

Working Conditions in Carpet Weaving Workshops and Musculoskeletal Complaints among Workers in Tabriz - Iran

*Jalil Nazari¹, Nader Mahmoudi², Iman Dianat¹, Richard Graveling³

¹Department of Occupational Health, School of Health, Tabriz University of Medical Sciences, Tabriz, Iran

²Department of Industrial Engineering, University of Tabriz, Iran

³Institute of Occupational Medicine (IOM), Edinburgh, UK

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ABSTRACT

Background: Background: Carpet weaving operations usually involve poor working conditions that can lead to the development of musculoskeletal disorders (MSDs). This study investigated MSDs among carpet weavers in relation to working conditions from workers' view in Tabriz City, Northwest Iran.

Method: This cross-sectional and descriptive study was conducted in city of Tabriz, Iran. Data were collected using interviews and questionnaires. The study population consisted of 200 randomly selected healthy weavers from twenty five active carpet weaving workshops.

Results: The results showed a high prevalence of musculoskeletal problems among the study population. The most commonly affected body areas were neck, lower back, ankles/feet, hands/wrists, upper back, shoulders and knees, respectively. More than half of the weavers were not satisfied with the thermal condition, noise level and cleanliness of the air in the workshops. The result indicated a significant relationship between upper back symptoms and daily working time and between lower back symptoms and the numbers of rows of knots woven in a day. Weavers' satisfaction with hand tools shape and thermal condition of the workshops were associated with lower back symptoms, whereas satisfaction with weaving looms were associated with upper back complaints.

Conclusion: The poor working condition of hand-woven carpet workshops such as environmental conditions and work station design and tools should be the subject of ergonomics interventions.

Keywords: Musculoskeletal, Carpet weaving, Working conditions

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Introduction

“Small-scale industries are a widespread, fundamental and essential form of production” [1]. In many countries, small-scale industries are the main providers of new employment. In addition, these industries play an outstanding part in the economic development of countries by producing export products [2]. In developing countries, great efforts are being directed towards encouraging the development of small-scale industries as the engine for the growth of their economies, while there is no internationally ac-

cepted definition of a small-scale industry [3]. In some cases, the number of employees has been the criterion for categorizing industries as a whole [4]. Based on that, industries employing fewer than 10 employees are considered as small-scale industries in Iran [5].

Carpet hand weaving is a common practice in countries such as Iran, China, Turkey, India, Pakistan, Russia, Egypt, Nepal and Afghanistan [6]. Hand-woven carpets are the most important Iranian non-oil exported goods and they have an out-

standing place in the country economy from the viewpoint of its share of 1% of GNP [7] and employment [6]. In Iran, hand-woven carpets are mainly produced in home-based workshops as an informal small-scale industry [6]. However, in limited cases, a number of weavers are gathered and weave carpets in a weaving complex [8].

Carpet looms are the most important element of the weaving operation. They are divided into two types: horizontal and vertical [2]. Vertical looms are recognized as being safer than horizontal ones [2], but there are more ergonomic defects in many parts of vertical looms that this study attempts to identify and eliminate. Carpet weaving is a sedentary job with 91.7% weavers work on vertical loom and sit on the ground or on a piece of lumber [9]. In this study all of the workshops studied work with vertical looms.

Musculoskeletal disorders (MSDs) are a common health problem throughout the world and a major cause of disability [6]. At the present time, MSDs are one of the most important problems that ergonomists are encountering in the workplace all over the world [10]. In many countries, the prevention of work-related MSDs (WMSDs) has become a national priority [11]. In carpet weaving, operations are awkward and, with incorrect postures and no backrest or support in the weavers' seats, result in symptoms of WMSDs in weavers. Reported WMSDs include abnormalities and deformities of the spine, arms, legs and pelvis [12-14].

In any workplace, there may be a variety of factors that influence workers' health, safety and performance. For example, in many workshops, lighting is not adequate, resulting in considerable eyestrain [13]. It has been noted that in weaving workshops, which have low income, a lack of cooling and heating systems results in inappropriate thermal conditions, or continuous work without rest breaks increases the risk of physical disorders [2]. However, the extent to which these factors influence workers' satisfaction with their work station, tools and environmental conditions of weaving

workshops is unknown due to lack of research in this area.

Carpet weaving is one of the most tedious professions, which requires long hours of static work [12] and can be a high-risk occupation for developing MSDs as awkward posture, repetitive movements and contact stress are common [2]. Several previous attempts have been made to address ergonomic problems of carpet weavers in other regions of the country with more emphasis on musculoskeletal problems among weavers [6, 15-17].

However, the present study was conducted to investigate the musculoskeletal complaints among carpet weavers in relation to carpet hand-weaving workplace conditions. This study is of particular interest as it considers other aspects of working condition such as work station design and tools as well as environmental condition of workshops through subjective assessments. It is also one of the first studies that attempt to determine the prevalence of musculoskeletal symptoms and associated risk factors in the carpet industry of the East Azerbaijan Province in Northwest Iran. This information can be used to highlight areas needing attention and ergonomic problems which the weavers encounter in workshops.

Materials and Methods

Subjects and Setting

This cross-sectional, descriptive study was conducted in Tabriz City, the capital of East Azerbaijan Province in Northwest Iran. The study was conducted during a six-month period from July 2010. Twenty five active carpet weaving workshops in the area were selected for the purpose of this study. A random group of 200 weavers were selected from these workshops to participate in this study. A total of 200 weavers (117 males, 83 females) declared their agreement to assist in this part of study. All participants were familiarised with the study, their questions were answered by the investigator and they were given the opportunity to refuse participation. They each signed a consent

form before participating in the study and were under no obligation to complete the questionnaire.

Data collection

A questionnaire was used to collect data in this study. Arrangements were made with individual workshops and the questionnaires were completed by interviewing the weavers. There were four types of questions: demographic and job items, work station design and tools, environmental conditions of the work station, and the presence of MSD symptoms at different body regions. The questionnaire first recorded demographic (age, weight, height, body mass index, marital status, smoking, exercise, education, and medical back-ground) and job items (job experience, daily working time, number of rows of knots woven in a day, average time of continuous seated position for doing a single row). The questions regarding musculoskeletal symptoms in different body regions was taken from the standardised Nordic Musculoskeletal Disorders Questionnaire [13], together with a body map that was selected based on Corlett and Bishop (1976) [18]. The Nordic questionnaire has been used in a number of previous studies among different occupational groups and, thus is well tried and tested [19-24]. Participants were asked to indicate if they had experienced any symptoms and pain in the last 12 months for each of the body parts using the body map. Subjects with background diseases (including high blood pressure, heart disease, arthritis, lung problems, kidney trouble and taking drug for disease) or accidents unrelated to their job were excluded from the study. The questions about environmental conditions were based on risk factors identified in the literature [9], including details about workshop noise and lighting, floor type and colour, wall colour, cleanliness of the air, thermal conditions, and noise affecting the ratio of tranquillity. The questions regarding weavers' satisfaction with their workstation including seat,

weaving-loom, hand tools shape, hand tools weight and hand tools size were also included. The assessments of the work station and environmental conditions of the work station consisted of questions with five items, answered on a likert-scale (from very dissatisfied to very satisfied). All questionnaires were completed by one investigator in this study.

Statistical analysis

Statistical analyses were performed using SPSS 14 (SPSS Inc., Chicago, IL, USA). Prevalence rates were expressed as the number of cases per MSC region and the percentage of all weavers. Chi-square tests were used to determine univariate associations between individuals and ergonomics variables and reported musculoskeletal symptoms. Correlation between continuous variables was determined using Pearson correlation coefficient. The level of significance adopted for statistical testing was $P < 0.05$.

Results

Table 1 shows the demographic and job details of the carpet weavers participated in the study. The mean age, height, weight and body mass index of the participants in the study were 31.4 years (SD = 10.2), 165.7 cm (SD = 10.8), 66.5 kg (SD = 11.8) and 24.2 kg/m² (SD = 3.8), respectively. The result showed that 64.4% of employees worked 3–8 h/day, while others worked more than 8 h/day (between 9-14 h). The employees worked 8.2 h/day on average on the loom (SD = 1.8).

The reported musculoskeletal symptoms in the different body regions of weavers in last 12 months prior to the study, and time off due to these disorders are presented in Table 2. All of the participants reported some kind of musculoskeletal symptom at some time during the last 12 months preceding data collection and 34% needed to take days off due to such symptoms during this period.

Table 1: Demographic and job details of carpet weavers participated in the study

Variables		Male (n=117)	Female (n=83)	Total (n=200)
Age (yr)	Mean (SD)	34.0 (10.4)	27.7 (8.7)	31.4 (10.2)
	Min-Max	18-58	13-48	13-58
Weight (kg)	Mean (SD)	70.3 (10.2)	61.2 (12.0)	66.5 (11.8)
	Min-Max	49-98	38-93	38-98
Height (cm)	Mean (SD)	171.7 (9.2)	157.2 (6.3)	165.7 (10.8)
	Min-Max	120-189	142-180	120-189
Body Mass Index (BMI)	Mean (SD)	23.8 (3.1)	24.8 (4.6)	24.2 (3.8)
	Min-Max	17.9-31.2	16.4-36.9	16.4-36.9
Marital status (%)	Single	29.9	39.4	34.0
	Married	70.1	59.0	65.5
	divorce	00.0	1.2	0.5
Smoking	Yes	34.2	0.0	20.0
	No	65.8	100	80.0
Exercise (%)	Yes	47.0	13.2	33.0
	No	53.0	86.8	67.0
Education level (%)	Illiterate	6.0	12.0	8.5
	Primary	40.2	72.3	53.5
	Secondary	24.8	9.6	18.5
	Diploma and higher	29.0	6.0	19.5
Experience (years)	Mean (SD)	15.1 (8.3)	11.0 (6.4)	13.4 (7.8)
	Min-Max	3-40	3-30	3-40
Daily working time (hours)	Mean (SD)	8.2 (1.7)	8.1 (1.8)	8.2 (1.8)
	Min-Max	3-14	4-14	3-14
Continuous sitting time for doing a single row (min)	Mean (SD)	36.7 (8.3)	39.0 (7.8)	37.6 (8.2)
	Min-Max	20-26	30-60	20-60
Number of rows of knots woven in a day	Mean (SD)	14.1 (3.3)	12.8 (2.9)	13.6 (3.2)
	Min-Max	5-24	8-18	5-24

Forty six participants (36.5%) reported musculoskeletal symptoms in 1–3 body regions, 30 (23.8%) reported symptoms in 4–6 body regions, and 11 (8.8%) reported symptoms in more than 6 body regions. As shown in Table 2, the most commonly affected body parts were the neck (78.7%), lower back (68.1%), ankles/feet (63.8%), hands/wrists (55.3%), upper back (53.2%), shoulders (48.9%) and knees (48.9%).

The carpet weavers' satisfaction with the environmental conditions of their work station is shown in Table 3. Accordingly, 91.5%, 57.5%, 53.1%, of weavers were somewhat to completely dissatisfied with workshop thermal condition, noise and cleanliness of the air, respectively.

Table 2: Frequency of reported symptoms in different body regions during the last 12 months prior to the study and time off due to the symptoms

Body regions	Symptoms in last 12 months (%)	Time off due to symptoms in last 12 months (%)
Any region	100	34.0
Neck	78.7	14.9
Shoulders	48.9	4.3
Elbows	27.7	4.3
Wrists/Hands	55.3	8.5
Upper back	53.2	4.3
Lower back	68.1	17.0
Thighs	17.0	0
Knees	48.9	8.5
Ankles/Feet	63.8	0

The results showed no significant association between the occurrence of musculoskeletal symptoms and environmental con-

ditions of the work station, except between thermal conditions and lower back symptoms ($P < 0.001$).

Table 3: Carpet weavers' satisfaction with the environmental conditions of their work station

Environmental conditions of the work station	Carpet weavers (%)				
	Very satisfied	Somewhat satisfied	Neutral	somewhat dissatisfied	Very dissatisfied
Noise	10.6	17.0	14.9	4.3	53.2
Lighting	23.4	17.0	17.0	17.1	25.5
Floor type and colour	63.8	6.4	12.8	10.6	6.4
Wall colour	21.3	17.1	21.3	29.8	10.6
Cleanliness of the air	8.5	4.3	34.0	34.0	19.1
Thermal conditions	0.0	0.0	8.5	17.0	74.5

Table 4 indicates the carpet weavers' satisfaction with their work station design and tools. This table shows that on workshop instruments: 80.9% of the weavers were somewhat to very dissatisfied with their seat, 51.1% with hand tools shape and 44.7% with hand tools weight. Somewhat to complete dissatisfaction in the weaving looms was expressed by 27.6% of the weavers, respectively. Similarly 19.1% of the weavers were somewhat to very dissatisfied with the size of their hand tools. A statistically significant association was found be-

tween the satisfaction with hand tools shape and the occurrence of lower back ($p < 0.001$) and elbow symptoms ($P < 0.05$). Elbow symptoms were also associated with satisfaction with hand tools weight ($P < 0.05$). However, no association was found between the hand tools size and the occurrence of symptoms. Regarding the work station design, results showed a statistically significant association between upper back symptoms and satisfaction with weaving loom ($P < 0.001$).

Table 4: The carpet weavers' satisfaction with their work station design and tools

Work station design and tools	Carpet weavers (%)				
	Very satisfied	Somewhat satisfied	Neutral	somewhat dissatisfied	Very dissatisfied
Seats	8.5	6.4	4.3	21.3	59.6
Weaving looms	6.4	29.8	36.2	2.1	25.5
Hand tools shape	4.3	10.6	34.0	14.9	36.2
Hand tools weight	4.3	27.7	23.4	21.3	23.4
Hand tools size	14.9	48.9	17.0	2.1	17.0

Table 5 indicates the relationship between job factors and the presence of musculoskeletal symptoms in different body regions of carpet weavers during the last 12 months prior to the study. As shown in this table, there is a significant relationship between the reported symptoms in the upper back region and daily working time ($P <$

0.01). In addition, there was a significant relationship between the presence of lower back symptoms and the number of rows of knots woven in a day ($P < 0.05$). However, the results of this study did not show any other significant relationship between ergonomics factors and the presence of symptoms in different body regions.

Table 5: Relationship between job factors and frequency of reported symptoms (%) in different body regions in last 12 months

Body region	Job factors							
	Experience (years)		Daily working time (h)		Continuous sitting time for doing a single row (min)		Number of rows of knots woven in a day	
Neck	<10	35.1	<7	18.9	<40	51.4	≤10	16.2
	10-15	32.4	7-8	51.4	≥40	48.6	10-15	54.1
	>15	32.4	>8	29.7			>15	29.7
	P-value	0.645	P-value	0.825	P-value	0.524	P-value	0.19
Shoulders	<10	30.4	<7	21.7	<40	60.9	≤10	21.7
	10-15	43.5	7-8	65.2	≥40	39.1	10-15	56.5
	>15	26.1	>8	13.0			>15	21.7
	P-value	0.244	P-value	0.088	P-value	0.109	P-value	0.839
Elbows	<10	38.5	<7	15.4	<40	61.5	≤10	0.0
	10-15	30.8	7-8	61.5	≥40	38.5	10-15	69.2
	>15	30.8	>8	23.1			>15	30.8
	P-value	0.993	P-value	0.777	P-value	0.285	P-value	0.087
Wrists/hands	<10	34.6	<7	7.7	<40	53.8	≤10	15.4
	10-15	34.6	7-8	61.5	≥40	46.2	10-15	50.0
	>15	30.8	>8	30.8			>15	34.6
	P-value	0.836	P-value	0.084	P-value	0.454	P-value	0.23
Upper back	<10	28.0	<7	32.0	<40	48.0	≤10	24.0
	10-15	36.0	7-8	32.0	≥40	52.0	10-15	44.0
	>15	36.0	>8	36.0			>15	34.0
	P-value	0.294	P-value	0.005	P-value	0.891	P-value	0.385
Lowe back	<10	37.5	<7	25.0	<40	50.0	≤10	31.3
	10-15	31.3	7-8	50.0	≥40	50.0	10-15	50.0
	>15	31.3	>8	25.0			>15	68.7
	P-value	0.95	P-value	0.326	P-value	0.831	P-value	0.035
Thighs	<10	62.5	<7	25.0	<40	75.0	<10	12.5
	10-15	12.5	7-8	50.0	≥40	25.0	10-15	37.5
	>15	25.0	>8	25.0			>15	50.0
	P-value	0.261	P-value	0.898	P-value	0.105	P-value	0.217
Knees	<10	30.4	<7	17.4	<40	52.2	<10	17.4
	10-15	39.1	7-8	60.9	≥40	47.8	10-15	47.8
	>15	30.4	>8	21.7		0.664	>15	34.8
	P-value	0.48	P-value	0.565	P-value		P-value	0.355
Ankles/feet	<10	40.0	<7	20.0	<40	46.7	<10	20.0
	10-15	23.3	7-8	50.0	≥40	53.3	10-15	50.0
	>15	36.7	>8	30.0			>15	30.0
	P-value	0.193	P-value	0.838	P-value	0.679	P-value	0.647



Fig. 1: Weavers weaving at a vertical loom

All of the weavers reported pain in at least one painful region in their bodies (Mean = 5, SD = 2, Min = 1, Max = 8). As shown in Fig. 1, all of the studied workstations use vertical loom for weaving carpets and the seats were a simple wooden bench with no support or back rest. No adjustment mechanism was observed in any of the studied workshops in the components of the workstations including, seats, looms and weaving heights.

Discussion

The aim of the present study was to investigate the musculoskeletal complaints among carpet weavers in relation to working conditions in hand-woven carpet workshops in Tabriz – Iran. The major finding of the study was that the prevalence of musculoskeletal complaints was considerably high in almost all of the body regions of the hand-woven carpet weavers, with the most reported symptoms were in the neck, lower back, ankles/feet, wrists/hands, upper back, shoulders and knees, respectively. Almost all of the carpet weavers participated in this study experienced some type of musculoskeletal symptom in at least of their body regions. More than one-third of those who reported musculoskeletal symptoms in the last 12 months, needed to take days off due to such symptoms. These findings may not be surprising as most of the participants reported that they were not satisfied with their work station design, tools or environmental condition of the workshops. The results also showed significant relationship between the reported symptoms in the upper back area and daily working time as well as between the presence of lower back symptoms and the number of rows of knots woven in a day.

The results showed a high prevalence of musculoskeletal symptoms among weavers. The prevalence of reported symptoms in the back area was about 68% which is higher than that reported by Merasy [15] who reported the prevalence of pain in this region to be 35.5%. Differences in results may arise from the sample size and differences in age between the two studies. Fotohabadi [17]

found the prevalence of musculoskeletal disorders in the back, shoulder and knees to be 59%. This study agrees with Fotohabadi's findings [17], as the prevalence of disorders of these regions in this study was 54.8%. The result of this study showed that the average of musculoskeletal symptoms in different body regions was 54.6%, but Mazloomi [16] found this average to be 36.5%. The author found that the most and the least grievances were related to the back and neck, respectively. In contrast, the present study found that the back and thighs had the most and the least complaints among weavers, respectively.

Regarding the environmental condition of workshops, as shown by the results of this study, more than half of the participants were not satisfied with the environmental condition of their workshops such as thermal condition, noise level and cleanliness of the air. The results also indicated that weavers' satisfaction with thermal condition of the workshops were associated with lower back symptoms, suggesting that the environmental conditions of the work place should be taken into account in risk assessments for musculoskeletal problems. In addition, about 43% of weavers were somewhat to completely dissatisfied with workshop lighting condition which is consistent with previous reports [14], which have shown inadequate lighting in many weaving workshops. With respect to the work station design and tools, most of the participants in this study expressed dissatisfaction with their seat (a plank of wood). The results indicated that the weavers' satisfaction with hand tools shape was associated with lower back and elbow symptoms, whereas satisfaction with weaving looms was associated with upper back complaints. In addition, weavers' satisfaction with hand tools weight was associated with elbow complaints. These findings suggest that the worker's satisfaction can be regarded as an important indicator of the musculoskeletal problems working population. Choobineh et al. [7] found a link between seat type and the occurrence of neck, shoulders, upper back,

lower back, thighs and knees symptoms with musculoskeletal problems in those regions occurring at higher rates among those who sat on the ground or on a piece of lumber. Therefore, to reduce the prevalence of musculoskeletal complaints, a well designed chair that increases comfort level while weaving is suggested.

More than one third (36.2%) of the carpet weavers were also dissatisfied with their hand tools shape and weight, while somewhat to complete dissatisfaction regarding weaving looms were found to be less common (25.5%). In their study, Choobineh et al. [7] found that weavers working at horizontal looms tended to be twice as likely to suffer from musculoskeletal problems as those working at vertical looms.

The results of the present study indicated that poor working conditions may increase the rate of musculoskeletal problems and complaints among weavers in the hand-woven carpet industry. Accordingly, significant relationships were found between job factors and reported musculoskeletal symptoms in some body areas. There is a significant relationship between upper back symptoms and daily working time that confirms the findings of previous studies [9, 25]. Also, lower back symptoms were found to be related to the numbers of rows of knots woven in a day, although no other relationship was found between reported symptoms and study variables. Therefore, to prevent upper back and lower back symptoms, it is strongly recommended that weavers should have several regular short breaks during their working hours.

There are several limitations that need to be taken into account when applying the findings of the study. First, the study was cross-sectional in design, which prevents an evaluation of the relationship between cause and effect. Another limitation is that there are possible limitations associated with the reliability and accuracy of self-reported data on musculoskeletal problems. In addition, a further empirical investigation into detailed discomfort areas in relation to hand-woven carpet tasks and working postures may

benefit the industry to prevent workers from suffering work related musculoskeletal disorders.

Conclusions

This study has shown a high rate of musculoskeletal problems and complaints from workshop conditions in the Iranian hand-woven carpet industry. Upper back symptoms were found to be related to daily working time, while lower back symptoms were associated to the numbers of rows of knots woven in a day. Moreover the result of study indicated that weavers' satisfaction with thermal condition of the workshops were associated with lower back symptoms. Thus, it is essential to overcome those problems in workshops and to modify some non-ergonomic activities in hand-woven carpet producing. Very small improvements in working conditions, implements, tools design or working methods can potentially lead to large benefits [26]. Hand-woven carpet workshops should be the subject of ergonomic interventions in all aspects namely light, noise, thermal and air conditions, and the design of looms, seats, and hand tools.

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References

- [1] Glass B. Small enterprises and occupational health and safety. In: Stellman JM, editor. Encyclopaedia of occupational health and safety. 4th ed. Geneva, Switzerland: International Labour Office; 1998.
- [2] Choobineh AR, Shahnava H, Lahmi MA. Major health risk factors in Iranian hand-woven carpet industry. *JOSE* 2004;10: 65.
- [3] Reverente BR. Occupational health services for small-scale industries. In: Jeyaratnam J, editor. Occupational health in developing countries. New York, NY, USA: Oxford University Press. 1992.
- [4] McCann M. Hazards in cottage industries in developing countries. *Am J Ind Med* 1996;30:125-129.

- [5] Sanaat and Maadan Bank. Small-scale industry strategy and essential of small-scale industry bank establishment in the country. 2001 (in Persian).
- [6] Choobineh AR, Hosseini M, Lahmi MA, et al. Musculoskeletal Problems in Iranian Hand-woven Carpet Industry: Guidelines for Workstation Design. *Appl Ergon* 2007; 38: 617-624.
- [7] Choobineh AR, Hosseini M, Lahmi MA, et al. Musculoskeletal Problems in Iranian Hand-woven Carpet Industry: Guidelines for Workstation Design. *JOSE* 2004; 10: 157-168.
- [8] Mahdavi H. What should be done for Iranian carpet export? *Kayhan* [a newspaper], 2000; 16940:5 (in Persian).
- [9] Choobineh AR. principles of educational furniture design. *Newsletter of Iranian Ergonomics Society* 2004; 16:3-12.
- [10] Choobineh AR, Lahmi MA, Hosaini M, et al. Musculoskeletal problems and corrective measure in Iranian hand-woven carpet industry. In: Proceeding of the XVth Triennial Congress of the International Ergonomics Association and the 7th Joint Society of Korea/Japan Ergonomics Society. Seoul, Korea: Ergonomics Society of Korea 2003; 7.
- [11] Vanwonterghem K. CERGO International and Hasselt. Work-related musculoskeletal problems: Some ergonomics considerations. *J Hum Ergol* 1996; 25: 5.
- [12] Spielholz P, Silverstein B, Morgan M, et al. Comparison of self-report, video observation and direct measurement methods for upper extremity musculoskeletal disorder physical risk factors. *Ergonomics* 2001; 44: 588-613.
- [13] Kuorinka I, Jonsson B, Kilbom A, et al. Standardized Nordic Questionnaires for the analysis of musculoskeletal symptoms. *Appl Ergon* 1987; 18:233-237.
- [14] Radjabi A. Carpets, hand-woven. In: Encyclopedia of occupational health and safety. 3rd ed. Geneva, Switzerland: International Labour Office; 1983.
- [15] Merasy MR. Prevalence of skeletal disorders based on individual and environmental characteristics in Najafabad's weavers from 1993 to 1994 [Master of Science thesis, 2305] Tehran, Iran: School of Public Health, Tehran University of Medical Sciences; 1994 (in Persian).
- [16] Mazloomi SS. Study of weavers' health conditions in Yazd province villages. In: Proceedings of Bagha program conference and workshop. Tehran, November 23-24. Ministry of Jihad-Sazandegi; 1996. 31-43 (in Persian).
- [17] Fotohabadi MR. Prevalence of musculoskeletal disorders among Fasa's weavers. In: Proceeding of the 8th Iran physiotherapy congress. Tehran, May 12-14 1997. Iranian Physiotherapy Society. 1997;13-5. (in Persian).
- [18] Corlett EN, Bishop RP. A technique for assessing postural discomfort. *Ergonomics* 1976; 19: 175-182.
- [19] Hagen KB, Magnus P, Vetlesen K. Neck/shoulder and low-back disorders in the forestry industry: relationship to work tasks and perceived psychosocial job stress. *Ergonomics* 1998; 41: 1510-1518.
- [20] Szeto GPY, Straker L, Raine S. A field comparison of neck and shoulder postures in symptomatic and asymptomatic office workers. *Appl Ergon* 2002; 33: 75-84.
- [21] Dahlberg R, Karlqvist L, Bildt C, et al. Do work technique and musculoskeletal symptoms differ between men and women performing the same type of work tasks? *Appl Ergon* 2004; 35: 521-529.
- [22] Arvidsson I, Arvidsson M, Axmon A, et al. Musculoskeletal disorders among female and male air traffic controllers performing identical and demanding computer work. *Ergonomics* 2006; 49: 1052-1067.
- [23] Kjellberg A, Wadman C. The role of the affective stress response as a mediator of the effect of psychosocial risk factors on musculoskeletal complaints—Part 1: Assembly workers. *Int J Ind Ergon* 2007; 37: 367-374.
- [24] Thornton LJ, Barr AE, Stuart-Buttle C et al. Perceived musculoskeletal symptoms among dental students in the clinic work environment. *Ergonomics* 2008; 51: 573.
- [25] Wearsted M, Westgaard RH. Working hours as a risk factor in the development of musculoskeletal complaints. *Ergonomics* 1991; 34: 265-76.
- [26] Sen RN. Application of ergonomics to industrially developing countries. *Ergonomics* 1984; 27: 1021-1032.