International Journal of Public Health Science (IJPHS)
Vol. 12, No. 4, December 2023, pp. 1727~1735
ISSN: 2252-8806, DOI: 10.11591/ijphs.v12i4.22689

Computer vision syndrome among university students during the corona virus pandemic

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Article Info

Article history:

Received Nov 7, 2022
Revised Aug 23, 2023
Accepted Sep 14, 2023

Keywords:

Computer vision syndrome
COVID-19 pandemic
CVS
Major complaints
University students

ABSTRACT

Computer vision syndrome (CVS) is a group of eye and visual problems related to computer use and it is associated with near work. The aim is to determine CVS prevalence, major complaints and main preventive practices among the University of Jordan students after the COVID-19 pandemic era. We conducted a cross-sectional descriptive study using an online pre-tested structured questionnaire. Each participant completed the questionnaire before and after the COVID-19 pandemic and the results were compared. A total of 634 students were included in the study. A high prevalence of CVS was observed after the COVID 19 era. The most significant risk factors for the presence of CVS before and after the pandemic were daily hours use of E-device for studying ($p<0.001$) and the use of glasses or contact lens ($p<0.05$). Brightness adjustment, keeping sufficient distance away from the device, taking breaks, increasing the screen font size and using eye drops were the most significant preventive measures taken by students before and after the pandemic ($p<0.05$). It is a necessity to raise awareness among students regarding computer related health problems and preventive measures need to be adopted to address the risk factors.

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1. INTRODUCTION

Computer vision syndrome (CVS) is defined as a range of eye and vision-related problems that result from prolonged use of digital screens according to the American Optometric Association [1]. CVS symptoms occur when there is a need to increase the visual demand to a level that is beyond visual ability [2]. The image on the screen requires higher visual demand compared to printed images as the margins are not well demarcated and depend on the resolution, the background contrast, and the glare of the screen [3], [4]. Furthermore, decreased blinking during staring at the screen, which increases dry eyes, is a major contributing factor to CVS. As a result, managing dry eye is essential in order to minimize the symptoms of CVS [4], [5]. The use of lubricating eye drops has provided some eye relief in computer users; however, the symptoms were not completely resolved [6]. Nevertheless, the recurrence and severity of symptoms may necessitate an optometrist review and detailed assessment [7]. Other factors like the duration of usage, taking breaks, distance from the screen, screen brightness, and sitting posture were considered known risk factors of CVS [8]. This group of complaints increased in prevalence among computer users. The most commonly reported symptoms were eyestrain, headache, blurred vision, dry eyes and shoulder, and neck pain [1].

Simple ergonomic strategies can alleviate or prevent many of the CVS symptoms. Taking regular short breaks from the computer screen was the most effective practice in multiple studies [8], [9], adjusting brightness based on the surrounding illumination was the most helpful and common preventive measure in a study conducted on medical students in Saudi Arabia, followed by taking multiple breaks and sitting while the digital screen is on the face level [10].

Despite the fact that most CVS symptoms are transient, some computer workers experience long term visual difficulty and a decrease in their productivity by 40% caused by eye and musculoskeletal discomfort [11]. The prevalence of CVS among computer users in the general population reached as high as 68.5% [3], a higher prevalence was reported among university students (90%) [4], [5]. Since the first spread of the coronavirus at the end of 2019, a large number of universities programs in Jordan and all over the world have been transformed to online learning, which may demand a prolonged use of different E-devices along with new users compared to the pre-pandemic numbers [9], [12].

There is a lack of studies that focus on evaluating and discussing CVS among university students in the Middle East especially in Jordan after the coronavirus pandemic (COVID-19), the aim of the study is to determine the disease prevalence, major complaints, and main preventive practices among the University of Jordan students from all colleges and departments after the pandemic and to compare the prevalence, major symptoms and, major preventive measures before and after the pandemic.

2. RESEARCH METHOD

We conducted a cross-sectional descriptive study aiming to determine the prevalence of CVS, major complaints, and main preventive measures among the University of Jordan students from all colleges and departments after the COVID-19 pandemic era in comparison to the last year before the pandemic. The study was approved by the Deanship of Scientific Research at the University of Jordan and written informed consent was obtained at the beginning of the questionnaire. The study was according to the declaration of Heleniski with the Ethical approval number of 4928/2020/67. The inclusion criteria were undergraduate students who use their electrical devices during studying for at least one month prior to our study after the COVID-19 pandemic and who had experienced face to face teaching for at least one month before the pandemic.

We applied a non-probability convenience sampling technique. The participants must be current students at the University of Jordan at the time of participating in the study and students were required to verify their response using their institutional e-mail. The participants were surveyed using an electronic survey prepared from a pre-tested structured questionnaire from the literature [11]–[13]. The survey included the basic demographic profile, duration of computer uses per day, frequency of breaks while working on computers, refractive errors, using spectacle or contact lenses for vision correction, chronic illnesses and eye diseases, duration of studying using computers, seating posture and source of lightning, using antiglare screen, screen brightness, frequency of CVS symptoms before and after the pandemic, and preventive measures were taken to reduce the symptoms. CVS symptoms were categorized into ocular and extraocular symptoms. Ocular symptoms were redness, burning sensation of eye, blurred vision, dry eyes, and heaviness in the eyes, diplopia and light sensitivity after using electronic devices. Extraocular symptoms were headache and neck, back, or shoulder pain. Study subjects were asked to mark whether they had experienced none, mild (transient symptoms persist for few minutes to hours), moderate (persist for few hours and subsides after rest or sleep), or severe (needs medical consultation) visual problems during or after computer use. Participants were reassured in maintaining their confidentiality and anonymity.

Statistical analysis was performed using the IBM SPSS program version 26. The analysis included finding frequency, percentages, charts, cross tabulations, Likert relationships, Chi-square, and Wilcoxon rank-sum test. Simple descriptive statistics were presented in percentages. Comparisons were made to find relationships. A p-value of 0.05 or less was considered significant.

3. RESULTS AND DISCUSSION

A total of 634 students were included in the study after excluding 14 students who didn't meet the inclusion criteria. 18.8% (119) were males, and 81.2% (515) were females. 50.6% (321) of students were of (18-20) year age group. Medical colleges represented 40.5% (257), human colleges represented 30.6% (194) and science colleges represented 28.9% (183) of this study sample. 96.4% (611) of the students did not have any chronic diseases. 97.0% (615) of students did not have eye disease and only 3% (19) of them had dry eye disease. 42.3% (268) of students used glasses, contact lenses, or both.

A High prevalence of CVS was observed, in which 92.7% (588) reported at least one symptom of CVS during studying before COVID-19 pandemic which increased to 95.7% (607) after the pandemic

(p <0.05). The most frequently reported symptoms before the COVID-19 were neck, back, or shoulders pain 84.1% (533), headache 77.0% (488), burning sensation 67.4% (427), blurring of vision 57.7% (366), photophobia 55.7% (353), eye heaviness 54.3% (344) and eye redness 48.7% (309). The most frequent symptoms remained relatively the same but with a statistically significant increase in frequency after COVID-19 as shown in Figures 1 and 2.

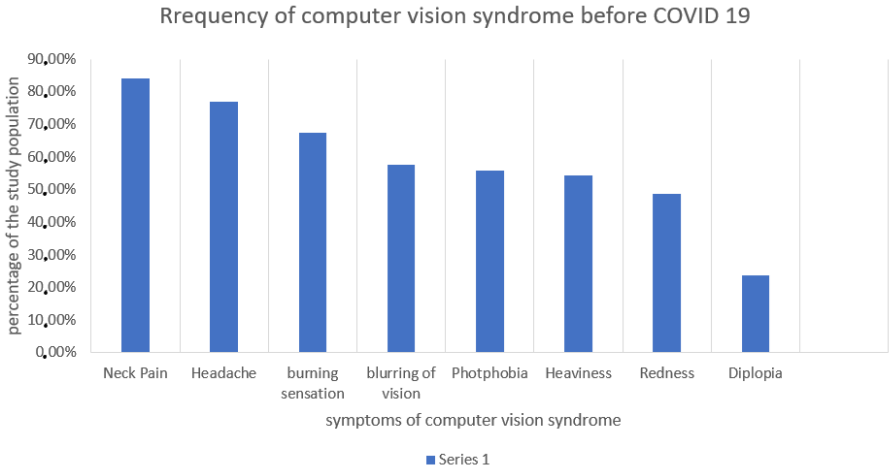

Figure 1. Frequencies of computer vision syndrome symptoms before COVID-19 pandemic

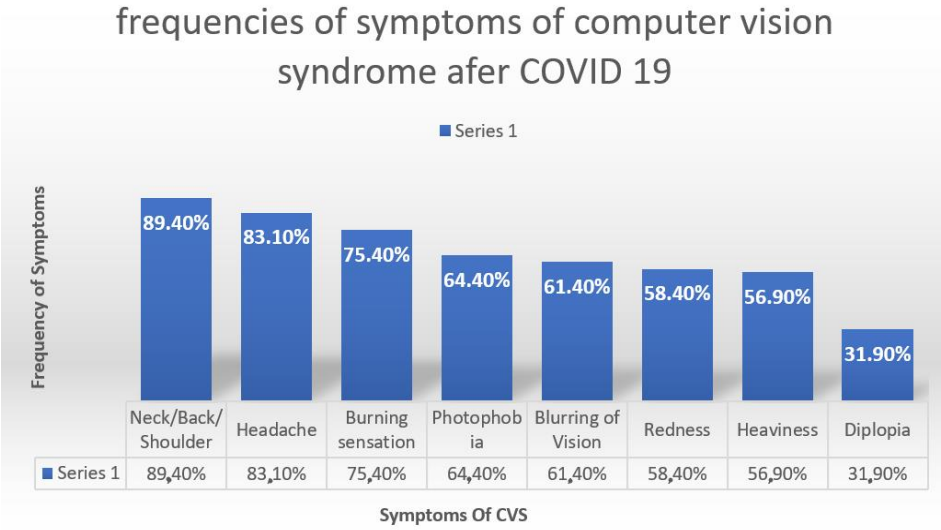

Figure 2. Frequencies of computer vision syndrome symptoms after COVID-19 pandemic

CVS is very common among university students [14], [15]. Altalhi *et al.* in their work conducted on Saudi medical students reported a nearby prevalence of 97.3% among health sciences students [10]. Bahkir and Grandee [14] found a prevalence of 90.4% of different categories of people, 36.4% of them were university students. In contrast, a study conducted in India by Logaraj *et al.* reported a prevalence of 81.9% and 78.6% in engineering and medical students respectively [11], which is lower than our prevalence due to increased duration of using E-devices among university students after starting of the COVID-19 pandemic compared to electronic hours use before the pandemic.

Association between the presence of CVS and several factors were analyzed in this study before and after the pandemic and were the same; in which the most significant risk factor was the daily hours use of E-device for studying (p<0.001) followed by use of glasses or contact lens (p<0.05). There was no statistically

significant correlation between the presence of CVS and the age group of the students, college of students, type of E-device, screen brightness, manner of use, and the presence of eye disease as shown in Table 1.

All universities and schools in Jordan and around the world turned to use E-learning instead of face-to-face classes due to the pandemic lockdown rules and continued afterward [16], [17]. Accordingly, we recognized a significant increase in daily hours of use of E-devices for studying purposes among the University of Jordan students and the world wild [18], [19]. The prevalence of using E-devices for studying for more than 4 hours daily jumps from 29.4% of university students before the pandemic to 68% after starting online learning [18]. In India, Bahkir and Grandee [14] noted a remarkable increase in using E-devices from pre-lockdown by 5 hours or more among 51.1% (208/407) of their sample, of which 40.9% (85/208) were students and 49.3% of them mostly used digital devices for studying purposes, while in UK medical students, a significant rise in the duration of screen time before and during the pandemic was found in which a prevalence of 7.35% of students who spent >15 hours per week before the COVID-19 pandemic raised to 23.56% during the pandemic ($p<0.05$) [19]. Lockdown affected school-aged children as Mohan *et al*. [20] reported an average screen time of 3.9±1.9 (range 1–9 hours) among secondary school children -who attended E-learning during the pandemic- and 36.9% of them spent >5 hours per day using E-devices.

Concerning the most frequently reported symptoms of CVS in the literature; In Malaysia, the most commonly reported complaint was headache (19.7%) followed by eye strain (16.4%). On the other hand, it was noticed that in Nigeria, tiered eyes (62.5%) were the most suffered symptom followed by blurred vision (59.4%) [16]. Eye strain was the most frequent complaint in the Kingdom of Saudi Arabia (62.14%) and İndia (97.8%) followed by burning sensation (7.57%), and headache (82.1%) respectively [10], [14], [21], [22] in Spain it was noticed that that the most frequent symptoms were itching (73.4%), difficulty focusing for near vision (72.5%) and feeling that sight is worsening (69.7%), followed by blurred vision, dryness, eye redness and increased sensitivity to light, with prevalences between 50%-57%. Less frequent symptoms were double vision and coloured halos around objects, with prevalences below 20% and that, in general, women present symptoms more frequently and intensely [1].

Table 1. Association of presence of computer vision syndrome with several factors. CL: contact lenses, PC: personal computer

Variables	Groups	Computer vision syndrome				Total	p-value
		Yes		No			
		N	%	N	%		
Age	18-21	312	97.20%	9	2.80%	321	
	21-23	246	97.20%	7	2.80%	253	>0.05
	>23	58	96.70%	2	3.30%	60	
Type of college	Medical colleges	251	97.70%	6	2.30%	257	
	Human colleges	187	96.40%	7	3.60%	194	>0.05
	Science colleges	178	97.30%	5	2.70%	183	
Use of Glass or CL	Glasses	199	99.00%	2	1.00%	201	
	Both	67	100.00%	0	0.00%	67	<0.05*
	Non	350	95.60%	16	4.40%	366	
Eye diseases	Yes	19	100.00%	0	0.00%	19	>0.05
	No	597	97.10%	18	2.90%	615	
Type of E-device	PC/Laptop	284	97.90%	6	2.10%	290	
	iPad/Tablet	64	98.50%	1	1.50%	65	>0.05
	Phone	268	96.10%	11	3.90%	279	
Brightness	<25%	161	96.40%	6	3.60%	167	
	26-50%	229	98.30%	4	1.70%	233	>0.05
	51-75%	140	98.60%	2	1.40%	142	
	76-100%	86	93.50%	6	6.50%	92	
Daily hours use for study	0	5	83.30%	1	16.70%	6	
	<1 hour	26	100.00%	0	0.00%	26	
	1-3 hours	161	94.70%	9	5.30%	170	<0.001*
	4-6 hours	228	97.90%	5	2.10%	233	
	> 6 hours	196	98.50%	3	1.50%	199	
Manner of use	Continuous	161	95.80%	7	4.20%	168	>0.05
	Intermittent	455	97.60%	11	2.40%	466	

The frequency and severity of CVS symptoms before and after the COVID-19 pandemic were studied and the increase in frequency and severity was statistically significant in all symptoms of CVS after the pandemic ($p<0.05$) as shown in Table 2. Neck pain, headache and burnibg sensation were the most frequent symptoms. The severity of all symptoms was significantly increased. Red eye, burning sensation and blurred vision were the main symptoms in which the severity worsened.

Table 2. The frequency and severity of computer vision syndrome symptoms before and after COVID-19 pandemic

Symptoms	Before COVID-19	After COVID-19				Total
		No	Mild	Moderate	Severe	N
Headache	No	92	32	21	1	146
	Mild	12	128H	68	16	224
	Moderate	3	20	159	23	205
	Severe	0	0	3	56	59
Burning sensation	No	130	57	18	2	207
	Mild	23	156	52	8	239
	Moderate	3	22	100	22	147
	Severe	0	2	7	32	41
Eye redness	No	241	49	31	4	325
	Mild	19	123	40	12	194
	Moderate	3	12	72	12	99
	Severe	1	1	1	13	16
Blurring of vision	No	216	38	10	4	268
	Mild	23	168	33	12	236
	Moderate	5	10	63	19	97
	Severe	1	3	7	22	33
Back, neck or shoulder pain	No	52	19	21	9	101
	Mild	10	113	62	23	208
	Moderate	5	18	173	29	225
	Severe	0	3	12	85	100
Eye heaviness	No	224	41	23	2	290
	Mild	41	121	41	10	213
	Moderate	7	19	64	9	99
	Severe	1	4	9	18	32
Diplopia	No	412	53	14	5	484
	Mild	19	62	15	8	104
	Moderate	1	4	23	5	33
	Severe	0	1	2	10	13
Photophobia	No	206	56	16	3	281
	Mild	18	132	43	10	203
	Moderate	2	19	62	17	100
	Severe	0	2	5	43	50

Daily hours use of E-device for studying were analyzed and there was a statistically significant increase in daily hours of use after COVID-19; 4.29 hours per day compared to 2.62 hours of daily use Before COVID-19 ($p<0.05$). Before and after the pandemic, students used the computer and the digital screen for studying and for other use, all the hours spent on digital screens and computers were increadead with most users had a between 1 and 3 hours with an average of on hour and 40 minutes. However, some users expiereinced more than 6 hours of increase use.

Concerning the preventive measures taken by students during studying using computers before the COVID pandemic and the presence of computer vision syndrome; students adapted many measures. The majority of students adjusted the brightness during studying (61.5%) and 50.3% of students took breaks during studying. About one third 32.3% kept a sufficient distance away from the E-device, and one third 32.0% used eye drops. Less frequent measures found in 22.9% was sitting while the top of the screen at their eyes level, and 20.8%increased the screen font size. However only 12.5% did nothing, 10.7% visited a doctor and 8.7% used an anti-glare screen as shown in Figure 3. After the start of the pandemic students almost usec the same measures where brightness adjustment and keeping sufficient distance away from the device were the most frequently used measures in which two third of students used theses measures. Taking breaks was performed in more than the half while increasing the screen font size in 25.2% and using eye drops was more freguently used. All these measers were significantly related to the presence of CVS ($p<0.05$). Other measures (i.e., using anti glare screens, sitting while the top of the screen is at the eye level, seeing a doctor and doing nothing) showed no significant association with presence of CVS ($p>0.05$) as shown in Table 3.

Many proper strategies in the workplace can decrease or prevent symptoms of CVS. These preventive measures included environmental factors modification [23]–[25]. Lighting and anti-glare screens; using proper blinds, or adjusting room arrangement helps to get an acceptable level of lighting to minimize visual fatigue [26], [27]. Moreover, using screen glare filters for modifying room lights is not applicable as a valuable option [28]. These filters decline the amount of light reflected from screens as screen brightness was associated with developing CVS [29], [30]. A study conducted at King Abdul-Aziz University, Saudi Arabia, reported that a higher brightness level was statically and significantly correlated with increased eye sensitivity to light [21]. Our study confirmed that adjusting screen brightness was the most significant preventive measure of CVS

(p<0.05), as most Jordan University students (61.5%) adjust brightness during studying while 8.7% of them use anti-glare screen filters.

Considering workstation position; it was recommended that eyes should be about 35-40 inches away from the screen, to relax the eyes and reduce the strain; and it was preferred to place the screen 10-20 degrees below, or keep the middle of the screen 5-6 inches below eyes level to reduced musculoskeletal and visual discomfort [19], [26]. In our study, 32.3% of students kept sufficient distance from E-devices and 22.9% of them sit while the top of the screen was at their eyes level. We found a statically significant correlation between keeping sufficient distance away from the E-device and prevention of CVS symptoms (p<0.05). Taking regular small breaks during the work with E-devices, helps in reducing the frequency of CVS symptoms, simply by considering the 20-20-20 rule (take 20 seconds break to view something 20 feet away after 20 minutes of digital use) [20], [27]. It was shown that the most statically significant risk factor for CVS was the duration of studying with E-devices [10], [21]. This was consistent with our study, in which taking regular small breaks through studying with digital devices was one of the most significant preventive methods as reported by 50.3% of the University of Jordan students. Keeping the eyes moist by frequent blinking, or applying lubricating eye drops (artificial tears) are important preventive measures [2], [19]. In our study, 33% of students use eye drops as a significant relieving factor for CVS symptoms.

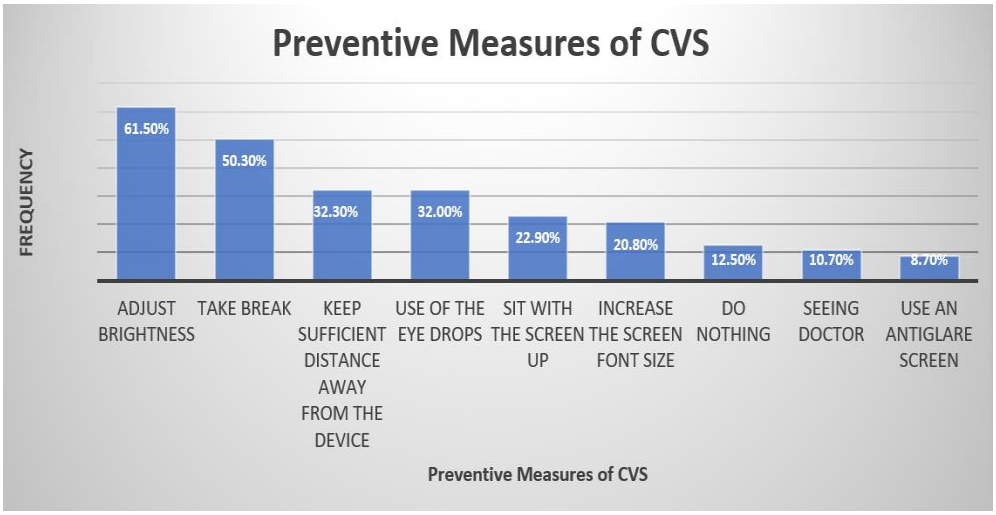

Figure 3. Frequencies of preventive measures of computer vision syndrome

Table 3. The association between preventive measures taken by students during studying using E-devices after COVID-19 and computer vision syndrome

Variables	Groups	Computer vision syndrome				Total	p-value
		Yes		No			
		N	%	N	%		
Brightness adjustment	Yes	388	99.50%	2	0.50%	390	<0.05*
	No	228	93.40%	16	6.60%	244	
Keeping sufficient distance away from the device	Yes	205	100.00%	0	0.00%	205	<0.05*
	No	411	95.80%	18	4.20%	429	
Taking Breaks	Yes	318	99.70%	1	0.30%	319	<0.05*
	No	298	94.60%	17	5.40%	315	
Increasing the screen font size	Yes	132	100.00%	0	0.00%	132	<0.05*
	No	484	96.40%	18	3.60%	502	
Using an anti-glare screen	Yes	55	100.00%	0	0.00%	55	>0.05
	No	561	96.90%	18	3.10%	579	
Sitting while the top of the screen is at your eyes level	Yes	144	99.30%	1	0.70%	145	>0.05
	No	472	96.50%	17	3.50%	489	
Using eye drops	Yes	202	99.50%	1	0.50%	203	<0.05*
	No	414	96.10%	17	3.90%	431	
Seeing Doctor	Yes	68	100.00%	0	0.00%	68	>0.05
	No	548	96.80%	18	3.20%	566	
Do nothing	Yes	79	100.00%	0	0.00%	79	>0.05
	No	537	96.80%	18	3.20%	555	

4. CONCLUSION

Our study shows CVS is very common with 95.7% of students complained of at least one symptom of CVS during studying with E-devices. The prevalence and frequency of all CVS symptoms increased during and after the COVID-19 pandemic, which is linked with the sudden increase in daily hours of use of E-devices for studying during online learning as compared with the results before the pandemic. The development of CVS is associated significantly with the following risk factors: longer duration of computer use, higher screen brightness, not taking breaks not using lubricant eye drops, and small screen front size. The widespread use of E-devices for online learning in universities after the COVID-19 pandemic warrants actions to raise awareness about CVS and preventive measures as CVS-related symptoms reduce productivity.

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