

Original Article

Gender differences in musculoskeletal discomfort due to computer use among university students in the United States

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Abstract

Objective: Women report higher incidence of musculoskeletal discomfort due to computer use. This study examines the gender differences in the association of musculoskeletal discomfort and computing characteristics among university students. **Methods:** A cross-sectional survey design was used with a sample size of 338 students from a public university. Multivariable logistic regression models were used to assess associations of musculoskeletal discomfort and participant characteristics. **Results:** 61% of students reported having MSD. Male students between the age group of 26-35 years (AOR=5.086 [CI=1.05-24.48]) and those who only sometimes took breaks (AOR=3.835 [CI=1.25-11.71]) were more likely to report MSDs. Female students who used computer for more than 8 hours a day (AOR=6.199 [CI=2.38-16.11]), those who spent between 5-8 hours (AOR=2.174 [CI=1.04-4.51]), and those who assumed awkward postures (AOR=5.588 [CI=1.24-25.1]) were more likely to report MSDs after adjustment. **Conclusion:** It is important to emphasize the benefits of ergonomics for males in the adult age group. Regardless of age, for female students' adequate breaks from using the computer, and avoiding awkward postures are necessary to prevent and mitigate the risk factors of musculoskeletal discomfort. The different risks factors for male and female students have important implications for prevention of musculoskeletal disorders.

Keywords: Computer use, Gender, Musculoskeletal disorders, Students

Introduction

Individual risk factors for musculoskeletal disorders and discomfort among college computer users include age, female gender, number of hours spent on the keyboard, awkward postures, static load, poor ergonomic conditions, and low physical activity¹⁻⁴. Musculoskeletal disorders and discomfort (MSD) are soft-tissue injuries caused by exposure to repetitive motion, force, vibration, and awkward positions and can affect the muscles, nerves, tendons, joints and cartilage in the human body⁵. The importance of ergonomics, good posture, and good computing habits in work and daily life has been emphasized by workers using computers in the midst of the COVID-19 pandemic where the predominant mode of learning has been online⁶. Literature emphasizes the role of risk factors of musculoskeletal disorders among school and college students and the potential for predisposing adults to musculoskeletal conditions such as neck and low back pain in their working life⁷. Student posture in classroom has been implicated as a risk factor for spinal MSD⁷.

Women suffer approximately twice as much as men from computer work-related complaints in the neck and upper extremities mainly due to the skeletal differences between male and female, wherein women may need to work in more extreme postures or use higher relative muscle forces than men⁸⁻¹⁰. Anthropometry defines the differences in physical characteristics between individuals such as a person's size, form, and functional capacities^{9,10}. Research suggests that women had higher muscular activity in certain muscles such

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Characteristics	Total N (%)	Female N (%)	P value	Male N (%)	P value
Total	338 (100)	232 (100)		106 (100)	
Gender					
Females	232 (68.6)				
Males	106 (31.3)				
Age groups in years			0.932		0.030
18- 25	231 (68.3)	154 (66.4)		77 (72.6)	
26-35	89 (26.3)	67 (28.9)		22 (20.8)	
36 and above	18 (5.3)	11 (4.7)		7 (6.6)	
Student type			0.891		0.079
Undergraduate	230 (60)	157 (67.7)		73 (68.9)	
Graduate	108 (40)	75 (32.3)		33 (31.1)	
MSD					
Yes	207 (61.2)	153 (65.9)		54 (50.9)	
No	131 (38.7)	79 (34.1)		52 (49.1)	
Reported hours/day on computer			0.005		0.158
Less than 4 hours	62 (18.3)	44 (19.0)		18 (17.0)	
5- 8 hours	175 (51.8)	127 (54.7)		48 (45.3)	
More than 8 hours	101 (29.9)	61 (26.3)		40 (37.7)	
Reported assuming awkward positions			0.035		0.003
Yes	321 (94.9)	223 (96.1)		98 (92.5)	
No	17 (5.0)	9 (3.9)		8 (7.5)	
Reported taking breaks			0.040		0.921
Often take breaks	70 (20.7)	43 (18.5)		27 (25.5)	
Sometimes take breaks	175 (51.7)	118 (50.9)		57 (53.8)	
Do not take breaks	93 (27.5)	71 (30.6)		22 (20.8)	

Note: Boded p value= statistically significant. MSD- Musculoskeletal discomfort.

Table 1. Computing characteristics by gender in university students.

as having the highest exertion in the neck and shoulder than men when operating a computer mouse, as the average female has a smaller skeletal system and a shorter reach distance than the average male⁸⁻¹¹.

Several studies have highlighted college students risk factors for MSDs when using computer such as typing duration, and not taking breaks, however there is not much research that explores the computing characteristics and their impact on the incidence of MSD and the differences across gender. Based on the evidence in the literature, there is a need to emphasize the importance of educating students about MSD especially given the differences for risk factors based on gender. Healthy computing attitudes and behaviors based on gender is imperative to avoid female students risk factors related to their skeletal type^{3,9,10}. Thus,

this study examines the gender differences in the association of musculoskeletal discomfort related to computing characteristics among university students. This has significance for educating male and female students about reducing the risk factors of developing musculoskeletal disorders based on anthropometrics and computing habits as they enter into the workforce. This knowledge could help offset a future workforce's probability for developing computer related musculoskeletal disorders.

Methods

A cross-sectional survey design was used for this study with a sample size of 338 undergraduate and graduate students from a public university in the east coast of the United States. An email invitation containing the link to the

Characteristics	Female		Male	
	OR ² (95% CI) ¹	AOR ³ (95% CI) ¹	OR ² (95% CI) ¹	AOR ³ (95% CI) ¹
Age groups in years				
18- 25	Reference	Reference	Reference	Reference
26-35	1.073(0.58-1.97)	1.208(0.50-2.87)	3.200(1.13-9.05)	5.086(1.05-24.48)
36 and above	0.918(0.25-3.27)	0.500(0.12-1.99)	0.900(0.18-4.29)	1.009(0.14-7.01)
Student type				
Undergraduate	Reference	Reference	Reference	Reference
Graduate	0.960(0.53-1.71)	0.675(0.29-1.55)	2.121(0.91-4.14)	0.756(0.21-2.69)
Reported hours/day on computer				
Less than 4 hours	Reference	Reference	Reference	Reference
5- 8 hours	1.822(0.91-3.64)	2.174(1.04-4.51)	1.330(0.44-4.01)	1.027(0.29-3.55)
More than 8 hours	4.08(1.72-9.69)	6.199(2.38-16.11)	2.619(0.83-8.21)	1.874(0.49-7.05)
Reported assuming awkward positions				
Yes	4.110(1.00-16.89)	5.588(1.24-25.1)	-	-
No	Reference	Reference	-	-
Reported taking breaks				
Often take breaks	Reference	Reference	Reference	Reference
Sometimes take breaks	1.380(0.65-2.90)	1.427(0.65-3.11)	2.337(0.91-5.99)	3.835(1.25-11.71)
Do not take breaks	0.691(0.31-1.51)	0.558(0.24-1.28)	1.700(0.54-5.33)	2.493(0.64-9.71)

¹Confidence Interval. ²OR, Odds Ratio. ³AOR, Adjusted Odds Ratio, adjusted for the variables listed in this table.

Table 2. Association between computing characteristics and gender among university students with musculoskeletal discomfort due to computer use.

survey was sent using REDCap. A total of 362 students responded to the survey. Incomplete surveys were excluded from the analysis.

Instrument

The survey consisted of the demographic variables such as age (Between 18- 25 years, 26-35 years and above 36 years), gender (male and female), number of hours spent using the computer per week, (less than 4 hours, 5-8 hours and more than 8 hours), class standing (undergraduate and graduate) and incidence of MSD (yes/no) and behaviors such as assuming awkward positions (yes/no) and taking breaks (often, take breaks, sometimes take breaks and do not take breaks) while using computers. The survey was adapted from the Cornell musculoskeletal discomfort questionnaire and was designed solely for research purposes¹².

Statistical Analysis

The frequencies and percentages of MSD for the participant characteristics were calculated across gender. Chi-square test and Fischer Exact test were used to measure the bivariate association between each MSD and demographic and computing characteristics for males and

females separately. Multivariable logistic regression models were used to assess associations of MSD and participant characteristics. The unadjusted and adjusted odds ratio and 95% confidence intervals (CIs) were calculated, adjusting for age group, number of hours spent using on the computer per day, class standing, assuming awkward positions, and taking breaks. Separate models were constructed for males and female students. All analyses were conducted using SPSS, (Chicago) version 27. Statistical significance was set at the 0.05 level.

Results

In this sample of 338 college students, there were 232 females (68.6%) and 106 (31.3%) males. There were 231 students (68.3%) in the age group of 18-25 years, and 260 (60%) were undergraduate students. Sixty one percent of students reported having musculoskeletal discomfort. Table 1 presents the demographic and computing characteristics of the students. Most of the students spent 5-8 hours (52%) using the computer in a day and assuming an awkward posture (95%). About 52% of students reported sometimes taking a break while using the computer, while 27.5% students reported not taking a break.

Table 2 shows the association between computing characteristics and gender among college students with musculoskeletal discomfort due to computer use. The logistic regression analysis showed that age was significantly associated with reporting MSDs among males. Male students between the age group of 26-35 years were more likely to report MSD (AOR=5.086 [CI=1.05-24.48]) than male students in the 18-25 years age group after adjusting for the other variables. There was no significant association between age groups and reporting MSDs among female students.

Female students who used computer for more than 8 hours a day (AOR=6.199 [CI=2.38-16.11]), and those who spent between 5-8 hours (AOR=2.174 [CI=1.04-4.51]) were more likely to report MSDs than female students who spent less than 4 hours on the computer per day, after adjusting for other variables. There was no significant association between hours spent on the computer per day and reporting MSDs among male students (Table 2). Female students who assumed awkward postures while using computers were more likely to report MSDs (AOR =5.588 [CI= 1.24-25.1]) than those who did not assume awkward postures after adjustment. The sample size was too small for analysis to explore the association between awkward postures and MSD among male students. Male students who some times took breaks were more likely to report MSDs (AOR=3.835 [CI= 1.25- 11.71]) compared to male students who often took breaks, after adjusting for other variables. There was no significant association between taking breaks and reporting MSDs among female students (Table 2).

Discussion

The findings reveal significant differences in student demographic and computing characteristics between male and female students and show that differences in musculoskeletal discomfort are likely multifactorial. Male students between 26-35 years, female students who spent more than four hours using the computer per day, and female students who assumed awkward postures while using the computer were more likely to suffer from musculoskeletal discomfort.

Several differences in the risk factors of musculoskeletal discomfort between male and female students were highlighted in the findings. Consistent with previous literature, although females in this sample reported higher MSD compared to males^{3,8}, it was interesting to note that, the incidence of MSD in females were not related to age, however for male students, those in the age group of 26-35 years reported higher incidence of MSD. In a similar study, those participants over the age of 30 years had high burden of MSD¹³. Female students also reported higher incidence of MSD if they spent more than four hours using the computer, which was not reported by the male students. This difference in risk factors could be attributed to the anthropometric differences between male and female skeletal system^{9,10}, as females have a

smaller skeletal system and a shorter reach distance than males on average. This may lead them to adopt awkward postures more often to adjust to their computer or desk or chair. In a study it was found that women had higher muscular activity in the right and left trapezius muscles and had the highest exertion in the neck and shoulder than men when operating a computer mouse¹⁴. Similar findings were reported in this study, as female students who assumed awkward postures were more prone to MSD. The anthropometric differences between male and female skeletal systems may have implications for MSD, explaining the lack of significant association between hours spent on the computer per day and MSDs among male students, while the female students reported having MSD after using the computer more than four hours in a day.

There is a correlation relation between sitting duration and hours spent using a computer and MSD^{2,7,15,16} as sitting for long increases the thoracic kyphotic curve and decreases the lumbar lordotic curve which, in turn, leads to the compression of intervertebral discs and causes MSD¹⁰. Importance of taking breaks has been highlighted in previous studies, the lack of which leads to repetitive trauma of the soft tissues^{2,6,9,10,13}. The present study also reports similar findings as male students who only sometimes took breaks were more likely to report MSDs than those students who often took breaks. What is however interesting is that this finding was only seen in male students. There was no significant association between taking breaks and reporting MSDs among female students, although research show that repetitive computer use may lead to inadequate time for complete recovery with the adverse effect that prolonged sitting may predispose them to MSD^{9,10}.

Remarkable differences in the risk factors related to computing behaviors among male and female students represent a significant opportunity to educate students based on their gender, age group and anthropometry to prevent the development of musculoskeletal discomfort or disorders^{9,10,12,17}. These findings have important implications for college student health and wellness professionals as well as human resource professionals and indicate the importance of ergonomic education and interventions in the college and workplace^{6,18}. Some of the findings that were not significant in this study, could be due to the small sample size of male students, that warrants further investigations with a larger sample size representing different age groups and gender. Given the finding that age group was significant only for male students, it is worthwhile to explore risk factors with a larger sample containing different age groups of male and female students. The findings of this study indicate that it is important to emphasize the benefits of ergonomics and prevention of MSD for male in the age group of 26-35 years, both in the college atmosphere as well as in the workplace for men^{18,19-21}. Similarly, it is worth noting that regardless of age, for females due to the difference

in the skeletal system, adequate breaks from using the computer, and avoiding awkward postures are necessary to mitigate the risk factors of MSD and prevention. Education and awareness are the key especially for those who are entering the workforce to be aware of the potential occupational hazard associated with long duration of working in front of the computer^{9-11,13,15}.

Limitations

There are several limitations to this study. The study was a cross-sectional survey with a small sample size, thus may not establish the causal relationship between the independent variables and musculoskeletal discomfort. The survey relied on self-reports from the participants and may be subject to social desirability bias. Additional information on individual and health behaviors characteristics associated with MSD, were not assessed in the analysis, and could further our understanding of factors that relate to the incidence of MSD in students. As MSDs are multi-factorial, other factors such as use of ergonomic furniture, individual knowledge of ergonomics, behavioral factors, and psychosocial factors, were not included in this study. Future studies that take these variables into consideration are warranted. Future studies with an even distribution of male and female students will help in analyzing the association of awkward postures for male students, which could not be analyzed due to a smaller sample size in this study.

Conclusion

This study found significant differences in demographic and computing characteristics for musculoskeletal discomfort among male and female college students. For male college students age and inadequate break while using computers were significant factors, while computing behaviors such as using computer for more than four hours, and assuming awkward postures were significant for female college students. The different risks factors for male and female college students have important implications for educational institutions and employers alike to emphasize the urgency to develop better strategies highlighting the risks factors for male and female skeletal systems to prevent musculoskeletal discomfort and from having an impact on students before entering the workforce.

Ethics approval

This study was approved by the Institutional Review Board (IRB) of the Virginia Commonwealth University, ID: HM20012910.

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