



Musculoskeletal Disorders Risk Assessment in Serviceman Workers of a Petrochemical Company

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ABSTRACT

Aim: Ergonomic risk factors are one of the main factors in the occurrence of Work-related Musculoskeletal Disorders (WMSDs). The serviceman workers are exposed to various health and safety risk factors during their activities. This study aimed to assess the risk of musculoskeletal disorders in serviceman workers of a Petrochemical company.

Method and Instruments: In this descriptive cross sectional study, first, the posture of 106 serviceman workers were assessed using REBA method. Then, the prevalence of WMSDs symptom was investigated using Nordic Questionnaire (NQ). The collected data were analyzed by SPSS software using statistical Chi-square test.

Findings: Rapid Entire Body Assessment (REBA) score for serviceman workers involved in insulation, electrical and Instrumentation related work was 11, 12 and 13 (high risk) respectively. The highest prevalence of musculoskeletal disorders was reported in the lower back and knees. Significant relationship ($p < 0.05$) was observed between work experience and disorders symptom in knee.

Conclusion: This study showed high prevalence of WMSDs symptom in study population, especially in their waist and knee. Moreover, it was indicated that the working conditions of serviceman workers needs to be improved. Training the workers to identify the risk factors and use proper ergonomic principles and procedures is recommended.

Keywords: Musculoskeletal Disorders, Nordic Questionnaire, REBA, Ergonomics

Introduction

Musculoskeletal Disorders (MSDs) are the muscles, bones, joints, peripheral nerves, and blood vessels disorders that result from prolonged stress over time or from acute trauma. When these disorders caused by work, they are considered to be Work-related Musculoskeletal Disorders (WMSDs) [1]. MSDs are common causes of occupational injury and disability in industrialized and developing countries [2-8]. Ergonomic risk factors are one of the main factors in the occurrence of (WMSDs). Working in the wrong position, sitting or standing for long periods of time, lifting and carrying objects repeatedly, and exerting force are examples of these factors. When these risk factors occur together

simultaneously, increase the risk of MSDs. Based on the 39 studies results that investigated the association between mechanical factors and shoulder problems showed that, there was a relationship between shoulder problems and repetitive work with static postures. More than 40 studies have investigated the association between mechanical factors and low back pain. According to the reports of this study, back problems are associated with heavy physical work, lifting the load, improper postures and vibration of the whole body [9]. Esfandiari et al. studied the prevalence of musculoskeletal disorders and ergonomic risk factors in repair men. They concluded prevalence of MSDs was high among the workers and the most

common MSDs was in the lumbar region ^[10]. Nasaruddin et al. studied the prevalence of MSDs and its association with risk factors among auto repair mechanics. It was observed 87.4% of auto repair mechanics suffered from MSDS ^[11]. Asadi et al. studied risk factors for musculoskeletal injuries in airline serviceman, repair and overhaul. Nordic Musculoskeletal Questionnaire indicated that the low back was the most commonly reported region of the body experiencing aches, pain, and discomfort (41% of participants). Rapid Entire Body Assessment (REBA) assessments showed that 57% of the jobs examined fell within the high-risk category ^[12].

Serviceman job have many ergonomic risk factors, for which few studies have been conducted on the health of its employees. Serviceman personnel face different risks when doing work. They operate in conditions such as different weather, exposure to vibration, noise, chemicals, and poor ergonomic conditions, and often face a combination of these risks.

Most of the work done by repairmen puts pressure on various organs, including bending, kneeling, stretching, pushing and pulling, working in confined spaces and rotating and holding the arm without support are the factors that aggravate the injuries inflicted on the employees of this job. According to reports, 27% of the workers complained about fatigue, 19% about standing work, 34% about working in the same posture and 35% about bending. Based on a study conducted in France, among repairmen, more complaints are related to standing posture, foot movement during work, kneeling position, moving heavy loads and other limitations such as squatting and rotation ^[13]. The importance of serviceman workers health and reducing the costs of disease and disability require special attention to the study of their job ergonomic

risk factors. The aim of this study is the risk assessment of MSDs in service workers of a petrochemical company.

Method and Instruments

The present work is a descriptive-analytical cross-sectional study that was carried out among serviceman workers in a petrochemical company. The study population was all serviceman in areas 1 and 2 of the studied company who were included in the study by census method. Serviceman worker were divided into five groups based on their related work including repair services (scaffolding, work on insulation), electric, machine, Instrumentation and mechanic related work. The number of people studied was 106, of which 29 works were in repair \ services group, 15 in the electric group, 18 in the machine group, 19 in the Instrumentation group and 25 in the mechanic group.

In this study, the REBA (Rapid Entire Body Assessment) method was used to determine the level of risk of MSDs. The REBA method is a globally accepted method which was used due to its ease of use, analysis of a wide range of different postures and high sensitivity, reliability and validity ^[14]. In the REBA method, the organs are classified into two groups, A and B. Group A includes the trunk, neck, and legs, and group B includes the arms, forearms, and wrists, each of which creates a combined 60 and 36 postures, respectively. Scoring and combined effect of postures in each group is done according to the tables provided. The points related to the application of force, which are specified in the table, are added to the score of group A, and the score related to the coupling of the hand with the load, which is specified in the table, is added to the score of group B. In the relevant table,

the scores of groups A and B are combined for determining of score of C. The activity score obtained from the table is added to the C score to obtain the final score. Then the level of risk and priority of corrective actions are determined.

For risk assessment using REBA method, serviceman workers workplace was observed by researchers to identify the worst and repetitive posture of them. The selected postures were assessed to determine the level of risk and corrective actions required. In addition, in the present study, the Nordic questionnaire was used to determine the prevalence of MSDs [15]. The Nordic Questionnaire (NQ) includes a number of demographic factors such as age, sex, weight, height, level of education, work experience and marital history, as well as MSDs in nine areas of the body (neck, shoulders, elbows, wrists, hands, upper back, lower back, thighs, knees, and ankles). The questionnaire was completed by all subjects. The data were entered into SPSS statistical software version 19, chi-square test and Fisher's exact test were used to assess the relationship between variables.

Findings

In the present study, 106 serviceman

workers were investigated. All participants in the study were male and had a mean age of 42 ± 6 , mean weight of 80 ± 11 , mean height of 173 ± 12 , and an mean work experience was 16 ± 5 years old. About 95.3% workers were married and 4.7% were single. In terms of education, 24.5% were undergraduate, 38.7% were diploma, 11.3% were postgraduate, 24.5% were undergraduate and were 0.9% postgraduate and in terms of shift work, 72.6% of workers work daily and 27.4% of them were shift workers. 88.7% of workers were right-handed and 11.3% were left-handed.

According to Table 1, the highest prevalence of MSDs during the last 12 months was in workers knee who doing the scaffolding, insulation and electric work with 46.7%, 50% and 44.4%, respectively. According to the data of Table 2, the highest prevalence of MSDs during the last 7 days was in the workers waist who doing Instrumentation related work with 47.4%.

Table 3 shows the prevalence of MSDs during the last 12 months that prevent doing work. Based on the Table 3, highest prevalence of MSDs was in lumbar of workers who doing mechanical work with 56%.

According to Figure 1, the lowest and highest percentages of MSDs in the studied

Table 1) Musculoskeletal disorders symptoms in the last 12 months in nine areas of the body

Work	Neck	shoulder			Elbow			Hand / wrist			Back	Waist	Thigh	Knee	Foot / Ankle
		Right	Left	both	Right	Left	both	Right	Left	both					
Scaffolding	26.7	13.3	7.6	0	26.7	0	6.7	13.3	0	6.7	33.3	40	6.7	46.7	20
Insulation	21.4	21.4	7.1	0	28.6	0	7.1	14.3	14.3	7.1	21.4	42.9	7.1	50	28.6
Electric	33.3	5.6	5.6	16.7	0	0	5.6	11.1	5.6	0	22.2	38.9	11.1	44.4	22.2
Machining	33.3	6.7	0	0	13.3	0	13.3	20	0	6.7	40	53.3	13.3	33.3	26.7
Instrumentation	42.1	26.3	0	10.5	15.8	0	5.3	10.5	0	1.5	42.1	68.4	0	31.6	21.1
Mechanic	52	8	12	12	8	8	24	16	4	12	44	64	32	52	44

groups during the last 12 months were 8% in the left elbow and 68.4% in the lower back, respectively. The lowest and highest percentages of MSDs among the studied groups during the last 7 days were 5.6% in both shoulders and 47.4% in the waist, respectively.

According to T-test, there was no significant relationship between age and the report of pain and discomfort symptoms in different parts of the body ($P > 0.05$). There was a significant relationship ($p < 0.05$) between work experience and knee disorders, meaning

that with increasing work experience, the amount of knee disorders has increased. Table 4 shows the level of risk and priority of corrective action in the worst posture in each group. According to this Table, the workers doing scaffolding, machining and mechanic related work have a REBA score of 9, high risk level and they need corrective action as soon as possible, and the workers doing insulation, electric and Instrumentation related work have a REBA score of 11, 12 and 13, respectively, a very high level of risk, they need urgently doing corrective action.

Table 2) Percent of Musculoskeletal Disorders symptoms in the last 7 days in nine areas of the body

Job	Neck	shoulder			Elbow			Hand / Wrist			Back	Waist	Thigh	Knee	Foot / Ankle
		Right	Left	both	Right	Left	both	Right	Left	both					
Scaffolding	20	13.3	0	0	26.7	0	6.7	20	0	6.7	13.3	33.3	6.7	26.7	13.3
Insulation work	21.4	14.3	7.1	0	28.6	0	0	14.3	7.1	0	21.4	28.6	0	21.4	14.3
Electric	22.2	5.6	5.6	5.6	5.6	0	0	5.6	5.6	0	21.4	28.6	0	21.4	14.3
Machining	33.3	6.7	0	0	6.7	6.7	0	13.3	0	6.7	13.3	46.7	13.3	26.7	20
Instrumentation	31.6	21.1	0	5.3	5.3	0	0	5.3	5.3	5.3	21.1	47.4	5.3	26.3	21.1
Mechanic	32	20	8	4	8	4	20	8	0	8	4	40	24	40	24

Table 3) Musculoskeletal Disorders symptoms that have prevented occupational activity in the past 12 months in nine areas of the body (N=106)

Work	Neck	shoulder		elbow			Hand / wrist				Back	Waist	Thigh	Knee	Foot / Ankle
		Right	Left	both	Right	Left	both	Right	Left	both					
Scaffolding	13.3	13.3	0	0	13.3	0	6.7	6.7	0	0	6.7	20	13.3	13.3	6.7
Insulation	21.4	7.1	0	14.3	14.3	0	7.1	7.1	7.1	7.1	26.8	28.6	14.3	28.6	28.6
Electric	11.1	5.6	5.6	0	5.6	0	0	5.6	0	0	11.1	27.8	5.6	27.8	11.1
Machining	0	6.7	0	0	6.7	0	0	0	0	6.7	6.7	33.3	6.7	6.7	6.7
Instrumentation	10.5	0	5.3	5.3	10.5	0	5.3	5.3	0	5.3	31.6	52.6	0	21.1	26.3
Mechanic	32	8	8	8	0	0	20	12	0	8	28	56	20	32	28

Table 4) Rapid Entire Body Assessment final score, level of risk and priority of corrective actions in the worst posture in work groups

Work group	*REBA score	Risk level	Necessity and timing of corrective actions
Scaffolding	9	High	Necessary (as soon as possible)
Insulation	11	Very high	Necessary (immediately)
Electric	12	Very high	Necessary (immediately)
Machining	9	High	Necessary (as soon as possible)
Instrumentation	13	Very high	Necessary (immediately)
Mechanic	9	High	Necessary (as soon as possible)

*REBA (Rapid Entire Body Assessment)

Table 5) Rapid Entire Body Assessment final score, level of risk and priority of corrective actions in the most frequent postures during the shift in work groups

Work group	*REBA score	Risk level	Posture repetition during a shift (percent)	Necessity and timing of corrective actions
Scaffolding	8-10	High	62	Necessary (as soon as possible)
Insulation	8-10	High	33	Necessary (as soon as possible)
Electric	7-4	Moderate	50	Necessary
Machining	8-10	High	33	Necessary (as soon as possible)
Instrumentation	7-4	Moderate	50	Necessary
Mechanic	8-10	High	50	Necessary (as soon as possible)

*REBA (Rapid Entire Body Assessment)

Table 5 shows the level of risk and priority of corrective actions in the most frequent postures during the shift in work groups. According to this table, 62% of postures in the scaffolding work group have a score of 8-10, high risk level, urgent need, and corrective action as soon as possible.

Discussion

According to the results of the present study,

the highest prevalence of MSDs in repairmen, was back and knee. In a study conducted in France, more repairmen complained about knee condition, standing and lifting heavy loads, which is consistent with the results of the present study^[13]. Among the factors causing the prevalence of the disorders and injuries to the back and upper part of repairmen body are lifting loads in inappropriate postures, improper design (lack of access, lack of space

to move, working at a height lower than knee or above shoulder height), lack of access to equipment that can assist repairers in lifting loads, lifting heavy loads alone, carrying heavy loads on ladders or in narrow spaces, performing repetitive movements by twisting and use non-ergonomic tools. Complaints of MSDs in the right elbow, wrist, and shoulder are more common than in the left elbow, wrist, and shoulder, and this result is reasonable given that 88.7% of servicemen were right-handed. In a study conducted by Habibi et al., Most assemblers (88.9%) were right-handed, and most complaints in the wrist and fingers were related to the right hand ^[16].

In the results, there was no significant relationship between age and musculoskeletal disorder. This has been reported in some other studies ^[16]. Based on the analysis, there was a significant relationship between work experience and the prevalence of MSDs; therefore, it can be concluded that with increasing work experience, the prevalence of MSDs increases, which can be due to the increased accumulation of traumas and injuries in the long run. There are conflicting results on the relationship between the prevalence of MSDs and work experience. The findings of some studies show that people with more work experience are less likely to suffer from MSDs, which can be due to reduced stress following an increase in work experience. However, in agreement with the results of the present study, Gorgi et al. have reported in their separate studies that with increasing work experience, the prevalence of these disorders increases significantly ^[17]. In this regard, other studies have reported significant relationship between work experience and MSDs ^[17, 18].

Conclusion

This study showed high prevalence of MSDs symptom in study population, especially

in their waist and knee. Moreover, it was indicated that the working conditions of servicemen workers needs to be improved. Training the workers to identify the risk factors and use proper ergonomic principles and procedures is recommended.

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