ORIGINAL ARTICLE

Computer Vision Syndrome: Prevalence and Associated Risk Factors among Undergraduates in a Tertiary Institution in North western Nigeria

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ABSTRACT

Background: Computers and other visual display devices have become essential in the present era and have led to a rise in computer-related health problems. Using computers in homes, universities and other institutions has increased output greatly but has also led to an increased risk of developing Computer vision syndrome (CVS). **Objectives**: To determine the prevalence and risk factors associated with computer vision syndrome among undergraduates. M**ethodology**: A cross-sectional study was conducted among153 respondents who were selected using a multi-stage sampling technique. A pretested, structured, interviewer-administered questionnaire was used to collect data. SPSS version 23 was used to analyze the data. A Chi-square test was used to determine the relationship between CVS and associated risk factors at a P-value of <0.05. **Results**: The mean age of respondents was 22.4 ± 3.4 years. The prevalence of CVS in this study was 83 (54.3%). The common symptoms experienced among the respondents were headache (51, 61.4%), eye strain (48, 57.8%) and blurred vision (42, 50.6%). The risk factors significantly associated with CVS in this study were duration of computer use, hours of computer use per day, level of a computer screen and taking breaks during computer use. **Conclusion**: About half of the students in this study had at least one symptom of CVS. Therefore, awareness of CVS should be created by the institution during which students would be educated on CVS and its prevention.

Key words: *Computer vision syndrome, Prevalence, Risk factors, Undergraduates.*

INTRODUCTION

With the advent of modern technology, the use of computer devices and gadgets has almost become indispensable in every aspect of life.[1] These devices are considered a necessity of the 21st century. They are not only being used in workplaces and academic institutions but also recreational places and homes.[1] University students are using computers for studies and research work and also for watching movies, playing computer games and online chatting.[2] In recent years, other devices have been added to computer use, these include tablets, e-readers and smartphones that are characterized, among others, by being lightweight and therefore more portable than computers. All of these devices have a backlit screen and are referred to jointly as video display terminals (VDTs).

In the present era of prolonged computer use, there has been a rapid upsurge in computer-related health problems. Globally, it has been estimated that 60 million people experience computer vision syndrome and approximately a million new cases occur each year.[1,3,4] It has also been estimated that the prevalence of CVS ranges from 64% to 90%

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among computer users.[4] CVS is a group of eye and vision-related problems that occur due to prolonged computer usage. [5] The condition of a person experiencing one or more eye symptoms as a result of operating a computer is generally referred to as CVS. [2] CVS is caused by the constant effort it takes for the eyes to focus when viewing a computer screen. Unlike printed text in a book, the images on a computer screen are made up of small characters called pixels. Since pixels do not have sharply defined edges or background contrast, the eyes cannot focus the images automatically. Continually, eyes drift out of their natural resting state and then strain to regain focus on the screen. This constant refocusing overworks eye muscles and, thus, causes eyestrain symptoms. Elements of screen contrast, resolution, flicker, and glare further contribute to CVS.[6] It is estimated that people who spend more than two hours on a computer every day will experience symptoms of CVS. [7] The major contributor to CVS is thought to be the visual effects of VDT such as lighting, glare, display quality, refresh rates, radiation and positioning of computer monitors. These symptoms may be experienced by up to 90% of computer users.[3,8] In contrast to the pervasiveness of computer use and the prevalence of CVS among computer users, CVS is largely unknown to professional computer users, ordinary computer users, and even many physicians.[9]

While most ministries of education in developing countries are advocating modernization of libraries, building and furnishing computer laboratories and enhancing ICT application in teaching and learning, there is not much literature on the impact of the computer on vision in developing countries, more specifically in Africa. It is also known that CVS is a worldwide problem, but in Nigeria and other African nations, there is limited evidence to prove the magnitude and risk of this problem.[10,11,12]

Therefore, this study aimed to determine the prevalence and risk factors associated with computer vision syndrome among undergraduates in Ahmadu Bello University, Zaria.

MATERIALS AND METHOD

Ahmadu Bello University, Zaria was established on 4th October 1962 following the enacted legislation of northern Nigeria. It has 2 campuses namely; Congo and Samaru campus. It has 13 faculties, 83 departments, a post-graduate school, 5 institutes, 6 specialized centres, a division of Agricultural Colleges, a school of General and Remedial studies, a Demonstration Secondary School, a Staff Primary School, 3 organized extensions and consultancy services.[13] The university has an institute of computing and Information and Communication Technology (ICT) centre which facilitates delivery of high-speed internet and intranet access suitable for e-learning services, online applications and multimedia communication services.[13]

A descriptive cross-sectional study was conducted between July and August 2017, with the study population being undergraduate students of ABU who had used a computer for at least one year before this study. The sample size for the study was determined using the formula[14] $n = [Z^2pq]/d^2$. Where p is the proportion of students who had CVS in a previous study $(0.899)^2$. The final sample size was 153 after adding 10% for non-response. A multistage sampling technique was used to select respondents.

A multi-stage sampling technique was used in this study. Four faculties were randomly selected by balloting after labelling all the faculties numerically from 1 to 13. Faculties of Art, Life Sciences, Engineering and Medicine were selected. From each selected faculty, simple random sampling by balloting was used to select 3 departments after labelling the department numerically. Three levels in each of the selected department were selected by simple random sampling by balloting. Eligible students from each faculty were selected using proportionate sampling. A total of 13 questions on symptoms of CVS were asked and all students that had symptoms of CVS either intermittently or continuously for at least one week in the last 1 year were included in the diagnostic criteria of CVS. Questions were adapted from previous studies.[1,2,4,7,11] Participants with CVS were classified into two subgroups depending on the severity of CVS:

Mild to moderate cases: Subjects having seven or fewer symptoms, with all symptoms disappearing after a short rest. [15] Severe cases: Subjects that had more than 7 symptoms and/or subjects having at least one symptom that does not disappear even after a short rest.[15]A total of 10 questions on risk factors associated with CVS was asked. Questions were adapted from previous studies.[2,16,17,18] One mark was given for any risk factor present and 0 for

the absent risk factor. Permission was obtained from the Dean of faculties of Arts, Medicine, Life sciences and Engineering before the study was conducted. Information about the objectives of the study was provided to the respondents, voluntary participation was emphasized and confidentiality of information provided was assured after which consent was sought and obtained from each of the respondents.

RESULTS

A total of 153 questionnaires were administered and all were completely and correctly filled giving a response rate of 100%. The mean age was 22.4 ± 3.4 years. Two-thirds of the respondents (93, 60.7%) were male. About a third of the respondents (56, 36.6%) were within the age group of 19 - 21 years. Most were single (143, 93.5%) and 58 (37.9%) of them were in 200 Level. About half the respondents had one or more symptom of CVS (83, 54.3 %) (Table 1). The most common ocular symptom experienced by respondents was eye strain (48, 57.8%) while headache was the most common (51, 61.4%) extra-ocular symptom (Table 2). Almost half (76, 49.7%) of the respondents had used a computer for 7 years or more. Just above half (86, 56.2%) used the computer for less than 6 hours a day. Sitting position was the most frequently assumed position when using the computer (107, 69.9%). The majority of the respondents (128, 83.7%) did not use anti-glare for their computer screen and most (144, 75%) had poor viewing distance i.e., ≤ 50cm. Most of the respondents (95, 62.1%) took breaks > 20 minutes while using the computer. About half (85, 55.6%) used the computer screen at the same level as their eyes. The majority of the respondents (110, 71.9%) didn't know how many times they blinked per minute when using a computer (Table 3). A statistically significant relationship was found between duration of computer use, hours of computer use per day, the level of the computer screen, taking breaks and the prevalence of CVS. There was no statistically significant relationship between viewing distances, blink rate, use of anti-

Table 1: Distribution of symptoms of CVS among respondents.

Number of symptoms	Frequency (n=153)	Percent (%)
No symptom	70	45.7
1	40	26.1
2	24	15.7
3	12	7.8
4	3	2.0
5	3	2.0
6	1	0.7
TOTAL	153	100

Table 2: Distribution of symptoms of respondents with CVS.

Symptom	Frequency(n=83)	Percent (%)
Ocular symptoms	42	50.6
Blurred vision	48	57.8
Eye strain	26	31.3
Eye fatigue	23	27.7
Redness of eyes	33	39.8
Watery eyes	10	12.0
Dryness of eyes	19	22.9
Double vision	30	36.1
Eye irritation	15	18.0
Burning sensation in the eye		
Extra-ocular symptoms	51	61.4
Headache	41	49.4
Neck pain	38	16.9
Shoulder pain	42	50.6
Backache		

Table 3: Risk factors associated computer vision syndrome

Variable	Frequency	Percentage
Duration of computer use (years)		
1-3	29	19.0
4-6	48	31.4
≥7	76	49.7
Hours of computer use per day		
1-3	49	32.0
4-6	37	24.2
≥7	67	43.8
Frequently assumed position		
Sitting	107	69.9
Lying	46	30.1
Anti-glare computer screen		
Use anti-glare	25	16.3
Do not use anti-glare	128	83.7
Viewing distance		
Appropriate viewing distance	38	25.0
Poor viewing distance	114	75.0
Timing of breaks		
>20 minutes after work	95	62.1
<20 minutes after work	58	37.9
Screen level		
Above eye level	26	17.0
Same level with eyes	85	55.6
Below eye level	42	27.5
Blink rate during computer use		
<15 times a minute	32	20.9
>15 times a minute	11	7.2
Don't know	110	79.1

Table 4: Relationship between computer vision syndrome and associated risk factors

Variable	CVS present	CVS absent	Test statistic
Duration of computer use (years)			
1-3	21	8	χ^2 = 2.712,
4-6	24	24	df=2, p=0.002
≥7	25	51	
Hours of computer use per day			
1-3	41	8	χ^2 =41.559
4-6	17	20	df=2, p<0.001
≥7	12	55	
Anti-glare computer screen			
Use anti-glare	7	9	χ^2=0.592
Do not use anti-glare	63	74	df=1, p=0.441
Viewing distance			
Appropriate viewing distance	24	15	χ^2=1.051
Poor viewing distance	46	68	df=2, p=0.591
Timing of breaks			
>20 minutes after work	27	28	χ^2 =4.561
<20 minutes after work	31	67	df=1, p=0.033
Screen level			
Above eye level	8	18	χ^2=8.08
Same level with eyes	36	47	df=2, p=0.0176
Below eye level	28	16	
Blink rate during computer use			
<15 times a minute	9	20	χ^2=0.344
>15 times a minute	4	6	df=2, p=0.842
Don't know	57	57	

DISCUSSION

In this study, the mean age of the respondents was 22.4 ± 3.4 years. This is similar to the mean age of 21 years from a study conducted in Malaysia and lower than the mean age of 31 years from a study in Abuja, Nigeria.[2,19] The lower mean age in this study may be because the study population is composed of university students and 83.4 % of the respondents were below 27 years whereas the study in Abuja, Nigeria was conducted among workers with 58% of them above 30 years.

In this study, the prevalence of CVS was 54.3%. This is similar to studies conducted in Brazil, Mauritius, Agartala and Kolenchery, India with a prevalence of 54.6%, 59.5%, 55.5 % and 59.5% respectively.[20,21,22,23] The prevalence from this study is however higher than a study in Zaria, Nigeria which found a prevalence of 44.8% but lower than a study in Chennai, India with a prevalence of 80.3%.[4,7] The higher prevalence in the study from Chennai, India may be because they had no specification on the duration of symptoms of CVS and therefore included even transient symptoms whereas in this study only the symptoms lasted for at least 1 week in the past year were considered as symptoms of CVS. The Zaria study did not state what parameters it used to determine the presence of CVS. The prevalence of CVS among students in this study is worrisome considering that most of them are below 27 years of age and were yet to enter the workforce. CVS is the foremost hazard affecting the workforce in the 21st century. It reduces productivity, increased error rate, reduced job satisfaction, impaired visual abilities and generally affects the quality of life.[24]

The common symptoms experienced among the respondents in this study were headache (61.4%), eye strain (57.8%) and blurred vision (50.4%). This is similar to results from the Abuja study where headache(30.9%) and eye strain(30.9%) were the common symptoms experienced.[10] A similar study in Sri Lanka reported the common symptoms as headache (45.7 %), followed by dry eyes (31.1 %).[19] The findings from this study is however in contrast to a study carried out in Iran, where the common symptoms experienced by the respondents were pain in the eyes (41%) and excessive watering (18%).[22] Because these symptoms are vague, they are likely to become severe before medical attention is sought.

In this study, those that spent seven or more hours on the computer daily recorded a higher prevalence than those that spent less time. This finding is similar to that of the study in Karachi, Pakistan which showed that the prevalence of visual symptoms was higher among individuals who spend more than four hours working on VDT.[1] Another study showed that visual complaints were reported by 75% of VDT operators working 6–9 hours in front of their screens.[25] A study in Chennai, India showed that students who were using a computer for 4-6 hours were at significantly higher risk of developing redness, burning sensation and dry eyes compared to those who use the computer for less than 4 hours.[4] A study in Ethiopia showed that respondents who used computers for > 7 hours per day were 2 times more likely to suffer from CVS as compared to those who used computers for < 7 hours per day.[18] In a study among computer users in Abuja, CVS symptoms were reported more commonly among the employees who spent 6 to 8 hours on the computer daily as compared to those who spent less time.[26] A similar trend is seen in the relationship between CVS symptoms and the hours of computer use per day. In this study, there was a statistically significant relationship between hours of computer use per day and CVS. This was also the case in the Karachi, Chennai and Ethiopian studies.[1,4,18] The duration of work on the computer is directly related to eye symptoms. Working on the computer for prolonged periods at a time results in long-lasting effects. Studies have shown that the prevalence of visual symptoms is higher among people who spend more than four hours working on video display terminals (VDTs).[10,16]

The duration of computer use was also significantly associated with CVS in this study. The respondents that used the computer for more than 7 years were more likely to develop CVS compared to those who used the computer for 7 years or less. This finding is similar to the Ethiopian and Agartala studies where there was a significant relationship between CVS and the use of the computer for more than 7years.[18,21] To prevent eyestrain, eyes should be rested when using the computer for long periods. Eyes should be rested for 15 minutes after two hours of continuous

computer use.[27] The Chennai study showed that students who took frequent breaks while using a computer were at a lower risk of developing symptoms of CVS compared to those who did not take frequent breaks.[4] In a study in Ethiopia, those working on a computer for more than 20 minutes without break were nearly 2 times more likely to suffer from CVS as compared to those taking a break within 20 minutes.[12]

In this study, there was a significant relationship between taking less frequent breaks and developing CVS. This is similar to what was found in the Chennai,[4] and Ethiopia studies, which also found a significant relationship between taking less frequent breaks and CVS.[12] This is however in contrast to a study in Sri Lanka that did not find a significant relationship between taking frequent breaks and CVS.[19]

The distance between the VDT and the eyes is a risk factor for CVS. The recommended viewing distance is between 30cm and 70cm.[26] In this study two-thirds of the respondents' viewing distance was poor. Benin, Nigeria study revealed that visual complaints were more pronounced with people employing a viewing distance of less than 10inches. Visual complaints were less for respondents employing viewing distances of 20-30inches and 30-40inches.[11]

The average person blinks 10 to 15 times per minute. The blinking rate of computer users is reduced by 60%. This reduction in blinking rate contributes to poor tear production, therefore, resulting in dry eyes.[6] Most respondents in this study did not know their blink rate per minute. This is not unexpected considering that counting blinks per minute are not something that people usually do. It takes more visual effort to view a screen compared to viewing a paper. This is because blinking is 22 times per minute while viewing a paper compared to seven blinks per minute when viewing a computer screen leading to straining of the eyes and dryness. Eye strain, as well as the other symptoms of CVS, can reduce the performance of a specific task by as much as 40%.[28]

Glare and reflections on VDT cause ocular symptoms of CVS. Using a screen glare filter decreases the amount of light reflected from the screen.[6] Only a small proportion(16.3%) of respondents in this study had anti-glare on their computer screen. The Benin study showed that Visual symptom complaints were less for respondents employing dark background VDU screen.[11]

There was a significant relationship between the level of a computer screen and CVS in this study. Respondents that viewed the computer screen below the level of the eye were less likely to develop CVS than those that viewed the computer screen above or at the same level as the eyes. This is similar to results from the Malaysia study, which revealed a significant reduction in symptoms of CVS between respondents who viewed the computer screen below eye level than those who viewed the screen at or above the eye level.[12]

Most people find it more comfortable to view a computer when the eyes are looking downward. Optimally, the computer screen should be 15 to 20 degrees below eye level (about 4 or 5 inches) as measured from the centre of the screen.[27] A study conducted among university students in Malaysia, showed a significant reduction in symptoms of CVS between students who viewed the computer screen below eye level than those who viewed the screen at or above the eye level.[2]

There is no proof as at yet that CVS causes permanent damage, but may cause a reduction in work accuracy and this can reduce productivity by as much as 40%. This is not enough to discourage the use of computers. On the contrary, it should be encouraged to keep up with the fast-moving world of technology, research and science.[12]

CONCLUSION

The prevalence of CVS in this study was 54.3% with the common symptoms experienced among the respondents being headaches, eye strain and blurred vision. The risk factors significantly associated with CVS in this study were duration of computer use, hours of computer use per day, level of the computer screen and taking breaks during computer use. CVS is preventable. The university authorities should carry out health education programmes to educate students on CVS, including its risk factors and its prevention.

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