

## Original Article

# Musculoskeletal Disorders and Ergonomic Hazards among Iranian Physicians

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## Abstract

**Background:** The aim of this study was to determine the prevalence of musculoskeletal disorders (MSDs) and ergonomic hazards and their relationship among Iranian physicians who work in teaching hospitals.

**Methods:** A self-administered questionnaire was provided to 405 physicians in four teaching hospitals. The questionnaire had three major parts: the first part gathered individual and work-related data, the second was a modified version of the Standardized Nordic questionnaire for musculoskeletal symptoms, and the last part evaluated the duration of exposure to ergonomic hazards at work.

**Results:** Knee pain (19.8%) was the most common complaint among physicians, followed by low back (15.1%) and neck pain (9.8%). A total of 169 physicians (41.7%) reported symptoms in at least one part of their bodies. Prolonged sitting, standing, and neck flexion were the most common reported ergonomic hazards among participants. Multiple logistic regression analysis reported statistically significant associations for the outcomes of knee pain and symptoms in any part of the body with the work-related factors of years of employment and work hours per shift.

**Conclusion:** The prevalence of musculoskeletal complaints among physicians was low, less than other health care workers, but similar to those reported in the general population. These musculoskeletal complaints were, however, associated with traditional work-related and ergonomic factors.

**Keywords:** Ergonomic hazards, Iran, musculoskeletal diseases, physicians

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## Introduction

Physicians experience daily exposure to occupational hazards at their workplace, the majority of which are biological hazards, ergonomic hazards, and work-related stress. Although physicians' work-related complaints and diseases may differ based on their specialty, some complaints including musculoskeletal disorders (MSDs) are common among all groups of physicians.

Health care work is known as a high-risk job for MSDs.<sup>1-3</sup> It is estimated that almost one-third of all cases of sick leave among health care workers are related to MSDs.<sup>4</sup> Even in developed countries, it appears that MSDs are under reported among health care providers.<sup>5</sup> Back, neck, shoulder, and knee problems are the most common complaints among medical, dental, and nursing students.<sup>6-8</sup> Studies of MSDs among health care providers have mainly focused on dentists, physical therapists, and nurses.<sup>9-11</sup>

The body of knowledge about MSDs among physicians is limited. Although physicians provide health care for patients, their own occupational health has usually been neglected. Since physicians are usually busy during their working hours, only a few studies have evaluated MSDs among them. Many of these measurements are carried out among specific groups of physicians such as ophthalmologists<sup>12</sup> and radiologists.<sup>13</sup> Few, if any studies, have

explored and identified general ergonomic risk factors within a cohort of multiple specialties of physicians.

Our goal was to determine the prevalence of MSDs among Iranian physicians. Through a cross-sectional design we aimed to determine associations between individual, work, and ergonomic factors commonly reported to be related to MSDs.

## Materials and Methods

This cross-sectional study recruited 450 physicians in four teaching hospitals affiliated with Tehran University of Medical Sciences during the Spring of 2008. Our research protocol was approved by the Ethics Committee of Tehran University of Medical Sciences as a referral organization. We prepared a list of all physicians from numerous specialties in four hospitals. The only criterion for eligibility to the study was at least two years of physician work experience at their current positions. Physicians with histories of fractures or major trauma, degenerative disc disease, spondylosis and spinal stenosis, neurological deficits and systemic illnesses were excluded. Based on the number of physicians in each hospital, we stratified our sample size between hospitals before selecting our targeted participants. Participants were chosen from each hospital by simple random sampling. According to the schedules of the selected physicians, we contacted them during their work shifts in the hospital wards. Through group or individual meetings, we explained to the potential participants the importance of occupational health and MSDs for physicians, then we asked for their consent to participate in our study. If they agreed, verbal informed consent was obtained.

At the time of verbal consent, a self-administered questionnaire was provided to the physicians by the researchers. It was requested

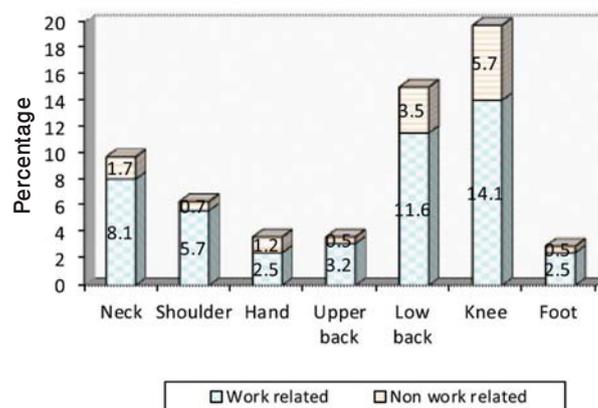
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**Table 1.** Distribution and univariate analysis of individual and work-related factors.

		Total (n = 405)	With MSDs (n = 169)	Without MSDs (n = 236)	P- value
Age (years)	Mean (SD)	44.6 (7.9)	45.8 (8.7)	43.7 (7)	0.01
Sex	N (%)				0.73
	Female	190 (47)	81 (48)	109 (46)	
	Male	215 (53)	88 (52)	127 (54)	
Weight (kg)	Mean (SD)	68 (6.7)	68.2 (8.1)	67.8 (6.1)	0.57
Height (cm)	Mean (SD)	169 (0.1)	168.7 (0.1)	168.7 (0.1)	0.97
BMI	Mean (SD)	23.7 (2)	23.7 (2.3)	23.7 (1.7)	0.87
Smoking	N (%)				0.90
	Yes	9 (2.5)	4 (2.6)	5 (2.4)	
	No	352 (97.5)	149 (97.4)	203 (97.6)	
Shift work	N (%)				0.00
	Yes	192 (48)	98 (58)	94 (41)	
	No	205 (52)	70 (42)	135 (59)	
Secondary job	N (%)				0.88
	Yes	199 (51)	84 (51)	115 (50)	
	No	193 (49)	80 (49)	113 (50)	
Employment	N (%)				0.25
	Permanent	342 (85)	147 (87)	195 (83)	
	Temporary	60 (15)	21 (13)	39 (17)	
Years of employment	Mean (SD)	13.8 (7.9)	15.8 (8.6)	12.3 (7.1)	0.00
Work hours per week	Mean (SD)	50.9 (10.8)	51.0 (13)	50.9 (9)	0.94
Work hours per shift	Mean (SD)	8 (4.6)	9.2 (5.1)	7.1 (4)	0.00
Stress	N (%)				0.90
	No or mild	14 (3.5)	5 (3)	9 (4)	
	Moderate	253 (62.5)	106 (63)	147 (62)	
	Severe	138 (34)	58 (34)	80 (34)	
Lost days	N (%)				0.00
	Yes	46 (11.4)	34 (20)	12 (5)	
	No	359 (88.6)	135 (80)	224 (95)	

**Figure 1.** The prevalence of musculoskeletal complaints and their work-relatedness for various body parts

that physicians complete and return the questionnaire during the same shift. Many complied and returned their completed questionnaires within their respective shifts. For those who did not, we reminded them twice during their two next shifts to complete and return the questionnaire.

The questionnaire consisted of three major parts: the first part gathered individual and work-related data that included age, gender, marital status, height, weight, smoking, shift work, secondary job, number of hours worked per week, type of employment (permanent or temporary), and duration of work. The second part was a modified version of the Standardized Nordic Questionnaire for the Analysis of Musculoskeletal Symptoms<sup>14</sup> which had been translated into Persian. After translation, we asked a small group

of physicians to complete the questionnaire in order to establish and measure the reliability of the translated version. Then, a group of experts discussed the translation and its validity. To determine if symptoms were work-related the questionnaire also included questions asking if symptoms increased during workdays and by the end of the work shift and decreased on holidays. Symptoms with the answer "yes" to all three questions were considered work-related. To assess severity, the questionnaire also queried about lost days due to musculoskeletal problems during the last 12 months.

The third part of the questionnaire evaluated duration of exposure to ergonomic hazards at work. These factors included the duration worked with the neck flexed in a downward position of more than 20 degrees; the arm above shoulder level; repetitive movements of

**Table 2.** Prevalence [n(%)] and univariate analysis of self-reported ergonomic hazards at physicians' workplaces.

Ergonomic hazards	Total (n = 405)	With MSDs (n = 169)	Without MSDs (n = 236)	P-value
Neck flexion more than 20 degrees	94 (23.2)	58 (34.3)	36 (15.3)	0.00
Arm level higher than shoulder	43 (10.6)	26 (15.4)	17 (7.2)	0.01
Repetitive work more than 2/minute	20 (4.9)	15 (8.9)	5 (2.1)	0.00
Forceful work	31 (7.7)	22 (13.0)	9 (3.8)	0.00
Forward bending	51 (12.6)	37 (21.9)	14 (5.9)	0.00
Lateral bending or twisting	59 (14.6)	35 (20.7)	24 (10.2)	0.00
Prolonged sitting more than 20 minutes	167 (41.2)	78 (46.2)	89 (37.7)	0.09
Prolonged standing more than 20 minutes	214 (52.8)	103 (61)	111 (47)	0.01
Lifting, pulling, pushing	9 (2.2)	5 (3.0)	4 (1.7)	0.39

more than four per minute; forceful exertions with the trunk bent forward or twisted or bent in the lateral direction; prolonged sitting or standing; and manual handling or carrying in each work shift. The participants answered the questionnaire in a few minutes and a trained researcher was also available to answer their farther questions.

After completing and returning the questionnaires, we divided our participants into two groups, those with musculoskeletal complaints during the last year as cases and a group with no complaints as the reference group.

Univariate analysis compared individual (demographic), work-related factors, and ergonomic hazards between the case and reference groups using the independent sample *t*-test or Mann-Whitney U test for continuous variables, and the chi square test for nominal or ordinal variables. We calculated the one year prevalence of MSDs in each body part among physicians.

Multiple logistic regression analysis evaluated the association of work-related factors (work duration reported as years of employment and work hours per shift) as continuous variables with MSDs in certain body parts adjusted for individual variables. We considered four binary outcome variables as independent variables and attempted to find work-related predictors for each. Complaints in the neck, lower back, and knees were the most common problems among this group of physicians. Therefore we assessed the association between work and symptoms in these body sites. Other symptoms in any part of the body were considered to be independent variables. We calculated the odds ratio and confidence interval (CI) for work duration and work hours per shift as predictors of MSDs. We adjusted for ergonomic hazards at work and stress at work to minimize the effect of task related factors, as well as adjustments for age, gender, and BMI as individual factors that possibly affect these associations.

Further multiple logistic regression analysis evaluated the ergonomic risk factors associated with neck, low back, and knee pain, and complaints in any body part. This analysis adjusted for both individual and work-related factors such as age, gender, BMI, shift work, type of employment, and secondary job. During all steps of analysis *P* values less than 0.05 were considered statistically significant.

## Results

A total of 405 out of the 450 (90%) physicians approached completed and returned the questionnaires. The response rates were similar in four hospitals (87%–92%). Knee pain was the most common complaint among physicians followed by low back and neck pain. The hand/wrist, upper back and ankle/foot locations had

fewer problems. About three-fourths of the symptoms in the knees, low back and neck were work-related (Figure 1).

Over the past 12 months, 169 physicians (41.7%) reported symptoms at least in one part of their bodies. Univariate analysis demonstrated differences between the case group and the reference group for age, shift work, years of employment, work hours per shift and lost work days (Table 1). In general, physicians in the musculoskeletal complaint group were older, had more years of employment and more working hours per shift. Additionally, they worked more shifts and had more absences. There were no statistically significant differences in terms of gender, height, weight, BMI, smoking, secondary job, type of employment, work hours per week, and level of stress between the two groups (Table 1).

Prolonged sitting, standing, and neck flexion were the most common ergonomic hazards reported; lifting, pulling and pushing at work, and repetitive, forceful work were the least common reported among participants (Table 2). Univariate analysis comparison of ergonomic hazards between physicians with and without MSDs showed a statistically significant longer duration of exposure to ergonomic factors for the group with MSDs. Prolonged sitting and handling, pulling or pushing at work did not differ between the two groups.

Multiple logistic regression analysis reported statistically significant associations for the outcomes of knee pain and symptom in any part of the body with the work-related factors of years of employment and work hours per shift (Table 3). Although the number of hours worked per shift was not a significant factor for neck pain, however, the regression reported an association with years of employment. Low back pain had little to no association with years of employment and work hours per shift.

For ergonomic factors (Table 4), the multiple logistic regression analysis reported that neck pain was associated with an increased duration of neck flexion of more than 20 degrees, prolonged sitting, and frequent forward bending. Low back pain was associated with increased duration of standing and forceful work. Knee pain was associated with increased duration of standing and symptom in any part was associated with increased duration of exposure to torso bending and neck flexion (Table 4).

## Discussion

Our goal was to determine the prevalence of work-related MSDs among a diverse group of Iranian physicians that were both specialist and general practitioners. While our prevalence was modest in the range of 10% to 20%, there were significant associations between these outcomes and both work-related and ergonomic factors.

**Table 3.** Multivariate analysis of musculoskeletal symptoms for work-related factors. Significant relationships are presented in bold.

		$\beta$	Odds ratio	95% CI	P-value
Neck					
	Years of employment	0.13	1.14	1.01 – 1.28	0.04
	Work hours per shift	0.04	1.04	0.95 – 1.13	0.42
Low back					
	Years of employment	0.06	1.06	0.96 – 1.16	0.24
	Work hours per shift	0.03	1.03	0.95 – 1.11	0.49
Knee					
	Years of employment	0.14	1.16	1.04 – 1.28	0.01
	Work hours per shift	0.14	1.15	1.07 – 1.24	0.00
Any part					
	Years of employment	0.11	1.12	1.03 – 1.21	0.01
	Work hours per shift	0.14	1.15	1.07 – 1.24	0.00
Adjusted for: Age, gender, BMI, ergonomic factors in Table 2 and stress.					

**Table 4.** Multivariate analysis for ergonomic predictors. Significant relationships are presented in bold.

		$\beta^*$	Odds ratio	95% CI	P-value
Neck					
	Neck flexion>20°	0.188	1.207	1.015 – 1.435	0.034
	Prolonged sitting	0.204	1.227	1.032 – 1.458	0.020
	Forward bending	0.157	1.170	1.017 – 1.345	0.028
Low back					
	Prolonged standing	0.147	1.159	1.003 – 1.339	0.045
	Forceful exertion	0.259	1.295	1.026 – 1.635	0.030
Knee					
	Prolonged standing	0.206	1.229	1.066 – 1.416	0.004
Any part					
	Frequent bending	0.339	1.404	1.179 – 1.671	0.000
	Neck Flexion>20°	0.184	1.202	1.030 – 1.404	0.020
* $\beta$ = per 30 minutes of exposure.					

Compared to other health care professionals, the prevalence of MSDs among Iranian physicians in this study was much lower (Table 5); however, many of these other studies have examined groups of specific medical professionals that may have very different work-loads. For example, Cromie et al.<sup>15</sup> and Adegoke et al.<sup>16</sup> have reported MSDs among physical therapists in Australia and Nigeria, respectively; while Smith et al.<sup>17</sup> reported MSDs among Japanese nurses. This higher prevalence possibly indicated increased physical demands that were expected and documented in these types of jobs.

The prevalence for physicians is also lower than dentists, ophthalmologists and radiologists. Leggat et al.<sup>18</sup> have researched MSDs among Australian dentists, whereas Dhimitri et al. conducted a survey among ophthalmologists in the Northeastern US and reported 39% low back pain, 32.9% upper extremity symptoms, and 32.6% neck pain in this group of physicians.<sup>12</sup> The prevalence of MSDs in this study was higher than our study with 15.1% low back pain and 9.8% neck pain. In addition, Boiselle et al. have reported a prevalence of 58% for any repetitive stress symptom among modern radiologists.<sup>7</sup> Again, the physical workload of dentists, ophthalmologists, and radiologists may differ from general physicians.

Overall, the prevalence of MSDs among these physicians is similar to the Iranian general population, which is 18% for low back pain and 7% for neck pain.<sup>19</sup> The reasons for this similarity are the “healthy worker effect”, which is a well-known effect in occupational health research settings, meaning that healthy physicians have a better chance to enter and continue their work. Secondly, the definition of work-related MSDs means a complaint that worsens during working hours and work days, and is not merely a complaint which has been induced by work. Alipour et al. report

7% neck pain and 6.1% shoulder pain among Iranian auto manufacturing workers which is similar to our results.<sup>20</sup> However, more than three-fourths of physicians with musculoskeletal symptoms in their knees, as well as low back and neck pain have reported worsening of their symptoms during workdays and work hours, with amelioration during weekends or holidays and when at home. The differentiation between work-related and non-work-related MSDs is, however, problematic as it is often difficult to find a non-working population between 18 to 65 year of age.<sup>21</sup>

Nevertheless, within this population self-reported exposure to classic work-related and ergonomic factors were associated with musculoskeletal complaints even after adjustment for individual factors. Increased work hours per shift was associated with knee pain and symptom in any part of the body. In addition, increased years of employment was associated with neck and knee pain, and symptom in any part of the body (Table 4). Trinkoff et al. reported an association between long hours per shift and increased risk of neck, back and shoulder pain among nurses.<sup>22</sup> Lipscomb et al. reported an association between low back pain and long hours per shift, although they were unable to find an association between long shifts and neck pain or shoulder pain.<sup>23</sup> Our results were similar to studies that found an association between long hours per shift and MSDs. Alipour et al. reported a relation between neck and shoulder pain with years of employment among Iranian auto manufacturing workers.<sup>20</sup>

In addition, the musculoskeletal symptoms were also related to classic ergonomic factors. Neck pain was related to longer exposure to neck flexion, prolonged sitting and forward bending; low back pain was related to prolonged standing and forceful exertion; knee pain was related to prolonged standing; and symptom in any

**Table 5.** Comparison of musculoskeletal complain among different groups of health care workers.

Occupation (country)	Neck (%)	Low back (%)	Knee (%)	Citation
Physicians (Iran)	9.9	15.1	17.3	This study
Physical therapists (Australia)	47.6	62.5	11.2	Cromie et al. <sup>15</sup>
Nurses (Japan)	36.8	82.6	23.5	Smith et al. <sup>17</sup>
Dentists (Australia)	24.6	22.1	6.3	Leggat et al. <sup>18</sup>
Physiotherapists (Nigeria)	31.1	69.8	15.9	Adegoke et al. <sup>16</sup>

part of the body was related to frequent bending and neck flexion (Table 4). Alexopoulos et al. reported a relation between physical load and number of MSDs among Greek nurses.<sup>24</sup> Choobineh et al. reported a relation between MSDs and perceived physical demand among Iranian nurses.<sup>25</sup> Alipour et al. reported relation between repetitive work, sitting position and awkward position with neck and shoulder pain among Iranian auto manufacturing workers.<sup>20</sup>

The results of this study need to be considered within the methods that were used. First, the outcomes and exposures were self-reported. In studies which have used self-reported questionnaires, participants may report their complaints more or less than clinically diagnosed disorders. A major cause of less reporting of symptoms is the inability to recall musculoskeletal problems during the previous year or recall bias. Recall bias could be one explanation for the lower prevalence of MSDs among physicians in our study in comparison with other studies that had higher prevalence of MSDs. Another limitation of our study was that we have relied on participants' reports of exposures to ergonomic hazards, which could be a source of recall bias and higher prevalence of ergonomic predictors among physicians with MSDs. Our study was a cross-sectional study; therefore we could not determine any causal inference from relation between years of employment and work hours per shift with MSDs.

Also, we were unaware of the total distribution of the specialties of physicians who participated in this study. The questionnaire contained a question about physician specialty, however, only 25% of participants responded. Possibly, the remaining 75% did not respond due to fear of losing anonymity during the recruitment process.

The most common MSDs among this group of Iranian physicians were knee, low back and neck pain. The prevalence of musculoskeletal complaints among physicians was low, less than other health care workers, but similar to those reported in the general population. These musculoskeletal complaints were, however, associated with traditional work-related and ergonomic factors.

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## References

1. Campo M, Weiser S, Koenig KL, Nordin M. Work-related musculoskeletal disorders in physical therapists: a prospective cohort study with 1-year follow-up. *Phys Ther*. 2008; **88**: 608 – 619.
2. Lorusso A, Bruno S, L'Abbate N. Musculoskeletal complaints among Italian X-ray technologists. *Ind Health*. 2007; **45**: 705 – 708.
3. Ylipaa V, Szuster F, Spencer J, Preber H, Benko SS, Arnetz BB. Health,

mental well-being, and musculoskeletal disorders: a comparison between Swedish and Australian dental hygienist. *J Dent Hyg*. 2002; **76**: 47 – 58.

4. Meijssen P, Knibbe HJ. Work-related musculoskeletal disorders of peri-operative personnel in the Netherlands. *AORN J*. 2007; **86**: 193 – 208.
5. Menzel NN. Underreporting of musculoskeletal disorders among health care workers: research needs. *AAOHN J*. 2008; **56**: 487 – 494.
6. Smith DR, Wei N, Ishitake T, Wang RS. Musculoskeletal disorders among Chinese medical students. *Kurume Med J*. 2005; **52**: 139 – 146.
7. Thornton LJ, Barr AE, Stuart-Buttle C. Perceived musculoskeletal symptoms among dental students in the clinic work environment. *Ergonomics*. 2008; **51**: 573 – 586.
8. Smith DR, Leggat PA. Musculoskeletal disorders among rural Australian nursing students. *Aust J Rural Health*. 2004; **12**: 241 – 245.
9. Alexopoulos EC, Stathi IC, Charizani F. Prevalence of musculoskeletal disorders in dentists. *BMC Musculoskelet Disord*. 2004; **5**: 16.
10. Salik Y, Ozcan A. Work-related musculoskeletal disorders: a survey of physical therapists in Izmir-Turkey. *BMC Musculoskelet Disord*. 2004; **5**: 27.
11. Alexopoulos EC, Burdorf A, Kalokerinou A. A comparative analysis on musculoskeletal disorders between Greek and Dutch nursing personnel. *Int Arch Occup Environ Health*. 2006; **79**: 82 – 88.
12. Dhimitri KC, McGwin G, Jr., McNeal SF. Symptoms of musculoskeletal disorders in ophthalmologists. *Am J Ophthalmol*. 2005; **139**: 179 – 181.
13. Boiselle PM, Levine D, Horwich PJ. Repetitive stress symptoms in radiology: prevalence and response to ergonomic interventions. *J Am Coll Radiol*. 2008; **5**: 919 – 923.
14. Kuorinka I, Jonsson B, Kilbom A. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Appl Ergon*. 1987; **18**: 233 – 237.
15. Cromie JE, Robertson VJ, Best MO. Work-related musculoskeletal disorders in physical therapists: prevalence, severity, risks, and responses. *Phys Ther*. 2000; **80**: 336 – 351.
16. Adegoke BO, Akodu AK, Oyeyemi AL. Work-related musculoskeletal disorders among Nigerian physiotherapists. *BMC Musculoskelet Disord*. 2008; **9**: 112.
17. Smith DR, Kondo N, Tanaka E, Tanaka H, Hirasawa K, Yamagata Z. Musculoskeletal disorders among hospital nurses in rural Japan. *Rural Remote Health*. 2003; **3**: 241.
18. Leggat PA, Smith DR. Musculoskeletal disorders self-reported by dentists in Queensland, Australia. *Aust Dent J*. 2006; **51**: 324 – 327.
19. Noorbala AA, Mohammad K. Health and disease in Iran. Research Project, Final Report. 2001; 42 – 50.
20. Alipour A, Ghaffari M, Shariati B, Jensen I, Vingard E. Occupational neck and shoulder pain among automobile manufacturing workers in Iran. *Am J Ind Med*. 2008; **51**: 372 – 379.
21. NRC/IOM. *Musculoskeletal Disorders and the workplaces: Low Back and Upper Extremities*. Washington, D.C: National Academy Press; 2001.
22. Trinkoff AM, Le R, Geiger-Brown J, Lipscomb J, Lang G. Longitudinal relationship of work hours, mandatory overtime, and on-call to musculoskeletal problems in nurses. *Am J Ind Med*. 2006; **49**: 964 – 971.
23. Lipscomb JA, Trinkoff AM, Geiger-Brown J, Brady B. Work-schedule characteristics and reported musculoskeletal disorders of registered nurses. *Scand J Work Environ Health*. 2002; **28**: 394 – 401.
24. Alexopoulos EC, Burdorf A, Kalokerinou A. Risk factors for musculoskeletal disorders among nursing personnel in Greek hospitals. *Int Arch Occup Environ Health*. 2003; **76**: 289 – 294.
25. Choobineh A, Rajaeefard A, Neghab M. Association between perceived demands and musculoskeletal disorders among hospital nurses of Shiraz University of Medical Sciences: a questionnaire survey. *Int J Occup Saf Ergon*. 2006; **12**: 409 – 416.