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The physical workload of nursing personnel: association with musculoskeletal discomfort

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Abstract

Direct care-nursing personnel around the world report high numbers of work-related musculoskeletal disorders. This cross-sectional study examined the association between the performance of high-risk patient-handling tasks and self-reported musculoskeletal discomfort in 113 nursing staff members in a veterans' hospital within the United States. Sixty-two percent of subjects reported a 7-day prevalence of moderately severe musculoskeletal discomfort. There was a significant association between wrist and knee pain and the number of highest-risk patient-handling tasks performed per hour interacting with the load lifted. On units where lifting devices are readily available, musculoskeletal risk may have shifted to the wrist and knee.

Keywords: Work-related musculoskeletal disorders; Nurse; Lifting; Manual handling; Wrist pain; Knee pain

1. Introduction

Direct care nursing personnel around the world report high numbers of work-related musculoskeletal disorders (Menzel, 2004). In the United States (US), nursing assistant (NA)[1] and registered nurse (RN) are among the ten occupations reporting the greatest number of nonfatal musculoskeletal disorders resulting in days away from work (US Bureau of Labor Statistics, 2003). Most of these work-related musculoskeletal disorders (WMSDs) among nursing personnel are back injuries, although they also include neck, shoulder, arm, wrist, and knee disorders (Daraiseh et al., 2003). For direct care nursing staff, manual patient handling (moving or repositioning a patient using their own body strength) is the major cause of these injuries (Harber et al., 1985; Hollingdale, 1997; Knibbe and Friele, 1996; Smedley et al., 1995). After such an injury, many health care workers leave the field, either temporarily or permanently (Helminger, 1997; Lewis, 2002).

One of the major difficulties in reducing WMSDs is the multifactorial etiology, with many associated causes, including physical, work organizational, psychosocial, individual, and sociocultural factors (World Health Organization, 1985; US Department of Health and Human Services, 1997; National Research Council,

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[1] Nursing assistants are also known as nursing aides, orderlies, and attendants.

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2001). The position of the US Occupational Safety and Health Administration (OSHA) is that physical risk factors alone are necessary and sufficient to produce WMSDs, that these physical risk factors exert more influence than other risk factors, and that reducing them reduces the incidence of WMSDs (US Department of Labor, 2000). However, unlike Great Britain's Health and Safety Executive, which passed Manual Handling Operations Regulations in 1992, OSHA's attempt to regulate workplace lifting in the US was overruled when Congress rescinded OSHA's ergonomics standard in early 2001.

For nursing personnel, there are several individual patient-handling tasks that are considered high-risk for producing WMSDs, such as turning, bathing, or dressing a patient, pulling a patient up in bed, and transferring a patient from bed to stretcher or bed to chair or toilet and back again (Garg et al., 1992; Nelson et al., 2003). Other risk factors for WMSDs in health care include weight of patients being moved or lifted, frequency of handling and moving patients, and level of postural awkwardness required by a task, particularly tasks with longer durations (Garg et al., 1991; Owen and Garg, 1991; Owen et al., 2000-2001; Smedley et al., 1995; Stobbe et al., 1988; Winkelmolen et al., 1994; Zhuang et al., 1999). Patient assistance or resistance can change the level of risk associated with a given task (Love, 1997). Some patient-handling and movement tasks present a risk to caregivers every time they perform them (e.g., lifting the torso of a patient to a sitting position on the edge of the bed, transferring a patient from bed to chair or chair to chair) (Zhuang et al., 1999; Marras et al., 1994), while with other tasks the risk builds over time through cumulative trauma (e.g., forward flexing while preparing to apply a sling or harness to a patient) (Daynard et al., 2001). Against the background of a growing obesity epidemic in the US population (US Department of Health and Human Services, 2004), the risk to direct-care nursing personnel from manual handling increases.

To assess the risk for incidence of WMSD, it is important to identify the most hazardous nursing tasks. In a study of models predicting overexertion injuries resulting from manual handling, Herrin et al. (1986) found that the most stressful tasks in a job were the most predictive of WMSDs. They concluded that aggregating highly stressful and less stressful tasks obscured important differences in predictive ability.

It has been suggested that there is a link between time pressure (an indicator of insufficient staffing resources) and musculoskeletal injuries (Bongers et al., 1993). Larese and Fiorito (1994), for example, found that nurses on units with high patient-to-nurse ratios (e.g., 12 patients to 1 caregiver) had more back pain and injuries than those who worked on units with lower ratios (e.g., 4 patients to 1 caregiver). Owen et al. (2000-2001) reported that nursing personnel identified insufficient staffing as one factor that increased the stress of manual handling by increasing the patient-to-nurse ratio and thereby increasing the frequency of lifts per caregiver per shift.

While individual hazardous nursing tasks have been identified (Garg et al., 1991; Love, 1997; Marras et al., 1999; Nelson et al., 2003; Zhuang et al., 1999), there are limited studies that quantify the frequency of high-risk tasks performed over time (Myers et al., 2002). Such studies must take into consideration variables that affect per-hour manual handling tasks. These include job classification, the weight of patients handled or moved, the patients' dependency level, availability of patient handling equipment, and patient-to-nurse ratios. The purpose of this study, therefore, was to (1) quantify the high-risk tasks and associated factors that comprise the manual handling workload of nursing personnel over a 7-day period and (2) assess the association between the manual handling workload of nursing personnel and self-reported musculoskeletal discomfort.

2. Materials and methods

2.1. Study design

We devised a cross-sectional study design to examine the association between high-risk patient-handling tasks and musculoskeletal discomfort in nursing personnel. Pain and discomfort may be the first indications of WMSDs (National Research Council, 2001). Therefore, the dependent variables were frequency and severity of musculoskeletal discomfort. The independent variables examined were frequency of performance of high-risk patient-handling tasks per hour worked, job classification, patient's weight per task, patient's physical dependency level per task, the availability of patient-handling equipment, and the ratio of the number of patients to the number of direct care staff members (excluding those on modified duty) working concurrently with the subject per shift.

We conducted the investigation at one US Veterans' Hospital, with a predominantly male patient population (96%). Subjects included RNs, Licensed Practical Nurses (LPNs), and NAs (collectively, "nurses") from the five patient care units with the highest reported numbers of back injuries in nursing staff (high-risk units) and from five patient care units with lower numbers of back injuries (low-risk units). The high-risk units included two spinal cord injury and three long term care units, where patients have high degrees of dependency. The low-risk units included a medical intensive care unit, three medical-surgical units, and a psychiatry unit. Ergonomic assessments had been conducted in this facility and mechanical lifting devices were available on the study units based on need. We recruited subjects via posters, e-mail, and in-person requests. Nurses were eligible to participate in the study if they were full- or part-time employees between the ages of 18 and 64 and provided direct patient care at least 80% of the time. Nurses were excluded if a previous injury had resulted in current modified duty with any type of lifting restriction. The University of South Florida Institutional Review Board approved this study. Subjects received a small value prepaid telephone card upon signing their informed consent forms.

2.2. Physical workload assessment

We assessed workload by identifying the patient assignment for each subject during his or her assigned work shift, then determining handling and movement tasks for each assigned patient by using the following sources: physicians' orders for patient activity and its frequency (e.g., turning, ambulation), nursing activities required due to the patient's degree of dependency, diagnosis, and time of day (e.g., complete bed baths or showers, toileting assistance, applying anti-embolism stockings), and scheduled activities requiring transfer to chairs, wheelchairs or stretchers.

We recorded the date, the shift, each patient's most recently recorded weight, each patient's numerical classification score (a facility-specific measure of dependency), the assigned subject's code number, and the number of hours the subject worked over the 24-h period beginning at 7 a.m. daily. We also collected the following data about the subject's unit at the time the workload was assessed: number of pieces of handling and movement equipment present, number of full-time-equivalent and job classification of nursing staff assigned, and the total number of patients on the unit (daily census).

Patient-handling and movement tasks were grouped into three categories by risk—high, higher, highest—based substantially on the hazard rankings developed by Nelson and associates in 1996 (unpublished data). Tasks not listed by Nelson were categorized based on the findings of subsequent research reports (Owen et al., 2000-2001; Zhuang et al., 1999). Table 1 lists patient-handling tasks encountered in this study by category. (Because there were no tasks involving the use of hand-operated hydraulic full body lifts during the study period, this Category III task does not appear in the table.)

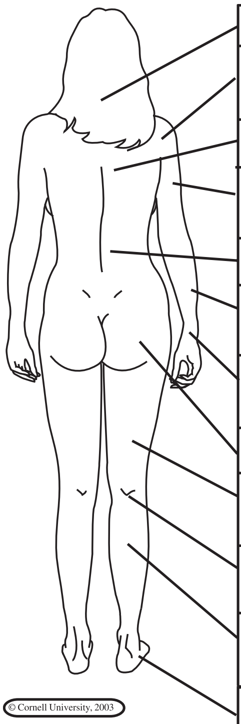
2.3. Musculoskeletal discomfort assessment

Because we were interested in pain severity and its 7-day prevalence, we used the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). The CMDQ is a 54-item questionnaire containing a body map diagram and questions about the prevalence of musculoskeletal ache, pain, or discomfort in 18 regions of the body during the previous week. See Fig. 1. Test-retest reliability for a group completing the CMDQ at a 3-week interval found a 7% difference in responses for upper body parts and a 1% difference for lower body parts (Hedge et al., 1999). Respondents indicate frequency of discomfort on an ordinal scale from 0 (none) to 4 (daily) and severity of discomfort from 1 (slightly uncomfortable) to 3 (very uncomfortable). A pain level of at least "moderately uncomfortable" was selected as a severity threshold for determining prevalence and frequency. The level at which the discomfort interfered with work was scored from 0

Table 1
Patient-handling tasks by risk category

Category I (High risk)	Category II (Higher risk)	Category III (Highest risk)
Pushing patient in a wheelchair	Transferring patient from bed to wheelchair using a mechanical lift	Manually transferring patient from wheelchair/bathtub to toilet/bed or from toilet/bed to wheelchair/bathtub
Transporting patient in a shower trolley/stretcher	Repositioning a patient in bed (moving to head of bed)	Repositioning a patient a dependency chair or wheelchair
Bathing patient in a shower chair/shower trolley	Repositioning patient in bed (side to side)	Making an occupied bed
Applying anti-embolism stockings (TED hose)	Weighing patient using sling lift/bed scale	Dressing a patient (clothing)
	Lifting patient from floor using a mechanical lift	Manually transferring a patient from bed to stretcher
	Manually transferring a patient from bed to shower trolley	Performing neurogenic bowel care in bed
	Bathing patient in bed	Transferring a patient from bed to chair using a stand-assist lift

The diagram below shows the approximate position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.



		During the last work week how often did you experience ache, pain, discomfort in:					If you experienced ache, pain, discomfort, how uncomfortable was this?			If you experienced ache, pain, discomfort, did this interfere with your ability to work?		
		Never	1-2 times last week	3-4 times last week	Once every day	Several times every day	Slightly uncomfortable	Moderately uncomfortable	Very uncomfortable	Not at all	Slightly interfered	Substantially interfered
Neck		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shoulder	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Back		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Arm	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Back		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Forearm	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wrist	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hip/Buttocks		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Thigh	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Knee	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Leg	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Foot	(Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	(Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Fig. 1. Cornell musculoskeletal discomfort questionnaire, female. (Reproduced with permission from the Human Factors and Ergonomics Laboratory at Cornell University (http://ergo.human.cornell.edu/ahmsquest.html).)

(no interference) to 2 (substantial interference). We achieved a score for each item by dropping the lower of the two scores for those body parts with separate left and right side sub-questions.

We also obtained data on the subject's age, gender, job category, years of experience, and usual shift worked. We included two five-point Likert scales asking how often the subject used patient-handling equipment and how often they obtained assistance from a coworker for performing patient handling tasks.

2.4. Data collection procedures

From August 5 to 18, 2001, a single data collector recorded the information described above on all subjects' manual handling workloads and associated risk factors. Half of the subjects were assessed in the first week and half in the next. To confirm that the required tasks and their frequencies were correct as gathered via chart review, the data collector questioned subjects once a shift to verify their assignments and to ascertain which activities and patients required patient handling equipment. Following each subject's shift, the data collector consulted nurses' notes to determine whether all of the scheduled tasks had been completed. Immediately after the completion of one week of data collection, subjects were instructed to complete and mail in the CMDQ and a demographic questionnaire.

2.5. Response rate

Complete data were collected on 113 of the 121 subjects recruited (93.4% response rate). Two subjects (both RNs from low-risk units) dropped out before their workloads were assessed due to unwillingness to have the participation incentive reported as income. The remaining six failed to return their surveys for unknown reasons. Two of these were RNs from low-risk units, three were NAs from high-risk units, and the sixth was an LPN from a high-risk unit. With post hoc calculations, this sample size had a power of 0.73 to detect a moderate effect of R^2 of 0.10, α of 0.05.

2.6. Demographics and sample description

See Table 2 for a summary of selected demographic and workload characteristics.

2.7. Limitations

The tool used to collect data on the number and type of lifts performed focused on assigned patients and did not capture incidental handling and movement activities. Incidental handling and movement activities include those that the participant performed on patients to whom they were not assigned or physically stressful tasks not associated with a patient, such as pushing equipment or empty beds. This data collection tool was of unknown reliability and validity. In addition, because this study used methods other than direct observation or videotaping for estimating the number of times a staff member performed particular tasks, frequencies of high-risk activities could have been under- or over-recorded. The musculoskeletal discomfort self-report instrument (CMDQ) may lack sufficient sensitivity and specificity to differentiate between the true positives and the true negatives for musculoskeletal discomfort. Also, the CMDQ makes no distinction between musculoskeletal discomfort associated with work activities versus that due to other non-work related activities, such as hobbies or sports, and it does not differentiate between chronic and acute pain.

Because the evidence is inconclusive on the influence of host factors (e.g., height, weight, physical fitness, and smoking habits) on the etiology of WMSDs (National Research Council, 2001), the authors did not collect anthropomorphic or other health information from the subjects. This study examined only physical risk factors for musculoskeletal discomfort in nursing staff. It did not assess the influence of psychosocial factors, thought by some researchers to act synergistically with heavy workload to produce musculoskeletal discomfort.

Because this study was cross-sectional, cause and effect cannot be ascribed to the findings. This study had only a small number of participants who did not perform any at-risk patient handling and movement tasks. The study was of brief duration and used a convenience sample of direct care nursing staff.

Table 2
Sample characteristics

Variable	N	Percent
Gender		
Female	100	88%
Male	13	12%
Type of nurse		
Registered nurse	58	51%
Licensed practical nurse	30	27%
Nursing aide	25	22%
Level of risk of assigned unit		
Low risk unit[a]	42	37%
High risk unit	71	63%
Variable	**Mean**	**SD***
Age	42	10.7
Years of experience	13.0	10.7
Hours worked during study week	38	8.0
Average weight of patients handled/moved	169	37.5

[a] High risk units had the highest reported numbers of back injuries in nursing staff, while low risk units had lower numbers of back injuries.

* Standard deviation of the mean.

3. Results

3.1. Musculoskeletal discomfort

Sixty-two percent of the subjects experienced discomfort at or above the moderate severity level in at least one body part in the 7 days prior to questionnaire completion. Surprisingly, there was no significant difference in the prevalence of musculoskeletal discomfort between nursing personnel who worked on high- versus low-risk units (66% versus 57%). Furthermore, age was not correlated with prevalence of musculoskeletal discomfort. However, the prevalence of musculoskeletal discomfort was significantly higher in females (66%) than in males (31%) ($\chi^2[1, N = 113] = 6.1$, $p = 0.014$).

3.2. High-risk task analysis

Two regression models were significant ($p = <.05$). The first model included the number of highest-risk tasks performed per hour and the number of patients weighing 212 pounds (96.4 kg) or more,[2] as well as an interaction variable to predict frequency of knee pain

[2] The weight of 212 pounds (96.4 kg) reflects the level above which the heaviest 20% of the US male population is represented.

Table 3
Model 1: Summary of linear regression analysis for variables predicting frequency of knee discomfort ($N = 113$)

Variable	B	$SE\ B$	β
(Intercept)	0.336	0.158	
Number of highest risk tasks per hour (N)	0.060	0.191	−0.030
Number of patients ⩾212 pounds (96.4 kg)[a] (P)	0.195	0.065	0.290*
Interaction variable[b]: $N \times P$	−0.166	0.125	−0.131

Note: $R^2 = 0.080$. $^*p < 0.05$. Significance of overall regression $p < 0.05$ (0.027). B = unstandardized regression coefficient; $SE\ B$ = standard error of B; β = standardized regression coefficient.

[a] The weight of 212 pounds (96.4 kg) reflects the level above which the heaviest 20% of the US male population is represented.

[b] Interaction variable (highest-risk tasks per hour × # patients ⩾212 pounds [96.4 kg]).

Table 4
Model 2: Summary of linear regression analysis for variables predicting frequency of wrist discomfort ($N = 113$)

Variable	B	$SE\ B$	β
(Intercept)	0.108	0.127	
Number of highest risk tasks per hour (N)	0.322	0.153	0.203*
Number of patients ⩾212 pounds (96.4 kg)[a] (P)	0.062	0.053	0.113
Interaction variable[b]: $N \times P$	0.208	0.100	0.202*

Note: $R^2 = 0.095$. $^*p < 0.05$. Significance of overall regression $p < 0.05$ (0.012). B = unstandardized regression coefficient; $SE\ B$ = standard error of B; β = standardized regression coefficient.

[a] The weight of 212 pounds (96.4 kg) reflects the level above which the heaviest 20% of the US male population is represented.

[b] Interaction variable (highest risk tasks per hour × # patients ⩾212 pounds [96.4 kg]).

(Table 3). The second model included the same variables to predict wrist pain (Table 4). Logistic regression for the same predictor variables was also significant for both knee and wrist. Neither linear nor logistic regressions were significant for predicting frequency of back discomfort.

NAs performed significantly more high-risk tasks than licensed nurses (Table 5). However, a chi-square analysis found no significant difference in the prevalence of at least moderate musculoskeletal discomfort in at least one body part among RNs, LPNs, and NAs ($\chi^2[1, N = 113] = 0.65$, $p = 0.419$). Consistent with their

Table 5
At-risk tasks per hour by job category

Job category	N	M	SD
Registered nurse	58	0.74	0.54
Licensed practical nurse	30	1.06	0.62
Nursing aide	25	1.82*	0.70
Total	113	1.06	0.73

* Difference $p \leqslant 0.05$ using Games-Howell t-test.

Table 6
Analysis of variance for highest risk tasks per hour by high risk/low risk unit

Source	SS	df	MS	F	η^2	p
Highest risk tasks per hour	3.7	1	3.7	13.7	0.11	0.000
Within groups	30.1	111	0.27			

categorization into high- and low-risk units based on employee injury incidence, there were significantly more Category III tasks performed per hour on high-risk units than on low-risk units (0.70 versus 0.33, respectively) (Table 6). The following variables had no predictive effect on musculoskeletal discomfort frequency or severity: patient-to-nurse ratio, patient classification rating (dependency level), or the availability of patient-handling equipment.

4. Discussion

The age and gender distribution of the sample reflected the nursing staff demographics at the facility as well as national demographics for US nurses (i.e., nurses are primarily over the age of 40 and female) (US General Accounting Office, 2002). The majority of study subjects (64%) were drawn from high-risk units. Propensity to volunteer may have been related to the degree of musculoskeletal discomfort the staff member was experiencing, which could have produced a biased sample. However, there is no indication that the prevalence rate for this sample was higher than that found in other studies of nurses using a similar questionnaire (Menzel, 2004). The 7-day prevalence rate of 62% for musculoskeletal discomfort in at least one body part is close to the 30-day prevalence of 64% that a previous study found for the same facility's population of nurses (unpublished data). Other studies using the Nordic Musculoskeletal Questionnaire (NMQ) (Kuorinka et al., 1987), on which the CMDQ is based, reported 7-day prevalence rates of 69% for neck, shoulder, upper and lower back pain in Swedish nurses (Josephson et al., 1997) and 61.2% for back pain in

German nurses (Hofman et al., 2002). A survey of 1163 US nurses using a modified version of the NMQ found the 1-year prevalence rate for musculoskeletal pain in at least one body part to be 72.5% (Trinkoff et al., 2002).

The lack of variance in the prevalence of musculoskeletal discomfort between high-and low-risk units may have contributed to the lack of significant findings in most of the regression analyses by failing to provide sufficient contrast. The similar prevalence rate of musculoskeletal discomfort among subjects from high-risk and low-risk units indicates the need for groups of equal sizes and a larger sample size to detect differences. The healthy worker effect may have contributed to this lack of contrast, as nurses who develop WMSD request transfers to units perceived to have less dependent patients (Hartvigsen et al., 2001). In addition, the high annual prevalence of back pain in the general population of up to 56% (Taylor and Curran, 1985) also indicates a need for a larger sample to detect associations between work-related risk factors and back pain.

The finding that NAs have a significantly heavier workload than RNs supports what has been previously reported in the literature (Banaszak-Holl and Hines, 1996; Estryn-Behar et al., 1990; Videman et al., 1984). However, in this study, despite an exposure to risky tasks that was 2.5 times higher (Table 5), NAs did not have a significantly higher musculoskeletal discomfort than RNs. Because NAs have both a higher number and a higher rate of lost-time claims for WMSDs than either RNs or LPNs in the US, this finding may support only a limited association between musculoskeletal discomfort and lost-time workers' compensation claims. The disparity in the lost-time injury claim rates may reflect NAs' higher rates of exposure to manual handling tasks or to other factors that increase the likelihood for lost time associated with a WMSD claim, such as economic gain from receiving workers' compensation benefits, which in the US includes the cost of medical care and wage replacement (indemnity). However, it may also reflect an increased propensity for NAs to report work-related injuries due to factors not identified in this study, such as lower job satisfaction, a factor that has been linked to workers' compensation claims (Bigos et al., 1992). At the same time, NAs, who are the lowest paid of all direct care staff, may have second jobs that increase their lifting exposure and associated cumulative trauma.

4.1. Self-reported pain

Pain is subjective and influenced by many psychosocial and physical variables. That male staff members reported significantly less pain than females is consistent with studies in the pain literature that have found similar gender difference in reporting pain (Fillingim and Maixner, 1995; Robinson et al., 2001). The finding that nearly two-thirds of the subjects were working with pain of at least moderate severity may have implications for quality of nursing care; caregivers experiencing pain may try to avoid discomfort by limiting high risk tasks, such as turning, giving bed baths, or changing of bed linens. However, this premise awaits further investigation.

4.2. Cumulative trauma

The finding that highest-risk tasks combined with patient weight has no association with the prevalence or severity of musculoskeletal discomfort in body regions other than the wrist and knee runs counter to the cumulative trauma model described in the literature (National Research Council, 2001). According to this model, it is the accumulation of external loads over time that ultimately exceeds the musculoskeletal system's ability to withstand the stress of patient handling tasks. If the cumulative trauma model is correct, the frequency at which subjects performed the highest-risk patient-handling tasks should have been associated with prevalence and severity of musculoskeletal discomfort in the shoulders and lower back. There are several possible explanations as to why these findings did not support the model. The aggregation of tasks into three risk grades may have concealed relationships between particular tasks and musculoskeletal discomfort. Furthermore, tasks may have been grouped into the highest-risk category inappropriately. It is also possible that the use of patient handling equipment shifted the load from the back to other body parts, such as to the hands for lifts involving the use of full body slings. Further, data were not available on whether patient-handling equipment was used correctly.

5. Conclusions and recommendations

Although the cumulative workload of highest-risk patient-handling tasks did not explain the variation in back pain among caregivers in this sample, there was an association with knee and wrist pain. With the introduction of new lifting technology and the increase in weight of US patient populations, WMSDs in those body parts among nursing personnel may rise. Previous prevalence rates for hand/wrist pain in nurses range up to 14% and for knees up to 20% (Daraiseh et al., 2003). Lifting equipment has been tested to evaluate its ability to reduce back compressive force (Nelson et al., 2003). However, little attention has been given to the possibility of stress shifting to other body parts, such as hands and wrists when applying and manipulating slings or manually pumping some types of lifts. Awkward postures assumed when guiding lifts loaded with patients may stress knees. Employers, once patient-handling equipment is in place, should remain alert for the possibility of risk shifting from the back to other body parts by scrutinizing injury and illness logs and be prepared to take exposure-reduction steps. Wrist and hand injuries may also increase due to the increasing use of computers in US hospitals and the new government requirement for bar coding all medications (US Food and Drug Administration, 2004), which requires repeated high pinch pressure to open bar coded unit dose packages.

It is possible to draw from this study a number of recommendations for future research into the important area of work-related musculoskeletal injuries in nursing personnel. The method used in this study to assess the physical workload of nursing personnel may provide more detail than subject-completed recall surveys alone. However, to quantify the total workload more accurately, the method should be expanded to include incidental tasks not formally associated with a subject's assignment, such as assisting another nurse in moving or handling patients or pushing equipment or beds. Incidental tasks add to a nursing staff member's manual handling burden and are unequally distributed. Data collection should also be expanded to include the number of staff members assisting the subject during high-risk tasks. In addition, psychosocial factors (e.g., job satisfaction, stress, social support, second jobs) identified as possible predictors of WMSDs should be assessed concurrently with cumulative load. Finally, collecting subjects' anthropometric data would allow assessment of the role of these factors, if any.

For economic reasons, US employers and insurers are most interested in the outcome variable of WMSD-related workers' compensation claim incidence and severity. However, little is known about the factors that precipitate nursing staff members to file such claims. Additional research is needed on whether nursing staff members are most likely to file a claim after an acute WMSD or after a long period of chronic low-level persistent discomfort. Nelson (1996, unpublished data) found that nurses reported an acute injury only when it could be attributed to a specific patient. For chronic pain, the nurses waited to report until pain and limitation of function exceeded the individual's tolerance level. Additional information is needed on the effect of perceived stress and working conditions on propensity to report injury. To determine whether musculoskeletal discomfort is a leading risk for workers' compensation claims in the US, particularly in light of its high prevalence among working staff members, prospective studies are needed to assess discomfort levels before the reporting of a WMSD, at the time of filing of a worker's compensation claim, and before return to work. It has not been demonstrated that reducing the prevalence of WMSD-related discomfort will result in fewer claims filed or reduce their severity. Finally, further research is needed on the relationship between the presence of musculoskeletal discomfort in nursing personnel and whether it affects the quality of patient care.

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