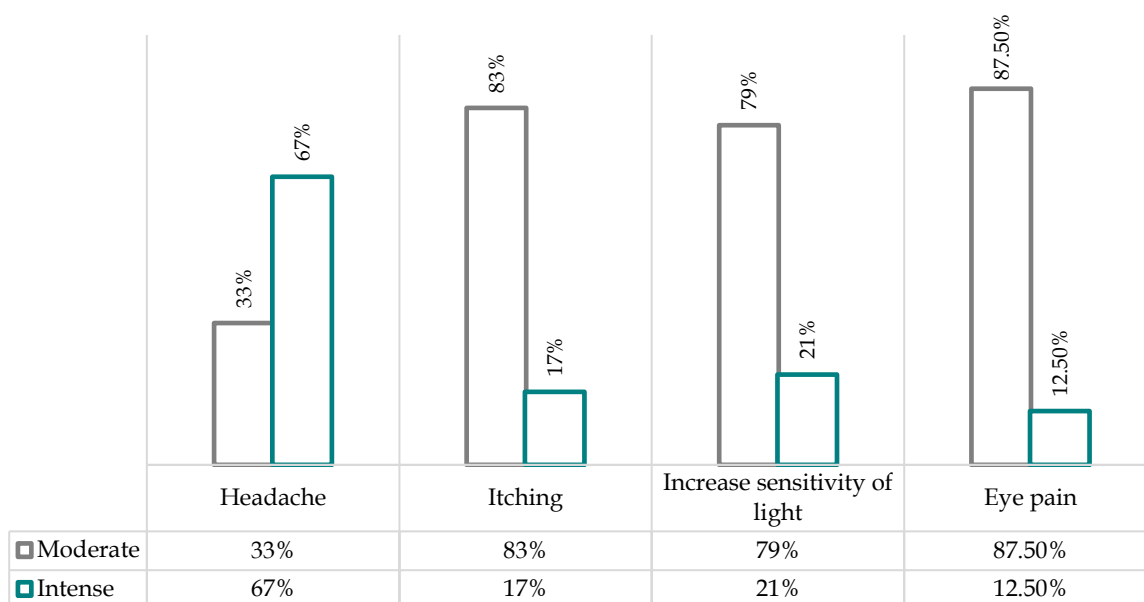


Figure 1: Intensities of four most reported symptoms

Intense headache was reported by 67% participants while in case of itching majority reported moderate intensity (83%), same was in the case of light sensitivity and eye pain.

From the collected data it has also been observed that use of optical (p-value =0.003) recorded as 54.9%, duration of digital screen usage for 4-8 hours (p-value =0.116) recorded as 40.5%, distance from digital screen and eyes during work at 15-20 inches (p-value =0.30) recorded at 50.8% and sitting position in the middle row of class (p-value =0.004) recorded as 41.5%, taking care of eye hygiene (p-value =0.31) recorded as 64.1% which showed a statistically significant contribution in the prevalence of CVS.

Table 3: Association of variables related to daily vision routine and computer vision syndrome

Variables		Total n(%)	Computer Vision Syndrome		p-value
			Yes	No	
Optical Use	Yes	176(55)	116(65.91)	60(34.09)	0.003
	No	144(45)	52(36.11)	92 (63.89)	
Duration of digital screen usage (hours)	1-2	35(10.9)	20(57.14)	15(42.86)	0.116
	2-4	77(24.1)	49(63.64)	28(36.36)	
	4-8	130(40.6)	77(59.23)	53(40.77)	
	>8	78(24.37)	44(56.41)	34(43.59)	
Distance between digital screen and eyes (inches)	10-15	100(31.2)	67(67)	33(33)	0.30
	15-20	162(50.62)	89(54.94)	73(45.06)	
	20-25	51(15.9)	18(35.29)	33(64.71)	
	25-30	7(2.18)	5(71.43)	2(28.57)	
Breaks during prolong use of digital device	No breaks	61(19.06)	30(49.18)	31(50.82)	0.672
	15 sec	71(22.18)	43(60.56)	28(39.44)	
	20 sec	62(19.37)	34(54.52)	28(45.16)	
	≥30 sec	126(39.3)	75(59.52)	51(40.48)	
Viewing position in classroom	Front row	108(33.7)	41(37.96)	67(62.04)	0.004
	Middle row	133 (41.5)	92(69.17)	41(30.83)	
	Last row	79(24.6)	49(62.03)	30(37.97)	
Eye care habits & hygiene	Yes	205(64)	105(51.22)	100(48.78)	0.31
	No	115(35.9)	77(66.96)	38(33.04)	
Sleep duration	<06 hrs	56(17.5)	36(64.29)	20(35.71)	0.3
	06-07 hrs	169(52.8)	100(59.17)	69(40.83)	
	08-10 hrs	82(25.6)	38(46.34)	44(53.66)	
	>10 hrs	13(4.06)	8(61.54)	5(38.46)	

* $p < 0.05$ is considered significant.

Discussion

Exposure to music stimulates brain areas, but the process occurs differently among males and females which are attributed to various genetic, hormonal and environmental factors. However, both genders are equal in intelligence, but tend to work in a different manner. This is because both male and female use different parts of their brain to recognize faces, sense emotions, encode memories, make decisions and solve certain problems. According to our results, reaction time was much faster among females as compared to males in the control group as well as experimental group (Table 1).

However, it is generally accepted that males have faster reaction time as compared to females. Men tend to have larger diameter of axons than women. Larger diameter of axons causes signals to be transmitted faster up to the nerve fibres, leading to a shorter latency between stimulus and response¹⁵. But our results are contradictory to previous researches. This might be due to the neuroanatomical differences among both the genders. That is female have bigger Corpus callosum as compared to males which is the larger tract of neural fibres that allows the free flow of communication between both hemispheres of the brain¹⁶. Furthermore, regions for frontal lobe that are responsible



for problem solving and decision making were larger in women¹⁷.

In addition, our graphs also showed that both the genders took more time in Stroop interference (Table 1) it is because, there are two brain regions involved in the processing of Stroop task cingulated cortex and dorsolateral prefrontal cortex. Hemisphere difference has also been proved by a study that right cerebral hemisphere reads the colour, the left cerebral hemisphere insists to read the words. When the meaning of a word and its colour are congruent, it is easy to recognize the actual colour of the word. But when the meaning of the word is incongruent with the colour, it creates a conflict between the colour and the word's meaning. The "conflict" between two brain processes is word-recognition and colour-recognition. Thereby, extra time is required by brain to process and resolve this conflict. It turns out that we are so fluent in our language that word-recognition is slightly faster/stronger than colour-recognition¹⁸. Most people will recognize the meaning of the word before recognizing the colour. In order to name the colour correctly, the two processes compete for the final decision-making process. The brain has to inhibit the faster/stronger word-recognition process in order to allow the colour-recognition to win in the final response. This inhibition requires "selective attention" (attention focus) to inhibit the competing conflicting process. The reaction time is an indicator of the "attention process" in the brain it increases with attention fatigue and/or inattentiveness¹⁹. However, when comparing between both the genders, it was found out that females perform somewhat better than males this is because the neurons in the pre frontal cortex of female's brain are more closely packed together than male's brain²⁰. And the prefrontal cortex is involved in Stroop task and problem-solving ability.

Many researches have been done proving different effects of music on psychological parameters, all with contradictory conclusions to one another. Like authors have concluded that music does not have any

effect on memory²¹. On the other hand, some have also reported that sound in the background actually enhances the learning ability²². In our study, the overall working capacity was decreased along with the verbal fluency (Table 1). This can be due to the perspective proposed by Kahneman as Cognitive Capacity model. In this model it is demonstrated that cognitive processing can be done only for a limited pool of resources at a given moment. When multiple tasks occur at the same time, they compete for the limited resources and thereby exceeding the available capacity due to combined demand. And ultimately capacity interference occurs. This causes the processing of only portion of the task and thereby performance deteriorates. Thus, increasingly complex distractions due to music cause decline in cognitive performance²³. This might be the possible reason that the working capacity of our participants decreased from high to average, in addition to the verbal fluency. This is similar to other researches which demonstrated that background music has small but continuous negative effect on memorizing words or nonsense syllables (especially when listening to loud music)²⁴, remembering advertisements²⁵ and also in memorizing earlier read texts and reading performance²⁶. Listening to music has also been reported to hinder with many other cognitive processes, including multimedia learning, performance on diagrammatic, numerical and verbal analysis, the ability to perform arithmetic, reading, performance inhibition on Stroop task and also in the learning of new procedures²⁷⁻²⁹.

This study provides the positive effects of music on attention, verbal fluency, and short-term memory and also on reaction time. However, more significant data is required in future in support of the positive effects associate with music. Moreover, the negative effects were not evaluated in this study which play a significant role in one's health and well-being, thereby, future researches should also focus both the negative and positive aspects of the music and comparative data must be represented in order to evaluate the

overall significance and outcomes of musical interventions.

Conclusion

Limited data is in favour of positive effect of music on psychological parameters but it is firmly demonstrated that music consistently and reliably interferes with the mental performance, also indicated by our study. But it is recommended that further studies should be performed to compare the positive or negative impacts of music or the specific type of music causing either positive or negative effect on memory and attention.

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