Risk Factors for Low-Back Pain Among Nurses

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A survey of nurses was conducted to assess the frequency and severity of low back pain(LBP) and to determine the risk factors. Nearly half(48.3%) of the respondents have experienced low back pain in the past year. Univariate logistic regression revealed that aging, length of employment, cardiopulmonary resuscitation, bending to pick-up objects, rolling or transferring patients, and moving furniture, equipment were most important factors associated with occurrence of LBP. Multivariate logistic regression showed that a high score of index of inappropriate posture(IIP) in moving furniture or equipment, transfer of patients and greater walking duration in service hours are significantly associated with the prevalence of LBP. We concluded that inappropriate postures during transfer of patients and moving of equipment are the most important risk factors of nurses to get LBP. (JPTA ROC 1998;23(2):90-97)

Key Words: Low back pain, Nurses, Risk factors

It has been recognized that the life time occurrence of low back pain(LBP) in the general population is as high as 80%[1,2]. Back injuries constituted nearly 20% of workers' compensation claims and were responsible for over 40% of the total injury costs in the United States[3]. With a lifetime prevalence rate of 35-79%, nurses are at high risk particularly for this ailment among hospital employees[4-6]. Furthermore, LBP is primarily responsible for a loss of ability to perform social roles at work because of the physical limitation[7,8].

Investigators have linked LBP risk factors in nurses to non-patient care activities (moving equipment, furniture, heavy lifting) as well as to caregiving tasks (patient washing, transfering, feeding and making beds)[9-12]. In addition, previous studies have established associations between LBP and other risk factors such as work division [6,13,14], workshift[13,15], satisfaction at work, relation with their supervisor[16] and history of LBP[13]. However, the effect of incorrect postures and

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frequencies of such postures have never been quantified because these variables have never been included in previous studies.

The purposes of this paper were to report the prevalence of low back pain among nurses of a university hospital and to estimate the risk by task performance at work and in other situations. Besides, we were particularly interested in the relative frequency of inappropriate postures associated with the prevalence of nurses' LBP.

MATERIALS AND METHODS

The study sample population included all nurses of a university hospital. The investigators contacted 998 nurses at the hospital and solicited their participation in the study. Participants were asked to complete a structured self-reported questionnaire consisting of three sections. The first section dealt with their socio-demographic background, leisure time activities, household works and level of work satisfaction at the hospital. The second section inquired the work load and five specific nursing tasks performed in a day and throughout a week, including object pick-up, bed making, patient rolling, patient transferring and furniture moving. We prepared drawings of these tasks with adequate and inadequate postures in random order (see Fig. 1.) and presented them to participants. They were asked to estimate the relative frequency of each task and posture from the drawings in a typical day and week. The third section looked at the self-reported prevalence of low back pain in the past week, month, and year. Level of pain was determined subjectively by each participant from Grade 1(the least pain) through the Grade 5 (most severe pain). Grade 1 is when the pain occurs after walking for more than 10 minutes with an object over 20 kg. Grade 2 is when the pain occurs from lifting an object over 20 kg without walking. Grade 3 is when the pain occurs from lifting an object less than 20 kg without walking. Grade 4 is when the pain occurs from ordinary activities. Grade 5 is when the pain can be sensed at any time.

Table 1. Comparison of Hours of Various Pos-tures between Nurses with/without Low-Back Pain(LBP)

	Nurses with LBP		
Posture	yes(N=417)	no(N=446)	P-value
standing	3.9 ± 2.0	3.8 ± 2.1	0.65
sitting	2.0 ± 1.4	2.1 ± 1.5	0.17
walking	3.7 ± 1.9	3.3 ± 1.6	0.003

In order to evaluate the associations between nursing tasks and LBP, subjects were categorized into 3 posture groups. Group 1 consisted of those who take adequate postures more than inadequate postures of every 10 performances. The 2nd group included those who have equal frequency of adequate and inadequate postures. Subjects whose inadequate postures exceeded their adequate postures in every 10 performances are in the 3rd group. Using the following formula, an Index of Inappropriate Posture (IIP) was calculated for the 5 representative nursing tasks (moving equipment, picking up objects, preparing bed, rolling patients and transferring patient):

$$IIP = (Ia/A)*P$$

In which, Ia represents number of inappropriate posture in performing 10 tasks, A represents number of appropriate posture in performing these 10 tasks, and P represents number of a specific task that have been performed in a specific period.

The SAS package[17] was used to analyze data and calculate prevalence rates. Univariate and multivariate logistic regressions were also used to estimate the odds ratios (OR) for risk factors and

the scores of IIP.

RESULTS

Of 998 questionnaires handed out, 863 were returned and valid, corresponding to a response rate of 86.5%. Among the 863 valid respondents to the survey, 85 persons were randomly selected and asked for a re-interview to assess reliability of the survey. The Kappa value was 0.68.

About 70% of respondents were younger than 30 years old with average of 8-year nursing experience. Most subjects were not married (63%) or had no experience of childbirth (69%). Watching television (88%) and reading (91%) were their common hobbies. 63% of respondents did laundry and 43% performed housekeeping at home.

Overall, less than half of respondents reported Grade 1 low back pain, 35% in the previous week, 40% in the previous month and 49% over a 12-month period. Over 65% of nurses working in acute stroke, rehabilitation, and pediatric surgery units have experienced Grade 1 low back pain. However, about 49% of nurses had this experience in last year. We also contacted with 62.5% of nurses who had not responded to this survey and found that 44% of these non-respondents had low back pain in the past year.

Results from the univariate logistic regression analyses revealed that the development of LBP has the strongest association with only age and years of work among all the demographic variables. About 90% of respondents associated their LBP with work and only 12.5% of respondents associated it with household tasks. An increment of one year of age or one year of work experience would increase the likelihood of developing LBP at a factor of 1.02 ($p<0.003$).

Average hours or frequency contributing to daily tasks are summarized in Tables 1 through 3 for nurses with LBP and nurses without LBP. Odds ratios of corresponding tasks are reported in Table 3. Nurses with LBP walked longer hours than nurses without LBP(3.7 hours vs. 3.3 hours, $p<0.003$, see Table 1). Time cost for standing and sitting was similar for these two groups. Nurses with LBP were more likely to roll patient, lift patient, assist ambulation, assist toilet and conduct cardiopulmonary resuscitation (Tables 2 and 3). Assisting toilet had an odds ratio of 1.22 and cardiopulmonary resuscitation had 1.28 (Table 3).

Table 2. Average of Frequencies of Task Performance for Nurses with and without Low-Back Pain(LBP)

Tasks(freq.)	yes(N=417)	no(N=446)	P-value
move equipment(times/day)	1.5 ± 2.5	1.2 ± 1.5	0.09
prepare bed(time/week)	3.9 ± 5.7	3.2 ± 4.7	0.06
bed-side care(times/day)	2.8 ± 3.6	2.5 ± 4.4	0.35
roll patient(times/day)	2.7 ± 2.7	2.2 ± 2.8	0.01
sit up patient(times/day)	2.5 ± 3.7	1.9 ± 3.4	0.01
transfer patient(times/day)	2.0 ± 3.9	1.7 ± 3.7	0.15
assist ambulation(times/day)	0.7 ± 1.5	0.5 ± 0.9	0.03
assist toilet(times/day)	0.7 ± 1.3	0.4 ± 1.0	0.004
insert intravenous injection (times/day)	2.6 ± 3.1	2.1 ± 5.4	0.11
cardiopulmonary resuscitaion (times/day)	0.6 ± 1.4	0.3 ± 0.8	0.001

Table 4 shows the LBP prevalence rates and odds ratios for each of the five postures described in the survey by posture group. Compared with Group 1 who acknowledged a greater frequency of adequate postures at work than of inadequate postures, groups 2 and 3 tended to have higher LBP prevalence rate. Group 3 usually had the highest OR in developing LBP. Tasks which had significant elevated risks for Group 3 nurses were moving equipment (OR=1.86), picking up objects (OR=1.65) and rolling patient (OR=1.93).

The odds ratio of LBP occurrence increased as the Index of Inappropriate Postures (IIP) increased in the univariate analysis when nurses were categorized evenly as three IIP groups. Comparing with IIP Group 1 which had the lowest IIP scores, the IIP Group 3 which had the highest IIP scores had significant elevated OR for transferring patient (OR=1.84), rolling patient (OR=1.79) and moving equipment (OR=1.70).

The result of multivariate logistic regression showed that when controlling the other factors, the highest group of IIP score in preparing bed, rolling patient, transferring patient, moving equipment and walking time in daily activities have significant influence on the prevalence rate of LBP(Table 5, model 1). In Table 5, the model 2 is developed from changing the selection criteria of LBP. The subjects in LBP group with least severity in the model 1 were grouped as healthy in the model 2. A history of delivery significantly increased the frequency of LBP in model 2, the odds ratio is 1.90 among those who had previous delivery experience.

Table 3. Results of Ubuvariate Logistic Legression with Risk Factors as Independent Variables

Risk Factors	Estimate	Odds Ratio
standing(hour)	0.0159	1.02
sitting(hour)	-0.0679	0.94
walking(hour)	0.1171	1.12*
move equipment(times/day)	0.0490	1.05
prepare bed(times/week)	0.0256	1.03
bed-side care(times/day)	0.0163	1.02
roll patient(time/day)	0.0654	1.07*
sit up patient(time/day)	0.0596	1.06*
transfer patient(time/day)	0.0292	1.03
assist ambulation(time/day)	0.1392	1.15*
assist toilet(times/day)	0.2054	1.22*
insert intravenous injection (time/day)	0.0316	1.03
cardiopulmonary resuscitation (times/week)	0.2475	1.28*

*p<0.05

Table 4. LBP Prevalence Rate within One Year Prior to Survey by Nursing Task and Posture Group

		Year	Prevalence
Task Item	Group No#	%	Odds Ratio
Move equipment			
	(1)	40.26	1.00
	(2)	47.85	1.36
	(3)	55.72	1.86*
Pick up objects			
	(1)	44.60	1.00
	(2)	64.44	2.25*
	(3)	57.04	1.65*
Prepare bed			
	(1)	45.33	1.00
	(2)	49.64	1.19
	(3)	54.01	1.42
Roll patient			
	(1)	42.31	1.00
	(2)	50.32	1.38
	(3)	58.26	1.93*
Transfer patient			
	(1)	44.12	1.00
	(2)	47.73	1.16
	(3)	54.79	1.54

*P<0.05

#Nurses in group 1 generally used more numerous adequate than inadequate postures in a particular take equal frequencies of adequate and inadequate prostures, and group 3 take more numerous inadequate than adequate postures in a particular task.

DISCCUSION

The accuracy of the prevalence rate as reported on the questionnaire is a crucial issue. The kappa value of test-retest reliability of this study is 0.68, which seems acceptable. Furthermore, the higher the severity of a LBP, the more a subject would be likely to spend in medical expenses[18] which demonstrated to some extent the validity of our measurement of LBP. We also found that the yearly LBP prevalence rate of non-respondents (44%) was close to the prevalence rate of respondents (48.3%) in this study. The overall prevalence rates from both respondents and non-respondents was 47.4%.

Table 5. Multivariate Logistic Regression Model for Low Back Pain(LBP) with Risk Factors as Independent Varibles

Risk Factors	model 1	model 2
Prepare bed(IIP)#		
lower third	1.00	1.00
middle third	1.04	1.00
higher third	1.34	1.08
Roll patient(IIP)		
lower third	1.00	1.00
middle third	0.84	0.86
higher third	1.07	0.81
Transfer patient(IIP)		
lower third	1.00	1.00
middle third	1.19	1.40
higher third	1.48*	1.82*
Move equipment(IIP)		
lower third	1.00	1.00
middle third	1.13	1.52
higher third	1.34*	1.49*
History of delivery	1.20	1.90*
Work experience	1.02	1.002
Time of standing	1.03	1.05
Time of sitting	1.05	1.05
Time of walking	1.11*	1.05

*P<0.05

#IIP(index of inappropriate postures) was calculated by taking account of relative frequencies of inappropriate to appropriate postures and the frequency of each paticular task performed in a day or a week.

@Two models are fitted according to the varied severity of LBP. LBP of subjects in model 1 is the least painful, pain is aggravated after walking over 10 minutes with an object over 20kg. Pain of subjects in model 2 is aggravated by moving an object over 20kg

The yearly prevalence rates of this study were in the range of previous studies, i.e., 43-52 %[8,9,19]. The possible reasons are: (1) This university hospital usually allows patient's relatives on the bedside to take care of the patient. A nurse's work load is thus partly released. (2) The prevalence rate of LBP generally increased with increasing age[8]. Nurses in this study were relatively young (70% are younger than 30 years old), so the prevalence rate is somewhat lower than that of other studies.

However, since working duration is highly correlated with age (r=0.95) in this study, we were unable to separate the two effects by a simple statistical analysis. Since most victims attributed their LBP to one or more origins, and since they had a relatively high frequency of inappropriate postures at work, the type of work and years at the work would explain why the prevalence rate increased along with age. Nurses working in different units had a different likelihood of getting low back pain. The reason for such differences might be attributed to different workloads and the working postures commonly observed in different units[11,13,16]. Patients in the 3 units (acute stroke, rehabilitation and pediatric surgery wards) with the highest prevalence rates of LBP of nurses in this study were relatively more dependent and required heavy nursing care. Our results seemed to be consistent with Harber's study[9].

The results of univariate logistic regression indicated that an increased LBP prevalence rate was associated with age, work experience, history of delivery, frequencies of rolling patient, transferring patient, assisting ambulation, assisting toilet, and performing cardiopulmonary resus-

citation, hours of walking in daily activities, and frequency of inadequate postures as well. Specifically, IIP of rolling patient, transferring patient and moving equipment are important risk factors. Including these variables in the multivariate logistic regression model, we found that high scores of IIP in transferring patient and moving equipment, and a longer walking time in daily activities had significant association with the occurrence of low back pain (Table 5, Model 1) when controlling the other factors. After excluding the least severe subjects of back pain, we still found that high scores of IIP in transferring patient and moving equipment were the major risks of back pain (Table 5, Model 2). In addition, the model revealed that the experience of childbirth aggravated back pain.

Turning and transferring patients are generally accepted as risk factors for nurses' low back pain[6,9-13]. In order to perform these tasks, a nurse must bear the weight of the patient and usually twist her trunk in awkward or inappropriate postures which may lead to back injury[20-22]. These two tasks make a greater contribution than other tasks in IIP estimation. IIP is a useful tool in determining the likelihood of developing low back pain even after controlling other possible confounding factors in multivariate logistic modeling (Table 5). IIP can be adapted in other studies to falsify our findings applied in LBP prevention education to monitor the effect of intervention.

Harber[11] claimed that most American nurses recognized the risk from turning or transferring patients, but the risk from moving equipment was often neglected, and back injury often resulted. We reached a similar conclusion from our study, and recommended that pre-employment education should focus on the training of appropriate working postures during the moving of equipment. Walking time in daily activities as a risk factor of low back pain was not reported in the previous studies. Since increased walking time may suggest increased workload, it may be only an indirect risk factor. The fact that walking time does not show a statistical significance in Model 2(which excluded cases with the least severe back pain) also supports such a conclusion.

According to the above results, we concluded that nurses should be provided with a comprehensive back program to enable them to understand musculoskeletal mechanics and appropriate

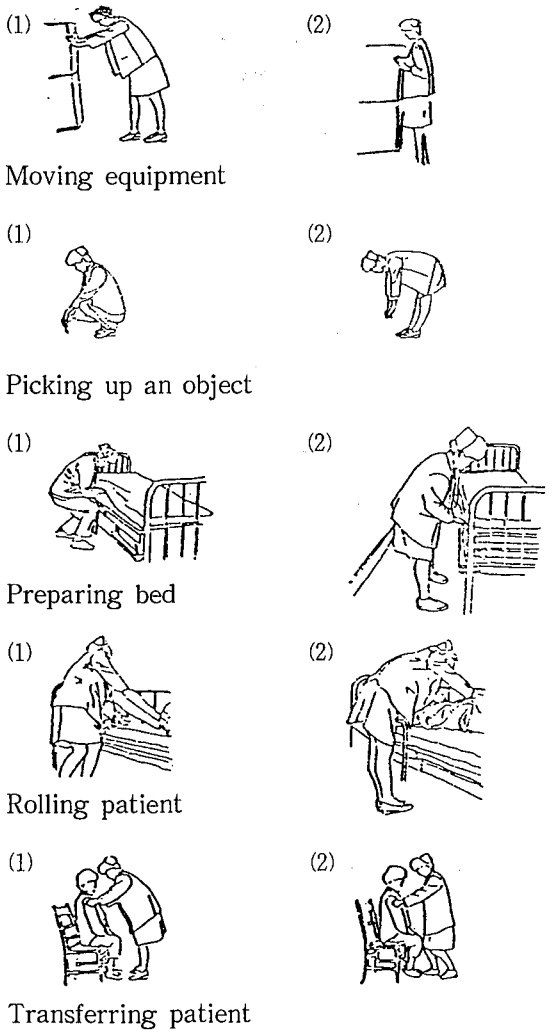

Fig 1. Pictures Demonstrate Adequate and Inade quate Postures in Differenyt Tasks

preventive measures of low back pain.

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護理人員下背痛之危險因子研究

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本研究之目的在於找出護理人員下背痛之盛行率與相關之危險因子，以期提供護理人員預防職業性下背痛之原則與方法。本研究之對象爲某醫學中心之護理人員，共發出問卷998份，回收之有效問卷爲863份，回收率爲86.4%。在受訪前一年中，共有48.3%的受訪者曾發生下背痛。單變項logistic迴歸之分析結果顯示，年齡、工作年資、執行心肺復甦術、彎腰拾物、幫病人翻身、轉位及搬動家俱或器材都與下背痛之發生相關。爲了同時估計工作量與工作姿勢的影響，作者發展出不良姿勢指數。由多變項分析結果顯示，爲病人轉位及搬動家俱或器材之不良姿勢指數最高的一組及工作時走動時間多者，較易引發下背痛。由以上之研究結果，作者的結論爲爲病人轉位及搬動家俱或器材之不良姿勢是護理人員得到下背痛之最重要的危險因子。(中華物療誌 1998;23(2):90-97)

關鍵詞：下背痛，護理人員，危險因子

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