ORIGINAL ARTICLE

PRACTICE OF ERGONOMIC PRINCIPLES AND COMPUTER VISION SYNDROME (CVS) AMONG UNDERGRADUATES STUDENTS IN CHENNAI

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ABSTRACT

Background: With increasing use of computers by young adults in educational institutions as well as at home there is a need to investigate whether students are adopting ergonomic principles when using computers.

Objective: To assess the practice of students on ergonomic principles while working on computers and their association with the symptoms of Computer Vision Syndrome (CVS).

Methodology: A cross-sectional study was conducted among the undergraduate students using pre-tested structured questionnaire on the demographic profile, practice of ergonomic principles and symptoms of CVS experienced while on continuous computer work within the past one month duration.

Results: Out of 416 students studied, 58% of them viewed computer at a distance of 20 to 40 inches, 61 % viewed the computer screen at the same level, 42.8% placed the reference material between monitor and key board, 24.5% tilted screen backward and 75.7% took frequent breaks to prevent CVS. Students who viewed the computer at a distance of less than 20 inches, viewed upwards or downwards to see the computer, who did not avoid glare and did not took frequent breaks were at higher risk of developing CVS. Students who did not used adjustable chair, height adjustable keyboard were at higher risk of developing neck and shoulder pain.

Conclusion: The students who were not practicing ergonomics principle and did not check posture and make ergonomic alteration were at higher risk of developing CVS.

Keywords: Ergonomic principles, computer vision syndrome, undergraduate students.

INTRODUCTION

The use of computers has become universal. Computer technology plays an integral role in our personal, professional and educational lives.[1] With increasing use of computers by young adults in educational institutions as well as at home there is a need to investigate whether students are adopting ergonomic principles when using computers. Recent studies have reported the most frequently occurring health problem among computer users are Computer Vision Syndrome (CVS)[2-5] ,wrist and shoulder pain and overuse syndrome to musculoskeletal injuries.[6,7] The American Optometric Association defines computer vision syndrome as a complex of eye and vision problems related to the activities which stress the near vision and which are experienced in relation, or during the use of the computer.[8] The main ocular symptoms reported among computer workers are eye strain, irritation, burning sensation, redness, blurred vision and double vision.[8] At present very little research has been conducted on health and safety issues associated with computer use among college students. To fill up this gap, this research was undertaken to study the practice of ergonomic principles while working on computer and the association of current practices and vision related ocular discomfort among undergraduate students.

METHODOLOGY

A cross-sectional study was conducted among the undergraduate students of a private university, a higher education institution situated in the sub-urban area of Chennai comprising of final year Medical and Engineering (Computer science and Information technology) students. The inclusion criterion was all those students who were using computer in the last one month from the date of the study. Institutional ethical clearance was obtained and all those students willing to participate on the day of visit to the college were included in the study. The participants were surveyed using pre-tested structured questionnaire which include the demographic profile, practice of ergonomic principles while working on computer(viewing distance, positioning of screen, avoiding glare, frequent breaks,

place of reference materials, posture check etc.) and symptoms of CVS experienced while on continuous computer work either at college or at home within the past one month duration. The eye symptoms were redness, burning sensation of eye, headache, blurred vision, dry eyes, neck and shoulder pain. They were asked to mark whether they had none, mild, moderate to severe vision problems they experienced during and related to computer use. The data was analyzed with the help of Microsoft excel and SPSS version 17. The descriptive data were presented as percentages, unadjusted odds ratio to measure the strength of association and 95% confidence interval were calculated. The chi-square test of significance was used for analyses of categorical variables.

RESULTS

A total of 416 final year students were included in the study based on the inclusion criteria, of which 201 (48.3%) belonged to medical stream while 215 (51.3%) belonged to the engineering stream. In the population studied, 198 (47.6%) were females while 218(52.4%) were males. Of the total 176(42.3%) students who were wearing either spectacle or contact lens, 127(72.2%) of them were wearing only spectacle, 43(24.4%) were wearing both contact lens and spectacle and 6(3.4%) were wearing only contact lens. The assessment of the magnitude of the symptoms of CVS showed 78(18.7%), 157(37.8%), 184(44.2%), 101(24.3%), 102(24.5%) and 255(61.3%) of the students reported to have redness, burning sensation, headache, blurred vision and neck and shoulder pain respectively.

Table.1 depicts the practice of the students on ergonomics principles while working on computers and its association with CVS. Nearly 58% of the students reported they practice a viewing distance of between 20 and 40 inches. On studying the association of viewing distance and symptoms of CVS experienced, students who were viewing the computer at a distance of less than 20 inches were at higher risk developing burning sensation [OR=1.5], headache [OR=1.2], blurred vision [OR=1.6] and dry eyes [OR=1.4] compared to students who were viewing computer at a distance of more than 20 inches. Assessment of the way of viewing computer screen revealed that 61.1 % looked at the screen at the same level, 10.3% look upward and 28.6% looked downwards. Students who were looking upwards were at higher risk of developing all the symptoms of CVS, redness (OR=1.3), burning sensation (OR=1.7), headache (OR=1.5), blurred vision (OR=3.1) and dry eyes (OR=1.9) compared to the students looked at the same level. Students who look downwards were at higher risk of developing redness (OR=1.5), burning sensation (OR=2.1) and headache (OR=1.4) and not for blurred vision (OR=0.9) and dry eyes (OR=0.9) compared to the students looked at the same level.

Table 1: Practice of ergonomics principles while working on computers & CVS

Practices	Total (n=416)	Redness		Burning sensation		Headache		Blurred vision		Dry eyes	
		Yes	OR 95%CI P value	Yes	OR 95%CI P value	Yes	OR 95%CI P value	Yes	OR 95%CI P value	Yes	OR 95%CI P value
Computer viewing distance											
20-40 inches	244 (58.7)	45	1.04	83	1.5	103	1.2	51	1.6	54	1.4
10-20 inches	172 (41.3)	33	0.6-1.7 0.8	74	1-2.2 0.06	81	0.8-1.8 0.3	50	1-2.4 0.05	48	0.9-2.1 0.2
Screen viewing											
Same level	254 (61.1)	42	1	80	1	104	1	56	1	60	1
Up ward	43 (10.3)	9	1.3 0.6-3 0.4	19	1.7 0.9-3.3 0.1	22	1.5 0.7-2.9 0.2	20	3.1 1.6-6 0.001	16	1.9 1-3.8 0.06
Downward	119 (28.6)	27	1.5 0.9-2.5 0.2	58	2.1 1.3-3.3 0.001	58	1.4 0.9-2.1 0.2	25	0.9 1-3.8 0.8	26	0.9 0.5-1.5 0.7
Avoided glare											
Yes	250 (60.1)	47	1	91	1.2	112	0.9	55	2.5	56	1.3
No	166 (39.9)	31	0.6-1.6 0.9	66	0.8-1.7 0.5	72	0.6-1.4 0.8	120	1.7-3.7 .0001	46	0.8-2.1 0.2
Used anti glare screen											
Yes	86 (20.7)	14	1.2	30	1.2	40	0.9	25	0.7	23	0.9
No	330 (79.3)	64	0.7-2.3 0.5	127	0.7-1.9 0.5	144	0.5-1.4 0.6	76	0.4-1.2 0.2	79	0.5-1.5 0.6
Frequent breaks											
Yes	315 (75.7)	56	1.3	114	1.3	136	1.2	75	1.1	69	1.7
No	101 (24.3)	22	0.7-2.2 0.4	43	0.8-2.1 0.2	48	0.81.9 0.4	26	0.71.9 0.7	33	1.12.8 0.02
Positioning of computer											
Tilt screen backward	103 (24.7)	19	1.0	46	0.7	47	0.9	30	0.7	22	1.3
Tilt screen straight or forward	313 (75.3)	59	0.6-1.8 0.9	113	0.4-1.1 0.1	137	0.6-1.5 0.7	71	0.4-1.2 0.2	80	0.7-2.2 0.4

(Mild, moderate and severe cases amalgamated)

Table 2: Association between practices and neck and shoulder pain

Practices	Total (n=416)	Neck & shoulder pain		OR	95% CI	P value
		Present	absent			
Screen viewing						
Same level	254(61.1)	118	136	1	-	-
Upward	43(10.3)	29	14	2.4	1.2-4.7	0.01
Downward	119(28.6)	29	90	0.4	0.2-0.6	0.0001
Placed reference material						
Between monitor & key board	178(42.8)	113	65	1	-	-
Above the monitor	28(6.7)	13	15	0.5	0.2-1.1	.08
Sides of the monitor	210(50.5)	128	82	0.9	0.6-1.4	0.6
Use of adjustable chairs						
yes	256(61.5)	146	119	1	-	-
No	160(38.5)	104	42	2.0	1.3-3.1	.001
Use of adjustable key						
Yes	185(44.5)	106	86	1	-	-
No	231(55.5)	139	75	1.5	1.1-2.2	0.04

(Mild, moderate and severe cases amalgamated)

About 24.5% of the students said they tilted screen backward to get proper lighting and to avoid glare. Students who did not do any computer adjustments to avoid glare while working on computer were at greater risk of developing blurred vision [OR=2.5], burning sensation [OR=1.2] dry eyes [OR= 1.3] compared to students who did some adjustments to avoid glare. About 20.7% of the students were using antiglare screening. Risk of developing symptoms of redness [OR=1.2] and burning sensation [OR=1.2] was marginally higher for those students who did not use anti-glare screen compared to those used but it was not statistically significant. Nearly 75.7% of the students said they use to take frequent breaks (every one hour). Students who did not took frequent breaks (every one hour) were at higher risk of getting redness [OR=1.3], burning sensation [OR=1.3] headache [OR=1.2] blurred vision [OR=1.1] and dry eyes [OR=1.7] compared to students who took frequent breaks.

Table 2 depicts the practice of the students on ergonomics principles while working on computers and its association with neck and shoulder pain. Around 61% of the students were viewing at the same level to see the computer. On studying the association of screen viewing and neck and shoulder pain, students who look upwards to see the computer screen were at higher risk [OR=2.4] than the students who look at the same level to view the computer screen and was statistically significant[p=0.01]. Students who look downwards to see the computer screen were at lesser risk of CVS [OR= 0.4] than the students who look at the same level to view the computer screen and it was statistically significant [p=0.0001]. Nearly 50.5 % of the students had a habit of keeping the reference material on the sides of the monitor and 42.8% had a habit of keeping the reference material between the monitor and key board. Students who kept reference material above the monitor [OR=0.5] and sides of the monitor [OR=0.9] were at lesser risk of neck and shoulder pain compared to students who kept the reference material between monitor and key board monitor**.** About 61.5% of the students used adjustable chair. Risk of developing neck and shoulder pain was higher among students who did not use adjustable chair while working on computer [OR= 2.0] compared to students who used adjustable chair and it was statistically significant [p = 0.01]. Nearly 44.5% of the students had the habit of using height adjustable key boards. Risk of developing neck and shoulder pain was higher among students who did not use height adjustable key board while working on computer compared to students who used [OR=1.5]and it was statistically significant[p=0.04].

Table 3: Practice of posture check while working on computer

Posture practice	Yes	No
Thigh horizontal		
Medical (n = 201)	149 (74.1)	52 (25.9)
Engineering (n = 215)	149 (69.3)	66 (30.7)
Total	**298 (71.6)**	**118 (28.4)**
Feet on floor or on foot rest		
Medical (n = 201)	142 (70.6)	59 (29.4)
Engineering (n = 215)	146 (68.0)	69 (32.0)
Total	**288 (69.2)**	**128 (30.8)**
Lower leg kept vertical		
Medical (n = 201)	119 (59.2)	82 (40.8)
Engineering (n = 215)	109 (50,7)	106 (49.3)
Total	**228 (54.9)**	**188 (45.1)**
Arms and forearms at right angle		
Medical (n = 201)	134 (66.6)	67 (33.4)
Engineering (n = 215)	125 (58.1)	90 (41.9)
Total	**259 (62.3)**	**157 (37.7)**
Wrist rest on keyboard		
Medical (n = 201)	127 (63.2)	74 (36.8)
Engineering (n = 215)	148 (68.9)	67 (31.1)
Total	**275 (66.1)**	**141 (33.9)**

Values in the parenthesis indicate percentage

Table.3 depicts practice of posture check while working on computer. Nearly 71.6% and 69% of students kept

their thighs horizontal and their feet resting on floor respectively while working on computer. Students who kept their lower leg vertical were 54.9%, arms and forearms at right angle were 62.3% and wrist rest on key board were 66.1%. The practices of posture check while working on computer revealed that equal proportion of medical and engineering students did postural check while working on computer.

Table 4: Practice of ergonomics alteration in work stations

Posture practice	Yes	No
Use of easily adjustable chair		
Medical (n = 201)	121 (60.2)	80 (39.8)
Engineering (n = 215)	135 (62.8)	80 (37.2)
Total (416)	**256 (61.5)**	**160 (38.5)**
Use of height adjustable key board		
Medical (n = 201)	85 (42.3)	116 (57.7)
Engineering (n = 215)	115 (53.5)	100 (46.6)
Total (416)	**185 (44.5)**	**231 (55.5)**
Use of a document holder		
Medical (n = 201)	54 (26.9)	147 (73.1)
Engineering (n = 215)	48 (22.3)	167 (77.7)
Total(416)	**102 (24.5)**	**314 (75.5)**
Use of anti glare screen		
Medical (n = 201)	41 (20.4)	160 (79.6)
Engineering (n = 215)	45 (20.9)	170 (79.1)
Total (416)	**86 (20.7)**	**330 (79.3)**

Values in the parenthesis indicate percentage

Table.4 depicts practice of ergonomics alteration in work stations. The students who used easily adjustable chair were 61.5% and had used height adjustable keyboard were 44.5%. Only 24.5% and 20.7% used document holder and anti-glare screen respectively. In both the medical and engineering students there were no differences in proportion students who practices of ergonomics alterations in work station while working on computers. Use of adjustable chair 60.2% and 62.8, Use of height adjustable key board 42.3% and 53.5%, use of a document holder 26.9% and 22.3%, and use of anti glare screen 20.4% and 20.9% among medical and engineering students respectively**.**

DISCUSSION

The present study on the practice of ergonomics principles among undergraduate students revealed 80.3% of them had any one of the symptoms of computer vision syndrome. Similar findings were reported by other investigators Richa talwar et al 76% among computer professional in Delhi.[9] Iwakiri et al reported 72.1% among office workers in their self reported survey were having eye strain and/or pain[10] and Sen and Richardson reported even higher prevalence of 46% to 87% of various eye symptoms among their respondents.[5]

Viewing distance and CVS: The assessment of practice of the students on the correct use of ergonomics principles while working on computer revealed only 58.7% of them were practicing the ideal viewing distance of 20 to 40 inches. Stella C. et al reported in her study 26.2%, of respondents employ a viewing distance of 20-30inches. Jaschinski reported in his study the participants preferred viewing distances was between 60 and 100 cm.[11] Taptagaporn et al. based on their study, recommended viewing distance of 50 to 70 cm.[12] Kanitkar K in his recent studies demonstrate that farther placement of the monitor (90 to 100 cm) may produce even fewer symptoms. [13] Studies have shown that computer users tend to prefer to view monitors at distances of 70 to 90 cm.[11,14] In our study those students who view at distance of less than 50 cm were at higher risk of developing CVS and it was statically significant only for blurred vision.

Screen viewing and CVS: In our study nearly one third of them said they looked downward to view the screen, 61% of them said at the same level and 10% said upward. In our study increased odds ratio was seen for all the symptoms of CVS among students who looked upwards compared to students who viewed at the same level and increased odds ratio was seen for redness, burning sensation and headache and not for dry eyes and neck and shoulder pain. Bergqvist and Knave reported increased odds ratios for certain eye discomfort symptoms when the computer operator keeps the terminal at about eye level rather than below eye level.[15] Jaschinski et al. in their study, found that high screens result in greater eyestrain than low screens.[11] Dinesh J Bhanderi et al classified the respondents in his study into three categories: those who have the top of their computer screen (1) above the level of eyes, (2) at the same level of eyes and (3) below the level of eyes. Significantly higher proportion of subjects who had their computer screen at or above the eye level reported asthenopia.[16] Slightly tilting the screen backward, so that the bottom is closer than the top, can help improve screen visibility providing it doesn't increase screen glare.[17] Quaranta Leoni FM et al recommended a downward gaze so as to work comfortably on VDT. [18]

Anti-glare and CVS: In the present study nearly 60% of them said they avoid glare and reflections while working on computer and one fifth of them used antiglare while working on computers. Sen et al reported in his study 30% were using anti-glare screens.[5] A WHO press release (1998) mentions that glare and reflections from VDT displays can be a source of eyestrain and headache. Use of antiglare filters over VDT screens has been associated with shorter, less frequent and less intense eye complaints in some studies.[13] Significantly lower prevalence of visual complaints in the subjects who used antiglare screen were also observed Dinesh J Bhanderi et al and Saurabh R et al. [17,19]

Taking breaks: Three fourth of the students said they took break for every hour of working on computers.

Taking short breaks of 5 min or so every hour, has been shown to decrease discomfort (eye and musculoskeletal) while not impeding productivity.[19] in our study students who did not took frequent breaks were at higher risk of developing CVS. Many studies recommend frequent breaks to avoid computer vision syndrome.[12, 20]

Practice of posture check: On the assessment of posture check while working on computer showed 55% to 72 % of the students practice correct posture while working on computers. Using ergonomically designed furniture and good posture is an importance factor in preventing adverse physical health if the computer is to be used for an extended period of time. The prevalence of various computer related problems is not only dependent on the type of profession but also on the environment of the working place and posture adopted. The musculoskeletal symptoms of computer vision syndrome are usually a result of poor posture while seated at a computer.[5] K. Mohamed Ali et al reported in his study 51.5% of the computer professionals had their wrist in neutral position i.e. the lower arm and hand kept in a straight line without flexion or extension at the wrist. There is an increased risk of carpal tunnel syndrome when the hand is kept flexed or extended at wrist joint compared to neutral position.[21] [22] Creating awareness among computer professionals regarding keeping the hand in a neutral position is also important. Some studies have identified constrained and awkward wrist and forearm postures as contributors to hand and arm pain during keyboard-like activities.[23] In our study 66% of the students said they were using wrist rest. Sen et in his study reported 88.9% were using the traditional keyboard without wrist rest.[5]

Use of adjustable chair: In our study 61.5% of the students used adjustable chair in contrast sen et al reported in his study only that thirty-six percent of the respondents used chairs with adjustable backrest while working on their PCs[11]. Similarly Szeto et al had reported the use of swivel chairs with height adjustability is still very uncommon.[24] The most common adjustment is the seat height. The seat height should be set so the user's feet rest comfortably on the floor, thighs horizontal, lower legs vertical. If it is fixed it puts undue stress on the undersides of the thighs and other musculoskeletal discomfort. Placing a height-adjustable footrest under the desk solves the problem by giving people working on computer proper support for their feet and legs.

Using height adjustable Key board: in the present study 56% of the students used height adjustable key board. Two third of the students said their wrist rest on boards. To achieve a neutral hand/wrist position when using a keyboard one should use the flattest keyboard which may give the hands some rest time in a neutral position. It appears that lowering the height of the keyboard to or below the height of the elbow and resting the arms on the desk surface or chair armrests is associated with reduced risk of neck and shoulder musculoskeletal disorders.

Having document holder: In the present study about one fourth of the students used document holder. The use of a document holder placed at the same distance as the computer monitor will prevent the eyes from having to change focus. It will also help eliminate extra movement of the neck to look down at a document on a desk top. Document holders should be positioned near the computer screen and in the same plane as the screen to avoid eye strain; they should also be frequently alternated between the left and right sides of the screen.

LIMITATION

The main limitation of this study was that it was a cross sectional study and it was purposive sampling involving students of a university in the sub urban area of Chennai. The study involves only the self reported practices by the students and did not include the examination of their practices while they were in actual work on their computers like the viewing distance, the screen level (up gaze, down gaze), the posture of the subjects and the symptoms of CVS.

CONCLUSION

In the present study the practice of ergonomics principles among medical and engineering students revealed nearly 50 to 60% of the students practice the right methods i.e. ideal viewing distance, screen viewing at the same level, taking frequent breaks. Regarding postural check 55-72 % of the students were making postural check while working on computer and 20- 62 % were practicing some of the ergonomic alterations. The students who were not practicing ergonomics principle and did postural check and make ergonomic alteration were at higher risk of developing CVS. Using ergonomically designed furniture and maintaining good posture is an importance factor in preventing adverse physical health if the computer is to be used for an extended period of time.

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