ERGONOMIC EDUCATION – A TOOL TO MAINTAIN HEALTH

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ABSTRACT

Objective: To identify the occurrence of leg pain amongst computer users and assess its relation to age, sex, occupation and duration of computer use.

Methodology: It was a cross sectional study conducted from January till December 2011. A self reported questionnaire tailored with Occupational Health and Safety Act of the Ministry of Labor, Ontario, Canada was used. Participants were randomly selected; responses analyzed by SPSS software version 15. Chi square test was applied to results and considered significant with p value <0.05

Results: A total of 416 participants responded with mean age of 34.87±8.78 years. There were 231(55.5 %) males. Out of 416, 123(29.5%) participants had work related leg symptoms [66(15.8%) male and 57 (13.7%) female]. Occurrence of leg pain within one to two hours of consecutive work was significantly more in 26-35 and 36-45 year age groups. Postural changes incorporated through frequent short breaks improved leg symptoms in between eight to nine out of ten participants (104/123). The improvement was significantly more in 26-35 and 36-45 year age groups. Leg symptoms showed no relation with the length of computer usage or daily usage or between both sex and working groups.

Conclusion: Leg pain/tingling/numbness is an early sign of repetitive injuries that can be timely addressed by ergonomic education and improving postural health through short breaks.

Key Words: Ergonomics, Musculoskeletal symptoms, Leg pain.

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INTRODUCTION

With the increasing use of computers in almost all spheres of life, it is important to know the potential risks associated with its use. The knowledge of Ergonomics is concerned with the designing of job; equipment; and workplace; to prevent repetitive injuries, thus enabling the worker fit and perform in a better way[1].

In developing countries computer usage has become widespread in almost all trades of life such as education, health services and delivery, administration, finance, management, commerce, business, marketing and industry[2]. The machine, with just a click of the mouse opens up vast horizons of knowledge, facts, data, recreation and amusement in fractions of a second entrancing the user to spend unaccounted hours in front of computer screen without a break resulting in increased exposure to a number of risks that overtime, may become visible as musculoskeletal disorders (MSDs).

The term Musculoskeletal disorders (MSDs) are minor physical disabilities that affect the muscles, bones, and joints due to repetitive or prolonged exposure to physical factors (excluding sudden physical contact of the body with other objects)[3,4]. In the 1970's the etiologic factors of MSDs were examined by epidemiologic methods and now ergonomics has a considerable importance in the workplace[3].The prevalence of MSDs has been estimated to be 4-5 percent of the general adult population and more in females and it also increases with age[5]. The pain and physical disability affected social wellness and mental health which compromises the quality of life[5]. MSDs represent one third or more of all registered occupational diseases in United States, Nordic countries and Japan[6]. The incidence of MSDs has increased by 25 percent over the past decade and disorder make up 2% of the global disease burden[6].

According to WHO between 10 and 30% of the workforce in developed countries, and up to 80% of the workforce in developing and newly-industrializing countries, are exposed to physical factors such as noise, vibration, radiation etc. etc that have occupational health impacts[7]. ILO and WHO estimated as many as 250 million occupational injuries each year, resulting in 330,000 fatalities posing a burden on health and compromising quality of life years (QALYs).

Lower limb disorders (LLDs) are MSDs that affect the legs from hips to toes either because of overuse or because of fixed postures without breaks. In Britain about 20% of all work-related MSDs affect the lower limbs. In a survey conducted in 2009 and 2010 almost 94,000 people who worked in the past 12 months were diagnosed to have LLD caused or worsened by work. Thirty thousands of these were new cases, which is about 100 out of every 100,000 workers in Britain. According to Health and Safety Executive (HSE) each case of LLD means that each worker takes an average of 25 days off work. In the 2009 and 2010 survey about 2.4 million working days were estimated to be lost because of LLDs[8]. A cost effective ergonomic approach is to identify the presence of symptoms in the leg such as pain/tingling/numbness to determine that recognizes the onset of LLDs. MSDs amongst computer users have also been examined. The growing prevalence of MSD's is a potential threat to the health burden in industrially less developed countries[9]. There is evidence that neck pain, wrist pain, elbow pain, back pain, leg pain etc can be reduced by creating awareness of ergonomics and its appropriate application[9].Visual displays on how to stretch while at work and short breaks can minimize the risks for leg pain.

MSDs comprise of backache and lower leg pain; salient features, causative factors and preventive measures of both were identified by authors[10]. The objective of present study was to identify the occurrence of one of the MSDs; leg pain amongst computer users and to assess whether it is associated with age, sex, occupation and duration of computer use.

METHODOLOGY

It was a cross sectional study conducted from January till December 2011. A self reported questionnaire (Annexure 1) on ergonomics was developed using the guidelines of the Occupational Health and Safety Act of the Ministry of Labor[11], Ontario, Canada; and "Easy Ergonomics for Desktop Computer Users" (prepared for publication by the Cal/OSHA Consultation Service, Research and Education Unit, Division of Occupational Safety and Health, California Department of Industrial Relations) to assess workstation ergonomics and MSD by identified users.

Organizations where computer ergonomics were applied, were given a formal invitation of participation and participants were explained the procedure by description of questionnaire. Participants who had been using computers on a regular basis for a minimum of five years met the inclusion criteria. Those using computers for less than five years or having orthopedic prescription for any MSDs were excluded from participation. Based on inclusion/exclusion criteria, a list of potential participants (through random sampling) was obtained from each institution and a letter sent to participants for their willingness to be included in the study. Written informed consent was taken from all the participants. On the basis of age, participants were divided into four groups to identify an association of the problem with a particular age group. Groups were: 15-25 years, 26-35 years, 36-45 years, and 46-55 years.

Based on the work similarities, the participants were categorized into teachers, doctors, bankers, marketers (included all those concerned with product development, promotion as well as sales), information technology workers and students. A fifteen minute briefing on terms such as Ergonomics and a few others, objectives of study and the use of instrument was conducted by the researcher followed by a question and answer session to address any queries. The study was designed using a semi structured questionnaire, to have responses of all work groups for low backache and lower limb pain, formerly published by authors[10]. Sample size was calculated for the study, with e (margin of error) of 5% and z (confidence interval) of 95%. SPSS version 15 was used for data entry and analysis. Values were presented as mean ± SD; SE of mean; Chi square test was applied to evaluate results of test; significant with p value <0.05.

RESULTS

Questionnaire was distributed to 460 participants. Complete response was obtained from 416 participants; 44 incomplete forms were rejected and excluded from the study.

Out of 416 participants that responded, 231(55.5 %) were males and 185 (44.5%) were females, the age range was 22 to 59 years, the mean being 34.87; median 35 and mode 26 years. The standard deviation was 8.78 years.

Of the 416 participants, 80(19.2%) participants [12% male, 7.2% female] were from information technology (labeled as IT in tables); 83(20%) participants [12.5% male, 7.5% females] were from marketing departments (labeled as M); 68(16.3%) comprised of bankers [9% male,7.2% female] (labeled as B); 63(15.1%) [6.7% male, 8.4% female] were doctors (labeled as D); the group of

teachers (labeled as T) had 59(14.2%) participants [6.5% male, 7.7% female] while 63(15.1%) were students (labeled as S) [8.7% male, 6.4% females].

Out of 416 participants, 181(43.5%) [109; 26.2% male, 72; 17.3% female] were using computer for 10 or more years, while 235(56.5%) participants [122; 29.3% male, 113;27.2% female] were using it for 5-9 years. Use of computers for less than five hours each day was reported by 54(13%) participants while 185(44.5%) were using it for 5-7 hours and 177(42.5%) for more than eight hours each day. The consecutive use of computers without breaks for 1-2 hours was observed in 301 (72.4%) participants as compared to 115 (27.6%) who had no breaks for 3 or more hours.

Work related pain/tingling/numbness in legs (either alone or in combination) was reported by 123(29.5%) participants [66; 15.8% male, 57; 13.7% female]. The occurrence of symptoms was the same in both sexes. Out of these 123, the use of computers for 5-9 years was reported by 66(15.8%) as compared to 57(13.7%) who were using it for 10 or more years; however the difference in the occurrence of symptoms in the two groups was not significant. Symptoms were observed to be more in those who were working for eight or more hours in a day but this had no statistical significance (p=0.6). Of those who developed leg symptoms, 41 (3.1%) were using computers for less than five hours each day, 129(13.4%) for 5-7 hours and 123(12.98%) for eight or more hours each day. Symptoms showed no relation (p=.06) to the use of computer each day. The onset of symptoms within 1-2 consecutive hours of work was reported by 113 (27%) participants [14.4% male, 12.6% female] as compared to 10(2.4%) participants [1.5% male, 0.9% female] who had similar complaints only after two or more hours (p<.010).

Of those who developed leg symptoms, 7(1.7%) were in 15-25 years age group, 44(10.6%) were in 26-35 years age group, 49(11.8%) in 36-45 years group and 23 (29.6%) in 46-55 years age group. The occurrence of symptoms was significantly more (p=.005) in the 26-35 and 46-55 years age groups. The difference was not significant between working groups.

The appearance of symptoms in those who were using computers without any break within 1-2 consecutive hours of work was also significantly more (p<.001) in the same 26-35 and 46-55 years age groups.

The improvement of symptoms with frequent short breaks was noticed by 104 (25%) participants [13.7% male, 11.3% female; p<.001]. No significant difference was observed between the two sexes or working groups, but significantly more (p<.007) in the 26-35 and 36-45 years age groups (8.7% and 9.9% respectively).

Self prescription was common across all age groups though participants in the 15-25 years age group never consulted a doctor for such complaints. 92(22%) of all participants self prescribed to relieve their symptoms. Self prescription was significantly high (p=0.003) in 36-45 and 46-55 age groups.

Consultation with doctor for leg symptoms was reported by 20(4.8%) participants [2.9% male, 1.9% female] in the age range between 26-55 years. Consultations were significantly more p<.001 in the 46-55 age group; 2.9% of these were also self prescribers (p<.001). All those who consulted a physician were also prescribed medicines; however only 11(2.6%) [1.7% male,

Table 1: Leg pain in various work groups

Pain Legs n==123	IT	M	B	D	T	S	Total
Occurs in 1-2 hrs	17(4*)	15(3.6)	22(5.2)	19(4.6)	21(5)	19(4.6)	113(27)
Occurs in > 2 hrs	6(1.5)	1(0.24)	0	1(0.24)	1(0.24)	1(0.24)	10(2.4)
Improves with short breaks	20(4.8)	15(3.6)	15(3.6)	17(4)	19(4.6)	16(4.3)	104(25)
Self prescriptions	16(3.8)	11(2.6)	20(4.8)	15(3.6)	15(3.6)	15(3.6)	92(22)
Doctor's visit	4 (1)	3(0.7)	3(0.7)	1(0.24)	7(1.7)	2(0.48)	20(4.8)
Medicines prescribed	4 (1)	3(0.7)	4 (1)	1(0.24)	6(1.5)	2(0.48)	20(4.8)
Exercises recommended	3(0.7)	2(0.48)	2(0.48)	0	4(1)	0	11(2.6)

Table 2: Leg pain in various age groups

Pain Legs (n=123)	Age Groups of participants (yrs)				Total	
	15-25	26-35	36-45	46-55		P value
Occurs* in 1-2 hrs	5(1.2)	43(10.3)◙	44(10.6)◙	21(5)	113(27.1)	0.01
More than 2 hrs	2(0.5)	1(0.2)*	5(1.2)*	2(0.5)	10(2.4)	0.01
Improves with short breaks	6(1.4)	36(8.7)×	41(9.9)×	21(5)	104(25)	.007
Self prescriptions	5(1.2)	30(7.2)ð	37(8.8)ð	20(4.8)	92(22)	.003
Visited a doctor	0	5(1.2)	5(1.2)	10(2.4)™	20(4.8)	.001
Prescribed medicines	0	5(1.2)	6(1.4)	9(2.2)₳	20(4.8)	.001
Exercise recommended	0	0	3(0.7)	8(1.9)℗	11(2.6)	.001

◙ p= .005 * p= .010 × p= .007 ð p= .003

™p= .001 ₳ p= .001 ℗ p= .001

0.9% female] were additionally recommended exercises (p<.001) and they belonged to 36-45 years (3; 0.7%) and 46-55 years (8; 1.9%) age groups. On the whole, only 2.4% of all participants who suffered from work related pain/tingling or numbness in legs either alone or in combination were prescribed medicines or recommended exercises (p<.001). Distribution of leg pain complaints with various age and working groups is given in Tables 1 and 2.

DISCUSSION

Cumulative trauma disorders with computer usage have enhanced with global progress in computer technology and its wide spread use all over the world. One of the reasons can be prolonged and repetitive work at computer workstation especially with improper posture which may create discomfort; muscle aches, and reduced blood supply with the onset of work related injuries[11]. The symptoms finally end up in MSD/ LLDs which may lead to physical ailments, doctor's visits, hospitalization and sometimes permanent disabilities. A large number of studies, including our set of studies (some of which have already been published[2, 10]), are therefore carried out for awareness of computer ergonomics to avoid onset of MSDs for health and safety of computer users[5,10,12].

Suitable design of workstation with capacity to adjust the equipment mainly computer chair, display screen and key board can prevent onset of a number of MSDs. It is understood from studies that at-ease position requires the individual's feet flat resting comfortably on a foot rest; knees slightly lower than hips with a 2-4 inch gap between the back of knees, front edge of the chair with the back aligned with the chair[10]. Computer users also should have adequate space to stretch legs so as to prevent leg injuries[10]. Studies suggest that an excessive hour of sitting in a chair which is deemed as ergonomically incorrect is a major cause of leg pain in computer users[13]. In our study, participants revealed a positive association of leg pain with number of consecutive hours spent in front of a computer. The complaint of leg pain was registered more by males as compared to females which is contrary to a study with greater number of females complaining of MSDs that compromised their quality of work[5]. In our study, majority of patients complaining of leg pain were in the age range 25-35 years. However, advanced age was declared to be a risk factor for many musculoskeletal symptoms by Antonopoulou et al[12].

Likelihood of MSDs is aggravated by awkward seated postures and lengthy periods of sitting without any breaks[11, 14]. According to a study, computer users need to be aware of the importance of short breaks which decrease stress in soft tissues, disc and nerves that is produced by static postures and prolonged sitting[13]. Participants improved their leg symptoms with application of short breaks which is comparable to a study by Henning et al[14]. They recognized that postural changes and/or a

little break from working position was effective in relieving symptoms especially in 26-35 and 36-45 years age groups. In our study, 104 out of 123 participants with leg symptoms showed improvement with a change in posture coupled with short breaks. Only 20(4.8%) needed to consult a doctor and were prescribed medicines and 11(2.6%) were recommended exercise. This shows that preventive measures helped more in the recovery from leg pain as compared to therapeutic measures. Thus, beneficial effects of regularly scheduled micro breaks documented by our study and supported by Henning et al need to be explained to all the computer users[14].

At present, dynamic interactions between the lover limb and ground are considered to minimize injury risk in athletes[15]. Proper ergonomic design is thus necessary to prevent repetitive strain injuries, which can develop over time with computer usage and may lead to long-term disability[16]. Together with this, occupational wellness demands workers to know and practice safe ergonomics for prevention of MSDs, reduction in; physical ailments, doctor's visits, hospital costs and permanent disabilities[17]. The wisdom to know conscious connections between episodes of leg pain, poor posture and interplay of ergonomics may be the prize to all computer users who care to prevent onset of MSDs.

LIMITATIONS

It was beyond the scope of the study to verify the ergonomic standards that existed at work stations; we had to rely on the verbal statement of participants. Moreover the questionnaire's reliability and validity was not tested.

CONCLUSION

With the increasing use, popularity and dependence on computers, the risk of computer associated health complaints has been amplified. While strategies to improve working conditions are awaited, some preventative steps to create ergonomics awareness and improve human computer interface can minimize the occurrence of MSDs. The complaint of leg pain in our study was only related to continuous hours of computer work without short breaks. Preventive measure to relieve the symptoms through short breaks was cost effective suggesting the need of ergonomic education to reduce physical ailments and psychological stress factors.

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CONTRIBUTORS

RR conceived the study and wrote the manuscript. RK helped in making the questionnaire and in statistical analysis. HK helped in the data collection and the write up of the manuscript. AS helped in drafting the manuscript. All authors contributed significantly to the final manuscript.

Annexure 1: Research Questionnaire

S. No:_____ Research Code No:_____ Name:_____ Age:_____ Gender: M / F Occupation:_____ ARE YOU: Right handed:_____Left handed:_____Both:_____ Are you currently on any medication: Yes No Do you have any impairment: Yes No Address: Contact Info: Phone:_____ E-mail:_____		
How long have you been using computers? (encircle the number) 1 = 5 - 9 years, 2 = 10 years or more		
How long do you work on the computer in a day? (encircle the number) 1 = 8 hours or more, 2 = 5 - 7 hours, 3 = < than 5 hours,		
How many consecutive hrs do you work on the computer? 1 = 1 - 2 hours, 2 = 3 - 4 hours		
Do you work on a desk top for the above mentioned hours?	Yes	No
Do you experience leg pain or discomfort (either alone or in combination) with consecutive hours of work?	Yes	No
If Yes, do you experience it: 1: 1-2 consecutive hours 2: 3 or more hours	1	2
Does leg pain improve with a short break from work either by stretching or change in position?	Yes	No
Do you self prescribe medicines (pain killers) to relieve it?	Yes	No
Did you need to visit a doctor for this problem?	Yes	No
If yes, were you prescribed medicines?	Yes	No
If yes, were you recommended exercises?	Yes	No
Were you recommended an extra support for your chair?	Yes	No