2008-5435/14/63-132-138
INTERNATIONAL JOURNAL OF OCCUPATIONAL HYGIENE

IJOH 7: 132-138, 2015

ORIGINAL ARTICLE

Prevalence and Factors Associated with Musculoskeletal Disorders among Thai Hospital Orderlies

WITHAYA CHANCHAI[1]; WANPEN SONGKHAM[2]; PRANOM KETSOMPORN[3]; PUNNARAT SAPPAKITCHANCHAI[3]; WATTASIT SIRIWONG[1*]

[1]*College of Public Health Sciences, Chulalongkorn University, Bangkok 10330, Thailand;*

[2]*Faculty of Nursing, Chiang Mai University, Chiang Mai 50200, Thailand;*

[3]*Department of Patient Transfer Service, Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.*

Received May 09, 2015; Revised July 15, 2015; Accepted July 23, 2015

This paper is available on-line at *http://ijoh.tums.ac.ir*

ABSTRACT

Musculoskeletal problems, resulting from lifting and transferring patients, are often reported among hospital orderlies worldwide. The purpose of this study was to describe the prevalence and factors associated with musculoskeletal disorders in Thai hospital orderlies. This cross sectional study was conducted in a government tertiary care hospital (2,221-bed hospital) in Bangkok, Thailand. Data were collected over three months between April and May 2014. The self-administered questionnaires assessing their demographic characteristic, musculoskeletal symptom were distributed to 189 hospital orderlies. Finally, 153 hospital orderlies that met the criteria participated in the study. The prevalence rate of musculoskeletal disorders among hospital orderlies was 84.3%. Musculoskeletal disorders were present in various body parts with the lower back being reported most often (74.4%), followed by hips/thighs (72.1%), and upper back (60.5%). Factors affecting causality of musculoskeletal disorders were years of employment (OR 3.9, 95% CI 1.58-9.60), repetitive movement (OR 2.5, 95% CI 1.04-6.13), heavy load handling (OR 2.6, 95% CI 1.07-6.73), and tasks that required handling patients over 30 round per day (OR 2.8, 95% CI 1.12-7.09). Work-related musculoskeletal disorders are common among Thai hospital orderlies with low back pain being injured most often. These results suggest that intervention programs on participatory ergonomic (PE) approach and coping strategies for musculoskeletal disorders are recommended for hospital orderlies in order to reduce the rate of occupational hazards.

KEYWORDS: *Musculoskeletal disorders, Risk factors, Hospital orderlies*

INTRODUCTION

Work activities and tasks of healthcare workers including repetition, contact stress, forceful contraction, awkward postures, and sustained position were associated with high risk of work-related musculoskeletal disorders, such as lifting and transferring patients [1-5]. The majority of hospital orderlies in tertiary care settings undertake a wide range of tasks related to repeated manual patient handling activities [6-7]. These activities often involve heavy manual lifting associated with transferring and repositioning patients and working in extremely awkward postures [8]. In addition, hospital orderlies face added physical and psychosocial ergonomic risk factors when undertaking other everyday tasks such as transporting patients by wheelchair or gurney to an operating room, x-ray department, ward to ward, or other locations around the facility.

Most studies involving hospitals have focused on patient-related tasks, such as the lifting and transferring of patients by nursing-aides and orderlies. Nursing aides and orderlies are often injured during patient transfer activities and are at

**** Corresponding Author: Wattasit Siriwong***

Email: *wattasit.s@chula.ac.th*

higher risk of injury than other health care professionals [6-8]. National data compiled by the U.S. Department of Labor found that, in 2010, nursing aides, orderlies, and attendants had the highest rates of MSDs with 27,020 cases, equating to an incidence rate (IR) of 249 per 10,000 workers. This figure is more than seven times the average for all industries. By comparison, the IR for all workers was of 34 per 10,000 [9]. In a sample of Turkish healthcare workers, hospital nurses and nursing aides had the highest rate of MSDs (77.1%) [10]. In Norway, the prevalence of MSDs in nursing aides was as 89% [11], whereas in Japan it was much lower at around 37% [12]. Patient care requires lifting and transfer tasks that pose a demonstrated risk of injury to workers. High rates of back injuries and other musculoskeletal disorders have been well documented among health care workers [8, 13-15].

Many orderlies suffer from MSDs and pain. In Thailand, there have been studies describing the factors associated with musculoskeletal disorder [16-17], but research regarding MSDs in the healthcare industry and workforce has been limited. We need to understand fully the nature of MSDs, including all types of arthritis and conditions affecting muscles, bones, soft tissue, joints, and the spine among Thai hospital orderlies.

The objective of this study was to describe the prevalence and factors associated with musculoskeletal disorders in Thai hospital orderlies.

MATERIALS AND METHODS

Study setting: This cross sectional study was conducted in a government tertiary care hospital (2, 221-bed hospital) in Bangkok, Thailand, from April to May of 2014. The sample group consisted of 189 hospital orderlies. The self-administered questionnaires were sent to the target hospital. Participants' inclusion criterion were full-time orderlies who working at this hospital at least 1 year. Two female hospital orderlies completed the questionnaire. However, due to the small number of female hospital orderlies they were cut from the analysis. Thirty-four subjects who did not meet qualification requirements or had not completed the questionnaires were excluded. A self-report questionnaire was distributed to 153 hospital orderlies in this hospital.

The main duties of these hospital orderlies were lifting and transferring patients from one hospital department to another. Shift-workers were defined as those who intermittently worked in the morning (07.00 a.m. - 03.00 p.m.), afternoon (04.00 p.m.- 12.00 p.m.), and night (12.00 p.m.- 08.00 a.m.). The findings relating to the duties of the hospital orderlies under investigation revealed that their work was physically demanding, involving awkward posture, heavy loads, repetitive movement, and local muscle fatigue. In addition, those responsible for the morning shift did an average of 30 rounds of lifting and transferring tasks, which was the highest number of all shifts. All hospital orderlies were found to conduct some degree of both types of lifting and transferring tasks, including the use of wheelchairs and wheeled stretchers.

Data collection: Data were collected through self-reported questionnaires. Questionnaires gathered demographic, work history, and musculoskeletal symptom data of participants. The Nordic Musculoskeletal Questionnaire (NMQ), validated by Kuorinka et al. , was used to measure the prevalence of MSDs [18]. The NMQ was translated into Thai [15], and its reliability was acceptable.

The questionnaire included items on demographic conditions and musculoskeletal symptoms. Demographic items were age, education level, income, shift work and duration of employment. The questionnaire directed participants to identify musculoskeletal disorder symptoms encountered over the previous 12 months in specific anatomical regions in a body diagram chart. Nine symptom sites were examined: neck, shoulders, upper back, elbows, lower back, wrists/hands, hips/thighs/buttocks, knees, and ankles/feet. Respondents were asked if they had suffered from any musculoskeletal trouble (such as aches, pains, discomfort, and numbness) in the last 12 months that 'prevented them from carrying out normal activities (e.g. job, housework, hobbies). The scores were calculated by using binary score. Additional information on employment history and level of exposure to lifting and transferring patients at work was also recorded. Respondents were asked to grade the frequency with which they performed different activities as 'sometimes', 'often', 'always', or 'never'. A response of 'sometimes' or 'never' was considered Rare and a response of 'often' or 'always' was considered Frequent.

Ethics approval: This study was approved by the Ethics Review Committee of Siriraj Insitutional Review Board, Faculty of Medicine Siriraj Hospital, Mahidol University, Thailand (COA No.Si296/2014). All participant signed consent forms indicating their willingness to participate in the study before starting the assessment.

Statistical Analysis: Overall, 153 hospital orderlies responded to the study, with a response rate of 81%. Data were analyzed using SPSS version 16 (Chicago, IL, USA). Descriptive statistics (frequency and percentage) were used to summarize the data. Logistic regression was used

Published online: September 29, 2015

to estimate the odds ratio (OR) of factors associated to musculoskeletal disorder. The statistically significant criterion was set at P<0.05.

RESULTS

Descriptive data for sample: Results pertaining to the demographic characteristics of the subjects showed that all were male with an average age of 33.31 years (±8.71). Their average weight was higher than a standard value at 25.47 kg/m^2 (±10.53). At the time of the study, respondents had worked at the present hospital for an average of 6.8 years (±7.40 years). 34.6% of them had a secondary school education, and 62.7% earned a monthly income of over 10,000 baht. Slightly over half (59.4%) worked the morning shift from the hours of 7:00 to 15:00 is presented in Table 1.

Table 1. Demographic characteristics of the hospital orderlies (n=153)

Characteristic	***n* (%)**
Age)mean ± SD (yr = 33.31 ± 8.71	153(100)
BMI (mean ± SD) = 25.47 ± 10.53	
Years of working (mean ±SD) = 6.85 ± 7.40	
Gender	
Male	153(100)
Educational Level	
Primary school	10(6.5)
Secondary school	12(7.8)
Junior high school	36(23.5)
High school	53(34.6)
Diploma degree	35(22.9)
Bachelor degree	7(4.6)
Income (Thai Baht,THB*)	
≤10,000	57(37.3)
>10,001	96(62.7)
Shift work	
Morning shift (07:00 a.m.- 03.00 p.m.)	91(59.4)
Afternoon shift (04.00 p.m.- 12.00 p.m.)	44(28.8)
Night shift (12:00 p.m.- 08.00 a.m.)	18(11.8)

*1 USD approx. 30 THB

Prevalence of musculoskeletal symptoms in various body regions: According to results of the NMQ, the frequency of musculoskeletal symptoms in various body regions among hospital orderlies during the 12-month period, as shown in Table 2, were 84.3%. The largest number of hospital orderlies complained of pain in the lower back (n=96; 74.4%), followed by hips/thighs (n=93; 72.1%), upper back (n=78; 60.5%), knees (n=69; 53.5%), shoulders, (n=65; 50.4%) and, finally, neck (n=61; 47.3%). Other reported sites were ankles/feet (n=60; 46.5%), arms (n=53; 41.1%), and wrists/hands (n=51; 39.5%).

Table 2. Number of musculoskeletal symptoms in various body regions among 153 hospital orderlies during the last 12 months

		Number	**Percentage**
Pain	Reported pain	129	84.3
Pain site	Neck	61	47.3
	Shoulders	65	50.4
	Arm	53	41.1
	Upper back	78	60.5
	Wrists/hands	51	39.5
	Lower back	96	74.4
	Hips/thighs/buttocks	93	72.1
	Knees	69	53.5
	Ankles/feet	60	46.5

Results of the multiple logistic regressions are shown in Table 3. The hospital orderlies who had worked more than 7 years were more likely to have musculoskeletal disorder problems (OR 3.9, 95% CI 1.58-9.60). Orderlies whose tasks involved repetitive movement significantly reported more issues of MSDs (P<0.05). Also significant were heavy load handling (P<0.05) and conducting patient handling tasks over 30 rounds per day (P< 0.05).

Published online: September 29, 2015

Table 3. Multivariate logistic regression analysis of risk factor of self-reported 12- month prevalence of MSDs among hospital orderlies (n=153)

12- month prevalence of MSDs (n%)		Multivariate		
		OR	95% CI	p-value
Age(year)				
Less than 33	77(79.4)	Reference		
33 or more	52(92.0)	3.377	1.019-10.450	0.035
Marital Status				
Single or divorce	91(82.7)	Reference		
Married	38(88.4)	1.587	0.552-4.559	0.339
Monthly income (THB*)				
≤10,000	56 (86.2)	Reference		
>10,001	73(83.0)	0.782	0.319-1.918	0.591
Education level				
Lower bachelor degree	123 (84.8)	Reference		
Bachelor degree or higher	6 (75.0)	0.463	0.102-2.832	0.537
Nutritional status				
Non-obese (BMI ≤22.9 kg/m^2)	40 (78.4)	Reference		
Obese (BMI >23kg/m^2)	89 (87.3)	1.883	0.777-4.564	0.161
Current smoking				
Yes	57(83.8)	Reference		
No	72(84.7)	1.069	0.446-2.564	0.881
Current alcohol consumption				
Yes	91 (95.0)	Reference		
No	38 (80.5)	1.648	0.674-4.031	0.273
Sport				
Yes	82 (83.7)	Reference		
No	47(85.5)	0.872	0.347-2.192	0.771
Years of employed (yr)				
7 or less	30(68.9)	Reference		
More than 7	99 (90.0)	3.900	1.584-9.601	0.003*
Work schedule				
Day work	72(79.1)	Reference		
Afternoon shift work	57(91.9)	2.375	0.885-6.373	0.086
Prolonged standing				
Rare	54(77.1)	Reference		
Frequent	75(90.4)	2.315	0.944-5.679	0.067
Repetitive movement				
Rare	46(76.7)	Reference		
Frequent	83(89.2)	2.562	1.040-6.138	0.041*
Uncomfortable postures				
Rare	89(87.3)	Reference		
Frequent	40(78.4)	1.883	0.777-4.456	0.161
Heavy load handling				
Rare	55(76.4)	Reference	1.076-6.736	0.034*
Frequent	74(91.4)	2.691		
Physical and mental stress				
Yes	53(85.5)	Reference		
No	76(83.5)	0.860	0.351-2.111	0.743
Task of Lifting patient				
≤30 (round per day)	26(74.3)	Reference		
≥٣٠ (round per day)	103(87.3)	2.830	1.129-7.090	0.026*
Patient lifting activities				
≤30 (round per day)	13(72.2)	Reference	0.751-7.341	0.142
≥30 (round per day)	116 (85.9)	2.348		

P-value < 0.05

DISCUSSION

Prevalence of musculoskeletal disorders among respondents was 84.31%. Musculoskeletal disorders were more prevalent in the lower back (n=96; 74.4%), followed by hips/thighs (n=93; 72.09%) and then upper back (n=78; 60.47%).

The nature of their work, including lifting and transferring patients, constant repetition, constant stress, forceful contraction, awkward postures, and sustained positions place orderlies at higher risk of MSDs.

Published online: September 29, 2015

The results strongly suggest that MSDs are a significant problem confronting healthcare workers, especially patient escort orderlies, in tertiary care hospitals in Thailand. The prevalence of MSDs, over a 12 month period, among the sample group in this study stood at 84.3%, a much higher percentage compared to that indicated for other healthcare professionals such as cytotechnologists 58% [19], dentists 53% [20], nurses 72% [21], and physiotherapists 58% [22]. This disparity may be attributable to the fact that although the work of healthcare workers and healthcare professionals similarly involves lifting and transferring patients the specific tasks each of the groups performs are different. Discrepancies in the findings may have resulted from differences in terms of research methods, procedures, and sampling techniques between those applied in the present study and those used in other studies.

Lower back symptoms were found to be the most common among questionnaire respondents, 74.4% of respondents reported discomfort in that region. This is consistent with the work of Ains et al. where the prevalence of MSDs, specifically lower back pain, among healthcare professionals in hospitals was of 74.5% [1]. Other studies have shown the prevalence of MSDs at 43%-76% [23-26].

The present study shows that hospital orderlies with more than 7 years of work experience were more likely to have musculoskeletal disorders. This may be the result of their wide range of responsibilities, carrying out both types of lifting and transferring tasks and assisting patients all day. This result was similar to a previous study among Thai hospital nurses where nurses with more than 20 years of work experience were more likely to have poor mental health and musculoskeletal symptoms [27].

As in previous studies, our analysis of work activities such as awkward or tiring positions [28-29], awkward grip and hand movements [29-30], repetitive movement [28,32], prolonged standing, duration of work, uncomfortable postures, physical and mental stress [1], were all associated with MSDs. While all orderlies experience these conditions throughout their working life, our analysis of site of pain and type of work showed that 129 of 153 (84.3%) orderlies who reported lower back pain were involved in heavy load handling. This pain may result from constant standing and the posture they were adopting while lifting and transferring patients [32, 34]. This is consistent with observations that body flexion, rotation and weight loading are leading factors in lower back pain [20, 33-34].

As regards factors contributing to the risks of MSDs, the present study demonstrated that repetitive movement, heavy load handling, and frequent lifting all had a statistically significant impact. Repetitive movement entails unnatural motions and hence muscle fatigue, including arm or wrist twisting, overexertion, and awkward posture. Thus, it is not surprising that the patient escort orderlies that participated in this study suffered from MSDs as every round of their lifting and transferring tasks inevitably requires frequent repetitive movement. Such a finding supports Anis et al., research, which found a correlation between frequent repetitive movement and MSDs [1].

Heavy load handling, such as transferring overweight or obese patients, was another risk factor causing MSDs among patient escort orderlies. These movements involve overloading of the lower back in the sacral vertebrate area, resulting in awkward posture and movement [35]. This result is consistent with that of Holtermann, which associated MSDs with heavy load handling required during the transfer of patients [36].

An analysis of the workstations indicated that the patient escort orderlies that performed over 30 rounds of lifting and transferring patients between different workstations had a statistically significant chance of suffering from MSDs. This finding is consistent with the literature. Nurses that conducted 10 rounds of patient lifting were at a statistically significant risk of suffering from MSDs [36]. However, as a caveat to these findings, males have been reported to be more physically robust than females [4, 37].

Despite these findings, statistical analysis of the present data revealed no significant association between duration of work, prolonged standing, uncomfortable postures, physical and mental stress, patient transfer activities, and work shift to the occurrence of MSDs.

This study had some limitations due to some recovery factors that may lead to a reduction in MSDs for hospital orderlies such as medical treatment, spontaneous recovery, and rehabilitation activities. The respondents were recruited from one hospital of a selected locale. In addition, there was no measurement scale for measuring the intensity of pain/discomfort reported by respondents.

CONCLUSION

WMSDs are common among hospital orderlies from Thailand with the low back being injured most often. We recommend the development of educational materials and programs that raise awareness of these risk factors in order to reduce MSDs among hospital orderlies and improve work efficiency. Furthermore, we recommend that participatory intervention programs and coping strategies for MSDs be made mandatory in order to reduce the rate of MSDs among hospital orderlies.

ACKNOWLEDGEMENTS

This study was supported by the 90th

Anniversary of Chulalongkorn University Fund (Ratchadaphiseksomphot Endowment Fund). It was conducted as part of a doctoral dissertation at the College of Public Health Sciences, Chulalongkorn University, Thailand. Special thanks are owed to all participants in the Departments of Patient Transfer Service, Faculty of Medicine Siriraj Hospital, Mahidol University, Thailand. The authors declare that there is no conflict of interests.

REFERENCES

1. Anis Jellad, Hanene Lajili, Soumaya Boudokhane, Houda Migaou, Sarra Maatallah, Zohra Ben Salah Frih. Musculoskeletal disorders among Tunisian hospital staff: Prevalence and risk factors. *The Egyptian Rheumatologist* 2013; 35: 59–63.
2. Aasa, U., Barnekow-Bergkvist, M., Angquist, K.-A., Brulin, C. Relationships between work-related factors and disorders in the neck-shoulder and low-back region among female and male ambulance personnel. *J Occup Health* 2005; 47 (6) :481-489.
3. Mike Fray & Sue Hignett, TROPHI: development of a tool to measure complex, multi-factorial patient handling interventions. *Ergonomics* 2013; 56 : 1280–1294.
4. Long, M.H., Johnston, V., Bogossian, F. Work-related upper quadrant musculoskeletal disorders in midwives, nurses and physicians: a systematic review of risk factors and functional consequences. *Appl Ergon* 2013; 43 (3) : 455-467.
5. European Agency for Safety and Health at Work. Introduccion a los trastornos musculoesquele´ ticos de origen laboral. 2007, Available form: https://osha.europa.eu/es/publications/factsheets/71.
6. Magnago, T.S., Lisboa, M., Souza, I., Moreira, M. Musculoskeletal disorders in nursing workers: evidences associated to work conditions. *Rev Bras Enferm* 2007; 60 (6) : 701–705.
7. Solidaki, E., Chatzi, L., Bitsios, P., Markatzi, I., Plana, E., Castro, F., Palmer, K.,Coggon, D., Kogevinas, M. Work-related and psychological determinants of multisite musculoskeletal pain. *Scand J Work Environ* 2010; Health 36 (1) : 54–61.
8. Evanoff, B.A., Bohr, P.C., Wolf, L.D. Effects of a participatory ergonomics team among hospital orderlies. *Am J Ind Med* 1999; 35 (4): 358–365.
9. Risk Control 360° LLC Safe Patient Handling. 2015, Available form: http://www.riskcontrol360.com/wp-content/uploads/Safe-Patienthandling2.pdf
10. Karahan, A., Kav, S., Abbasoglu, A., Dogan, N. Low back pain: prevalence and associated risk factors among hospital staff. *J Adv Nurs* 2009; 65 (3) : 516–524.
11. Willy, E. The prevalence of musculoskeletal pain in Nor-wegian nurses' aides. *Int Arch Occup Environ Health* 2003; 76 (8) :625–630.
12. Matsudaira, K., Palmer, K., Reading, I., Hirai, M., Yoshimura, N., Coggon, D. Prevalence and correlates of regional pain and associated disability in Japanese workers. *Occup Environ. Med* 2010; 68 (3) : 191–196.
13. Dinora Bernal, Javier Campos-Serna, Aurelio Tobias, Sergio Vargas-Prada, Fernando G. Benavides, Consol Serra. Work-related psychosocial risk factors and musculoskeletal disorders in hospital nurses and nursing aides A systematic review and meta-analysis. *Int J Nursing Studies* 2015; 52 : 635–648.
14. Tzu-Hsien Lin, Yen Chun Liu, Tien-Yu Hsieh, Feng-Ying Hsiao, Yi-Chen Lai, Chin-Shun Chang. Prevalence of and risk factors for musculoskeletal complaints among Taiwanese dentists. *J Dental Sci* 2012; 7 : 65-71.
15. Songkham Wanpen, Wattasit Siriwong, Mark Gregory Robson. Effects of a healthy unit guidance (HUG) program on work environments and health outcomes among nursing personel. *J Health Res* 2013; 27)4(: 243-251.
16. Klangsin P. *Ergonomic intervention for reducing work-related musculoskeletal disorders by WISE technique in a cardboard box factory*. *Master's thesis of Science, Physical Therapy*. Graduate studies, Mahidol University Bangkok,2007.
17. Ebara T, Khuvasanont T, Krungkraiwong S, Amornratanapaichit R, Tachi N, Takeyama H. Impact of ISO/TS 20646-1 ergonomic procedures for the improvement of local muscular workloads'on work-related musculoskeletal disorders. *Int Health* 2007; 45: 256-6.
18. Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sorensen, F., Andersson, G., Jorgensen, K. Standardised nordic questionnaires for the analysis of musculoskeletal symptoms. *Appl Ergon* 1987; 18 : 233–237.
19. Thompson, S.K., Mason, E., Dukes, S. Ergonomics and cytotechnologists: reported musculoskeletal discomfort. *Diagn Cytopathol* 2003; 29: 364–367.
20. Palliser, C.R., Firth, H.M., Feyer, A.M., Paulin, S.M. Musculoskeletal discomfort and work-related stress in New Zealand dentists. *Work Stress* 2005; 19: 351–359.

Published online: September 29, 2015

21. Lipscomb, J.A., Trinkoff, A.M., Geiger-Brown, J., Brady, B. Work-schedule characteristics and reported musculoskeletal disorders of registered nurses. *Scand. J. Work Environ". Health* 2005; 28: 394–401.
22. Glover, W., McGregor, A., Sullivan, C., Hague, J. Work-related musculoskeletal disorders affecting members of the Chartered Society of Physiotherapy. *Physiotherapy* 2005; 91: 138–147.
23. Choobineh A, Movahed M, Tabatabaie S, Kumashiro M. Perceived demands and musculoskeletal disorders on operating room nurses of Shiraz city hospital. *Ind Health* 2010; 48: 74–84.
24. kromark K, Dulon M, Beck B, Nienhaus A. Back disorders and lumbar load in nursing staff in geriatric care: a comparison of home-based care and nursing homes. *J Occup Med Toxicol* 2009; 4 : 33–42.
25. Maumet S, De Gaudemaris R, Caroly S, Balducci F. Risk factors related to musculo skeletal disorders in health care workers. Elements to take into consideration of risk assessment procedures. *Arch Mal Prof Environ* 2005; 66 : 236–43.
26. Bejia I, Younes M, Jamila HB, Khalfallah T, Ben Salem K, Touzi M. Prevalence and factors associated to low back pain among hospital staff. *Joint Bone Spine* 2005; 72 : 254–9.
27. Orawan Kaewboonchoo, Tipagorn Saipech , Pimsupa Chandanasotthi , Sara Arporn. Mental Health Status among Thai Hospital Nurses. *J Med Assoc Thai* 2009; 92 (Suppl 7): 83-87.
28. Bernard, B.P. (Ed.). *Musculoskeletal Disorders and Workplace Factors: a Critical Review of Epidemiologic Evidence for Work-related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back*. National Institute of Occupational Safety and Health (NIOSH), Cincinnati, 1997; pp 100-103.
29. MacDonald, W. Workload, stress and psychosocial factors as hazards for musculoskeletal disorders. *J Occup Health Saf Aust N Z* 2004; 20 : 37–47.
30. Huang, G.D., Feuerstein, M., Sauter, S.L. Occupational stress and work-related upper extremity disorders: concepts and models. *Am J Ind Med* 2002; 41: 298–314.
31. Fredriksson, K., Alfredsson, L., Thorbjornsson, C.B., Punnett, L., Toomingas, A., Torgen, M., Kilbom, A.s. "Risk factors for neck and shoulder disorders: a nested case-control study covering a 24-year period". *Am J Ind Med* 2002; 38 : 516–528.
32. Leclerc, A., Chastang, J.F., Niedhammer, I., Landre, M.F., Roquelaure, Y. "Incidence of shoulder pain in repetitive work". *Occup. Environ. Med* 2004; 61 : 39–44.
33. Hagen, K., Thune, O. Work incapacity from low back pain in the general population. *Spine* 1998; 23 : 2091–2095.
34. Hoogendoorn, W.E., Bongers, P.M., de Vet, H.C.W., Ariens, G.A.M., van Mechelen, W.,Bouter, L.M. High physical work load and low job satisfaction increase the risk of sickness absence due to low back pain: results of a prospective cohort study. *Occup Environ Med* 2002; 59 : 323–328.
35. Inga-Lill Engkvist, Ewa Wigaeus Hjelm, Mats Hagberg,Ewa Menckel, Lena Ekenvall. Risk Indicators for Reported Over-Exertion Back Injuries among Female Nursing Personnel". *Epidemiology* 2002; 11 No. 5: 519-522.
36. Holtermann A, Clausen T, Jørgensen MB, Burdorf A, Andersen LL. Patient handling and risk for developing persistent low-back pain among female healthcare workers. *Scand J Work Environ Health* 2013; 39(2): 164-169.
37. Messing K. Ergonomic studies provide information about occupational exposure differences between women and men. *J Am Med Womens Asso* 2000; 55: 72–75.

Published online: September 29, 2015