



Scientific Journal of Musculoskeletal Disorders

Research Article

Study of Musculoskeletal Disorders Risk Factors among Oil Refinery Staff of Iran by Using RULA & REBA Methods - @

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Submitted: 09 April 2018; **Approved:** 07 June 2018; **Published:** 09 June 2018

Citation this article: Mohammadi G, Agharezaei S, Nasab ME, Mohammadi P. Study of Musculoskeletal Disorders Risk Factors among Oil Refinery Staff of Iran by Using RULA & REBA Methods. Sci J Musculoskelet Disord. 2018;2(1): 001-006.

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ABSTRACT

Work-related Musculoskeletal Disorders (MSD) are one of the most common occupational diseases of office workers. The aim of this study is investigating the prevalence of these disorders, determining the risk factors of occupational diseases and providing control strategies. The aim of this study is evaluating the prevalence of these symptoms among oil refinery staff. The studies conducted 200 administrative staff, 150 were male and 50 were female. It was observed that most musculoskeletal symptoms were in the neck (50%), knee (42.5%), shoulders (38.5%), the hip (10%) and lower arm (8.5%). To investigate the risk factors of musculoskeletal symptoms, we use the new methods of RULA and REBA so that we can take the necessary action to reduce the musculoskeletal symptoms and prevent potential dangers.

Practitioner Summary: This study was conducted to evaluate the prevalence of musculoskeletal disorders among one company of Iran's oil refineries staff. Basically, because refinery workers need to do a lot of technical and physical work, therefore they have many musculoskeletal disorders. This study suggests that, with these disorders, there should be some necessary measures.

Keywords: Risk Factors; Musculoskeletal Disorders; Oil Refinery; Staff; RULA; REBA

INTRODUCTION

Musculoskeletal disorders are considered as one of the most common and costly problems associated with jobs in many countries all over the world [1]. Economic losses in view of these disorders not only for individuals but also affects the organization and society in which we live [2]. So that these kind of disorders can impose individual, social and economic impacts on every society. On the other hand, these disorders are considered due to high incidence as a major cause of death and disability among the adults in developing countries [1]. It is estimated that on the whole, direct and indirect costs caused by musculoskeletal disorders might be about 1 % of Gross Domestic Product (GDP) of industrialized countries [3]. Additionally, about 60% to 90% of all over the lifetime for some time, they suffer from back pain and also about 15% to 20% of compensation received by workers due to these problems [3]. The 2009 International Labor Organization is estimated that about 1.2 million workers have been fired due to disabilities and about 28% of these layoffs have been associated with work-related musculoskeletal disorders [4]. Conservative estimate in the American society shows that the economic burden caused by these injuries is between \$45 billion to \$54 billion during a year. In 1999 nearly one million Americans had been absent from their work for the treatment and improvement of musculoskeletal pain. In addition, considering the increase population rates and demographic forecasting changes, it is estimated that around 59 million people (18.4%) will be affected by the United States by 2020 [5]. It seems that the prevalence and severity of musculoskeletal injuries, it is relevant to the current ways of organizing work which is mainly characterized by new technologies, job specializations and job intensification. In developing countries, the negative effects of these methods are due to hazardous work conditions reduced wages and inadequate medical coverage has intensified [6] number of risk factors associated with these disorders are involved such as 1. Physical conditions that include: Environment (work environment) and biomechanics (risk of gestures and movements). 2. Organizational conditions lack of co-worker and equipment sufficient. 3. The psychological and social condition of work exceed the individual's ability, time pressure, low independence and competition [7]. According to the above mentioned contents and considering the long-term management of the computerized oil refinery management system, it can be said that this group of individuals, as one of the occupational groups are at risk for musculoskeletal. Therefore, in the present survey, the prevalence of musculoskeletal disorders was studied among the staffs of oil refinery Administration System.

METHODS

Population

This present study was carried out on a census of 200 of oil refinery administrative system in 2017 who are at least have one-year experience at official work. A questionnaire was used to collect information. The questionnaire of this research has three general sections, In the first part, demographic information such as age, gender, work experience, working hours are considered and all the questionnaire did not have name in order to staff can trust to this research truly. Since our aim was about evaluation of musculoskeletal disorders during the past year, a standard questionnaire was used for this purpose [8]. In section two, those attending for fill the questionnaire should have indicated that in which of the 8 parts of his/her body i.e. (Neck, shoulder, upper back, lower back, Lower arm, wrist, hip, knee) has been distressed or troubled over the past 12 months. Subsequently, the respondent should specify that whether this problem caused his/her to leave or unable to work. Meanwhile, questions were asked about any pain or discomfort for each of abovementioned areas. If their answer was positive, third part of questionnaire which consists of 11 questions related to discomfort in the affected limb was completed. This type of questionnaire from 1987 at the Institute of Occupational health in Scandinavia by Korhan et al. with the aim of determining the prevalence of musculoskeletal disorders caused by work, was developed and implemented [9]. This questionnaire can be used for screening of musculoskeletal disorders. Reliability and validity of this Persian version of this questionnaire have already been reviewed [10]. Also, questions were asked about job satisfaction and work experience of staff.

Data analysis

At the end, data collected from questionnaires were analyzed by SPSS software version 24. Finally, the data are quantitatively deformed \pm Average and qualitative data were reported as numbers (%). In order to test the relationship between quantitative variables and musculoskeletal disorders, t test of two examples and to determine the relationship between qualitative and musculoskeletal disorders, Chi-square test was used. The significance level of the tests was 0.05%.

According to the table 1, those filling questionnaire was 150 people (75 %) men and 50 people (25%) women. Of the 200 employees surveyed 20(10%) of people aged 20 to 27 years, 33(16.5%) between 28 and 34, 65(32.5%) of people between 35 and 45 years old and 82(41%) of people over 46 years of age. 10 (5%) people under 5 years of work experience, 23 (11.5%) of people between 6 and 8 years

of work experience, 73 (36.5%) of people between 9 and 12 years of work experience, 94 (47%) of people between 9 and 12 years of work experience.

RESULTS

The prevalence of musculoskeletal disorders in different organs of the subjects is presented in table 2. Based on the results of collected data, on the whole of 140 (70%) of the studied population in the past 12 months suffered from at least one of the 8 areas of the body. The prevalence of these disorders are related to the neck segment (50%), Knee (42.5%), shoulder (38.5%), upper back (37%) and The lowest amount is for the lower arm (8.5%), and the hip were (10%). It was observed that the prevalence of musculoskeletal disorders in women was 76% and in men was 64% and in general, the chances of women having musculoskeletal disorders are 1.18 times higher than men.

According to the information obtained from the questionnaire, the highest and lowest musculoskeletal disorders in the subjects are presented in table 3.

The data show that the incidence of musculoskeletal disorders in the lower extremities (hip, knee) is lower than the upper extremity (neck, shoulder, wrist, lower arm). It was found that 30 (60%) of women and 70 (46.66%) of Men suffer from musculoskeletal disorders of the upper extremity. This difference was statistically significant ($P = 0.046$). Also, 15 (30%) of women and 28 (18.66%) of men had musculoskeletal disorders of the lower extremities. This difference also was statistically significant ($P = 0.005$). These values indicated that the prevalence of musculoskeletal disorders in the upper and lower extremities was significantly higher in men than women. It was found that 35 (70%) of women and 65 (43.33%) of men had both upper limb and lower limb disorders simultaneously. This result shows that the prevalence of musculoskeletal disorders in the upper and lower extremities is significantly ($P = 0.042$) in mean are higher than women. Information is provided in table 4. As seen,

Table 1: Demographic characteristics of the subjects (n = 200)

Variable	Category	Number (percentage)
Gender	Female	50 (25%)
	Male	150 (75%)
Age	20-27	20 (10%)
	28-34	33 (16.5%)
	35-45	65 (32.5%)
	Up to 46	82 (41%)
Work Experience	0-5	10 (5%)
	6-8	23 (11.5%)
	9-12	73 (36.5%)
	Up to 12	94 (47%)

Table 2: The prevalence of musculoskeletal injuries of the extremities of eight body parts in the last 12 months studied in staff.

Symptoms	Number	Percentage
Neck	100	50%
Shoulder	77	38.5%
Upper back	74	%37
Lower back	56	%28
Lower arm	17	%8.5
Wrist	50	%25
Hip	20	%10
Knee	85	%42.5

Table 3: Maximum and minimum musculoskeletal disorders in women and men.

	Male n = 150 Member Name · Number (percentage)	Female n = 50 Member Name · Number (percentage)
Most of the symptoms	90(45%), Neck	25 (50%), Knee
Least of the symptoms	20(10%), Lower arm	4 (2%), hip

Table 4: Distribution of musculoskeletal symptoms in various body organs during the past 12 months on the basis of experience of the participants.

Parts of body	0-5	work experience 6-8	9-12	Up to 12	P-value(t-test)
	Number (Percentage)	Number (Percentage)	Number (Percentage)	Number (Percentage)	
Neck	8 (8%)	14 (14%)	23 (23%)	55 (55%)	0.154
Shoulder	6 (7.79%)	16 (20.77%)	20 (25.97%)	35 (45.45%)	0.412
Upper Back	20 (27.02%)	13 (17.56%)	21 (28.37%)	30 (40.54%)	0.123
Lower Back	8 (14.28%)	10 (16.66%)	15 (26.78%)	23 (41.07%)	0.77
Lower arm	1 (5.88%)	3 (17.64%)	7 (41.17%)	6 (35.29%)	0.54
Wrist	2 (4%)	9 (18%)	8 (16%)	31 (62%)	0.67
Hip	0 (0 %)	4 (20%)	4 (20%)	12 (60%)	0.044
Knee	9 (10.58%)	9 (10.58%)	16 (18.82%)	51 (60%)	0.002

the highest prevalence of symptoms of musculoskeletal disorders in the hip and shoulder areas, people with a history of 6 to 8 years of age, in the upper back and lower arms for people aged 9 to 12 years and in the neck, wrist, knee and hip for people with work experience of 12 years and up. In this table, t-test was used for analysis.

Table 5 shows the prevalence of musculoskeletal disorders in women based on the age of women. This information is analyzed by Chi-square test. The highest prevalence of musculoskeletal disorders in the lower back and hip is for people between the ages of 28 and 34, in the areas of the wrist and lower back, it is related to people between the ages of 35 and 45 and finally in the wrist and hip area is related to people between ages 46 and older.

Table 6 shows the prevalence of musculoskeletal disorders in men based on the age of males. This information was analyzed by Chi-square test. The highest prevalence of musculoskeletal disorders in the lower arm was related to people aged 20 to 27 years. In the shoulder and hip of people aged between 28 and 34, in the lower back, wrist and neck areas of people between the ages of 35 and 45. In the shoulder region, and wrist are for people between the ages of 46 and up. It is also observed that with the increasing age in men, the prevalence of these disorders increases in these areas.

The RULA and REBA tables were set up based on the type of staff being studied. Five of the 200 employees were randomly selected and each of these 5 was tested for 30 minutes. The results, the final score of the posture, and the level of actions were recorded in the tables. Using these two tables of musculoskeletal disorders in each area and taking the necessary measures to prevent these disorders.

DISCUSSION

Main results

On the whole, 200 staff evaluated for musculoskeletal disorders,

Table 5: Distribution of musculoskeletal symptoms in various body organs during the past 12 months according to age range (women) studied.

	20-27	28-34	Women age range 35-45	Up to 46	
Parts of body	Number (Percentage)	Number (Percentage)	Number (Percentage)	Number (Percentage)	P-value(Chi-square)
Neck	(%20)3	3 (%20)	4 (%26.66)	(%33.33)5	0.001
shoulder	(%20)2	2 (%25)	3 (%30)	(%30)3	0.0004
Upper back	(%37.5)3	0 (0%)	3 (%37.5)	(%25)2	0.194
Lower back	(%14.28)1	(%28.57)2	3 (%42.85)	(%14.28)1	0.0087
Lower arm	(%0)0	1 (%20)	2 (%40)	(%40)2	0.03
Wrist	(%0)0	0 (%0)	4 (%44.44)	(%55.55)5	0.12
Hip	(%0)0	(%33.33)1	(%0)0	(%66.66)2	0
Knee	1 (%16.66)	0 (%0)	2 (%33.33)	(%50)3	0.003

Table 6: Distribution of musculoskeletal symptoms in various body organs during the past 12 months according to age range (men) studied.

	20-27	28-34	Men age range 35-45	Up to 46	
Parts of body	Number (Percentage)	Number (Percentage)	Number (Percentage)	Number (Percentage)	P-value(Chi-square)
Neck	(%5.88)5	13 (15.29%)	22 (25.88%)	(%52.94)45	0.005
Shoulder	(%2.98)2	14 (20.89%)	8 (11.94%)	(%64.17)43	0.0084
Upper back	(%7.57)5	9 (13.63%)	17 (25.75%)	(%53.03)35	0.24
Lower back	(%12.24)6	(%18.36)9	15 (30.61%)	(%38.77)19	0.009
Lower arm	(%16.66)2	1 (8.33%)	3 (25%)	(%50)6	0.78
Wrist	(%2.43)1	7 (17.07%)	11 (26.82%)	(%53.65)22	0.003
Hip	(%0)0	(%23.52)4	(%23.52)4	(%52.94)9	0.04
Knee	10 (12.65%)	15 (18.98%)	18 (22.78%)	(%45.56)36	0.032

Table 7: Table of Rapid Upper Limb Assessment (RULA) by typing studied staff.

Staff	Points organs of the Group A	Points organs of the Group B	Rated force	Rating muscle	final score posture	level of activity	Ergonomic intervention necessary
1	6	5	0	1	7	4	Instantly
2	4	1	0	0	3	2	Necessary
3	7	7	0	1	7	4	Instantly
4	3	4	0	0	4	3	Very necessary
5	4	5	0	0	5	3	Very necessary

Table 8: Table of Rapid Entire Body Assessment (REBA) by typing studied staff.

Staff	Points organs of the Group A	Points organs of the Group B	Points Group C	Rating activity	final score posture	level of activity	The need for and timing of
1	5	8	9	1	10	3	Essential (sooner)
2	8	9	10	1	10	4	Immediate
3	3	5	5	1	6	2	Essential
4	4	7	7	1	9	4	Immediate
5	6	5	8	1	9	3	Essential (sooner)

140 of people are suffered from these disorders during the past year, the highest prevalence of these disorders was related to neck, knee and shoulder segments, and the lowest prevalence in the hip, lower arm and wrist segments. Also, in the present study, the prevalence of these disorders was higher in women than in men. The researchers found that the incidence of neck, shoulder and knee disorders in women was more common than men. The data showed that with increasing work experience, the amount of musculoskeletal disorders significantly has increased. So that neck, shoulder and knee disorders are more common in people with higher work experience. Finally, the findings of the present research emphasize that the chance of having these disorders in people with very low job satisfaction is significantly higher. In this regard, it was respectively observed that the most parts which involved in these disorders were neck, lower back and wrist, and the lowest member involved in the lower arm and hips which is in agreement with the results of this study.

Comparison with organizations results

It was also observed that 76.66% of the subjects complained about musculoskeletal disorder in at least one of the 8 areas Choobineh. Also, studies have been done on employees of Sabzevar University of Medical Sciences shows that some parts such as waist, knee, back and wrist areas are more susceptible to musculoskeletal disorders and elbow and thigh areas are more resistant to these disorders [12].

This is despite the fact that, in contrast to the present study, in the above study, neck area disorders had a lower prevalence which could be due to the non-observance of ergonomic principles when using the computer in the work environment. Because of studies done among Iranian computer users, it was observed that failure of ergonomic principles in them could cause more disturbance of neck area compared to other areas [13,14]. In addition, Mansouri et al. mentioned in their study that factors such as sex, duration of

Table 9: Comparison of musculoskeletal disorders in different organizations.

Number	Organization	Number of employees	Symptoms								
			Neck	Wrist	Shoulder	Upper back	Lower back	Knee	Elbow	Hip	Lumbar
1	Oil refinery	200	50%	25%	38.5%	37%	28%	42.5%	-	10%	-
2	Tehran shipping staff	60	46.66%	25%	36.60%	13.33%	16.66%	43.33%	-	8.33%	-
3	Hamedan general dentists	71	49.70%	47.80%	29.60%	23.90%	16.90%	14.10%	1.40%	-	-
4	Iranian carpet weavers	1439	35.20%	38.20%	47.80%	-	-	34.60%	19.20%	16%	45.20%
5	Computer users of Yazd University of medical sciences	217	46.50%	12.40%	20.30%	-	-	-	5.10%	-	57.60%
6	Administrative staff Tehran University of Medical Sciences	420	38%	30.50%	35.40%	38.30%	48.50%	40.10%	13.50%	12.40%	-
7	Nurses in the operating room	54	37.10%	59.30%	53.70%	-	70.40%	59.30%	37.10%	38.90%	72.20%
8	Green space laborers in Isfahan	108	35.20%	42.20%	51.90%	39.90%	52.80%	59.30%	36.10%	42.60%	-
9	Workers in automotive parts	1383	45.70%	59.2%	48%	43.80%	-	30.60%	48.70%	24%	61.80%

Table 10: Sajjad Agharezaei's suggested methods to reduce damages on the various parts of the body related to computer users.

Parts of body	suggested methods to reduce damages
Neck	Distance of the neck to the monitor is 60 - 50 cm, it should be flat and without angle, visual angle of the monitor screen is between 40 to 45 degrees.
Shoulder	Angle of arm and lower arm is between 70 - 135 degrees.
Upper back	In the design of the backing, the lumbar curve should be considered and used from the right sit cushion.
Lower back	Sticking to the seat
Lower arm	Be on the table or arm of the chair and be in the same direction
Wrist	Be in the same direction with lower arm and without angle
Hip & knee	Angle of hip and knee joint should be 90 to 110 degrees and metatarsus should exactly be on the ground or on the footrest.

inappropriate physical condition and doing computer work can contribute to the prevalence of neck pain among employees [15]. Also, Mesbah et al. In their study found that discomfort among office workers was mainly related to neck and shoulder areas and the high rates of disturbance in these areas were attributed to static and repetitive work [15].

In the present research, neck area disorders are considered the most important factor in absence which coincided with previous studies [12]. In this study, the prevalence of disturbances in the neck, shoulders and knees among women was higher than men. In the following, our results indicate that the chance of musculoskeletal disorders among women are significantly higher than men. These results are in agreement with other findings in studies [10,16-18]. Since the design of many workplaces, mainly the anthropometric data used for men than women, so these places are inappropriate in terms of ergonomics for women [19]. On the other hand, in comparison with men, women are more exposed to various occupational stresses while performing similar tasks. This issue can affect many aspects of their health, including musculoskeletal disorders [16,19].

The current study showed that the prevalence of lower and upper extremity disorders in men was significantly higher than women; however, the researchers did not find that they reported in this respect. Furthermore, present research shows that the prevalence of upper

limb disorders in women is more common than men. These results are consistent with previous researches findings [11,20]. Possible explanations for the higher prevalence of upper limb disorders in women can be caused women are often doing repetitive work and occupational stress in women is higher than men [20].

This study showed that the prevalence of upper and lower extremity disorders was significantly higher in men. Also, this study shows that the prevalence of upper limb disorders is more common in women. Of course, it is likely that the prevalence of these disorders in women also can be related to factors such as hormonal, pregnancy and childbirth that there is a need for further research in this regard.

There are contradictory results in relation to the prevalence of musculoskeletal disorders and work experience [11,12,21]. So that the findings of some studies show that people with more work experience less likely to develop musculoskeletal disorders, this could be due to a reduction in job stress due to increased work experience [16]. However, in concordance with the results of the present study, the prevalence of these disorders significantly has gone up in relation with increasing work experience [11,12,21]. The results of this study showed that the average work experience of people with disturbances in the neck, shoulders and knees was significantly higher than other subjects. Considering the relationship between the prevalence of musculoskeletal disorders and ergonomic factors in the work environment, such as inappropriate postures [7]. Therefore, it is likely that the increased prevalence of these disorders in people who have got more work experience.

In two studies, it was observed that ergonomic interventions such as inappropriate postural correction can significantly reduce the incidence of musculoskeletal disorders in different areas such as knee and hip [13,22].

In the study population, the incidence of musculoskeletal disorders in patients with very low job satisfaction was higher. In the ancient study, the most complications in the neck, waist, and shoulders were 53%, 48% and 12% respectively [23].

The study of musculoskeletal disorders in chicken slaughterhouse workers in 11 stations has shown that The wrapping was the most common discomfort in hand / wrist (23%), shoulder (22.2%) and

elbow (18.4%) and neck (17.5%) in the last 12 months. The results show that hand / wrist, shoulder, elbow and neck problems are major health problems in women who are working. Their reports indicate more pain in the hands / wrists, shoulders, elbows and necks than men [24]. This study showed that musculoskeletal disorders related to work in Iranian bank employees are high. The incidence of neck, upper back, lower back and hip / hip was higher in this study than the other part of the body [25].

Individual Musculoskeletal symptoms compared in various organizations is presented in table 9.

In table 9, with the calculations performed, the most disturbances are related respectively Lumbar region 59.2%, neck 41.75%, lower back 41.05%, shoulder 40.4%, knee 40.19%, and wound 39.22% which should be taken to these disorders.

Table 10 is based on research conducted on computer users.

Limitation

In the design of this study, we faced a number of limitations such as the lack of measurement tools and limited access to ask staff question. In the future studies we should set questions about rest strategies, and future research should include more descriptive evaluations that examine other elements of pain.

CONCLUSION

In a nutshell, as per to this research, the prevalence of neck, shoulder and knee disorders among oil refinery official staff is more common than the rest of the members. Also, the prevalence of these disorders is more common among the women, People with a job experience of more than 5 years and people with lower job satisfaction are more common. The prevalence of musculoskeletal disorders in the studied population is high, especially in the neck and upper limbs. Many employees have cited these inefficiencies because of inactivity, working hard with computers, and inappropriate desks and chairs. Most of these disorders are related to those have job experience above 12 years and have an age of over 46 that is a low job satisfaction. Regarding this issue, the implementation of ergonomic interventions in the work environment seems necessary. Designing appropriate ergonomic devices, training and informing employees to the ergonomic principles when working with computers and creating a variety in their tasks can be mentioned as part of the program.

ACKNOWLEDGEMENT

The authors thank all those who made possible this study and also thank the oil refinery staff who were allowed to investigate the common musculoskeletal disorders in this organization.

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