

data, it may have limited the use of the mail and Web approaches. For example, approximately one third of those interviewed in a telephone follow up of Web nonrespondents indicated that they did not complete the Web survey because they did not have access to the Internet.⁹ Third, in the absence of more direct measures (such as patient records or medical tests), we cannot determine which mode is the most accurate. We know only that strong differences exist in the measures obtained using these various modes. Finally, the study was conducted in 4 states, which may not be representative of either the nation or other populations.

In conclusion, mode of interview affects the estimates produced. However, as this study shows, the impact of mode can be unpredictable. For some measures, mode had a strong effect, whereas for others, there was minimal evidence of mode effects. Additionally, the direction of the impact (positive or negative) is not clearcut across health measures. As health surveys take advantage of new technologies such as the Web, and move toward combinations of modes to address concerns over low participation, researchers need a better understanding of when and how mode can impact their estimates. At a minimum, they need to test and, if necessary, account for the effects of mode in the models and estimates they report.

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Risk Factors for Work-Related Assaults on Nurses

Susan Goodwin Gerberich,* Timothy R. Church,*†
 Patricia M. McGovern,* Helen Hansen,‡
 Nancy M. Nachreiner,* Mindy S. Geisser,*†
 Andrew D. Ryan,*† Steven J. Mongin,† Gavin D. Watt,†
 and Anne Jurek*

Background: Work-related homicides have been the subject of considerable study, but little is known about nonfatal violence and relevant risk factors.

Methods: We surveyed 6300 Minnesota nurses who were selected randomly from the 1998 licensing database and determined their employment and occupational violence experience. In a nested case-control study, we examined environmental exposures and physical assault. Cases of assault in the previous 12 months and controls randomly selected from assault-free months were surveyed about prior-month exposures.

Results: After adjustment by multiple logistic regression, incidence of physical assault was 13.2 per 100 persons per year (95% confidence interval = 12.2–14.3). Among 310 cases and 946 control subjects, odds ratios for assault were increased: in nursing homes or long-term care facilities (2.6; 1.9–3.6), emergency departments (4.2; 1.3–12.8), and psychiatric departments (2.0; 1.1–3.7); in environments not “bright as daylight” (2.2; 1.6–2.8); and for each additional hour of shift duration (1.05; 0.99–1.11). Risks were decreased when carrying cellular telephones or personal alarms (0.3; 0.2–0.7).

Conclusions: These results may guide in-depth investigation of ways protective and risk factors can control violence against nurses.

From the *Regional Injury Prevention Research Center and Center for Violence Prevention and Control, Division of Environmental Health Sciences, School of Public Health; †Health Studies, Division of Environmental Health Sciences, School of Public Health; and ‡School of Nursing, University of Minnesota, Minneapolis, Minnesota.

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Correspondence: Susan Goodwin Gerberich, Professor and Director, RIPRC/CVPC, Division of Environmental Health Sciences, School of Public Health, University of Minnesota, MMC-807, 420 Delaware Street SE (Room 1260), Minneapolis, MN 55455. E-mail: gerbe001@umn.edu. DOI: 10.1097/01.ede.0000164556.14509.a3

Violence is a major public health problem,¹ particularly important in the work environment. Homicide is the third-leading cause of occupational fatality and the second-leading cause of occupational fatality for women.² Although much is known about work-related homicides, research on nonfatal violence and relevant risk factors is limited. Nearly

2 million acts of nonfatal work-related violence occur annually in the United States alone.³

Hospital and health care workers are at high risk for violence, particularly nonfatal violence.^{4,5} Violence against nurses specifically is a major occupational health problem.⁶⁻⁹ On the basis of the 1992 Minnesota Workers' Compensation files, nurses accounted for more than 7% of the total work-related assault cases leading to more than 3 days of lost time; women's assault rate was twice that of men.¹⁰ Biologic,¹¹ psychologic,¹² and sociocultural¹³ theories have been generated to explain causes of violence. Understanding the factors that place persons at risk for violence is critical to development of effective interventions. The current study, following up on a smaller case-control study,¹⁴ was designed to identify environmental and other exposures associated with the risk of work-related violence. Such factors may provide a basis for interventions to reduce the risk of work-related violence.

METHODS

Study Population

Licensing is required for both registered nurses (RNs) and licensed practical nurses (LPNs) who practice in Minnesota. The target population was defined as licensed RNs and LPNs who had worked in Minnesota during the 12 months before the date they completed the survey. With approval by the University of Minnesota Institutional Review Board, we randomly sampled 6,300 nurses from the population ($n = 79,128$) of currently active RNs ($n = 57,388$) and LPNs ($n = 21,740$) who were licensed in the state of Minnesota as of 1 October 1998. Besides name, license type, and address, the state database included birth date, sex, and year of first licensure.

Selection of Cases and Control Subjects

We initially mailed a questionnaire to the entire sample of 6300 nurses to determine employment status and the incidence and consequences of work-related violence.¹⁵ On the basis of the responses, we identified 475 cases (those who reported at least 1 event of physical violence during the previous 12 months) and 1425 control subjects. Control subjects were selected randomly from all months during the study period in which the nurses indicated having worked but before any reported physical assaults to those nurses. This sampling method ensured that the distribution of sampled calendar months represented the distribution of months worked.

Definitions

Physical assault was defined as being hit, slapped, kicked, pushed, choked, grabbed, sexually assaulted, or otherwise subjected to physical contact intended to injure or harm. Violence was work-related if it occurred in the work

environment or during any activities associated with the job (including travel). This is consistent with the definition used by the U.S. National Institute for Occupational Safety and Health (NIOSH).¹⁶

Exposures Addressed

We assessed exposures based on previous research on violence and evidence from other areas of the injury epidemiology literature.¹⁷ General exposures included work experience (years worked as a licensed nurse; years worked in department), average patient contact hours per shift, average number of nurses and number of overall staff located in the immediate work environment on the shift worked most often, primary facility and department/unit/area worked, the main patient population, and primary professional activity. Factors pertinent to environmental design included accessibility of exits and physical barriers preventing view of others in the work environment and level of lighting. Environmental protection factors (assault deterrents in the immediate work environment) included video monitor, metal detector, security alarm/panic button, controlled access, security personnel, or escort/body guard. Personal protection factors included cellular telephone and personal alarm.

Data Collection

For both the initial survey and the nested case-control study, we sent up to 4 follow-up mailings. These mailings included a cover letter providing information for participant consent, together with the pertinent survey, and a postage-paid return envelope.

Contact Procedures

Initial Survey

The initial survey collected the following data: (1) months in which the nurses worked in a nursing position in the previous 12 months; (2) demographic information; and (3) information on physical and nonphysical work-related violence events during the study period. Overall, 79% responded (an estimated 78%, adjusting for the estimated eligible fraction among nonrespondents for age, gender, license-type, and location).^{18,19} The response rates for RNs and LPNs, respectively, were 81% (79%, adjusted) and 75% (73%, adjusted).¹⁵

Case-Control Study

A conceptual model based on a priori hypotheses served as the foundation for a causal model²⁰ that in turn guided survey design and analysis.^{21,22} The survey questionnaire ascertained exposures for the month before and during the incident itself for cases; if multiple events were reported, cases were surveyed about the month before the earliest event. For controls the questionnaire ascertained exposures for random months, selected as described above. Question-

TABLE 1. Demographic and Occupational Characteristics of Cases and Controls

	Cases (n = 310)	Controls (n = 946)
Sex; %		
Women	95	96
Men	6	4
Age (years); %		
<30	7	6
30 to 39	19	14
40 to 49	39	39
50 to 59	26	30
60+	9	10
Practice type; %		
RN	69	74
LPN	31	26
Nursing education; %		
Diploma	39	38
Associate Degree	38	27
Bachelor's Degree	21	27
Master's or Doctorate Degree	1	6
Missing	1	2
Type of Facility; %		
Hospital in-patient	42	41
Nursing home/long-term care/rehabilitation	46	17
Hospital/Non-Hospital outpatient	4	9
Clinic/health care provider office	3	13
Other*	5	21
Missing	0	<1
Department/unit/area; %		
Medical/surgical; obstetrics/gynecology	23	28
Emergency	4	3
Psychiatric/behavioral	11	6
Intensive care unit	9	7
Long-term/assisted care	40	15
Other†	14	41
Missing/Refused	0	<1
Primary patient population; %		
Adult	36	44
Geriatric	47	22
Neonatal, Pediatric, Adolescent	4	14
Split time	14	20
Missing/refused	0	1
Average patient length of stay; %		
<1 day	6	23
1-4 days	14	18
4 days to <1 week	15	13
1 week to <2 weeks	6	5

(Continued)

TABLE 1. (Continued)

	Cases (n = 310)	Controls (n = 946)
2 weeks to <3 weeks	2	2
3 weeks to <1 month	3	2
1 month or more	44	26
Unsure	9	9
Missing/refused	1	1
Primary professional activity; %		
Provided patient care	68	62
Supervised patient care	16	8
No patient care‡	17	30
Missing	0	<1
Years in department, mean ± SD	7.9 ± 7.2	9.1 ± 8.2
Years as Licensed Nurse, mean ± SD	15.9 ± 10.6	18.4 ± 10.8
Patient contact hours, mean ± SD	5.5 ± 2.5	4.9 ± 3.2
No. personnel on shift; mean ± SD	11.0 ± 9.9	12.7 ± 13.7
Number of nurses on shift, mean ± SD	7.4 ± 5.9	8.0 ± 9.4

*Home/public health agency; school/college/university; independent practice/consulting; insurance/utilization review; industry; split time.

†Operating/recovery; public health/home care; family practice; occupational health; school health; education/research; split time.

‡Administration; teaching; research; case management; insurance/utilization review; telephone triage/health information; split time.

naires specific to the respective month were sent to all participants.

Analyses

We obtained responses to the full case-control questionnaire from 324 cases (68%) and 946 control subjects (66%). However, we focused primarily on patient- or client-initiated work-related assaults (310 cases, 96% of all physical assaults). For each exposure of interest, we selected confounders for multiple logistic regression using the principles in Maldonado and Greenland,²³ and based on directed acyclic graphs.²⁰⁻²² These methods identify parsimonious models and exclude covariates that should not be entered into the regression because they could introduce bias.

To account for variability from sampling and also from uncertainty about adjustment weights and eligibility fractions, we calculated bootstrap confidence intervals (CIs)²⁴ for all odds ratios. Potential response bias was controlled by inversely weighting observed responses by probabilities of response,²⁵ estimated as a function of the following characteristics available from the licensing database: age; sex; license type; and type of home address (metropolitan versus nonmetropolitan). To adjust the weighting for unknown eligibility among nonrespondents, we estimated the probability of eligibility from these same factors.¹⁸ The entire weighting

TABLE 2. Univariate and Multivariate Analyses of Occupational Exposures and Risk of Physical Assault

	Unadjusted OR (95% CI)	Partially Adjusted* OR (95% CI)	Fully Adjusted† OR (95% CI)
Years worked as licensed nurse			
Change per 10 years	0.83 (0.73–0.94)	0.92 (0.78–1.09)	0.90 (0.76–1.06)
Years worked in department			
Change per 10 years	0.83 (0.69–1.01)	0.91 (0.74–1.11)	0.91 (0.74–1.11)
Patient contact hours per shift			
Change per hour	1.07 (1.03–1.12)	1.06 (1.00–1.12)	1.05 (0.99–1.11)
Number of nursing personnel on shift			
Change per 10 nurses	0.95 (0.81–1.11)	0.90 (0.72–1.12)	0.96 (0.75–1.17)
Number of all personnel on shift			
Change per 10 personnel	0.91 (0.81–1.02)	0.93 (0.81–1.08)	0.98 (0.83–1.14)
Facility			
Hospital in-patient‡	1.0	1.0	1.0
Nursing home/long term care/ rehabilitation	2.62 (1.94–3.54)	2.68 (1.98–3.63)	2.64 (1.91–3.60)
Hospital-outpatient/nonhospital outpatient	0.39 (0.20–0.75)	0.40 (0.20–0.77)	0.39 (0.20–0.77)
Clinic/health care provider	0.22 (0.11–0.45)	0.23 (0.11–0.46)	0.24 (0.11–0.54)
Other§	0.24 (0.14–0.41)	0.24 (0.14–0.42)	0.24 (0.14–0.43)
Department			
Medical/Surgical; Obstetrics/Gynecology‡	1.0	1.0	1.0
Emergency	1.88 (0.90–3.94)	4.19 (1.63–10.77)	4.22 (1.33–12.79)
Psychiatric/Behavioral	2.24 (1.36–3.69)	2.01 (1.18–3.44)	2.03 (1.05–3.73)
Intensive Care	1.56 (0.93–2.63)	1.34 (0.79–2.27)	1.18 (0.64–1.98)
Long-term/assisted care	3.19 (2.24–4.55)	0.98 (0.48–2.01)	1.02 (0.47–2.60)
Other§	0.42 (0.28–0.63)	0.69 (0.43–1.10)	0.78 (0.49–1.34)
Primary patient population			
Adult‡	1.0	1.0	1.0
Neonatal, pediatric, adolescent	0.38 (0.21–0.71)	0.44 (0.23–0.83)	0.44 (0.22–0.99)
Geriatric	2.64 (1.96–3.56)	1.56 (0.92–2.63)	1.50 (0.85–2.58)
Split time	0.85 (0.58–1.26)	1.11 (0.72–1.71)	1.02 (0.57–1.59)
Primary professional activity			
No patient care‡,§	1.0	1.0	1.0
Provided patient care	2.00 (1.42–2.78)	1.58 (1.04–2.40)	1.49 (0.89–2.31)
Supervised patient care	3.80 (2.38–6.08)	1.61 (0.95–2.74)	1.51 (0.75–2.52)
Environmental lighting/design			
Less than bright as daylight(vs. bright as daylight)	2.06 (1.57–2.70)	2.22 (1.68–2.94)	2.15 (1.58–2.83)
Easily accessible exits (yes vs. no)	0.84 (0.47–1.52)	0.94 (0.51–1.71)	0.96 (0.50–1.78)
Physical barriers blocking vision (yes vs. no)	1.33 (1.03–1.73)	1.32 (1.01–1.73)	1.25 (0.91–1.63)
Environmental protection (yes vs. no)			
Video monitor	1.22 (0.86–1.73)	1.01 (0.65–1.57)	1.14 (0.63–1.83)
Metal detector	1.40 (0.53–3.71)	0.92 (0.30–2.87)	0.92 (0.17–3.93)
Security alarm/panic button	1.45 (1.08–1.94)	1.45 (1.01–2.08)	1.56 (0.96–2.39)
Controlled access	0.87 (0.67–1.14)	0.90 (0.65–1.26)	0.94 (0.62–1.43)
Security personnel	0.68 (0.52–0.88)	0.96 (0.66–1.40)	0.90 (0.59–1.42)
Escort/body guard provided by any source	0.61 (0.46–0.82)	0.80 (0.55–1.16)	0.84 (0.53–1.36)
Escort/body guard provided by employer	0.64 (0.48–0.86)	0.83 (0.57–1.21)	0.86 (0.53–1.41)

(Continued)

TABLE 2. (Continued)

	Unadjusted OR (95% CI)	Partially Adjusted* OR (95% CI)	Fully Adjusted† OR (95% CI)
Personal protection (yes vs. no)			
Carry personal protection	0.83 (0.57–1.21)	0.88 (0.60–1.31)	0.89 (0.60–1.41)
Nurse provided own cellular telephone/personal portable alarm	0.33 (0.18–0.61)	0.30 (0.16–0.58)	0.30 (0.15–0.71)
Cellular telephone/personal portable alarm provided by employer	1.01 (0.71–1.44)	1.03 (0.70–1.50)	1.01 (0.70–1.54)

*Partially Adjusted Model adjusts for confounders, as follows: (1) for years worked as licensed nurse and years worked in department: gender, age, education; (2) for patient contact hours: staffing, professional activity, number of patients, hours worked per month; (3) for number of nursing personnel on shift and number of all personnel on shift: number of patients, policies, administrators' attitudes, primary facility, primary department (4) for facility: gender, race; (5) for department: gender, facility; (6) for primary patient population: gender, race, facility, department; (7) for primary professional activity: gender, age, race, marital status, license type, years worked as licensed nurse, years worked in department, primary facility, primary department, patient population; (8) for environmental lighting/design: video monitor, metal detection device, security alarm, controlled access, security personnel, escort/body guard; (9) for environmental protection: primary department, primary patient population, policies, training, hours worked per month, personnel and patient demographics, patient contact hours, average length of patient stay, patient impairment status; and (10) for personal protection: video monitor, metal detection device, security alarm, controlled access, security personnel, escort/body guard, morale, personnel respect/trust level.

†Fully Adjusted Model adjusts for confounders, as noted for the Partially Adjusted Model; in addition, the odds ratios and confidence intervals are calculated using weights to adjust for nonresponse and ineligibility.

‡Reference category.

§See details of "other" category in Table 1 footnotes.

procedure was recalculated on each bootstrap iteration. Validation procedures, reported elsewhere, were conducted for self-reported physical assault injury occurrences and various workplace exposures.²⁰ We conducted sensitivity analyses to determine the potential effect of an unmeasured confounder on the multivariate odds ratios.^{20,26}

RESULTS

On the basis of the initial survey, 96% of nurses were women. On average, participants were 46 years of age (\pm SD, 10.1); 75% were RNs, and the rest were LPNs. The estimated physical assault rate was 13.2 per 100 persons per year (95% CI = 12.2–14.3). The assault rate was lower for RNs (12.0; 10.9–13.3) than for LPNs (16.4; 14.2–18.7).¹⁵

Characteristics of cases and controls are shown in Table 1. Cases and control subjects were similar by sex and age. Cases were less likely to have bachelor's degrees or higher and more likely to be working primarily in nursing homes or long-term care facilities and with geriatric patients.

Table 2 provides risk estimates at 3 levels of analyses: unadjusted; partially adjusted for a minimal set of confounders^{20,21}; and the corresponding fully adjusted multivariate analysis, weighted for nonresponse and unknown eligibility.

Nurses at greatest risk of assault were those working in nursing homes or long-term care facilities (2.6; 1.9–3.6) and emergency (4.2; 1.3–12.8) and psychiatric (2.0; 1.1–3.7) departments. Risk increased for each additional hour of shift duration (1.05; 0.99–1.11).

Of all the environmental factors, the amount of lighting was most strongly associated with risk. The odds of assault were doubled when lighting was less bright than daylight (2.2; 1.6–2.8). Other elements of environmental protection (such as video monitors and security personnel) had little apparent effect. Risk was substantially reduced among nurses who provided their own cellular telephones or portable alarms (0.30; 0.15–0.71). However, cellular telephones provided by the employer provided no apparent protection (1.0; 0.70–1.5).

DISCUSSION

We found increased risks of work-related physical assault among nurses who worked in nursing home or long-term care facilities and also among those working in psychiatric and emergency departments. Other studies^{27,28} have identified similar risks using designs different from the present study. We also found increased risk of assault in environments that were not fully illuminated. A previous case-control study of occupational homicide has identified reduced risks with bright exterior lighting;²⁹ however, the importance of interior lighting had apparently not been considered. Although every hour of patient contact increased risk at least 5%, both nursing and total staffing might moderate this risk. Further research may confirm this finding. The lower risk among nurses carrying their own cellular telephone or personal portable alarm is apparently not due to the availability of the telephone itself, since those provided by employers conferred no protection.

Our information on both the exposures and the outcome was based on self-report, which is a potential weakness. We attempted to minimize this bias by limiting the recall of violent events to the previous 12 months³⁰ and the recall of exposures to a 1-month period within the preceding year,¹⁴ as has been done in previous studies. To further minimize information bias, nurses were contacted again by mail to clarify ambiguous or missing information.²⁰ We also conducted validation substudies of environmental exposures and health care treatment.²⁰ Potential response bias was controlled for by Horvitz and Thompson reweighting²⁵ using weights adjusted for the probability of being eligible among nonrespondents.¹⁸ Sensitivity analyses conducted on key exposures of interest²⁶ suggest that the results are not due to unmeasured confounding.²⁰

In summary, we estimated the incidence of violence in licensed nursing professionals, a large occupational population, and identified relevant risk and protective factors. These results can guide further investigation of relevant factors, and perhaps lead to effective methods for reducing the substantial risk of physical assault in health care settings.

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