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Source: *Infection Control and Hospital Epidemiology*, Vol. 28, No. 2 (February 2007), pp. 156-164
Published by: The University of Chicago Press on behalf of The Society for Healthcare Epidemiology of America
Stable URL: http://www.jstor.org/stable/10.1086/510785

ORIGINAL ARTICLE

Work Schedule, Needle Use, and Needlestick Injuries Among Registered Nurses

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OBJECTIVE. To examine the association between working conditions and needlestick injury among registered nurses. We also describe needle use and needlestick injuries according to nursing position, workplace, and specialty.

DESIGN. Three-wave longitudinal survey conducted between November 2002 and April 2004.

SETTING AND PARTICIPANTS. A probability sample of 2,624 actively licensed registered nurses from 2 states in the United States. Follow-up rates for waves 2 and 3 were 85% and 86%, respectively. Respondents who had worked as a nurse during the past year (n = 2,273) prior to wave 1 were included in this analysis.

RESULTS. Of the nurses, 15.6% reported a history of needlestick injury in the year before wave 1, and the cumulative incidence by wave 3 was 16.3%. The estimated number of needles used per day was significantly related to the odds of sustaining a needlestick injury. Hours worked per day, weekends worked per month, working other than day shifts, and working 13 or more hours per day at least once a week were each significantly associated with needlestick injuries. A factor combining these variables was significantly associated with needlestick injuries even after adjustment for job demands, although this association was somewhat explained by physical job demands.

CONCLUSIONS. Despite advances in protecting workers from needlestick injuries, extended work schedules and their concomitant physical demands are still contributing to the occurrence of injuries and illnesses to nurses. Such working conditions, if modified, could lead to further reductions in needlestick injuries.

Infect Control Hosp Epidemiol 2007; 28:156-164

Nursing jobs increasingly entail long hours and heavy workloads, because of attempts to control costs and offset nursing shortages. Studies have found that extended work schedules (eg, longer workdays, working off-shifts and weekends, and working while sick) increase risks of work-related injuries and illnesses, such as musculoskeletal disorders,[1-3] that are likely the result of exposure to physical and psychological job demands.[4] Many of these schedules also can produce fatigue,[5,6] increasing the risk for injury. The impact of work schedules on the risk of sustaining acute injuries, such as needlesticks, has been less explored.

In the United States, an estimated 384,325 percutaneous injuries to healthcare workers (HCWs) occur annually.[7] Each year, more than 1,000 US HCWs contract a serious infection from a needlestick injury.[8] Nurses have among the highest rates and proportions of needlestick injuries, compared with all other HCWs.[9] As a result, the US Needlestick Safety and Prevention Act of 2000 required that safer needle devices be used in the workplace. Despite this, unsafe devices are still in use, which limits the law's impact.[10] Also, for certain healthcare situations, safer alternatives do not exist[11] (eg, hollow-bore pediatric needles and prefilled medicine syringes).

Working conditions have also been shown to affect the rate of occurrence of needlestick injuries, although there is a paucity of data on the impact of scheduling and job demands. The rate of needlestick injuries was found to increase during the first hour and the last 2 hours of a shift.[12] Work pace and shift work predisposed workers to needlestick injuries, cuts, splashes, and contact with open wounds.[13] Temporary or contractual work significantly increased the odds of percutaneous exposures (odds ratio, 4.50 [95% confidence interval, 2.24-9.04]),[14] and temporary work assignments were associated with an increased risk of needlestick injuries among nurses.[15] Temporary or contract workers were also more likely to have extended work schedules.[16-18]

The purpose of this study was to examine workplace conditions, especially schedule characteristics, job demands, and estimated daily frequency of needle use, in relation to needlestick injury among registered nurses. We also describe the consequences of needlestick injuries and the frequency of

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Received August 17, 2005; accepted December 30, 2005; electronically published January 17, 2007.

needlesticks according to nursing position, workplace, and specialty.

METHODS

Sample and Data Collection

We conducted a 3-wave longitudinal survey as part of the Nurses Worklife and Health Study, Part 3, after obtaining approval from the university institutional review board. A total of 5,000 randomly selected actively licensed nurses from 2 US states (Illinois and North Carolina) were contacted. Of these nurses, 4,229 were sent questionnaires (138 had an invalid addresses and 633 declined to enroll). From these, 2,624 usable questionnaires were received for wave 1, for a 62% completion rate. Follow-up response rates for waves 2 and 3 were 85% and 86%, respectively.

For wave 1, nurses received an optically scannable mailed survey form in November 2002. Contacts for this wave included an introductory letter, up to 2 questionnaire mailings, and a reminder postcard, if needed. A $2 incentive and study logo pencil were included in the first questionnaire packet, to promote response, as recommended by Dillman.[19] Wave 2 and 3 mailings used the same process, except that the wave 3 survey contained a $5 incentive. The average time between returned questionnaires from waves 1-2 was 6 months (180 days), and from waves 1-3 was 15 months (454 days). The enrolled sample contained demographic characteristics and job distributions (for position, workplace, and specialty areas) that were comparable to the National Sample Survey of Nurses,[20] which supports generalizability of the sample to US registered nurses. For this analysis, respondents must have worked in nursing during the year prior to wave 1 (n = 2,273).

Study Variables

A history of needlestick injury in the past year was defined as a self-reported needlestick injury that occurred in the year before wave 1 (baseline), whereas an "incident needlestick" (longitudinal) was defined as a nurse's report of a workplace needlestick injury that occurred since wave 1. Both needlestick outcome measures were used in the analysis, similar to those presented by Aiken et al.[15] The history of needlestick injuries in the past year according to position, workplace, and specialty were collected for the nurses' primary job (see Table 1 for complete list).

The number of needles used per day was estimated using 6 items from the wave 1 baseline survey (eg, "giving injections"; see Table 2 for complete list). Each item was measured with a 4-point scale: never, rarely (1-2 times/day), sometimes (3-9 times/day), and often (10 or more times/day). To estimate the number of needle tasks performed daily, the midpoint of the response range was used, except for reports of 10 or more needles used, for which the value of 10 was substituted. To estimate the daily total number of needles used, the scores for all 6 tasks were summed, generating total scores that ranged from 0 to 60. To estimate the odds of needlestick injury by daily needle use, 3 needle-use levels were defined on the basis of these scores: no or low needle use (0-20 needles used/day), medium needle use (21-40 needles used/day), and high needle use (41-60 needles used/day) (Table 3). For their most serious wave 1 needlestick injury, nurses were asked about the consequences of the injury (eg, missed work) and whether the needle that was involved had a "safer" design (ie, was self-blunting, self-sheathing, or retractable) (Table 4).

Work-schedule variables were derived from the Standard Shiftwork Index[21,22] (Table 5). Three National Institute for Occupational Safety and Health (NIOSH) experts also examined the survey for content validity (NIOSH personal communication, September 2002). For wave 1, nurses were asked to consider their typical work schedule for the past 6 months on average, for all jobs held. This was designed to increase the validity of schedule data, by minimizing the chance that participants would provide responses that included an unusual or atypical work period.[23] Nurses were asked to report on actual hours worked, including overtime, as opposed to the hours they were scheduled to work.[23]

The impact of psychological and physical demands on the association between schedule characteristics and the frequency of needlestick injury was examined. For psychological demands, 7 items from the Job Content Questionnaire[24] were used: working very hard, working very fast, excessive work, long periods of intense concentration, enough time to get the job done, tasks often interrupted, and waiting on work from other people or departments (α = 0.76). For physical demands, 12 items measured the frequency of awkward postures, heavy lifting, and pushing and pulling heavy loads on the job (α = 0.85).[24,25] Responses for the job-demand items were dichotomized (strongly agree or agree vs strongly disagree or disagree), were summed, and were treated as continuous variables in the analysis.

Data Analysis

The history of needlestick injuries in the past year and the estimated needle use (mean number of needles used during a typical work day) were described according to job position, workplace, and specialty. Consequences of the most serious wave 1 needlestick injury were presented according to type of needlestick (needlestick with contaminated needle, possibly contaminated needle, or uncontaminated needle).

Finally, logistic regression with age-adjustment was used to estimate the impact of the level of needle use during a typical work day on the odds of needlestick injury in the past year. We also estimated the odds of needlestick injury in relation to each individual work-schedule characteristic. We performed principal-components analysis on 15 wave 1 work-schedule items, to assess underlying patterns, extracting fac-

tors with eigenvalues of 1.0 or more. Five factors assessing combinations of work-schedule characteristics were created (see Table 5, footnote a). The regression method was used to compute factor scores, which were then regressed on prevalent and incident needlestick injuries. Finally, the explanatory impact of psychological and physical demands on the relationship between schedule factors and the occurrence of needlestick injury was examined.

RESULTS

Of the nurses, 15.6% reported a history of needlestick injury in the past year, and the cumulative incidence of needlestick injury by wave 3 was 16.3%. Similar percentages of past-year and incident needlestick injuries involved needles that were definitely or possibly contaminated (40% and 37%, respectively). One-third of the injuries were from needles that incorporated "safer" designs. Groups reporting a greater percentage of needlestick injuries in the past year included staff nurses and hospital nurses; those with specialties in emergency, adult critical care, operating rooms, oncology, transplantation, acquired immunodeficiency syndrome, and catheterization laboratory, diagnostics, or hemodialysis (Table 1). These nurses also had higher estimated daily frequency of needle use, although specialties varied in the number and

TABLE 1. History of Needlestick Injury in the Past Year Before Baseline Among 2,273 Nurses, According to Position, Workplace, and Specialty, 2002-2003

Characteristic	No. of nurses	No. (%) of nurses with needlestick injury in the past year
Position		
Staff or general duty	1,500	288 (19.2)
Nurse manager or supervisor	541	39 (8.8)
Coordinator	97	5 (5.2)
Advanced practice[a]	104	15 (14.4)
Educator or researcher	99	4 (4.0)
Other	4	0
Workplace		
Hospital	1,317	244 (18.5)
Nursing home or skilled nursing facility	170	26 (15.3)
Ambulatory clinic, office, or HMO	307	45 (14.7)
Home health agency, hospice, or assisted living facility	164	14 (8.5)
School of nursing	39	2 (5.1)
School other than nursing school	59	2 (3.4)
Government or community agency	142	14 (9.9)
Business or industry	51	4 (7.8)
Other	2	1 (50)
Specialty		
Emergency, trauma, or triage	143	30 (21.0)
Adult critical care	197	46 (23.4)
Operating room or ambulatory surgery	198	42 (21.2)
Postanesthesia care unit	56	8 (14.3)
Neonatal or pediatric ICU	78	11 (14.1)
Family practice or other pediatrics	149	25 (16.8)
Women's health or labor and delivery	178	20 (11.2)
Catheterization lab, diagnostics, or hemodialysis	82	18 (22.0)
Orthopedics, rehabilitation, or neurology	86	15 (17.4)
Oncology, transplantation, or HIV/AIDS	70	14 (20.0)
Other medical surgical, internal medicine, or telemetry	363	68 (18.7)
Case management, utilization review, or admininstration	122	3 (2.5)
School health	54	2 (3.7)
Community health, occupational, or corrections	154	12 (7.8)
Gerontology	168	24 (14.3)
Psychiatric, mental health, or substance abuse	129	11 (8.5)
Other	9	0

NOTE. Nurses had worked 1 or more years in nursing at baseline. AIDS, aquired immunodeficiency syndrome; HIV, human immunodeficiency virus; HMO, health maintenance organization; ICU, intensive care unit.

[a] Advanced practice: nurse practitioner, certified registered nurse anesthetist, clinical nurse specialist, or certified nurse-midwife.

TABLE 2. Estimated Daily Frequency of Needle Use by 2,273 Nurses, According to Position, Workplace, and Specialty, 2002-2003

Characteristic	Mean no. of needles used during a typical working day, by associated procedure(s)						
	Total	Giving injections	Drawing blood	Placing iv catheters	Injecting into or aspirating from iv catheters	Recapping needles	Assisting with invasive procedure requiring needles
Position							
Staff or general duty	19.88	4.55	2.92	3.37	4.54	1.78	2.71
Nurse manager or supervisor	8.91	2.29	1.47	1.59	1.75	0.70	1.36
Coordinator	7.96	1.91	1.29	1.25	1.48	0.88	1.55
Advanced practice[a]	13.31	2.15	1.62	1.94	3.15	1.97	2.66
Educator or researcher	6.29	1.45	1.09	0.93	1.24	0.82	0.79
Workplace							
Hospital	21.41	4.27	2.99	3.92	5.34	1.87	3.07
Nursing home or skilled nursing facility	9.07	3.42	1.22	1.34	1.58	0.72	0.78
Ambulatory clinic, office, or HMO	13.31	3.96	2.20	1.52	1.57	1.69	2.39
Home health agency, hospice, or assisted living	7.43	2.01	1.80	1.15	1.36	0.61	0.49
School of nursing	4.57	1.33	0.47	0.73	1.35	0.27	0.71
School other than nursing school	4.36	1.23	0.71	0.53	0.70	0.56	0.62
Government or community agency	7.01	3.44	1.51	0.51	0.45	0.69	0.70
Business or industry	2.38	0.98	0.69	0.09	0.24	0.21	0.27
Specialty							
Emergency, trauma, or triage	30.48	6.11	5.45	6.33	6.19	1.80	4.46
Adult critical care	24.58	4.91	4.23	3.96	6.71	1.64	3.23
Operating room or ambulatory surgery	18.11	1.96	1.12	2.86	4.14	2.89	5.26
Postanesthesia care unit	23.58	4.77	2.07	3.74	6.92	2.94	3.34
Neonatal or pediatric ICU	24.31	3.66	4.96	3.91	5.72	2.47	3.28
Family practice or other pediatrics	13.26	4.73	2.36	1.24	1.70	1.39	1.79
Women's health or labor and delivery	17.80	4.32	2.40	3.33	4.16	1.08	2.64
Catheterization lab, diagnostics, or hemodialysis	26.43	3.50	4.19	5.51	6.10	2.57	4.74
Orthopedics, rehabilitation, or neurology	13.11	3.38	1.32	2.39	3.45	1.09	1.56
Oncology, transplantation, or HIV/AIDS	24.17	4.62	4.75	4.50	5.72	2.18	2.39
Other medical surgical, internal medicine, or telemetry	18.14	4.59	2.23	3.35	4.42	1.70	1.80
Case management, utilization review, or admininstration	2.83	0.74	0.55	0.56	0.43	0.27	0.30
School health	2.19	1.14	0.17	0.09	0.42	0.45	0.26
Community health, occupational, or corrections	7.65	3.43	1.89	0.57	0.61	0.50	0.75
Gerontology	7.84	3.06	1.17	1.03	1.24	0.80	0.56
Psychiatric, mental health, or substance abuse	5.40	2.50	0.88	0.53	0.63	0.70	0.31
Overall	16.30	3.72	2.42	2.74	3.63	1.50	2.29

NOTE. Nurses had worked 1 or more years in nursing at baseline. AIDS, aquired immunodeficiency syndrome; HIV, human immunodeficiency virus; HMO, health maintenance organization; ICU, intensive care unit; iv, intravenous.

[a] Advanced practice: nurse practitioner, certified registered nurse anesthetist, clinical nurse specialist, or certified nurse-midwife.

TABLE 3. Age-Adjusted Odds Ratio (OR) of Needlestick Injury in the Past Year, According to Estimated Daily Frequency of Needle Use, for 2,273 Nurses Who Had Worked ⩾1 Year at Baseline, 2002-2003

Variable	OR (95% CI)[a]
Total no. of needles used daily	
0-20	1.00
21-40	2.55 (1.98-3.29)
>40	3.64 (2.41-5.50)
Daily frequency of needle use, by task[b]	
Giving injections	
Never or rarely (0-2)	1.00
Sometimes (3-9)	1.59 (1.21-2.08)
Often (⩾10)	3.66 (2.70-4.96)
Drawing blood	
Never or rarely (0-2)	1.00
Sometimes (3-9)	1.56 (1.19-2.05)
Often (⩾10)	1.47 (0.97-2.23)
Placing iv catheters	
Never or rarely (0-2)	1.00
Sometimes (3-9)	1.74 (1.33-2.27)
Often (⩾10)	2.44 (1.73-3.44)
Injecting into or aspirating from iv catheters	
Never or rarely (0-2)	1.00
Sometimes (3-9)	2.27 (1.71-3.01)
Often (⩾10)	3.08 (2.30-4.12)
Recapping needles	
Never or rarely (0-2)	1.00
Sometimes (3-9)	1.99 (1.43-2.78)
Often (⩾10)	3.64 (2.41-5.49)
Assisting with invasive procedures requiring needles	
Never or rarely (0-2)	1.00
Sometimes (3-9)	1.49 (1.12-1.99)
Often (⩾10)	2.15 (1.48-3.14)

NOTE. CI, confidence interval; iv, intravenous.

[a] Data for 352 nurses. Reference group was respondents without needlestick injury (n = 1,900).

[b] Numbers in parentheses are no. of needle-use tasks per day.

type of daily needle tasks performed (Table 2). For example, emergency nurses placed more intravenous catheters than did any other specialty, and critical care and postanesthesia care nurses aspirated or injected into intravenous catheters more often than did other nurses.

The number of needles used during a typical workday was related to the odds of needlestick injury (Table 3). Nurses who performed a high number (more than 40) or medium number (21-40) of needle-use tasks daily were 2-3 times more likely to sustain a needlestick injury, compared with those who performed none or few (0-20) needle-use tasks. Similarly, for each individual task, nurses that often or sometimes performed it were more likely to report having sustained needlestick injuries than were those who never or rarely performed these tasks.

Regarding consequences, most nurses who were stuck by a contaminated or possibly contaminated needle reported their injuries (81%), whereas those stuck by an uncontaminated needle rarely did so. They were also more likely to see a healthcare provider, to miss work, to file a report, and/or to use medications (Table 4). In contrast, the same percentage of nurses who were stuck by a needle modified their work, regardless of whether the needle was contaminated.

Regression of the individual work-schedule components with age adjustment revealed that many schedule variables were significantly associated with occurrence of both incident needlestick injuries and needlestick injuries in the past year (hours worked per day, weekends worked per month, working other than day shifts, and working 13 or more hours per day) (Table 5). In addition, hours worked per week, work with fewer than 10 hours off between shifts, past days worked in a row, and work on days off were significantly associated with sustaining needlestick injuries in the past year.

Analysis of work-schedule factors showed that the "day" factor (comprising hours worked per day, working 13 or more hours per day, working nonday shifts, working weekends, and having fewer than 10 hours off) was significantly related to the occurrence of needlestick injuries, when all other work-

TABLE 4. Consequences of Most Recent Serious Prevalent Needlestick Injury Among Nurses Who Had Worked ⩾1 Year at Baseline, 2002-2003

Consequence	No. (%) of nurses, by type of needlestick		
	Any (n = 352)	By a contaminated or possibly contaminated needle (n = 123)	By an uncontaminated needle (n = 229)
Saw a doctor or other provider	73 (22.9)	64 (56.6)	9 (3.9)
Missed work	6 (2.0)	4 (4.0)	2 (0.9)
Modified work	20 (6.6)	6 (6.1)	14 (6.8)
Changed jobs	2 (0.7)	1 (1.0)	1 (0.5)
Filed a report	123 (38.0)	93 (80.9)	30 (14.4)
Used prescription medications	11 (3.6)	9 (9.0)	2 (1.0)

schedule factors were taken into account ($P < .001$). The day factor remained significantly associated only with occurrence of incident needlestick injuries ($P < .001$) after adjustment for job demands, although this was also partially explained by physical demands of the job.

DISCUSSION

Adverse schedule characteristics, such as long work hours and working nonday shifts and weekends, significantly increased the risk of needlestick injury. Cross-sectional data showed increased odds of needlestick injury for nurses working many days in a row and with little time off between shifts. In other research, adverse scheduling was associated with an increased risk of musculoskeletal injuries among nurses.[3] Landsbergis et al.[1] found that long work hours were associated with chronic illness in nurses as well, providing additional evidence that schedule modifications are needed to reduce the incidence of nurse injury. When schedule factors were considered simultaneously, the day factor was strongly associated with increased odds and risk of needlestick injury. This was also related to physical job demands, indicating that limiting schedules that have excessive work hours and the resultant physical exertion could further prevent needlestick injury.

Needlestick injury prevention has benefitted from requirements that safer needle systems and devices be used in the workplace.[26,27] This is an excellent beginning, but the fact that one-third of needlestick injuries in our study occurred with safer-designed needles suggests that some safer devices are not as effective as others. As expected,[28] we found that the risk of needlestick injury among nurses with high needle use (eg, those who often gave injections and/or placed intravenous catheters) was much greater than among those with low use (those who rarely or never performed tasks involving needles). By identification of the needle-use tasks that lead to injury, preventive efforts can be further focused, perhaps spurring introduction of new safer designs to address the major remaining hazards. In addition, reasonable work hours should be promoted as a potential preventive, to reduce the incidence of needlestick injuries.

The use of workplace controls along with safety devices was an important component in reducing needlestick injuries in an intervention study.[29] Dale et al.[30] found that use of a phlebotomy team reduced needlestick injury rates, because of the increased experience and training of team members in the use of safer devices, as did the provision of a variety of devices, so that team members could choose their preferred device. Yet many hospitals view such teams as costly and are decentralizing tasks such as placing intravenous catheters, thereby increasing the population of HCWs who are exposed to these tasks.

Interpretation of our findings should be considered in light of the study's strengths and limitations. Strengths include the longitudinal design, with the use of incidence rates, and the high follow-up rate across survey waves. Limitations of the study largely stem from the reliance on self-reported survey data, which can be affected by recollection and recall, and the wave 1 completion rate. Because the survey covered many topics and because needlestick questions appeared well into the document, it is unlikely that there was specific nonresponse bias for this particular outcome, and other health outcomes were also measured in this survey. Furthermore, when invited to participate, respondents were told that the study would address the health and work environment of nurses; no mention was made of a focus on needlestick injury. Although the possibility of sampling bias is always present, the large sample size allows us to have confidence that the parameter estimates are reasonably accurate.[19] Use of typical and average schedule descriptors in collecting the schedule characteristics should increase the validity of the findings, as the reported schedules will thus be less likely to reflect an unusual time period.[23] Others have similarly measured typical work schedules[31] and the number of years during which nurses worked particular shifts.[32,33] Survey questionnaires that measure work demands have been found to have acceptable reproducibility over time[34] and when compared with direct observations.[35] When needlestick-injury consequences are assessed, restriction of responses to the most serious needlestick injury enhances recall, because more-serious incidents should

TABLE 5. Age-Adjusted Odds Ratios (OR) for Needlestick Injury in the Past Year and Relative Risk (RR) for Incident Needlestick Injury Among Nurses Who Had Worked ⩾1 Year at Baseline, According to Work Schedule at Baseline, 2002-2004

Work-schedule variable[a]	OR (95% CI) for needlestick injury in the past year[b]	RR (95% CI) for incident needlestick injury[c]
Status		
Part-time	1.00	1.00
Full-time	1.13 (0.86-1.48)	0.77 (0.56-1.04)
No. of jobs		
1	1.00	1.00
>1	1.07 (0.81-1.43)	0.88 (0.62-1.26)
Hours worked per day		
⩽8	1.00	1.00
9-11	1.19 (0.88-1.61)	0.92 (0.64-1.32)
⩾12	1.68[d] (1.27-2.22)	1.63[e] (1.17-2.26)
Continuous	1.10[d] (1.05-1.16)	1.09[e] (1.02-1.17)
Hours worked per week		
⩽40	1.00	1.00
41-49	0.85 (0.62-1.17)	1.10 (0.77-1.56)
⩾50	1.12 (0.80-1.57)	0.70 (0.44-1.12)
Continuous	1.01 (1.00-1.02)	0.99 (0.98-1.01)
Days worked per week		
1-5	1.00	1.00
6-7	0.89 (0.50-1.58)	0.95 (0.49-1.83)
Continuous	0.92 (0.83-1.01)	0.86 (0.77-0.97)
Weekends worked per month		
0-1	1.00	1.00
2-4	2.03[d] (1.60-2.58)	1.70[d] (1.28-2.26)
Continuous	1.30[d] (1.18-1.43)	1.25[d] (1.11-1.39)
Shift		
Days only	1.00	1.00
Other than days	1.68[d] (1.32-2.12)	1.59[d] (1.20-2.11)
Breaks per day		
⩾2	1.00	1.00
0-1	0.89 (0.70-1.13)	0.79 (0.59-1.05)
Continuous	0.93 (0.80-1.08)	0.92 (0.77-1.10)
Worked ⩾13 h at least weekly		
No	1.00	1.00
Yes	1.66[d] (1.28-2.15)	1.55[e] (1.15-2.09)
Worked while sick		
No	1.00	1.00
Yes	1.31 (0.93-1.85)	1.12 (0.76-1.67)
Worked on a day off or vacation day		
No	1.00	1.00
Yes	1.32[f] (1.00-1.74)	1.34 (0.95-1.89)
Mandatory overtime		
No	1.00	1.00
Yes	1.25 (0.93-1.68)	1.08 (0.75-1.55)
On-call hours		
Never to monthly	1.00	1.00
At least weekly	1.26 (0.87-1.83)	1.30 (0.84-2.03)

(continued)

TABLE 5.

Work-schedule variable[a]	OR (95% CI) for needlestick injury in the past year[b]	RR (95% CI) for incident needlestick injury[c]
<10 h off between shifts at least weekly		
No	1.00	1.00
Yes	1.46[e] (1.15-1.86)	1.26 (0.95-1.67)
Most days worked in a row		
0-5	1.00	1.00
⩾6	1.41[e] (1.10-1.82)	1.19 (0.88-1.61)

NOTE. CI, confidence interval.

[a] There were 5 work-schedule factors: (1) the "day" factor (hours worked per day, weekends worked per month, shift, ⩾13-hour days, and <10 hours off between shifts), (2) the "week" factor (hours worked per week and full-time vs part-time status), (3) the "working during time off" factor (working while sick, working on a day off or vacation day, and breaks taken), (4) the "mandatory overtime and on-call" factor, and (5) the "number of jobs and most days worked in a row" factor.

[b] Data for 352 nurses. Reference group was respondents who did not have needlestick injuries (n = 1,900).

[c] Data for 250 nurses. Reference group was respondents who did not have needlestick injuries by wave 3 (n = 1,266).

[d] Significant at the $P < .001$ level (2-tailed test).

[e] Significant at the $P < .01$ level (2-tailed test).

[f] Significant at the $P < .05$ level (2-tailed test).

have a higher likelihood of being recalled.[36] Estimates of needle use involved the midpoint of the interval, which could overestimate or underestimate the total number of needlestick injuries. Despite this, the association between use and injury should be unaffected.[37]

Because the costs—economic, psychological,[38,39] and physical—of needlestick injury are great, everything possible should be done to prevent them. Despite the advances in protecting workers from needlestick injury, extended work schedules and their concomitant physical demands are still contributing to the occurrence of injuries and illnesses among nurses. The modification of such working conditions could lead to further reductions in needlestick injuries.

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ACKNOWLEDGMENT

This study was supported by National Institute for Occupational Safety and Health grant RO1 OH007554.

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