International Journal of Occupational Safety and Ergonomics (*JOSE*) 2005, Vol. 11, No. 4, 431–440

Epidemiology of Musculoskeletal Symptoms Among Korean Hospital Nurses

Derek R. Smith

Department of Hazard Assessment, National Institute of Industrial Health, Kawasaki, Japan

Myoung-Ae Choe

College of Nursing, Seoul National University, Seoul, Korea

Mi Yang Jeon

Keukdong College, Chungcheong-do, Korea

Young Ran Chae

College of Medicine, Kangwon National University, Chuncheon, Korea

Gyeong Ju An

College of Medicine, Catholic University of Daegu, Daegu, Korea

Jae Sim Jeong

Department of Clinical Nursing, University of Ulsan, Seoul, Korea

We investigated the epidemiology of musculoskeletal symptoms (MSS) among a complete cross-section of 330 nurses from a large Korean hospital, by means of a questionnaire survey (response rate: 97.9%). The prevalence of MSS at any body site was 93.6%, with symptoms most commonly reported at the shoulder (74.5%), lower back (72.4%), neck (62.7%), lower legs (52.1%) and hand/wrist (46.7%). Logistic regression indicated that nurses who undertook manual handling of patients were 7.2 times as likely to report MSS (OR 7.2, 95%CI 1.2–42.3, P = *.0275), while nurses suffering from periodic depression experienced a 3.3-fold MSS risk (OR 3.3, 95%CI 1.3–8.3,* P = *.0104). Overall, our study suggests that Korean nurses incur a very high MSS burden when compared internationally. A greater commitment is needed to improve physical conditions, occupational tasks and psychosocial work issues among nurses in this country.*

musculoskeletal symptoms nurse Korea low back pain epidemiology

---

We are grateful to all nurses who completed our questionnaire. The authors would also like to thank Dr. Shun-Yue Cheng and Dr. Sa Tang from the University of Yamanashi in Japan, for their kind assistance during the early development of our survey form. This project was designed and conducted by the Korean Nurse Occupational Health Research Group (KNOHRG).

Correspondence and requests for offprints should be sent to Derek R. Smith, Department of Hazard Assessment, National Institute of Industrial Health, 6-21-1 Nagao, Tama-Ku, Kawasaki 214-8585 Japan. E-mail: <smith@niih.go.jp>.

1. INTRODUCTION

1.1. Background

Adverse symptoms and disorders of the musculoskeletal system represent an important cause of occupational morbidity for nurses around the world [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]. Risk factors can usually be divided into extrinsic occupational aspects (such as strenuous tasks, repetitive work, heavy lifting and manual handling) [6, 7, 8, 9, 10, 11, 12], or intrinsic personal items (such as age, tobacco smoking and body size variability) [13, 14, 15, 16]. The importance of psychosocial factors (such as limited work-support from superiors, low mood and poor job satisfaction) has also been demonstrated in recent years [17, 18, 19, 20, 21]. Although musculoskeletal symptoms (MSS) are well-known to affect nurses in many countries [1, 2, 3, 4, 5, 6, 7, 8, 9, 10], few epidemiological investigations have been undertaken in Korea [22, 23, 24], or published in English [25]. This is particularly surprising, as MSS have already been shown to affect a variety of Korean workers, other than nurses, at reasonably high rates [26, 27, 28, 29, 30].

1.2. Aim of This Study

Given the lack of available epidemiologic information on Korean nurses' MSS, we considered it necessary to investigate the issue among a complete cross-section of this demographic. The aim of our study was to not only define the prevalence and distribution of MSS among Korean nurses, but also to identify statistical associations between MSS and various physical [6, 7, 8, 9, 10, 11, 12], personal [13, 14, 15, 16] or psychosocial [17, 18, 19, 20, 21] risk factors. A further aim was to evaluate any potential relationships between MSS and adverse sequelae. As previous studies have already demonstrated the reliability, validity and cost-effectiveness of self-reporting MSS surveys in English [31, 32, 33, 34, 35] and Korean [36, 37], we also considered it appropriate to use this particular data collection methodology.

2. MATERIALS AND METHODS

2.1. Questionnaire Design

This study involved an epidemiological analysis of Korean nurses' MSS, with data gathered by means of a self-reporting questionnaire. Our anonymous three-page form was based predominately on the Standardised Nordic Questionnaire [38, 39, 40] and other MSS investigations conducted among hospital nurses in various countries [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17]. It comprised a simple tick-box format, with the first section covering demographic items such as age, height, weight, tobacco smoking, alcohol consumption, work hours, shift work and years of experience. MSS questions included a simple anatomical diagram which focussed on the occurrence of symptoms at specific body sites occurring the previous 12 months [3, 15, 17]. Clearly labelled arrows indicated specifically-shaded regions on the diagram, corresponding to 11 different body sites. Additional questions asked about the duration of MSS symptoms, whether they affected the nurse's daily life and whether any medical treatment was needed. A 12-month recall period was used throughout, as this has been shown to be an appropriate time-scale in previous Asian studies [3, 7, 10, 17, 28]. The original English version was translated into Korean by a team of experienced, bilingual professionals, and then evaluated for accuracy and clarity by an expert nursing panel. It was subsequently back-translated into English and checked against the original document. The terminology and layout of Korean characters was specifically designed to be clearly understood by nursing professionals.

2.2. Participants and Methods

A cover sheet was attached to the front of all questionnaires, which explained our survey and provided instructions for the anonymous return of completed forms. Surveys were then distributed to all nurses within the hospital and returned within a 1-week period. All nurses were eligible for inclusion within the study. There were no penalties or rewards for participation, and nurses

were free to answer as many or as few questions as they wished. Informed consent was implied if questionnaires were voluntarily completed and returned. Nurses were grouped into three main departments as follows: Intensive Care Units, Inpatient Departments and "Other" Departments. This division was undertaken to help stratify participants into three broad groups with similar daily work-tasks. The category Other was used to signify departments with very small staff numbers (usually fewer than 15), and also helped keep the number of participants similar in each group.

2.3. Statistical Analysis

Data was entered into a common spreadsheet program and analysed with statistical software (JMP version 4). Data was stratified by hospital department as mentioned in section 2.2., with statistically significant differences between the departments evaluated using Pearson's chi square test (*P* for Trend). MSS information was analysed as group and sub-category percentages. Logistic regression was then performed to determine possible risk factors for MSS, with results expressed as adjusted Odds Ratios (OR), 95% Confidence Intervals (95%CI) and Probability (*P*) values. A further logistic regression analysis was also undertaken to ascertain possible correlations between MSS and adverse sequelae (whether it affected their daily life and whether medical treatment was required). All data were analysed in a combined regression model. Probability values below .05 were regarded as statistically significant throughout all analyses.

3. RESULTS

3.1. MSS Prevalence

We recruited a complete cross-section of professional nurses from a large university teaching hospital in Gangneung city, during 2004. A total of 330 completed questionnaires were obtained from 337 nurses (response rate: 97.9%). By department, there were 83 nurses from the Intensive Care Units, 148 from the Inpatient Departments and 99 from the Other departments. The prevalence of MSS at any body site was 93.6%, with Other departments reporting the highest individual prevalence (96.0%), although this difference across the departments was not statistically significant. By specific body site, MSS were most commonly

TABLE 1. Prevalence of Musculoskeletal Symptoms by Body Site and Department

	All Nurses		Intensive Care Units		Inpatient Departments		Other Departments	
Body Site [c]	***n***	**(%)**[a]	***n***	**(%)**[b]	***n***	**(%)**[b]	***n***	**(%)**[b]
Neck	207	(62.7)	52	(62.7)	89	(60.1)	66	(66.7)
Shoulders †	246	(74.5)	69	(83.1)	100	(67.6)	77	(77.8)
Upper back	98	(29.7)	22	(26.5)	49	(33.1)	27	(27.3)
Elbows	21	(6.4)	5	(6.0)	10	(6.8)	6	(6.1)
Forearms	32	(9.7)	6	(7.2)	12	(8.1)	14	(14.1)
Hand/wrist ‡	154	(46.7)	48	(57.8)	60	(40.5)	46	(46.5)
Lower back	239	(72.4)	64	(77.1)	109	(73.6)	66	(66.7)
Upper legs	47	(14.2)	10	(12.0)	24	(16.2)	13	(13.1)
Knees	116	(35.2)	34	(41.0)	44	(29.7)	38	(38.4)
Lower legs	172	(52.1)	48	(57.8)	74	(50.0)	50	(50.5)
Feet	128	(38.8)	30	(36.1)	62	(41.9)	36	(36.4)
Any category [d]	309	(93.6)	77	(92.8)	137	(92.6)	95	(96.0)

Notes. a—percentage of all nurses (*N* = 330), b—percentage of musculoskeletal symptom (MSS) cases by body site and hospital department (*n* = 83, 148 and 99, respectively), c—statistically significant differences in MSS prevalence by department evaluated using the chi square test († *P* for Trend = .0227, ‡ *P* for Trend = .0410), d—any MSS at any body site.

TABLE 2. Distribution of Musculoskeletal Symptoms (MSS) by Body Site and Sequale

	All MSS Cases		Affected Daily Life[a]		Lasted >1 Week		Needed Treatment[b]	
Body Site	***n***	**(%)[c]**	***n***	**(%)[d]**	***n***	**(%)[d]**	***n***	**(%)[d]**
Neck	207	(14.2)	83	(40.1)	64	(30.9)	27	(13.0)
Shoulders	246	(16.9)	112	(45.5)	100	(40.7)	35	(14.2)
Upper back	98	(6.7)	41	(41.8)	30	(30.6)	9	(9.2)
Elbows	21	(1.4)	12	(57.1)	7	(33.3)	6	(28.6)
Forearms	32	(2.2)	20	(62.5)	7	(21.9)	3	(9.4)
Hand/wrist	154	(10.5)	89	(57.8)	59	(38.3)	25	(16.2)
Lower back	239	(16.4)	141	(59.0)	117	(49.0)	51	(21.3)
Upper legs	47	(3.2)	25	(53.2)	17	(36.2)	6	(12.8)
Knees	116	(7.9)	54	(46.6)	37	(31.9)	6	(5.2)
Lower legs	172	(11.8)	82	(47.7)	57	(33.1)	8	(4.7)
Feet	128	(8.8)	58	(45.3)	41	(32.0)	14	(10.9)
Any category[e]	1460	(100)	717	(49.1)	536	(36.7)	190	(13.0)

Notes. a—such as work, sports or other activities of daily living, b—required professional medical treatment (from a chiropractor, family physician or hospital physician), c—proportion of the total number of MSS cases (n = 1460), d—percentage of MSS cases per body site subcategory (n = 207, 246, 98 and so on), e—total number of MSS cases at any body site.

reported at the shoulder (affecting 74.5% of all nurses), followed by the lower back (72.4%), neck (62.7%), lower legs (52.1%) and hand/wrist (46.7%). There were statistically significant differences in MSS prevalence by department at the shoulders and hand/wrist (P for Trend = .0227 and .0410, respectively). Refer to Table 1. By proportion, shoulder-related MSS accounted for 16.9% of all MSS cases, followed by the lower back (16.4%) and the neck (14.2%). Regarding adverse sequelae, MSS of the forearms were most frequently reported to affect their daily lives (reported among 62.5% of all forearm MSS cases), followed by the lower back (59.0%). The highest proportion of MSS cases lasting longer than 1-week was reported at the lower back (49.0%) and shoulders (40.7%). Medical treatment was most commonly sought for MSS of the elbows (28.6%) and lower back (21.3%). Refer to Table 2.

3.2. Statistical Associations

Logistic regression indicated that manually handling patients on a daily basis was statistically associated with an increased likelihood of MSS at any body site. Nurses who regularly performed these work-tasks were 7.2 times as likely to report MSS, when compared to those who did not undertake manual handling (OR 7.2, 95%CI 1.2–42.3, P = .0275). Nurses suffering from periodic depression were 3.3-times as likely to report MSS than those who were not depressed (OR 3.3, 95%CI 1.3–8.3, P = .0104). Refer to Table 3. Regarding adverse sequelae, MSS of the shoulder or hand/wrist were most likely to have interfered with their daily life (OR 2.4, 95%CI 1.2–5.2, P = .0182 and OR 3.8, 95%CI 2.0–7.8, P = .0001, respectively). MSS of the lower back or hand/wrist were significantly correlated with the need for medical treatment (OR 2.5, 95%CI 1.2–5.6, P = .0206 and OR 2.3, 95%CI 1.3–4.2, P = .0062). Refer to Table 4. No other statistically significant correlations were noted during regression analysis.

TABLE 3. Risk Factors for Musculoskeletal Symptoms at Any Body Site

	Number		Logistic Regression		
Risk Factor Analysis[a]	***n***	**(%)[b]**	**OR**	**(95% CI)**	***P* value**
Physical factors					
Washing patients	145	(43.9)	2.7	(0.9–8.7)	.0840
Manually handling patients	293	(88.8)	7.2	(1.2–42.3)	.0275
Bend, twist or stretch	299	(90.6)	1.1	(0.1–9.7)	.9186
High physical exertion	289	(87.6)	0.8	(0.1–4.9)	.8332
Hours worked per week[c]	330	(100)	0.2	(0.003–7.300)	.3906
Total years of work[c]	330	(100)	0.03	(0.002–5.700)	.1874
Psychosocial factors					
Very strenuous work	9	(2.7)	0.3	(0.04–5.60)	.2643
Periodic depression	235	(71.2)	3.3	(1.3–8.3)	.0104
High mental pressure	177	(53.6)	1.5	(0.6–3.5)	.3694
Not enough staff	152	(46.1)	2.3	(0.9–6.1)	.0801
Boring or tedious work	10	(3.0)	0.5	(0.1–4.6)	.5001
Inadequate work support	96	(29.1)	0.9	(0.3–2.5)	.8040

Notes. a—risk factors calculated simultaneously using logistic regression and expressed as Odds Ratios (OR) with 95% Confidence Intervals (95%CI) and Probability (*P*) values (adjusted for age, height, weight, work shift and department of employment), b—percentage of all nurses in each subcategory (*N* = 330), c—evaluated as continuous variables with increasing increments of 1 hour per week and 1 year of work, respectively.

TABLE 4. Statistical Associations With Musculoskeletal Symptoms (MSS)

	Number		Logistic Regression		
Statistical Associations[a]	***n***	**(%)[b]**	**OR**	**(95% CI)**	***P* value**
Affected my daily life[c]					
Neck MSS	82	(24.8)	2.2	(1.1–4.1)	.0176
Shoulder MSS	111	(33.6)	2.4	(1.2–5.2)	.0182
Upper back MSS	40	(12.1)	1.0	(0.5–1.9)	.9023
Lower back MSS	140	(42.4)	1.2	(0.6–2.3)	.6530
Hand/wrist MSS	89	(27.0)	3.8	(2.0–7.8)	.0001
Lower leg MSS	82	(24.8)	1.4	(0.8–2.6)	.2703
Needed medical treatment					
Neck MSS	27	(8.2)	1.1	(0.6–2.1)	.7616
Shoulder MSS	35	(10.6)	2.0	(0.9–4.6)	.1013
Upper back MSS	9	(2.7)	1.1	(0.6–2.0)	.7340
Lower back MSS	51	(15.5)	2.5	(1.2–5.6)	.0206
Hand/wrist MSS	25	(7.6)	2.3	(1.3–4.2)	.0062
Lower leg MSS	7	(2.1)	0.8	(0.4–1.4)	.3716

Notes. a—evaluated simultaneously using logistic regression and expressed as Odds Ratios (OR) with 95% Confidence Intervals (95%CI) and Probability (*P*) values (adjusted for age, height, weight, work shift, department of employment, hours of work per day, hours of work per week and total years of work), b—percentage of all nurses in each subcategory (*N* = 330), c—affected activities in either work or private life.

4. DISCUSSION

The prevalence of MSS at any body site during our investigation (93.6%) was slightly higher than previous nurse studies conducted in tropical Australia (92.6%) [15], Japan (78.4%) [3] and China (70.0%) [17]. It was also higher than the rate documented by researchers in Sweden (where 84% of professional nurses suffered either neck, shoulder, upper or lower back-related MSS) [6] and the USA (where 72.5% reported MSS at the neck, shoulder or back) [4]. MSS were most commonly reported at the shoulders during our study (74.5%), at a rate which was higher than previous nurse investigations from metropolitan Australia (60%) [2], Sweden (60%) [6], Japan (46.6%) [3], tropical Australia (43.2%) [15], South Africa (41%) [13], China (38.9%) [17] and the USA (35.1%) [4]. When compared to other Korean workers, the nurses' MSS rate was also higher than that reported by hairdressers (61.0%) [26], bank tellers (51.4%) [27], nursing home staff (35.2%) [28] and foundry workers (13.7%) [36]. This suggests that a large burden may be incurred from MSS among Korean nurses, particularly when compared to their counterparts in different occupations.

As many international studies have shown that MSS of the lower back, or low back pain (LBP), is usually the most common body site affected [1, 3, 4, 6, 15, 17, 36], we were surprised to find a different result among our Korean nurses. Interestingly, some previous investigations conducted among Korean workers also found that shoulder-related MSS were the most frequently reported [27, 28]. These results suggest that Koreans might experience MSS at different body sites than their counterparts from other countries, even those in similar occupations. However, another Korean study demonstrated that LBP was the highest MSS category (44.4%), shoulder-related MSS was 33.3%, and both were related to job stress in Korean nurses [42]. Differences in prevalence rates for LBP between our findings and previous research might be explained by the fact that our study investigated MSS occurring over the past 1 year, whereas other studies looked at MSS occurring at the time of the investigation. As the phenomena may also relate to differences in biomechanical load, body composition, work organisation or even a combination of these factors, further research will be necessary to more clearly elucidate the contributory factors of MSS in Korea.

LBP was the second most common symptom reported during our study, affecting 72.4% of all nurses. There is considerable international literature regarding LBP in nursing, with the 12-month period-prevalence previously reported in the following countries: Hong Kong (40.6%) [10], France (41.1%) [14], England (45%) [8], metropolitan Japan (54.7%) [1], rural Japan (59.0%) [3] and Sweden (64%) [6]. As such, our Korean nurses' LBP prevalence was much higher than their international nursing counterparts in a variety of countries. Their LBP prevalence was also higher than previous MSS investigations conducted among Korean foundry workers (29.4%) [36], bank tellers (38.3%) [27], welders (44.3%) [37] and hairdressers (53.2%) [26].

Work environmental factors, especially job satisfaction, job stress and work load and fatigue were observed to be related to LBP among Korean nurses, similar to some other studies [22, 41]. Neck-related MSS were the third most common category during our study, being reported by 62.7% of all nurses, which is slightly higher than some previous research conducted in Australia (just over 40%) [2], the USA (45.8%) [4] and Sweden (48%) [16]. As such, it appears that Korean nurses report MSS (over a variety of body sites) at very high levels, and much higher than their international counterparts. Given that nurses in many countries could be expected to perform similar work-tasks, the reasons for these elevated prevalence rates are unclear. Nevertheless, Korean nurses might have increased exposure to workplace stressors, or some other occupational factors, when compared internationally.

Manual handling of patients was shown to be an important MSS risk factor during this study, with a 7.2-fold increase noted during logistic regression. Manual handling is well-known to be an important ergonomic issue for nursing staff worldwide, as they must meet the demands of patients at any time [1, 7]. Patient-handling activities often need

to be undertaken in suboptimal time frames and less-than-ideal spaces, which can impart great biomechanical strain for nurses and may eventually lead to MSS [20]. Previous reports have described how manual patient-handling, transferring or moving are known to be important predictors of MSS [6, 7, 8, 9, 10, 11, 12]. It is reasonable to suggest that nurses working in intensive care units might be exposed to greater biomechanical stressors, due to their the urgent requirement of patients in emergency and possibly also due to constricted working space from intensive care equipment and so on. Therefore, we were surprised to find no statistically significant differences in MSS prevalence between the departments. Self-perceived high physical exertion, bending/twisting, work hours and total duration of employment were also unrelated to MSS during the current investigation, which is contrary to some previous reports from other countries [6, 10]. Furthermore, we did not find any relationships between age and MSS, despite a previous Swedish study reporting associations of this nature [16].

Discrepancies between our results and those from other investigations are difficult to explain conclusively, although they may relate to certain work-tasks intrinsic to Korean nursing practice. The identification of manual handling suggests that physical stressors are of great importance to Korean nurses. As they were predominately identified by self-reporting, such hypotheses are difficult to verify however, and are worthy of consideration in future epidemiological studies. Logistic regression analysis also revealed that periodic depression was significantly associated with MSS, even after adjustment for demographic factors. As such, this result supports an increasing body of evidence linking psychosocial factors with MSS in various countries [17, 18, 19, 20], including Korea [21]. It also reflects a prior study of hospital nurses in Sweden, where low support, low stimulation and high work demands were related to MSS [16]. If psychosocial risk factors are indeed as important as our study tends to indicate, a greater commitment should be directed to help improve physical conditions, work tasks and psychosocial issues among Korean nurses. To ensure an appropriate focus, further research should also be undertaken to help establish exactly where future interventions can best be targeted among Korean nurses.

MSS among Korean nurses were significantly associated with adverse sequelae during this study, with almost two thirds (62.5%) of all forearm MSS affecting their daily lives. Similarly, over half of all lower back MSS (59.0%) were also associated with a negative affect on the nurses' daily lives. When investigated by logistic regression, MSS of the shoulder or hand/wrist were most likely to have interfered with their daily life. Regarding duration of symptoms, the highest proportion of MSS cases lasting longer than 1 week were reported at the lower back (49.0%) and shoulders (40.7%), although no statistically significant associations were found between length of symptoms and MSS location. Either way, these results suggest that MSS at certain body sites is clearly associated with adverse outcomes for Korean nurses. Medical treatment was most commonly sought for MSS of the elbows (28.6%) and lower back (21.3%), although lower back or hand/wrist were the only body sites where a statistically significant correlation was found during logistic regression. Again, this suggests that MSS are not always a temporary event; rather, they may be a prolonged disability which intrudes on a nurse's working and private life. Further research should now be undertaken to more carefully ascertain the ongoing effects of MSS among Korean nurses, and one that may be best conducted as a multi-centre or national nursing survey.

It is reasonable to consider the limitations of our research, particularly the reliance on self-reporting. MSS are no doubt a subjective condition, the definition of which probably varies between different countries, cultures and occupational groups. To account for differences of this nature, we specifically chose a well-known MSS questionnaire (The Standardised Nordic Questionnaire) [38], which has been previously used in other countries, including Asia [3, 15, 17, 39, 40]. We also translated the English original in a manner specifically designed for Korean nurses to understand. Given these considerations, we expect the answers provided during our study would

adequately reflect the true nature of MSS among Korean nurses. Nonetheless, the development of a standardised Korean-language MSS questionnaire would certainly be helpful in addressing validity issues during future international studies. The development of a standardised questionnaire on the broader issue of Asian nurses' occupational health would also be valuable for professional nurses, particularly those in Korea.

5. CONCLUSION

Overall, our study suggests that Korean nurses suffer a very high MSS rate when compared internationally. Their MSS-related burden also appears to be higher than in other studies of Korean workers who are not nurses. The identification of physical and psychosocial MSS risk factors was consistent with previous research. Adverse sequelae arising from MSS also appear to be a major issue among this demographic. As such, a greater commitment is needed to help improve physical conditions, work tasks and psychosocial issues among Korean nurses. Further research should also be undertaken to help establish exactly where future interventions can best be targeted. A longitudinal study among a complete group of nurses may be very useful in this regard.

REFERENCES

1. Ando S, Ono Y, Shimaoka M, Hiruta S, Hattori Y, Hori F, et al. Associations of self estimated workloads with musculoskeletal symptoms among hospital nurses. Occup Environ Med 2000;57:211–6.
2. Lusted MJ, Carrasco CL, Mandryk JA, Healey S. Self reported symptoms in the neck and upper limbs in nurses. Appl Ergon 1996;27:381–7.
3. Smith DR, Ohmura K, Yamagata Z, Minai J. Musculoskeletal disorders among female nurses in a rural Japanese hospital. Nurs Health Sci 2003;5:185–8.
4. Trinkoff AM, Lipscomb JA, Geiger-Brown J, Brady B. Musculoskeletal problems of the neck, shoulder and back and functional consequences in nurses. Am J Ind Med 2002;41:170–8.
5. Knibbe JJ, Friele RD. Prevalence of back pain and characteristics of the physical workload of community nurses. Ergonomics 1996;39:186–98.
6. Josephson M, Lagerström M, Hagberg M, Hjelm EW. Musculoskeletal symptoms and job strain among nursing personnel: a study over a three year period. Occup Environ Med 1997;54:681–5.
7. Chiou WK, Wong MK, Lee YH. Epidemiology of low back pain in Chinese nurses. Int J Nurs Stud 1994;31:361–8.
8. 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.
9. Smedley J, Egger P, Cooper C, Coggon D. Prospective cohort study of predictors of incident low back pain in nurses. Br Med J 1997;314:1225–8.
10. Yip YB. A study of work stress, patient handling activities and the risk of low back pain among nurses in Hong Kong. J Adv Nurs 2001;36:794–804.
11. Estryn-Behar M, Kaminski M, Peigne E, Maillard MF, Pelletier A, Berthier C, et al. Strenuous working conditions and musculo-skeletal disorders among female hospital workers. Int Arch Occup Environ Health 1990;62:47–57.
12. Josephson M, Vingård E, MUSIC-Norrtälje Study Group. Workplace factors and care seeking for low-back pain among female nursing personnel. Scand J Work Environ Health 1998;24:465–72.
13. Botha WE, Bridger RS. Anthropometric variability, equipment usability and musculoskeletal pain in a group of nurses in the Western Cape. Appl Ergon 1998; 29:481–90.
14. Niedhammer I, Lert F, Marne MJ. Back pain and associated factors in French nurses. Int Arch Occup Environ Health 1994; 66:349–57.
15. Smith DR, Leggat PA, Smyth W, Wang RS. Musculoskeletal disorders among female Australian nurses working in a unique tropical environment. Ergon Aust 2003;17:14–7.
16. Lagerström M, Wenemark M, Hagberg M, Hjelm EW, the Moses Study Group. Occupational and individual factors related

to musculoskeletal symptoms in five body regions among Swedish nursing personnel. Int Arch Occup Environ Health 1995; 68:27–35.

17. Smith DR, Wei N, Kang L, Wang RS. Musculoskeletal disorders among professional nurses in mainland China. J Prof Nurs 2004;20:390–5.
18. Bongers PM, de Winter CR, Kompier MAJ, Hildebrandt VH. Psychosocial factors at work and musculoskeletal disease. Scand J Work Environ Health 1993;19:297–312.
19. Bongers PM, Kremer AM, ter Laak J. Are psychosocial factors, risk factors for symptoms and signs of the shoulder, elbow, or hand/wrist?: a review of the epidemiological literature. Am J Ind Med 2002;41:315–42.
20. Smith DR, Leggat PA. Musculoskeletal disorders in nursing. Aust Nurs J 2003;11: 1–3.
21. Kwon HJ, Ha MN, Yun DR, Cho SH, Kang DH, Ju YS, et al. Perceived occupational psychosocial stress and work-related musculoskeletal disorders among workers using video display terminals. Korean J Occup Med 1996;8:570–7. In Korean.
22. Kim SL, Cho TR. Industrial fatigue and low back pain of the nurses in general hospital. Korean J Occup Health Nurs 1999;8:162–8. In Korean.
23. Noh WJ, Lee KS. Health risk factors of nurses in the operating room. Korean J Occup Health 1998;37:17–29. In Korean.
24. Choi YH, Leem JH, Chae CH, Park CY, Kang SK. An evaluation of the occupational distribution of carpal tunnel syndrome diagnosed at a university hospital. Korean J Occup Environ Med 1999;11:313–22. In Korean.
25. Jhun HJ, Cho SI, Park JT. Changes in job stress, musculoskeletal symptoms, and complaints of unfavorable working conditions among nurses after the adoption of a computerized order communication system. Int Arch Occup Environ Health 2004;77:363–7.
26. Park SK, Choi YJ, Moon DH, Chun JH, Lee JT, Sohn HS. Work related musculoskeletal disorders of hairdresser. Korean J Occup Environ Med 2000;12:395–404. In Korean.
27. Yun MH, Lee YG, Eoh HJ, Lim SH. Results of a survey on the awareness and severity assessment of upper-limb work-related musculoskeletal disorders among female bank tellers in Korea. Int J Ind Ergon 2001;27:347–57.
28. Smith DR, Choi JW, Ki M, Kim JY, Yamagata Z. Musculoskeletal disorders among staff in South Korea's largest nursing home. Environ Health Prev Med 2003;8: 23–8.
29. Yi CH, Park JR, Cha AR, Koh KW, Kim YW, Lee SI. A study on the risk factors of low back pain in computer terminal operators. Korean J Occup Environ Med 1999;11:264–75. In Korean.
30. Kim JY, Kim JI, Son JE, Yun SK. Prevalence of carpal tunnel syndrome in meat and fish processing plants. J Occup Health 2004;46:230–4.
31. Baron S, Hales T, Hurrell J. Evaluation of symptom surveys for occupational musculoskeletal disorders. Am J Ind Med 1996;29:609–17.
32. Holmström E, Moritz U. Low back pain—correspondence between questionnaire, interview and clinical examination. Scand J Rehab Med 1991;23:119–25.
33. Kaergaard A, Andersen JH, Rasmussen K, Mikkelsen S. Identification of neck-shoulder disorders in a 1 year follow-up study. Validation of a questionnaire-based method. Pain 2000;86:305–10.
34. Ohlsson K, Attewell RG, Johnsson B, Ahlm A, Skerfving S. An assessment of neck and upper extremity disorders by questionnaire and clinical examination. Ergonomics 1994;37:891–7.
35. Björkstén MG, Boquist B, Talbäck M, Edling C. The validity of reported musculoskeletal problems. A study of questionnaire answers in relation to diagnosed disorders and perception of pain. Appl Ergon 1999;30:325–30.
36. Ha MN, Paek DM, Cho SH, Kang DH, Kwon HJ. Reliability of questionnaire for evaluating ergonomic exposure in occupational epidemiological studies. Korean J Occup Med 1997;9:659–70. In Korean.

37. Kim JY. The ergonomic evaluation of low back pain of the manual lifting workers. Korean J Occup Med 1998;10:343–61. In Korean.
38. Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sorensen F, Andersson G, et al. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon 1987;18:233–7.
39. Dickinson CE, Campion K, Foster AF, Newman SJ, O'Rourke AM, Thomas PG. Questionnaire development: an examination of the Nordic Musculoskeletal Questionnaire. Appl Ergon 1992;23:197–201.
40. de Barros ENC, Alexandre NMC. Cross-cultural adaptation of the Nordic Musculoskeletal Questionnaire. Int Nurs Rev 2003;50:101–8.
41. Kwon YS, Kim, CN. A survey on low back pain of general hospital nurses. J Korean Comm Nurs 1996;1:100–17. In Korean.
42. Eo K, Roh JH, Won JU. Work related musculoskeletal symptoms and their related factors in nurses. Korean Prev Med Symposium Proceedings 2001;53:453–4. In Korean.