Original Article

Risk Factors for the Musculoskeletal Pain Based on the Computer Ergonomics Related Practices among Medical Professionals

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Abstract

Background: *With The fast growing world, in Bangladesh also getting increased usage of digital connectivity has led to a rise in online activities and also rise in the musculoskeletal (MSK) pain among the professionals.*

Objective: *We investigating the relationship between MSK pain and discomfort among resident doctors because of computer ergonomics related issues.*

Materials and Methods: *The study collected computer ergonomics related information from 227 resident doctors who had used computer for at least one year. Along with descriptive statistical tools, this study addressed essential test of hypothesis and administered a binary logistic regression model to identify the risk factors of MSK pain among resident doctors.*

Results: *The prevalence of neck pain and lower back pain was estimated over 50% whereas more than one-third faced pain in one or both eyes as well as in their upper back. The different sorts of ergonomics significantly associated with different types of MSK pain. The faculty type- taking break, awkward posture, the shoulder placement had significant impact on the pain in one or both eyes. Besides, having gap between leg and seat as well as monitor placement were the significant predictor of neck pain. In addition, wrist not straightening was not the only risk factor for lower back pain and faculty type, device type, gap between legs and seat, Not having an armrest were the risk factors for upper back pain.*

Conclusion: *The computer ergonomics related practices are the fundamental codes for the medical professionals to avoid MSK pain and hence specific practice safeguards for specific pains.*

Key words: *Ergonomics, Musculoskeletal pain, Medical Professionals.*

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Introduction

Ergonomics deals with adjusting the work environment, tools, tasks, and equipment to fit with the employee's physical capability and limitations.[1] Easy access to digital information and communication has likewise transformed to computer usage in Bangladesh and consequently appears as a fundamental problem among professionals. In our nation and throughout the world, computer use in medical science has become a massive benefit to both doctors and patients. It has accelerated the pace of learning, clinical workflow, and the interchange of information and ideas among doctors, as well as reduced medical errors, enhanced patient experience, and reduced costs. However, if the computer is not designed ergonomically, it might lead to a variety of musculoskeletal disorders.

According to prior research, globally, the number of persons suffering from musculoskeletal diseaseshas grown by 25 percent over the previous decade, and these illnesses account for approximately 2 percent of the global disease burden.[2] On the other hand, ergonomics emerges as an issue since many of these musculoskeletal conditions are common computer-related injuries.[3] Besides that, Khan and Siddiqui concluded that low back pain is a widespread phenomenon among computer users in all age groups and is more common in the younger age group

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(16-18 years) with a second spike (23-30 years) specifically in the beginning of their carrier.[4] The neck and finger pain was found to be the highest complaints with 61.3% and 41.3%, respectively in some private and government offices of Bangladesh.[5] They also found a statistically significant association between musculoskeletal disorders (MSK) with longer duration and incorrect position of computer use. Despite above 50% users used adjustable furniture, monitor, and computer desk, more than half of the surveyed computers users complained neck pain and back pain.[6] Moreover, Over 50% of university students experience pain attributed to computer use.[7] In a continuation of this study, they found that notebook computer users reported a higher rate of musculoskeletal symptoms when compared with desktop users. A similar finding found and added that one in seven were had pain after working for an hour on the computer.[8,9] Recent studies found a growing body of epidemiological evidence that supports a causal relationship between repetition, force, posture, and upper extremity musculoskeletal disorders (UEMSKs).[8,10,11] Srilatha concludes that women (69%) were more prone to report symptoms than men (53%). Computer users aged 21-30 years (76%) were more to report symptoms than those aged 40-55 years (9 %).[12] However, AbulQasim et al. and Khan et al. express the standard view that computer use for an extended period predisposes to many health problems including shoulder, elbow, wrist, low back pain, and neck pain.[13,14] The position of a video display terminal (VDT) relative to the eyes can influence visual strain.[15] They added the two main parameters of VDT position are the viewing distance from the eyes to the screen and the height of the visual target relative to the eyes. One reported a concerning association between neck pain and the number of hours spent on a computer in adolescents.[16] Ergonomics training and intervention is generally considered as the most excellent strategy to minimize the occurrence of computer-related health issues. Moreover, there is a need to educate new computer users on computer-related ergonomics. The computer and the internet are increasingly becoming a crucial component of doctors' medical education and professional lives in many parts of the world. Unfortunately, there is no data available on this issue within the medical community of Bangladesh. Among all physicians, resident doctors have an unparalleled position since they have to fulfill the dual role of being a clinician and a student at the exact moment. In this respect, the current research aimed to investigate the relationship between musculoskeletal pain and discomfort among resident doctors because of computer ergonomics related issues.

Materials and Methods

This study was conducted in the Department of Physical Medicine and Rehabilitation of Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, for over one and a half years from March 2015 to September 2016. There were 20 disciplines in the Faculty of Medicine, 14 disciplines in the faculty of Surgery, and 8 disciplines in the Faculty of Basic and Paraclinical Science. On average, seven residents take 39 admissions in every discipline each year. Approximately 294 residents were admitted to different disciplines in residency courses at BSMMU and about 1470 residents in Phase A and Phase B from R-3 to R-7 batch. Only those residents who got admitted to these faculties in phase A in the five years from 2012 to 2016 were our study population. The population used either desktop/laptop computer or both for at least one year were our sampling unit. Besides the study was also excluded some respondent who were used computer for less than a year, R-1 and R-2 batch residents, residents admitted in phase A before 2012, had any physical disability which prevented him/her from practicing computer ergonomics, had history of fractures, significant trauma, inflammatory rheumatic diseases like RA, SPA, and systemic illness.

The data were collected using structured questionnaire from 227 resident doctors (age 26 to 42 years) of three faculties who used desktop/laptop computer for at least one year. Based on the availability of sampling frame, the study used Cochran's sample size formula for a sufficiently large population and collected data on socio-demographic and computer ergonomics related information adopting simple random sampling technique.[17] Computer ergonomics related general information includes durationof computer usage, type of computer use, knowledge and awareness of ergonomics, practice of computer ergonomics, and occurrence of MSKs among resident doctors of BSMMU. The questionnaire was prepared based on previous studies on ergonomics, theory, a standard questionnaire on computer ergonomics (Easy ergonomics for desktop computer users, 2005), and a Standardized Nordic Questionnaire to analyze musculoskeletal symptoms.

The data were managed and analyzed statistically using Statistical Package for Social Sciences (SPSS) (Version-25.0). Data analyzing tools include descriptive and inferential statistics.Based on the types of the study variables, this study explored the study variables using frequency and proportion to identify misleading and inconsistent responses of the respondent. Based on the aim of the study, test of independence (Chi-square test) was used to determine the association between categorical variables, i.e., to assess associations of general variables (age, sex, residency phase and medical faculty) and computer ergonomics related variables and their consequences for MSK pain among medical faculties in Bangladesh.This study focused on the major four MSK pain (figure 1) such as pain in one or both eyes, neck pain, lower back pain, and upper back pain. The study relied on the chi-square test to fix the set of covariates to identify the cause and effect relationships between MSK pains and computer ergonomics practices along with some basic variables. The study used same set of covariates for all models and therefore, includes each variable which had significant association with the dependent variable.

Results

The study estimated the prevalence of all possible MSK pain occurred by the consequence of ergonomics related practices. Figure 1 illustrates the occurrence of pain in different parts of the body during the last one year. Almost 60% of the total study respondents claimed that they were suffered from neck pain after using computer. In addition, more than half of the

computer user medical professionals had discomfort in their lower back. More than one-third of the professionals had one or both eye and upper back pain as well. It was also seen that about 25% of the resident doctor had misery on their shoulder and wrist or hand.

At the beginning, Chi-square test was used to specify the covariates for the binary logistic regression model. A covariate having significant ($p<0.05$) association with any one dependent variable was included in the binary logistic regression model (Table I).

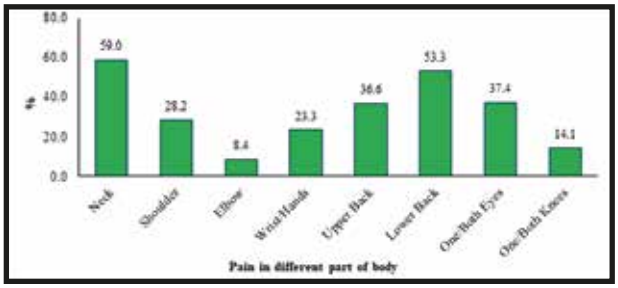

Figure 1: Occurrence of pain in different parts of the body in last one year.

Table I: Measure of association (Chi-square (P-value)) between computer ergonomics practice and MSK pain (N=227).

Variables	One or both eye	Neck	Lower back	Upper back
	χ^2(P-value)	χ^2(P-value)	χ^2(P-value)	χ^2(P-value)
Age group	3.39 (0.335)	0.66 (0.882)	1.36 (0.714)	1.16 (0.764)
Sex	9.78 (0.002)	0.26 (0.611)	0.47 (0.493)	11.79 (0.001)
Medical faculty	15.53 (<0.01)	1.37 (0.505)	1.40 (0.496)	8.58 (0.014)
Type of computer	1.74 (0.418)	2.39 (0.302)	1.79 (0.410)	7.83 (0.020)
Regularly take a break for 20 -30 min	5.88 (0.015)	4.85 (0.028)	2.23 (0.135)	1.70 (0.192)
Chair height adjusted for footrest	0.64 (0.424)	2.63 (0.105)	0.10 (0.747)	0.03 (0.873)
Have a 2 - 4 inch gap between the legs and the seat	4.52 (0.033)	5.13 (0.024)	1.85 (0.174)	11.71 (0.001)
Thighs parallel to the floor with hip and Knee at 90^0	1.14 (0.285)	0.60 (0.437)	1.45 (0.229)	4.65 (0.031)
The curve of the chair fit into the lower back	1.39 (0.239)	0.04 (0.843)	5.29 (0.021)	1.55 (0.213)
The chair has an armrest	0.03 (0.866)	0.09 (0.762)	5.02 (0.025)	5.78 (0.016)
Can type without overreaching/awkward posture	4.14 (0.042)	0.26 (0.608)	0.02 (0.882)	0.50 (0.478)
Elbows bend to 90 degrees and close to the body	0.96 (0.328)	2.62 (0.106)	6.12 (0.013)	3.25 (0.072)
Keyboard at the same height as elbows	0.28 (0.595)	0.24 (0.623)	3.21 (0.073)	5.74 (0.017)
Wrists remain straight during typing	7.85 (0.005)	0.88 (0.348)	8.27 (0.004)	14.62 (<0.01)
Shoulder remains relaxed (not hunched)	3.86 (0.050)	0.40 (0.525)	0.46 (0.499)	6.37 (0.012)
The mouse at the same level to the keyboard	0.07 (0.791)	1.61 (0.204)	0.01 (0.968)	3.63 (0.057)
Top of the screen at or below eye level	0.44 (0.508)	0.21 (0.646)	1.28 (0.258)	1.44 (0.230)
Monitor placed at 50 -100 cm distance	3.42 (0.064)	0.83 (0.361)	1.24 (0.266)	11.72 (0.001)
Document at the same distance as monitor	0.48 (0.491)	0.32 (0.572)	0.52 (0.470)	0.03 (0.873)

Table I shows the measurement of the association between computer ergonomics practice and MSK pain. The study revealed that the age group of the computer user, chair height adjusted for footrest, the mouse at the same level to the keyboard, top of the screen at or below eye level, and document at the same distance as monitor were not significantly($p>0.05$) associated with any kind of MSK pain. The study findings indicate that gender of the user, medical faculty type, monitor placed at 50-100 cm distance and shoulder remains relaxed (not hunched) were significantly ($p<0.05$) associated with one or both eye and upper back pain. The study also finds that types of computers and thighs parallel to the floor with hip and knee at 90o were significantly ($p=0.02$) matters for upper back pain of the user. In addition, regularly taking a break for 20-30 min is significantly associated with one or both eye and neck pain. The study findings also revealed that there was a significant association between having a 2–4 inch gap between the legs and the seat and one or two eyes, neck, and upper back pain. The study further revealed that there was a significant ($p=0.021$) association between the curve of the chair fit with the lower back and lower back pain. The chair having an armrest, elbows bend to 90 degrees, and close to the body and keyboard at the same height as elbows were significantly associated with lower and upper back pain. The study findings also show that typing ability without overreaching/awkward posture was significantly ($p<0.05$) associated with one or both eye pain. The study findings further indicate that wrists remain straight during typing had a significant ($p<0.05$) association with one or both eye, lower and upper back pain.

Table II: Determinants of MSK pain identified from computer ergonomics related factors.

Variables	One or both eye	Neck	Lower back	Upper back
	β^1 (SE)	β^1 (SE)	β^1 (SE)	β^1 (SE)
Female gender	0.454 (0.362)	-0.078 (0.349)	-0.070 (0.348)	0.586 (0.369)
Medical faculty				
Medicine faculty *Reference*				
Surgery faculty	0.207 (0.407)	0.058 (0.372)	0.087 (0.379)	0.455 (0.421)
Basic and paraclinical science faculty	**1.218 (0.436)**	0.237 (0.419)	0.217 (0.413)	**0.924 (0.441)**
Type of computer				
Desktop computer *Reference*				
Laptop computer	0.843 (0.766)	0.778 (0.657)	0.381 (0.637)	**1.950 (1.126)**
Both desktop and laptop computer	0.442 (0.783)	0.931 (0.667)	0.814 (0.654)	**2.042 (1.129)**
Regularly take a break for 20 -30 min	**-0.650 (0.360)**	-0.509 (0.319)	-0.265 (0.321)	-0.107 (0.364)
Have a 2 -4 inch gap between the legs and the seat	-0.629 (0.385)	**-0.750 (0.362)**	0.086 (0.353)	**-0.755 (0.388)**
Thighs parallel to the floor with hip and Knee at 90 ^{0}	0.243 (0.392)	0.111 (0.358)	0.012 (0.357)	0.244 (0.406)
The curve of the chair fit into the lower back	-0.108 (0.376)	0.269 (0.346)	-0.561 (0.342)	0.251 (0.386)
The chair has an armrest	0.041 (0.358)	0.040 (0.329)	-0.527 (0.324)	**-0.626 (0.366)**
Can type without overreaching/awkward posture	**0.882 (0.395)**	0.220 (0.347)	0.036 (0.345)	-0.104 (0.375)
Elbows bend to 90 degrees and close to the body	0.049 (0.375)	-0.359 (0.343)	-0.398 (0.339)	0.134 (0.382)
Keyboard at the same height as elbows	0.462 (0.377)	0.119 (0.340)	0.179 (0.338)	-0.203 (0.369)
Wrists remain straight during typing	-0.361 (0.374)	-0.237 (0.341)	**-0.807 (0.340)**	-0.532 (0.365)
Shoulder remains relaxed (not hunched)	**-0.608 (0.357)**	-0.269 (0.334)	0.117 (0.330)	-0.416 (0.348)
Monitor placed at 50 -100 cm distance	-0.550 (0.399)	**0.642 (0.379)**	0.257 (0.373)	-0.582 (0.388)

/ Bold number represent the estimates is statistically significant at 5% significance level.

Table II shows the results of the binary logistic regression models for four kinds of MSK pain which is used to identify the determinants of four types of MSK pain. The study findings revealed that basic and paraclinical science faculty, regularly take a break for 20-30 min, can type without overreaching/awkward posture and shoulder remains relaxed (not hunched) were the significant predictor for one or both eye pain. Doctors with basic and paraclinical science faculty backgrounds suffer from one or both eye pain on an average of 1.218 units more than medical faculty doctors. It was documented that doctors who took a regular break for 20-30 minutes during computer use felt one or both eye pain on an average of 0.650 units less than doctors who didn't take a break, and the doctors who can type without overreaching/awkward posture suffered from one or both eye pain on an average of 0.882 units higher than those who can't type without overreaching/awkward posture. The study findings indicated that in case of one or both eye pain, doctors who kept their shoulder remains relaxed (not hunched) during computer use were on an average 0.608 units less sufferer than those who didn't follow this computer ergonomics. In case of neck pain, the two types of computer ergonomics viz., having a 2-4 inch gap between the legs and the seat and monitor placed at a 50-100 cm distance were significant predictors. The study findings show that during computer use the respondents who keep a 2-4 inch gap between the legs suffered from an average of 0.750 units lower than those who didn't keep a 2-4 inch gap between the legs. The doctors who placed the monitor at 50-100 cm distance were suffered from upper back pain. The only significant predictor of lower back discomfort was keeping the wrists straight when typing. The doctors who followed the computer ergonomics had an average of 0.807 units fewer lower back pain than those who didn't. The study also found that basic and paraclinical science faculty, laptop computer, both desktop and laptop computer, had a 2-4 inch gap between the legs and the seat and the chair had an armrest had significant effect on upper back pain. The positive value of the regression coefficients indicates that the doctors with basic and paraclinical science faculty backgrounds, laptop computer or both laptop and desktop computer user were significantly ($p<0.05$) feeling pain in their upper back as compared with medicine faculty doctors and desktop computer user respectively. On the other hand, the negative value of the coefficients indicates that the doctors who maintain the computer ergonomics like having a 2-4 inch gap between the legs and the seat and the chair had an armrest were facing significantly ($p<0.05$) fewer pain in their upper back than who didn't maintain those computer ergonomics.

Figure 2: Illustrates the relationship of pain with work and computer use. The study discovered that about 60% of the doctors stated that their MSK pain increased during workdays. More than half of the study respondents agreed that the various pain was related to computer work. There is clear indication

that almost one-fourth of the study partakers stated that the MSK pain prevent them from normal work.

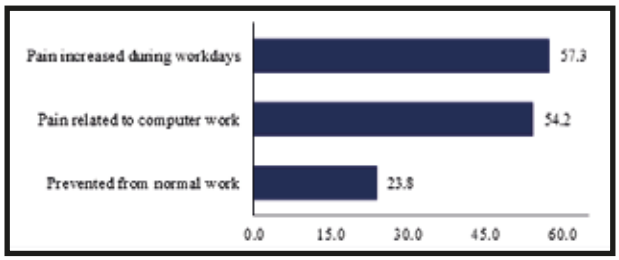

Figure 2: Relationship of pain with work and computer use.

Discussion

The reason behind the high prevalence of MSK problems in students who use computers, stating that students typically spend a large portion of their day in a static sitting position, in a classroom, the library or at a desk in their dorm room on a hard wooden or plastic chair that has limited support.[9] Desks are often small and cluttered, and the chairs are not adjustable, which may contribute to awkward postures. Computing is done in the dorm room at the student's desk, on the bed or on the floor, which would be even more difficult to rectify except through education. When the notebook used without any peripherals is set on a desk or table, the keyboard is usually too high, which causes hunching of the shoulders and contact between the hand/wrist/forearm and the hard desk edge. In addition, the monitor is too low, which pulls the head and neck forward and down, which may cause neck strain and discomfort.[18] Asundi et al. found that postures assumed when using a notebook on a lap desk were less neutral than those associated with using a desktop computer configured with an external monitor, keyboard and pointing device.[19] It is to be noted that prolonged use of computers during daily work activities and recreation is often cited as a cause of neck pain. While some retrospective studies support the hypothesis that frequent computer operation is associated with neck pain, few prospective studies reveal causal relationships.[20]

Reluctance to implement preventive measures, absence of good ergonomic computer set-up, and faulty posture are the culprits causing all these computer-related havoc.[4,13,14] Important risk factors appear to be a repetitive motion of the arm or wrist, movements that require extremes of hand and arm position, and prolonged static postures.[21] Long duration of improper posture contributes to repetitive injuries to the back. Prolonged sitting or standing without breaks or rest increases intra-discal load and weakens posterior lumbar structures.[14]

Conclusion

To safeguard physicians from musculoskeletal injury risks, there is a need to enhance awareness and practice of computer-related ergonomics through formal computer ergonomics instruction and training after ergonomic assessments of computer work stations and adopt steps to encourage healthy computer use in Bangladesh's health sector. It can be included in public health education programs.

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