

Original article

Computer vision syndrome: a study of knowledge and practices in university students

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Abstract

Introduction: Computer vision syndrome (CVS) is a condition in which a person experiences one or more of eye symptoms as a result of prolonged working on a computer. **Objectives:** To determine the prevalence of CVS symptoms, knowledge and practices of computer use in students studying in different universities in Malaysia, and to evaluate the association of various factors in computer use with the occurrence of symptoms. **Material and methods:** In a cross sectional, questionnaire survey study, data was collected in college students regarding the demography, use of spectacles, duration of daily continuous use of computer, symptoms of CVS, preventive measures taken to reduce the symptoms, use of radiation filter on the computer screen, and lighting in the room. **Results:** A total of 795 students, aged between 18 and 25 years, from five universities in Malaysia were surveyed. The prevalence of symptoms of CVS (one or more) was found to be 89.9%; the most disturbing symptom was headache (19.7%) followed by eye strain (16.4%). Students who used computer for more than 2 hours per day experienced significantly more symptoms of CVS ($p=0.0001$). Looking at far objects in-between the work was significantly ($p=0.0008$) associated with less frequency of CVS symptoms. The use of radiation filter on the screen ($p=0.6777$) did not help in reducing the CVS symptoms. **Conclusion:** Ninety percent of university students in Malaysia experienced symptoms related to CVS, which was seen more often in those who used computer for more than 2 hours continuously per day.

Keywords: Computer vision syndrome, headache, eye strain, blurred vision

Introduction

Technological advances have made an impact in almost every aspect of our lives (office work, accounting, designing, medical facilities, database management, experimental work and daily tasks) after the availability of computers. A personal computer is a common item now-a-days in offices,

colleges, universities and home. Its use has increased efficiency in easy access to information, writing articles, and communicating to others. Millions of people including children, college students are using computers for prolonged hours. A video display terminal (VDT) is also known as computer screen. The symptoms reported were eyestrain, tired eyes, headache, blurred vision, irritation, burning sensation, redness, double vision, neck pain, and backache which might be caused by combination of individual visual problems, poor

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workplace conditions and improper work habits (Cole et al, 1996 ; Collins et al, 1998). However, eye related symptoms were reported as the most common health problem among VDT users (Shaedy, 1992; Costanza, 1994; Thomson, 1998). The condition of a person experiencing one or more of these eye symptoms as a result of operating a computer is generally referred as computer vision syndrome (CVS); and the symptoms have been divided broadly into four categories (: (i) asthenopic — eye strain, tired eyes, sore eyes, (ii) ocular surface related — watering, irritation, dry eye, (iii) visual — blurred vision, slowness of focus change, double vision, and (iv) extraocular — neck pain, back ache, shoulder pain, (Blehm et al, 2005).

Now-a-days, large number of university students are using computers for studies and for research work. In addition, computers are used by them for seeing movies, playing computer games and online chatting. Pubmed search revealed only one report among the college students in India (Bhandari et al 2008). There is no report available in the literature on computer vision syndrome in university students in Malaysia. Therefore, we conducted a questionnaire survey in students studying in different universities in Malaysia to determine the (i) prevalence of CVS symptoms, knowledge and practices of computer use, and (ii) to evaluate the association of various factors in computer use with the occurrence of symptoms.

This was a research project of students as part of the curriculum for phase II medical course in International Medical University, Kuala Lumpur.

Material and methods

A research questionnaire was prepared after reviewing the articles available on computer vision syndrome. The questionnaire included (i) demography details, (ii) spectacles use, (iii) computer use, (iv) symptoms of computer vision syndrome, (v) any measures practiced to prevent eye problems, (vi) use of radiation filter, and (vii) lighting in the room. Data collected in questions (iii) and (iv) provide information on knowledge and

in questions (v), (vi) and (vii) provide information on practices of computer use.

A pilot study was conducted among 20 undergraduate students of different faculties (medical, pharmacy and nursing) from International medical university and the questionnaire was edited for easy understanding by the respondents. Following this, a cross sectional survey was carried out in students from colleges of different universities in Malaysia from April 2007 to September 2007.

After making sure that the respondents were using the computer daily for one hour or more over a period of some months/years, the students were explained about the objectives of the research project, confidentiality of the data collected; and verbal consent was taken for their willingness to participate in the study. All the students agreed for participation in the study and hence, all of them were taken as sample for this study.

All the students present in the class at the time of giving the questionnaire were included in the study as per the inclusion criteria. After collecting the filled up pro formas from the students, they were checked for the responses in all the sections. The pro formas from the students with insufficient data were excluded from the study as per the exclusion criteria. The data was collected in a proforma (Appendix-1) and analyzed using SPSS version 16.0 program.

Appendix-1 Research questionnaire for computer vision syndrome

Please fill up the blank or circle the appropriate word in all the questions

(i) Demography

Age : years

Gender : male/ female

Race : malay/ chinese/ indian/ others

Name of University

(ii) Spectacle use

Are you wearing glasses: yes/no

If yes, duration of wearing glasses: months/years

Power of glasses: Right eye

Left eye



Are you wearing contact lenses: yes/no
 If yes, duration of wearing contact lenses:
 months/ years

(iii) Computer use

How long have you been using computer?
 months/ years
 Average duration of computer use in a day:
 hours
 Are you aware that prolonged use of computer has
 bad effects on the eyes?: yes/ no

(iv) Computer vision syndrome symptoms

- Have you experienced any one of the following symptoms while using/ after finishing the work on computer? *You can circle more than one as answer.*

Eye strain (irritation, heaviness)/ tiredness of eyes/
 watering of eyes/ redness of eyes/ blurring of vision/
 dry eye/ discomfort/ double vision/ headache/
 backache/ neck pain/ shoulder pain/ no symptoms.

- What is the most disturbing symptom? *You should circle only one as answer.*

Eye strain (irritation, heaviness)/ tiredness of eyes/
 watering of eyes/ redness of eyes/ blurring of vision/
 dry eye/ discomfort/ double vision/ headache/
 backache/ neck pain/ shoulder pain/ no symptoms.

- After how many hours of computer use you experience the above symptoms? hours

(v) Preventive measures

- Do you practice any of the following measures to prevent/ relieve the above symptoms? *You can circle more than one as answer.*

Taking breaks in between use/ looking at far objects
 in between use/ massage of eyes/ use of eye drops/
 use of radiation filter on the screen/

(vi) Level of the computer screen

At what level is your computer screen during work?
above the eye level/ at the eye level/ below the
 eye level

(vii) Lighting in the room

What type of lighting is used in the room?
 Fluorescent light/ natural light.

If the student had experienced at least one symptom during/following use of computer, he/she was considered to be having symptom of CVS. Some of them might have experienced more than one symptom. Therefore, to determine the association of various factors with the presence or absence of symptoms, all the symptoms were added together (cumulated number) for statistical purpose. Thus, the total number of symptoms are much more than the number of students. Chi square test was used to evaluate the significance of symptoms with various factors during computer use. A p value <0.05 was taken as statistically significant.

Results

A total of 843 students were recruited in this study, of which 795 students responded all the seven parts of the questionnaire completely (response rate 94.3%). Majority of the participant students were from International Medical university (Table 1).

Table 1: Number of participant students from different universities in Malaysia (n=795)

| Name of university | No. of students |
|--------------------------------------|-----------------|
| International Medical University | 313 |
| University Putra Malaysia | 201 |
| Multimedia University, Melaka Campus | 143 |
| Melaka Manipal Medical College | 99 |
| Penang Medical College | 39 |

Females were more (482, 60.6%) in our study than males (313, 39.4%). The mean age of students was 21.3 years (range 18 - 25 years). Chinese students were 387 (48.7%) followed by Malays 290 (36.5%), Indians 91 (11.4%) and others — different races of foreign students 27 (3.4%). Out of 795 students 543 were wearing spectacles (68.3%); 172 of them were using contact lenses and all were myopes and some had astigmatism also. The mean duration of daily computer use was 3.5 hours (range 1 - >10 hours), Table 2.

Table 2: Duration of daily computer usage in male and female students

| Daily computer use | Male | Female | Total |
|--------------------|------------|------------|------------|
| 1 hour | 71 | 145 | 216 |
| 2 hours | 69 | 45 | 114 |
| 3 hours | 49 | 72 | 121 |
| 4 hours | 27 | 43 | 70 |
| 5 hours | 32 | 46 | 78 |
| 6 hours | 39 | 34 | 73 |
| 7 hours | 8 | 2 | 10 |
| 8 hours | 6 | 20 | 26 |
| 9 hours | 2 | 3 | 5 |
| >10 hours | 10 | 6 | 16 |
| Total | 313 | 482 | 795 |

There was no significant difference of mean duration of daily computer use between the two genders (males 3.9 hours and females 3.2 hours ($p=0.7$). Majority of students (87%) were aware of the bad effects of prolonged use of computer on the eye. The mean total duration of computer use (by all students) was 8.9 years (range 10 months - 15 years). Seven hundred and fifteen (89.9%) students had one or more symptoms of CVS, while 80 (10.1%) did not have any symptoms. The most disturbing symptom was headache (19.6%) followed by eye strain (16.4%), Table 3.

Table 3: Most disturbing symptoms following computer usage in male and female students (n=795)

| Symptom | Male | Female | Total | Percent |
|----------------|------------|------------|------------|---------------|
| Headache | 57 | 100 | 157 | 19.7% |
| Eye strain | 51 | 79 | 130 | 16.4% |
| Dry eye | 32 | 76 | 108 | 13.6% |
| Blurred vision | 38 | 43 | 81 | 10.2% |
| Neck pain | 36 | 43 | 79 | 9.9% |
| Backache | 18 | 36 | 54 | 6.8% |
| Shoulder pain | 7 | 34 | 41 | 5.2% |
| Watery eye | 18 | 16 | 34 | 4.3% |
| Red eye | 10 | 9 | 19 | 2.4% |
| Discomfort | 4 | 5 | 9 | 1.1% |
| Double vision | 1 | 2 | 3 | 0.3% |
| No symptoms | 41 | 39 | 80 | 10.1% |
| Total | 313 | 482 | 795 | 100.0% |

The association of various factors in computer use with the occurrence of symptoms of CVS is shown in Table 4. Students who used computers for more than 2 hours experienced symptoms of CVS significantly more often than those who used computer up to 2 hours ($p=0.0001$). Students who were wearing spectacles experienced symptoms significantly more often than those who were not wearing spectacles ($p=0.0001$). However, there was no statistically significant difference between students who were high myopes than those who were low and moderate myopes together ($p=0.2927$).

Taking breaks in between the use of computer (547, 68.8%) was the most common preventive measure taken for relief of symptoms of CVS; the mean duration of time taken was 15 minutes (range 5 – 60 minutes). However, there was no statistically significant association between taking breaks during the use of computer and relief of symptoms ($p=0.3238$). Looking at far objects in-between the work ($p=0.0008$), massage of eyes ($p=0.0021$), use of eye drops ($p=0.0001$) were found statistically useful in reducing the CVS symptoms.

Majority of students (610, 76.7%) were not using any radiation reducing filter on the monitor. The use of this filter did not help the students in reducing the symptoms of CVS ($p=0.6615$). There was 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 ($p=0.0001$).

While working on the computer, 649 (81.6%) students used fluorescent light in the room; 106 (13.3%) utilized natural sunlight available in the room; 22 (2.8%) used other forms of lighting; while 18 (2.3%) worked without any light in the room. There was no statistically significant difference between CVS symptoms and presence of fluorescent lighting in the room ($p=0.3056$).

Table 4: Association of various factors associated with computer usage and occurrence of cumulated symptoms of computer vision syndrome (CVS)

| Variable | No. of students | CVS symptoms present | No symptoms | P value | |
|--|-----------------|----------------------|-------------|---------|--------|
| Duration of computer use | | | | | |
| Up to 2 hours | 330 | 1716 | 1647 | 0.0001 | |
| More than 2 hours | 465 | 1684 | 2133 | | |
| Wearing spectacles | | | | | |
| Yes | 543 | 2559 | 3414 | 0.0001 | |
| No | 252 | 993 | 1779 | | |
| Degree of myopia | | | | | |
| upto -6 dioptrres | 412 | 1971 | 2561 | 0.2927 | |
| >6 dioptrres | 78 | 356 | 502 | | |
| Preventive measures | | | | | |
| Taking breaks | Yes | 547 | 2465 | 3552 | 0.3238 |
| In-between work | No | 248 | 1087 | 1641 | |
| Looking at far objects in-between work | Yes | 431 | 2003 | 2738 | 0.0008 |
| | No | 364 | 1549 | 2455 | |
| Massage of eyes | Yes | 402 | 1867 | 2555 | 0.0021 |
| | No | 393 | 1685 | 2638 | |
| Use of eye drops | Yes | 203 | 996 | 1237 | 0.0001 |
| | No | 592 | 2556 | 3956 | |
| Use of radiation filter on screen | Yes | 185 | 818 | 1217 | 0.6615 |
| | No | 610 | 2734 | 3976 | |
| Level of computer screen | | | | | |
| At or above eye level | 599 | 2678 | 1667 | 0.0001 | |
| Below eye level | 196 | 874 | 3615 | | |
| Lighting in the room | | | | | |
| Fluorescent lighting | 777 | 3479 | 5057 | 0.3056 | |
| Natural lighting | 18 | 73 | 125 | | |

Discussion

The prevalence of computer vision syndrome (CVS) symptoms in our study was 89.9%, of which eye strain (asthenopia) was 16.4%. A much higher frequency of asthenopia has been reported from different countries — 31.9% from Italy (Mocci et al, 1996), 46.3% from India (Bhanderi et al, 2008), 68.5% from Spain (Sanchez-Roman et

al, 1996), among computer users. Mutti and Zadnik (1996) from USA reported that 75% of computer users who worked for long hours at the computer had complaints of visual symptoms. The most common two symptoms of CVS reported in the literature are shown in Table 5.

Table 5: Frequency of most common two symptoms reported in computer users

| Author and year | Most common two symptoms | |
|----------------------------|--------------------------|--|
| | First | Second |
| Shrestha et al (2011) | Headache (13.3%) | Tired eyes (12.5%) |
| Edema & Akwukwuma (2010) | Tired eyes (62.5%) | Blurred vision (59.4%) |
| Megwas & Daguboshim (2009) | Headache (41.7%) | Pain in eyes (31.5%) |
| Bali et al (2007) | Eye strain (97.8%) | Headache (82.1%) |
| Singh et al (2007) | Burning sensation (31%) | Tired eyes (25%) |
| Smith et al (1981) | Eye strain (91%) | Painful or stiff neck and shoulder (81%) |
| Present Study | Headache (19.7%) | Eye Strain (16.4%) |

The symptoms of headache, eye strain, dryness, burning, grittiness, heaviness or watering, stiff shoulders, low back pain and general fatigue were reported higher with increasing duration of daily VDT use (Acousta et al, 1999; Nakazawa et al, 2006). The duration of computer work is directly related to eye symptoms; and longer duration tends to result in long-lasting complaints even after the work is finished (Bergqvist and Knave, 1994; Sanchez-Roman et al, 1996; Shima et al, 1995).

In our study, more than 2 hours continuous use of computer was significantly associated with occurrence of CVS symptoms (Table-4). Mutti and Zandic (1996) reported more pronounced visual symptoms in people spending 6-9 hours daily at a computer, while Stella et al (2007) observed the same in people using computer more than 8 hours daily. Spending long time on the computer screen without pause also can lead to problem of shifting focus on screen, documents and keyboard. The constant process of drifting and refocusing on fuzzy pixel of texts on the screen can leave eyes strained and fatigued (Wimalasundara, 2006).

Computer work place illumination, screen contrast, duration of work on compute, viewing distances and angles, specific work related task, pressure and interest, screen reflection, image quality, and work place ergonomics were found to have significant role in manifesting symptoms in VDT users (Stella et al, 2007; Cole, 2003). The level of the computer screen can be at or above or below the eye level of computer user. A higher proportion of subjects who had their computer screen at or above the eye level reported asthenopia (Bhandari et al, 2008; Jaschinski et al, 1998; Bergqvist and Knave, 1994).

The following strategies have been reported by the researchers to prevent/ reduce the symptoms of CVS: (i) Keeping the computer screen at a distance of 35-40 inches away may allow the

eyes to relax and may reduce eye strain (Jaschinski et al, 1998). (ii) Adjusting the computer monitor to a viewing angle of 15° lower than horizontal level may reduce the musculoskeletal discomfort (neck pain and back pain) and visual discomfort (Psihogios et al, 2001). In our study, there was 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 (Table-4), (iii) Taking regular small breaks may relax accommodation process of the eyes, thereby preventing eye strain (Mc Lean et al, 2001). Taking breaks in between the use of computer was the most common preventive measure taken for relief of symptoms of CVS. However, there was no statistically significant association between taking breaks during the use of computer and relief of symptoms (Table 4). It will be easy to practice the small breaks in between the work by following the rule of 20/20/20 as suggested by Anshel (2005) i.e. after 20 minutes of computer use, one should look at something 20 feet away for 20 seconds. In our study, looking at far objects in-between the work was significantly associated with less frequency of CVS symptoms (Table 4). (iv) Maintaining good sitting posture to avoid neck pain and back pain (Liao and Drury, 2000). (v) Correction of visual problems by wearing spectacles or contact lenses is important to avoid eye strain (Sheedy, 2000). (vi) The screen lighting, contrast and brightness should be adjusted to the optimum before starting the work on the computer. The luminance of the room should not exceed three times than the mean luminance on the screen (Sheedy et al, 2005).

Artificial tears (Bali et al, 2007), herbal eye drops - itone (Biswas et al, 2003), polysorbate 0.5% - optizen and tetrahydrozoline 0.05% - visine (Skilling et al, 2005), povidone 2% preservative-free eye drops (Gullion et al, 2004) have been prescribed to alleviate the symptoms related to CVS. In our study, use of eye drops

was significantly associated with less frequency of CVS symptoms (Table-4). These eye drops rewet the ocular surface, contribute to tear volume; and thus decrease symptoms of ocular tiredness, dryness and difficulty in focus, thus improve dynamic visual acuity.

Conclusion

From the present study, it is concluded that 90% of university students in Malaysia experienced one or more symptoms of computer vision syndrome. The most common symptom was headache, followed by eye strain. The symptoms were reported more often in students who used computers for more than 2 hours in a day. Looking at far objects in-between work, viewing the monitor below the eye level, massage of eyes, and use of eye drops helped in reducing the symptoms. Taking rest in-between the work, use of radiation reducing filters on the monitor did not help in reducing the symptoms.

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