International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 7 (2017) pp. 1355-1359

Ergonomic Risk Factors associated with Muscuslokeletal Disorders in Computer Workstation

Mohd Nasrull Abdol Rahman*
Department of Manufacturing and Industrial Engineering
Faculty of Mechanical and Manufacturing Engineering
Universiti Tun Hussien Onn Malaysia (UTHM)
86400 Batu Pahat, Johor, Malaysia.

Ibrahim Masood
Department of Manufacturing and Industrial Engineering
Faculty of Mechanical and Manufacturing Engineering
Universiti Tun Hussien Onn Malaysia (UTHM)
86400 Batu Pahat, Johor, Malaysia.

Nur Farahanim Awalludin
Department of Manufacturing and Industrial Engineering
Faculty of Mechanical and Manufacturing Engineering
Universiti Tun Hussien Onn Malaysia (UTHM)
86400 Batu Pahat, Johor, Malaysia.

Mohd Fahrul Hassan
Department of Material and Design Engineering
Faculty of Mechanical and Manufacturing Engineering
Universiti Tun Hussien Onn Malaysia (UTHM)
86400 Batu Pahat, Johor, Malaysia.

Abstract

Ergonomics Risk Factors (ERFs) at computer works are commonly related to Musculoskeletal Disorders (MSDs) such as repetitive movements, doing work in awkward postures and static postures while prolonged seating at works. The main objective of this study was to investigate the ergonomic risk factors associated with MSDs among employees in computer workstation. In this study, the data were obtained by structured interview using self-reported questionnaire and direct observation. The results show that there is significant association between neck and stress score with musculoskeletal symptoms and among office workers. As a conclusion, by assessing ERFs at workplace, the effectiveness of workplace interventions can be evaluated without waiting for changes in the prevalence of MSDs.

Keywords: ergonomic; risk factor; musculoskeletal disorders; computer workstation; office works

INTRODUCTION

Ergonomics Risk Factors (ERFs) at computer works are commonly related to Musculoskeletal Disorders (MSDs) such as repetitive movements, doing work in awkward postures and static postures while prolonged seating at works [1]. As a result of ERFs, the employees will experience a variety of symptoms such as discomfort in the neck, pain in the shoulders, elbows, hands, fingers, hips and knees [2]. An awkward posture for computer users has been characterized as having excessive tilt of the neck, trunk bent forward, rounded shoulders, wrists and ulnar deviation [3]. Non-neutral wrist postures are risk factors of musculoskeletal disorders among computer users. Intensive keyboard use has been associated with an increased risk of developing musculoskeletal symptoms and disorders of the hand, wrist, and forearm [4-5]. Repetitive movements of the arms and hands are at risk of ergonomic because it involves joint or muscle groups that together when we do the same motion too often, too fast, and long period [2-5]. Therefore, the main objective of this study was to investigate the ergonomic risk factors associated with Musculoskeletal disorders (MSDs) among employees in computer workstation.

METHODS

A. Subjects and Data Collection

In this study, the data were obtained by structured interview using self-reported questionnaire and direct observation. The questionnaires were based on the Nordic Musculoskeletal Questionnaire [6]. Structured interview using the questionnaire was performed among office workers. First, the subjects were asked questions about their demographic data such as has gender, “what year were you born?”, “How many years and months have you been doing your present type of work?”, “on average, how many hours a week do your work?”, “how much do you weight?”, “how tall are you?” and “are you right-handed or left-handed?”. Second, the subjects were asked the questions about the musculoskeletal symptoms (ache, pain, discomfort) they had over the last 12 months and they were asked to mark on the body discomfort chart. Symptoms of pain or discomfort were recorded as presence of pain. They also asked “Have you at any time during the last 12 months had trouble?” to determine feelings of participants about their work. This question is for neck, shoulder, elbows, wrist/hands, upper back, low back, hips/thighs, knees and also ankles/feet. They were asked to select from one of the following choices for neck, shoulders, elbows, wrists/hands: “No”, or “Yes”, in the right”, “Yes, in the left” and “Yes, in both side”. Besides that, for the upper back, low back, hips/thighs, knees, and ankles/feet, theywere asked to select “No” or “yes” only. In the second section of the questionnaire, information collected about low back trouble, neck and shoulder trouble, and shoulder questionnaire. The participant must answer the question by putting a cross in the appropriate box.

Ergonomics risk factors at office workstations were assessed through direct observation using the Quick Exposure Check (QEC) method [7]. First, interview among office workers to

complete the worker's assessment in QEC. Subjects were asked questions about "what is the maximum weight handled in this task?' and must choose the answer light (5kg or less), moderate (6-10kg), heavy (more than 20kg). The subjects also were asked " on average, how much time do you spend per day on this task ?", " when performing this task, is the maximum force level exerted by one hand?", "at work do you drive a vehicle for?" and subjects must select one from the answer given. They were asked to select low or high for the visual demand question. Besides that, subjects also were asked " at work do you use vibrating tools for"?, " do you have difficulty keeping up with this work?" and "in general, how do you find this job?". Subjects must select one of the answers given. Video and picture was taken during the 10 minutes when they are working in office. Observer's assessment can be done at home. After that, the QEC marks exposure based on a combination of risk factors identified by the observer for each area of the body which is back, shoulder/arm, wrist/hand and neck and by the subjective reaction of the employee. Scores represent the relationship between the assumption of increasing the level of exposure and potential health outcomes. Current epidemiological evidence is insufficient to determine the actual relationship to different working conditions. However the existing scoring system provides a basis for comparing the exposure level before and after the intervention. In addition, level of increase in exposure that is marked by dark shading in the box in both valuation and balance the scoring.

B. Data Analysis

Statistical analysis was performed with SPSS software version 22.0. Chi square test analyses were used to evaluate the relationship between musculoskeletal symptoms and demographic data. The independent variables in chi square test included demographic which are gender, age, working experience (year), weekly working time (hours), body mass index and hand dominance. Demographic data and job characteristics of the study population were presented as mean, standard deviation (SD) and percentage. Chi Square Test was used to estimate the association between independent variables and self-reported musculoskeletal symptoms for each body region. For all statistical tests, $p< 0.05$ was considered as statistically significant.

RESULTS

A. Relationship between Musculoskeletal Symptoms and Demographic Data

Table I shows the relationship between musculoskeletal symptoms and demographic data. From the result, there are no statistically significant relationship were found between musculoskeletal symptoms and age, working experience, weekly working time, body mass index and hand dominance ($p>0.05$). From the previous finding, the relationship of body mass index and musculoskeletal symptoms are significantly higher with higher body mass index [8].

In addition, there were no significant value were found between musculoskeletal and gender ($p>0.05$). Other research found no correlation between working posture and the prevalence of MSD [9] related to the fact that there is no significant difference between genders. In a study conducted by McLean [10] shown that regular rest breaks reduced the neck, shoulder and low back discomfort among computer workers. In many studies, intense physical activity, high BMI, years worked, age and inadequate education were found to increase the musculoskeletal symptoms [11]. In this study, however, no statistically significant relationship was found between these factors and MSDs ($p>0.05$).

TABLE I. RELATIONSHIP BETWEEN DEMOGRAPHIC DATA AND MUSCULOSKELETAL SYMPTOMS (N=80)

Independent Variables (n)	Musculoskeletal Symptoms		Statistics	Significant
	Yes (%)	*No (%)*		
Gender				
Male (51)	92.2	5.1	X^2=0.727 df = 2	p>0.05
Female (29)	86.2	13.8		
Age				
≤20 (2)	100	-		
21-40 (61)	93.4	6.6	X^2=4.482 df= 2	p>0.05
≥ 41 (17)	76.5	23.5		
Working Experience (Year)				
1-5 (25)	95.8	4.2	X^2=1.296 df = 1	p>0.05
≥ 6 (56)	87.5	12.5		
Weekly Working Time (hours)				
40-50 (79)	89.9	10.1	X^2=0.113 df =1	p>0.05
≥ 51 (1)	100	-		
Body mass index				
Underweight (5)	80	20		
Normal weight (27)	85.2	14.8	X^2=2.016 df =2	p>0.05
Overweight (29)	93.3	6.7		
Obesity (18)	94.4	5.6		
Hand Dominance				
Right-handed	89.9	10.1	X^2=0.113 df =2	p>0.05
Left-handed	100	-		

p>0.05 no significant, p<0.05 significant

B. Relationship between Musculoskeletal Symptoms and Observers Assessment

Table II shows the relationship between musculoskeletal symptoms and observer's assessment. The findings of this study indicated a significant association between neck score

and musculoskeletal symptoms among office workers ($p<0.05$). The most common posture adopted by the office workers during the office task performance was the bending posture of the neck (more than 20º flexion) to the front. A neck flexion is associated with greater neck extensor load moment resulting in fatigue and pain when sustained [12]. However, the results of the present study shows there are no significant relationship between back score (static), shoulder/arm score and wrist/hand score ($p>0.05$). Working with elevated upper arms, especially at or above shoulder height, is recognized as a risk factor for shoulder WMSDs [13] as the load on shoulder musculature increases with greater elevation [14]. In this study, most of the office workers performed their task at about chest height and the exposure levels for shoulder/arm are moderate.

TABLE II. RELATIONSHIP BETWEEN OBSERVERS ASSESSMENT AND MUSCULOSKELETAL SYMPTOMS (N=80)

Independent Variables (n)	Musculoskeletal Symptoms		Statistics	Significant
	Yes (%)	*No (%)*		
Back Score (Static)				
Low (23)	94.9	5.1		
Moderate (45)	86.2	13.8	X^2=0.335 df = 2	p>0.05
High (12)	91.7	8.3		
Very High	-	-		
Shoulder/Arm Score				
Low (19)	78.9	21.1		
Moderate (59)	93.2	6.8	X^2= 4.481 df= 2	p>0.05
High (2)	100	-		
Very High	-	-		
Wrist /Hand (Score)				
Low (22)	81.8	18.2		
Moderate (36)	91.7	8.3	X^2= 2.475 df= 1	p>0.05
High (22)	95.5	4.5		
Very High	-	-		
Neck Score				
Low	-	-		
Moderate (19)	73.7	26.3	X^2= 8.434 df= 2	p<0.05
High (37)	91.9	8.1		
Very High (24)	100	-		

p>0.05 no significant, p<0.05 significant

C. *Relationship between Musculoskeletal Symptoms and Workers Assessment*

Table III shows the relationship between musculoskeletal symptoms and workers assessment which are driving score, vibration score, work pace score and stress score. The finding of this study indicated a significant association between stress score and musculoskeletal symptoms ($p<0.05$). Several previous studied has been identified stress as an important factor in the development of WMSDs [15-16] and subjective perceptions outweigh what other behavioral and performance measures may indicate. In the stress process, an individual's cognition and subjective appraisal of a potential risk factor is considered to be crucially important [16]. The findings of this study also indicated no significant association between driving score, vibration score, work pace score and musculoskeletal symptoms ($p>0.05$). Most of the office worker only driving between 1 and 4 hours per day. There are no statistically between vibration score and musculoskeletal symptoms because vibration score are constant.

TABLE III. RELATIONSHIP BETWEEN WORKERS ASSESSMENT AND MUSCULOSKELETAL SYMPTOMS (N=80)

Independent Variables (n)	Musculoskeletal Symptoms		Statistics	Significant
	Yes (%)	*No (%)*		
Driving Score				
Low (22)	90.8	9.2		
Moderate (58)	89.7	10.3	X^2= 0.028 df= 1	p>0.05
High	-	-		
Vibration				
Low (80)	90	10		
Moderate	-	-	No statistic are computed because vibration score is a constant	
High	-	-		
Work Pace Score				
Low (7)	83.3	28.6		
Moderate (69)	93.8	7.2	X^2= 4.264 df= 2	p>0.05
High (4)	75	25		
Stress Score				
Low (9)	55.6	44.4		
Moderate (57)	94.7	5.3	X^2= 13.41 df= 2	p<0.05
High (14)	92.9	7.1		

p>0.05 no significant, p<0.05 significant

D. *Relationship between Musculoskeletal Symptoms and QEC Final Score*

Table IV shows the QEC final score and their relationship to musculoskeletal symptoms. The finding of this study indicated not significant association between QEC final score and musculoskeletal disorder ($p>0.05$). The assessment question in QEC tools is not suitable to assess the exposure of workers and musculoskeletal risk factor.

TABLE IV. RELATIONSHIP BETWEEN QEC FINAL SCORE AND MUSCULOSKELETAL SYMPTOMS (N=80)

Independent Variables (n)	Musculoskeletal Symptoms		Statistics	Significant
	Yes (%)	*No (%)*		
QEC Final Score				
≤ 40% (4)	75	25		
41-50% (18)	83.3	16.7	X^2=13.41 df= 3	p>0.05
51-70% (46)	91.3	8.7		
≥ 70% (12)	100	-		

p>0.05 no significant, p<0.05 significant

E. Relationship between QEC Final Score and Demographic Data

Table V shows the relationship between QEC final score and demographic items. The findings of this study show the significant association between age and QEC final score (p<0.05). Several previous studies shows the risk of incident carpal tunnel syndrome as observed at baseline among the same sample of workers, increased linearly with age [17]. These agree with clinical reports of a higher prevalence of carpal tunnel syndrome (CTS) in patients aged 40-60 years [18] and longitudinal surveys in the working population [19]. A better understanding of the task characteristics may provide an insight into the job design to support the user needs of older workers in future [20]. However, there are no significant association between working experience and weekly working time. In this study, most of the office worker work not more than 50 hours and rest just in time.

TABLE V. RELATIONSHIP BETWEEN QEC FINAL SCORE AND DEMOGRAPHIC DATA (N=80)

Independent Variables (n)	QEC Final Score		Statistics	Significant
	Acceptable	*Not Acceptable*		
Age				
≤ 20 (2)	50	50		
21-40 (61)	4.9	95.1	X^2=9.422 df= 2	P<0.05
≥ 41 (17)	-	100		
Work Experience (Year)				
1-5 (24)	8.3	91.7	X^2=0.802 df =1	p>0.05
≥6 (56)	3.6	96.4		
High	-	-		
Weekly Working Time (hours)				
40-50 (69)	5.1	94.9	X^2=0.053 df=1	p>0.05
≥51 (1)	-	1		

p>0.05 no significant, p<0.05 significant

CONCLUSION

As a conclusion, by assessing ergonomic risk factors at workplace the effectiveness of workplace interventions can be evaluated without waiting for changes in the prevalence of MSDs to become an evident. From the SPSS analysis result of the relationship between musculoskeletal symptoms and demographic data, there are no statistically significant correlations were found between musculoskeletal symptoms and gender, age, working experience, weekly working time, body mass index and hand dominance (p>0.05). The relationship between musculoskeletal symptoms and observer's assessment shows only neck score are significant. The finding indicated no significant association between musculoskeletal symptoms and back scores (static), shoulder/arm score, wrist/hand score (p>0.05). Other than that, the result of relationship between musculoskeletal symptoms and workers assessment shows that stress score are significant (p<0.05). However, no significant association indicated between driving, vibration, work pace score and musculoskeletal symptoms (p>0.05). The findings of this study shows no significant association between QEC final score and musculoskeletal symptoms (p>0.05) and only age are significant association between QEC final score and demographic data (p<0.05).

ACKNOWLEDGMENT

This research is funded by Universiti Tun Hussein Onn Malaysia (UTHM) under Short Term Grant (STG, Vot U122). Appreciation also express to the office workers for their cooperation to conduct this research at their workplace.

REFERENCES

[1] Z. Torghabeh, S. Hosseinian, and A. Ressang, "Risk Assessment of Ergonomic Risk Factors at Construction Sites," Applied Mechanics and Materials, 330, 2003, pp. 857-861

[2] V. Jangga, and S. Verma, "Occupational and its association with Carpal Tunnel Syndrome – A Review," Journal of Exercise Science and Physiotheraphy, vol. 7(2), 2011, pp. 68-78.

[3] M. Dadwal, J. Kistwaria, A. Katoch, A. Rana, "A study to identify the musculoskeletal disorders in women computer users," Asian J. Home Sciece, vol. 8, 2003, pp. 72-75.

[4] F. Gerr, M. Marcus, C. Ensor, D. Kleinbaum, S. Cohen, A. Edwards, "A prospective study of computer users: Study design and incidence of musculoskeletal symptoms and disorders," Am. J. Ind. Med. vol. 41 (4), 2002, pp. 221-235

[5] C. Jensen, "Development of neck and hand-wrist symptoms in relation to duration of computer use at work," Scand. J. Work Environ. Health, vol. 29 (3), 2003, pp. 197-205

[6] I. Kuorinka, B. Johnson, A. Kilbom, H. Vintrberg, F. Sorensen, G. Andersson, K. Jorgensen, "Standardize Nordic questionnaires for the analysis of musculoskeletal symptoms," Appl. Ergon. vol. 18, 1987, pp. 233-237.

[7] G. David, V. Woods, P. Buckle, "Further Development of the Usability and Validity of the Quick Exposure Check (QEC)," Research Report: RR211/2005. HSE Books, Sudbury, Suffolk.

[8] J. Sethi, J. Sandhu, V. Imbanathan, "Effect of body mass index on work related musculoskeletal discomfort and occupational stress of computer workers in a developed ergonomic setup," Sports Med Arthrosc Rehabil Ther Technol. vol. 3(1), 2011, pp. 22

[9] K. Shuval, M. Donchin, "Prevalence of upper limb extremity musculoskeletal symptoms and ergonomic risk factors at a hi-tech company in Israel," International Journal of Industrial Ergonomics, vol. 35, 2005, pp.569-581

[10] J. Village, D. Rampel, K. Teschke, "Musculoskeletal disoeders of the upper extremity associated with computer work: a systematic review," Occup.Ergon. vol. 5, 2005, pp. 205-218

[11] J. Wahlstrom, "Ergonomics, musculoskeletal disorders and computer work," Occup.Med.(Chic. Ill.) vol. 55, 2005, pp. 168-176

[12] J. Andersen 2003. Computer use and carpal tunnel syndrome: a 1-year follow up study. JAMA 289, 296329969 http://dx.doi.org/10.1001/jama.289.22.2963.

[13] R. Wigley, "Desk-edge syndrome: median nerve injury proximal ot the carpal tunnel," APLAR J. Rheumatol. vol. 7, 2004, pp. 215-218

[14] M. Benth, and K. Jones, "Epidemiology of chronic musculoskeletal pain," Best Practice & Research Clinical Rheumatology, vol. 21(3), 2007, pp. 403-427

[15] D. Rempel, P. Keir, and J. Bach, "Effect of wrist posture on carpal tunnell between work-related physical exposures and neck and/or shoulder complaints: a systematic review," Int. Arch. Occup. Environ. Health, vol. 85 (6), 2008, pp. 587-603.

[16] Y. Roquelaure, "Personal, biomechanical, and psychosocial risk factors forrotator cuff syndrome in a working population. Scand. J. Work Environ. Health," vol. 37 (6), 2011, pp. 502-511.

[17] D. Rempel, P. Keir, J. Bach, "Effect of wrist posture on carpal tunnel pressure while typing," J. Orthop. Res, vol. 26, 2008, pp. 1269-1273.

[18] R. Van Rijn, "Associations between work-related factors and the carpal tunnel syndromeea systematic review," Scand. J. Work Environ. Health vol. 35, 2009, pp. 19-36

[19] M. Hagberg, H. Morgenstern, M. Kelsh, "Impact of occupations and job tasks on the prevalence of carpal tunnel syndrome," Scand. J.Work Environ. Health 18, 1992, pp. 337-345

[20] A. Stedsmon, H. Howells, J. Wilson, I. Dianat, "Ergonmics human factors needs of an ageing workforce in the manufacturing sector,". Health Promot.Perspect, vol. 2, 2012, pp. 112-125