

Risk Assessment of Musculoskeletal Disorders and Determination of the Associated Factors among Workers of a Dairy Products Factory

Zahra Zamanian¹, PhD; Hadi Daneshmandi², PhD student; Hojjatollah Setoodeh³, BS student; Ebrahim Nazariipoor³, BS student; Abdollah Haghayegh³, MSc student; Saeed Shaban Sarvestani¹, MSc

¹Department of Occupational Health, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran;
²Research Center for Health Sciences, Shiraz University of Medical Sciences, Shiraz, Iran;
³Student Research Committee, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran

Correspondence:

Hadi Daneshmandi, PhD student;
 Research Center for Health Sciences,
 Shiraz University of Medical Sciences,
 P.O. Box: 71645-111, Shiraz, Iran
Tel: +98 71 37251001(296)
Fax: +98 71 37260225
Email: daneshmand@sums.ac.ir
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Abstract

Background: Musculoskeletal disorders (MSDs) are one of the most common causes of occupational injuries that appear in the lower back, neck and upper and lower extremities mainly. This study was conducted to assess the risk of MSDs and determine of its associated factors in workers of a dairy products company.

Methods: In this cross-sectional study, 100 male employees (21-41yrs) using census sampling method participated. Data were collected using demographic questionnaire, Nordic musculoskeletal disorders questionnaire (NMQ) and QEC method for assessment of postures during the work. Data were analyzed using statistical tests including test of proportion, multiple logistic regression, and Fisher's Exact by SPSS software (Version 16.0).

Results: The results of this study showed that the lower back (37%), shoulders (36%), and hand/wrist (33%) had the highest prevalence of symptoms of disorders among workers. The results of multiple logistic regression showed a significant association between the prevalence of musculoskeletal disorders in different regions of the body and age, job experiences, shift working and BMI. The results of assessment of physical exposure to musculoskeletal risks by QEC technique showed that in 52% of the studied workers, the level of exposure to musculoskeletal risks was in Action Level (AL) 1, 9% in AL2, 30% in AL3, and 9% in AL4. Also, the finding revealed a significant relationship between the prevalence rate of MSDs and the risk level (low and high risk) achieved by QEC method.

Conclusions: Prevalence of symptoms of pain in different regions of the body had an association with age, job experience, shift working and BMI. Corrective measures seemed essential in improvement of working condition in the studied workers.

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Introduction

Musculoskeletal disorders (MSDs) are an important cause of morbidity and disability in developed countries.¹ The risk of these disorders is more serious in industrially

developing countries compared to developed ones. Unsafe work conditions are seen obviously in many workplaces. Since few investigations have been conducted in this field, no exact information is available in this regard and it is not possible to have a true perception of the

importance of this problem (MSDs).²

Work-related Musculoskeletal Disorders (WMSDs) are considered as one of the main reasons for absence from work and probably reduced productivity^{3,4} so that WMSDs are responsible for more than half of the absences in work environments.² Furthermore, the economic loss due to such disorders affects not only the individual but also the organization and society as a whole.⁵⁻⁷

The risk factors of WMSDs include physical (such as carrying heavy loads, repetitive motions, awkward working postures),⁸ psychological, organizational, and personal ones.⁹

As mentioned before, awkward working postures have been considered as one of the most important risk factors of WMSDs.⁹ Hence, posture analysis has been viewed as the basis of many methods employed for assessment of MSDs risk factors.⁸

In dairy industries, there are a large number of risk factors, such as repetitive motions, manual lifting, pulling, pushing, and awkward working posture ones. Results of Rahimabadi and colleagues' study in a dairy factory showed that 76% of the participants had experienced musculoskeletal disorders in one part of their body.³ Also, Habibi and colleagues in their study showed that low back pain, shoulder, knee and wrist disorders have been the most prevalent MSDs among workers of a dairy company.¹⁰

Few studies performed to date have been conducted on the employed dairy company workers. Also, under the above-mentioned conditions, the prevalence rate of MSDs is expected to be high. Thus, the main aim of the present study was to investigate the risk of musculoskeletal disorders and determine their associated factors among workers in a dairy products factory in Fasa, Fars province, Iran.

Methods

The present study was performed in 2013 on 100 male workers selected using census sampling. All the subjects voluntarily participated in the study after being informed about the aims of the study. Also, the participants signed an informed consent form before commencement of the study. All the participants were involved in dynamic tasks and had at least one year work experience. Employees with background diseases or accidents affecting the musculoskeletal system were excluded from the study.

Data Collection Tools

a) Demographic characteristic questionnaire: This questionnaire included questions regarding age, weight, height, marital status, job tenure in the current job, etc.

b) Nordic questionnaire: This questionnaire was used to determine the prevalence rate of MSDs.¹¹ The validity and reliability of the Persian version of NMQ had been determined by Choobineh et al.¹²

c) Quick Exposure Check (QEC) method: This method was used to assess the participants' risk of physical exposure to MSDs.

Based on QEC method, the workers' body parts (back, shoulders/arms, hands/wrists and neck) were categorized according to their body postures during a task and assigned a special code. For example, when the back posture was approximately normal, it was given A₁ code. If the back was slightly twisted or bent toward one side, A₂ code was assigned to it. Finally, in case the back was intensely twisted or bent toward one side, it was given A₃ code. A similar coding method was used for other parts of the body, as well. Finally, regarding the whole points (exposure percentage E) gained from each working posture, the sum of scores for the four sites of the body was calculated separately, and the achieved score was divided by 176 and 162 for manual material handling and the other tasks, respectively. At last, the action level of the musculoskeletal disorders was determined [2]. After assessments through this method, each case was interpreted in accordance to the Action Levels (AL) described below:

AL 1 (QEC Score (E) ≤ 40%) = Indicates acceptable musculoskeletal loading.

AL 2 (41% < E < 50%) = Further investigation is needed and changes may be required.

AL 3 (51% < E < 70%) = Investigation and changes are required soon.

AL 4 (70% ≤ E) = Investigation and change immediately are required.

After the questionnaires were completed, the collected data were entered into the SPSS statistical software (version 16) and analyzed using test of proportion, multiple logistic regression and Fisher's Exact.

Results

In the present study, the participants' means (SD) of age and working experience were 30.64 (±5.8) and 2.88 (±1.36) years, respectively. In addition, their means (SD) of weight, height, and Body Mass Index (BMI) were 71.52 (±11.8) kg, 172.5 (±5.3) cm, and 23.94 (±3.37) kg.m⁻², respectively. Besides, 11% of the participants were single, 89% married, 82% shift workers, 18% day workers, and 10% smokers.

The prevalence rates of MSDs in different parts of the subjects' bodies in the previous year are presented in Table 1. As shown in the table, the highest

prevalence rates of MSDs were related to lower back, shoulders, and wrists/hands. In the studied population, we observed different awkward posture such as standing posture with bent spine for a long time, shoulder abduction, and wrist extension and flexion.

Table 1: Reported symptoms in different body parts in the previous 12 months (n=100)

Body Region	No (%)
Neck	22 (22)
Shoulders	36 (36)
Elbows	13 (13)
Wrists/ Hands	33 (33)
Upper Back	24 (24)
Lower Back	37 (37)
Thighs	16 (16)
Knees	19 (19)
Legs/ Feet	18 (18)

Table 2 compares the prevalence rate of the symptoms among the studied workers and general Iranian population.¹³ Statistical analysis (test of proportion) revealed that the differences between the prevalence rates of symptoms in the neck, upper/lower back and large joints among the studied workers and the general Iranian population were significant ($P<0.001$).

Table 3 shows the significant factors associated with musculoskeletal disorders for each body region.

For the initial selection of the potential risk factors for musculoskeletal complaints, univariate logistic regression analysis was used with a significance level of $P<0.3$. Subsequently, all independent variables that showed significant associations were included in the multivariate logistic regression model. Hosmer and Lemeshow goodness of fit was used for selection of the strongest logistic regression model ($\chi^2=4.88$, $df=8$, and $P=0.768$).

The results of assessment of the subjects' physical exposure level using QEC method are shown in Table 4.

Table 4: Assessment of the subjects' level of exposure to risk of MSDs by QEC method (n=100)

Exposure Level	No.	%
$\leq 40\%$	52	52
41% - 50%	9	9
51%- 70%	30	30
70%<	9	9
Total	100	100

The relationship between the prevalence rate of MSDs and the risk level achieved by QEC method is presented in Table 5. This results showed that there was a significant difference between the prevalence rate of MSDs and the risk level (low and high risk) achieved by QEC method ($P<0.001$). In this association, Positive Predictive Value (PPV) and Negative Predictive Value (NPV) calculated 46% and 87.1%, respectively.

Table 2: Comparison of the prevalence rate of MSDs symptoms in the neck, back and large joints in the studied workers and general Iranian population

Body region	Employees studied (age=21–45)	General Iranian population (age=15–69)
Neck	22%	10.20%
Upper and lower back	45%	25.29%
Large joints*	58%	20.00%

*Including: shoulders, elbows, wrists, knees and ankles

Table 3: Models indicating factors with the strongest influence on the musculoskeletal disorders in different body parts of dairy workers (n=100)

Body Region	Variables Retained in the Model			
	Variables	OR**	95% CI†	P value
Neck	Job experience	1.48	1.31-1.73	0.001
	Shift working	1.08	1.01-1.76	0.028
Shoulders	Age	1.87	1.80-1.94	0.001
Elbows	Age	1.67	1.15-2.34	0.007
Wrists/hands	Job experience	1.70	1.23-2.36	0.002
	Age	2.19	1.44-3.41	<0.001
Upper back	Age	1.50	1.10-2.03	0.008
Lower back	Age	1.38	1.18-1.83	0.012
	Job experience	1.60	1.05-2.36	0.002
Thighs	BMI*	1.70	1.32-2.22	<0.001
	Job experience	1.85	1.30-2.63	<0.001
Knees	Job experience	1.58	1.23-2.04	<0.001
	BMI	1.72	1.17-2.56	0.006
Legs/feet	Age	1.33	1.01-1.74	0.021
	BMI	1.59	1.22-2.09	0.001

*Body Mass Index, **Odds Ratio, †Confidence Interval

Table 5: The relationship between the prevalence rate of MSDs and risk level achieved by QEC method (n=100)

Risk level	MSDs				P value*
	Yes		No		
	No.	%	No.	%	
Low risk (n=59)	32	52.4	27	45.8	<0.001
High risk (n=41)	37	90.2	4	9.80	
Total (n=100)	69	69	31	31	

*Fisher's Exact Test

Discussion

Results of the present study showed that owing to the nature of the activities such as lifting, pulling, pushing, handling and so on, the prevalence rate of MSDs symptoms among participants was high, at least in one part of the body in the previous 12 months (69%).

The results also revealed that the highest prevalence rate of MSDs symptoms was related to the lower back, shoulders and wrists/hands, respectively. In the dairy factory, the workers worked in standing posture with bent spine for a long time. Also, in these workers we observed repetitive movements and awkward postures in the upper extremities. This situation can induce pressure on the lower back and upper extremities (shoulders, wrists, and hands) of the subjects. This is in line with the findings of previous studies,^{8,12} indicating that lower back symptoms were the most common affected region reported by the studied subjects.

Table 2 shows that the prevalence rate of the MSDs symptoms among the studied workers was statistically higher than the general Iranian population. This could partly be explained by the fact that the studied workers, as compared to general Iranian population, are faced with different risk factors of MSDs.

The results of the multivariate analyses on risk factors for the occurrence of different region complaints are shown in Table 3. Age was significant for the shoulders, elbows, wrists/hands, upper back, lower back, and legs/feet pain with OR ranging from 1.33 to 2.19. This means with increasing of age, the prevalence rate of MSDs increase as well. This finding is in line with the results of other studies¹⁴⁻¹⁷ that showed the chance of MSD occurrence in different body parts of older people was more than the younger subjects. Job experience was a significant factor for neck, wrist/hand, lower back, thigh, and knee disorders (OR: 1.48-1.85). This means with increasing of the job experience the prevalence rate of MSDs increases as well. This is in agreement with the finding the previous study¹² that revealed the chance of MSDs occurrence in different body regions of people with work experience >10 years was more than those with lower job experience (OR: 1.32-1.99). Shift working was significant only for neck pain with OR=1.08. The results revealed that in those workers who worked in shift working system the

prevalence rate of MSDs in the neck was higher than the other colleagues. This is in line with the findings of Zamanian and colleagues' study.¹⁸ In Zamanian's study, it was revealed that generally risk of MSDs in workers who worked in shift working system was higher, than other counterparts. BMI was a significant factor for the lower back, knees and legs/feet pain with OR ranging from 1.59 to 1.72. This means that with increasing the BMI the prevalence rate of MSDs in the mentioned regions increases as well. This finding is in agreement with the Health and Safety Executive (HSE) report.¹⁹ In this report, it has been denoted that BMI is a risk factor for MSD occurrence in the lower back and lower extremities.

QEC assessment showed that in 39% of the studied workers the level of exposure to musculoskeletal risks was high or very high. This finding indicated that the nature of jobs and working conditions in the dairy factory was conducive for developing MSDs. Therefore, ergonomics interventions and corrective measures are necessary to improve the working conditions and decrease the exposure level to musculoskeletal disorders. The result is different from that of Choobineh and colleagues⁸ study that reported in QEC assessment, in 73.8% of Iranian petrochemical workers, the level of exposure to musculoskeletal risks was high or very high. This issue can be attributed to the difference in the nature of work and working condition in the two studies.

Also, the results showed a significant correlation between the risk level achieved by QEC method and the prevalence of MSDs. Thus, it can be concluded that QEC method is an appropriate and reliable method for identification of workers with no MSDs symptoms (NPV=87.1%). Mohammadi and colleagues in their study revealed that QEC is a reliable method for determining the risk of MSDs among the workers involved in dynamic tasks.²⁰

The perceived symptoms of MSDs were measured by Nordic questionnaire. The participants' ache, pain and discomfort were not medically diagnosed which might have biased the results with over- or underestimation as a consequence, and this needs to be considered in the interpretation of the results in this study. However, the study focused on the respondents' own perceptions of their work environment factors, ache, pain and discomfort, and this subjective perception must be

considered if a correct picture of how work influences respondent health is to be obtained.

Conclusion

The findings of the study showed that the prevalence rate of MSDs symptoms among studied workers was high. According to the researchers' observations in this study, awkward posture such as standing posture with bent spine for a long time, shoulder abduction, and wrist extension and flexion were among the risk factors of MSDs.

Considering the prevalence rate of MSDs in different areas of the subjects' bodies in the present study, more attention must be paid to the risk factors of these disorders as well as to periodical assessment in such factories.

The prevalence rate of symptoms of pain in different parts of the body had an association with age, job experience, shift working and BMI. QEC method is an appropriate and reliable method for identification of workers with no MSDs symptoms.

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