ISSN: 2476-5279; International Journal of Musculoskeletal Pain Prevention. 2018;3(2):63-67

Application of Ergonomic Approach in Assessing Musculoskeletal Disorders Risk Factors among Administrative Employees of Medical University

ARTICLE INFO

Article Type
Descriptive Study

Authors
Gholami T.*[1] *MSc*,
Maleki Z.[2] *BSc*,
Ramezani M.[3] *MSc*,
Khazraee T.[3] *MSc*

How to cite this article
Gholami T, Maleki Z, Ramezani M, Khazraee T. Application of Ergonomic Approach in Assessing Musculoskeletal Disorders Risk Factors among Administrative Employees of Medical University. International Journal of Musculoskeletal Pain Prevention. 2018;3(2) :63-67.

ABSTRACT

Aims Musculoskeletal disorders (MSD) is a usual complaint among workers engaged in static work, tasks requiring repetitive motion, and prolonged computer work. The aims of the present study were to assess office work-associated ergonomic risk factors using ROSA method as well as to identify which office equipment is more conducive to musculoskeletal disorders in office workers.

Instruments & Methods This cross sectional descriptive study was conducted among 163 employees of Fasa University of Medical Sciences (FUMS), Iran, in 2017. Data were collected by simple random sampling method. Demographic characteristics questionnaire, Standardized Nordic questionnaire (NMQ), and rapid office strain assessment (ROSA) checklist were used to collect data. Descriptive statistics and binary logistic regression were used for data analysis. All the statistical analyses was carried out using SPSS 20 software.

Findings The majority of musculoskeletal disorders in the last 12 months had occurred in lower back (60.7%), neck (50.9%), and knee (48.5%). Risk level for 137 participants (84.04%) was at the notification area (Score 3 to 5) and for 26 participants (15.95%) was at the need for ergonomic intervention area (score>5). Chair was identified as the major cause of pain in many parts of the body including elbows, lower back, knees, and legs.

Conclusion Various risk factors, such as office equipment, in the workplace, may contribute to MSDs in different body regions. Chair is the major cause of pain in many parts of the body.

Keywords Musculoskeletal Pain; Ergonomics; Office Equipment; ROSA

CITATION LINKS

[1] Applied Research Branch, Human Resources Development ... [2] Working with ... [3] Ergonomics, musculoskeletal disorders and ... [4] Effect of physical ergonomics on VDT workers' health ... [5] Keyboard use and musculoskeletal outcomes among computer ... [6] Prevalence rates and odds ratios of shoulder-neck ... [7] Work related and individual predictors for incident neck pain among ... [8] Musculoskeletal symptoms and duration of computer ... [9] A comparison of methods for the assessment of postural load and duration ... [10] Effects of computer mouse design and task on carpal tunnel ... [11] The effect of forearm support on musculoskeletal discomfort ... [12] Ergonomic evaluation of office workplaces with Rapid Office ... [13] An investigation of rapid office strain assessment and rapid upper limb assessment ... [14] The Rapid Office Strain Assessment (ROSA): Validity ... [15] Standardised Nordic questionnaires for the analysis of ... [16] Development and evaluation of an office ergonomic risk checklist: ROSA--Rapid office ... [17] Musculoskeletal injuries and their associated ... [18] Individual and work-related risk factors for musculoskeletal pain: A cross-sectional study among ... [19] Prevalence and impact of musculoskeletal disorders in New Zealand nurses, postal workers and ... [20] Cultural differences in musculoskeletal symptoms and ... [21] Are neck flexion, neck rotation, and sitting at work risk factors for neck pain? Results of a prospective ... [22] Self-reported workplace related ergonomic conditions as prognostic factors for musculoskeletal symptoms: The "BIT" follow up study ... [23] Match between school furniture dimensions and children's ... [24] Classroom furniture dimensions and anthropometric measures ... [25] Musculoskeletal, visual and psychosocial stress in VDU operators before and after multidisciplinary ergonomic ... [26] Effect of four computer keyboards in computer users with upper extremity musculoskeletal ... [27] The effectiveness of a chair intervention in the workplace to reduce musculoskeletal symptoms ... [28] Mechanical effects of continuous passive motion on the lumbar ... [29] Epidemiology of musculoskeletal disorders among computer users: Lesson learned from the role of ... [30] The effects of using a single display screen versus dual screens on neck-shoulder muscle activity during computer ...

[1]"Non-Communicable Disease Research Center" and "Public Health Department, Health Faculty", Fasa University of Medical Sciences, Fasa, Iran
[2]Public Health Department, Health Faculty, Fasa University of Medical Sciences, Fasa, Iran
[3]Non-Communicable Disease Research Center, Fasa University of Medical Sciences, Fasa, Iran

Correspondence
Address: Public Health Department, Health Faculty, Fasa University of Medical Sciences, Fasa, Iran
Phone: -
Fax: -
gholamitahereh@yahoo.com

Article History
Received: January 15, 2018
Accepted: February 26, 2018
ePublished: June 21, 2018

Introduction

In the past 20 years, the amount of computer work has increased dramatically. Sixty percent of the workers were required to use a computer as part of their job duties in 2000, and 80% of employees reported that they used a computer to perform all their duties [1, 2]. This increase in the use of computers at work results in compromised employee wellbeing. The prevalence of musculoskeletal disorders (MSD) was reported to be between 10% and 62% for all computer workers by Wahlström [3]. In the reviews were done by Bayeh and Smith in 1999 [4] and Wahlström in 2005 [3], there were similar increases in the number of musculoskeletal disorders since the inception of occupational computer use.

Musculoskeletal disorders resulting from computer work are mainly linked to the upper limbs [5], head, neck [6, 7], and back [8]. Office work has been associated with some Work-Related MSD (WRMSD) risk factors such as awkward or critical postures, prolonged static sitting [9], sustained non-neutral postures of the upper limbs [10], static low-load or repetitive work, increased muscular activity in the upper back and shoulders, and duration of the work and time pressure. Most of these risk factors are related to the interaction of the office workers with components of the workstation such as the desk, chair, monitor, mouse, keyboard, and telephone [11, 12]. So far, there are many methods to evaluate ergonomics risk factors that based on body bias from the natural state and factors such as static force and dynamically entered the body, repetition, duration and other peripheral factors, organizational and individual differences. Mardi et al. have shown that rapid office strain assessment (ROSA) method can be a good way of evaluating ergonomics in the office environment and measuring the status of office equipment [13]. Among the ergonomic evaluation methods, such as ovako working posture analyzing system (OWAS), rapid upper limb assessment (RULA), rapid entire body assessment (REBA) and etc., only the ROSA method evaluates the office equipment used by the employees [14]. ROSA method is a highly specialized method for assessing office workstation.

Despite many studies concerning the assessment of ergonomic risk factors in the office jobs, to our best knowledge, a study highlighting which office equipment is more conducive to musculoskeletal disorders has not been provided till now.

The aims of the present study were to assess office work-associated ergonomic risk factors using ROSA method as well as to identify which office equipment is more conducive to musculoskeletal disorders in office workers.

Instruments and Methods

This study is a randomized cross-sectional descriptive study that was conducted on 163 office workers at Fasa University of Medical Sciences (FUMS) in 2017. The sample size was calculated based on the results of previous studies on the office work and ROSA methods. Data were collected by a simple random sampling method.

Male and female employees with more than 1 year of work experience were eligible for inclusion. Exclusion criteria were a history or presence of trauma, surgery, cancer, malignant tumors, and infections, or sores in the musculoskeletal system.

A demographic data sheet was used to obtain individual characteristics such as age, sex, work experience, and education.

Standardized Nordic Musculoskeletal Questionnaire (NMQ) was used to define the frequency of musculoskeletal disorders in the past 12 months [15].

The Nordic questionnaire is a yes/No questionnaire that has two parts: 1) a general questionnaire and 2) additional questions. In this study, the first part of the questionnaire was used to evaluate the prevalence of musculoskeletal disorders in the last 12 months. Completion is aided by a body map to indicate nine symptom sites being the neck, shoulders, upper back, elbows, low back, wrist/hands, hips/thighs, knees, and ankles/feet. It was asked from participants respondents about having musculoskeletal problems in the last 12 months.

Ergonomic risk assessment was done using ROSA pen and paper checklist. ROSA was developed by Michael Sonne that based on ISO standard ENISO 9241. ROSA is a picture-based postural targeting screening tool for quantifying exposure to risk factors for office workers. A-ROSA assessment gives a quick and systematic assessment of the postural risks to a worker. ROSA scores greater than 5 are deemed to be high risk and corrective measures should be considered [16].

For the analysis, descriptive statistics (Mean, standard deviation, and frequency) and binary logistic regression were used. All the statistical data analyses were carried out using SPSS 20 software.

Findings

The majority of the respondents were female (57.1%). The majority of the nursing personnel had a BSc degree (44.8%; Table 1).

The Statistical mean of age of the participants was 36.39±7.74 years, ranging between 23 and 59 years. The Statistical mean of work duration was 10.7±6.8 years, range 1–30 years. (Table 2)

The majority of musculoskeletal disorders in the last 12 months were in the lower back (60.7%), neck (50.9%), and knees (48.5%; Table 3).

The risk level for 84.04% (n=137) of the participants was at the notification area (Score 3 to 5), and for 15.95% (n=26) at the need for ergonomic intervention area (Score>5).

Each of the office equipment used by the staff was a source of pain in a particular region of the body. The chair was one of the devices that caused the pain in many parts of the body, such as the elbow, low back, knees, and legs (Table 4).

Table 1) Frequency distribution of demographic characteristics of the participants (The numbers in parentheses represent percentages; n=163)

Variables	Frequency
Sex	
Female	93 (57.1)
Male	70 (42.9)
Marital status	
Single	40 (24.5)
Married	123 (75.5)
Education	
Associate diploma	27 (16.6)
BSc	73 (44.8)
MSc	47 (28.8)
PhD	16 (9.8)

Table 2) Statistical mean of variables of the participants (n=163)

Variables	M±SD	Range
Age (year)	36.39±7.74	23-59
Work duration (year)	10.70±6.80	1-30
Weight (kg)	69.00±10.89	48-102
Height (cm)	166.63±9.20	147-190
BMI (kg/m^2)	24.83±3.20	17.2-35.2

Table 3) Frequency of reported musculoskeletal pains among participants based on NMQ (The numbers in parentheses represent percentages; n=163)

Body region	Yes	No
Neck	83 (50.9)	80 (49.1)
Shoulder	70 (42.9)	93 (57.1)
Elbow	23 (14.1)	140 (85.9)
Wrist/Hand	57 (35.0)	106 (65.0)
Upper back	78 (47.9)	85 (52.1)
Lower back	99 (60.7)	64 (39.3)
Thigh	32 (19.6)	131 (80.4)
Knees	79 (48.5)	84 (51.5)
Feet and ankles	52 (31.9)	111 (68.1)

Table 4) Effective factors in the occurrence of MSD in different body regions (n=163)

Body region	Variables	Odds ratio	95% CI	p-value
Neck	Monitor	0.563	0.353–0.898	0.016
Elbow	Chair	1.868	1.067–3.273	0.029
Wrist	Keyboard	1.796	1.182–2.729	0.006
	mouse	0.595	0.379–0.935	0.024
Lower back	Chair	1.561	1.026–2.374	0.037
Knee	Chair	1.435	0.985–2.091	0.06
Foot	Chair	0.592	0.374–0.935	0.025

Those office equipment entered in the model that had no real effect on the occurrence of symptoms of musculoskeletal disorders in the organs of the body were not presented in the table

Discussion

The aims of the present study were to assess office work-associated ergonomic risk factors using ROSA method as well as to identify which office equipment is more conducive to musculoskeletal disorders in office workers.

The results of this study indicate that computer users were exposed to musculoskeletal disorders due to the nature of their work. According to the results of NMQ, the most prevalent MSD among office workers were those involving the lower back and neck, respectively. Previous studies on the health and disease in Iran, imply that the prevalence of musculoskeletal complaints in the neck, upper back, and lower back of the administrative staff is higher than the general population of the country [17].

The observed 12-month prevalence of neck pain was similar to that reported in Estonian computer users (51%) [18] and New Zealand office workers [19] and fairly higher than that among a sample of UK office workers (38%) [20]. This situation could be due to the inappropriate design of workstations for these staff. Because of its occupational nature, office work often requires maintaining a static posture in the body and sitting on a chair for a long time. According to studies, this condition has recently been introduced as a major risk factor for neck pain [21]. The interaction between prolonged sitting at workplace and inappropriate workstation condition may result in long-term static muscle contractions, which could increase the pressure on the intervertebral discs, create muscle tension on ligaments, decrease the tissue flexibility, and alter the curvature of the spine. Finally, such changes may increase the risk of musculoskeletal disorders in the spine [3, 15]. Consistent with the result of the present study, Christensen *et al*. also showed that the prevalence of these discomforts in the neck and lower back regions were high [22].

The results of this study based on the ROSA checklist showed that chair, monitor, keyboard, and the telephone had the highest association with pain in different areas of the musculoskeletal system, respectively. In the present study, the used chairs in the office environment had an adjustable seat height, non-adjustable backrest, and static arms. The staff had not been trained in the use of adjustable seats and were unaware that seat height was adjustable. The results of this study support the role of the chair in the development of musculoskeletal disorders among workers who are required to sit for prolonged periods. Because of the high prevalence of MSD among office workers, changing their chairs are often suggested. In selecting a chair, adjustability of the seat height and the seat pan depth in proportion to the anthropometrics of the user should be considered [23, 24]. Lack of adjustability in the dimensions of the chair impairs the ability of the postural muscles to support the body and could also cause unusual strain of the neuromuscular system, thereby causing pain [25, 26]. Chairs that can prevent these effects can be helpful in the prevention of

spinal pain. A chair meeting the ergonomic necessities is, thus, assumed to reduce the occurrence of musculoskeletal symptoms; however, since studies have reported different body regions, it is not possible to be more specific, about which kinds of MSDs benefit the most [27].

The most common factor to consider in chair interventions is to have an adjustable feature such as the seat or backrest height. Electromyography studies have shown that a chair with adjustable seat height, backrest, and arms can decrease the muscle activities of the neck, shoulders, and the back, and also reduce the inter-vertebral disc pressure [28]. The second most common chair intervention is that the employees receive training as to how to adjust their chair appropriately. This is particularly important, as studies support this training as an important aspect of ergonomic interventions [27]. Gerr *et al*. [29] and Szeto *et al*. [30] reported that static neck and upper limb posture associated with prolonged looking at display screens has been identified as a major risk factor for WRMSD. Static neck posture is associated with higher levels of postural muscle activity frequently, and this has been shown to be a common feature among symptomatic office workers with chronic neck and upper limb pain [30].

Gerr *et al*. also reported that prolonged hours of computer use is associated with elevated rates of musculoskeletal disorders in the arms and neck. The evidence linking awkward wrist and forearm postures during keyboard use to elevated risk for arm disorders are equivocal [29].

The results of the present study showed that the effectiveness of the ROSA ergonomic approach in assessing the risk factors for the development of musculoskeletal disorders in the office staff. In this regard, in order to reduce the prevalence of skeletal musculoskeletal disorders, applying corrective measures in high-risk workstations, performing regular exercise, equipping the workplace with ergonomic office equipment, and training for the use of equipment can be considered.

The findings of this study indicated a consistent trend of support for the role of a chair intervention to improve musculoskeletal symptoms among workers who are required to sit for prolonged periods. It seems that the main limitation of the present study was that the disorders had to be documented by some sort of physical examination and not solely based on subjective reports. The cross-sectional design of the study may have affected the results. Various risk factors, such as office equipment, in the workplace, may contribute to MSDs in different body regions. Therefore, it is suggested that the choice of office equipment be greatly taken into account and ergonomic equipment be selected.

The suggestions are interventional studies to improve the administrative activities and reduce the musculoskeletal disorders in office environments.

Conclusion

Various risk factors, such as office equipment, in the workplace, may contribute to MSDs in different body regions. Chair is the major cause of pain in many parts of the body.

Acknowledgments The authors express their appreciation and acknowledgment to all the administrative staff of the university who, with their cooperation, provided the opportunity to conduct this study.

Ethical permissions: The study was approved by the ethical committee of Fasa University of Medical Sciences. The participants were informed about the study objectives, and their verbal consent was obtained.

Conflicts of interests: The authors declared no potential conflicts of interest with respect to the research\authorship, and/or publication of this article.

Authors' Contribution: Gholami T. (First author), Introduction author/ Methodologist/ Original researcher/ Statistical analyst/ Discussion author (50%); Maleki Z. (Second author), Methodologist/ Assistant researcher (30%); Ramezani M. (Third author), Methodologist/ Assistant researcher (10%); Khazraee T. (Fourth author), Methodologist/ Assistant researcher (10%)

Funding/Support: Funding through Shiraz University of Medical Sciences, Contract No. 94018, supported this study.

References

1- Lin Z, Popovic A, Human Resources Development Canada, Applied Research Branch, Human Resources Development Canada, Strategic Policy. Working with computers in Canada: An empirical analysis of incidence, frequency and purpose. Canada: Human Resources Development Canada; 2003.

2- Marshall K. Working with computers. Perspectives on Labour and Income. 2001;13(2):9.

3- Wahlström J. Ergonomics, musculoskeletal disorders and computer work. Occup Med (Lond). 2005;55(3):168-76.

4- Derjani Bayeh A, Smith MJ. Effect of physical ergonomics on VDT workers' health: A longitudinal intervention field study in a service organization. Int J Human Comput Interact. 1999;11(2):109-35.

5- Gerr F, Monteilh CP, Marcus M. Keyboard use and musculoskeletal outcomes among computer users. J Occup Rehabil. 2006;16(3):265-77.

6- Hagberg M, Wegman DH. Prevalence rates and odds ratios of shoulder-neck diseases in different occupational groups. Br J Ind Med. 1987;44(9):602-10.

7- Korhonen T, Ketola R, Toivonen R, Luukkonen R, Häkkänen M, Viikari-Juntura E. Work related and individual predictors for incident neck pain among office employees working with video display units. Occup Environ Med. 2003;60(7):475-82.

8- Jensen C, Finsen L, Søgaard K, Christensen H. Musculoskeletal symptoms and duration of computer and mouse use. Int J Ind Ergon. 2002;30(4-5):265-75.
9- Heinrich J, Blatter BM, Bongers PM. A comparison of methods for the assessment of postural load and duration of computer use. Occup Environ Med. 2004;61(12):1027-31.
10- Keir PJ, Bach JM, Rempel D. Effects of computer mouse design and task on carpal tunnel pressure. Ergonomics. 1999;42(10):1350-60.
11- Cook C, Burgess-Limerick R. The effect of forearm support on musculoskeletal discomfort during call center work. Appl Ergon. 2004;35(4):337-42.
12- Matos M, Arezes PM. Ergonomic evaluation of office workplaces with Rapid Office Strain Assessment (ROSA). Procedia Manuf. 2015;3:4689-94.
13- Mardi Gh, Kouhnavard B, Ahmadipanah V, Aghanasab M. An investigation of rapid office strain assessment and rapid upper limb assessment in visual display terminal users. J Health Res Commun. 2015;1(3):25-32. [Persian]
14- Sonne M, Andrews DM. The Rapid Office Strain Assessment (ROSA): Validity of online worker self-assessments and the relationship to worker discomfort. Occup Ergon. 2011;10(3):83-101.
15- Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sørensen F, Andersson G, et al. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon. 1987;18(3):233-7.
16- Sonne M, Villalta DL, Andrews DM. Development and evaluation of an office ergonomic risk checklist: ROSA--Rapid office strain assessment. Appl Ergon. 2012;43(1):98-108.
17- Choobineh AR, Rahimi Fard H, Jahangiri M, Mahmood Khani S. Musculoskeletal injuries and their associated risk factors. Iran Occup Health J. 2012;8(4):70-81. [Persian]
18- Oha K, Animägi L, Pääsuke M, Coggon D, Merisalu E. Individual and work-related risk factors for musculoskeletal pain: A cross-sectional study among Estonian computer users. BMC Musculoskelet Disord. 2014;15:181.
19- Harcombe H, McBride D, Derrett S, Gray A. Prevalence and impact of musculoskeletal disorders in New Zealand nurses, postal workers and office workers. Aust N Z J Public Health. 2009;33(5):437-41.
20- Madan I, Reading I, Palmer KT, Coggon D. Cultural differences in musculoskeletal symptoms and disability. Int J Epidemiol. 2008;37(5):1181-9.
21- Ariens G, Bongers P, Douwes M, Miedema M, Hoogendoorn W, van der Wal G, et al. Are neck flexion, neck rotation, and sitting at work risk factors for neck pain? Results of a prospective cohort study. Occup Environ Med. 2001;58(3):200-7.
22- Juul-Kristensen B, Jensen C. Self-reported workplace related ergonomic conditions as prognostic factors for musculoskeletal symptoms: The "BIT" follow up study on office workers. Occup Environ Med. 2005;62(3):188-94.
23- Gouvali MK, Boudolos K. Match between school furniture dimensions and children's anthropometry. Appl Ergon. 2006;37(6):765-73.
24- Panagiotopoulou G, Christoulas K, Papanckolaou A, Mandroukas K. Classroom furniture dimensions and anthropometric measures in primary school. Appl Ergon. 2004;35(2):121-8.
25- Aarås A, Horgen G, Bjørset HH, Ro O, Walsøe H. Musculoskeletal, visual and psychosocial stress in VDU operators before and after multidisciplinary ergonomic interventions, A 6 years prospective study--Part II. Appl Ergon. 2001;32(6):559-71.
26- Tittiranonda P, Rempel D, Armstrong T, Burastero S. Effect of four computer keyboards in computer users with upper extremity musculoskeletal disorders. Am J Ind Med. 1999;35(6):647-61.
27- van Niekerk SM, Louw QA, Hillier S. The effectiveness of a chair intervention in the workplace to reduce musculoskeletal symptoms, A systematic review. BMC Musculoskelet Disord. 2012;13:145.
28- van Deursen DL, Lengsfeld M, Snijders CJ, Evers JJ, Goossens R. Mechanical effects of continuous passive motion on the lumbar spine in seating. J Biomech. 2000;33(6):695-9.
29- Gerr F, Marcus M, Monteilh C. Epidemiology of musculoskeletal disorders among computer users: Lesson learned from the role of posture and keyboard use. J Electromyogr Kinesiol. 2004;14(1):25-31.
30- Szeto GPY, Chan CCY, Chan SKM, Lai HY, Lau EPY. The effects of using a single display screen versus dual screens on neck-shoulder muscle activity during computer tasks. Int J Ind Ergon. 2014;44(3):460-5.