Low Back Pain Among RNs

Advantages and potential pitfalls of longitudinal research

By George Byrns, Guang Jin, Caroline Mallory, Glenn D. Reeder and Jennifer Harris

Abstract: *The prevalence of low back pain (LBP) among nurses is high, and little success has been reported in reducing this costly and debilitating problem. This article describes the relationships between LBP and nurse behavior. The need for longitudinal research on LBP and potential pitfalls in conducting such research are also discussed.*

MUSCULOSKELETAL DISORDERS (MSDs) are a serious concern in the healthcare industry, and the prevalence of occupational low back pain (LBP) in nurses is higher than in most other industries (Owen and Garg 717-755; Hignett 1238-1246). The number of individuals entering nursing schools is declining and the average age of registered nurses (RNs) increased from 38.4 in 1983 to 42.9 years in 1998 [Hoogendoorn, et al 3087-3092; Buerhaus, et al(a) 2948-2954]. Since increased age is a known LBP risk factor (Hoaglund and Byl 64-88), this may further aggravate the nursing shortage [Nelson and Baptiste 4; Buerhaus, et al(b) 191-198]. This article explores the relationship between LBP and nurse behavior. The need for longitudinal research on potential causes and preventive measures for LBP in nurses are also discussed, as are potential pitfalls in conducting such research.

The Study of LBP

Most research on LBP has used a cross-sectional design because LBP usually has a gradual onset and it is difficult to differentiate between new and recurrent episodes of pain [NIOSH(a); Checkoway, et al(b) 59-81]. However, cross-sectional studies are unable to determine whether an exposure to a risk factor preceded the onset of LBP symptoms because they are measured at the same time. This makes it difficult to draw conclusions about cause and effect.

To overcome this limitation, prospective cohort, retrospective cohort (also called historical cohort) and repeated measures (also called linked cross-sectional) studies are preferred as they allow for an assessment of the temporal relation between an exposure and an outcome [Checkoway, et al(b) 59-81]. A cohort study starts with one group of people exposed to a risk factor, then locates a comparison group (similar to the other group in all ways except for the exposure of interest). The study then follows both groups for a period of time until some individuals develop the disease of interest. Finally, a comparison is made of the incidence of disease in the exposed group compared to that in the nonexposed group. This comparison is reported as a relative risk of disease.

The difference between prospective and retrospective cohort designs is that a prospective study starts in the present and moves forward in time. A retrospective study uses records to locate these individuals in the past, then moves forward in time. A cross-sectional study compares two or more groups of people at a single point in time. A repeated measures study follows the same subjects from the initial cross-sectional study for a period of time to determine any changes in either their exposure or disease status [Checkoway, et al(a) 211-245]. This allows the researcher to determine whether exposures preceded the onset of disease.

Potential problems involved in conducting longitudinal research are attrition and the need to maintain an adequate sample size. Determining the reasons and controlling for study attrition is essential to prevent misinterpretation of results. For example, the prevalence rate of LBP may appear to have decreased when in actuality the injured employees have left the study, leaving a population of survivors.

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The loss of employees to LBP disability may result in a situation known as "the healthy worker survivor effect" (HSE) (Arrighi and Hertz-Picciotto 189-196; Punnett and Wegman 13-23). Baillargeon and Wilkinson describe the HSE as "a selection process whereby healthy workers are selectively retained in the workforce while unhealthy workers are removed" (Lundstrom, et al 93-106). The healthcare industry cannot afford to lose existing employees and must plan to retain those entering by providing an ergonomically safe work environment. Understanding what contributes to LBP and the means to prevent it will allow the healthcare industry to retain workers.

To prevent LBP, it is important to understand the relationships among LBP, nurse behaviors and RN attitudes—especially opinions about the effectiveness of mechanical lifting devices and other safety equipment. For example, if an RN develops LBP, that individual would be expected to reduce the frequency of manual lifting. However, unless behavior changes and nurses use mechanical lifting equipment, either patient care will suffer or other nurses will be asked to increase their frequency of manual lifting. Asking younger nurses to do the heavy lifting simply transfers the risk of LBP to others.

The present research employed a repeated measures design to study risk factors for LBP in RNs and potential obstacles to the use of mechanical lifting devices. Studies have shown that increased use of mechanical lifting devices, special adjustable beds and other types of mechanical safety devices help to reduce the likelihood of developing LBP (Brophy, et al 508-511; Engkvist, et al 519-522; Nelson and Baptiste 4). The objectives for the first year of study were to identify RN perceptions regarding the cause(s) of and means of preventing LBP. In addition, the initial research identified several potential LBP risk factors, such as more frequent lifting of either people or heavy objects, more years worked as a nurse, low levels of coworker social support and less-frequent exercise. However, since this was a cross-sectional design, it is possible that the presence or absence of LBP influenced how RNs reported their frequency of lifting, exercise or even the types of jobs performed (e.g., someone with recurrent back pain may wish to transfer from the orthopedic unit to the newborn nursery).

This article reports data from this repeated measures research design. The researchers hypothesized that the presence of LBP would affect RN behavior by causing RNs to change their self-reported frequency of exercise; change their frequency of lifting; and increase job changes (e.g., duration of work, type of work). Such changes may be viewed as an attempt to reduce physical demand in the presence of LBP.

In line with past research, the researchers also hypothesized that having LBP during the first year of study would increase the likelihood of having LBP in the follow-up study (Kanekar and Miranda 271-282; Biering-Sorensen, et al 151-157; van Poppel, et al 81-86). Finally, the researchers hypothesized that individuals who became LBP asymptomatic would have a more-positive opinion about the effectiveness of mechanical lifts and would be more likely to use them. The rationale is that individuals recovering from LBP should desire to avoid a recurrence, and the most effective means of doing so is to use a mechanical lifting device.

Thus, the purpose of this study was to clarify relationships between nurse behaviors and LBP. Although cross-sectional research sheds some light on these relationships, longitudinal research that employs a repeated measures design may enable a more accurate picture.

Study Methods

Design & Target Population

In late 1999 and early 2000, a cross-sectional study was conducted; it involved 132 RNs currently employed by two hospitals in central Illinois. The results of this study have been published previously [Byrns, et al(b) 11-21].

Approximately one year after the initial study, a follow-up questionnaire was mailed to the same 132 RNs. This repeated measures approach meant that each study participant served as his/her own comparison subject a year later. Information from the initial and follow-up questionnaires was entered into a database using SPSS 11.0 software, and all data entry was double-checked for accuracy. The response rate for the follow-up survey was 79.5 percent (105 of 132).

Lifting Policies & Training at the Study Sites

Neither hospital had adopted a policy that restricted manual lifting at the time of the survey. RNs at both hospitals had been trained in manual lifting techniques and in the use of mechanical lifts. Furthermore, both hospitals' training programs had been reviewed by the Joint Commission on Accreditation of Healthcare Organizations and were found to be acceptable.

Instrument Description

The follow-up questionnaire was similar to that used in prior studies of garment workers and in the initial survey of RNs [Byrns, et al(a) 752-764; Byrns, et al(b) 11-21]. Information was gathered on work history, job tasks, description of work, basic health history, leisure time activities, current health, potential causes of back pain and basic personal information (see sample questions on pg. 43). Since LBP is a symptom—not a disease—characterization of case status becomes a challenge.

One prospective study found that so-called "objective" measures such as MRI or radiographs were no more effective in identifying LBP than symptoms questionnaires (Boos, et al 2613-2625). In the current study, the primary outcome of interest was any self-reported pain, aching, stiffness or cramping in the lower back within the last 12 months that limited movement or interfered with work at home or on the job and that was not due to a sports injury or other nonoccupational cause. This is the same definition used in the prior nursing study and in research on LBP in garment workers. [See Byrns, et al(a) for a complete description of the survey instrument, including reliability and validity data.]

Human Rights Protections

Participation was voluntary and those who agreed to participate signed written informed consent forms. This study had Institutional Review Board (IRB) approval from Illinois State University and both hospitals that participated. Questionnaires collected individual identifying information such as age, gender and body mass index, but did not ask for individual information such as name, address or Social Security number. Data taken in two points of time were linked using an individual case number. One hospital IRB prohibited the researchers from making additional contact with individuals lost to follow-up from the initial survey in order to determine whether they were still employed. As detailed later, this restriction placed some limitations on data interpretation.

Measurement

To determine whether certain exposures (frequent manual lifting) preceded the onset of LBP symptoms, a longitudinal repeated measures design was employed. A new dependent variable, "change in case status," was created that had three possible responses: 1) a new LBP case (individual did not have LBP in the initial survey, but developed LBP in the follow-up interval); 2) a former LBP case (individual had LBP but became LBP-free); or 3) no change (individual either still did not have LBP or continued to have LBP).

This new variable was needed in order to determine whether the presence or absence of LBP influenced how RNs reported their exposures to certain independent variables of interest. Independent variables measured in both the initial and follow-up studies were total years of work experience, age, lifting frequency, exercise frequency, hours worked per week, equipment use, social support or perceived causes of LBP.

Data Analysis

Bivariate analysis was used to determine associations between the dependent variable and independent variables. Continuous independent variables were analyzed using the student's t-test or ANOVA. Other analyses that were performed included chi-square, odds ratio (OR) and correlation coefficient. Further analyses determined whether associations existed between any of the two independent variables. If two independent variables were both associated with LBP, a stratified analysis was used to verify that none were confounding factors.

Sample Questions from Follow-Up Questionnaire

The 10-page follow-up Health Survey for Nurses was divided into five parts: 1) Work History and Job Tasks; 2) Description of Your Work, Basic Health History and Leisure Time Activities; 3) Your Health; 4) Potential Causes of Back Pain; and 5) Personal Information. Sample questions from Part 1 and Part 4 are presented here.

Part 1: Job Tasks

Respondents were asked to respond strongly agree, disagree or strongly disagree.

1) I am often required to move or lift heavy patients on my job.
2) My work requires rapid and continuous physical activity.
3) My job requires long periods of intense concentration on the task.
4) I am often required to work for long periods with my body in physically awkward positions.
5) I am often required to work for long periods with my head or arms in physically awkward positions.
6) My tasks are often interrupted before they can be completed, requiring attention at a later time.
7) I usually take a break during my workshift.
8) I usually take a break to eat during my shift.

Part 4: Patient Manipulations or Other Risk Factors

For each statement, respondents were asked to indicate the number of times they performed the task. For tasks performed less than daily, they were instructed to use the terms rarely (less than once a week); seldom (one to three times per week) or infrequently (more than three times in a week but less than daily). For tasks never performed, they were instructed to enter a zero.

How often would you perform each of the following tasks on an ambulatory patient?

1) On a typical day, how often do you pull a patient up in bed?
2) On a typical day, how often do you turn a patient from side to side or reposition a patient?
3) On a typical day, how often do you assist a patient from the bed to the toilet?
4) On a typical day, how often do you transfer a patient from bed to a chair?
5) On a typical day, how often do you transfer a patient from the bed to a stretcher?
6) On a typical day, how often do you lift a fallen patient from the floor?
7) On a typical day, how often do you use a gait belt on a patient during ambulation?
8) On a typical day, how often do you use a mechanical lifting device when moving a patient?

How often would you perform each of the following tasks on a non-ambulatory patient?

1) On a typical day, how often do you pull a patient up in bed?
2) On a typical day, how often do you turn a patient from side to side or reposition a patient?
3) On a typical day, how often do you transfer a patient from the bed to a stretcher?
4) On a typical day, how often do you lift a fallen patient from the floor?
5) On a typical day, how often do you use a slide board to assist in the transfer of a patient between beds and stretchers?
6) On a typical day, how often do you use a mechanical lift when moving a patient?

How often would you perform each of the following tasks? (Write your best estimate in the blank.)

1) On a typical day, how often do you lift heavy materials or equipment?
2) On a typical day, how often do you push or pull heavy equipment?
3) On a typical day, how often do you do tasks that require you to be in an awkward body position?

Table 1

Comparison of Change in Case Status & Total Years of Experience in Nursing

Change in Case Status	N	Years	Standard Deviation	95% C.I.	F-Statistic	p-Value
Negative	19*	16.6	9.5	12.0-21.2	3.25	0.043
No change	81	12.4	9.8	10.3-14.6		
Positive	4	3.9	2.9	-0.7-8.5		
Total	104	12.8	9.8	10.9-14.7		

**One of the 105 RNs failed to answer the question on years of experience.*

Table 2

Comparison of Change in Case Status & Lifting Frequency for Years One & Two

Change in Case Status	N	Lift. Freq. Year 1	F-Statistic Year 1	p-Value Year 1	Lift. Freq. Year 2	F-Statistic Year 2	p-Value Year 2
Negative	19	42.4	3.67	0.029	33.8	1.10	0.34
No change	78	23.7			18.7		
Positive	4	28.3			29.3		
Total	101*	27.3			22.0		

**Four of the 105 RNs did not report their frequency of lifting.*

Results

The 105 RNs in the follow-up study represented all shifts and a majority of the nursing departments, excluding homecare, satellite clinics and skilled nursing. Analysis of change in case status found the following: 20 RNs who initially had LBP reported that they were now asymptomatic (former LBP cases); four RNs developed LBP during the follow-up period (new cases); and 81 RNs did not change their case status. Interestingly, of the 27 RNs lost to follow-up, 13 had initially reported they had LBP in the first survey. Since one of the 27 failed to report LBP status in the initial survey, 50 percent (13 of 26) of those lost to follow up reported having LBP at year one. Those who initially had LBP were 3.2 times more likely to be lost to follow-up [OR=3.2; 95% confidence interval (C.I.)=1.3-7.8). Since only four new and five recurrent LBP cases were reported, the prevalence of work-related LBP among female RNs decreased from 36.2 percent (38 of 105) in the initial survey to 10.5 percent (9 of 86) in the current study. RNs who initially reported LBP were also more likely to report having back pain at the time of follow-up (OR=4.6; 95% C.I.=1.1-18.6).

In the second year of study, working fewer years in nursing was significantly associated with the development of LBP (F=3.25, p=0.043). The 19 RNs who became asymptomatic had worked an average of 16.6 years and the 81 RNs who did not change case status had worked an average of 12.4 years. The four RNs who were new LBP cases had only worked for 3.9 years on average. Case status, sample size, mean, standard deviation and the 95-percent confidence interval (C.I.) are detailed in Table 1. While age was not significantly associated with change in case status, it should be noted that age was highly correlated with total years' work experience in nursing (Pearson's correlation =0.7, p-value<0.001).

Former LBP cases who became asymptomatic differed from other RNs in the study in their ratio of age to years of experience working as a nurse. While these individuals had been working more years in nursing compared to the other groups, their average age was the same as those with no change in case status (41.9 years old). As would be expected, RNs who became new cases were younger (31.7 years old) because of their fewer years of experience.

Case Status & Manual Lifting

Increased frequency of lifting of either patients or heavy objects was identified as a potential risk factor in the initial study [Byrns, et al(b) 11-21]. Lifting frequency in year one was also significantly associated with a change in case status at year two (F=3.67, p=0.029). RNs who became LBP-free lifted 42.4 times a day in year one, but decreased their lifting to 33.8 times in year two. New cases who developed LBP in year two of the study lifted, on average, 28.3 times a day at year one and 29.3 times in year two. In other words, those who became painfree changed behavior by decreasing the frequency of lifting, while those who newly developed LBP had little change. Case status, sample size, and the mean number of lifts for years one and two are detailed in Table 2.

Case Status & Frequency of Exercise

Table 3 describes the effects of case status on frequency of exercise. A change in case status was associated with self-reported daily exercise (ANOVA p=0.050). RNs with LBP exercised 0.9 days per week at year one, but when they became asymptomatic, they increased their exercise to 1.1 days at year two.

RNs who developed LBP in year two demonstrated the reverse pattern. They exercised 2.4 times

Table 3

Comparison of Change in Case Status & Frequency of Exercise for Years One & Two

Change in Case Status	N	Exer. Freq. Year 1	F-Statistic Year 1	p-Value Year 1	Exer. Freq. Year 2	F-Statistic Year 2	p-Value Year 2
Negative	20	0.9	3.09	0.050	1.1	0.91	0.41
No change	81	1.9			1.7		
Positive	4	2.4			1.5		
Total	105	1.7			1.6		

One explanation for the association between change in case status and lifting is that individuals in pain change behaviors by reducing their physical demands. Neither hospital had adopted a restricted lift policy, so even individuals in pain would continue to manually lift patients.

per week when they were pain-free and decreased their exercise to 1.5 times when they developed pain. A slight decrease was found in the frequency of exercise for those individuals who did not change case status (1.9 to 1.7 days per week).

Case Status & Job Changes

A change in case status was not significantly associated with changes in job status. While no statistical association was observed, the following changes were reported at the time of follow-up: 17 percent of RNs changed their workshift; 26 percent changed the number of hours worked per week; 16 percent changed the number of hours worked per shift; and 19 percent changed departments. In addition, the reported turnover for all RNs leaving employment was estimated to be between eight and 10 percent each year at both participating hospitals.

Opinions about & Use of Mechanical Patient Lifting Equipment

Contrary to expectations, former LBP cases did not have a more-positive opinion about the effectiveness of lifting equipment, and none of the individuals with a change in case status reported using mechanical lifts. The research assumption was that individuals who had become asymptomatic would be more likely to want to use the lifts to avoid reinjury. A related finding was that a change in case status was not significantly associated with how an RN perceived the cause of LBP.

Table 4 illustrates lifting equipment use patterns between year one and year two. It is interesting to note that after an intense lift equipment educational program was implemented after year one at one participating hospital, more RNs stated they were not trained on how to use the equipment (from 17.4 percent initially to 38.6 percent in year two). A larger number of RNs in the second study stated that patients exceeded the weight capacity of the mechanical lifts; however, there were no known changes in the patient population, such as development of a bariatric surgery program, to explain this change.

Table 4

Lift Equipment Use Patterns

Use Category	Year 1	Year 2
Lift Used	13/115 (11.3%)	9/87 (10.3%)
Lift Not Available	92/120 (76.7%)	75/87 (86.2%)
No Time to Use Lift	22/115 (19.1%)	17/76 (22.4%)
Not Trained	20/115 (17.4%)	32/83 (38.6%)
Patient Exceeds Weight Capacity	15/119 (12.6%)	38/71 (53.5%)

Discussion

This study specifically focused on the effects of LBP case status on RN behavior because in order to prevent LBP, the relationships among LBP, nurse behaviors and nurse attitudes must be understood. Change in case status was significantly associated with lifting frequency and frequency of exercise. In year one of the study, it was found that more frequent manual lifting was strongly associated with increased LBP [Byrns, et al 11-21(b)]. One year later, those who became LBP-free reduced their frequency of lifting at year two (from 42.4 times per day to 33.8). Those individuals with no change reported a smaller decrease (23.4 versus 19.1), and those who developed LBP in the second year only slightly increased lifting (28.3 versus 29.3).

One explanation for the association between change in case status and lifting is that individuals in pain change behaviors by reducing their physical demands. It must be noted that neither hospital had adopted a restricted lift policy, so even individuals in pain would continue to manually lift patients. Recent research in Sweden found that individuals with LBP adopted a slower work pace, cutting back on their frequency of lifts (Kjellberg, et al 468-477). These patterns are also consistent with the HSE, since "survivors" would be expected to modify behaviors to avoid future injury. The Swedish study also reported that individuals in pain demonstrated poor technique during manual lifts of patients. The authors expressed concern that such technique would increase the hazard of an already risky procedure.

The longitudinal data in the current study also shed light on the relationship between frequency of exercise and LBP. In the initial survey, more frequent

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exercise appeared to be protective against the development of LBP [Byrns, et al(b) 11-21]. In the first year of the study, individuals with LBP exercised significantly fewer times than those who were pain-free. In year two, those who became pain-free increased their exercise slightly (from 0.9 to 1.1 times per week), and those who developed pain decreased their exercise (from 2.4 to 1.5). Using a longitudinal design, this study was able to show that those in pain are less likely to exercise than those who are pain-free.

In contrast to the conclusions that emerged from the first cross-sectional study, these findings do not support a protective relationship between frequent exercise and prevention of LBP. This conclusion is consistent with research conducted by de Looze, et al, who found that having greater muscle strength was not protective against developing LBP (1095-1104). This is not surprising given that manual patient lifting exceeds safe lifting criteria (Steinbrecher 62-66).

One expectation was that case status would be associated with a change in job status. There appeared to be evidence of changes in job categories and work schedules between the initial and follow-up surveys. However, in this study, job mobility was not significantly associated with case status. This may have been due to the small sample size compared to the large number of possible job types.

Punnett conducted a cross-sectional study of occupational musculoskeletal disorders among garment assemblers who engage in repetitive manual work and compared them to hospital workers who do more diverse work (1068-1076). Punnett concluded the HSE was more likely to occur among garment workers than hospital workers. According to Punnett, garment workers had fewer employment alternatives compared to hospital workers in terms of moving into other job categories if they became physically unable to perform their current jobs (1068-1076). In general, healthcare workers typically have the option of moving into other less-physically demanding job categories, but the results of this study suggest that even RNs who have more flexibility in job opportunities may be affected by HSE.

As expected, having LBP at year one increased the odds of having LBP at year two (OR=5.7, 95% C.I.=1.2 to 26.6). It is conceivable that the odds would have been even greater had the research group been allowed to collect data from the RNs who left the workplace (as noted, 50 percent of that group had reported LBP at year one). Since only four new LBP cases were reported in year two, the prevalence rate in the second survey decreased from 36.2 percent to 10.5 percent.

Although it appears that the prevalence of LBP among RNs improved, this finding must be interpreted with caution. First, the HSE selectively removes the most susceptible individuals from the population. Second, no evidence was found to suggest an improvement in the use of mechanical lifts or other types of safety equipment. The most plausible reason for a real improvement in LBP prevalence would be a change in behavior that included the use of mechanical lifting devices.

In year one of the study, the prevalence of LBP in RNs increased with total years of experience in nursing (15.4 years versus 11.4 years). However, at year two, the highest incidence of LBP in this study was among younger RNs with the least total years of experience in nursing (3.9 years on average). Also, those RNs who became asymptomatic in year two had the most experience (16.6 years on average). These findings are consistent with the HSE and with other research which has demonstrated that younger, less-experienced workers have the highest incidence of injury [Bigos, et al(b) 252-256; Skovron 559-573; Biering-Sorensen, et al 151-157].

It was also important to note that while the asymptomatic RNs had more experience, they were the same age as RNs with no change in case status (41.9 years on the average). This may have important implications because as the average age of an RN increases, the ability to recover from a disabling condition such as LBP may diminish, thus increasing the nursing shortage [Buerhaus, et al(b) 191-198; Nelson, et al 126-34]. In addition, LBP in the younger, less-experienced worker is a problem because prior history of LBP is the most important predictor of future LBP [Feyer, et al 116-20; van Poppel, et al 81-86; Bigos, et al(a) 21-34]. The initial onset of LBP must be prevented as it is a debilitative cycle once started.

The final research expectation was that case status would influence the use of mechanical lifting devices and that individuals who became asymptomatic would have a more-favorable opinion about the effectiveness of lifting equipment and be more likely to report using the devices. No association was found

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between case status and opinions about the cause of LBP nor with opinions about the effectiveness of lifting equipment. Use of mechanical lifting equipment at the two hospitals involved did not change from year one to year two, and none of the individuals with a change in case status reported using the devices.

It is unclear why case status was not associated with attitudes about or use of lifting equipment. It is possible that confusion about potential causes of LBP may be to blame. For example, if RNs blame themselves for not using proper body mechanics, they may focus on this and not on the need to use a mechanical device for lifting.

Another important issue was the high percentage of individuals (Table 4) who indicated that mechanical lifts were unavailable. One possible reason for this perception is that lifting equipment was located in storage rooms which were not centrally located to the nursing unit. In addition, one RN mentioned that on two occasions when she attempted to use the lift, the equipment was not in proper operating condition. So, even if the equipment is provided in a centrally located space, it must be in working order or nurses will perceive it to be unavailable and have low opinions about its usefulness.

The issue of perceptions about the availability of lifting equipment is very important and requires additional study, particularly the minimum number, type and location of devices. The lack of evidence of use of lifting equipment also indirectly supports the presence of HSE because there was no other likely explanation for the drop in LBP prevalence from year one to two. These researchers believe that RNs would be able to function better and prevent possible injury if they used mechanical equipment when moving patients.

Limitations & Future Research

HSE presents a special challenge to research that uses a longitudinal design. HSE can bias results in a closed study (one where no new participants are added over time) because the loss of susceptible individuals gives the appearance of a reduction in the prevalence of the outcome of interest. Strong evidence was found that this form of bias was present in this study. For example, the prevalence rate of LBP decreased from 36.2 percent to 10.5 percent, and the four new LBP cases had less experience in nursing than those who became asymptomatic or had no change in case status.

The fact that only four new cases were reported also limited the researchers' ability to analyze risk factors for the onset of LBP. Clearly, it is important to control for the minimum sample size in order to achieve a minimum statistical power. Use of an open sampling frame (i.e., new participants are added as individuals leave the study) is one way to control this problem. Also, approval to contact individuals who are lost to follow-up in order to determine their reasons for nonparticipation should be sought from the IRB before the study is initiated.

Finally, response bias is always a potential problem in this type of research. For example, evidence suggests that workers in pain are more likely to overreport their exposures (Wiktorin, et al 208-214). While it is impossible to rule out this form of response bias, little change was reported in lifting patterns of the four individuals who developed LBP in the second year of the study.

Conclusion

The purpose of this study was to clarify relationships between nurse behavior and LBP case status using a longitudinal design. The researchers in this study hypothesized that workers would change their behaviors in the presence of pain in order to reduce the physical demand.

Evidence suggests that nurses did change their frequency of exercise and lifting. RNs who were in pain decreased the frequency of exercise. Also, RNs who were in pain during year one and who became asymptomatic decreased their reported lifting in year two. RNs who developed LBP demonstrated only a small change in lifting frequency. While nurses appeared to be highly mobile in terms of job locations and other factors, the researchers were not able to link job changes with case status changes.

Evidence also suggests that these RNs were affected by the HSE which occurs when healthier individuals maintain employment in their occupation and the less-healthy individuals do not. This is a form of bias that gives the appearance of an improvement in disease prevalence, whereas the sample population may be shifting to be made up of the healthiest workers. In this study, 50 percent of those RNs lost to follow-up had initially been LBP cases.

While the prevalence of LBP increases with total years of experience in nursing, the highest incidence of LBP in this study was among the younger RNs with the least total years of experience in nursing. This is particularly a problem as it is indicative of the HSE. The HSE not only presents challenges in research conducted to prevent LBP disability among RNs, but it also affects nurse retention. HSE can "bring about change in job task, occupation or employment status among susceptible individuals leaving behind a more-resistant, less-representative group of individuals." HSE can be easily overlooked in healthcare because nurses tend to transfer frequently from department to department, change from full-time status to part-time status and vice versa, or change job categories.

"A serious shortage of nurses is expected in the future as pressures are exerted on both demand and supply" (Hoogendoorn, et al 3087-3092). As the shortage worsens, all efforts to retain qualified and experienced RNs must be implemented—including measures to reduce LBP. One potential means of addressing the loss of nurses due to LBP disability would be to enforce a no-lift policy that encourages nurses to use mechanical equipment instead of their backs for patient lifting. Burdorf, et al's model of back pain posits that a combination of individual factors, physical workload, psychological factors

What is needed is a new LBP intervention model that is designed to address the three factors that are most amendable to change: organizational policy, physical workload and psychological attitudes.

and organizational factors influence whether or not a worker develops LBP (142-152). According to Burdorf, et al, these factors interact to increase or decrease the likelihood of LBP.

It is important to recognize that some elements of risk are more easily addressed than others. While individual characteristics may be important with respect to LBP prevention, it is impractical to target variables such as worker age or gender. What is needed is a new LBP intervention model that is designed to address the three factors that are most amendable to change: organizational policy, physical workload and psychological attitudes.

These reseachers propose that an administrative no-lift policy has a key indirect effect in the prevention of LBP. The policy should have a direct effect on nurse behaviors that are manifested by increased used of mechanical lifts and decreased frequency of manual manipulation of patients. The other direct effect of the policy should be on attitudes regarding the safety climate in the healthcare facility. A no-lift policy demonstrates organizational support for the average worker to change behaviors by using safety equipment such as mechanical lifts.

Increased use of lifting equipment should reduce psychological stress associated with fear of back injury, and stress is another known risk factor for LBP [NIOSH(b); Waddell and Burton 124-135; Burton, et al 25-32]. Thus, the new policy should decrease physical workload, improve organizational climate and decrease psychological stress about workplace hazards. The combination of decreased physical workload and psychological strain should result in fewer reports of LBP. ■

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