

Field Study

Musculoskeletal Problems among Workers of an Iranian Rubber Factory

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Abstract: Musculoskeletal Problems among Workers of an Iranian Rubber Factory: Alireza CHOOBINEH, et al. Occupational Health Department, School of Health, Shiraz University of Medical Sciences, Iran—Musculoskeletal disorders (MSDs) are a common health problem throughout the world and a major cause of disability among the work force. Assessment of exposure level to MSD risk factors can be an appropriate base for planning and implementing interventional ergonomic programs in the workplace. This study was conducted among workers of an Iranian rubber factory with the objectives of (a) determination of the prevalence of MSDs among production line workers, and (b) assessment of the level of exposure to MSD risks. In this study, all 16 production units of the factory were studied. In each unit, 50% of the workers were randomly selected and included in the study. A total of 454 workers participated. The Nordic Musculoskeletal Questionnaire was used to study the prevalence of MSDs and the Quick Exposure Check (QEC) technique was applied to assess physical exposure to the risks. The videotaping technique was used to collect the required data for each worker. The vast majority of the workers (73.6%) had suffered from some kind of musculoskeletal symptoms during the last 12 months. The highest prevalence was reported in the lower back (50.2%), knees (48.5%) and upper back (38.1%). In 85.5% of the workers studied, the QEC score was high or very high. Statistical analysis showed a significant association between the QEC level of risk and MSDs symptoms ($p < 0.001$). The most common ergonomics problems were found to be awkward postures and manual material handling. MSDs had occurred with a high rate among workers of this rubber factory. Corrective measures for reducing risk level seemed essential. Elimination of awkward postures

and manual material handling in the workplace were recommended.

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Musculoskeletal disorders (MSDs) represent one of the leading causes of occupational injury and disability in the industrially developed and developing countries^{1–4}. The economic loss due to such disorders affects not only the individual but also the organization and the society as a whole³. At the present time, MSDs are one of the most important problems ergonomists encounter in workplaces around the world⁵. In many countries, the prevention of MSDs among the workforce is considered a national priority⁶.

In industrially developing countries (IDCs), the problems of workplace injuries are extremely serious¹. Poor working conditions and the absence of an effective work injury prevention program in IDCs has resulted in a very high rate of MSDs⁷.

Risk factors of MSDs are known to include workplace activities such as heavy load lifting, repetitive tasks and awkward working postures⁸, while demographic characteristics and psychosocial factors are also known to be important predictive variables^{9–11}.

In Iranian rubber factories, workers are directly involved in the production process. In these factories, physical activities such as manual material handling (e.g., heavy load lifting, lowering, carrying, pulling and pushing) and awkward working postures are very common (Figs. 1 and 2). In this situation, a high rate of MSD occurrence is expected.

As far as we know, no ergonomics study has previously been conducted in Iranian rubber factories to determine the prevalence of MSDs and to assess the physical exposure to musculoskeletal risks. Therefore, the present study was conducted in an Iranian rubber factory with

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Fig. 1. A worker is lifting a bag of 20 kg with awkward posture of the back.



Fig. 2. A worker is lowering a tire from a high rack. Postures of arms, shoulders and back are deviated from neutral. The tire weighs nearly 70 kg.

the objectives of (a) the determination of the prevalence of MSDs among rubber workers, and (b) the assessment of the level of workers' exposure to MSD risk factors. It is believed that the results of this study could be an appropriate base for planning and implementing interventional ergonomics programs in the workplace and improving workers' health in the Iranian rubber industry.

Materials and Methods

This cross-sectional study was conducted among production line workers of an Iranian rubber factory. A total of 941 male workers were employed on the production line of the factory. They worked in 3 shifts and in 4 groups at 16 different units. In this study, in each unit, nearly 50% of the workers with at least one year of job tenure was randomly selected and included in the study. Workers with background diseases or occupational or non-occupational accidents affecting the musculoskeletal system were excluded from the study. In all, 454 workers participated in the study. Data were collected via questionnaires. The questionnaire consisted of two parts and covered the following items: (a) personal details (including weight, height, age, job tenure, education, smoking, health and medical background); and (b) musculoskeletal problems in different body regions. The general Nordic Questionnaire of musculoskeletal symptoms¹²⁾ was used to examine reported cases of MSDs among the study population. Reported MSDs symptoms were limited to the past 12 months. All units were visited and the questionnaires were completed by interviewing the workers.

In order to assess physical exposure to musculoskeletal risks, QEC (Quick Exposure Check), known as a pen-paper observational method, was applied^{13, 14)}. The technique includes the assessment of the back, shoulder/

arm, wrist/hand and neck, regarding their postures and repetitive movement. In QEC, task duration, maximum weight handled, hand force exertion, vibration, visual demand of the task and subjective responses to the work are also taken into consideration and the required data is obtained from the worker. The magnitude of each assessment item is classified into exposure levels, and the combined exposures between different risk factors for each body part are calculated by using a score table. Up to five pairs of combination are considered for obtaining exposure scores of the mentioned 4 body regions, i.e. posture versus force, movement versus force, duration versus force, posture versus duration and movement versus duration. The total score for each body area is determined from the interactions between the exposure levels for the relevant risk factors and their subsequent addition. The exposure scores for the back, shoulder/arm, wrist/hand and neck are categorized into 4 exposure categories: low, moderate, high and very high. Moderate, high and very high scores should be urgently addressed to reduce the level of exposure to risk factors. To obtain overall exposure score, total scores of body parts are summed and the result is divided by the highest possible score for the overall body: i.e. 176 for manual handling tasks and 162 for other tasks. Low overall exposure scores (less than 40%) indicate acceptable musculoskeletal loading (low risk). For overall exposure scores ranging from 41% to 50%, further investigation is needed and changes may be required (moderate risk). Prompt investigation and changes are required soon for overall exposure scores between 51% and 70% (high risk); and immediate investigation and changes are required for overall exposure scores higher than 70% (very high risk).

Studies have shown that QEC is a sensitive, suitable

Table 1. Some personal details of the workers who participated in the study (n=454)

Personal characteristics	Mean	Standard deviation	Min–Max
Age (yr)	29.8	7.3	20 – 60
Weight (kg)	72.1	9.7	50 – 110
Height (cm)	174.6	9.8	110 – 197
Job tenure (yr)	6.8	6.1	1 – 25

Table 2. Frequency of reported musculoskeletal symptoms in different body regions during the 12 months prior to the study (n=454)

Body regions	No.	(%)
Neck	91	20.0
Shoulders	151	32.2
Elbows	70	15.4
Wrists/Hands	159	35.0
Upper back	173	38.1
Lower back	228	50.2
Thighs	77	17.0
Knees	220	48.5
Legs/Feet	170	37.4

method for assessing physical exposure to musculoskeletal risks in the workplace with fair inter/intra-observer reliability¹⁵.

To conduct the assessment by the QEC system, all workers were videotaped during their routine job activities for nearly 20 min representing the shift activities to find the most awkward postures of the body regions. For each worker, working postures were analyzed by reviewing the tapes in laboratory and the QEC score was calculated. A total of 454 workers from 56 workstations of 16 units of the production line were studied by the QEC system.

Upon completion of the field survey, the collected data were transferred to a computer for statistical analysis. Statistical analyses were performed using SPSS (Ver. 13).

The independent t-test and chi-square test were used to study associations between personal and work variables with reported musculoskeletal symptoms.

Results

Table 1 summarizes personal details of the workers who participated in the study. Table 2 presents the prevalence of MSDs symptoms in the different body regions of the workers during the last 12 months. As Table 2 shows, the most commonly affected regions among the workers were the lower back (50.2%), knees (48.5%) and upper back (38.1%).

Table 3 shows the association between some demographic variables and reported musculoskeletal problems in at least one region of the workers' bodies. There was a positive significant association between age and job tenure with reported musculoskeletal problems ($p < 0.001$).

Figure 3 presents the frequency of sick leave due to musculoskeletal problems in different body regions during the last 12 months. The percentage of workers reporting sick leave caused by musculoskeletal disorders in the past year was 39.4%. As shown in Fig. 3, problems of the lower back, upper back and knees were the causes of the highest rates of sick leave.

The results of the assessment of physical exposure to musculoskeletal risks show that:

- (a) in 4.4% of the workers studied, the calculated exposure level was less than 40% indicating that the level of exposure to musculoskeletal risks was

Table 3. Associations between some demographic variables and reported musculoskeletal problems among the workers studied (n=454)

Variables	Musculoskeletal problems				p-value*
	Reported		Not reported		
	M	SD	M	SD	
Age (yr)	30.60	7.51	27.43	5.94	<0.001
Weight (kg)	72.15	9.38	71.90	10.46	0.811
Height (cm)	174.62	10.50	174.43	7.47	0.850
Job tenure (yr)	7.53	6.41	4.64	4.66	<0.001

* Independent t-test.

- acceptable (low risk);
- (b) in 10.1% of the workers studied, the calculated exposure level was between 41% and 50% indicating that the level of exposure to musculoskeletal risks needed considering (moderate risk);
- (c) in 37.5% of the workers studied, the calculated exposure level was between 51% and 70% indicating that the level of exposure to musculoskeletal risks was high and ergonomics intervention to decrease exposure level seemed essential (high risk); and
- (d) in 48% of the workers studied, the calculated exposure level was higher than 70% indicating that the level of exposure to musculoskeletal risks was very high and immediate ergonomics intervention to decrease exposure level was essential (very high risk).

Table 4 demonstrates the prevalence rate of reported symptoms at different levels of risk exposure among the workers studied. As shown in Table 4, the prevalence

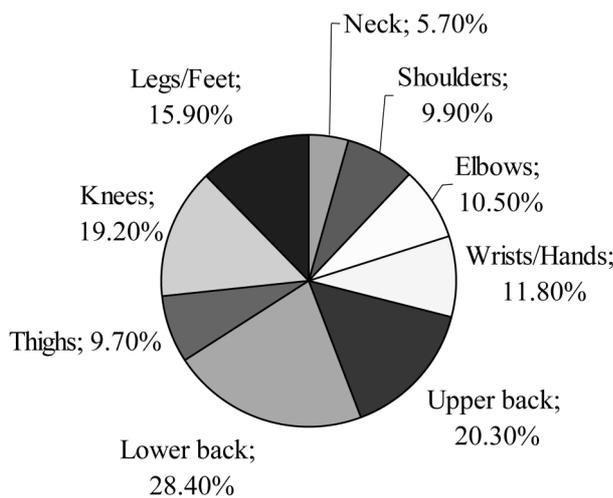


Fig. 3. Percentage of sick leaves due to musculoskeletal problems in different body regions in the last 12 months reported by the workers studied (n=454).

rate increased with increasing risk. The chi-square test revealed that there was a significant association between QEC risk level and the prevalence rate of reported musculoskeletal problems ($p < 0.001$) such that the prevalence rate in very high-risk level group was significantly higher than that of the other groups.

Discussion

The Nordic Musculoskeletal Questionnaire showed that symptoms from the musculoskeletal system were common among the rubber workers studied. The vast majority of the study population (73.6%) had experienced some form of symptoms of musculoskeletal disorder during the last 12 months. Comparison of the results of this study with the results of the National Health Survey of Iran¹⁶⁾ revealed that the differences between the prevalence of musculoskeletal problems were significant (Table 5). This indicates that the rubber factory should be considered as a high-risk industry for developing musculoskeletal disorders.

This indicates that the problem of musculoskeletal disorders in the factory was serious and needed appropriate attention. Back and knee symptoms were found to be the most prevalent problem among the workers studied. This could be attributable to awkward working postures, manual material handling and long hours of standing work, which were common at almost all workstations and job activities observed. Besides, the results reveal that symptoms of the back and knees were the causes of the highest rates of sick leave. This implies that any interventional program for preventing or reducing musculoskeletal problems among the rubber workers should focus on reducing physical exposure to the MSD risk factors of these regions.

The results also indicate that age and job tenure were significantly associated with musculoskeletal symptoms in the different body regions. This is in agreement with the findings of other researchers¹⁷⁻²⁰⁾. No association was found between weight and height and the prevalence rate of MSDs.

Table 4. The prevalence rate of reported musculoskeletal symptoms at different levels of risk exposure among the workers studied (n=454)

Risk level (overall exposure score)	Musculoskeletal problems				n (%)
	Reported		Not reported		
	n	%	n	%	
Low	9	45.0	11	55.0	20 (4.4)
Moderate	32	69.6	14	30.4	46 (10.1)
High	106	62.4	64	37.6	170 (37.5)
Very high	187	85.8	31	14.2	218 (48)
Total	334	73.6	120	26.4	454 (100)

Table 5. Comparison of point prevalence of musculoskeletal symptoms in neck, back and large joints in general Iranian male population and the rubber workers studied

Body region	Rubber workers studied (age=20–60)	General Iranian male population (age=15–69)	p-value*
Neck	11.00%	4.72%	<0.0001
Upper and lower back	44.05%	15.27%	<0.0001
Large joints [†]	53.50%	12.30%	<0.0001

*Test of proportion; [†] Including: shoulders, elbows, wrists, knees and ankles.

The results of physical exposure to work-related musculoskeletal risk assessment by QEC show that 85.5% of the workers studied had levels of exposure to musculoskeletal risks that were high or very high. This indicates that the jobs and working conditions on the production line of the factory were conducive for developing MSDs. Therefore, ergonomic interventions were deemed necessary to improve working conditions and decrease the level of exposure to musculoskeletal risks.

The results demonstrate an association between QEC risk level and the prevalence rate of the reported symptoms. This implies that QEC was an appropriate system for determining levels of exposure to musculoskeletal risks in this factory and provided reliable results. This is in agreement with the findings of other researchers²¹.

The most common observed risk factors the workers encountered were awkward working posture, manual material handling of heavy loads, working in a standing position for a long time and lack of rest. Regarding this, the following corrective measures were recommended for reducing exposure level and consequently preventing MSDs in the rubber industry:

- a) Reducing the weight of loads which are handled manually.
- b) Reducing the height of shelves or racks on which heavy loads or tires are stored.
- c) Using mechanical devices such as lifter to lift and carry loads.
- d) Designing sitting-standing workstations on the production line.
- e) Devising an appropriate work-rest cycle.

Conclusion

It was concluded that MSDs occurred at a high rate in this factory and that workers' level of exposure to MSDs risks was high. Taking corrective measures to reduce the risk level seemed essential. An ergonomics intervention program in the workplace should focus on eliminating awkward postures, manual handling of heavy loads and designing sitting-standing workstations on the production line.

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