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Prevalence of Musculoskeletal Disorders and Related Risk Factors among the Water-Counter Manufacturer Workers

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Authors
Falaki H.[1] *BSc,*
Motallebi Kashani M.[1] *PhD,*
Bahrami A.[1] *MSc,*
Sarsangi V.* *MSc,*
Akbari H.[2] *PhD,*
Rahimizadeh A.[3] *MS*

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ABSTRACT

Aims Musculoskeletal disorders are common occupational hazards and disabilities in developing countries. This study was to assess postures and determine musculoskeletal disorders in employees of a water flow meter manufacturing factory in Iran.

Materials & Methods In this descriptive analytical study that was done among workers of Iran Ensheab Factory from Water-Counter Manufacturing industry in Qom province in 2013, 85 workers from different departments were selected by objective sampling method. Demographic data of the workers like age, sex, period of work experience, weight and height were recorded in a checklist and "Rapid Upper Limb Assessment" approach and Nordic questionnaire were used for data gathering. Data analysis was done by SPSS 16 software using independent T and Chi-square tests.

Findings There was a significant correlation between musculoskeletal disorders and movement postures of shoulder, lumbar, pelvic and knee. There were significant correlation between work experience ($p<0.05$) and unit of working ($p<0.05$) and musculoskeletal disorders.

Conclusion Most of the workers of water-counter manufacturing industry are from level 2 according to "Rapid Upper Limb Assessment" approach and lumbar disorders are the most prevalent work-related musculoskeletal disorders.

Keywords Musculoskeletal Diseases; Posture; Upper Extremity; Movement Disorders

*Occupational Health Engineering Department, Health Faculty, Kashan University of Medical Sciences, Kashan, Iran
[1]Occupational Health Engineering Department, Health Faculty, Kashan University of Medical Sciences, Kashan, Iran
[2]Vital Statistics Department, Health Faculty, Kashan University of Medical Sciences, Kashan, Iran
[3]Social Determinants of Health Promotion Research Center, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

Correspondence
Address: Occupational Health Engineering Department, Health Faculty, Kashan University of Medical Sciences, Pezeshk Boulevard, Kashan, Iran. Postal Code: 8715981151
Phone: +983155540021
Fax: +983155540111
valisarsangi@yahoo.com

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Introduction

Musculoskeletal disorders are common occupational hazards and disabilities in developing countries [1]. The results of different studies indicated that despite of daily development of mechanized and automatized processes, a large proportion of occupational activities are done manually by humans. For this reason, the prevalence of work-related musculoskeletal disorders (WMSDs) is high and is the leading cause of wasted office hours, increased costs and damaged work forces [2-4]. It is also a professional health challenge in industrialized countries as in the US, 33% of all morbidities are due to this reason [5]; in Britain, 439,000 out of 1,073,000 cases of work-related diseases in 2011, were somehow connected to WMSDs [6].

The onset and prevalence of WMSDs in developing countries is more intense since the mechanization and automatization process in industrialized countries has reduced a great deal of physical demand on individuals and has eliminated or controlled the risk factors of WMSDs. Most operations in non-developing countries are done manually yet. In this traditional method, laborers are exposed to biomechanical risk factors and other factors related to WMSDs [7, 8]; namely biomechanical (unsuitable posture, applying force, lifting and carrying heavy weights, tasks with repetitive physical movements or sedentary tasks, continuous turning and bending), environmental (temperature and moisture), mental and organizational (high production demand, low control and lack of social support) factors and parameters such as sex, age, and body mass index [9].

Several studies have investigated the relationship between unsuitable postures while working and the symptoms of MSDs to determine the extent of these disorders and many models have been proposed to analyze it as well. One of the approaches to assess the hazards of MSDs was proposed by McAutomni and Courltder named ”Rapid Upper Limb Assessment” (RULA) [10].

RULA is a survey method developed for use in ergonomics investigations of workplaces where work-related upper limb disorders are reported. This tool requires no special equipment in providing a quick assessment of the postures of the neck, trunk and upper limbs along with muscle function and the external loads experienced by the body. A coding system is used to generate an action list which indicates the level of intervention required to reduce the risks of injury due to physical loading on the operator. The coding system combines the different limb postures, muscle use and force score and categorizes in seven score (1 to 7: higher score shows higher risk). These ratings scores are used to determine the corrective action list [10]:

- Action level one: a score of one or two indicates that posture is acceptable if it is not maintained or repeated for long period of time.
- Action level two: a score of three or four indicates that further investigation is needed and changes may be required.
- Action level three: a score of five or sex indicates investigation and changes are requiring soon.
- Action level four: a score of seven or more indicate investigation and changes are requiring immediately.

According to *Nordic*'s standardized questionnaire which is a standard instrument to determine the frequency of MSDs in body organs, especially upper body limbs [11], 24% of employees have pain in neck, 17% in shoulder/arm, 20% in thigh, 9% in upper back, 50% in back and 23% in wrist [12]. Total frequency of MSDs in agricultural hardware factories was found 40.3%; 12.8% had developed back, 8.7% knee, 7.8% hand, 6% neck and 5% shoulder pain [13]. The prevalence of wrists, neck, shoulder, back and foreleg pain on ergonomic circumstances of barbers is reported as 8, 20, 36, 46 and 86%, respectively [14].

To assess different postures using RULA's approach in agricultural hardware factories, welding and painting units scored 7 and storage and assembly units scored 6 (high risk and extremely high risk units respectively) and were categorized in corrective measures 3 and 4, respectively [13]. MSDs assessment in communications company employees by RULA's approach shows that 88.1% of units have high and extremely high scores (action levels 3 and 4) and there is a significant correlation between the risk level and MSDs in the back area [15].

Given the high rate of MSDs in the workers and also the necessity of conducting more

studies in this field in different industries, this study was to assess postures and determine MSD_S in employees of a water flow meter manufacturing factory in Iran.

Materials & Methods

In this descriptive analytical study that was done among workers of Iran Ensheab Factory from Water-Counter Manufacturing industry in Qom province in 2013, 85 workers from different departments were selected by objective sampling method. The criterion for selecting samples was working in producing unit (no services workers or engineering). Since some workers were engaged in multiple tasks, the criteria for selecting assessment postures included the tasks with the highest frequency and pace in a working shift.

Demographic data of the workers like age, sex, period of work experience, weight and height were recorded in a checklist and RULA approach and *Nordic* questionnaire were used for data gathering.

RULA's approach was designed to quick assess the risk of MSD_S in different upper body limbs' postures, especially in standing occupations (arm, forearm, wrist and its rotation, neck, body and leg). Higher scores indicate greater musculoskeletal pressure. First, the scores of arm, forearm, wrist, neck, body and leg postures and their movement were calculated (according to RULA approach). The posture score of different limbs were merged and the final score (in this study set from 1 to 7) was calculated which is indicative of MSD_S and the level of necessity to run an ergonomic intervention program (in this study set from 1 to 4 was determined in order to reduce the risk. Studies have shown the acceptable reliability and validity of RULA's approach in ergonomic assessment of MSD_S risks in upper limbs [16, 17]

In order to determine the prevalence of MSD_S in different limbs of the workers, the *Nordic* questionnaire was used [18]. This questionnaire was comprised of a general (A) and a special (B) part. The objective of A (9 questions) is the general assessment of general disorder symptoms of the whole body, Whereas, B (9 questions) part tends to analyze the depth of symptoms in specific areas of the body; neck, back, shoulder and wrist [11]. The Nordic questionnaire is a valid and reliable questionnaire which was used in many researches for assessing the MSDs in all limbs [1, 13, 19]. Answer to questions is designed as "Yes" or "No" and calculate the rate of pain experience in limbs of workers. The questionnaire was given to each person during survey and they answered to each question.

Data analysis was done by SPSS 16 software using independent T (for assessing the relationship between MSDs experience and RULA scores) and Chi-square (for assessing the relationship between, work experience and working unit, BMI and MSDs) tests.

Figure 1) The Frequency distribution of MSDs regarding to the level determined by RULA's approach and the significance level between have pain and no pain in each part of the body according to Chi square test (the numbers in parentheses are percent)

Para-meter	Level 1	Level 2	Level 3	Level 4	p Value
Neck					
Pain	1 (4.2)	16 (66.7)	6 (25)	1 (4.2)	0.27
No pain	12 (19.7)	32 (52.5)	12 (19.7)	5 (8.2)	
Shoulder					
Pain	0	2 (22.2)	4 (44.4)	3 (33.3)	0.002
No pain	13 (17.1)	46 (60.5)	14 (18.4)	3 (3.9)	
Elbows					
Pain	0	2 (100)	0	0	0.76
No pain	13 (15.7)	46 (55.4)	18 (21.7)	6 (7.2)	
Wrist					
Pain	1 (10)	6 (60)	3 (30)	0	0.70
No pain	12 (16)	42 (56)	15 (20)	6 (8)	
Back					
Pain	3 (23.1)	4 (30.8)	4 (30.8)	4 (15.4)	0.19
No pain	10 (13.9)	44 (61.1)	14 (19.4)	4 (5.6)	
Lumbar					
Pain	4 (14.3)	13 (64.4)	6 (21.4)	5 (17.9)	0.05
No pain	9 (15.8)	35 (61.4)	12 (21.1)	1 (1.8)	
Pelvic					
Pain	2 (50)	0	1 (25)	1 (25)	0.05
No pain	11 (13.6)	48 (59.3)	17 (21)	5 (6.2)	
Knee					
Pain	4 (57.1)	1 (14.3)	1 (14.3)	1 (14.3)	0.013
No pain	9 (11.5)	47 (60.3)	17 (21.8)	5 (6.4)	
Leg					
Pain	1 (50)	0	1 (50)	0	0.267
No pain	12 (14.5)	48 (57.8)	17 (20.5)	6 (7.2)	

Findings

51 (60.0%) of sample workers of the production unit of Iran Ensheab Factory were male. 61 samples (74.1%) had BMI between 25 and 29.9 and 21 (24.7%) had BMI between 30 to 34.9. 55 persons of participant (64.7%) had less than 5 years of work experience. Considering the tasks of workers, 28 (32.9%) worked in assembly, 8 (9.4%) in testing, 9 (10.6%) in packing, 3 (3.5%) in bolts and spool, 20 (23.5%) in exfoliation and shotplast,

9 (10.6%) in injection and pressing, 4 (4.7%) in services sections and 4 (4.7%) as foreman.

According to the scores obtained in RULA's approach, 13 workers (15.3%) were on level 1, 48 (56.5%) on level 2, 18 (21.2%) on level 3 and 6 (7.1%) on level 4. There was a significant correlation between MSD_S and movement postures of shoulder, lumbar, pelvic and knee (Figure 1).

The highest prevalence of MSD_S was in lumbar (31.8%), neck (28.2%) and back (14.1%). Also the least observed value belonged to elbow and leg (each 2.4%). According to Nordic questionnaire, most of disorders (31.8%), reducing the occupational activity (23.5%) and reducing the daily entertainment (12.9%) in the last 12 month ended to the study time were due to lumbar disorders (Figure 2).

Figure 2) *Nordic* questionnaire results (numbers in parentheses are percent from total number of samples; 85)

Neck	Shoulder	Lumbar	Wrist & Hand
Presence of discomfort and musculoskeletal pain during the last 12 months ended to the study			
25 (29.4)	10 (11.8)	28 (31.8)	10 (11.8)
Musculoskeletal limbs injuries in the accident			
4 (4.7)	1 (1.2)	1 (1.2)	5 (5.9)
Accident in the workplace			
1 (1.2)	0	0	3 (3.5)
Changing the job due to disorders			
2 (2.4)	0	1 (1.2)	1 (1.2)
Work factor in a business environment			
20 (23.5)	10 (11.8)	25 (29.4)	9 (10.6)
Extent of severe pain experience in the limbs			
9 (10.6)	5 (5.9)	18 (21.2)	7 (8.2)
Extent of very severe pain experience in the limbs			
3 (3.5)	0	2 (2.4)	2 (2.4)
Reducing the occupational activity due to MSDs in limbs during the last 12 months ended to the study			
13 (15.3)	8 (9.4)	20 (23.5)	7 (8.2)
Reducing the Daily entertainment due to MSDs in limbs during the last 12 months ended to the study			
10 (11.8)	5 (5.9)	11 (12.9)	3 (3.5)

There were significant correlation between work experience ($p<0.05$) and unit of working ($p<0.05$) and MSD_S. The rate of absence from work due to MSD_S was 15.3 days for lumbar (13 workers), 9.4 days for neck (8 workers), 7.1 days for wrist & hand (6 workers) and 3.6 days for shoulder (3 workers) disorders.

Discussion

This study aimed to investigate the postural and musculoskeletal disorders among the water counter manufacturer workers by using of two standard and practical methods (RULA's approach and *Nordic* questionnaire) for the first time in Iran. The results showed that the prevalence of MSD_S in production unit of Ensheab Company is relatively high as the more of the workers had MSD_S in the previous months.

Nordic questionnaire showed that the highest prevalence of MSD_S was in lumbar, neck and back, respectively and opposite to the findings in assembly and manufacturing units, it was far lower than other studies [19, 20]. The high percent of workers had less than 5 years of experience that can be considered to affect the results.

Also, there was a significant correlation between work experience and MSD_S which concords with the findings of Sarsangi *et al.* and Barkhordari *et al*. [1, 19]. There were significant correlation between RULA scores and MSDs prevalence in lumbar, knee and shoulder. These results are consistent with Nasl-Seraji *et al.* findings in electricity manufactory [17] and Dormohammadi *et al.* findings in a power company [21].

There was no significant correlation between the age and BMI and MSD_S prevalence, which is consistent with the results of Choobineh *et al*. [22]. Choobineh *et al*. in a study assessed the relationship between height and MSDs in a sugar producing factory and found no significant correlation between these parameters [23]. With the investigations of different work positions it was found that unsuitable and static postures, turning and winding of back, repetitive tasks, inappropriate lifting of weights and prolonged standing tasks due to lack of ergonomic chairs are the leading causes of such disorders [19, 24, 25].

21.2% of the cases with disorder in back area were reported to be severe that is confirmed by Habibi *et al*. study [26]. The average length of absence due to lumbar pain was 12.2 days that is in agreement with the study done by Nasl-Seraji *et al*. on miners. The average length of absence is 36 days in Scandinavian countries, 28.6 days in US, 36.2 days in Britain and 21.4 days in Canada for back pain [22]. These differences could be due to differences in the pattern of work in different countries.

In addition to gender, body mass index, age, postures and work experience, organizational and psychological factors also contribute to musculoskeletal disorders.

Of limitations of this study was that the psychological and organization factors which can affect the MSDs didn't considered.

The working circumstances in some stations in this industry have led to an increase in MSD_S prevalence due to hazardous ergonomic work factors. Hence, since the workers are the most valuable asset in an industry, running instructional and preventive programs and designing ergonomic work stations seem essential in order to improve work situation.

Conclusion

Most of the workers of water-counter manufacturing industry are from level 2 according to RULA approach and lumbar disorders are the most prevalent WMSDs.

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