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Association between perceived inadequate staffing and musculoskeletal pain among hospital patient care workers

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Abstract

Objective—To examine association between perceived inadequate staffing and musculoskeletal pain and to evaluate the role of work-related psychosocial and physical work factors in the association among hospital patient care workers.

Methods—A cross-sectional study was conducted among 1572 patient care workers in two academic hospitals. Perceived inadequate staffing was measured using the ‘staffing adequacy subscale’ of Nursing Work Index, which is a continuous scale that averages estimates of staffing adequacy by workers in the same units. Musculoskeletal pain (i.e. neck/shoulder, arm, low back,

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lower extremity, any musculoskeletal pain, and the number of area in pain) in the past 3 months was assessed using a self-reported Nordic questionnaire. Multilevel logistic regression was applied to examine associations between perceived inadequate staffing and musculoskeletal pain, considering clustering among the workers in the same units.

Results—We found significant associations of perceived inadequate staffing with back pain (OR: 1.50, 95% CI: 1.04, 2.15) and the number of body area in pain (OR: 1.42, 95% CI: 1.01, 2.00) after adjusting for confounders including work characteristics (job title, having a second job or not, day shift or not, and worked hours per week). When we additionally adjusted for physical work factors (i.e. use of a lifting device, and the amount of the time for each of five physical activities on the job), only the association between perceived inadequate staffing and back pain remained significant (OR: 1.50, 95% CI: 1.03, 2.19), whereas none of the associations was significant for all of musculoskeletal pains including back pain (OR: 0.92, 95% CI: 0.66, 1.41) when we additionally adjusted for work-related psychosocial factors (i.e. job demands, job control, supervisor support, and co-worker support) instead of physical work factors.

Conclusions—Perceived inadequate staffing may be associated with higher prevalence of back pain and work-related psychosocial factor may play an important role in the potential pathway linking staffing level to back pain among hospital workers.

Keywords

Inadequate staffing; musculoskeletal pain; health care; back pain; hospital worker

Introduction

Staffing adequacy in hospitals continues to be a serious issue with detrimental consequences for the quality of care delivered in the US (Kane et al. 2007; Lang et al. 2004; Weinstein et al. 2008). A growing number of studies and meta-analytic reviews show that inadequate staffing can degrade the quality of patient care and threaten patient safety (Christine et al. 2002; Needleman et al. 2002). A high patient-to-nurse ratio is related to an increase in patient mortality within 30 days of admission (Aiken et al. 2002) and neonatal mortality in preterm infants (Hamilton et al. 2007). Likewise, inadequate staffing is associated with an increase in pneumonia and urinary tract infection after major surgery (Christine et al. 2002; Kovner and Gergen 1998). In addition, inadequate staffing has been shown to increase nosocomial infection rates because it decreases patient care workers' hand-hygiene compliance and increases movement of patients and staff between hospital wards (Archibald et al. 1997; Clements et al. 2008; Fridkin et al. 1996).

Despite mounting evidence linking inadequate hospital staffing to patients' outcomes, relatively little is known about the associations between inadequate staffing and workers' health outcomes. Since inadequate staffing could increase the psychological and physical demands and pace of patient care workers' jobs, it could place them at high risk for occupational injuries such as needlestick injuries and musculoskeletal disorders (MSDs) (Clarke 2007; Clarke et al. 2002). However, it is not clear whether inadequate staffing is associated with MSDs among hospital patient care workers despite their high prevalence of MSDs (Engels et al. 1996). In a qualitative interview study of 218 nurses who sustained a

back injury at a Canadian tertiary care hospital, 30 (13.8 %) of the nurses cited inadequate staffing as the main cause of their injury (Yassi et al. 1995). Trinkoff et al found a significant relationship between nursing home staffing levels and injury rates including MSDs in 445 nursing homes after adjusting for organizational characteristics, although the design of the study raises the possibility of ecological bias (Trinkoff et al. 2005). However, one empirical study of nurses, which analyzed the individual level data, found no statistically significant association between staffing level and musculoskeletal injury and any injury among nurses in intensive care units (Stone and Gershon 2006).

Therefore, the goal of this study was to add to the evidence by testing the hypothesis that workers within units that perceive inadequate staffing have a higher prevalence of MSDs. In this study, we first estimated perceived inadequate staffing at the unit level using the average score of individual's perceived staffing level from patient care workers in the same units. Workload is usually shared among workers within the unit; therefore, this measure captures the collective experiences of the workers in a unit (Clarke et al. 2002; Hofmann and Mark 2006). We then examined the association between perceived inadequate staffing and musculoskeletal pain after adjusting for potential confounders. Finally, we sought to evaluate how the associations changed when we additionally adjusted for potential intermediate factors linking inadequate staffing to musculoskeletal pain: work-related psychosocial factors (i.e. job demands, job control, supervisor support, and co-worker support) and physical work factors (i.e. use of a lifting device, and the amount of time on the job for each of five physical activities).

Materials and Methods

Study population

Our study sample was part of the "Be Well Work Well" study which was conducted by the Harvard School of Public Health Center for Work, Health and Wellbeing. The study included a cross-sectional survey of 2000 randomly selected patient care workers in two large academic hospitals in the metropolitan Boston area between October 2009 and February 2010. The study was designed to evaluate associations between organizational policies and practices along with physical and psychosocial exposures on the job and workers' health behaviors and health outcomes.

Eligible participants included registered nurses, licensed practical nurses, and patient care/nursing assistants with direct patient care responsibilities. Patient care workers assigned to the "float" unit were eligible to participate in the survey but we excluded those in environmental services and physical medicine units (e.g., physical therapy, occupational therapy), traveling or contract nurses, and those who were on an extended absence greater than 12 weeks. We provided incentives in the form of $20 gift card for the workers who completed surveys. A detailed description about the eligibility of survey participants and the process of data collection are provided elsewhere (Sorensen et al. 2011). All workers provided signed informed consent and all project materials and methods were approved by the Institutional Review Board of the Partners HealthCare.

From 1572 patient care workers who participated in the survey, we excluded survey participants with missing values for any covariates used in the analyses. As a result, we analyzed a total of 1339 patient care workers in 105 units including 12 different types of units (i.e. emergency department, operating room, adult medical/surgical, adult intensive care, step-down, pediatric medical/surgical, pediatric/ neonatal intensive care, psychiatry, obstetrics/postpartum, float pool, ambulatory units and orthopedics)

Independent measure: perceived inadequate staffing

Perceived staffing adequacy was measured by four questions from the staffing adequacy subscale of the Nursing Work Index-Revised questionnaire (Aiken and Patrician 2000), which is commonly used to measure the professional nursing practice environment and has been shown to have a high reliability and validity(Aiken and Patrician 2000; Vahey et al. 2004). The questions were: In the last year on your unit, how often has there been: (1) enough patient care workers to get the work done? (2) enough registered nurses' to provide necessary patient care? (3) adequate support services to allow patient care staff to spend time with patients? (4) enough time to discuss patient care problems with other staff? For each question, five ordinal answers were available (1: always, 2: often, 3: sometimes, 4: rarely, 5: never). The Cronbach's alpha among four questions was 0.84. We opted to use a unit level aggregation of responses as the exposure variable for several reasons. First, patient care workers usually share workload with others on the unit (Clarke et al. 2002; Hofmann and Mark 2006; Mark et al. 2007). Also, the NWI-R was developed to measure staffing adequacy as an organizational attribute instead of an individual-level trait (Aiken and Patrician 2000). To calculate unit level staffing adequacy, we first calculated the average score of responses for the four questions for each worker. Then, we estimated an average of the resulting score among workers in the same units, reflectingthe average score for each of the 105 units could have ranged from 1 to 5, but the actual distribution ranged from 1.25 to 3.75 with the higher score indicating inadequate staffing level on the unit.

Outcome measures

Musculoskeletal pain in the past 3 months—Musculoskeletal pain was assessed for the past 3months based on the Standardized Nordic Questionnaire for musculoskeletal symptoms (Kuorinka et al. 1987; Trinkoff et al. 2006). Specifically we asked, "During the past 3 months, have you had pain or aching in any of the areas shown on the diagram?" The areas were lower back, shoulder, neck, wrist or forearm, knee, ankle or feet, and none of the above. We combined responses for the neck and shoulder into a single neck/shoulder area and the responses for the knees, ankle and feet were grouped into a single lower extremity body area. We then created an ordinal variable of the number of body areas in pain (0 to 4) by summing the responses. We also created a variable of any musculoskeletal pain to assess whether worker had a pain at least one body part (coded as 1) with those who did not have any pain (coded as 0) as referent.

Covariates—We considered individual demographic variables, occupational conditions (i.e. job title, hours worked per week, and shift) and BMI, which may be associated with both perceived staffing adequacy and musculoskeletal pains, as potential confounders (Camerino et al. 2010; Dex and Bond 2005; Eriksen et al. 2004; Trinkoff et al. 2006). All

potential confounders were included as categorical dummy variables: age (18–24 years, 25–34 years, 35–44 years, 45–54 years, 55–64 years, > 65 years); race (Hispanic, White, Black, and mixed race/others); job title (staff nurse, patient care associate, and others including assistant nurse manager, clinical nurse specialist, and operational coordinator); shift work (working only on daytime or not) (Camerino et al. 2010; Eriksen et al. 2004).; hours worked per week (<30 hours, 30–34 hours, 35–39 hours, 40–44 hours, >45 hours) (Dex and Bond 2005; Trinkoff et al. 2006); having a second job or not; and BMI (<25 kg/m^2, 25–29.9 kg/m^2, ≥30kg/m^2).

Work-related psychosocial factors and physical work factors—We assessed work-related psychosocial factors and physical work factors to understand their role in the association between perceived inadequate staffing and musculoskeletal pain. Four different work-related psychosocial factors were measured using a modified the Job Content Questionnaire (Karasek et al. 1998; Karasek 1979; Landsbergis et al. 2002): psychological demands (5 items) and decision latitude (9 items) (Ariens 2001; Grönlund 2007), supervisor support (2 items) and co-worker support (3 items) (Eriksen et al. 2004; Pisarski et al. 2008). Each of four work-related psychosocial factors was included in the data analysis as a continuous variable.

Six different physical work factors were measured: the amount of the time on the job for each of five physical activities on the job and use of a lifting device. Five different physical activities on the job were assessed using questions asking patient care workers to “estimate how much of a typical shift you spend: a) sitting, b) standing, c) walking, d) lifting and carrying, e) pushing and pulling” [Reis, et al. 2005]. The five-point scale response (all, more than half, about half, less than half, and none) was included as a categorical variable with response “all” as a reference in the data analysis. Use of a lifting device was measured using a question ‘‘In general, when a patient needs to be moved, how often do you use a lifting device?’’ was used to assess use of a lifting device. Workers could answer in a five ordinal scale from “never” to “always” or “not applicable” indicating that they do not move patient on their job and their response was included as a categorical variable with response “never” as a referent group.

Statistical analyses

The analysis took the hierarchical data structure where patient care workers were nested within units into account. We applied multilevel logistic regression with a random intercept at the unit level to examine the relationship of perceived inadequate staffing with musculoskeletal pain (i.e. pain in neck/shoulder, arm, low back, lower extremity and any musculoskeletal pain) in the past 3 months considering clustering among workers in the same units. For the association between perceived inadequate staffing and the number of body areas in pain, we applied multilevel ordinal logistic regressions considering an ordinal scale of the variable. We confirmed that the proportional odds assumption for the ordinal logistic regression was not violated. All analyses were performed using STATA/SE version 11.0 (StataCorp, College Station, TX).

Results

Among 1,288 hospital patient care workers, 90.2% were female, 81.7% were non-Hispanic white and 73.3% were staff nurses (Table 1). Most patient care workers did not have a second job (85.5%) and worked a shift other than a regular day shift (71.0%). Table 2 displays the distribution of self-reported musculoskeletal pain in the past 3 months. The highest prevalence of musculoskeletal pain was for the self-reported low back pain (54.3%) and the lowest prevalence was for the arm pain (10.5%) (Table 2).

We found significant associations of perceived inadequate staffing with back pain (OR: 1.50, 95% CI: 1.04, 2.15) and the number of body area in pain (OR: 1.42, 95% CI: 1.01, 2.00) after adjusting for confounders including work characteristics (job title, having a second job or not, day shift or not, and worked hours per week). When we additionally adjusted for physical work factors (i.e. use of a lifting device, and the amount of time on the job for each of five physical activities), only the association between perceived inadequate staffing and low-back pain remained significant (OR: 1.50, 95% CI: 1.03, 2.19) whereas the association between perceived inadequate staffing and the number of body areas in pain was attenuated and became non-significant (OR: 1.34, 95% CI: 0.95, 1.90). However, when we adjusted for work-related psychosocial factors (i.e. job demands, job control, supervisor support, and co-worker support) instead of physical work factors in addition to other confounders, all of the associations between perceived inadequate staffing and musculoskeletal pain including back pain (OR: 0.92, 95% CI: 0.66, 1.41) were attenuated and became non-significant (Table 3).

Discussion

We found that perceived inadequate staffing would be associated with musculoskeletal pain (i.e. back pain and the number of body areas in pain) in the past 3 month, after adjusting for confounders including work characteristics (job title, having a second job or not, day shift or not, and worked hours per week).The association between perceived inadequate staffing and back pain was robust when we additionally adjusted for physical work factors (i.e. use of a lifting device, and the amount of time on the job for each of five physical activities) whereas the association was almost completely attenuated and became non-significant when we additionally adjusted for work-related psychosocial factors (i.e. job demands, job control, supervisor support, and co-worker support). These findings suggest that work-related psychosocial stress may play an important role in the pathway linking perceived inadequate staffing to low back pain.

The observed significant association between perceived inadequate staffing and back pain and the number of body area in pain are supported by the findings from one qualitative study (Yassi et al. 1995) and one ecological study (Trinkoff et al. 2005) that reported the potential association between understaffing and musculoskeletal pain among patient care workers. However, our study is different from a previous study of health care workers, which reported no statistically significant association between low staffing level and MSDs (i.e. any reported injury or disability to the upper or lower back, neck, and feet) (Stone and Gershon 2006). One possible reason for this discrepancy is that the previous study assessed MSD as

self-reported injury or disability which may represent more severe health condition than self-reported pain.

Our finding suggests that work-related psychosocial stress may play an important role in the association between perceived inadequate staffing and musculoskeletal pain, particularly low-back pain. Because we adjusted for four different work-related psychosocial factors simultaneously, we examined how the association between perceived inadequate staffing and back pain is changed when we adjust for each of four work-related psychosocial factors separately as a post-hoc analysis. We observed the greatest attenuation in association between perceived inadequate staffing and back pain when we adjusted for job demand (OR: 1.10, 95 CI: 0.75, 1.60) in addition to potential confounders (i.e. age, race, gender, job title, having a second job or not, day shift or not, worked hours per week, and BMI) although the other three psychosocial factors attenuated more than 20% of the observed associations. These findings could be supported by the previous findings reported the importance of work-related psychosocial factors, particularly job demand, on musculoskeletal pain (Eriksen et al. 2004). Lang et al reviewed 23 longitudinal studies across different industries including health care, clerical, and manufacturing and found that psychosocial work stressors had significant effects on the development of musculoskeletal problems (Lang et al. 2012). Furthure study is required to examine the role of work-related psychosocial factors in the relationship linking inadequate staffing to other occupational health outcomes among patient care workers, such a s needlestick injuries (Clarke 2007; Clarke et al. 2002), burnout (Aiken et al. 2002), and assault by patients (Lanza et al. 1997).

Several limitations of this study should be noted. Worker-reported assessments of inadequate staffing would be less likely to reflect actual staffing levels compared to previous studies that estimated staffing levels using nurse-to-patient ratio from administrative data (Aiken et al. 2002; Clarke et al. 2002). However, several studies reported that the nurse patient ratio may have weakness as a measure of sufficient staffing because sufficient nurse-patient ratio could be different based on several factors including characteristics of the patient or nurse in the unit (Kane 2004; Unruh 2008). Therefore, a nurse-patient ratio that is considered as sufficient staffing on one unit could not be applied to another unit. We assessed inadequate staffing using a standardized questionnaire, the staffing adequacy subscale of the Nursing Work Index-Revised questionnaire (Aiken and Patrician 2000), which was developed explicitly to assess nursing practice environment. Although this aggregate self-reported measure of inadequate staffing is more likely to be influenced by worker's perception compared to the nurse-patient ratio, our measure may capture aspects of inadequate staffing not measured by the nurse-patient ratio in administrative data (Unruh 2008). Future studies need to examine how worker-perceived inadequate staffing is related to nurse-patient ratio from administrative data and how these two different measures can be used to understand the association between inadequate staffing and occupational health outcome among patient care workers.

In addition, because of the cross-sectional survey design, we cannot rule out the possibility of a reverse causation. For example, there could be a recall bias such that workers who were injured or had musculoskeletal pain were more likely to report an unfavorable staffing level at their unit during last year. Another possibility is that workers with musculoskeletal pain

might perceive the same staffing level as inadequate compared with those without because of their functional limitation. However, because perceived inadequate staffing was assessed as the average score of patient care workers within each unit and the potential bias caused by individual reporting would not fully explain the association we observed. Furthermore, this cross-sectional evidence can provide motivation to examine these associations in prospective cohorts.

As a final limitation, our findings about the non-significant role of physical work factors in the association between perceived inadequate staffing and back pain should be interpreted cautiously. Although we assessed use of a lifting device and the amount of the time on the job for each of the five physical activities and also applied multilevel modeling to consider different physical workloads between units, there could be physical exposures related to musculoskeletal pains that were not considered in this research. Previous studies reported other physical exposures such as self-reported awkward posture (Trinkoff et al. 2003b) or biomechanical factors such as higher peak lumbar shear or higher cumulative lumbar disc compression (Grieco et al. 1998; Kerr et al. 2001) as significant risk factors for musculoskeletal pain.

There are also strengths in this study. First, we examined the association of unit-level understaffing with musculoskeletal pains, which have been cited as top safety concern among nurses (Trinkoff et al. 2003a; Trinkoff et al. 2006). Second, we investigated the association after adjustment for potential confounders such as hours worked per week, having a second job or not and job title.

Little is known about its association with patient care workers' musculoskeletal pain although safe work environment could be one step to improve patient safety (Burström and Fredlund 2001; Sorensen et al. 2011). This study found that perceived inadequate staffing is associated with low back pain and the number of body areas in pain in the past 3 months among hospital patient care workers. In addition, our findings suggest that work-related psychosocial factors may play an important role in the pathway linking staffing level to low back pain among hospital workers. More research studies of adequate staffing, particularly with a prospective study design, are required in order to make hospitals safer places for both workers and patients.

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Table 1

Distribution of study population by key covariates (N=1,339)

Characteristics	Distribution	
	N	%
Gender		
Male	131	9.8
Female	1,208	90.2
Age (years)		
18 – 24	97	7.2
25 – 34	365	27.3
35 – 44	322	24.1
45 – 55	358	26.7
55 – 65	183	13.7
65 -	14	1.1
Race		
Hispanic	50	3.7
White, non-Hispanic	1,091	81.5
Black, non-Hispanic	125	9.3
Other	73	5.5
Education		
Grade 12/GED or less	55	4.1
1–3 years of college	309	23.1
Baccalaureate degree	737	55.0
Graduate degree	238	17.8
Job title		
Staff Nurse	978	73.0
Patient Care Associate	86	6.4
Others	275	20.5
Hours worked per week		
< 30	315	23.5
30–34	161	12.0
35–39	392	29.3
40–44	414	30.9
> 45	57	4.3
Having a second job		
Yes	195	14.6
No	1,144	85.4
Having only day shift, %		
Yes	954	71.3

Characteristics	Distribution	
	N	%
No (also night shift)	385	28.8
BMI (Kg/m2)		
18–24.9	657	49.1
25 – 29.9	400	29.9
≥ 30	282	21.1
	Mean (SD)	Min-Max
Perceived inadequate staffing		
Individual-level	2.28 (0.69)	1.00 ~ 5.00
Unit-level[a]	2.28 (0.33)	1.25 ~ 3.75

[a]The average score of perceived inadequate staffing using the responses of individual workers in the same units

Table 2

Distribution of self-reported musculoskeletal pain among hospital patient care workers (N=1,339)

Characteristics	Distribution	
	N	%
Neck/Shoulder pain	577	43.1
Arm pain	144	10.8
Low back pain	719	53.7
Lower extremity	503	37.6
Any musculoskeletal pain	1,004	75.0
Number of areas in pain		
0	335	25.0
1	372	27.8
2	375	28.0
3	207	15.5
4	50	3.7

Table 3

Association between perceived inadequate staffing[a] and self-reported musculoskeletal pain during the past week among hospital patient care workers

Self-reported musculoskeletal disorders	Unadjusted (N=1,399)		Adjusted[b] (N=1,399)		Adjusted + Physical work factors[c] (N=1,288)		Adjusted + Psychosocial factors[d] (N=1,248)	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Neck/Shoulder pain	1.33	(0.92, 1.93)	1.30	(0.89, 1.92)	1.24	(0.82, 1.88)	1.07	(0.70, 1.63)
Arm pain	1.25	(0.72, 2.15)	1.38	(0.82, 2.32)	1.19	(0.66, 2.12)	1.00	(0.56, 1.77)
Low back pain	1.49*	(1.04, 2.13)	1.50*	(1.06, 2.14)	1.50*	(1.03, 2.19)	0.96	(0.66, 1.41)
Lower extremity	1.15	(0.77, 1.73)	1.21	(0.79, 1.84)	1.10	(0.70, 1.73)	0.99	(0.63, 1.54)
Any musculoskeletal pain	1.36	(0.90, 2.07)	1.36	(0.88, 2.09)	1.20	(0.77, 1.87)	0.93	(0.57, 1.51)
Number of area in pain	1.42*	(1.02, 1.99)	1.42*	(1.01, 2.00)	1.34	(0.95, 1.90)	1.01	(0.70, 1.47)

Note. OR = odds ratio, CI = confidence interval

[a] The average score of perceived inadequate staffing using the responses of individual workers in the same units, ranged from 1.25 to 3.75

[b] Adjusted: Adjusted for age, race, gender, job title, having a second job or not, day shift or not, worked hours per week, and BMI

[c] In addition to the adjusted model, additionally adjusted for physical work factors including use of a lifting device, and the amount of time on the job for each of five physical activities on the job (i.e. sitting, standing, walking, lifting and carrying, pushing and pulling)

[d] In addition to the adjusted model, additionally adjusted for work-related psychosocial factors (i.e. job demands, job control, supervisor support, co-worker support)

* $p<0.05$,

** $p< 0.01$

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