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A STUDY OF COMPUTER-RELATED UPPER LIMB DISCOMFORT AND COMPUTER VISION SYNDROME

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Personal computers are one of the commonest office tools in Malaysia today. Their usage, even for three hours per day, leads to a health risk of developing Occupational Overuse Syndrome (OOS), Computer Vision Syndrome (CVS), low back pain, tension headaches and psychosocial stress. The study was conducted to investigate how a multiethnic society in Malaysia is coping with these problems that are increasing at a phenomenal rate in the west. This study investigated computer usage, awareness of ergonomic modifications of computer furniture and peripherals, symptoms of CVS and risk of developing OOS. A cross-sectional questionnaire study of 136 computer users was conducted on a sample population of university students and office staff. A 'Modified Rapid Upper Limb Assessment (RULA) for office work' technique was used for evaluation of OOS. The prevalence of CVS was surveyed incorporating a 10-point scoring system for each of its various symptoms. It was found that many were using standard keyboard and mouse without any ergonomic modifications. Around 50% of those with some low back pain did not have an adjustable backrest. Many users had higher RULA scores of the wrist and neck suggesting increased risk of developing OOS, which needed further intervention. Many (64%) were using refractive corrections and still had high scores of CVS commonly including eye fatigue, headache and burning sensation. The increase of CVS scores (suggesting more subjective symptoms) correlated with increase in computer usage spells. It was concluded that further onsite studies are needed, to follow up this survey to decrease the risks of developing CVS and OOS amongst young computer users.

Key words: computers; upper limb discomfort; computer vision syndrome; ergonomic modifications; computer furniture.

INTRODUCTION

Malaysia is one of the major economic centres in the Southeast Asia. The government has encouraged abundant use of computers and multimedia to rapidly expand its information technology sector and to attain a developed nation status by 2020. Together with the dwindling prices, Personal Computers (PCs) have therefore become popular tools among college students and office users very quickly. It is known that PC usage, even for three hours per day, leads to a chance of injury or health risk including Occupational Overuse Syndrome (OOS), Computer Vision Syndrome (CVS), low back pain, tension headaches and psychosocial stress (Richardson and Tan, 1986). Nearly 60 million people suffer from CVS globally: a million new cases occur each year. Although many studies (Aaras et al., 1997; Carter et al., 1994), have reported the association between prolonged computer use, poor postures at workstations and various musculoskeletal discomforts, most of them mainly focused on Western adult subjects. However, very little research has been done about the effects of computer use on the physical health of Malaysian users especially after prolonged use.

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The study was conducted to survey the health problems associated with PC usage in a Malaysian sample including the prevalence of various symptoms of CVS, frequency distribution of such symptoms with the duration and spell of PC usage and the frequency distribution of Rapid Upper Limb Assessment Scores.

METHODOLOGY

Questionnaire design and development: An iterative process of questionnaire development and refinement was used and a final questionnaire developed. A cross-sectional study design was utilized. Each subject was surveyed using questions on four main areas viz. Computer usage; Awareness of Ergonomic modifications of computer furniture and peripherals; Symptoms of CVS and degree of OOS. Additional questions were added to collect information on computer usage habits, such as frequency, purpose and type of computer usage. The prevalence of the problem of CVS was studied by questionnaire techniques that incorporated a 10-point scoring system for each of the various symptoms of CVS.

Rapid Upper Limb Assessment (RULA): It is a technique, which evaluates people's exposures to postures, forces and muscle activities that contributes to Repetitive Strain Injuries (RSI). It was developed to detect risk factors that deserve further attention (McAtamney and Corlett, 1993). The resultant Modified RULA for office work incorporated changes to increase its appropriateness for evaluating computer work. (Lueder, 1996). In the present study, detailed modified RULA scores was used to evaluate OOS. Pictorial representation of different postures were included and the respondents were asked to pick the one which best described the one they usually adopt during their VDT work. Muscle and force scores, usually a part of RULA, were not used because all participants have almost identical values for muscle score and force score. Respondents all received 1 on the muscle score because their activity was either repeated for more than four times per minute during key strokes, or because their upper limb was held for more than one minute in an awkward, static position during mouse work or keyboard work or while gazing at the VDT. Respondents all received 0 on the force score because their tasks required negligible resistance

Subjects: The sample consisted mainly of volunteer under graduate students (studying computing or medicine) and some secretarial staff. This sample was chosen as they frequently used computers for prolonged periods.

Exclusive and inclusive criteria: The exclusive criteria chosen for OOS were a past history of musculoskeletal trauma and diseases and/or other diseases affecting their musculoskeletal systems. For assessing eye symptoms of Computer Vision Syndrome, the respondents were asked to mark the eye problems only if these eye problems satisfied the criteria for CVS as defined by the American Optometric Association. The inclusion criteria for CVS was the usage of computers together with any problem that occurred in the previous 12 months and was not caused by an acute injury and also lasted at least one week or occurred at least once per month. The exclusion criteria was any existing eye diseases over the past one year.

The questionnaire results were statistically analyzed. Given the ordinal nature of the data, analysis was done using descriptive non-parametric statistics. Descriptions of the results for individual questions were made using frequency counts and central tendency calculations.

RESULTS AND DISCUSSION

About 150 questionnaires were distributed, and an online version of the questionnaire was put on the web. One hundred forty questionnaires (including the online responses) were returned. One hundred thirty-six PC users were studied, four being rejected, as they met the exclusive criteria for CVS. In the sample, nearly 71% of the respondents were less than 30 years old. The gender distribu-

tion revealed that 65 % of the sample was females.

Analysis of demographic data revealed that 43% of the samples were Indians, 33% were Chinese and 24% were Malays. The sample population was skewed, as it did not represent the actual ratio of the Malaysians where two-thirds are of Malay origin. Regarding rest pauses it can be seen from Table 1 that many (42.9 %) used computers for a continuous spell of more than 2 hours without taking any breaks of which 20 % were using the computers for 4 to 6 hours per day (5 days a week). In a study in Hong Kong (Szeto, 2003) where computers are fast catching up with day to day activities, amongst high school students, about 11% used computer for 8-14 hours at home per week and 6% for 15-28 hours per week.

Table 1. Percentage of respondents using computers in various spells of continuous PC work.

Duration of daily PC use (hrs)	Less than 4 hrs	4-6 hrs	6 or more hrs
Continuous spells > 2 hrs	14.3	20.0	8.6
Continuous spells 1-2 hrs	31.4	4.3	2.9
Continuous spells < 1 hr	15.7	1.4	1.2
All users	61.4	25.7	12.9

Office furniture: Of the respondents surveyed, 11 % had heard about the ergonomic keyboard and only 16% of them knew its details.

It was seen that thirty-six percent of the respondents used chairs with adjustable backrest while working on their PCs. However, on asked if they knew how to adjust the chairs only 51 % of them responded affirmatively. One of the methods of reducing low back pain and other musculoskeletal disorders is the adoption of the Ergonomic seating posture during prolonged computer usage. Though 38.6 % had heard about the Ergonomic seating posture, in our survey we found that only 20% of the respondents knew the details of what it is. About other computer furniture and workstation components, because of the widespread use of modern monitors, and their inclusion in the package of the PC, 79 % had tiltable monitors though only 30% were using Anti glare screens (Figure 1).

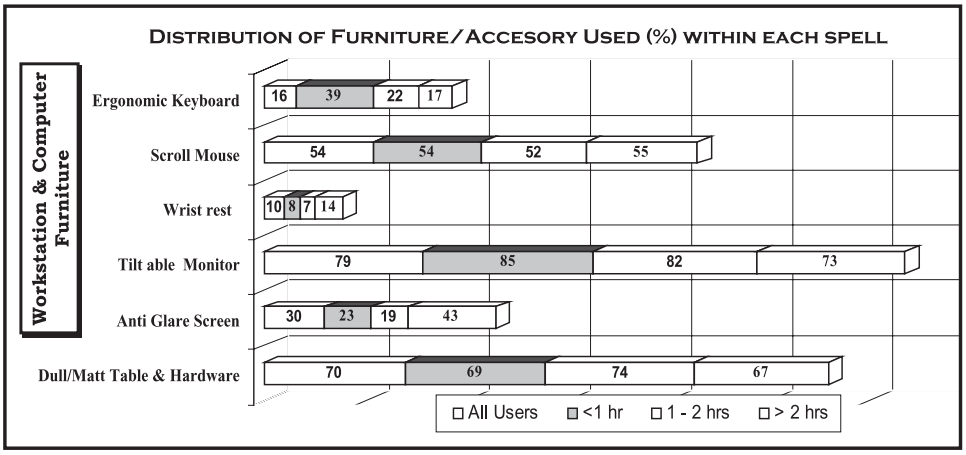

Fig. 1. Percentage distribution of computer furniture/accessory used.

Even in other Asian countries with well-equipped computer laboratories for students, the use of swivel chairs with height adjustability is still very uncommon in these “newer” computer laboratories (Szeto, 2003). However, as in the west (Cheryl L. Bennett) in Asian scenario also, funding designated for computers usually cannot be spent on tables, keyboard trays or wrist rests. The computer furni-

ture, which comes along in many offices and homes in Malaysia is meant for desk jobs rather than especially adapted for VDT work. Hence no special furniture especially those with ergonomic designs were being used especially amongst prolonged PC users.

We analysed the sample according to the amount of low back pain they had complained on a scale of 10. We took up the cases that have scored their low back pain at least 3 or above and found that only 16.9 % of those who had detailed knowledge of the ergonomic seating posture (Figure 2) had some low back pain in comparison to 30.50% of those who had no knowledge of ergonomic seating posture at all (Figure 2).

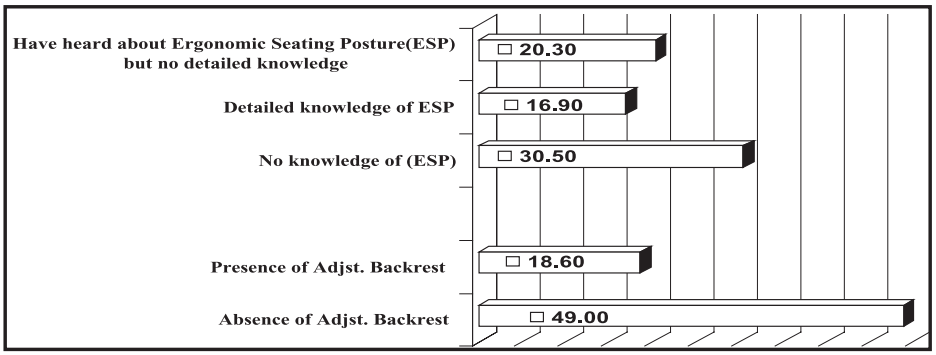

Fig. 2. Percentage of the sample with some low back pain (with a score of 3 or more on a scale of 10).

Symptoms of Computer Vision Syndrome (CVS): When asked about their existing condition of their eyes, sixty-four percent of the respondents stated that they were using correction spectacles for vision. None were using contact lenses. We found that many had considerable symptoms of CVS. Around 55% had some burning sensation in their eyes while 61% reported some headache. About less than half (46%) complained of some redness in their eyes. Majority (87%) complained of some problems of eye fatigue. After analysing the mean scores (on a scale of 0 to 10) for each of the symptoms of CVS (Table 2) it was found that eye fatigue was the symptom with the highest score (5.1 ± 1.2).

Table 2. Mean scores (on a scale of 1-10) of the various reported symptoms of CVS.

Symptoms of CVS	*Mean (±SD) scores*	Continuous spells								
		<1 hr			1 – 2 hrs			> 2 hrs		
		Duration of PC use			Duration of PC use			Duration of PC use		
		<4 hrs	4-6 hrs	>6 hrs	<4 hrs	4-6 hrs	>6 hrs	<4 hrs	4-6 hrs	>6 hrs
Burning Sensation	3.3 (±1.3)	2	2.3	5.6	1.5	2.3	3	3.2	4.1	7
Redness	2.7 (±1.4)	1.8	0	4	2.6	2.4	3.5	2.7	2.9	4.8
Headache	3.3 (±(1.4)	2	3	4	2.7	3.5	3.5	3.3	3.8	4.3
Eye fatigue	4.5 (±1.2)	3.5	4	4	4	4	4.7	4.5	4.8	6
Double vision	2.1 (±0.08)	0	1.8	1	2.2	1.6	2.5	2	2	4.4
Focusing problem	2.7 (±1.3)	1.2	4	2	2	3.3	3.3	2.4	3	3

An interesting fact was revealed in our study. As the duration of the PC use as well as the continuous spell increased so did the scores of each of the symptoms increase (Table 2). For example, in case of double vision, it was almost nil in PC users of less than 1 hour of continuous spell or those who were using the PC infrequently (less than 4 hours/day). However in those who were on the other

end of the spectrum and using the PC for continuous spells of more than 2 hours and for more that 6 hours a day, their average score increased to 4.4.

The estimated incidence of eyestrain or other visual problems attributable to computer use is between 70 and 88% (Salibello and Nilsen, 1995). The American Optometric Association (1997) identifies three main causes of computer eyestrain: frequent, long saccadic movements, continuous accommodation changes, and continuous changes in alignment (vergence). These movements stress the visual system, particularly the musculature and hence cause the visual fatigue.

Occupational Overuse Syndrome (OOS): Various questionnaires and techniques have been developed for assessment of Work Related Musculoskeletal Disorders or OOS. We have chosen the RULA scoring for preliminary assessment. In some studies (Kilroy and Dockrell, 2000) analysis of findings indicate that RULA scores generally corresponded with reporting of symptoms in Nordic Musculoskeletal Questionnaire (NMQ), and discomfort in Body Discomfort Chart (BDC) .

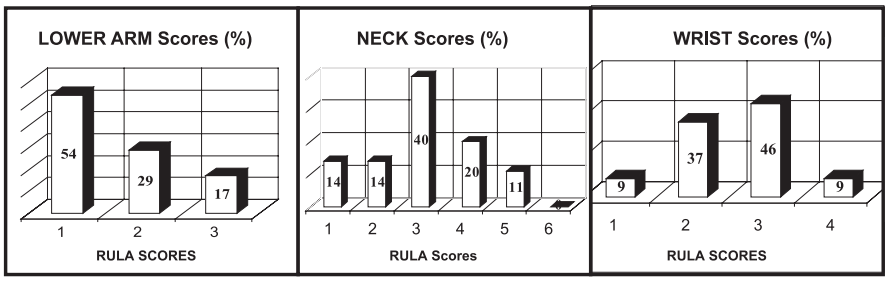

Fig. 3. Percentage of Lower Arm RULA Scores (1 - 3) ; RULA Neck Score (1-6) and RULA Wrist Scores.

In the modified RULA, the upper arm scores ranged from 1 to 3 depending upon the degree of flexion about the elbow joint during computer work. Most of the subjects (60%) had a score of 1. However, about forty percent of the respondents had RULA scores of three or more of the Upper arm. According to the modified RULA, wrist scores were from 1 to 4 depending upon the angle of the wrist in relation to the keyboard that was adopted by the respondent. Analysing the RULA Scores of the Wrist (Figure 3), we found that 46% of the subjects had a high score – 3 (suggesting a greater problem) of wrist. Research (Shuval and Donchin,2005) which used RULA to assess the posture of adults during computer use found no subject to have an acceptable position.

In earlier studies on musculoskeletal pain amongst VDT workers (Dalkilinç et al., 2002) significant correlation between pain and RULA was also found ($p < 0.05$).

The neck scores ranged from 1 to 6 depending upon the degree of flexion or extension of the neck posture adopted by the user during office computing. About 40 % had a score of three of the neck (Figure 3).

Literature on effects of prolonged computer usage especially CVS and OOS has been reviewed (Sen and Richardson, 2002). In the present study it was found that the majority who use computers for a prolonged period or long spells did not have or did not insist that they have Ergonomic modifications of computer peripherals and workstation. Whatever office equipment came with the package the user accepted it. In many places the space constraints and trying to fit in as many workstations in a confined place was a priority than that if adopting ergonomic design of workstation layout. These problems mean that very little consideration is given to ergonomic principles in designing computer laboratories in schools or in the home situation as found out in studies carried out in other fast developing Asian countries (Szeto, 2003).

In general, awareness of Ergonomic designs for mitigating OOS and CVS problems were lacking though the users are at risk of developing them because of their prolonged use especially for continuous spells. About 40 % of the respondents had a score of three of the neck. In an earlier survey among office workers in Hong Kong (HKOSHC, 1997), predominantly of Chinese origin, the prevalence rates of neck and upper limb discomforts were in the range of 50-70%. Cross cultural differ-

ences do exist (Richardson et al., 1972) in many such cases.

CONCLUSIONS

The present study has shown some important frequency distribution of computer usage and the development of OOS and various symptoms of CVS in prolonged computer users of Malaysia. Concerning the computer furniture, thirty six percent of the respondents used chairs with adjustable backrest while working on their PCs though 51 % of them knew how to adjust it. Only 20% of them had any idea about the Ergonomic seating posture. These preliminary findings suggest a great risk of developing OOS in neck and wrist regions amongst the sample population. Many users had high RULA scores of the wrist. Most (88.9%) were using the traditional keyboard without wrist rest. However, the sample size needs to be increased to form any significant associations between such RULA Scores and plausible cause of OOS .

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