

Effect of Fatigue on Job Performance and Musculoskeletal Disorders among Power Plant Staff

Somayeh Bolghanabadi^{1*}, Seyed Hojat Mosavi Kordmiri², Shima GHalehassani³, Fariba Delkhani³, Fateme Tazili³

¹ Instructor, Department of Occupational Health Engineering, Neyshabur University of Medical Sciences, Neyshabur, Iran • ²Msc, department of Occupational Health Engineering, faculty of health, Tehran University of Medical Sciences, Tehran, Iran • ³Students Research Committee, Neyshabur University of Medical Sciences, Neyshabur, Iran • *Corresponding author: Somayeh Bolghanabadi, Email: bolghanabadi1@num.s.ac.ir, Tel : +98-514-2632471

Abstract

Background: The sustainability and strength of an organization strongly depends on the mental, physical, and physiological health of its employees. The purpose of this study is to investigate the effect of fatigue and stress on the incidence of musculoskeletal disorders, job performance and their relationship considering some demographic variables in this society.

Methods: This cross-sectional analytical study was conducted in 2017. The study populations were administrative employees of the power plant, and sampling was done by census method. Three standard questionnaires about job fatigue and job performance and Nordic questionnaire were distributed among 62 employees. Data were analyzed by SPSS 20; descriptive statistics and Pearson correlation test. **Results:** All 62 samples were male, and the mean and standard deviation of their age were 41.52 (7.71) years and the mean of work experience was 12.13 (6.25) years. According to the results, 53% of the samples showed high and very high fatigue; the fatigue score was 3.96 that indicated the moderate level. The job performance score was 38.3, which was considered at the low level. Also, there was an inverse and significant relationship between fatigue and job performance ($P = 0.03$, $r = -0.37$), and there was a significant relationship between fatigue, performance and neck and back areas ($p < 0.05$).

Keywords: Fatigue; Job performance; Power plant personnel; Musculoskeletal disorders

Introduction

Recently human resources are taken into consideration as the key factors in the success of organizations. In other words, the power of organizations stems from the mental, psychological and physical capabilities of their employees.¹ Fatigue can be defined as the inability to maintain the required power or lack of energy in

doing tasks.² Usually fatigue can be caused by mental or physical disease, stress and inappropriate work conditions.³ Fatigue have negative effects on job performance and social relationships, and can impair physical and cognitive functions in the long run.⁴ In the United States, fatigue-related problems that lead to accidents and reduction in productivity

Citation: Bolghanabadi S, Mosavi Kordmiri SH, GHalehassani Sh, Delkhani F, Tazili F. **Effect of Fatigue on Job Performance and Musculoskeletal Disorders among Power Plant Staff.** Archives of Occupational Health. 2019; 3(1): 252-8.

Article History: Received: 4 September 2018; Revised: 14 November 2018; Accepted: 17 December 2018

Copyright: ©2017 The Author(s); Published by Shahid Sadoughi University of Medical Sciences. This is an open-access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

cost \$ 18 billion annually.⁵ One of the effects of fatigue is known as reduction in the job performance of the employees. Job performance is defined as the degree of success in doing job tasks. A good performance can increase the productivity of the organization and promote the economy of the society.⁶ Job performance reflects the potential and actual ability, strengths and weaknesses of employees, which ultimately, along with an appropriate assessment, can draw their career path in the organization.⁷ Improvement and development of job performance can increase the skills and motivation of employees through providing feedback and job counseling, so employees can overcome their weaknesses.⁸

Physical, psychosocial, organizational and individual factors can cause musculoskeletal disorders in the work environments.⁹ Working hours, repetitions, and inappropriate postures are considered as the factors causing these disorders.¹⁰ According to the results of some studies, individual factors such as age, sex, body mass index and smoking have a significant relationship with musculoskeletal discomforts.^{9,11} Research has shown that increase in fatigue and stress can affect the level of cognitive performance, which can reduce the skills of individuals.¹² Research has shown that reducing the physical and mental tensions of the employees in the work environment can lead to working conveniently and more focused, increasing cooperation and accountability, reducing the number of absences and delays related to disease and as a result job performance will be improved.¹³ According to the study of Yip et al. conducted on nurses, there was a significant relationship between the feeling of pleasure in job, fatigue and the occurrence of low back pain in nurses.¹⁴ In a study by Frimour on the risk factors affecting musculoskeletal disorders, fatigue has been reported as one of the factors affecting pain in different areas of the body.¹⁵ According to a study carried out by Kohnavard et al. on fatigue, stress and

job performance of dentists; with increase in fatigue, job performance would be decreased.¹⁶

Considering the multi factors causing fatigue,¹⁷ lack of a specific source for fatigue³ and some fatigue causing assumptions such as personal hygiene, environmental conditions, long working hours, inadequate rest, excessive stress¹⁸ and due to rare studies in this regard in this industry, present study was conducted to identify factors affecting fatigue causing musculoskeletal discomfort. The aim of this study is to identify the effective factors to decrease and control these two variables in order to increase job performance, improve the employees' health and to increase productivity and job satisfaction in the power plant in the long run.

Methods

The present study was a cross-sectional analytical study conducted in 2017 to investigate the effect of fatigue on the incidence of musculoskeletal disorders and job performance among the administrative staff of the power plant. The study was conducted on 62 male employees who were selected by simple random sampling method. Before distributing the questionnaire, the necessary licenses were obtained from the security department and the administrative department of the industry in order to confirm the questionnaires. A briefing session was held for samples and a written consent form was provided for them, also samples were assured of the confidentiality of information. Four following standard questionnaires were used to collect data. Demographic Characteristics and Background Information: The questionnaire included questions about age, work history, marital status, educational level, height and weight of staffs working in this unit. Nordic Questionnaire: This questionnaire analyzes nine body regions including neck, shoulders, back, waist, elbows, hands, thighs, knees and legs for musculoskeletal symptoms. Its validity in Iran has been calculated with a correlation coefficient of 91% and has been used in several studies.^{19,20} Job Fatigue Questionnaire: Fatigue

rate was measured by a questionnaire prepared by the Ministry of Health, Labor and Welfare of Japan²¹ and was standardized by Qassem Khani et al.²² The questionnaire categorizes fatigue rates in four levels of low fatigue (0-1), moderate fatigue (2-3), high fatigue (4-5) and very high fatigue (6-7). This questionnaire has been used in various studies to assess the level of fatigue.

Job Performance Questionnaire: The Paterson Job Performance Questionnaire was used to collect data on job performance. The questionnaire has 15 questions with score range of 15-75; its validity and reliability have been evaluated and approved by various studies.¹⁶ Scores less than 40 are categorized as low level of job performance, scores 40-60 are categorized as average level of job performance and scores over 60 demonstrate high level of job performance. Questionnaires were distributed among employees who had a work experience over one year and were collected by the researcher after a specified deadline. Data were analyzed by SPSS version 20. For which, descriptive analysis, quantitative variables, mean, standard deviation and range were calculated. Data were analyzed using Pearson correlation coefficient and Chi-square test.

Results

The study was carried out on 62 male employees in

a power plant. The mean age of the subjects was 41.52 (7.71) years and their working experience average was 13.13 (6.25) years. Regarding the fatigue classification in four levels of low, moderate, high and very high; 53% of staffs were at high and very high fatigue levels. The average fatigue score of employees was 3.96 (1. 54). Figure 1 depicts the percentage of job fatigue among employees.

According to the job performance questionnaire, 61% of the subjects had low job performance and only 7% have experienced high job performance. The job performance average in the power plant staff members was 38.3 (12.48) which was obviously at the low level. Table 1 presents the frequency of musculoskeletal disorders and the correlation between demographic variables, fatigue and job performance. According to the results, the most painful areas were related to the waist and neck and the least frequency of pain was germane to the thighs and elbows, and there was also a significant correlation between body mass index and most body parts ($p < 0.05$).

According to Chi-square test, there was a significant relationship between fatigue level, age ($p = 0.02$) and educational level ($p = 0.03$).

According to Spearman test, there was not a significant relationship between marital status, work experience and the mean fatigue scores ($p > 0.05$).

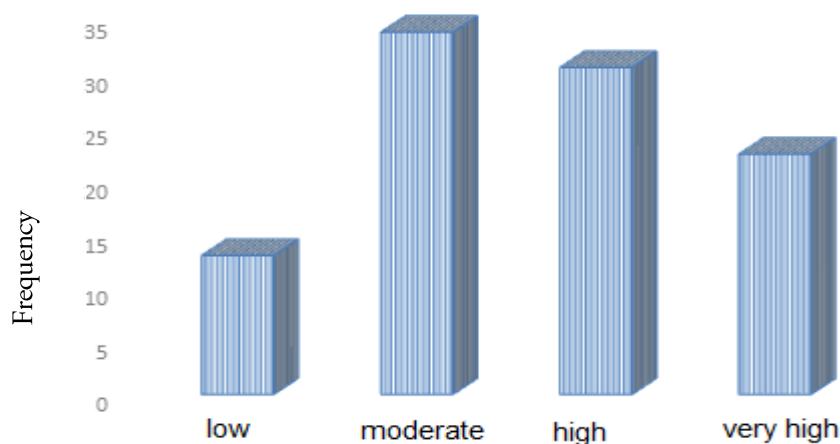


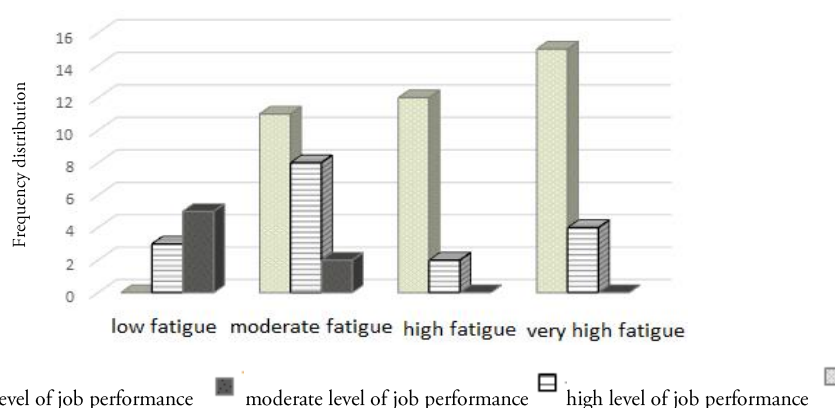
Figure 1. Distribution of fatigue frequency among administrative staff of the power plant

Table 1. Relationship between musculoskeletal disorders, demographic variables, fatigue and job performance among the administrative staff of the power plant

Body organs	Frequency (percent)	The correlation coefficient				
		Age	work experience	BMI	Fatigue	Job performance
Neck	(66.10)41	0.38	0.21	0.24	0.29	0.16
Shoulder	(61.30)38	0.41	0.44	0.34	0.51	0.38
Elbow	(38.70)24	0.31	0.27	0.53	0.17	0.49
Hand	(63.00)39	0.14	0.49	0.44	0.53	0.33
Back	(71.00)44	0.33	0.42	0.28	0.32	0.28
Thigh	(27.40)17	0.47	0.35	0.11	0.47	0.01
Knee	(50.00)31	0.36	0.30	0.16	0.46	0.26
Leg	(54.80)34	0.14	0.54	0.36	0.19	0.47

* $p < 0.05$ ** $p < 0.001$ **Table 2.** Relationship between demographic variables, fatigue and job performance among the administrative staff of the power plant

Variable	<i>p</i> -value				
	Age	work experience	BMI	Marital statues	Educational level
Fatigue	0.02	0.05	0.06	0.17	0.03
Job performance	0.07	0.04	0.02	0.19	0.23

**Figure 2.** Frequency distribution of fatigue and job performance among administrative officers of the power plant

According to Table 1, there was a significant relationship between fatigue and pain in neck, shoulder, back and knee areas ($p < 0.05$), also there was a significant relationship between job performance, wrist, shoulder and back pain ($p < 0.05$). According to the Table 2, there was a significant relationship between age, educational level and fatigue. As the age increases, the fatigue level ($r = 0.44$) showed an increase and with the decrease in educational level ($r = -0.19$), the fatigue level was increased. Also, there was a significant and reverse relationship between the variables of work experience ($p = 0.04$, $r = -0.26$) and body mass index ($p = 0.02$, $r = -0.31$) with the job performance. According to Pearson correlation test, there was a

significant and inverse relationship between fatigue and job performance ($P = 0.03$, $r = -0.37$), which with an increase in the fatigue, employees' job performance decreased. Figure 2 shows the relationship between fatigue and job performance. Staff members with very high der level did not have high job performance while at low level of fatigue; they had a high level of performance.

Discussion

In this study, the effect of fatigue on job performance and musculoskeletal disorders in the staff of the power plant was scrutinized. The average fatigue score among administrative staff in the power plant was 3.96 (1.54), which reveals a moderate level.

This result is consistent with the result of Belghan abadi et al.¹⁹ which indicated a moderate level of fatigue in workers. According to the results of the Nordic questionnaire, the highest painful areas were related to waist (71%) and neck (66%), and the lowest painful area was related to thigh (27%). It might be due to long working hours or the inappropriate status of the chair and table, which caused the unsuitable posture. In another study done by Belghan Abadi et al.¹⁹ on musculoskeletal disorders, occupational stress and fatigue in workers of a food industry, the most painful area was waist and the least one was reported in the thigh. In a study carried out by Chobineh et al.²³ neck and waist were among the most painful areas of the studied staff. Juul-Kristensen et al.²⁴ reported the highest incidence of abnormalities in administrative staff in neck and waist area, which is consistent with the result of the present study. Over 50% of the samples showed high or very high level of fatigue, given that, 100% of them have experienced pain at least in one area of the body. Consequently, it can be concluded that fatigue can cause musculoskeletal discomfort. The results also showed that there was a significant relationship between age, educational level and fatigue. These findings were consistent with the results of Rezaei et al. investigating the relationship between duration of fatigue, age and education.²⁵ The most important factors that cause this condition can be inappropriate condition of the body during working hours, physical exhaustion, age, obesity, work experience, long hours of sitting, inappropriate chair height, and psychological factors. The impacts of these factors have been proven in other studies and are consistent with the result of the current study.²⁶⁻²⁸

According to the results, 38 of the 62 samples had low job performance with a score less than 30. Staff with high work experience and high body mass index had revealed low job performance. Having high capability and motivation cannot guarantee job performance, it is of utmost importance to improve

the level of job performance by providing suitable job conditions and eliminating organizational barriers.²⁹ According to the Pearson correlation test, there was a significant and inverse correlation between fatigue score and job performance; those who had higher fatigue score had lower job performance. According to a study done by Kohnavard et al.¹⁶ on the degree of fatigue, stress and job performance in prosthodontics graduates, there was a significant and inverse relationship between fatigue and job performance, also there was no significant relationship between demographic variables and job performance, which was not consistent with the result of present study, in which there was a significant relationship between work experience, BMI and job performance. In a study carried out by Yip, there was a significant relationship between feeling of pleasure about work, fatigue, low mood in the workplace and back pain. The tedium of work with computers and control systems in this unit and the high levels of fatigue and musculoskeletal disorders in the neck, back and knees have reduced the job performance of the staff. In the workplace, individual, organizational and environmental factors such as stress and heavy workload are factors that increase the fatigue which results in the risk of physical health and musculoskeletal discomfort that undermines the ability of individuals and reduces the job performance of the staff.

Self-reporting was one of the limitations of this study, which may cause inaccurate responses, so participants were ensured that the data were confidential and participants were given necessary guidance while completing the information. Another limitation of the current study was investigating male samples, it is strongly recommended to do more studies in similar industry with gender diversity and more personnel in order to illustrate the relationship between variables more effectively. Regarding the effect of the level of education on job performance, encouraging staff to continue their education and conduct retraining courses is also recommended.

Conflict of interest

The authors did not report any contradiction of interests.

Acknowledgments

The study was approved by Ethics Committee of the Neyshabur University of Medical sciences (ethical approval number: IR.NUMS.REC.1396.30). Thus, the authors of the paper express their gratitude and gratitude to the Student Research Committee of Neyshabur University of Medical Sciences and the staff of the power plant that helped us in our study.

References

- Chen TH. The study of survivor's employee job stress for privatization of government enterprise--case of Taiwan fertilizer company employee. Institute of human resource management, national sun yat-sen university. 2000.
- Emery L, Sittler M, Ryan J. Mode of action and angular velocity fatigue response of the hamstrings and quadriceps. *Isokinetics and exercise science*. 1994;4(3):91-5.
- Yumang-Ross DJ, Burns C. Shift work and employee fatigue: implications for occupational health nursing. *Workplace health & safety*. 2014;62(6):256-61.
- Jalal EJ, Hajibabae F, Farahaninia M, Joolae S, Hosseini F. Relationship between job satisfaction, absence from work and turnover among nurses. *Nursing and midwifery sciences*. 2014;1(1):12-8.
- Rogers AE. The effects of fatigue and sleepiness on nurse performance and patient safety; 2008.
- Wright BE. The role of work context in work motivation: A public sector application of goal and social cognitive theories. *public administration research and theory*. 2004;14(1):59-78.
- Cooper CL. *Industrial and organizational psychology*. Cheltenham: United Kingdom: Edward Elgar Publishing; 1991.
- Appelbaum SH, Deguire KJ, Lay M. The relationship of ethical climate to deviant workplace behaviour. *Corporate Governance: The international journal of business in society*. 2005;5(4):43-55.
- da Costa BR, Vieira ER. Risk factors for work-related musculoskeletal disorders: a systematic review of recent longitudinal studies. *American journal of industrial medicine*. 2010;53(3):285-323.
- Harris Adamson C, Eisen EA, Dale AM, Evanoff B, Hegmann KT, Thiese MS, et al. Personal and workplace psychosocial risk factors for carpal tunnel syndrome: a pooled study cohort. *Occup Environmental Medicine*. 2013;eemed-2013-101365.
- Kaliniene G, Ustinaviciene R, Skemiene L, Januskevicius V. Associations between neck musculoskeletal complaints and work related factors among public service computer workers in Kaunas. *International journal of occupational medicine and environmental health*. 2013;26(5):670-81.
- Hales BM, Pronovost PJ. The checklist—a tool for error management and performance improvement. *critical care*. 2006;21(3):231-5.
- Daviglus ML, Liu K, Yan LL, Pirzada A, Garside DB, Schiffer L, et al. Body mass index in middle age and health-related quality of life in older age: the Chicago heart association detection project in industry study. *Archives of internal medicine*. 2003;163(20):2448-55.
- bing Yip Y. A study of work stress, patient handling activities and the risk of low back pain among nurses in Hong Kong. *advanced nursing*. 2001;36(6):794-804.
- Frymoyer JW, Pope MH, Clements JH, Wilder DG, MacPherson B, Ashikaga T. Risk factors in low-back pain. An epidemiological survey(JBJS). 1983;65(2):213-8.
- Kouhnavard B, Mahgoli H, bolghanabadi S, Yazdan Aval M, Aghdam Shendi MR, Kolahe Douzi M. The relationship between fatigue, stress and job performance with some demographic variables in dental prosthesis technicians. *Dental Medicine*. 2018;31(2):91-7.[persian].
- Grunfeld E, Whelan TJ, Zitzelsberger L, Willan AR, Montesanto B, Evans WK. Cancer care workers in Ontario: prevalence of burnout, job stress and job satisfaction. *Canadian medical association journal*. 2000;163(2):166-9.
- Punja S, Shamseer L, Olson K, Vohra S. Rhodiola rosea for mental and physical fatigue in nursing students: a randomized controlled trial. *PloS one*. 2014;9(9):e108416.
- Bolghanabadi S, Dehghan h, Mehdi Pour. The relationship between musculoskeletal disorders, stress and fatigue in the food industry employees. *Journal of Ergonomics*. 2014;2(1):54-63.[Persian].
- Antonopoulou M, Ekdahl C, Sgantzios M, Antonakis N, Lionis C. Translation and standardisation into Greek of the standardised general Nordic questionnaire for the musculoskeletal symptoms. *The European journal of general practice*. 2004;10(1):33-4.
- Sasaki T, Iwasaki K, Mori I, Hisanaga N, Shibata E. Overtime, job stressors, sleep/rest, and fatigue of Japanese workers in a company. *Industrial health*. 2007;45(2):237-46.
- Ghasemkhani M, Ziaee yon M. Assessment of fatigue in manufacture of various types of disconnecter switches workers. *Iran Occupational Health Journal*. 2005;2(1):2-6.[Persian].
- Dehghan N, Choobineh AR, Hasanzadeh J. Interventional ergonomic study to correct and improve working postures and decrease discomfort in assembly workers of an electronic industry. *Iran Occupational Health Journal*. 2013;9(4):71-9.[Persian].
- 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. *Occupational and environmental medicine*. 2005;62(3):188-94 .
- Rezaei M, Baghianimoghadam MH, Halvani G. Fatigue situation in tile industries workers. *Salāmat-i kār-i Irān*. 2007;4(3):57-63.[Persian].
- Karwowski W ,Marras WS. *Interventions, Controls, and Applications in Occupational Ergonomics*.US: CRC Press; 2006.
- Ortiz-Hernández L, Tamez-González S, Martínez-Alcántara S, Méndez-Ramírez I. Computer use increases the risk of

- musculoskeletal disorders among newspaper office workers. Archives of medical research. 2003;34(4):331-42.
- 28-Esmaeilzadeh S, Ozcan E, Capan N. Effects of ergonomic intervention on work-related upper extremity musculoskeletal disorders among computer workers: a randomized controlled trial. International archives of occupational and environmental health. 2014;87(1):73-83.
- 29-Mohammadi J, Rahimi F, Fagher E, Shoaibi G. Evaluation of Personality-Job Fit and Its Relationship with Job Performance: The Mediating Role of Organizational Commitment in Employees of Khuzestan Steel Company. Journal of Industrial and Organizational Psychology Studies. 2016;3(1):19-40.