ORIGINAL ARTICLE

Computer Vision Syndrome (CVS) and its Associated Risk Factors among Undergraduate Medical Students in Midst of COVID-19

Khola Noreen[1], Kashif Ali[2], Kausar Aftab[3], Muhammad Umar[4]
[1,4]*Rawalpindi Medical University, Rawalpindi,* [2]*Combined Military Hospital, Panu Aqil*
[3]*Gujranwala Medical College, Gujranwala*

ABSTRACT

Purpose: To determine the frequency of computer vision syndrome and its associated risk factors among under graduate medical students.

Study Design: Descriptive Cross–sectional study.

Place and Duration of Study: Gujranwala Medical College and Rawalpindi Medical University, Pakistan from 5th August to 28th August, 2020.

Methods: A validated self-designed questionnaire was used for this study. The survey instrument was tailored from a published questionnaire which comprised of questions on demographics, frequency of symptoms of computer vision syndrome, pattern of computer usage and ergonomic practices. Final analysis was run on 326 undergraduate medical students.

Results: There were 228 (69%) females and 98 (30%) males with age range between 17 to 25 years. Overall frequency of CVS was found to be 98.7%. Twenty-nine percent students experienced extra ocular complaints and 71% had ocular symptoms. Symptoms of CVS were more commonly observed among those using desktop/laptop at less than forearm length ($p = 0.001$). Distance of < 12 inches from mobile phone was found to be associated with eye irritation and neck shoulder pain ($p = 0.001$). Frequency of break of more than 60 minutes was found to be significantly associated with eye irritation ($p = 0.002$) and excessive blinking and light sensitivity ($p = 0.001$). The students not using ergonomically designed work station were found to suffer with more symptoms of CVS as compared to those using ergonomically designed work station ($p = 0.049$).

Conclusion: Health issues related to excessive use of digital devices has become alarmingly high during COVID-19 pandemic. Symptoms of CVS are significantly associated with distance from digital device and less frequent break intervals.

Key Words: COVID-19, Computer Vision Syndrome, Digital eye syndrome, ergonomics, visual display terminals.

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Correspondence: Khola Noreen
Rawalpindi Medical University
Rawalpindi
Email: khauladr@gmail.com

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INTRODUCTION

Prolonged and rampant use of visual display terminals (VDTs) during pandemic has predisposed our young generation to a variety of health issues not limited only to visual problems but also including various musculoskeletal problems. Since the report of first cluster of COVID -19 (Corona Virus) cases around the end of December 2019 in China, it has shown rapid spread over short span of time.[1] On 30th January 2020, International Health Regulations Emergency

Committee Meeting regarding the outbreak of Novel Corona Virus (2019-nCoV) declared it as Global Public Health Emergency of International Concern (PHEIC). On 11th February 2020, virus was labelled by WHO as 'severe acute respiratory tract coronavirus-2' (SARS-CoV-2; also referred to as 2019-nCOV) and disease as 'COVID-19'.[2]

On 11th March, 2020 this outbreak was declared as Global Pandemic by WHO.[3] The global pandemic has imposed cataclysmic impacts on almost every aspect of life. "Spatial distancing"[4] became one of the strongly recommended practice around the globe and it involves creating and maintaining safe social distance which has ultimately moved the world away from public spaces and shared locations to isolation.[4] This practice led to implementation of variety of regulation and recommendations that has resulted in shutting down of all major areas involving public gathering and human interaction including schools, colleges, offices, air ports, railway stations, shopping malls, mosques, temples, sports arena and has affected almost every field of life. Under such unprecedented circumstances work from home (remote working practices) has become obligatory practice and human life has become dependent on technology as it serves as a crucial requirement for linkage to the external world.[5]

Technology has become sole enabling tool for people to interact, communicate and continue their responsibilities. The human interaction has become virtual in the form of online meetings, audio, video conferencing, recreational activities like online gaming, blogging, social networking resulting in rapid upsurge in increased digitalization in every aspect of human life. Education sector is another domain in which long standing educational practices were disrupted and elicited the need to look for alternate educational strategies to be adopted during pandemic. The e-learning strategy emerged as alternative solution to continued education. The educational institutions around the globe have started using different educational platforms like Google classroom, Zoom, and Microsoft teams. Rapid upsurge in internet traffic has also been observed on these platforms.[6]

Rapid increase in digitalization during pandemic has resulted in increased time spent in front of video display terminals including desktops, computers, laptops, smart phones and e-readers. Increased use of video display terminals (VDTs) predisposes to variety of health problems restricted not only to visual problems but also include various musculoskeletal problems, collectively known as digital eye strain (DES) or computer vision syndrome.[7] American Optometric Association defined computer vision syndrome as "a complex of eye and vision problems related to activities, which stress the near vision and which are experienced in relation or during the use of the computer".[8] Symptoms related to CVS have been divided as: (i) symptoms related to ocular-surface like dry eye, excessive watering, eye irritation (ii) Asthenopic-eye fatigue, eye strain, sore eyes (iii) Visual related problems like double vision, difficulty in focus change, blurred vision (iv) Extra ocular symptoms including back, neck pain and headache.[9]

The massive increase in digitalization during this pandemic has predisposed million of the individuals around the globe to increased risk of Digital eye syndrome. As pandemic escalated quickly without any prior warning there was little reaction time available for preparedness and other mitigation measures. Under such unanticipated circumstances digital eye syndrome may turn up as an emerging public health issue which can be responsible not only for substantial health problems but might have significant economic impact also and its deleterious consequences may continue even when pandemic is over.

The objective of this study was to determine the frequency of computer vision syndrome and its associated risk factors among under graduate medical students during COVID-19. This study would provide baseline data to public health professionals to devise effective strategies to mitigate this emerging public health issue.

METHODS

A cross-sectional survey was conducted from 5th August to 28th August, 2020 after seeking ethical approval from university ethical review board. Sample size was calculated using WHO sample size calculator taking prevalence as 74.3% from a recent study.[10] Estimated sample size was found to be 295. However, estimated sample size was inflated to cater for non-responses and to assess a large number of participants and gather maximum possible data and enhance generalizability. Data was collected from two different medical universities to attain required sample size and statistical power.

Students within age range of 18 – 25 years, using computer since last 3 months or since educational institutes were closed due to lock down (whichever

was earlier) were selected for this study. Students with underlying systemic illness like Hypertension, Diabetes, Tuberculosis, Endocrine, metabolic disorders, Autoimmune disorders using medication having visual side effects (bisphosphonates, Cyclosporines, Tetracyclines, Hydroxychloroquine, Antituberculosis, Anticholinergics), topical eye drops were excluded.

The study participants were asked about the presence of symptoms of CVS during the previous 3 months or since the closure of academic institutions. Symptoms of computer vision syndrome are broadly classified into four categories: i) asthenopic – sore eyes, eye strain, (ii) ocular surface related- dry eye, irritation, watering, (iii) visual – double vision, blurred vision, slowness of focus change iv) extra ocular – shoulder pain, neck pain, back ache.Symptoms that lasted for at least one week during this time period were considered as presence of symptoms of CVS.

Study was started after approval from institutional review board. The data collection was in accordance with the Helsinki declaration and according to the National ethical guidelines. Anonymity and confidentiality of data was maintained. Since the students were subjected to observe social distancing, all educational institutes were temporarily closed and routine educational activities were suspended due to lock down, the data was collected using online questionnaire which was shared electronically. Questionnaire was prepared using online Google forms and shared through social networking sites for data collection. Before filling the form, students were given brief description about the purpose of study, its objectives and brief instructions to fill the questionnaire. Students were allowed to proceed only if they agreed to participate in the survey. The students were allowed to withdraw themselves at any stage if they were not willing to proceed. There was also an option of skipping any questions if they did not feel comfortable in providing particular information.

Data collection tool was developed after extensive literature search of already published studies and according to guidelines of American Optometric Association.[11] First draft was validated by two senior faculty members, one from Ophthalmology department and other from Public Health. After initial review, draft was revised and necessary alterations were made to finalize the tool. After finalization, pilot study was carried out on 30 students to check for its understanding.

Statistical analysis was performed by SPSS 25. Mean and standard deviation was calculated for quantitative variables and for categorical variables, frequencies and percentages were estimated. Chi square test was applied to find statistical association, p-value < 0.05 was taken as significant.

RESULTS

A total of 343 students were enrolled in the study. Final analysis was run on 326 undergraduate medical students. Females were 228 (69%) and 98 (30%) were males. Age of the participants ranged between 17 to 25 years, mean age of the participants was 21.41 years. Out of total 326 students, 322 claimed that they had experienced at least one symptom of Computer vision syndrome since last three months. Overall prevalence was found to be 98.7%.

Complaints associated with computer vision syndrome are broadly classified into two categories, ocular and extra ocular (musculoskeletal) complaints. Out of 322 students affected, total 29% students experienced extra ocular complaints, out of which 43 (13%) suffered musculoskeletal complaints and 52 (16%) had headache while rest of 227 (71%) had ocular symptoms. The frequency of ocular complaints in this study included irritation of eyes 25 (7.7%), blurred vision 21 (6.4%), redness of eyes 14 (4.3%), eye strain 17 (5.2%), excessive watering 7 (2.1%), increased sensitivity to light 5 (1.5%). Most commonly employed ergonomic practice was controlling light and glare. Rest of the details of ergonomic practices are shown in Fig. 1.

Symptoms of CVS were more commonly observed among those using desktop/laptop at less than forearm length ($p = 0.001$). Distance of < 12 inches from mobile phone was found to be associated with eye irritation and neck shoulder pain ($p = 0.001$). Rest of details are shown in table 1.

Frequency of break of more than 60 minutes was found to be significantly associated with eye irritation ($p = 0.002$) and excessive blinking and light sensitivity ($p = 0.001$). The students not using ergonomically comfortable chair were found to suffer more with symptoms of CVS as compared to those using ergonomically designed chair ($p = 0.049$**)**. Details are shown in table 2.

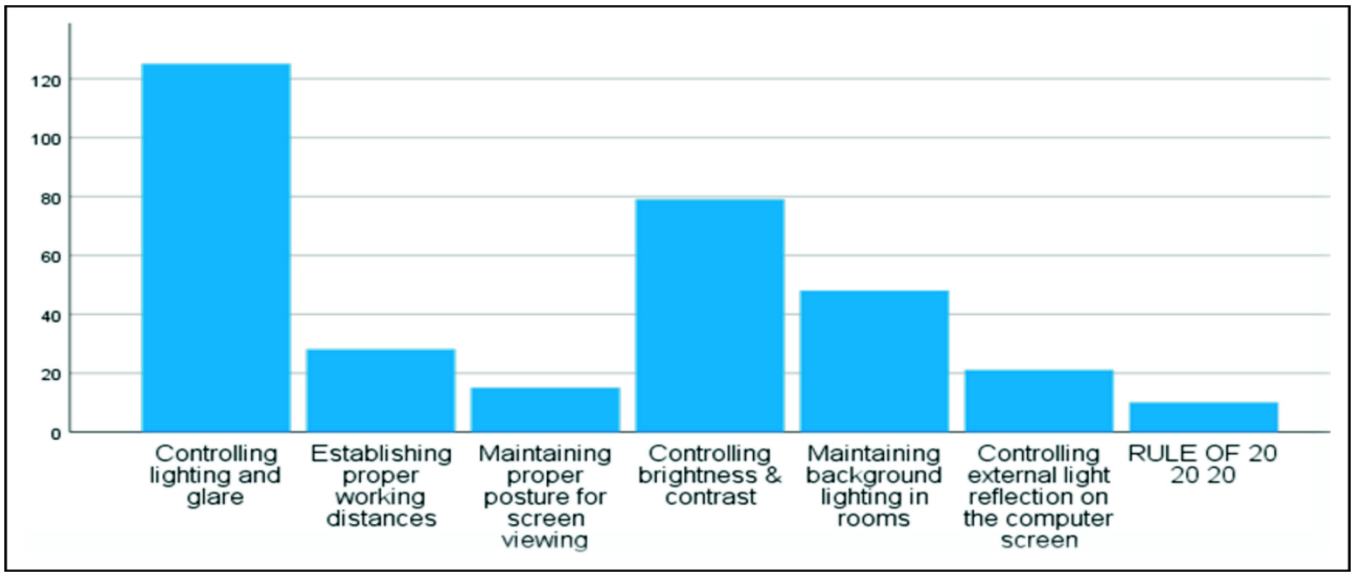

Fig. 1: Preventive strategies adapted by students during using digital devices.

Table 1: *Association of computer usage with symptoms of computer vision syndrome.*

Variable	Group	Eye Irritation	p-value	Blurring of Vision	p-value	Excessive Blinking	p-value	Sensitivity to light	p-value	Pain in Neck & back	p-value
Distance from laptop/ desktop	<forearm	182 (56)	0.001	124 (91)	0.001	143 (44)	0.418	96 (54.8)	0.001	122 (89.6)	0.890
	>forearm	143 (44)		11 (8.1)		162 (48)		62 (45.9)		158 (89.3)	
Distance from Mobile phone	<12inch	93 (68.9)	0.001	123 (91.1)	0.431	82 (59.9)	0.418	62 (45.9)	0.418	122 (90.4)	0.001
	12-16 inch	74 (42.8)		158 (91.3)		74 (42.8)		74 (42.8)		134 (79)	
	>16 inch	6 (54.5)		10 (90.9)		6 (54.5)		6 (54.5)		8 (72.7)	
Time spent in using digital device	<2 hrs	1 (16.7)	0.036	0 (0)	0.01	7 (93)	0.598	1 (16.7)	0.144	6 (98)	0.276
	2-4 hrs	19 (7.5)		1 (4.8)		34 (85)		19 (47.5)		34 (85)	
	4-6 hrs	49 (40.8)		5 (9.3)		110 (91.7)		49 (40.8)		110 (91.7)	
	6-8 hrs	83 (57.8)		21 (33.7)		79 (87.8)		43 (47.8)		79 (87.8)	
	>8 hrs	91 (67.7)		56 (86.2)		58 (89.2)		31 (47.7)		58 (89.2)	

Table 2: *Pattern of computer usage with symptoms of computer vision syndrome.*

Variable	Group	Eye Irritation	p-value	Blurring of Vision	p-value	Excessive Blinking	p-value	Sensitivity to Light	p-value	Pain in Neck & Back	p-value
Frequency of break	> 60 mins	99 (47.2)	0.002	94 (87)	0.667	182 (56)	0.001	64 (59.9)	0.001	94 (87)	0.667
	< 60 min	44 (40.5)		188 (90.4)		143 (44)		109 (52.4)		188 (90.3)	
Posture	Mostly lying	20 (33.3)	0.159	52 (86.1)	0.465	20 (33.3)	0.418	20 (45.9)	0.418	56 (93.4)	0.470
	Mostly sitting	38 (48.8)		67 (90.3)		36 (48.8)		74 (42.8)		66 (89.2)	
	Both	87 (45.5)		176 (92.1)		87 (45.5)		6 (54.5)		168 (88)	
Using ergono-mically designed station	Yes	14 (31.7)	0.049	221 (89.5)	0.429	14 (31.8)	0.045	1 (16.7)	0.044	42 (95.5)	0.667
	No	112 (45.5)		42 (95.5)		112 (45.5)		19 (47.5)		218 (88.3)	
	May be	149 (45.2)		29 (13.5)		14 (45.2)		49 (40.8)		28 (90.7)	

DISCUSSION

In this particular study, out of total 326 under graduate medical students, 322(98.7%)reported that they had experienced at least one symptom of CVS in last 3 months. This figure is remarkably high as compared to previous studies as the result of the study conducted on medical students of Karachi reported prevalence of 68%.[12] Similarly, study conducted on Government office workers of Ethiopia reported 69.5%[13], survey of university students of UAE reported 72%[14] and students of Engineering university of India reported 80.3%.[15] Other studies showed 67.4% in office workers of Sri Lanka[16] and 89.9% in Malaysian students.[17] However, report of recent study conducted in Jeddah, Saudi Arabia showed consistent results in which prevalence of computer vision syndrome was reported to be 97.3%.[18]

In most of the previous studies, there was no specification of duration or categorization of symptoms of CVS and all the symptoms even transient ones lasting less than one week were included in criteria of CVS. In our study, the participants were asked about symptoms they experienced during the previous 3 months. Symptoms lasting for at least one week were considered as symptom of CVS. This high frequency points towards the increased use of digital devices during pandemic. Possible reason for increased frequency could be that we conducted or study during COVID-19 pandemic when increased digitalization has been observed in every field of life. Students are subjected to the use these devices for long time without break as they were shifted to online teaching. There has also been increased digitalization for recreational purposes.[19]

In our study the most common symptoms of CVS in order of severity were irritation of eyes, blurred vision, redness of eyes, eye strain, excessive watering and increased sensitivity to light respectively. While in Ethiopia the commonest symptom was blurred vision, eyestrain and followed by eye irritation.[13] Results of recent study conducted in Saudi Arabia reported feeling of temporary long or short-sightedness (65%), itchy eyes (63%) and burning sensation of eyes (62%) as the most common symptoms.[20] Underlying mechanism involved in appearance of ocular symptoms during excessive use of digital devices could be the constantly changing focus. Since images and font size on computer tend to change rapidly, eye needs to focus and refocus constantly which stresses eye muscles leading to various ocular symptoms related to eye strain.[21] Reduced blink rate is also associated with asthenopic sore eyes and eye strain. It has been reported that blink rate during computer use reduces to 3.6 blinks/min as compared to normal mean blink rate i.e. 18.4 blinks/ min[11].

In our study headache was reported as the most common extra ocular symptom followed by back and neck pain due to poor posture which were also reported in previous studies.[16,17] In our study distance from both laptop/desktop (< forearm) and distance from mobile phone (<12 inch) was found to be significantly associated with CVS Symptoms. Similar results were reported by previous studies in which distance of < 20 inch was significantly associated with CVS Symptoms.[15] Moreover, American Optometric Association has also recommended the minimum viewing distance to be 20–28 inches.[11] Results of another study also showed that distance of 10 inches was associated with symptoms of CVS.[22]

In our study there was a significant association between duration of digital device usage and symptoms of CVS. These results are consistent with results of a recent study.[18] However, in contrast to this, another study showed that symptoms of CVS were not significantly associated with increased duration of use of digital device.[20] Results of previous studies also reported that more than 4 hours of digital device usage was associated with increased risk of symptoms of computer vision syndrome.[15] Similar findings are supported by American optometrist association.[11]

In our study, frequency of break more than 60 minutes was found to be significantly associated with symptoms of computer vision syndrome. Results of study conducted by Hassan et al also reported similar results.[23]

Our study also determined the use of ergonomic practices during digital work. It was found that symptoms of CVS were found pronounced among the students who were not using ergonomically designed work station. Students were only practicing control of excessive light and glare while using digital devices. Study carried out by Straker et al found consistent results.[24]

Best strategy to prevent computer vision syndrome is to limit screen time but this might not be possible in current unanticipated circumstances. Current pandemic has disrupted the long standing educational practices and elicited the need to adopt alternate online teaching strategy. It is the need of hour that we must sensitize

our students regarding detrimental health effects associated with rapid digitalization, specially students must be familiar with recommendations by American Optometrist Association for prevention of computer vision syndrome. These recommendations include keeping the Computer screen 4 – 5 inches below eye level and distancing the screen at least 25 inches, using anti-glare screen filter, calibration of the monitor to avoid excessive light and darkness and maintaining the seating position by ergonomically designed chair. It is also recommended to have a 20 seconds break to look at something 20 feet away every 20 minutes.

Limitation of this study was that it was done only in the undergraduate medical students. Other population groups were not included. Total hours of study were not considered in this study. Since data was collected using self-reported questionnaire, it can be potential source of bias. Moreover, as it was a cross sectional study so it was difficult to establish causal association between risk factors and disease. Even then, the results of our study can provide baseline data to stakeholders to devise effective strategies to reduce its rapid upsurge during pandemic.

CONCLUSION

Computer vision syndrome is highly prevalent among undergraduate medical students. Health issues related to excessive use of digital devices is alarmingly high due to the current pandemic**.** Symptoms of CVS are significantly associated with distance from digital device, less frequent break intervals and among students not following ergonomic practices. There is dire necessity to address this burning public health issue by sensitizing our young generation about deleterious health effects associated with excessive use of digital devices. There is urgent need to make an institutional policy involving all stakeholders to devise effective strategies to prevent young generation from its detrimental health effects of excessive digitalization during the pandemic.

Ethical Approval

The study was approved by the Institutional review board/ Ethical review board. **(222/GMC)**

Conflict of Interest

Authors declared no conflict of interest.

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Authors' Designation and Contribution

Khola Noreen; Assistant Professor: *Concepts, Design, Manuscript preparation.*

Kashif Ali; Consultant Ophthalmologist: *Literature search, Data analysis.*

KausarAftab; Assistant Professor: *Data acquisition, Statistical analysis.*

Muhammad Umer; Professor: *Manuscript editing, Manuscript review.*