

Musculoskeletal Disorders as Common Problems among Iranian Nurses: A Systematic Review and Meta-analysis Study

Abstract

Background: Considering the importance of musculoskeletal disorders (MSDs) as one of the health consequences of job stress among nurses and significant contradictions in prevalence in different parts of the body, this study was carried out to determine the prevalence of MSDs among Iranian nurses. **Methods:** All published studies from June 2000 until June 2015 were considered in reliable databases such as PubMed, Google Scholar, Google search, Scopus, ScienceDirect, and Persian databases such as SID, Iran Medex, and Magiran. These studies, after quality control, were entered into meta-analysis using the random effects model, a total of 41 papers were assessed between 2004 and 2015. **Results:** The prevalence rate of these disorders was 60.98%, 47.76%, 46.53%, 44.64%, 42.8%, 36.8%, 24.61%, and 17.5%, respectively, obtained for the back, neck, knees, upper back, ankles, shoulders, hands, hips, thighs, and elbows. Prevalence of MSDs will lead to high costs of medical, absenteeism from work, or even unemployment. **Conclusions:** Due to high prevalence of these disorders among Iranian nurses, providing effective training in the field of ergonomics and undergoing appropriate exercises are necessary to control it.

Keywords: Iran, meta-analysis, musculoskeletal disorders, nurses

Introduction

Musculoskeletal disorder (MSD) is one of the most important challenges of occupational health in today's world and is present in many jobs.^[1,2] In the developing and developed countries, a high prevalence of work-related MSDs has been reported.^[3] They are the main cause of disability in muscles, tendons, ligaments, joints, blood vessels, and peripheral nerves that lead to pain or discomfort.^[4,5] Despite the high prevalence of disorders among people, it seems that employees in some careers, especially in the field of medical care, are more encountered with those problems.^[6] Assessing the incidence of MSDs in health-care providers is seriously followed in many countries.^[7] Several studies show that work-related disorders among health-care staffs is one of the general and basic problems. Among them, staffs who are directly in contact with patients, especially nurses and nurse assistants are more involved.^[8,9] MSDs among nurses around the world have been reported to have a prevalence of between 40% and 90%.^[10] In Iran, nurses comprise 80% of health-care staffs, and prevalence

of these disorders has been reported to be 60%–80% among them.^[9] Because of the difficult nature of the nursing profession and its attending risk, one-third of work pressure is on them.^[5,11] They should constantly change the position of the patients which is one of the risk factors for musculoskeletal system. In this regard, occupational risk factors include variables such as transferring of patients, poor posture, night shifts besides stress while individual variables include age, sex, obesity, and job. There is a close relationship between MSDs and inappropriate body mechanics.^[12-14] MSDs occur in different parts of the body including neck, hands, knees, ankles, and back such that low back pain is the most prevalent one. Therefore, the prevalence of MSDs among nurses, and its relationship with some personal and professional factors requires some necessary educational and therapeutic actions to prevent them in this vulnerable group.^[15,16] Since experienced nurses play an important role in improving hospital care and being contradictions in the prevalence of musculoskeletal problems in prevalence in different parts of the body, many studies have been done in Iran. This systematic review and meta-analysis were

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carried out to determine MSD since there are different studies with different results on the prevalence of MSDs in Iranian nurses, and there was not any comprehensive study in this field, the present study aimed to analyze the total prevalence of MSDs in mentioned population regardless with the severity of pain in muscles at all anatomical sites during 2000–2015 in Iran.

Methods

Search strategy

In this study, cross-sectional studies and population-based studies were used to determine the prevalence of MSDs. All published studies from June 2000 until June 2015 were analyzed in reliable databases such as Google Scholar, PubMed, Scopus, ScienceDirect, and Persian data banks such as SID, Irandoc, Iran Medex, and Magiran. In this research to increase sensitivity, the following keywords were used: prevalence, frequency nurse, hospital, musculoskeletal disorders among nurses, prevalence or frequency of musculoskeletal disorders in hospital staffs, occupational diseases among nurses, frequency or prevalence, hospital staff, hospital, frequency, and prevalence and musculoskeletal disorders among nurses. All related articles and abstracts written in Persian and English were also collected and extracted.

Study selection and eligibility criteria

Two persons independently carried out the study. All related articles were collected. After reviewing the topics, irrelevant studies were deleted, and then the required information was extracted with reference to the full text of the articles.

We only included articles that used the following questionnaires: Nordic Musculoskeletal Questionnaire, Cornell Questionnaire, and Ergonomics Questionnaire. Since the goal of all three questionnaires was the calculation of pain among nurses regardless the severity of pain, we estimated the total prevalence of MSDs in different parts of the body among nurses.

Inclusion criteria

1. Cross-sectional studies and other studies which had determined the prevalence of MSDs among nurses (June 2000–June 2015)
2. All men and women nurses without age and ethnic restrictions and marital status. Among duplicated studies, the study with the largest number of cases was selected.

Exclusion criteria

Ecological studies, case–control, cohort and prospective studies, and studies that did not report the prevalence and sample size, or sample size of less than 120 were excluded from the study.

Quality assessment and extraction

To assess the quality of studies, strobe checklist was used. Strobe checklist includes 22 items thus: the exact point in the study scheme, exact measure to exposure and outcome, calculation of sample size and flowchart, selecting the samples, referring to the time of collection, and referring to the inclusion and exclusion criteria. After the evaluation of the above, studies rated at more than 8 were analyzed. The ranges of determined scores were 8–18, and this range was depended on the quality of different parts of paper, etc.^[17,18] All papers were assessed by experts. The data collection and critical quality evaluation of articles were separately done by two researchers (AS and SS), while the latter did not perform any searches in the literature. Before the critical assessment, a meeting was held to provide the researchers with the necessary explanations about the questions. Finally, both authors were employed to check the selected articles.

Data extraction

Article's first author's name, location of study, publication year, methods for determination of MSDs (Nordic, Cornell, and Ergonomics Questionnaire), prevalence of MSDs, gender, and average age of subjects were used in the analyses.

Statistical analysis

The Cochran's Q-test of heterogeneity and Higgins and Thompson's I^2 were performed to detect homogeneity. Depending on heterogeneity, fixed or random effects model were used, respectively, to produce the pooled estimates. Using Bayesian analysis, the ideal point estimation of the findings of all the studies was done to minimize the random variation. Results were displayed as forest plots. We used meta-regression method to check the effect of year of publication, mean age of subjects, and quality of studies as possible sources of heterogeneity among study findings.^[19,20] All data were recorded in Microsoft Excel. Using the binomial distribution formula, the variance of prevalence of MSDs was computed in each study. To detect homogeneity, Cochran's Q-test was applied. Since the true heterogeneity could be inherently limited by the mentioned test, Higgins and Thompson's I^2 was also employed. To aggregate the data obtained from the studies and produce the pooled estimates, fixed- and random-effects models were used, respectively, with regard to the large value of I^2 and the significance or nonsignificance of the homogeneity test. Bayesian analysis was performed for the point estimation of the findings of all the studies so as to minimize the random variation. Results were displayed as forest plots. Having described the findings in forest plots, the point estimations and their confidence intervals (CIs) of 95% were calculated. Analyses of the data were conducted with the help of STATA version 9.0 (College Station, TX, USA) software.

Having assessed the quality of potentially relevant studies, 41 cross-sectional studies from years 2000 to 2015 in 21 cities of Iran making a total of 16,350 subjects were included in this study (41 articles fulfilled the criteria) [Figure 1]. These studies reported neck, shoulders, upper back, lower back, elbows, hands, hips, knees, and ankles pain, respectively. All the studies were done on both men and women subjects. In general, out of 41 selected articles, the number of 38 articles used the Nordic Questionnaire, 2 articles used the Cornell Questionnaire, and the last used the Ergonomics Questionnaire [Figure 2]. The mean age of subjects in the studies was 33.09 ± 1.91 years. Detailed information of included studies and characterizations are shown in Table 1. The minimum MSDs were reported in 27.5%, 28.1%, 14.3%, 24.5%, 5.2%, 13.4%, 11.8%, 16.4%, and 19.1% of the study sample, whereas the highest rate of disorders was reported in 70.73%, 62.1%, 76.1%, 89.1%,

29.5%, 64.5%, 40.5%, 68.7%, and 68.2% for neck, shoulders, upper back, lower back, elbows, hands, hips, knees, and ankles, respectively.^[1,6,8,9,12,21-56]

The estimated MSDs in Iran using random effect model were 47.76 (95% CI: 43.08–52.44), 42.80 (95% CI: 38.79–46.80), 44.64 (95% CI: 36.58–52.69), 60.98 (95% CI: 55.92–66.04), 17.52 (95% CI: 13.66–21.38), 36.80 (95% CI: 29.71–43.89), 24.61 (95% CI: 19.78–29.44), 46.53 (95% CI: 39.66–53.41), and 43.67 (95% CI: 35.28–52.06) for neck, shoulders, upper back, lower back, elbows, hands, hips, knees, and ankles, respectively [Figure 1]. For parts of the body, the estimated vertical size of resistance (the diamond below the graph shows the pooled MSDs prevalence) and the horizontal lines define the reported 95% CI in the study as shown in Figure 1. To assess the source of heterogeneity, variables including “publication year, the mean age of subjects, and quality of studies” were reviewed using meta-regression model which showed that none of the

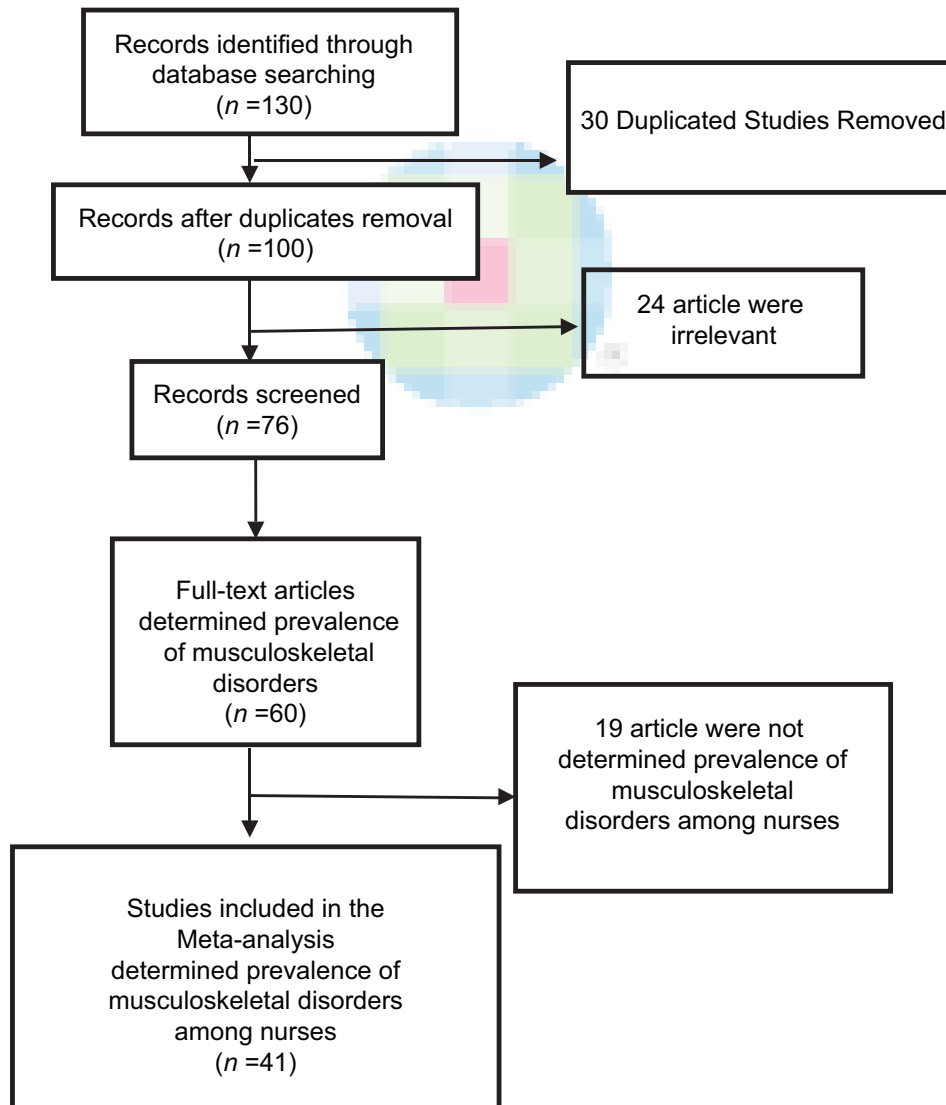


Figure 1: Flow diagram of study selection

Table 1: The description of studies that met our eligibility criteria

Authors' names	Province	Publication year	Samples size	Neck (%)	Shoulders (%)	Upper back (%)	Lower back (%)	Elbows (%)	Hands (%)	Hips (%)	Knees (%)	Ankles (%)
Karimain	Esfahan	2010	216	48.6	43.5	64.4	29.6	15.3	40.7	24.5	51.4	59
Barzideh	Shiraz	2012	385	48.6	45.5	54	61.8	15.8	48.1	-	59.7	54.8
Taheri	Esfahan	2014	247	61.8	30.8	76.1	76.1	23.9	37.7	-	22.7	48.2
Chobineh	Shiraz	2006	641	36.4	39.8	46.4	54.9	17.9	39.3	29.3	48.4	52.1
Sharifnia	Amol	2011	400	50	35.5	-	81.5	29.5	29.5	-	63.5	-
Raiesi	Tehran	2012	477	53.4	46.2	55.3	62.9	24.6	43.6	26.9	53.8	39.8
Bahrami	Kashahan	2008	278	33.1	28.1	29.1	60.4	7.6	30.9	21.9	51.8	25.5
Enaytmehri	Zahedan	2011	936	34.3	-	-	24.5	5.2	-	-	24.5	-
Mosadeghrad	Esfahan	2004	499	32.4	-	14.3	78.3	11.3	17.4	-	57.2	-
Dadarkhah	Tehran	2013	200	45.8	43.8	37.3	47.8	14.4	22.4	15.9	43.8	29.4
Ramezanibadr	Zanjan	2006	296	-	-	-	52.7	-	-	-	-	-
Rahimi	Hamedan	2004	180	-	-	-	43.3	-	-	-	-	-
Mohseni	Mazandaran	2005	1226	-	-	-	59.6	-	-	-	-	-
Chobineh	Shiraz	2012	118	-	-	-	74.9	-	-	-	-	-
Habibi	Esfahan	2010	120	-	-	-	89.1	-	-	-	-	-
Aliabadi	Birjand	2010	174	-	-	-	73	-	-	-	-	-
Eftekharsadat	Tabriz	2013	195	-	-	-	70.8	-	-	-	-	-
Habibzadeh	Khoy	2008	110	56	-	43	78	-	-	-	-	-
Chobineh	Shiraz	2008	375	51.9	51.7	54.6	60.6	22.9	47.1	30.7	58.1	59
Zakerian	Tehran	2013	335	66	-	-	30.7	21.8	13.4	-	36.4	19.1
Shafiezadeh	Ahvaz	2011	195	64	62.1	-	-	14.3	49.7	-	54.7	-
Pahlevan	Semnan	2014	286	65.4	-	-	66.1	-	-	-	59.4	-
Madani	Kashan	2014	200	32	28.5	41	-	13	26	29.5	48.5	41
Abedin	Shiraz	2013	400	42.2	42.2	33.8	71.5	21	64.5	16.5	35.5	68.2
Attarchi	Tehran	2014	454	44	42	47	57.4	24.2	37.1	19.3	48.4	32.5
Habibi	Esfahan	2015	247	27.5	46.6	-	59	-	-	11.8	16.4	-
Juibari	Golestan	2010	423	-	-	-	46.9	-	-	-	-	-
Sadeghian	Shahroud	2014	246	-	-	-	58.9	-	-	-	-	-
Barkhordari	Yazd	2013	351	-	-	-	76.3	-	-	-	-	-
Raeisia	Tehran	2014	560	-	-	-	59.5	-	-	-	-	-
Sharafkhani	Arak	2014	133	-	-	-	85.5	-	-	-	-	-
Golabadi	Tehran	2013	545	-	-	47.9	58.5	-	-	-	-	-
Mohseni-Bandpei	Mazandaran	2006	1226	-	-	-	50	-	-	-	-	-
Rezaee	Tehran	2014	1246	-	-	-	46.23	-	-	-	-	-
Imanzad	Qom	2014	264	70.73	-	-	74.86	-	-	-	-	-
Arsalani	Tehran	2014	520	49.8	-	-	65.3	-	-	-	56.2	-
Nikpoor	Tehran	2009	615	55.6	-	53.7	54.1	-	-	40.5	-	-
Mehrdad	Tehran	2010	317	46.3	48.6	43.5	73.2	16.6	42.2	28.8	68.7	39.3
Mirmohammadi	Sari	2014	120	28.2	-	17.3	-	-	-	-	18.2	-
Saremi	Tehran	2013	174	-	-	-	41	-	-	-	-	-
Farzad	Tehran	2014	420	50.7	50.7	-	63.5	-	-	-	-	-

variables could explain significant ($P > 0.05$) variations in the findings.

Discussion

The prevalence rate of 60.98%, 47.76%, 46.53%, 44.64%, 43.67%, 42.8%, 36.8%, 24.61%, and 17.52% of MSDs was recorded for back, neck, knees, upper back, ankles, shoulders, hands, hips, lower back, and elbows, respectively. Most of the problems were related to the back, neck, knees, upper back muscles, and legs and the least to shoulders, hands, hips, thighs, and elbows. The results of

high prevalence of pain in the body were obtained from most studies on the incidence rate of MSDs among nurse. In this study, the most frequent MSDs among nurses were related to back (60.98%) which is in agreement with studies by Chobineh *et al.*, Barzideh *et al.* reported that 89.9% of nurses have experienced symptoms of these disorders in one or more parts of their musculoskeletal systems in the past 12 years with backache being the most common problem (61.8%). Values of back pain in other countries: Saudi Arabia 65.7%, Stonia 1 month 39.8 and 1 year old 56.1%, Taiwan 58.76%: Italy 49% and Brazil 45% were

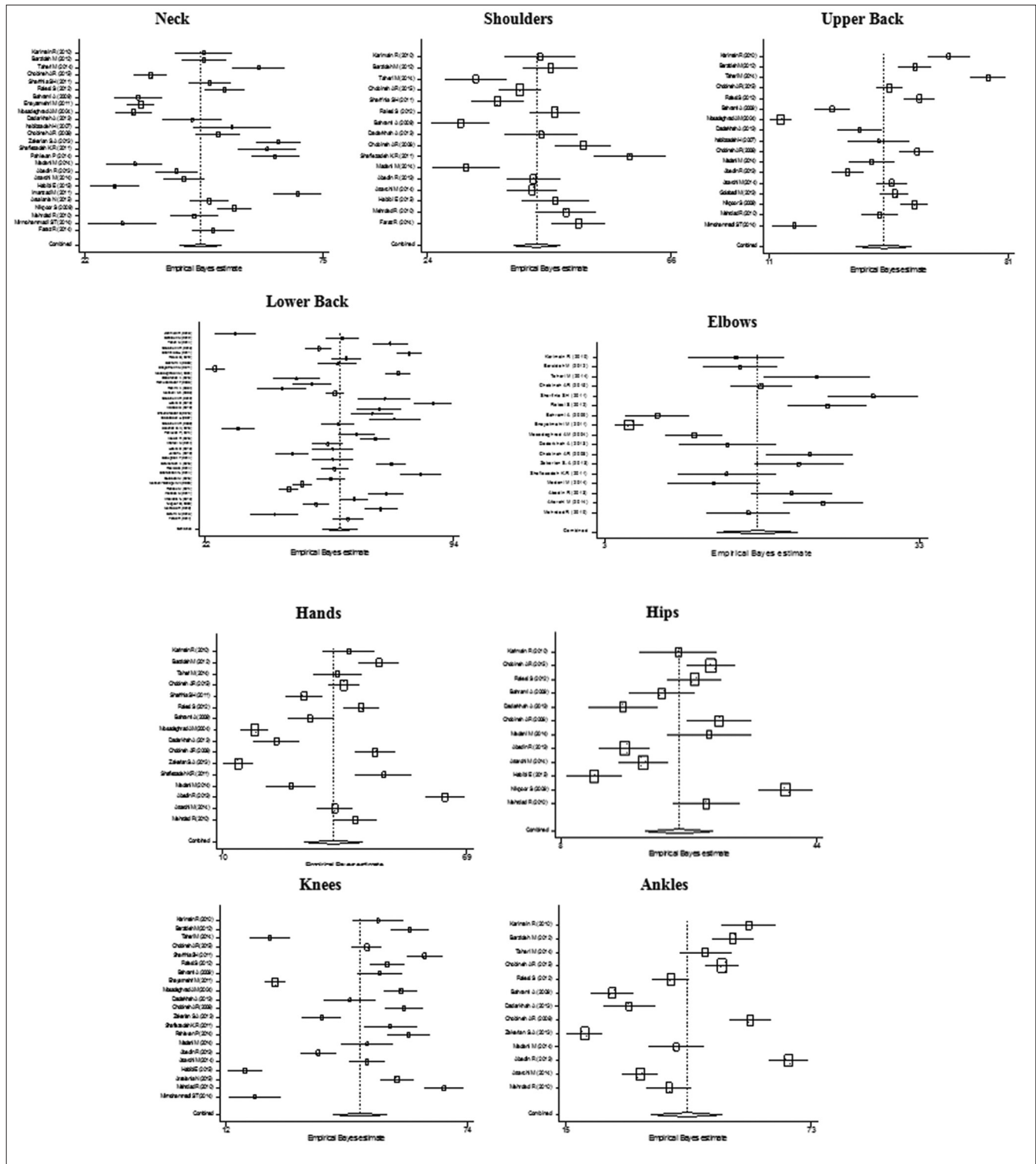


Figure 2: The reported prevalence of neck, shoulders, upper back, lower back, elbows, hands, hips, knees and ankles in different studies, and the overall estimated in Iran

reported. The reported results for backache are similar to results of other studies of nurses, in which prevalence of backache is the most common. High prevalence of backache among nursing staffs causes sickness, absenteeism, or even changing jobs.^[4,10,57-60]

Nursing requires physical efforts such as heavy lifting, inappropriate body postures, and exposure to psychological stressors. Continuous exposure of nurses to these risk factors causes MSDs.^[61] MSDs are related to the nature of nursing, particularly moving patients, which

requires sudden movement, bending, turning, lifting, and inappropriate body postures.^[12,13] These disorders occur in different parts of the body including the neck, shoulders, hands, wrists, and back with the back having the most prevalence.^[22] This prevalence shows the fact that nurses encounter the risk of damages related to the back. Prevalence of backache differs among nurses in different countries which may be due to differences in occupational factors; however, most studies have reported that more than half of nurses suffer from backache.^[48] Many reasons have been attributed for this including frequent bending and standing, frequent long walk, lifting (patients), pulling and pushing, and working in bad body postures.^[4,61]

Although the prevalence of shoulder and neck disorders is less than backache among nurses, it is one of the main causes of absenteeism and changing jobs. Among occupational risk factors, physical activities are the main factors for these problems. As they require standing up, pulling and pushing the hands, shoulders, and neck. Therefore, physical activities are some of the main causes of neck and shoulder disorders. Some risk factors of neck and shoulder problems are turning, bending, fixing, and sudden stretching in the upper parts of the body. However, the relationship between these disorders and physical risk factors is still unclear.^[62-64] Smedley *et al.* in their studies in England showed that physical activities at work compared with psychological factors have a greater impact on neck and shoulders disorders.^[65] Other researches have reported different factors in increasing shoulder and neck disorders including heavy lifting, poor postures, job stress, stretching arms and hands, and neck bending.^[62,66,67] The prevalence of neck disorders among nurses may be due to writing reports and dressing, patients relocation, etc.^[29] Devereux *et al.* noted the interaction between physical activities and job stress as factors affecting MSDs in neck and shoulders.^[68]

With regard to the high prevalence of disorders in the back, neck, and knees compared to other disorders, this could probably occur when nurses transfer patients which require sudden movements in inappropriate postures. Carrying patients requires a series of movements and postures including bending. Turning poor pairing of hands and repetitive movements exerts compression and shear forces to the spinal column while moving or changing postures of patients.^[14,59,69]

In the pursuit of a 24-year study in Sweden, the risk factors of neck and upper limb disorders in 232 men with 252 women with different careers were assessed. It was concluded that in women, long working hours, high mental workload, and working lopsided hours were associated with neck disorders.^[70] Raeisi *et al.* in their studies showed a significant relationship between high work experience and shift and females with lower

back, back, and knee disorders. Therefore, some groups of nursing personnel are more prone to MSDs.^[71] A significant relationship between gender and risk of neck and back disorders has been shown in previous studies. The prevalence of this disorder in women can be attributed to factors such as pregnancy and delivery and thus requires more research; however, some other studies have rejected this. Unfortunately, in our study, prevalence results were not reported according to gender which makes it a limitation of the study.^[24,45]

Abedini *et al.* in his study assessed MSDs among nursing personnel with the task of moving patients. The highest prevalence rate of MSDs among nurses after backache was legs and hand which ranked second and third, respectively, but it is inconsistent with our results.^[8] In most studies, after backache, the most frequent disorder was in the neck, knees, and upper back. The reason for this is that Abedini's study population included nursing staff with the task of moving patients. According to the findings of previous studies, we can say these nurses stand longer. They also use their hands for tasks such as changing position, lifting and transferring patients.^[72]

Leg disorders are one of the main problems related to health in the society. In population-based studies, between 18% and 63% of people reported pain, itching, and irritation in their legs.

A broad range of health-care personnel including general physicians, nurses, and physiotherapists suffer from leg and knee disorders. Different risk factors including age, gender, obesity, and chronic diseases such as diabetes are major causes of these disorders.^[73,74] Dargahi *et al* found that increasing BMI caused increased pain in the legs and thighs. They found that lack of fitness can increase MSDs. Dadarkhah and Abedini in their studies pointed out age as one of the main causes of leg pain among nurses. One major risk factor among nurses is continuous sitting and standing.^[8,29,75]

Some limitations of this study are that the results are not reported by gender, ward, job experience, etc. Therefore, reporting the prevalence of MSD according to different risk factors was not possible. The prevalence of MSDs among nurses reflects a significant proportion of work-related diseases which leads to high costs of medication, absenteeism, and even job loss. In this field, health policymakers should put in place necessary measures and offer appropriate solutions to reduce the prevalence of these disorders.

Conclusions

Due to high prevalence of these disorders among Iranian nurses, providing effective training in the field of ergonomics and undergoing appropriate exercises are necessary to control it.

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Conflicts of interest

There are no conflicts of interest.

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References

1. Sadeghian F, Hosseinzadeh S, Aliyari R. Do psychological factors increase the risk for low back pain among nurses? A comparing according to cross-sectional and prospective analysis. *Saf Health Work* 2014;5:13-6.
2. Smith DR, Leggat PA, Speare R. Musculoskeletal disorders and psychosocial risk factors among veterinarians in Queensland, Australia. *Aust Vet J* 2009;87:260-5.
3. Warnakulasuriya SS, Peiris-John RJ, Coggon D, Ntani G, Sathiakumar N, Wickremasinghe AR. Musculoskeletal pain in four occupational populations in Sri Lanka. *Occup Med (Lond)* 2012;62:269-72.
4. Chung YC, Hung CT, Li SF, Lee HM, Wang SG, Chang SC, *et al.* Risk of musculoskeletal disorder among Taiwanese nurses cohort: A nationwide population-based study. *BMC Musculoskelet Disord* 2013;14:144.
5. Ferreira RC, Griep RH, Fonseca Mde J, Rotenberg L. A multifactorial approach to sickness absenteeism among nursing staff. *Rev Saude Publica* 2012;46:259-68.
6. Shafizadeh KR. Prevalence of musculoskeletal disorders among paramedics working in a large hospital in Ahwaz, southwestern Iran in 2010. *Int J Occup Environ Med* 2011;2:157-65.
7. Souza AC, Alexandre NM. Musculoskeletal symptoms, work ability, and disability among nursing personnel. *Workplace Health Saf* 2012;60:353-60.
8. Abedini R, Choobineh A, Hasanzadeh J. Musculoskeletal load assessment in hospital nurses with patient transfer activity. *Int J Occup Hyg* 2013;5:39-45.
9. Choobineh A, Rajaefard 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;12:409-16.
10. Attar SM. Frequency and risk factors of musculoskeletal pain in nurses at a tertiary centre in Jeddah, Saudi Arabia: A cross sectional study. *BMC Res Notes* 2014;7:61.
11. Ferrie JE, Kivimäki M, Head J, Shipley MJ, Vahtera J, Marmot MG. A comparison of self-reported sickness absence with absences recorded in employers' registers: Evidence from the Whitehall II study. *Occup Environ Med* 2005;62:74-9.
12. Karimian R, Rahnama N, Habibi E, Ghasemi GA, Karimian M. The effect of corrective exercises on musculoskeletal disorders. *Health System Research* Fall 2010;6:540-48.
13. Alexopoulos EC, Burdorf A, Kalokerinou A. Risk factors for musculoskeletal disorders among nursing personnel in Greek hospitals. *Int Arch Occup Environ Health* 2003;76:289-94.
14. Smith DR, Mihashi M, Adachi Y, Koga H, Ishitake T. A detailed analysis of musculoskeletal disorder risk factors among Japanese nurses. *J Safety Res* 2006;37:195-200.
15. Aghakhani N, Javad A, Baghaei R, Rahbar N, Khodaei H. Epidemiological study of back pain among nurses working in teaching hospitals of Urmia. *Fac Nurs Midwifery Kerman* 2007;14:23-32.
16. Maul I, Läubli T, Klipstein A, Krueger H. Course of low back pain among nurses: A longitudinal study across eight years. *Occup Environ Med* 2003;60:497-503.
17. Whitehead A. *Meta-analysis of controlled clinical trials*. Chichester, England: John Wiley & Sons Inc; 2002. p. 216.
18. Knottnerus A, Tugwell P. STROBE – A checklist to strengthen the reporting of observational studies in epidemiology. *J Clin Epidemiol* 2008;61:323.
19. Sutton AJ, Abrams KR, Jones DR, Sheldon TA, Song F. *Methods for Meta-analysis in Medical Research*. Chichester, New York: John Wiley and Sons; 2000.
20. Konstantopoulos S, Osborne JW. *An introduction to meta-analysis. Best practices in quantitative methods*. 2008. p. 177-194.
21. Habibi E, Taheri MR, Hasanzadeh A. Relationship between mental workload and musculoskeletal disorders among Alzahra hospital nurses. *Iran J Nurs Midwifery Res* 2015-Feb; 20:1-6.
22. Barzideh M, Choobineh AR, Tabatabaee HR. Job stress dimensions and their relationship to musculoskeletal disorders in Iranian nurses. *Work* 2014;47:423-9.
23. Taheri MR, Habibi E, Hasanzadeh A, Mahdavi Rad M. Relative Stress Index (RSI): Macro-Ergonomics Risk Assessment of jobs in textile industry. *J Health Syst Res* 2014;10:775-85.
24. Bahrami N, Hojjati H, Hosseini FH. Relationship between backache and psychological and psychosocial job factors among the nurses. *Int J Nurs Midwifery* 2011;3:86-91.
25. Raeisi S, Hosseini M, Attarchi MS, Golabadi M, Rezaei MS, Namvar M. The association between job type and ward of service of nursing personnel and prevalence of musculoskeletal disorders. *Razi Journal of Medical Sciences* 2013;20:1-10.
26. Bahrami A, Akbari H, Namayindeh M, Abdollahi N. Survey of Musculoskeletal disorder health care workers hospitals in Kashan at 1385. *Trauma Res* 2009;12:2-12.
27. Mehri EM, Poodineh Z, Kiani F. Survey of Musculoskeletal disorders among nurses at hospitals related of University of Medical Sciences in Zahdan city Eleventh Seminar on Science and Health; 2011.
28. Mosadeghrad AM. The relationship between knowledge of ergonomics and occupational injuries among nurses. *Shahrekord Univ Med Sci* 2004;3:2-21.
29. Dadarkhah A, Azema K, Abedi M. Prevalence of musculoskeletal pains among nursing staff in AJA hospitals-Tehran. *Ebnesima* 2013;15:10-17.
30. Ramazani BF, Nikbakht A, Mohammadpour A. Low-back pain prevalence and its risk factors in nurses. *Iranian Journal of Nursing Research* 2006;1:37-42.
31. Rahimi A, Ahmadi F, Akhoond MR. An Investigation into the Prevalence of Vertebral Column Pains among the Nurses Employed in Hamedan Hospitals, 2004. *Razi Journal of Medical Sciences* 2006;13:105-14.
32. Mohseni-Bandpei MA, Fakhri M, Bargheri-Nesami M, Ahmad-Shirvani M, Khalilian AR, Shayesteh-Azar M. Survey of risk factors associated with low back pain among nurses in hospitals of university of medical science. *Reg Mazandaran* 2005;50:118-24.
33. Chobineh A, Tabatabaee SH, Kamalinia M. The level of knowledge of nurses working in hospitals Shiraz University of Medical Sciences of the risk factors for low back pain. *Health Saf Work* 2012;3-3-55:62.
34. Habibi E, Pourabdian S, Kianpour AA, Hosseini SM. Evaluation

- of work-related psychosocial and ergonomics factors in relation to low back discomfort in emergency unit nurses. *Health System Research* Winter 2011;6:752-61.
35. Kafaie S, Sarchahi K, Poor SA, Kazemi M. Prevalence of herniated lumbar disk among nurses working in two educational hospitals of Birjand University of Medical Sciences. *Modern Care Journal* 2010;7:25-9.
 36. Eftekhari Sadat B, Babaei A, Amidfar N, Jedari Eslami MR. Prevalence and risk factors for low back pain in nursing staffs of Tabriz hospitals in 1387. *J Urmia Nurs Midwifery Fac* 2013;11:12-20.
 37. Habibzade H, Motearefi H, Jafarizade H, Airemlou A, Lak Kh Ebadi R, *et al.* Study of lowback pain prevalence in nurses who work in khouy hospitals in 1386. *Journal of Nursing and Midwifery Urmia University of Medical Sciences* 2008;6:11-25.
 38. Choobineh A, Movahed M, Tabatabaie SH, Kumashiro M. Perceived demands and musculoskeletal disorders in operating room nurses of Shiraz city hospitals. *Ind Health* 2010;48:74-84.
 39. Zakerian SA, Monazzam MR, Dehghan SF, Mohraz MH, Safari H, Asghari M. Relationship between knowledge of ergonomics and workplace conditions with musculoskeletal disorders among nurses: A questionnaire survey. *World Appl Sci J* 2013;24:227-33.
 40. Pahlevan D, Azizzadeh M, Esmaili A, Ghorbani R, Mirmohammadkhani M. Association of musculoskeletal complaints with psychosocial factors among nurses in Semnan hospitals. *Middle East J Rehabil Health* 2014;1(1).
 41. Madani M, Masoudi Alavi N, Taghizadeh M. Non-specific musculoskeletal pain and Vitamin D deficiency in female nurses in Kashan, Iran. *J Musculoskeletal Pain* 2014;22:268-74.
 42. Attarchi M, Raeisi S, Namvar M, Golabadi M. Association between shift working and musculoskeletal symptoms among nursing personnel. *Iran J Nurs Midwifery Res* 2014;19:309-14.
 43. Juibari L, Sanagu A, Farrokhi N. The relationship between knowledge of ergonomic science and the occupational health among nursing staff affiliated to Golestan University of Medical Sciences. *Iran J Nurs Midwifery Res* 2010;15:185-9.
 44. Barkhordari A, Halvani G, Barkhordari M. The prevalence of low back pain among nurses in Yazd, Southeast Iran. *Int J Occup Hyg* 2013;5:19-21.
 45. Raeisi S, Namvar M, Golabadi M, Attarchi M. Combined effects of physical demands and shift working on low back disorders among nursing personnel. *Int J Occup Saf Ergon* 2014;20:159-66.
 46. Sharafkhani N, Khorsandi M, Shamsi M, Ranjbaran M. Low back pain preventive behaviors among nurses based on the health belief model constructs. *SAGE Open* 2014;4:1-7.
 47. Golabadi M, Attarachi M, Raeisi S, Namvar M. Effects of psychosocial strain on back symptoms in Tehran general hospital nursing personnel. *Archives of Industrial Hygiene and Toxicology* 2013;64:505-12.
 48. Mohseni-Bandpei MA, Fakhri M, Bagheri-Nesami M, Ahmad-Shirvani M, Khalilian AR, Shayesteh-Azar M. Occupational back pain in Iranian nurses: An epidemiological study. *Br J Nurs* 2006;15:914-7.
 49. Rezaee M, Ghasemi M. Prevalence of low back pain among nurses: Predisposing factors and role of work place violence. *Trauma Mon* 2014;19:e17926.
 50. Imanzad M, Gharlipour Z, Kohpaie A, Mohebi S, Arsang Gang S, Sayyarpour M, *et al.* Behavioral factors related to musculoskeletal disorders in nurses based on theory of planned behavior. *J Shahid Beheshti Sch Nurs Midwifery* 2014;23:5682.
 51. Arsalani N, Fallahi-Khoshknab M, Josephson M, Lagerström M. Musculoskeletal disorders and working conditions among Iranian nursing personnel. *Int J Occup Saf Ergon* 2014;20:671-80.
 52. Nikpour S, Nooritajer M, Haghani H, Ravandi A. Musculoskeletal disorders among nurses in teaching hospitals affiliated to Iran university of medical sciences and health services. *Iran J Nurs* 2009;22:8-18.
 53. Mehrdad R, Dennerlein JT, Haghghat M, Aminian O. Association between psychosocial factors and musculoskeletal symptoms among Iranian nurses. *Am J Ind Med* 2010;53:1032-9.
 54. Mirmohammadi S, Yazdani-Charati J. Prevalence of work-related musculoskeletal disorders and associated risk factors among nurses in a public hospital. *Iran J Health Sci* 2014;2:55-61.
 55. Saremi M, Khayati F, editors. Evaluation of Ergonomic Risk of Manual Handling of Patients with MAPO Index and its Relationship with Incidence of Low Back Pain among Nurses. *Advanced Engineering Forum*. Vol. 10. Switzerland: Trans Tech Publ.; 2013. p. 257-62.
 56. Faraz R, Kalroozi F, Pishgooie A, Taheriyani A, Lak M. Prevalence of spinal pain (upper and lower) and its related factors in Nurses of AJA. *Milit Caring Sci* 2014;1:36-42.
 57. Lorusso A, Bruno S, L'Abbate N. A review of low back pain and musculoskeletal disorders among Italian nursing personnel. *Ind Health* 2007;45:637-44.
 58. Carugno M, Pesatori AC, Ferrario MM, Ferrari AL, Silva FJ, Martins AC, *et al.* Physical and psychosocial risk factors for musculoskeletal disorders in Brazilian and Italian nurses. *Cad Saude Publica* 2012;28:1632-42.
 59. Freimann T, Coggon D, Merisalu E, Animägi L, Pääsuke M. Risk factors for musculoskeletal pain amongst nurses in Estonia: A cross-sectional study. *BMC Musculoskelet Disord* 2013 1;14:334.
 60. Louw QA, Morris LD, Grimmer-Somers K. The prevalence of low back pain in Africa: A systematic review. *BMC Musculoskelet Disord* 2007;8:105.
 61. Bernal D, Campos-Serna J, Tobias A, Vargas-Prada S, Benavides FG, Serra C. Work-related psychosocial risk factors and musculoskeletal disorders in hospital nurses and nursing aides: A systematic review and meta-analysis. *Int J Nurs Stud* 2015;52:635-48.
 62. Long MH, Bogossian FE, Johnston V. The prevalence of work-related neck, shoulder, and upper back musculoskeletal disorders among midwives, nurses, and physicians: A systematic review. *Workplace Health Saf* 2013;61:223-9.
 63. Schluter PJ, Dawson AP, Turner C. Pain-related psychological cognitions and behaviours associated with sick leave due to neck pain: Findings from the Nurses and Midwives e-Cohort Study. *BMC Nurs* 2014;13:5.
 64. Jensen RC. Back injuries among nursing personnel related to exposure. *Appl Occup Environ Hyg* 1990;5:38-45.
 65. Smedley J, Egger P, Cooper C, Coggon D. Manual handling activities and risk of low back pain in nurses. *Occup Environ Med* 1995;52:160-3.
 66. Hoe VC, Kelsall HL, Urquhart DM, Sim MR. Risk factors for musculoskeletal symptoms of the neck or shoulder alone or neck and shoulder among hospital nurses. *Occup Environ Med* 2012;69:198-204.
 67. Oude Hengel KM, Visser B, Sluiter JK. The prevalence and incidence of musculoskeletal symptoms among hospital physicians: A systematic review. *Int Arch Occup Environ Health* 2011;84:115-9.
 68. Devereux JJ, Vlachonikolis IG, Buckle PW. Epidemiological study to investigate potential interaction between physical and psychosocial factors at work that may increase the risk of

- symptoms of musculoskeletal disorder of the neck and upper limb. *Occup Environ Med* 2002;59:269-77.
69. Waters TR. When is it safe to manually lift a patient? *Am J Nurs* 2007;107:53-8.
 70. Fredriksson K, Alfredsson L, Köster M, Thorbjörnsson CB, Toomingas A, Torgén M, *et al.* Risk factors for neck and upper limb disorders: Results from 24 years of follow up. *Occup Environ Med* 1999;56:59-66.
 71. Raeisi S, Hosseini M, Attarchi MS, Golabadi M, Rezaei MS, Namvar M. The association between job type and ward of service of nursing personnel and prevalence of musculoskeletal disorders. *Razi J Med Sci* 2013;20:1-10.
 72. Reed LF, Battistutta D, Young J, Newman B. Prevalence and risk factors for foot and ankle musculoskeletal disorders experienced by nurses. *BMC Musculoskelet Disord* 2014;15:196.
 73. Menz HB, Jordan KP, Roddy E, Croft PR. Musculoskeletal foot problems in primary care: What influences older people to consult? *Rheumatology (Oxford)* 2010;49:2109-16.
 74. Menz HB, Jordan KP, Roddy E, Croft PR. Characteristics of primary care consultations for musculoskeletal foot and ankle problems in the UK. *Rheumatology (Oxford)* 2010;49:1391-8.
 75. Dargahi H, Saraji J, Sadr J, Sadri G. Ergonomics in Dentistry. *Journal of Dental Medicine* 2009;22:199-207.

