



Scheduling and shift work characteristics associated with risk for occupational injury in newly licensed registered nurses: An observational study



Amy Witkoski Stimpfel^{a,*}, Carol S. Brewer^{b,1}, Christine T. Kovner^{a,2}

^a New York University College of Nursing, 433 First Avenue, 6th Floor, New York, NY 10010, USA

^b University at Buffalo School of Nursing, 210 Wende Hall, Buffalo, NY 14214-3079, USA

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ABSTRACT

Background: Registered nurses across the globe bear a heavy injury burden. Every shift, nurses are exposed to a variety of hazards that can jeopardize their health, which negatively impacts their ability to provide high-quality patient care. Previous research suggests that inexperienced, or newly licensed nurses, may have an increased risk for certain occupational injuries. However, the current knowledge base is insufficient to fully understand how work hours influence newly licensed nurses' occupational injury, given the significant variation in hospital organization and work characteristics.

Objective: To describe newly licensed nurses' shift work characteristics and determine the association between shift type and scheduling characteristics and nurse injury, before and after adjusting for individual and combined effects of demographics, external context, organizational context, and work context, following the Organization of Work model.

Design: This study is a secondary analysis of a nationally representative survey of newly licensed registered nurses using a cross-sectional design.

Participants: The analytic sample includes 1744 newly licensed registered nurses from 34 states and the District of Columbia who reported working in a hospital and were within 6–18 months of passing their state licensure exam at the time of survey administration.

Methods: Descriptive statistics were calculated, followed by bivariate and multivariate Poisson regression models to assess the relationship between shift type and scheduling characteristics and nurse injury. Lastly, full models with the addition of demographics, external context, organizational context, and work context variables were calculated.

Results: The majority (79%) of newly licensed nurses worked 12-h shifts, a near majority worked night shift (44%), and over half (61%) worked overtime (mandatory or voluntary) weekly. Nurses working weekly overtime were associated with a 32% [incidence rate ratio (IRR) 1.32, CI 1.07–1.62] increase in the risk of a needle stick and nurses working night shift were associated with a 16% [IRR 1.16, CI 1.02–1.33] increase in the risk of a sprain or strain injury.

Conclusions: Overtime and night shift work were significantly associated with increased injury risk in newly licensed nurses independent of other work factors and demographic characteristics. The findings warrant further study given the long-term consequences of these injuries, costs associated with treatment, and loss of worker productivity.

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* Corresponding author. Tel.: +1 212 992 9387.

E-mail addresses: as8078@nyu.edu (A.W. Stimpfel), csbrewer@buffalo.edu (C.S. Brewer), ctk1@nyu.edu (C.T. Kovner).

¹ Tel.: +1 716 829 3241.

² Tel.: +1 212 998 5312.

What is already known about the topic?

- Nurses across the globe are at risk for a variety of occupational injuries, such as needle sticks and musculoskeletal injuries.
- The factors associated with injury in nurses have been studied for many years and have linked several shift length and scheduling variables to increased risk for injury.

What this paper adds

- Mirroring trends across all hospital-based nurses, we found that the majority of newly licensed nurses in this study worked 12-h shifts and most worked some form of overtime, primarily voluntary overtime.
- Scheduling and shift characteristics, specifically night shift and overtime of 8 h or more per week, are significantly associated with injury risk in newly licensed nurses.

1. Introduction

Nonfatal occupational injuries in healthcare, especially needle sticks and musculoskeletal injuries, are prevalent worldwide. These injuries burden employees, employers, and society with a range of costs – time, money, and human capital. Notably, studies spanning the globe from the United States to India to Korea have documented the disproportionate number of occupational injuries that professional nurses and nursing assistants bear (Chakravarthy et al., 2010; Clarke, 2007; Harcombe et al., 2010; Smith et al., 2006, 2009). As a large workforce engaged in direct care that involves repetitive lifting, turning, and transferring patients as well as injecting medication and inserting intravenous lines, it is easy to appreciate the hazards that nurses face every shift that they work. Despite the variation in national policy, hospital regulation, and health system sophistication, occupational injuries persist among healthcare workers (Griffith, 2013; Jagger et al., 2010).

Direct care nursing, consisting of a primarily female workforce, makes this occupational group vulnerable to musculoskeletal sprains and strains and other injuries. The factors associated with injury in nurses have been studied for many years and have linked several shift and schedule variables to increased risk for injury (Gershon et al., 2007; Hopcia et al., 2012; Lipscomb et al., 2002; Trinkoff et al., 2006, 2007). Out of this body of research, some evidence suggests that newly licensed nurses, i.e. inexperienced professional nurses, may be at increased risk for occupational injuries compared to their older, more experienced counterparts. For example, in two observational studies (Clarke, 2007; Clarke et al., 2002) and one case–control study (Canini et al., 2008) researchers observed that nurses with fewer than 5 years of experience were associated with increased odds of experiencing a needle stick; while, Patrician et al. (2011) found that experienced nurses had a protective effect against needle sticks. Inexperienced or younger nurses may incur more needle sticks because they are still developing skills, habits, and learning how to

manage work demands. Inexperience, coupled with long hours, could be especially dangerous for this group of workers transitioning to their new professional role, underscoring the need to study this population in greater depth.

1.1. Scheduling and shift work for U.S. nurses

Scheduling nurses in the hospital setting in the U.S. typically involve the clinical unit, its nursing staff, and one cost center. The methods used to assist with scheduling vary from using evidence-based staffing from professional organizations such as the American Nurses Association (2012) to using scheduling software to simply using a homemade spreadsheet (Eck Birmingham, 2010).

The number of nurses scheduled per shift varies among hospitals and depends on a number of factors, usually including annual budgets and estimated patient volume and/or acuity (Dent and Bradshaw, 2012). Some hospitals have formalized scheduling and staffing guidelines, based on state laws or based on collective bargaining agreements. Approximately 18% of U.S. nurses are union members (DPE, 2012). Other hospitals use informal scheduling or self-scheduling based on nurses' preferences and seniority, although most organizations have a time open for scheduling requests for a specified period (e.g. 6 or 8 weeks). Trading shifts, holidays, and vacation time may be negotiated among nursing staff, depending on the unit and organization. A nurse manager or formal guidelines might dictate how holidays and vacations are scheduled.

1.2. Scheduling and occupational injuries across health professions

Researchers have studied other professionals in safety sensitive industries to understand the relationship between work hours, scheduling, and safety outcomes (Barger et al., 2006, 2009). Resident physicians are also relatively inexperienced and are coping with new professional roles as they transition from medical student to physician. In a national prospective cohort study of 2737 first year residents in the U.S., lapses in concentration and fatigue were the top two reported contributing factors to percutaneous injuries. Residents working the night shift also had a higher proportion of percutaneous injuries compared with residents working on the day shift (Ayas et al., 2006). Indeed, a systematic review of residents' health and shift length found an increase in accidental exposure to blood borne pathogens during extended overnight shifts compared to regular day shifts (Reed et al., 2010).

1.3. Gaps in literature

There are few published studies with detailed information about the schedules and shift length practices of newly licensed registered nurses. Specifically, one study described the overtime patterns in newly licensed nurses relative to the overtime laws in the states where the nurses practiced, finding that overtime laws were associated with

reductions in mandatory overtime (Bae et al., 2011). An earlier study reported on basic shift type, scheduling features, and overtime of newly licensed nurses (Kovner et al., 2007a). Among the newly licensed nurses working in all settings, the majority worked 12-h shifts and almost 13% worked mandatory overtime. Aside from these studies, the literature has typically included all levels of age and experience together when examining nurses' shift patterns and practices. Thus, there is a need to study and compare newly licensed nurses to the general nursing population given their potential increased vulnerability to injury.

1.4. Conceptual framework

The Organization of Work framework provides the conceptual basis for the variables included in this study. The U.S. National Institute for Occupational Safety and Health (NIOSH) developed this framework in response to the dramatic changes in the work environment over the past several decades, resulting in increased stress levels, heavier workloads, and other factors that have led to potentially hazardous outcomes (NIOSH, 2002). The model is composed of three components. Each component represents one level of the multi-level organization of work that influences worker safety and well-being, including illness and injury. Beginning most broadly, the *external context* refers to economic, regulatory, and/or technological factors located in the workplace. *Organizational context* refers to types of management and supervisory practices as well as human resources policies. Lastly, job characteristics such as culture, worker roles, and task attributes are included in *work context*. Each component has variables which have the potential to contribute to or lead directly to worker injury or illness. The variables included in this study are described in greater detail in Section 2.

The purpose of this paper is twofold. First, we describe the type and frequency of occupational injury (i.e. needle sticks, sprains/strains) in newly licensed nurses employed in acute care hospitals by shift type and scheduling characteristics. Second, we determine the association between shift and scheduling characteristics and nurse injury, before and after adjusting for individual and combined effects of demographics, external context, organizational context, and work context.

2. Materials and methods

2.1. Study design and data

A secondary analysis of a nationally representative survey of newly licensed RNs was undertaken for this study. The data were drawn from a longitudinal parent study called the RN Work Project (<http://www.rnworkproject.org/>). The purpose of the parent study is to understand the work life and career trajectory of new nurses over a decade (2006–2016). The first wave of the RN Work Project included nurses who passed the National Council Licensure Exam (NCLEX), the examination required to become a registered nurse, between September

2004 and August 2005. The sample was chosen using a two-stage approach. Data were collected by sending a paper survey to nurses from 51 metropolitan statistical areas, geographical areas with high population densities, and 9 rural counties in 34 states plus the District of Columbia, using state board of nursing lists as a sampling frame. The sample design was modeled after the Community Tracking Survey (<http://www.hschange.com/index.cgi?data=01>), which is a national study of healthcare system changes over time. The overall response rate was 58% and the eligible responses included 3266 nurses. The survey contains nearly 100 questions measuring demographics, work setting, and work related attitudes and characteristics. Respondents to the parent study were compared to another national survey of newly licensed nurses and the two samples were similar. A full description of the parent study is explained elsewhere (Kovner et al., 2007a).

2.2. Sample

A subset of nurses from the RN Work Project was included in the present study. Nurses who responded to the parent study were included in the analytic sample if they reported working as a staff nurse in an intensive care unit, step down unit, emergency room, or general medical or surgical floor in an acute care hospital and had passed their NCLEX 6–18 months prior to when they completed the survey. This resulted in an analytic sample of 1744 RNs. This sample was similar to the parent study in terms of demographics, such as age, gender, and education however, a higher proportion of nurses in this sample worked 12-h shifts (79% versus 66%).

2.3. Variables and measurement

2.3.1. Outcomes

The two primary outcomes of interest in this study are needle sticks and sprains or strains, including back injury. In the survey, respondents indicated how often each injury occurred in their current job, with choices including zero, one, two or three or more times.

2.3.2. Predictors

Using the Organization of Work framework, predictors and covariates were classified into the domains of external, organizational, or work contexts. Under external context, unemployment by Metropolitan Statistical Area (MSA) and perceived local job opportunities were included. Increased competition for jobs, based on MSA unemployment, may influence the quality of working conditions in hospitals for the nurses (Kovner et al., 2006). The scale measuring local job opportunities consists of questions measuring the likelihood of finding a job of comparable desirability within the employee's local area, with response options ranging from 1 (very difficult) to 6 (very easy) (Price, 2001). This scale has been used by Kovner et al. (2007a,b, 2009) and Brewer et al. to understand nurses' work behavior (Brewer et al., 2012, 2013). For inclusion in the regression model, responses were dichotomized at the mean. Two variables were included under the organizational context

domain for their potential to influence the availability of jobs as well as the types of shifts and amount of overtime available: Magnet status and union/collective bargaining status. Magnet recognition is a voluntary award by the American Nurses Credentialing Center that indicates nursing excellence, high nurse satisfaction and retention, and improved patient outcomes (ANCC, 2015). The respondents also indicated if their work setting was a Magnet hospital, with a yes or no response. Respondents indicated whether the nurses are part of a collective bargaining unit or union where they work, with yes or no response.

The remaining variables were represented in the work context domain. This includes the major explanatory variables of interest related to shift length and scheduling: shift length (8, 10, 12 h or other shift), shift schedule (day, evening, night, or rotating), overtime (weekly hours), total weekly work hours (including a second job, if worked). In the survey, respondents were asked “Which one of the following best describes the shifts you typically work” with 8, 10, 12, flexible schedule, or other (please specify) as options. For scheduling, respondents were asked “Which one of the following best describes your typical work schedule?” with day, evening, night, rotating schedule as options. Overtime was separated by mandatory and voluntary overtime hours typically worked per week in the principal job. Total weekly work hours were a sum of typical weekly work hours, overtime hours, and hours from other jobs aside from the principal job. Additionally, hospital teaching status, unit type, and patient-to-nurse ratio on last shift worked were categorized within the work context (Patrician et al., 2011) and could influence injury risk. For analysis, teaching status was dichotomized with hospitals categorized as an academic or community teaching hospital or non-teaching site (reference group), similarly, unit type was dichotomized as intensive care unit (ICU) or step-down ICU compared to other units (reference group), and average patient to nurse ratio was dichotomized at the mean.

Also included in the models were three items from validated scales measuring quantitative workload, autonomy, and organizational commitment. The quantitative workload variable measures the amount and intensity of work required (“Does your job require you to work very fast?”) and is scaled from 1 (never) to 6 (five or more days a week). This instrument was selected from a scale adapted from Spector and Jex (1998), and has been used in studies of newly licensed nurses to predict work behavior (Brewer et al., 2012, 2013; Kovner et al., 2007a,b, 2009). Autonomy assesses the degree to which employees can exert independence in their job performance (“To what extent are you able to do your job independently of others?”) and is scaled 1 (none at all) to 5 (a great deal) (Sims et al., 1976). Organizational commitment measures feelings of loyalty to an employer (“I agree that my employer is a great organization to work for”) and is scaled 1 (strongly disagree) to 5 (strongly agree) (Price, 2001). Both were selected from scales that have been used in prior studies by Kovner et al. and were based on Price’s model (Kovner et al., 2007a,b, 2009; Price, 2001). Lastly, demographic measures included age, gender, ethnicity, children at

home, self-reported health status, marital status, and initial level of education as a nurse, which have been included in previous studies on the topic (Gershon et al., 2007; Hopcia et al., 2012; Smith et al., 2009).

2.4. Analysis

Prior to analysis, descriptive statistics (e.g. means, standard deviations) were calculated for all of the study variables to examine distributions and assess missing data. Summaries were also generated for dichotomously recoded variables (e.g. frequencies, percentages). Poisson regression was chosen based on the distribution of the primary outcome variables, i.e., counts of occupational injuries, which were positively skewed due to many zeros, indicating no injury occurred. The Poisson distribution is suited to the analysis of count data, in which the dependent variables have non-negative integer value (Allison, 1999). Bivariate and multivariate models were first conducted using SAS *proc genmod* to assess the relationship between shift and schedule characteristics and nurse injury.

Next, full multivariate models were constructed to account for demographics and potential confounders per the OW framework. Because Poisson models are susceptible to overdispersion, resulting in overestimating the chi-square statistics and underestimating the standard errors, all models were assessed for goodness-of-fit. If the deviance to degrees of freedom ratio was not about one, corrections were used with the *pscale* command in SAS, which corrects standard errors of the estimates. To accommodate variability in individuals’ time in the workplace, the log of the months worked since passing the NCLEX was added to the models because Poisson models assume that all observations occur during the same time frame. We also re-ran the models using continuous covariates and found no significant differences from the models using the dichotomously recoded variables. All analyses were conducted in SAS version 9.3. Significance was set at $p < .05$ level for all tests. This study was deemed exempt by the Institutional Review Board at the author’s institution.

3. Results

Characteristics of the nurses are displayed in Table 1 for the sample as a whole and stratified by shift length. Results were separated into 8-h, 12-h, or other shift, which included 10 h shift, flexible shifts or other scheduling lengths. The sample has a mean age of 31 (SD = 8.6 years) and is predominantly women (92%). The majority identified as being white non-Hispanic (79%) and just over half (53%) were married. Only 5% reported poor/fair health status. Regardless of shift length type, the age, gender, marital status, race/ethnicity, having children at home, and poor/fair health status were in nearly equal proportions. Notably, the percentage of nurses with baccalaureate education differed slightly according to shift type. Only 30% of nurses working 8-h shifts received a baccalaureate as their first nursing degree for licensure compared to over 40% of nurses in all of the other shift length types.

Table 1

Demographic features of the sample of newly licensed registered nurses by shift length.

Characteristic	8 h shift n (%)	12 h shift n (%)	Other shift n (%)	Total N (%)
Age, M (SD)	33 (9)	31 (8)	31 (9)	31 (8)
Gender, male	20 (7)	111 (8)	10 (11)	141 (8)
Education, baccalaureate	80 (30)	603 (44)	43 (46)	726 (42)
Marital status, married	141 (52)	733 (53)	44 (46)	918 (53)
Race/ethnicity, white non-Hispanic	227 (85)	1077 (79)	80 (85)	1384 (79)
Children at home	122 (45)	545 (40)	31 (32)	698 (40)
Health status, poor/fair	15 (6)	62 (5)	4 (4)	81 (5)

Note: Education is defined as baccalaureate as first degree leading to nursing licensure, health status is self-reported. Other shift includes 10-h, flexible, or other shift length. M = mean, SD = standard deviation. N = 1744.

Table 2 describes characteristics of the newly licensed nurses' work setting, shift length and scheduling type. The majority (79%) in the sample work 12-h shifts, and a near majority (44%) work at night. Almost two-thirds (61%) of the nurses reported working some amount of mandatory or voluntary overtime each week and 15% reported working a second job. Half of the sample worked in general/specialty units, and nearly two-thirds of nurses (65%) worked in a teaching hospital. (In this study, teaching hospital included community teaching hospitals, thus the extent of resident training varied.) Approximately one-third worked in a Magnet recognized hospital, and one-third reported that nurses where they work were part of a union or collective bargaining unit. Finally, the nurses cared for, on average, five patients on their last shift worked.

The frequencies of injury reported by the nurses are displayed by shift length characteristics in Table 3. We

Table 2

Newly licensed registered nurses' scheduling, shift, and work setting characteristics.

Characteristic	n (%)
<i>Scheduling and shift characteristic</i>	
Shift length	
8 h	270 (16)
12 h	1376 (79)
Other	95 (5)
Shift type	
Day	563 (32)
Evening	159 (9)
Night	760 (44)
Rotating schedule	251 (14)
Mandatory overtime, yes	181 (10)
Voluntary overtime, yes	895 (51)
Second job, yes	254 (15)
<i>Work setting characteristics</i>	
Unit	
Intensive care unit	429 (25)
Step-down unit	259 (15)
General/specialty	916 (53)
Emergency	140 (8)
Teaching hospital	1117 (65)
Magnet hospital	473 (29)
Union member	480 (28)
Rural location	279 (16)
Number of patients on last shift, M (SD)	5 (4)

Note: Other shift includes 10-h, flexible, or other shift length. Mandatory overtime, voluntary overtime, and secondary job hours reflect any hours worked per week, Magnet hospital status is self-reported, and rural location determined by Metropolitan Statistical Areas. M = mean, SD = standard deviation. N = 1744.

Table 3

Frequency of occupational injury by shift length, work hours, and overtime.

Schedule characteristic	Needle stick n (%)	Sprain or strain n (%)
Non-12 h shift	80 (24.2)	157 (42.7)
12 h shift	361 (26.1)	541 (39.3)
Total weekly hours ≤40 h	302 (25.5)	471 (39.7)
Total weekly hours >40 h	148 (26.5)	227 (40.7)
No overtime	315 (24.5)	510 (39.6)
Weekly overtime	135 (29.5)	188 (41.1)

Note: Overtime includes mandatory and/or voluntary hours of 8 h or more per week. Sprains or strains, including back injury are a single variable.

found that needle stick injuries were more frequent in nurses working 12-h shifts, total weekly hours over 40, and weekly overtime of 8 h or more. Sprains/strains were more frequently reported by nurses working in shifts other than 12 h, total weekly hours over 40, and weekly overtime of 8 h or more.

Lastly, Table 4 presents the results of the Poisson regression models assessing the relationship between shift length and scheduling characteristics and nurse injury, before and after controlling for potential confounds. In the first set of models in the column labeled Model 1, results indicate that there was a statistically significantly higher risk for needle stick injuries for nurses working 8 h or more overtime per week (incidence rate ratio (IRR) 1.25, CI 1.02–1.58). This was the only statistically significant shift or scheduling predictor in the model. Next, moving to Model 2, which accounts for potential confounding variables, we observed that nurses who worked 8 h or more of overtime per week compared to nurses who did not work overtime were associated with a 32% increase in the likelihood of a needle stick (IRR 1.32, 95% CI 1.07–1.62), also statistically significant. Results also indicated that being less than 30 years old, higher than average quantitative workload, and lower than average autonomy were other significant predictors of needle sticks.

There were no significant shift or scheduling associations in the initial sprain/strain model. After adjusting for covariates, we observed a 16% increase in the likelihood of a sprain/strain injury in nurses who worked night shift compared to other shifts (IRR 1.16, 95% CI 1.02–1.33). Additional associated factors that reduced risk of injury

Table 4

Relationship between newly licensed registered nurses' occupational injuries and shift length, work hours, and overtime.

	Model 1: needle sticks			Model 2: needle sticks		
	IRR	SE	95% CI	IRR	SE	95% CI
12-h shift	1.12	0.11	0.90–1.40	1.25	0.13	0.97–1.60
Night shift	0.84	0.09	0.70–1.00	0.90	0.10	0.74–1.09
Overtime	1.25	0.10	1.02–1.52	1.32	0.10	1.07–1.62
Total weekly hours	1.02	0.10	0.84–1.24	0.94	0.10	0.77–1.16
Age				1.27	0.11	1.03–1.57
Gender				1.19	0.16	0.86–1.63
Ethnicity				0.83	0.11	0.67–1.03
BSN				0.98	0.10	0.80–1.19
Marital status				1.09	0.10	0.90–1.32
Overall health				1.06	0.20	0.72–1.56
Children at home				1.12	0.11	0.90–1.39
Unemployment				0.89	0.10	0.73–1.09
Local job opportunities				1.09	0.10	0.90–1.31
Union membership				0.94	0.11	0.77–1.16
Magnet status				1.04	0.10	0.85–1.28
Quantitative workload				1.32	0.10	1.09–1.60
Autonomy				0.78	0.09	0.65–0.94
Organizational commitment				1.06	0.10	0.87–1.29
Teaching hospital				0.97	0.10	0.80–1.19
Unit				0.82	0.11	0.66–1.02
Rural location				1.08	0.14	0.81–1.43
Patient-to-nurse ratio				0.98	0.02	0.95–1.01
	Model 1: sprains/strains			Model 2: sprains/strains		
	IRR	SE	95% CI	IRR	SE	95% CI
12-h shift	0.87	0.07	0.75–1.00	0.94	0.08	0.80–1.10
Night shift	1.07	0.06	0.96–1.21	1.16	0.07	1.02–1.33
Overtime	1.03	0.07	0.90–1.19	1.06	0.07	0.92–1.23
Total weekly hours	1.10	0.07	0.97–1.25	1.03	0.07	0.90–1.19
Age				1.00	0.07	0.87–1.16
Gender				0.87	0.12	0.69–1.10
Ethnicity				1.12	0.08	0.96–1.32
BSN				0.86	0.07	0.75–0.99
Marital status				0.97	0.07	0.85–1.12
Overall health				1.58	0.11	1.26–1.97
Children at home				0.95	0.08	0.82–1.10
Unemployment				0.85	0.07	0.74–0.98
Local job opportunities				1.22	0.07	1.07–1.39
Union membership				1.04	0.07	0.90–1.20
Magnet status				1.13	0.07	0.99–1.31
Quantitative workload				1.50	0.07	1.31–1.72
Autonomy				0.96	0.06	0.85–1.09
Organizational commitment				0.80	0.07	0.70–0.92
Teaching hospital				1.09	0.07	0.95–1.25
Unit				0.92	0.08	0.79–1.07
Rural location				1.12	0.10	0.92–1.36
Patient-to-nurse ratio				0.96	0.01	0.94–0.99

Note: Reference groups: non-12 h shift, non-night shift, less than 8 h of weekly overtime hours, 40 h or less weekly work hours, age under 30, female gender, not White, non-Hispanic, not having a BSN at first licensure, being married, good health status, not having children at home, not having unemployment rates, local job opportunities, quantitative workload, autonomy, organizational commitment and patient-to-nurse ratio above the mean, non-Magnet status, intensive care/step down versus other units, and rural location. IRR = incidence rate ratios, bold indicates a statistically significant result.

included a baccalaureate degree (BSN) as a first degree in nursing, higher unemployment rates, higher than average organizational commitment, and better than average nurse to patient ratios. Poor health status, higher than average local job opportunities, and higher than average quantitative workload were associated with higher risk for sprain/strain injury.

4. Discussion

This study focused solely on the newly licensed nurse population and sought to describe the shift and

scheduling characteristics of this group as well as explore associations between occupational injury and scheduling and shift characteristics. Mirroring trends across all hospital-based nurses (Stimpfel et al., 2012), we found that the majority of the nurses in this sample worked 12-h shifts and most worked some form of overtime, primarily voluntary overtime (51% voluntary overtime versus 10% mandatory overtime). Further, our results suggest that certain scheduling and shift characteristics are significantly associated with injury risk in newly licensed nurses. Findings from this study are salient for hospital administrators, nurse managers, and occupational health

staff who are charged with using the timeliest evidence to develop effective strategies to improve nurses' safety at work.

In addition to finding most nurses worked 12-h shifts, our descriptive findings also showed that 44% worked night shift. This is not surprising because as the most junior employees, newly licensed nurses may have the last choice in scheduling or may have been hired into a night shift only position. Additionally, some may prefer nights because there is typically less interprofessional rounding on patients, fewer patients leaving the unit for testing or procedures, and fewer visits from physical or occupational therapists.

We observed variation in predictors of injury for needle sticks and sprains/strains, respectively. While our results were similar to some previous research, we also noted some differences. For example, Hopcia's findings indicated that registered nurses and patient care associates who worked more consecutive night shifts were at increased risk for occupational injuries (Hopcia et al., 2012). Our findings also suggest that night shift work compared to other shifts is associated with increased risk of sprain/strains. In contrast, Trinkoff et al. (2007) found increased odds and relative risk for needle stick injuries associated with long shifts, consecutive shifts, and weekend work but not overtime specifically. The results of our models showed point estimates in the same direction as Trinkoff, however, statistical significance was not achieved. Our findings as well as those by Gershon et al. (2007) determined overtime of 8 h or more to be significantly associated with needle stick injuries. Clarke (2007) and Canini et al. (2008) observed an increased risk for sharps injury with increased total work hours, however, overtime was not explicitly defined.

In addition to the scheduling characteristics, several other components of the organization of work were observed to be predictive of nurse injury. Notably, quantitative workload was found to be significantly associated with both types of injury. Trinkoff et al. (2006) ascertained that physical demands were significant for shoulder injuries only, not for back or neck injuries. Similar to other studies that discovered a relationship between staffing and needle sticks (Gershon et al., 2007; Patrician et al., 2011), our findings suggested that better nurse staffing was associated with a reduction in sprain/strain risk. Taken together, it is possible that a heavy workload in addition to long shifts or overtime may intensify injury risk, although we did not test this in our study.

Newly licensed nurses, specifically, are exposed to a number of physiological and physical stressors as they transition to their new professional roles, and interventions aimed at improving the safety of new nurses have the potential to enhance not only worker well-being, but quality of care as well. Nurse residency programs, which aim to reduce turnover and improve clinical care, are supported in the IOM report *The Future of Nursing* (Institute of Medicine, 2011). Considering our findings in combination with previous studies (Clarke, 2007; Clarke et al., 2002; Patrician et al., 2011), the evidence is growing to suggest that newly licensed nurses could benefit from

protection from excessive overtime and limited exposure to night shift work. Using new evidence to inform residency program development or modifications to existing programs may be warranted.

The main strength of this study is that it is the first study, to our knowledge, to focus exclusively on newly licensed registered nurses – a group at risk for injury – at the beginning their career and exposure to shift work. In addition, our study was also guided by a comprehensive conceptual framework. Using the OW framework and a rich data set provided us with the ability to conduct regressions containing variables previously unavailable or excluded from statistical models.

The major limitation of this study is that it is cross-sectional, which is not the strongest study design. This limits our understanding of these relationships, for example, some of the conditions linked to injury risk in previous research are unknown, e.g. rest breaks (Williamson et al., 2011). Future work using the parent study will allow for longitudinal analyses and will also allow more detailed responses related to each injury type. This study is subject to recall bias from participants and it is self-report although previous work has shown that nurses are reliable in recalling adverse events (Gerolamo, 2008) and there is under-reporting in administrative data (Gershon et al., 2007). Due to the sampling method, these data are generalizable to newly licensed nurses in the U.S. but caution should be used to apply findings to all nurses. Although the parent study was nationally representative, the subsample used in this analysis may not be. Lastly, the data were collected several years ago, as the parent study is being conducted from 2006 to 2016. In this time, there has been an increase in the availability of patient lift devices, which may affect several strain injuries; however, the uptake and consistent use of these devices is mixed (Lee et al., 2013).

Future surveys of newly licensed nurses and subsequent research could include whether or not the nurses received safety training during orientation or during their residency period and/or what type of continuing education they receive on the topic. Other modifiable risk factors related to nurse safety that could be included in future research are the availability and use of safety equipment, such as patient lift equipment. Lastly, including fatigue, sleep quantity, and sleep quality would add important detail to this inquiry.

5. Conclusions

Newly licensed nurses working in the U.S. hospital setting reported working primarily 12-h shifts and 61% reported working overtime each week. Overtime and night shift work were associated with increased risk of needle sticks and sprain or strain injuries, respectively, after controlling for demographics, external context, organizational context, and work context. Given the burden that occupational injuries place on employees and employers, further research should be conducted to evaluate these relationships, both domestically and abroad, and provide evidence for interventions to reduce injury rates.

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