



Original Article

Increased low back pain risk in nurses with high workload for patient care: A questionnaire survey



Shwn-Huey Shieh ^{a, b}, Fung-Chang Sung ^{a, c}, Chia-Hsien Su ^b, Yafang Tsai ^d,
Vivian Chia-Rong Hsieh ^{a, *}

^a Department of Health Services Administration, China Medical University, Taichung, Taiwan

^b Department of Nursing, China Medical University Hospital, Taichung, Taiwan

^c Department of Public Health, China Medical University, Taichung, Taiwan

^d Department of Health Policy and Management, Chung Shan Medical University, Taichung, Taiwan

ARTICLE INFO

Article history:

Accepted 13 June 2016

Keywords:

job stress
low back pain
nurses
occupational health
prolonged work shift

ABSTRACT

Objective: To examine whether the prevalence of low back pain (LBP) increased in hospital nurses with high patient care workload.

Materials and Methods: A structured, self-administered questionnaire was used to collect information on the prevalence of LBP and its associated factors from 788 registered nurses from a medical center in Taiwan.

Results: Among all nurses with eligible questionnaires, 567 (72.0%) had LBP. Mean daily hours of working, standing, and walking were persistently longer in the LBP group. Results from multivariate logistic regression analysis showed that daily working for 1 hour longer is linked to a 35% (95% confidence interval (CI) = 2–78%) greater risk of LBP. Compared with <2 years of service as nurse, nurses with 2–5 years of service had the highest risk (odds ratio (OR) = 2.11, 95% CI = 1.07–4.18). LBP risk was also higher for nurses with chore duty responsibilities (OR = 1.99, 95% CI = 1.12–3.53) and other back related disorders (OR = 4.43, 95% CI = 1.99–9.86).

Conclusion: Our results suggest that longer daily working hours and a large number of cared patients per shift should be discouraged in order to prevent musculoskeletal problems such as LBP in registered nurses.

Copyright © 2016, Taiwan Association of Obstetrics & Gynecology. Published by Elsevier Taiwan LLC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Low back disorders are prevalent in most societies and subsequently lead to a surge in the costs for caring individuals with such disorders [1,2]. In the United States, ~6% of the labor force have received compensation for back-related complaints among >3,200,000 occupational injuries [3]. Nurses, in particular, are at higher risk than other health professionals to suffer from injuries and work related musculoskeletal disorders such as low back pain (LBP) [4,5].

Trinkoff et al [6] found that the prevalence of LBP among 45 years old American nursing staff was 47%. A German study reported

a LBP prevalence of 61.2% among 2176 participated nursing staff with an average age of 31.9 years [7]. In Asia, a Japanese study revealed that 30% of nurses had the LBP complaints in the recent month before survey [8]. However, in Taiwan, a nationwide cross-sectional study observed a staggering LBP prevalence of nearly 70% in the surveyed hospital nurses [9]. The lifetime prevalence even reached 82% [10].

Musculoskeletal diseases remain the main cause of injury among hospital work forces, whereas LBP has been the major reason of absence in nursing staff [11,12]. Nurses are the main hospital staff in frequent close contacts with patients. They injure their backs from the physical burden associated with manual handling of patients. Persistent and repeated patient lifting and transferring combined with physical restrictions owing to poor ergonomics of hospital equipment leads to physiological stress for nurses. LBP is thus one important health concern in nursing practice [13–15]. This is especially true in many developed countries

* Corresponding author. Department of Health Services Administration, China Medical University, 91, Hsueh-Shih Road, Taichung, 40402, Taiwan.

E-mail address: hsiehchiarong@gmail.com (V.C.-R. Hsieh).

where high workloads in the delivery of healthcare services has drastically impacted the nursing practice [4].

The complex nature of patient care, extended shift schedules, and reduced staffing has increased job demands of nurses [16]. Long working hours, a large number of cared patients, in addition to the frequent manual lifting and improper postures, are all critical factors associated with LBP in nurses, implying that LBP is an occupational disease of complex origins [4,17–19].

Although LBP is not a life threatening disorder, it occurs relatively readily and requires long-term treatment. It also exerts financial impact on nursing practice, insurance costs, and occupational compensation. Therefore, it is important to constantly investigate factors associated with LBP in nurses, which has become one of the most critical healthcare issues for hospital staff with high patient-care workload.

Nevertheless, despite an abundance of evidence describing characteristics of LBP in nursing staff from the Western context, studies examining the factors associated with this occupational disorder in hospital nurses are still lacking from the Asian perspective. This study wishes to investigate the current working conditions of nurses with LBP in Taiwan in relation to their physical workload, and to depict whether working prolonged shifts is associated with events of LBP.

Materials and methods

This study is a cross-sectional survey which adopted the United States (US) Department of Health and Human Services definition of LBP—it is considered as chronic and/or acute pain experienced in the regions of lumbosacral, buttock, or upper leg [20]. We focused on the nonspecific type of LBP in this study.

Participants

Data used in this study was collected using the “Low Back Pain in Nurses” questionnaire, adopted from a previous study [21]. A total of 992 registered nurses working at a medical center in the central region of Taiwan were invited to participate in the self-administered questionnaire survey which they were asked to complete in their own leisure time. With informed consents, 796 (80.2%) participants completed valid questionnaires. This study has been reviewed and approved by the Institutional Review Board of China Medical University [No. 97.06.11–5].

Questionnaire

The questionnaire collected information including job title, age, educational level, marital status, history of pregnancy, and obligation to household chores. The questionnaire also asked for information on work-related indicators associated with LBP, including years of service as nurse, average daily hours of standing, sitting and walking at work, average daily hours at work, weekly frequency of exercise for >30 minutes, and history of selected diseases that can be associated with pain in the low back area (i.e., herniated intervertebral disk, degenerate arthritis of lumbar spine palsy, spondylolisthesis, sciatic nerve pain, scoliosis, osteoporosis, etc.).

To ensure the questionnaire contents would align with the purpose of the study, a measurement tool validation was performed to assess reliability. A Cronbach α of 0.95 suggests high reliability of the questionnaire used for this study.

Data analyses

Among all respondents, questionnaires from 788 nurses (out of 796; 99.0%) were eligible for data analyses. They were divided into

two groups, one group with LBP ($N = 567$) and the other group without LBP ($N = 221$). We compared the LBP group and non-LBP group regarding their age, job type, education level, marital status, employment years as nurse, history of delivery, whether conducted chore duties, life style (routine weekly exercise), and history of illnesses related to back problems (e.g., herniated intervertebral disk, degenerate arthritis of lumbar spine palsy, spondylolisthesis, sciatic nerve pain, scoliosis, visceral diseases, or other back-related problems). Characteristics at work such as hours of sitting, standing, working, and walking were also compared. Stepwise multivariate logistic regression analysis was finally conducted to estimate odds ratios (OR) and 95% confidence intervals (CI) for the presence and strength of association between LBP and risk factors. Confounders such as routine exercise, chore duties, history of specific illnesses, and age were adjusted in the final analyses to control for their extraneous effect. Statistical software SAS 9.1 (SAS Institute Inc., Cary, NC, USA) was used for data analyses.

Results

Most participants were clinical bed-side care nurses (94.5%) and only 3.7% ($N = 29$) participants were nursing administrators (Table 1). The majority of participants (83.4%) were 20–29 years old or younger, whereas the rest of participants were aged between 30 and 55 years (16.5%). The participants were well-educated and more likely to be unmarried. Only 95 (12.2%) participants had the experience of giving birth. More than 60% of nurses were responsible for chore duties at home.

Characteristics associated with LBP

Seven questions were designed to implicate the risk factors of LBP. Table 1 shows that 72.0% (567/788) of study participants reported having LBP. The prevalence increased with age, from 65.2% (214/328) in 20–24 year old group to 75.5% (37/49) in those aged 35 years and older. Nurses with LBP were older and had a longer work history, with a prevalence rate of 78.8% in those with a work history of 8 years or longer. Less than half of study participants worked for >5 years. The LBP group was more likely to have chore duties than the non-LBP group. Nurses rarely had exercise. Twenty-five percent of participants had a history of associated diseases such as herniated intervertebral disk, degenerate arthritis of lumbar spine palsy, spondylolisthesis, sciatic nerve pain, scoliosis, visceral diseases, or other back-related problems. These complaints were more prevalent in nurses with LBP than in those without LBP (30.8% vs. 9.9%).

Association with work condition

Daily work-related conditions were compared between nurses with and without LBP. Compared with non-LBP group, nurses with LBP had longer average hours at work (9.44 ± 1.11 vs. 9.15 ± 1.00 h, $p = 0.001$) (Table 2). They also had longer average hours of standing (2.59 ± 1.02 vs. 2.37 ± 0.94 h, $p = 0.009$), and walking (2.54 ± 0.97 vs. 2.29 ± 0.90 h, $p = 0.002$).

Logistic regression analysis

Variables that appeared to be significantly different between nurses with and without LBP in Tables 1 and 2 were included in the multivariate logistic regression analysis. Table 3 shows that LBP was associated with work as nurses for 2–5 years compared with work for <2 years (OR = 2.11, 95% CI = 1.07–4.18); chore duties (OR = 1.99, 95% CI = 1.12–3.53); selected spine or back related diseases (OR = 4.43, 95% CI = 1.99–9.86); and additional daily work hours (OR = 1.35, 95% CI = 1.02–1.78).

Table 1
General characteristic profile of nurses with and without low back pain.

| Variable | LBP | | Non-LBP | | Total | | <i>p</i> |
|--------------------------------|----------------|--------|----------------|--------|----------------|--------|----------|
| | <i>N</i> = 567 | | <i>N</i> = 221 | | <i>N</i> = 788 | | |
| | <i>N</i> | (%) | <i>N</i> | (%) | <i>N</i> | (%) | |
| Job title | | | | | | | 0.320 |
| Personal care attendant | 8 | (1.4) | 6 | (2.7) | 14 | (1.8) | |
| Clinical nurse | 534 | (94.5) | 209 | (94.6) | 743 | (94.5) | |
| Higher nursing administrator | 23 | (4.1) | 6 | (2.7) | 29 | (3.7) | |
| Missing | | | | | 2 | | |
| Age (y) | | | | | | | 0.006 |
| 20–24 | 214 | (37.9) | 114 | (51.6) | 328 | (41.7) | |
| 25–29 | 247 | (43.7) | 81 | (36.7) | 328 | (41.7) | |
| 30–34 | 67 | (11.9) | 14 | (6.3) | 81 | (10.3) | |
| 35–39 | 21 | (3.7) | 8 | (3.6) | 29 | (3.7) | |
| ≥40 | 16 | (2.8) | 4 | (1.8) | 20 | (2.5) | |
| Missing | | | | | 2 | | |
| Education level | | | | | | | 0.600 |
| Junior college | 271 | (48.4) | 114 | (52.3) | 385 | (49.5) | |
| Bachelor | 287 | (51.3) | 103 | (47.3) | 390 | (50.1) | |
| Postgraduate or above | 2 | (0.4) | 1 | (0.5) | 3 | (0.4) | |
| Missing | | | | | 10 | | |
| Marital status | | | | | | | 0.210 |
| Unmarried | 459 | (81.4) | 191 | (86.4) | 650 | (82.8) | |
| Married | 104 | (18.4) | 30 | (13.6) | 134 | (17.1) | |
| Divorced | 1 | (0.2) | 0 | (0.00) | 1 | (0.1) | |
| Missing | | | | | 3 | | |
| Years as nurse | | | | | | | 0.004 |
| <2 | 104 | (19.8) | 64 | (32.2) | 168 | (23.2) | |
| 2–5 | 185 | (35.2) | 66 | (33.2) | 251 | (34.7) | |
| 5–8 | 110 | (21.0) | 35 | (17.6) | 145 | (20.0) | |
| >8 | 126 | (24.0) | 34 | (17.1) | 160 | (22.1) | |
| Missing | | | | | 64 | | |
| Given birth | | | | | | | 0.110 |
| No | 487 | (86.6) | 199 | (90.9) | 686 | (87.8) | |
| Yes | 75 | (13.4) | 20 | (9.1) | 95 | (12.2) | |
| Missing | | | | | 7 | | |
| Chore duties | | | | | | | <0.001 |
| No | 156 | (32.6) | 93 | (48.2) | 249 | (37.1) | |
| Yes | 323 | (67.4) | 100 | (51.8) | 423 | (62.9) | |
| Missing | | | | | 116 | | |
| Routine exercise (>30 min) | | | | | | | 0.040 |
| None | 481 | (85.7) | 195 | (89.0) | 676 | (86.7) | |
| 1 time | 51 | (9.1) | 8 | (3.7) | 59 | (7.6) | |
| 2 times | 20 | (3.6) | 9 | (4.1) | 29 | (3.7) | |
| 3 times or above | 9 | (1.6) | 7 | (3.2) | 16 | (2.0) | |
| Missing | | | | | 8 | | |
| Special illnesses ^a | | | | | | | <0.001 |
| No | 351 | (69.2) | 182 | (90.1) | 533 | (75.2) | |
| Yes | 156 | (30.8) | 20 | (9.9) | 176 | (24.8) | |
| Missing | | | | | 79 | | |

LBP = low back pain.

^a Special illnesses include: herniated intervertebral disk, degenerate arthritis of lumbar spine palsy, spondylolisthesis, sciatic nerve pain, scoliosis, osteoporosis, visceral diseases, or other back related problems.**Table 2**
Comparison of work conditions for nurses with and without low back pain.

| Variable | <i>N</i> | Average | Standard deviation | <i>p</i> |
|----------------------|----------|---------|--------------------|----------|
| Daily working hours | | | | 0.001 |
| LBP | 529 | 9.44 | 1.11 | |
| Non-LBP | 194 | 9.15 | 1.00 | |
| Daily sitting hours | | | | 0.293 |
| LBP | 504 | 1.43 | 0.72 | |
| Non-LBP | 187 | 1.50 | 0.83 | |
| Daily standing hours | | | | 0.009 |
| LBP | 531 | 2.59 | 1.02 | |
| Non-LBP | 196 | 2.37 | 0.94 | |
| Daily walking hours | | | | 0.002 |
| LBP | 520 | 2.54 | 0.97 | |
| Non-LBP | 194 | 2.29 | 0.90 | |

LBP = low back pain.

Discussion

Nurses participating in this study were required to work for >9 hours per day on average, which is relatively longer for the LBP (vs. non-LBP) group. These nurses have longer work hours than those of nurses reported in an earlier study in Taiwan [22]. Our LBP group also reported to have longer hours of standing and walking than individuals without LBP. The present study shows significant correlations between the likelihood of getting LBP and hours of physical load such as working, standing, and walking. The risk of LBP increases by 35% for every additional daily work hour. The prolonged working shifts are clearly associated with elevated risk of LBP.

The observed prevalence of LBP is ~72% in this study, higher than the prevalence of 65.3% reported earlier for nurses at other medical

Table 3

Factors associated with low back pain using multivariate logistic regression analysis.

| Variable | Regression coefficient | Standard error | Odds ratio | 95% Confidence interval |
|--------------------------------|------------------------|----------------|------------|-------------------------|
| Age (y) | | | | |
| 20–24 (reference) | | | | |
| 25–29 | –0.197 | 0.340 | 0.82 | (0.42–1.60) |
| 30–34 | 0.590 | 0.643 | 1.80 | (0.51–6.36) |
| 35–39 | 0.194 | 0.956 | 1.21 | (0.19–7.91) |
| ≥40 | –0.100 | 0.861 | 0.91 | (0.17–4.90) |
| Years as nurse | | | | |
| <2 (reference) | | | | |
| 2–5 | 0.748 | 0.348 | 2.11 | (1.07–4.18)* |
| 5–8 | 0.693 | 0.491 | 2.00 | (0.76–5.24) |
| >8 | 0.308 | 0.521 | 1.36 | (0.49–3.78) |
| Chore duties | | | | |
| No (reference) | | | | |
| Yes | 0.688 | 0.293 | 1.99 | (1.12–3.53)* |
| Special illnesses ^a | | | | |
| No (reference) | | | | |
| Yes | 1.489 | 0.408 | 4.43 | (1.99–9.86)** |
| Routine exercise (>30 min) | | | | |
| None (reference) | | | | |
| 1 time | 1.186 | 0.667 | 3.27 | (0.89–12.1) |
| 2 times | –0.317 | 0.892 | 0.73 | (0.13–4.18) |
| 3 times | –0.806 | 0.940 | 0.45 | (0.07–2.82) |
| Per daily work h increase | 0.297 | 0.143 | 1.35 | (1.02–1.78)* |

* $p < 0.05$.** $p < 0.01$.^a Special illnesses include: herniated intervertebral disk, degenerate arthritis of lumbar spine palsy, spondylolisthesis, sciatic nerve pain, scoliosis, osteoporosis, visceral diseases, and other back related problems.

centers in Taiwan [23], and much higher than the prevalence rates reported in the U.S., Canada, Germany, Italy, and Japan [6–8,11,12].

Since the implementation of Taiwan's National Health Insurance in 1995, the management policy of human resources in hospitals has been constantly adjusted to accommodate the latest insurance policies. In order to minimize personnel costs and limit the number of employed hospital nurses, the number of patients cared per nurse has increased and working hours for the nursing staff have in turn risen. On average, the number of patients per nurse for day shift, evening shift, and night shift at medical centers increased from 7 to 9, 12 to 16, and 15 and over (data not shown), respectively. This expanded ratio is believed to be associated with not only their increased duration of standing and walking at work, but also their increased physical workload. Both may worsen LBP conditions especially for nurses with high patient care ratio.

In this study, 83.4% of nurses were 20–29 years of age, reflecting that young nurses have been the major forces for bed-side care at the hospital. Approximately 70.3% of them have LBP complaints. With regards to the number of years of working as nurses, those with 2–5 years in service possess a 2.11 times higher risk of LBP than those with <2 years in service. This difference was proven to be statistically significant. Previous studies have also shown that the average span for clinical nurses in Taiwan to stay on their job is only 5.5 years [23]. Therefore, it is reasonable to link LBP with the number of years these nurses have been in service. The nurses' intent to stay in clinical units may decline after 5 years of work. Those with 5–8 years of work history have an OR of 2.00 ($p > 0.05$) compared with those with <2 years of service. The risk of LBP for nurses with <2 years of work may not be significantly different from those with work history >5 years. It is possible that nurses may quit after working for 5 years because of LBP or other issues. Higher administrative nurses are older and have longer histories of employment as nurses. It is plausible that because LBP can persist for a long term period, these nurses with longer clinical experience could have already developed LBP early in the course of their

occupational development. Nevertheless, they may also have the tolerance to endure burden for a longer working period.

Our logistic regression analysis shows that years of service, responsibility to chore duties, daily working hours, and previous history of special diseases are significant factors associated with LBP for nurses. Whereas women make up most of the clinical nursing staff, the likelihood for nurses with chore duties to experience LBP was 1.99 times more than nurses without similar duties. This might be caused by the great amount of physical stress acquired both during and after work. Nurses with history of special selected diseases (i.e., herniated intervertebral disk, degenerative arthritis of lumbar spine palsy, sciatic nerve pain, spondylolisthesis, visceral diseases, etc.) were 4.43 times more likely to have LBP than those without the history of any these diseases. The recurrence of LBP under conditions of stressful work and excessive patient load per nurse should be paid close attention.

Implications of this study

LBP has adverse effects not only on quality of life for nurses, but also the quality of care at healthcare facilities. Inadequate staffing and high work stress may lead to LBP that can increase the turnover rate of skilled nurses. Teaching of self-care and preventative measures for these health risks is, nevertheless, still insufficient. This study shows a high LBP prevalence in nursing population, and this number is significantly increased for those who have worked for >2 years. Whereas this could affect the willingness for nurses to contribute professionally and stay in their jobs, the professional groups and medical institutions should place more attention on the notion of occupational setbacks and associated illnesses. Appropriate measures should also be implemented to lower the prevalence of LBP, such as providing educational programs prior to and during employment, raising self-awareness and encouraging proper physical activity and stretching exercises, and instructing how to act in response to LBP. Through effective education of preventive measures via public media and internet, nursing and other

related support groups may publicize the impact of LBP on the basis of a public policy established to ensure health and physical fitness. This systematic approach will surely deliver comprehensive information and subsequently decrease the occurrence of occupational hazards and severity of illnesses suffered by nurses. Authorities in charge of labor affairs should also directly tackle the issue of occupational hazards observed in patient care givers.

Higher administrators of hospitals, however, should prevent their nursing staff from working prolonged hours, attaining high patient-to-nurse ratios due to limited staffing, and intensive levels of stress. Medical equipment and hospital facilities should also be ergonomically supported for occupational safety and LBP prevention.

Limitations

As participants of this study were limited to nurses working at one medical center, the results may only apply to nursing staff working at hospitals of the same magnitude or ranking. However, the country's uniform accreditation standards towards nurse-to-patient ratios at all hospital levels allows for external validity of our outcome. As results were obtained from self-administered questionnaires, not from face-to-face interviews or experimental procedures, the potential for the severity of LBP conditions to be overestimated due to bias generates another concern. A larger group of participants may be recruited for future investigation, including staff of hospitals of different regions and sizes. More variables can also be incorporated, such as possible indicators for how nurses feel toward LBP, the level of their cognitive knowledge for the illness, and its preventative measures.

In conclusion, high physical workload is associated with increased risk of LBP for hospital nurses. Longer work hours, and long standing and walking per day at work are significantly associated with the high prevalence of LBP. To improve prevention of this disorder and effectively decrease the turnover rate due to this condition, the practice of individual nurses caring for large numbers of patients per shift should be discouraged. Occupational safety and educational programs are also recommended at workplaces to teach the nursing staff how to adjust to proper postures, particularly for those with spinal and other back disorders.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

Acknowledgments

The authors thank all the nurses at the China Medical University Hospital, Taichung, Taiwan who participated in this study. We sincerely appreciate all of your devotion during the study period. This research was supported in part by Taiwan Department of Health (Grant numbers DOH100-TD-B-111-004 and DOH100-TD-C111-005).

Authors' contributions

Study conception and design: SHS, CHS, YFT, and FCS. Analysis and interpretation of data: SHS, VCH, and FCS. Drafting of manuscript: SHS, VCH, YFT, and FCS. All authors read and approved the final manuscript.

References

- [1] Dagenais S, Caro J, Haldeman S. A systematic review of low back pain cost illness studies in the United States and internationally. *Spine J* 2008;8:2–80.
- [2] Lamb SE, Mistry D, Lall R, Hansen Z, Evans E, Withers EJ. Group cognitive behavioural interventions for low back pain in primary care: Extended follow-up of the Back Skills Training Trial. *Pain* 2012;153:414–501.
- [3] United States Department of Labor Bureau of Labor Statistics. Occupational Injuries and Illnesses and Fatal Injuries Profiles. 2009. Available at: <http://www.bls.gov/iif/> [accessed 25.02.12].
- [4] Trinkoff AM, Lipscomb JA, Geiger-Brown J, Storr CL, Brady BA. Perceived physical demands and reported musculoskeletal problems in registered nurses. *Am J Prev Med* 2003;24:270–5.
- [5] Dawson AP, Schluter PJ, Hodges PW, Stewart S, Turner C. Fear of movement, passive coping, manual handling, and severe or radiating pain increase the likelihood of sick leave due to low back pain. *Pain* 2011;152:1517–24.
- [6] 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.
- [7] Hofmann F, Stössel U, Michaelis M, Nübling M, Siegel A. Low back pain and lumbago–sciatica in nurses and a reference group of clerks: results of a comparative prevalence study in Germany. *Int Arch Occup Environ Health* 2002;75:484–90.
- [8] Matsudaira K, Palmer KT, Reading I, Hirai M, Yoshimura N, Coggon D. Prevalence and correlates of regional pain and associated disability in Japanese workers. *Occup Environ Med* 2011;68:191–6.
- [9] Chiou ST, Chiang JH, Huang N, Wu CH, Chien LY. Health issues among nurses in Taiwanese hospitals: National survey. *Int J Nurs Stud* 2013;50:1377–84.
- [10] Lin PH, Tsai YA, Chen WC, Huang SF. Prevalence, characteristics, and work-related risk factors of low back pain among hospital nurses in Taiwan: a cross-sectional survey. *Int J Occup Med Environ Health* 2012;25:41–50.
- [11] Videman T, Ojajarvi A, Riihimäki H, Troup JD. Low back pain among nurses: a follow-up beginning at entry to the nursing school. *Spine* 2005;30:2334–41.
- [12] d'Errico A, Viotti S, Baratti A, Mottura B, Barocelli AP, Tagna M, et al. Low back pain and associated presenteeism among hospital nursing staff. *J Occup Health* 2013;55:276–83.
- [13] Guo HR. Occupational low back pain. *Chin J Publ Health* 2000;19:332–7.
- [14] Cheung K, Gillen M, Faucett J, Krause N. The prevalence of and risk factors for back pain among home care nursing personnel in Hong Kong. *Am J Ind Med* 2006;49:14–22.
- [15] Trinkoff AM, Le R, Geiger-Brown J, Lipscomb J, Lang G. Longitudinal relationship of work hours, mandatory overtime, and on-call to musculoskeletal problems in nurses. *Am J Ind Med* 2006;49:964–71.
- [16] Bourbonnais R, Brisson C, Malenfant R, Vézina M. Healthcare restructuring, work environment, and health of nurses. *Am J Ind Med* 2005;47:54–64.
- [17] Chiou WK, Lee YH. Working posture and low back pain in nurses. *J Nurs* 1992;39:89–99.
- [18] Lipscomb J, Trinkoff A, Brady B, Geiger-Brown J. Healthcare system changes and reported musculoskeletal disorders among registered nurses. *Am J Public Health* 2004;94:1431–5.
- [19] Yip Y. 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.
- [20] Bernard BP, editor. Musculoskeletal disorders and workplace factors: a critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. U.S. Department of Health and Human Services: The National Institute for Occupational Safety and Health; 1997.
- [21] Tung CY, Huang CC, Ting JC, Chang CJ. Study on prevalence of lower-back pain among nurses of Taipei Municipal Hospitals and their training needs. *Institute Occup Safety Health J* 2004;2:36–49.
- [22] Tung CY, Huang CC, Ting JC, Chang CJ. The study of the low back pain preventive behaviors and its related factors of hospital nurses – apply health belief model. *J Health Educ* 2002;18:43–65.
- [23] Mah C, Lee LC, Liou SH, Chang M, Yang GY, Lin TF. Risk factors of low back pain among nursing staffs in a medical center. *Chin J Occup Med* 2003;10:175–84.