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Incidence of Low Back Injuries Among Nursing Personnel as a Function of Patient Lifting Frequency

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Occupational back injuries among nursing personnel are common. Although numerous factors affect risk, a widely recognized (but poorly documented) factor is exposure to patient lifting. Due to a lack of adequate documentation in the research literature, this investigation was undertaken to examine the relationship between the frequency of patient lifting and the frequency of back injuries. A major medical center was used to collect retrospective data on three work groups: (a) licensed practical nurses, (b) nurses' aides, and (c) attendants (orderlies). From these employees, two exposure groups were identified: one group exposed to frequent patient lifting and a control group of nursing personnel who infrequently lift patients. The reported back pain incidents of the two groups were then statistically compared. The statistical procedures used were logistic regression and survival analysis. Both comparisons showed significant differences between exposure groups. From this analysis, it appears that patient lifting frequency is indeed a significant causative factor in the production of low back injuries in nursing personnel.

Recent statistics highlight the magnitude of the work-related back injury problem. One analysis found that about one fourth of all workers' compensation claims in the United States are for injuries to the back (Klein, Jensen, & Sanderson, 1984). Another recent investigation estimated that in 1979 the number of lost-workday back injuries in the United States was about 630,000 (Bureau of Labor Statistics, 1982).

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The back injury problem as it relates to general industry has been studied at length by various authors (see Yu, Roht, Wise, Kilian, & Weir, 1984). Leading experts consider manual load handling, particularly lifting, to be the primary occupational risk factor for back injury. Consequently, the National Institute for Occupational Safety and Health (NIOSH) brought together a group of experts to develop a state-of-the-art document on manual lifting. The document they produced, *Work Practice Guide for Manual Lifting*, identifies such factors as lifting frequency, weight of lift, lifting posture, and load location as being critical factors in the injury process (NIOSH, 1981). None of the studies used to develop the Guide were conducted in the health care industry. Additionally, the literature reflects few attempts to apply the Guide to patient lifting in hospitals (Torma-Krajewski, 1987a, 1987b) because the Guide only applies to sagittal plane lifting tasks in which the lifter can get a secure grip on the load—conditions that are not generally met in patient lifting situations. While the Guide is predicated on a belief that manual lifting of heavy loads is a major risk factor for back injury, it cites no evidence linking patient handling/lifting to risk of back injury among nursing personnel.

In the health care industries, the back injury problem is generally thought to be related to patient lifting, but a review by Jensen (1985) found a lack of definitive studies supporting this belief. An English study found that nurses have twice as much sick leave as the rest of the population, and that one in six nurses will experience low back pain (Health Services Advisory Committee, 1983). A study by Stubbs, Buckle, Hudson, Rivers, and Worringham (1983) found that 38% of the health care professionals with low back pain reported having experienced their first incident while involved in patient handling. A 1984 study by Klein et al. found that, in the United States, nurses aides and licensed practical nurses had some of the highest rates of workers' compensation claims for back injuries. Other studies that compared the back injury rates and back pain prevalence of nursing personnel with other occupational groups are summarized by Jensen (1987b). These various studies indicate that a back injury problem exists in the health care industry, but fail to bring sufficient understanding to the problem.

In an effort to better understand this problem, NIOSH identified critical knowledge gaps (Jensen, 1987a) and initiated this and several other investigations designed to fill gaps considered critical to the eventual minimization of back injury frequency and severity among nursing personnel. The purpose of this particular investigation was to examine one aspect of the problem—that of patient lifting frequency and its relation to the incidence of back injuries.

METHODS

The medical center that participated in this study was a 770-bed facility. Initial contact with the institution was made through the facility's safety department. Management personnel were aware of the back injury problem and recognized it as being significant. After several meetings with individual managers, it was decided to call a meeting of staff personnel who might contribute to the data collection effort. This resulted in a plan to locate the information within the hospital record systems. Employee anonymity was assured by training a member of the hospital staff to review personnel and accident records.

Information was gathered from the personnel records for three job classifications: (a) Licensed Practical Nurses (LPN), (b) Nurses' Aides (NA), and (c) Attendants (ATT). This facility did not use the job classification of orderly. The personnel records were checked to identify all LPNs, NAs, and ATTs who worked at the facility during the period from January 1, 1982, to April 30, 1985. In order to be included in the study population, the employee must have worked for 12 consecutive months during this 40-month period.

After identifying the LPNs, NAs, and ATTs who met the above criteria, two groups were identified: (a) those whose jobs typically involve frequent patient lifting and (b) a control group whose jobs involve little patient lifting. In order to determine

which nursing personnel belonged to which group, estimates of patient lifting frequency for each of the nursing personnel were obtained through discussions with the hospital's director of nursing, the head nurse in each hospital unit, and some of the nursing supervisors.

Each discussion with a nursing supervisor or head nurse started with a statement of the study's purpose. This was followed by the definition of a patient lift. The definition used was that the health care person must personally support one half or more of the patient's weight while helping the patient from a bed to a chair, a chair to a bed, or a chair to a chair. A chair was defined as a wheelchair, toilet, or conventional chair. Following the definition presentation, the patient lifting activities on the hospital unit were discussed at some length. This was followed by asking for an estimate of average frequency of patient lifting per shift for members of each of the three job classifications. Each job classification was discussed separately and was subdivided by the required type of patient care in each unit. Throughout the discussions, the individual making the estimates was encouraged to discuss her thoughts, and the definition of patient lift was repeated several times. To avoid biasing the data, we did not provide any ranges of lifting frequency, but left the estimating to each head nurse (or nursing supervisor) for persons under her direction. The discussions lasted 25 to 45 minutes. For most hospital units, patient lifting frequency was a function of the unit's patient care activity, with some doing almost no patient handling and others doing very frequent handling.

The estimates of patient-lifting frequency were used to identify personnel who fit within one of the two patient lifting categories. High lifting frequency was defined as an average of more than five patient lifts per shift. Low lifting frequency (control group) was defined as an average of less than two lifts per shift. Those nursing personnel with estimated exposures of three to five patient lifts per shift were not included in the study population to insure the study groups had clearly different patient lifting frequencies. Conceptually, this approach helps to minimize the chance of erroneously including individuals in the frequent lifting group when their actual lifting was infrequent, and vice versa.

The next step in the study was to determine which of these individuals had experienced a back injury during the applicable period. This facility encourages employees to report all injuries using the standard OSHA form. The reported injury may or may not actually be OSHA reportable. In other words, the back injuries reported here include non-lost-time injuries, in which the employee was able to return to his or her normal job on the next scheduled shift, as well as lost-time injuries.

The employee groups were compared using a measure that considers the actual number of months of employment for each person in the study (Kleinbaum, Kupper, & Morgenstern, 1982, pp. 100–102). This allowed us to compute an injury incidence density for each job group, as well as the pooled data. Incidence density (ID) was defined as the number of injuries reported by a specific employee group divided by the sum of the person-months of employment of group members.

In the next analysis, logistic modeling was undertaken to determine the relationship between the chance of a reported back injury and the various potential causative factors (i.e., lifting frequency, occupation, and duration of employment). The logistic model relates a sigmoid-shaped function of a binary response to a linear combination of possible explanatory variables (Cox, 1970, p. 142). Each individual in the study constituted one observation, and the response variable was set to 1 if that individual had at least one injury or to 0 if no injury occurred. Lifting frequency and occupation were treated as classificatory variables, while employment duration was measured in days between the date of entry into, and exit from, the study. The program used to do the modeling was PROC LOGIST of the SAS® system (SAS Institute, 1986, p. 269).

The last analysis used methods often applied to failure time analysis (Kalbfleisch & Prentice, 1980, p. 321). In this approach, time to injury after entering the study was considered to be equivalent to time to fail-

ure. Survival curves, that is, the proportion of individuals surviving to any given time without having reported a back injury were then computed for the two lifting frequency groups. Occupation was ignored in this analysis because the logistic modeling had indicated that it had no great effect on injury. Nonparametric tests (log rank and Wilcoxon) were then performed on the difference between the two survival curves. In an additional analysis, persons who experienced multiple injuries were entered into the analysis multiple times, with the time to injury being computed from date of last injury. These analyses were performed using the SAS® procedure LIFETEST (SAS Institute, 1985, p. 529).

RESULTS

The study population was found to consist of 415 personnel, of whom 143 were LPNs, 252 were NAs, and 20 were ATTs. These personnel were spread over 28 separate hospital units. Back injury reports were made by 23 LPNs, 44 NAs, and 5 ATTs (72 total) during the 40-month period. Table 1 presents the frequencies of personnel in the three occupations according to a twofold classification: injured or not injured versus frequent or infrequent patient lifting.

The data in Table 1 were further refined in Table 2 by considering actual months of employment. Multiple injuries to the same person were counted in the number of injuries columns of Table 2. Comparison of incidence density (ID) ratios for the LPNs and NAs, as well as for the group totals, revealed apparent differences between the frequent lifting group and the controls. The right column of Table 2 shows the ratio of the frequent lifting group's ID to the ID of the infrequent lifting group. For all three occupational groups, these ratio values are greater than 1, indicating that those in the frequent patient lifting category were more likely to have reported a back injury. In fact LPNs who frequently lifted patients were over seven times more likely to have had a back injury than LPNs with infrequent lifting exposure. The NAs in the frequent lifting group were over twice as likely to have experienced a back injury as NAs in the control group. The ATT category had so few person-months of exposure that conclusions are not warranted.

The logistic analysis evaluated the following variables as candidates for inclusion in

TABLE 1
NURSING PERSONNEL CLASSIFIED ACCORDING TO PATIENT LIFTING EXPOSURE, OCCUPATION, AND BACK INJURY OR NO BACK INJURY

Occupation	Injury History	Patient Lifting Exposure: Frequent	Infrequent	Total
LPN	Injured	22	1	23
	Not injured	92	28	120
NA	Injured	37	7	44
	Not injured	153	55	208
ATT	Injured	4	1	5
	Not injured	9	6	15
Combined Occupations	Injured	63	9	72
	Not injured	254	89	343
Total		317	98	415

TABLE 2
TOTAL INCIDENCE DENSITY (ID) OF BACK INJURIES
AMONG THREE OCCUPATIONAL GROUPS
BY FREQUENCY OF LIFTING EXPOSURE (FULL EMPLOYMENT PERIOD)

	Frequent Exposure Group			Infrequent Exposure Group			
Job Classification	Number Injuries	Person Months	ID	Number Injuries	Person Months	ID	**ID Ratio**
LPN	26	4,151	.00626	1	1,205	.00083	7.54
NA	53	6,607	.00802	9	2,365	.00386	2.11
ATT	4	418	.00957	2	223	.00896	1.07
All persons	83	11,176	.00743	12	3,793	.00316	2.35

the logistic regression model: length of employment, frequency of patient lifting, and occupation. Results are shown in Table 3. Both length of employment and lifting frequency were significant at the 0.01 level. Occupation was not a significant variable.

The survival analysis results are shown in Figure 1. Survival analysis was used to describe the length of time individuals "survive," that is, continue working before reporting a back injury. Figure 1 depicts the percentages of the frequent and infrequent lifting groups surviving after n days. Occupational categories were pooled because the logistic analysis had shown that occupation was not a significant predictor of reported back injury. Both groups began on day 0 with 100% surviving. By day 200, the infrequent lifting group had 99% surviving, whereas the frequent lifting group had 94% surviving (a 5% difference). By day 600, the survival rates had declined to 95% and 87%, respectively (an 8% difference). By the end of the study, day 1,215, the survival rates were 89% for the infrequent lifting group and 79% for the frequent lifting group (a 10% difference). Nonparametric log rank and Wilcoxon tests both confirmed the difference in survival rates as being significant at the 0.01 level.

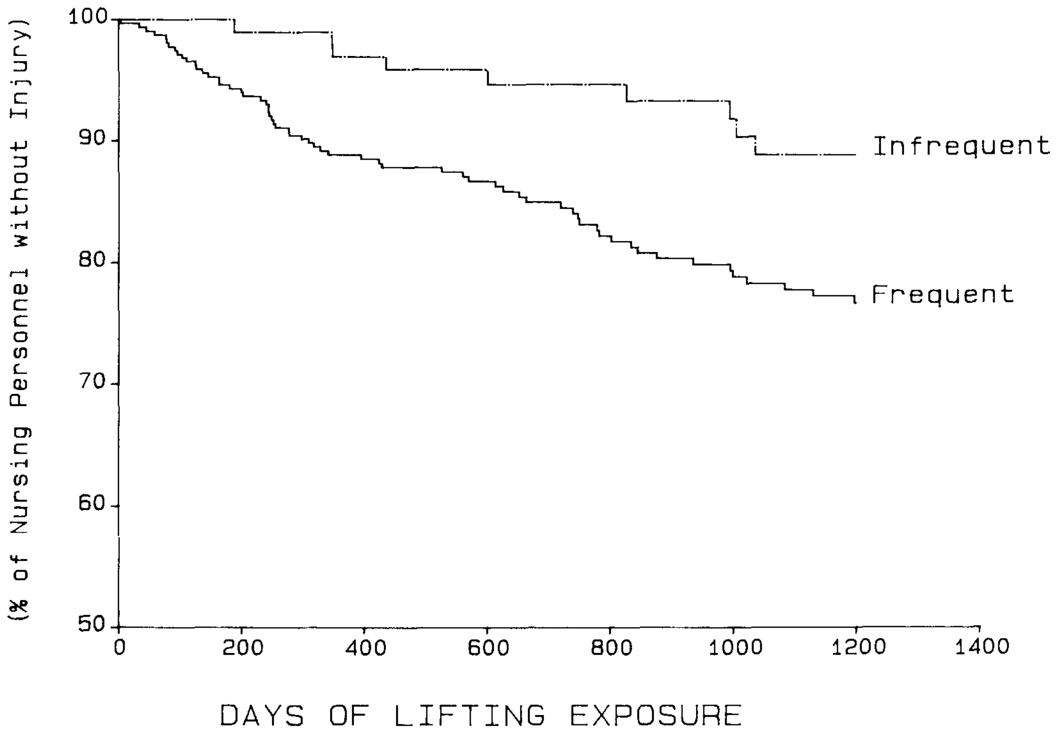
TABLE 3
RESULTS OF LOGISTIC REGRESSION

Variable	Coefficient	p
Intercept	-2.4220	.0000
Employment time	0.0013	.0085
LPN	0.7363	.1942
NA	-0.1064	.7147
Lifting frequency	0.9984	.0090

The second survival analysis was based on the assumption of independence of injury. In this analysis, a back injury report filed by an individual was counted as a failure, but when the individual resumed work after the injury, that person was considered as starting over at day zero with a probability of injury no different from anyone else. The survival patterns were very similar to those in Figure 1. By day 200, the infrequent lifting group had 98% surviving, whereas the frequent lifting group had 93% surviving. By day 600, the survival rates had declined to 93% and 83%, respectively. By the end of the study, day 1,215, the survival rates were 86% for the infrequent lifting group and 73% for the frequent lifting group. The nonparametric statistical analyses again led to the conclusion that infrequent lifters sur-

FIGURE 1
PERCENTAGE OF GROUP MEMBERS WITH NO REPORTED BACK INJURY
AS A FUNCTION OF THE NUMBER OF DAYS EMPLOYED SINCE BEGINNING OF STUDY

Comparison of Survival Rates for Nursing Personnel
Exposed to Frequent and Infrequent Patient Lifting



vived longer, with the difference between survival rates significant at the 0.01 level.

DISCUSSION

The purpose of this investigation was to examine the association between patient lifting frequency and the occurrence of back injuries in health care personnel. Table 2 shows that frequency of back injury reports is closely associated with frequent patient lifting. For each of the three occupational groups, the injury incidence density was greater for the frequent lifting group. This suggested that more sophisticated analyses would be appropriate, and both the logistic analysis and the survival distribution analyses revealed a statistically significant association between lifting frequency and back injury reporting frequency.

Clearly, the most important finding of the logistic and survival analyses was that it is lifting exposure, not occupation, that is an important factor for explaining the likelihood of a worker's reporting a back injury; that is, among nursing personnel, the risk of back injury is a function of the number of patient lifts performed. The nursing personnel in the frequent lifting group performed more lifts in a given time interval. Thus, they failed sooner, that is, in a given time period they had more injuries (greater incidence density) as a result of the greater number of lifts they performed. Similarly,

although nursing personnel in the infrequent lifting group performed fewer lifts in a specified time interval, given a long enough time interval, they performed enough lifts to experience an injury. For example, frequent lifters reached 90% survival in 298 days; infrequent lifters also eventually reached the 90% survival rate, but it took 1,006 days.

These results are consistent with the findings of general industry studies where lifting has been shown to be positively related to back injury rates (Herrin, Jaraiedi, & Anderson, 1986). It is, however, interesting to speculate about the reasons. One theory is that stressful lifting tasks result in mini-trauma to tissues. The effects of these mini-traumas accumulate with repetitive exposure. The morphological changes associated with healing in these tissues decrease their flexibility. Eventually, the cumulative effect of these mini-traumas alters the anatomy so that joint, ligament, and muscle motion is restricted. These restrictions lead to intermittent and/or chronic pain due to overloading during normal movement. A second theory is that pain results directly from single events such as excessive exertions, motions in extreme postural positions, slips, and/or falls. A third theory incorporates aspects of both other theories. It posits that the cumulative effect of the mini-traumas reduces tolerance of tissue to a level where this tolerance is exceeded during a single exertion (not necessarily a very stressful exertion), resulting in more extensive tissue damage and pain. It may be that each theory explains some portion of back pain cases. Regardless of which theory is preferred, reducing patient lifting frequency will decrease the risk of back injury since it will reduce the frequency of mini-trauma and reduce the number of times the worker is exposed to postural extremes or unexpected loads.

This research suggests that it is imperative that additional ways be found to lift and move patients in hospitals—ways that do not involve actual patient lifting by personnel. These alternatives to manual patient lifting are essential even if they are more time-consuming, because the alternative, more back injuries, is not acceptable. Expressed another way, each patient lift that is avoided extends the "survival time" of nursing personnel.

The data collected support the concept that employment in a job that requires frequent patient lifting increases the likelihood of experiencing a back injury. This is particularly noticeable in Figure 1 where different patterns were found between the frequent and infrequent patient lifting groups. Overall, these findings support the proposition that nursing personnel exposed to frequent patient lifting are more likely to report a back injury or episode of back pain. Like many other retrospective epidemiologic studies, these findings do not establish that patient lifting frequency is the only factor that affects the likelihood of back injury reports by nursing personnel. Risk of back injury may also be increased or decreased by nonpatient lifting tasks, previous back injuries, and numerous other task and personal factors. More detailed studies must be conducted to fully account for other potential confounding and contributing factors.

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