Health Care System Changes and Reported Musculoskeletal Disorders Among Registered Nurses

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Objectives. We evaluated the impact of health care system changes on nurses' health, and we studied reported musculoskeletal disorders associated with these changes.

Methods. This cross-sectional study (n = 1163) defined a musculoskeletal disorder case as moderate pain that lasted at least 1 week or occurred monthly during the past year. Nurses were asked about changes in the health care system in the past year, and responses to 12 changes were summed and were categorized as low, moderate, or high changes.

Results. When the changes were summed, the adjusted odds ratios for musculoskeletal disorders for more than 6 versus 0 to 1 changes were (1) neck: 4.45 (95% confidence interval [CI] = 1.97, 10.08), (2) shoulder: 2.63 (95% CI = 1.17, 5.91), and (3) back: 3.42 (95% CI = 1.61, 7.27).

Conclusions. The adverse impact on health caused by the changing health care system must be addressed to prevent further injuries among nurses. (*Am J Public Health.* 2004;94:1431–1435)

Few industries in the United States have undergone more sweeping organizational changes over the past 2 decades than the health care industry. The managed care movement has resulted in shorter hospital stays and higher acuity (severity of illness) levels of hospitalized patients, which has thereby required more skilled and time-consuming nursing care.[1] However, because nurses represent the largest expenditure in health care facilities, 1 of the major cost-cutting strategies has been to reduce the size of the nursing workforce, often to inadequate levels.[2] Between 1981 and 1993, total hospital employment grew steadily, while nursing personnel declined by 7.3% after case-mix was controlled.[3] Recent studies have examined the association between nursing staff levels and quality of care in hospitals and have concluded that a higher percentage of nursing care hours were correlated with better patient outcomes, including fewer medical errors.[4–9]

Inadequate staffing also has been associated with back injuries among nurses[10]; however, few studies have examined the association between nursing staff levels and other injuries and illnesses. The Minnesota Nurses Association did examine this association and found that when registered nurse positions in hospitals decreased by 9%, the number of work-related injuries or illnesses among registered nurses increased by 65%.[11] Clark et al.[12,13] found that poor organizational climates and high workloads were associated with a 50% to 200% increase in the likelihood of needlestick injuries and needlestick near misses among hospital nurses.

Nursing and personal-care facilities rank second (incidence rate = 13.8 per 100) and hospitals rank sixth (incidence rate = 8.4 per 100) among Occupational Safety and Health Administration–recordable nonfatal occupational injuries.[14] Nurses who work within these industry sectors face many occupational-health risks, the most common of which are musculoskeletal disorders. For example, the past-year prevalence of low-back pain/injury is 30% to 60%.[15–19] Nurses are often required to lift heavy loads, work in awkward postures, and transfer patients.[20–23] Because nurses are already at risk for musculoskeletal disorders, a reduction in professional nursing staff and other changes in nursing care delivery are likely to lead to even higher rates of these disorders.

The Institute of Medicine report on nursing staffing[10] and the National Occupational Research Agenda Organization of Work group report[24] both call for a study of the occupational-health consequences of changes in health care delivery. Therefore, we examined the individual and the combined impacts of health care organizational changes that have accompanied the move to managed health care on reported musculoskeletal disorders of the neck, shoulder, and back. If an association between inadequate nursing staff levels and injuries among nurses can be demonstrated, health care administrators may be compelled to improve current nursing staff systems, especially in light of the shortage of nurses throughout the United States.

METHODS

Sample and Data Collection

We conducted our study with a cross-sectional survey design. We selected a random sample of 2000 actively licensed registered nurses from 2 US state registries. The states of Illinois and New York were selected because of the ethnic diversity among their nursing workforces. Also, New York had a high rate of managed care penetration, while Illinois had a low rate at the start of the study.[25] Of the 2000 randomly selected nurses, 67 were ineligible because of death or incorrect mailing information, which left 1933 nurses in our sample. We contacted these nurses, and 1428 (74%) responded. Our analysis was restricted to the 1163 respondents who were currently working as nurses, who had been in their current jobs for at least 1 year, and who did not report a nonwork-related injury/accident up to 3 months before the onset of symptoms. Data were collected via an anonymous 8-page survey that was mailed to participants' homes from October 1999 through February 2000. The questionnaire included questions about neck, shoulder, and back problems; physical and psychological demands; and health care changes. Participant contact included up to 6

first-class mailings: an introductory letter, 2 reminder postcards, and 3 questionnaires.

Variables

We measured reported musculoskeletal disorder cases with items from the Nordic questionnaire of musculoskeletal symptoms,[26] including pictures of the affected body sites. The operational definition of a musculoskeletal disorder was having had a relevant symptom (pain, numbness, tingling, aching, stiffness, or burning) in the past year that lasted 1 week or more or occurred at least monthly with at least moderate pain on average. The level of pain was determined with a 5-point pain scale[27]: "none/no pain," "mild/minimal," "moderate," "severe," and "worst pain ever in my life." This definition of a musculoskeletal disorder was developed, tested, and validated in research conducted by scientists at the National Institute for Occupational Safety and Health.[28] Nurses who met the criteria for this definition (for any neck, shoulder, or back musculoskeletal-disorder case, or all 3) were compared with nurses who were completely asymptomatic for any neck, shoulder, or back musculoskeletal-disorder problem.

Nurses were asked to report whether 12 health care system changes that addressed staff levels, patient acuity, and the delivery of nursing care had increased, decreased, or stayed the same over the past year. These 12 items, which were selected from the 37 items used by Shindul-Rothchild,[29] represented those changes deemed to be most related to nursing care delivery. Responses that indicated a negative change, such as an increase in unfilled nursing positions or a decrease in the average length of stay, were assigned 1 point each; responses that indicated no change or a positive change were coded 0.

A negative change included an increase in "work/job responsibilities," "floating off regular unit/area"(assignment other than their usual unit), "unfilled registered nurse positions," "registered nurse layoffs," "facilities/units closed," "client/patient load per registered nurse," "full-time registered nurses replaced by part-time/temporary registered nurses," "patient acuity," and "unlicensed personnel providing direct care." Decreases in the number of "nurse executives," "advanced practice nurses"(registered nurses with advanced clinical training, usually a master's degree in nursing), or "length of stay" also were defined as negative changes. In addition to examining the 12 individual health care system change items, the negative change items were summed (α coefficient=.81) and were evaluated as low-risk (2–3 changes), moderate-risk (4–6 changes), or high-risk (>6 changes) categories. Those with 0 or 1 change served as the reference category. The reference and high-risk categories were designed to include the extremes (top 20% and bottom 20%) in the degree of changes. The remaining 60% of nurses reported health care system changes in either the low or moderate category. Three additional items asked respondents whether they agreed or disagreed (4-point scale) with the statement, "My job: (1) has adequate staffing levels; (2) security is good; (3) is very satisfying to me." Responses were dichotomized (agree/strongly agree=reference).

The potentially confounding variables of age and body mass index (BMI) were treated as continuous variables in our analysis. Smoking, race/ethnicity, having children under age 4, and caring for other dependents had as reference categories nonsmoker, White, having no children under 4, and having no other dependents, respectively. Having young children or other dependents was assessed to identify nonwork responsibilities that may place respondents at risk for a musculoskeletal disorder. Current primary workplace (hospital vs other) and position (staff nurse vs other) also were obtained from the respondents.

Psychological demands were measured with 8 items from the Job Content Questionnaire.[30,31] Each item (e.g., work hard, work fast) was measured with a 4-point scale to indicate frequency of exposure. Responses were dichotomized and were summed, which generated total scores that ranged from 0 to 8 for a continuous psychological demand scale (α=0.78). Exposure to physical demands, such as awkward postures and heavy lifting, was measured with 12 items. In addition to using the highly validated and widely cited Job Content Questionnaire items, we incorporated occupation-specific physical-demand items as recommended by Karasek.[32]

Data Analysis

The mean of the summed health care system change items was estimated for reported neck, shoulder, and back musculoskeletal-disorder cases and for the nurses who were completely asymptomatic. We generated the age-adjusted odds for being a musculoskeletal-disorder case (neck, shoulder, and back) in relation to each individual health care system change item. We then generated logistic regression models that used the categorized health care system changes variable adjusted for the identified potential explanatory or confounding factors. The covariates were forced into the model with the odds for musculoskeletal disorders reestimated after each addition for the following covariate groups: demographics and lifestyle (age, race/ethnicity, children under 4, dependent care, BMI, smoking), work characteristics (workplace and position), and psychological and physical demands. We used SPSS 10.0 software (SPSS Inc, Chicago, Ill) to conduct our analysis. We used logistic regression analysis because musculoskeletal disorders were not normally distributed among these populations. It should be noted that the odds ratio is an overestimate of the rate ratio or the relative risk in this analysis, where the risk of injury is greater than 10%.

RESULTS

The prevalence of reported neck, shoulder, and back musculoskeletal-disorder cases among this population was 20%, 17%, and 29%, respectively. Table 1 provides a description of the sample, including the percentage of nurses who reported the 12 health care system changes. Demographically, the sample reflected US nurses,[33] and more than half reported negative changes in 4 health care system change items (Table 1). The percentages of nurses who agreed/strongly agreed that "my job has adequate staffing levels," "my job security is good," and "my job is very satisfying to me," were 37%, 25%, and 27%, respectively.

When analyzed individually, 3 of the 12 health care system change items were significantly associated with musculoskeletal disorders at all 3 body sites (Table 2). Three additional changes were associated with back or with neck and back musculoskeletal disorders. The mean number of changes among

TABLE 1—Sample Demographics and Selected Health Care System Changes Among a Sample of Registered Nurses (n = 1163): New York and Illinois, 1999–2000

	No. (%)
Demographics	
Gender (female)	1091 (95.4)
Age (> mean of 45 years)	523 (46.3)
Race (White)	950 (83.0)
Marital status (married)	769 (71.0)
Educational attainment (bachelor's degree or higher)	579 (50.3)
Past-Year Health Care System Changes	
Work/job responsibilities[a]	886 (77.6)
Patient acuity[a]	653 (67.8)
Unfilled registered nurse positions[a]	597 (65.0)
Client/patient load per registered nurse[a]	647 (64.7)
Full-time registered nurse replaced by part-time/temporary registered nurse[a]	343 (49.6)
Facilities/units closed[a]	255 (48.7)
Float off regular unit/area[a]	316 (48.6)
Unlicensed personnel providing direct care[a]	293 (44.9)
Length of stay/visit/procedure[b]	331 (35.2)
Registered nurse layoffs[a]	130 (30.6)
Nurse executives[b]	187 (21.2)
Advanced practice nurses[b]	83 (13.3)

[a]Increased.
[b]Decreased.

TABLE 2—Age-Adjusted Odds Ratios for a Musculoskeletal Disorder vs Being Asymptomatic, by Past-Year Negative Health Care System Changes: New York and Illinois, 1999–2000

	OR (95% CI)		
Health Care Changes	Neck MSD	Shoulder MSD	Back MSD
Work/job responsibilities[a]	1.43 (0.98, 2.08)	0.93 (0.64, 1.35)	1.68 (1.18, 2.40)
Patient acuity[a]	0.89 (0.54, 1.45)	0.52 (0.29, .95)	0.96 (0.61, 1.51)
Unfilled registered nurse positions[a]	1.36 (0.94, 1.98)	1.17 (0.79, 1.73)	1.80 (1.27, 2.57)
Client/patient load per registered nurse[a]	1.47 (1.08, 1.99)	1.36 (0.98, 1.88)	1.66 (1.25, 2.21)
Full-time registered nurse replaced by part-time/temporary registered nurse[a]	2.57 (1.73, 3.80)	1.78 (1.19, 2.67)	2.60 (1.82, 3.91)
Facilities/units closed[a]	2.67 (1.67, 4.26)	1.97 (1.20, 3.21)	2.21 (1.45, 3.36)
Float off regular unit/area[a]	1.30 (0.78, 2.18)	1.01 (0.59, 1.71)	1.33 (0.83, 2.12)
Unlicensed personnel providing direct care[a]	2.29 (1.42, 3.68)	1.80 (1.11, 2.94)	2.28 (1.49, 3.49)
Length of stay/visit/procedure[b]	1.15 (0.73, 1.80)	1.08 (0.67, 1.73)	1.35 (0.88, 2.06)
Registered nurse layoffs[a]	0.91 (0.61, 1.36)	1.01 (0.66, 1.54)	1.31 (0.91, 1.88)
Nurse executives[b]	1.72 (0.91, 3.24)	1.61 (0.85, 3.05)	1.45 (0.81, 2.58)
Advanced practice nurses[b]	1.11 (0.53, 2.35)	0.87 (0.38, 1.98)	1.34 (0.70, 2.59)

Note. MSD = musculoskeletal disorder; OR = odds ratio; CI = confidence interval.
[a]Increased.
[b]Decreased.

asymptomatic nurses (3.33) was significantly different from that of nurses who reported neck, shoulder, or back musculoskeletal disorders (4.24–4.47 changes per nurse).

When the sum of health care system changes was categorized, there was a strong association (OR>2.40) between reported moderate and high levels of health care system changes and neck and back musculoskeletal disorders, and between reported high levels of change and shoulder musculoskeletal disorders, compared with those who reported low levels of health care system changes. After adjustment, the odds for reporting a musculoskeletal disorder at all 3 body sites were attenuated somewhat by psychological and physical demands, yet the odds were still highly significant for the highest level of changes (>6) compared with the reference group. The adjusted odds ranged from 2.63 to 4.45 (Table 3). In other words, an odds ratio of 4.45 meant that among all nurses who reported more than 6 health care system changes were more than 4 times as likely to meet the criteria for a neck musculoskeletal disorder compared with those who reported 0 or 1 changes after we adjusted for all other variables considered in our analysis. Because these analyses were at the injury level of analysis, and because some nurses reported injury at more than 1 body site, we also analyzed the data with "any case" as the outcome (data not shown). The findings from these analyses were similar to the body site–specific results.

DISCUSSION

We found that health care organizational changes were associated with reported musculoskeletal disorders, even after we controlled for demographics, work characteristics, and psychological and physical job demands. The odds ratios for neck, shoulder, and back musculoskeletal disorders showed a consistent and increasing trend with the level of reported health care system change. The physical workload associated with lifting and transferring patients is responsible for many back musculoskeletal disorders among nurses.[32] However, our findings indicate an association between organizational changes and musculoskeletal disorders that is independent of the effect of physical job demands. The limited published data on the impact of health care system changes, particularly staff levels, on injuries and illness among nurses support our findings.[15–17,31,34] These collective findings suggest a number of different levels at which the prevention of musculoskeletal disorders among nurses should be targeted.

In the United States, changes in health care delivery are having a profound impact on patient care and nursing practice. Our survey data from more than 1000 nurses indicate that nurses are experiencing difficult work conditions that have an impact on their health over and above the psychological and physical job demands. When we asked about health care system changes in the past year, 65% of the nurses reported an increase in patient loads and 68% reported an increase in patient acuity. The fact that only one fourth of the nurses reported their job as "very satisfying" and as "security is good" sug-

TABLE 3—Odds Ratios for Being a Musculoskeletal-Disorder Case by Categories of Health Care System Changes: New York and Illinois, 1999–2000

Categorical Health Care Changes	OR (95% CI) Neck MSD	Shoulder MSD	Back MSD
Unadjusted model			
Reference 0–1	1.00	1.00	1.00
Low (2–3)	1.80 (0.98, 3.31)	1.03 (0.58, 1.84)	2.27 (1.30, 3.98)
Moderate (4–6)	2.41 (1.37, 4.22)	1.16 (0.68, 1.98)	2.60 (1.53, 4.42)
High > 6	4.86 (1.38, 6.10)	2.92 (1.53, 5.60)	6.02 (3.18, 11.40)
1–Adjusted for demographics and lifestyle (age, race/ethnicity, children under age 4, dependent care, BMI, smoking)			
Reference 0–1	1.00	1.00	1.00
Low (2–3)	2.00 (1.07, 3.73)	1.10 (0.60, 2.01)	2.36 (1.32, 4.20)
Moderate (4–6)	2.61 (1.46, 4.65)	1.19 (0.68, 2.08)	2.72 (1.57, 4.71)
High > 6	5.79 (2.86, 11.73)	3.29 (1.66, 6.52)	6.25 (3.21, 12.17)
2–Adjusted for above (demographics, lifestyle) plus work characteristics (workplace and position)			
Reference 0–1	1.00	1.00	1.00
Low (2–3)	2.15 (1.14, 4.06)	1.17 (0.63, 2.16)	2.39 (1.33, 4.31)
Moderate (4–6)	3.01 (1.63, 5.56)	1.33 (0.73, 2.41)	2.72 (1.52, 4.87)
High > 6	7.10 (3.34, 15.08)	3.82 (1.83, 7.95)	6.29 (3.12, 12.66)
3–Adjusted for above (demographics, lifestyle, work characteristics) plus psychological demands			
Reference 0–1	1.00	1.00	1.00
Low (2–3)	1.97 (1.04, 3.74)	1.10 (0.59, 2.06)	2.25 (1.24, 4.08)
Moderate (4–6)	2.52 (1.33, 4.80)	1.16 (0.61, 2.22)	2.18 (1.20, 3.97)
High > 6	5.68 (2.58, 12.53)	3.28 (1.50, 7.19)	4.45 (2.15, 9.23)
4–Adjusted for above (demographics, lifestyle, work characteristics, psychological demands) plus 12-item physical demand scale			
Reference 0–1	1.00	1.00	1.00
Low (2–3)	1.88 (0.98, 3.61)	1.06 (0.56, 2.01)	2.08 (1.13, 3.80)
Moderate (4–6)	2.18 (1.12, 4.22)	1.00 (0.51, 1.96)	1.79 (0.97, 3.32)
High > 6	4.45 (1.97, 10.08)	2.63 (1.17, 5.91)	3.42 (1.61, 7.27)
Final Model			
χ^2	74.6	69.7	100.3
df	13	13	13
P	< 0.001	< 0.001	< 0.001

Note. MSD = musculoskeletal disorder; OR = odds ratio; CI = confidence interval; BMI = body mass index.

gests that an organizational approach to improving health care delivery and quality of care is critically needed. Our findings that health care system changes are associated with up to a 3-fold increase in neck and back musculoskeletal disorders suggest that if changes in workload and work complexity are not addressed, there may be further negative implications for the health care delivery system and, ultimately, patient care.

The cross-sectional design of our study is a limitation in that it prevented us from interpreting the temporal association among variables described in this report. By definition, this cross-sectional study was limited to the current workforce: nurses who no longer worked in nursing because of a musculoskeletal disorder or other health conditions were not included. The absence of these individuals from the study population underestimated the prevalence of reported musculoskeletal disorders and the association of health care system changes with a musculoskeletal disorder. We are currently conducting a longitudinal study to further estimate musculoskeletal-disorder prevalence and to clarify the association between reported past-year health care system changes and the onset of reported musculoskeletal disorders.

A second limitation is the exclusive use of self-reported data. To minimize the likelihood of poor recall of health outcomes, we limited the recall period for reported musculoskeletal disorder to the past year, and we used a threshold definition of a musculoskeletal disorder that was used in other occupational-health research.[28] Nurses, as a group, have been shown to provide valid and reproducible risk factor and health outcome data when surveyed.[35–37] Because there was no validation of a reported musculoskeletal disorder from observation or from a physical examination, these findings need to be interpreted with caution.

CONCLUSIONS

Our study is an important contribution to the literature because it examines the association between health care system changes and nurses' health (in this case, musculoskeletal disorders). Our finding that changes in health care services delivery compromises not only quality of care and patient safety but also nurses' health should provide further evidence of the need for a systematic approach to improving work conditions in the health care industry. ■

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This article was accepted April 10, 2003.

Contributors

A. Trinkoff and J. Lipscomb conceived the study and supervised all aspects of study implementation. J. Lipscomb synthesized the analyses and led the writing of the article. B. Brady assisted with study implementation and conducted data analyses. J. Geiger-Brown conducted data analyses. All authors contributed to the conceptualization of the study, the interpretation of study findings, and the writing of this article.

Acknowledgments

National Institute for Occupational Safety and Health grant #RO1 OH03702 funded this study. The authors would like to thank Alicia Lazarek and Molly Freitag for their assistance with manuscript preparation.

Human Participant Protection

The institutional review board of the University of Maryland, Baltimore, approved the study protocol.

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