Occupational Injury Among Janitors

Injury Incidence, Severity, and Associated Risk Factors

Deirdre R. Green, MS, PhD, Susan G. Gerberich, PhD, Hyun Kim, ScD, Andrew D. Ryan, MS, Patricia M. McGovern, PhD, Timothy R. Church, PhD, Adam Schwartz, MS, PhD, and Rony F. Arauz, MPH, PhD

Objective: Determine injury incidence and severity and potential associated risk factors for injury, among janitors. **Methods:** Questionnaires were disseminated to 1200 full-time janitors in the Service Employees International Union (SEIU) Local 26 union; 390 responded and provided information on their injury experiences and exposures, based on personal characteristics and work-related activities. Multivariable analyses, including bias adjustment, were implemented using directed acyclic graphs to determine potential risk. **Results:** Among the janitors, 34% reported experiencing at least one injury; 16% of cases resulted in hospital admittance. Significantly increased risks were identified for age, ethnicity, shift start time, and physician-diagnosed depression. **Conclusions:** Knowledge of specific risk and protective factors is valuable, and can serve as a basis for further in-depth studies and inform the development of targeted intervention strategies aimed to reduce occurrence of these injuries.

Keywords: epidemiology, janitors, occupational injuries, public health

Janitors and cleaners are responsible for keeping buildings in clean and orderly condition through activities such as cleaning restrooms, mopping floors, shampooing rugs, washing walls and windows, and removing trash. In 2016, according to the Bureau of Labor Statistics, janitors and building-cleaning workers held about 2.4 million jobs. Among them, approximately 36% were employed in services to the building and dwellings industry, 13% were employed in elementary and secondary schools, 7% were employed in healthcare, and 5% were employed in government.[1]

Occupational injury is a major safety and health issue among workers in the service industry, specifically those employed in janitorial and cleaning services.[1–10] Janitors are among the occupations that demand high musculoskeletal loads and are associated with the greatest number of cardiovascular conditions.[5,6,11] The main injury-related anatomical locations affected among janitors include elbows, knees, wrists, hands, lower back, neck, and shoulder.[6] In addition to physical hazards, janitors are also exposed to various chemical exposures resulting in respiratory diseases and dermatologic disorders.[7]

According to the Bureau of Labor Statistics, in 2015, the incidence of occupational injuries and illnesses involving days away from work, in private, state, and local government, was 277.4 per 10,000 full-time workers with 10 median days away from work.[12] Approximately 42,740 lost-time injuries and illnesses were reported for the janitorial industry in 2015,[12] compared with only 39,290 in 2014.[13] Among the injuries, sprains, strains, and tears had the highest incidence rates for non-fatal occupational injuries among janitors (113.1 per 10,000 full-time workers), followed by bruises (26.5) and fractures (23.3). The most common events or exposures leading to injuries were overexertion (106.9 per 10,000 full-time janitors), falls, slips, trips (79.8), and contact with objects (62.0).[12]

The prevalence of health problems in the cleaning workforce is high; however, most studies provide only a partial view, versus a big picture, of the occupation rather than evaluating specific tasks, the work environment, and the working conditions in a more comprehensive manner.[11] Literature reviews have revealed that janitors are exposed to both chemical and physical risks, resulting in high rates of injury and illness. Unfortunately, limited research addresses the relation between these exposures and injuries and other health effects. The current study addressed the occupational injury concerns among janitors by determining the injury incidence and potential risk factors—information that can provide a basis for relevant intervention efforts.

METHODS

Study Population

The study population included janitors who were members of the Service Employees International Union (SEIU), responsible for cleaning, maintaining, and providing security for commercial office buildings, co-ops, and apartment buildings, as well as public facilities like theaters, stadiums, and airports. The SEIU Local 26 chapter, comprised of approximately 4000 janitors, represents a major portion of janitors, security officers, and window cleaners in the Twin Cities metropolitan area. Among these janitors, the target population necessarily included only 1200 janitors who were classified as full-time (ie, working more than or equal to 30 hours per week). Full-time janitors were selected because of known higher turnover rates and difficulty in accessing the part-time janitor community over two, 6-month sequential data collection periods. This study was approved by the Institutional Review Board at the academic research institution.

Data Collection

To achieve the goal of this study—to determine injury incidence and severity and potential associated risk factors for injury among janitors—data were collected using a survey methodology. A questionnaire, appropriate for administration, was developed in coordination with experts from the fields of injury prevention, survey design, and epidemiology, incorporating modifications based on initial focus group pilot testing and discussions with the janitors and union representatives. Piloting was used to determine the

From the Midwest Center for Occupational Health and Safety Education and Research Center, Division of Environmental Health Sciences, School of Public Health, University of Minnesota, Minneapolis, Minnesota.

Funding: This research was supported by a MCOHS Pilot Projects Research Grant, Midwest Center for Occupational Health and Safety, Education and Research Center (T42OH008434) funded through: National Institute for Occupational Safety and Health (NIOSH), Centers for Disease Control, Department of Health and Human Services. Additional support was provided through the University of Minnesota Graduate School, Doctoral Dissertation Fellowship. The contents of this effort are solely the responsibility of the authors and do not necessarily represent the official view of NIOSH, the University of Minnesota Graduate School, or other associated entities.

Sources of Support: A special thanks to the Service Employees International Union (SEIU) Local 26 for their commitment and important contributions to this project.

Conflicts of Interest: None Declared.

Address correspondence to: Susan G. Gerberich, PhD, Division of Environmental Health Sciences, School of Public Health, University of Minnesota, 1156 Mayo Memorial Building, 420 Delaware Street SE, MMC - 807, Minneapolis, MN 55455 (gerbe001@umn.edu).

DOI: 10.1097/JOM.0000000000001505

likelihood that the study population would understand the questions, assess the effectiveness of educational materials provided prior to survey questioning, and estimate a likely response rate. In order to accurately capture the effectiveness of the data collection tool, it was essential to develop an optimal data collection instrument in a rigorous manner.

The questionnaire was piloted using a focus group of approximately 30 janitors, selected with the support of SEIU Local 26, to obtain feedback and assess the adequacy of the questionnaire. Based on initial feedback, the questionnaire was revised as appropriate. Following the piloting, questionnaires were translated into the different languages of the study participants (English, Spanish, and Somali) and validated by professionals to ensure accuracy. Questionnaires requested information on work-related exposures and personal characteristics, including demographics, injury, and general health status. The research team, following the focus group meeting, assessed participant feedback and modified the questionnaire, accordingly, based on responses to the questions.

Following relevant modifications of the questionnaire after development and pilot pre-testing, data collection was conducted in two sequential 6-month periods. Questionnaires were disseminated to participating janitors to collect data for each preceding 6-month period (baseline and follow-up), yielding data on a full year of the janitor's experience. The initial baseline questionnaire was administered in November 2016 and collected information regarding the 6-month period between May 1st and October 31st, 2016. The follow-up questionnaire was then administered 6 months later, during May 2017, and collected information regarding the 6-month period between November 1st, 2016 and April 30th, 2017. Questionnaire distribution was conducted using SEIU Local 26 representatives, who are referred to as stewards and are leaders within the union. Each steward is assigned a building or an area of janitors and is responsible for providing their members valuable union and contract information in addition to helping them resolve any issues and problems. At the onset of the study period, all stewards attended a 3-hour session during which they received training on how to distribute the questionnaires, answer questions that could arise during questionnaire completion, and how to collect and return the materials to the study team.

The questionnaires were distributed to all employees who agreed to participate in the study and had consented to participate. Questionnaire completion time ranged from approximately 30 to 45 minutes. The questionnaires were distributed at the commencement of janitors' work shifts and, following completion, were returned to the stewards in an individual sealed envelope addressed to the research team.

Measures

For each of the questions posed, pertinent to injury outcome or personal and work-related characteristics, they were identified within the context of the previous, respective 6-month data collection periods. For some questions (health conditions, demographics, duration working as a janitor), they were asked about their experiences over their lifetime.

Definition of Injuries

The definition used for work-related injury was based on the National Center for Health Statistics (NCHS) and Bureau of Labor Statistics.[14] ''Work-related'' includes any activities, including travel, associated with the job or events that occur in the work environment. Work-related injuries are defined as any wounds or damage to the body associated with the job that occur in the working environment; they result from acute traumatic events that involve: restriction of normal activities for at least 4 hours; and/or the use of professional medical care; and/or loss of consciousness, loss of awareness, or amnesia for any length of time. At the request of this population, via the focus groups, pain was included in the injury description and subsequently as an injury type. The janitor members of the focus group consistently identified work-related pain as a major concern and associated that pain as a type of occupational injury. Injury data collected included type (diagnosis), cause and severity (hospitalization; lost work time; time restricted from regular activity; time restricted from work) of the injury, together with the source, mechanism, and potential contributing factors.

Definition of Variables

Personal Characteristics

Janitors' demographic information collected for this study included age, sex, ethnicity, marital status, education, income, and language.

Physical and Mental Health Conditions

Physical health: Health status information, including physician-diagnosed heart conditions, asthma, cancer, lung disease, and diabetes were collected.

Mental health: This was determined by doctor-diagnosed depression, including currently being treated for depression, taking medications, or seeing a health professional for counseling.

Work-Related Characteristics

Job title: Based on the majority of job duties, janitors were classified as bathroom cleaners, floor cleaners, general cleaners, or special project workers.

Work experience: This involved years working as a janitor at the current company, as well as over their lifetime.

Other jobs: This included any additional jobs to their full-time employment as a janitor. Additional janitorial service jobs were also included.

Work start time: This category included the times that janitors began their work shifts on any given workday. There were four subcategories of work time commencement: 12:00 a.m. to 5:59 a.m., 6 a.m. to 11:59 a.m., 12:00 p.m. to 4:59 p.m., and 5:00 p.m. to 11:59 p.m.

Data Analysis

Descriptive statistics were utilized to summarize the frequencies of participant demographics, work characteristics and health conditions, as well as injury type, cause, and severity. A binary variable (yes/no) was used to indicate occupational injury, and Poisson regression with robust variance was used to estimate incidence probability for occupational injury among janitors.[15] A second analysis to estimate the rate of work-related injury events per person-year used a negative binomial regression. Regression estimates to determine incidence probability and the rate of injury utilized an offset term to differentiate between janitors who completed one survey only (6-month recall) versus those who completed both surveys (two 6-month recalls). To determine the strength of associations between personal and work-related characteristics and occupational injury, relative risks were calculated using Poisson regression models with robust variance estimators.[15]

Rates and associated 95% confidence intervals (CI) were estimated using generalized estimating equations (GEEs) with exchangeable working correlation matrices. GEEs are an extension of generalized linear models for correlated data; they produce marginal models, which establish average estimates across subjects, while accounting for dependence within subjects.[16] In this study, janitors could have completed both a baseline and a follow-up survey or completed just one of the surveys during the study period. For those participants who completed both surveys, GEEs accounted for any potential correlation between subjects. In the models, each janitor was considered to be independent. The

exchangeable working correlation structure assumes all observations, over time, within each janitor, have the same correlation and, thus, was used in the GEE models for each of the exposures of interest.

Bias Analyses

Non-response bias arising from missing data was a potential concern. To minimize non-response bias prior to data collection, and promote survey response: (1) the questionnaire was translated to relevant languages; (2) focus groups were utilized to determine questionnaire comprehensibility; (3) the research team collaborated with union representatives to identify ideal dissemination methods; and (4) all SEIU Local 26 members contacted for the study were given the opportunity to be entered into a drawing for a $50 Target giftcard, whether or not they participated. To account for any missing data following survey collection, and to minimize possible non-response bias, models were adjusted by weighting observed responses by inverse probabilities of response estimated as a function of characteristics known for all SEIU Local 26 janitors available from the union. This method provides greater upweighting for those categories of subjects with low response rates compared with those with higher response rates to account for potential differences in responses and exposures between responders and non-responders.[17] These characteristics included birth year, sex, and contractor.

Selection of Variables

Based on relevant literature and expert knowledge, a causal model was developed to determine the variables to be measured and controlled for in the study analyses. From the model, directed acyclic graphs (DAGs) were derived, a priori, based on relevant literature and experts' knowledge, to determine the minimum sufficient set of potential confounders for the identified characteristics and exposures of interest. When selecting potential confounders, the DAG allows identification of a minimal set of confounders for adjustment as well as any variables that would introduce confounding if adjusted for, following the methods described by Greenland et al[18] and illustrated by Hernan et al.[19] Figure 1 presents an example of a DAG for one exposure of interest—shift start time.

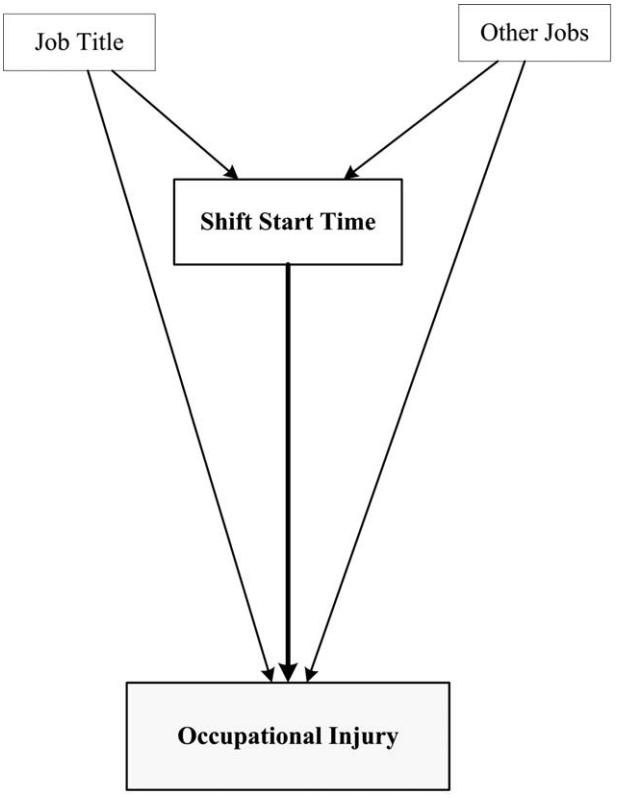

FIGURE 1. Example DAG for the association between shift start time and occupational injury: health and injury study of janitorial service employees. DAG, directed acyclic graphs.

RESULTS

Of the approximately 1200 full-time eligible participants, 390 participated in the study and completed at least one of the questionnaires (response rate = 33%) (Fig. 2). Table 1 shows the demographic distribution of all survey participants. The majority of the respondents were Hispanic (68%) and female (55%). Ages ranged from 19 to more than 60 years, with most (60%) of the janitors between 31 and 50 years of age, followed by age 51 to 60 (23%). Household income ranged from less than $25,000 to more than $75,000, with the majority of janitors earning between $25,000 and $35,000 (58%). The vast majority (72%) of the participants were married, living as married or living with a domestic partner, followed by separated or divorced (14%) and single (12%). The highest level of education was some form of college; however, participants reported a high school diploma (36%) followed by less than grade 12 (35%). Among the janitors, less than half (42%) reported English proficiency, 12% reported having been diagnosed with depression by a physician, and about a quarter (24%) reported other diagnosed physical health conditions.

Among the janitors, the majority were classified as floor cleaners (58%), followed by special projects (23%) and bathroom cleaners (14%). Approximately 17% reported additional jobs. The majority of janitors had worked in that capacity for 10 years or less; 30% for 5 years or less, and 38% for between 6 and 10 years. Approximately half (53%) had been with their current company for less than 5 years. Shift start times involved all hours of the day; however, the majority (68%) reported a start time and shift of 5:00 pm to 11:59 pm.

Over the course of the study period, 34% of janitors reported having at least one injury. As shown in Table 2, the adjusted injury rate for janitors, based on having at least one injury, was 46 per 100 janitors. The adjusted injury event rate, based on the number or count of injury events, was 0.92 per janitor per year. Among women, the adjusted injury event rate (1.13 events per janitor per year) was higher than among men (0.73 events).

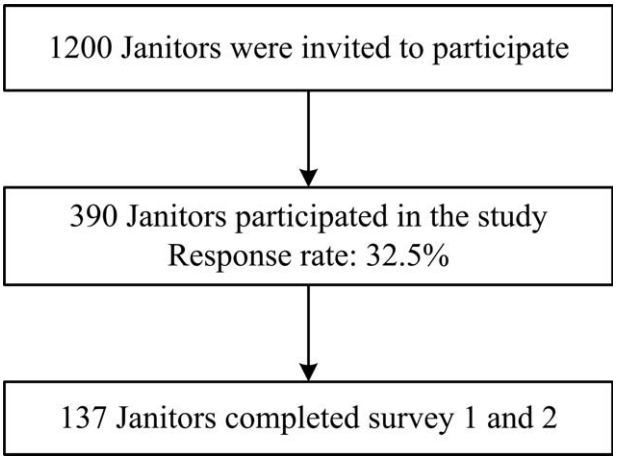

FIGURE 2. Sampling frame: health and injury study of janitorial service employees.

TABLE 1. Study Participant Characteristics: Health and Injury Study of Janitorial Service Employees

Participant Demographics	*N*	%
Gender		
Male	160	44.6
Female	199	55.4
Age		
19–30	25	10.3
31–40	74	30.3
41–50	74	30.3
51–60	56	23.0
>60	15	6.1
Ethnicity		
Hispanic	240	68.0
Not Hispanic	113	32.0
Household income		
Less than $25,000	55	15.7
$25,000–$34,999	202	57.6
$35,000–$49,999	74	21.1
$50,000–$74,999	18	5.1
More than $75,000	2	0.6
Marital status		
Married/living as married/living with domestic partner	257	72.0
Never married/single	43	12.0
Separated/divorced	49	13.7
Widowed	8	2.2
Race		
White	52	30.1
Black or African American	98	56.6
Other	23	13.3
English speaking ability		
Well	152	42.8
Not well	203	57.2
Education		
No schooling completed	32	18.5
Less than Grade 12	60	34.7
High School Graduate	63	36.4
College or some college	18	10.4
Work characteristics		
Job title		
Bathroom cleaner	54	14.3
Floor cleaner	218	57.8
Other/special projects	88	23.3
General cleaner	17	4.5
Other jobs		
Yes	58	16.5
No	294	83.5
Lifetime janitor duration		
0–5 years	112	29.9
6–10 years	144	38.4
11–15 years	52	13.9
>16 years	67	17.9
Current company janitor duration		
0–5 years	181	52.8
6–10 years	117	34.1
11–15 years	22	6.4
>16 years	23	6.7
Shift start times		
12 a.m.–5:59 a.m.	46	12.9
6 a.m.–11:59 a.m.	47	12.5
12 p.m.–4:59 p.m.	20	6.3
5 p.m.–11:59 p.m.	216	68.4
Physical and mental health conditions		
Mental health (depression)		
Yes	37	11.5
No	286	88.5
Physical health (stroke, heart issues, lung, etc)		
Yes	76	24.4
No	236	75.6

The most common sources/causes of reported injury events were overexertion (50%) and repetitive motion (57%), followed by contact with an object or piece of equipment (13%). As shown in Table 3, the major injury type was pain (66%), followed by abrasions, varicose veins, and cuts, lacerations, and scratches. The most common body parts injured involved primarily the back and lower extremities. Among the janitors who reported pain, the most common body parts affected included the back (34%), feet (33%), legs (26%), arms (25%), and shoulders (21%) (data not shown). Among the janitors who reported an abrasion, half were to either the legs (25%) or the hands (25%), followed by feet (19%), arms (13%), and stomach (13%) (data not shown).

Among the janitors reporting injuries, 16% reported hospital admittance (Table 4); these injuries primarily involved the back (53%), leg (40%), feet (27%), and arms (20%) (data not shown). Among those receiving emergency/hospital care, the most common injury types were pain (53%) and concussions (27%), with a small percentage reporting sprains (13%), amputations (13%), and nerve injuries (7%) (data not shown). Overexertion (47%), repetitive motion (53%), and contact with objects (27%) were the major sources/causes of injuries resulting in hospital admittance. The majority of injuries (55%) resulted in no treatment being sought, with the remainder primarily treated by a physician (28%) or the janitors themselves (19%), while small proportions were treated by a chiropractor (9%) or nurse/nurse practitioner (8%).

Also of importance, more than a quarter of janitors reported having lost work days (28%) or restricted work days (27%) as a result of an injury (Table 4). Among those who had restricted work days, the majority (59%) were restricted for no more than 1 week; 5% reported being restricted from 7 to 14 days; 5% reported being restricted for 14 days to 1 month; 9% reported being restricted for 1 to 3 months; and 5% reported being restricted for greater than 3 months (data not shown). Similar to hospital admittance, the majority of injuries resulting in restricted work time were a result of pain (36%), nerve injuries (23%), and cuts/scratches (18%) (data not shown). Among the body parts injured that resulted in restricted work time, hands were the most commonly affected (32%) (data not shown). While 16% of injured janitors reported that their activities were still restricted as a result of an injury, 51% reported they were still experiencing problems (Table 4).

Table 5 gives estimates of relative risks and 95% CIs from multivariable, weighted analyses. Although not statistically significant, decreased risks of injury were shown for men, compared with women. In particular, risk of injury was 2.3 times greater among those less than 30 versus those aged 31 to 40 years. In addition, those who identified as Hispanic, compared with non-Hispanic,

TABLE 2. Injury Incidence: Health and Injury Study of Janitorial Service Employees

	Unadjusted Rate (95% Confidence Interval)	Adjusted Rate (95% Confidence Interval)*
Injury (Yes) Per 100 Persons		
Total	49.8 (43.1–57.4)	45.5 (38.3–54.0)
Male	50.2 (39.8–63.4)	41.5 (30.9–55.9)
Female	48.5 (40.1–58.6)	47.9 (39.2–58.7)
Total events per person year		
Total	1.11 (0.88–1.39)	0.92 (0.67–1.25)
Male	1.09 (0.76–1.57)	0.73 (0.44–1.20)
Female	1.14 (0.84–1.55)	1.13 (0.78–1.66)

*Adjusted for nonresponse (birth year, sex, and contractor).

TABLE 3. Injury Characteristics: Health and Injury Study of Janitorial Service Employees

Injury Type*	***N***	***%***
Abrasion/bruise	16	14.4
Amputation/loss of body part	2	1.8
Asphyxia/loss of breath/loss of oxygen	3	2.7
Bite	0	0.0
Burn	1	0.9
Concussion	4	3.6
Crushing/Mangling	0	0.0
Cut/laceration/scratch	13	11.7
Fracture	2	1.8
Dislocation	0	0.0
Nerve injury	14	12.6
Pain	73	65.8
Penetration injury	4	3.6
Poisoning	5	4.5
Sprain/strain/rupture	8	7.2
Torn ligament	2	1.8
Varicose veins	16	14.4
Other	5	4.5
Missing responses among those who reported injuries	70	
Body Part Injured*	***N***	***%***
Head/skull/brain	10	7.8
Face (forehead, cheek, nose, lip, jaw, ear)	2	1.6
Eye/eyelid	8	6.3
Teeth	2	1.6
Neck/cervical area	14	10.9
Back	44	34.4
Chest	9	7.0
Spinal Cord/spine	11	8.6
Abdomen/stomach	6	4.7
Shoulder	24	18.8
Arm/elbow/wrist	34	26.6
Hand/fingers/thumb(s)	27	21.1
Hips	22	17.2
Buttocks	4	3.1
Genitalia/private body parts	3	2.3
Leg(thigh, shin, calf, knee, ankle)	26	20.3
Foot/heel/toes	33	25.8
Other	7	5.5
Missing Responses among those who reported injuries	53	
Source/Cause of Injury*	***N***	***%***
Contact with object, equipment	13	12.9
Overexertion	50	49.5
Struck by object	4	4.0
Struck against object	7	6.9
Caught in object, equipment, material	0	0.0
Fall to lower level	1	1.0
Fall to same level	5	5.0
Slip, trip	5	5.0
Repetitive motion	58	57.4
Exposed to harmful substance	5	5.0
Fires, explosions	0	0.0
Other	3	3.0
Missing responses among those who reported injuries	80	

*Question denotes "check all that apply"; therefore, responses may total more than 100%.

TABLE 4. Injury Severity: Health and Injury Study of Janitorial Service Employees

	N	***%***
Hospital admittance		
Yes	15	15.8
No	80	84.2
Missing	98	
Lost work days		
Yes	24	27.9
No	62	72.1
Missing	107	
Restricted work days		
Yes	22	26.8
No	60	73.2
Missing	99	
Restricted non-work days		
Yes	19	26.8
No	52	73.2
Missing	110	
Activities still restricted		
Yes	11	16.4
No	56	83.6
Missing	114	
Continuing problems		
Yes	41	50.6
No	40	49.4
Missing	100	
Workers' compensation claim		
Yes	9	12.0
No	66	88.0
Missing	106	
Injury treatment*		
No treatment	55	54.5
Physician	28	27.7
Dentist	2	2.0
Chiropractor	9	8.9
Nurse/nurse practitioner	8	7.9
Psychiatrist/psychologist	1	1.0
Paramedics/emergency med tech	2	2.0
Holistic, alternative, non-traditional	2	2.0
Treated yourself	19	18.8
Other	2	2.0
Missing responses among those who reported injuries	80	

*Question denotes "check all that apply"; therefore, responses may total more than 100%.

experienced a significant risk of injury that was two times greater. While not significant, risks of injury were also increased for janitors who reported English proficiency, compared with those who did not (Table 5).

Among work characteristics identified by the janitors, risks of injury were decreased for those who started work anytime between 6:00 a.m. and 11:59 a.m. compared with 5:00 p.m. to 11:59 p.m. Importantly, risk of injury was two times greater for those who reported that they experienced physician-diagnosed depression, compared with those who did not.

DISCUSSION

Previous research among janitors and cleaners have identified janitors as being at increased risk of occupational injury compared with other occupational sectors.[1–10] The current study identified the incidence of occupational injury among janitors in the Twin Cities metropolitan area, including injury severity and associated risk factors. Of particular importance was the identification of a high rate of injury (46 per 100 janitors per year). However, this rate is considered conservative, given that it was based on janitors incurring a minimum of one work-related injury event during a 1-year period. When accounting for multiple injury events, the adjusted rate of injury events is 0.92 per person per year (ie, 92 injury events per 100 janitors per year). Due to different study methods and populations, it is

TABLE 5. Multivariable Analyses of Personal and Occupational Exposures and Injury: Health and Injury Study of Janitorial Service Employees

	Occupational Injury			
	RR	**95% CI**	**RR**	**95% CI**
Demographics	**Unadjusted**		**Adjusted***	
Gender†				
Male	0.98	0.72–1.34	0.72	0.48–1.08
Female	1	–	1	–
Age†				
19–30	2.33	1.15–4.72	2.29	1.00–5.24
31–40	1	–	1	–
41–50	1.23	0.82–1.87	1.14	0.69–1.89
51–60	1.28	0.83–1.97	1.11	0.65–1.88
>60	0.72	0.31–1.66	0.89	0.36–2.20
Ethnicity†				
Hispanic	1.58	1.08–2.30	1.97	1.23–3.15
Not Hispanic	1	–	1	–
English speaking ability‡				
Well	1.30	0.75–2.26	1.79	0.86–3.73
Not Well	1	–	1	–
Household income§				
Less than $25,000	1	–	1	–
$25,000–$34,999	0.84	0.58–1.22	0.79	0.51–1.22
$35,000–$49,999	0.74	0.47–1.18	0.77	0.44–1.34
$50,000–$74,999	0.76	0.34–1.70	0.89	0.34–2.29
Marital status‖				
Married/living as married	1	–	1	–
Never married/single	0.96	0.61–1.52	0.78	0.42–1.45
Divorced/separated	1.02	0.66–1.60	0.78	0.46–1.31
Widowed	0.83	0.30–2.33	1.14	0.45–2.88
Education¶				
No schooling completed	1	–	1	–
Less than Grade 12	1.08	0.74–1.56	1.03	0.64–1.66
High school graduate	0.84	0.54–1.30	0.84	0.47–1.51
College or some college	1.22	0.73–2.04	0.97	0.49–1.93
	RR	**95% CI**	**RR**	**95% CI**
Work Characteristics	**Unadjusted**		**Adjusted***	
Job title§				
Bathroom cleaner	0.75	0.46–1.25	0.69	0.38–1.23
Floor cleaner	1	–	1	–
Other/special projects	1.05	0.74–1.49	1.19	0.77–1.84
General cleaner	1.07	0.59–1.92	1.28	0.64–2.56
Other jobs#				
Yes	1.24	0.85–1.79	1.25	0.78–2.01
No	1	–	1	–
Lifetime janitor duration**				
0–5 years	1	–	1	–
6–10 years	0.90	0.63–1.29	0.77	0.48–1.25
11–15 years	1.00	0.62–1.58	0.77	0.43–1.39
>16 years	0.87	0.55–1.35	0.90	0.51–1.58
Current company janitor duration††				
0–5 years	1	–	1	–
6–10 years	1.07	0.74–1.56	1.21	0.74–1.98
11–15 years	0.78	0.40–1.51	0.75	0.31–1.80
>16 years	1.03	0.58–1.82	0.85	0.38–1.90
Shift start times‡‡				
12 a.m.–5:59 a.m.	0.77	0.51–1.16	0.57	0.31–1.04
6 a.m.–11:59 a.m.	0.34	0.13–0.87	0.33	0.11–1.01
12 p.m.–4:59 p.m.	0.66	0.29–1.53	1.18	0.54–2.58
5 p.m.–11:59 p.m.	1	–	1	–

Health Conditions	RR	95% CI	RR	95% CI
	Unadjusted		Adjusted*	
Pre-existing health condition (physical health§§; mental health‖‖)				
Mental health (depression)				
Yes	1.65	1.14–2.40	1.93	1.28–2.93
No	1	–	1	–
Physical health (stroke, heart issues, lung, etc)				
Yes	1.04	0.71–1.54	1.06	0.68–1.65
No	1	–	1	–

RR, relative risk; 95% CI, 95% confidence interval.
*Results adjusted for nonresponse (birth year, sex, and contractor).
†No additional covariates.
‡Adjusted for ethnicity and education.
§Adjusted for sex, ethnicity, age, and education.
‖Adjusted for sex, ethnicity, and age.
¶Adjusted for sex, ethnicity, age, and marriage.
#Adjusted for education, marital status, and other household members.
**Adjusted for age and education.
††Adjusted for education, age, and lifetime janitor experience.
‡‡Adjusted for job title and other jobs.
§§Adjusted for sex, ethnicity, age, smoking status, and mental health condition.
‖‖Adjusted for marital status, ethnicity, age, sex, other household members, smoking status, education, and pre-existing health condition.

difficult to compare these results to other studies. However, a previous study among janitors in British Columbia, that assessed data from an injury reporting database for a 3-year period, supported these findings and concluded that among custodians, 38% reported an occupational injury, with a rate of 11.3 work injuries per 100 full time equivalent (FTEs).[8] Similarly, a study conducted from 2010 to 2013 found that, among 276 janitors in the state of Washington, reporting of work-related injuries remained steady with about 30% of janitors experiencing an injury each year.[10]

Among janitors and cleaners who incurred an injury, work-related pain was a major problem, as identified in previous studies.[3,6,20] Woods and Buckle (2000), reported that 74% of janitors experienced aches or pain during a 1-year period, which is consistent with current study results indicating that 66% of janitors experienced pain. In another study among Las-Vegas cleaners,[3] 75% reported experiencing work-related pain. Similarly, a study among cleaners in a Texas hospital, 82% complained of work-related pain in the previous 12 months.[20] In addition to pain, consistent with previous research,[2,6,8,10,12,20] the major types of occupational injuries identified in the current study among janitors included: musculoskeletal injuries; sprains, strains and tears; and bruises and fractures.

Also important, are the primary body parts injured among janitors. Results indicated that back injuries were the most prevalent body part injured; however, many janitors also reported injuries involving the arms, hands, legs, and shoulders. A study of musculoskeletal injuries among United Kingdom cleaners, indicated the main injury locations were elbows, knees, wrists, hands, lower back, neck, and shoulder.[6] Another study of injury risk among custodial workers in Canada found that the upper limbs (shoulder, elbows, wrist, and hand combined) were the most frequent body part injured (41%), followed by the back (28%).[8] These findings are consistent with the current results, indicating the burden of injuries involves not only the back but, also, the upper extremities, including the arms, hands, and shoulders as well as the lower extremities. In addition, this supports previous research identifying the burden of musculoskeletal injuries among janitors[2,6,8] and highlighted which muscle groups and body parts may be most at risk.

For janitors and cleaners who experienced a work-related injury, lost work time and compensable claims are major issues.[4] The current findings that 28% of janitors reported lost work time, and another 27% reported restricted work days, were slightly higher than recent research.[10] Previous research has identified that the majority of injuries, resulting in lost work time, among cleaners is attributable to musculoskeletal injuries and contusions/bruises.[2] The current study findings indicated that the majority of restricted work was a direct result of pain, potentially related to musculoskeletal injuries, cuts/scratches, and nerve injuries, and involved hands as the primary body part injured in relation to restricted work. Further, results indicated the majority of restricted work and lost work time injuries were due to exertion and repetitive motion. To protect janitors and cleaners from lost work time, and the financial burdens incurred by both employers and employees, understanding the impact of injury type, cause, and affected body part is essential.

There has been limited research of the associated risk and protective factors for occupational injury among janitors. In the adjusted multivariable models, the factors associated with increased risk of injury were sex (women vs men), age (19 to 30 vs 31 to 40), ethnicity (Hispanic vs not Hispanic), and English proficiency (well vs not well). Also consistent with some previous research,[4,8] the risk of injury was affected by age, with a doubling of risk for janitors under 30, compared with those aged 31 to 40. While there may be a potential for a healthy worker effect among the older age groups, inexperience in the younger age group may increase the risk of injury.

Also important was the increased risk of injury among janitors who were reported as Hispanic, compared with non-Hispanic. Previous research has highlighted disparities in injury rates among Hispanic/Latino workers in the United States,[21–27] which may be attributable to factors including language barriers, more hazardous working conditions, and immigration status. While not statistically significant, an unexpected finding, in contrast to previous studies,[4] was the increased risk of injury for those who reported being proficient in English, compared with those who did not. This may be attributable to customized training provided to those janitors who spoke primarily Somali or Spanish, including targeted and translated safety trainings, compared with a more general training provided to those who spoke English.

Of particular interest was the decreased risk of injury among janitors who started work in early morning hours compared with those who started in the evening. Most importantly, there was an important decrease in risk for those who started between 6:00 a.m. and 11:59 a.m. (vs between 5:00 p.m. and 11:59 p.m.). This can

potentially be explained by the quality of sleep for those starting in the morning hours, suggesting that those who have a traditional night of sleep are much less likely to have a work-related injury compared with those who start and work in the late evening hours. Previous research supports that short sleep length and poor sleep quality are associated with increased risks of occupational injury.[28–31] Among those janitors who worked evening work shifts, poor sleep quality would be a major concern and may explain the decreased risk of injury among those who likely had better sleep quality, based on their shift start time.

Of importance, is the strong association between physician-diagnosed depression and occupational injury among janitors, with a risk of injury 1.9 times higher among those who reported being depressed compared with those who did not. This is among the first studies to address mental health issues among janitors. Previous research suggests that there may be an association between preexisting depression and occupational injury[32]; however, this topic warrants further research. Identification of this association contributes to the literature and indicates the importance of mental wellness relevant to the occupational health and safety of janitors.

Advantages and Limitations

A strength of this study is that it provided valuable self-reports on injury occurrence and severity among janitors. In addition to highlighting the overall burden of injury among janitors, important risk and protective factors were identified. Further important was the ability to collaborate with this population which, prior to this time, has afforded limited access. As a result, this was among the first of studies to begin to address concerns specifically identified by the janitor population.

An additional advantage of this study was being able to access this neglected and underserved population of unionized janitors. Collaboration with SEIU Local 26 facilitated communication between the academic institution researchers and the janitor participants though survey dissemination, collection, and focus group set-up. In the past, this group of janitors had received inadequate attention; however, through this valuable partnership, janitors were able to openly communicate their health and safety concerns.

Despite the strengths of this study, there were several potential limitations regarding study findings, including potential for biases introduced by collecting information on injury experiences and relevant personal and work-related characteristics and exposures through self-report. Previous survey research involving non-fatal injuries have found that longer recall periods typically yield less accurate reported measures.[33–35] Therefore, to decrease potential information bias, recall was restricted to the respective 6-month periods.

In addition, janitors were provided with some assistance regarding survey completion to clarify questions and to minimize missing data. To ensure that interviewer bias was not introduced through this method, those who provided guidance with survey completion (ie, stewards or union representatives) were trained on questionnaire content, how to encourage survey completion, address any ambiguous information, and translate information as necessary, without ''leading'' the respondent.

Follow-up and attrition was a problem among this study population; thus, there was no opportunity to collect any missing information following initial data collection periods. Additionally, some survey measures required imputation from other collected variables. The final occupational injury outcome was imputed when not directly reported by the participant, using relevant information from other sections of the questionnaire including: reporting an injury to an employer; providing any information regarding injury description, time, type, cause, severity or body part affected; and indicating pain as a result of work-related efforts. To address any potential biases, information from these questions was only included if it could be directly linked to the injury outcome as determined by the research team, comprised of experts in the field of injury prevention.

Regardless of potential missing data in the descriptive analyses, summary information provides some understanding of this population and the relevant injury burden and severity. Additionally, as described earlier, potential response bias was controlled by inversely weighting observed responses by probabilities of response, estimated as a function of population characteristics available from the union. Although there may be residual bias due to unmeasured variables, this method controls such bias to the extent possible.

It is also acknowledged that findings from this study may lack generalizability to other populations of janitors including non-unionized custodians, those responsible for cleaning school buildings, and those who are located in different regions. Therefore, the effects of their characteristics and exposures of interest relevant to injury outcomes could potentially result in different levels of risk.

CONCLUSIONS

This study is among the first to comprehensively assess the injury burden among janitors and identify the potential risk and protective factors. The rate of injury was of particular concern, indicating the magnitude of the injury problem in this population. Results of this study identified several risk factors, in addition to protective factors, that are likely to affect the occurrence of an occupational injury, particularly among the population studied. Knowledge of these risks is valuable, and can serve as a basis for further in-depth studies and inform the development of targeted intervention strategies aimed to reduce occurrence of these injuries. Additionally, this information can be utilized by employers and contractors responsible for maintaining a healthy working environment for janitors.

REFERENCES

1. Bureau of Labor Statistics, U.S. Department of Labor. Occupational Outlook Handbook. *Janitors and Building Cleaners*; 2018. Available at: https://www.bls.gov/ooh/building-and-grounds-cleaning/janitors-and-building-cleaners.htm#tab-1. Accessed January 30, 2018.
2. Alamgir H, Yu S. Epidemiology of occupational injury among cleaners in the healthcare sector. *Occup Med (Lond)*. 2008;58:393–399.
3. Scherzer T, Rugulies R, Krause N. Work-related pain and injury and barriers to workers' compensation among Las Vegas Hotel Room cleaners. *Am J Public Health*. 2005;95:483–488.
4. Smith CK, Anderson NJ. Work-related injuries among commercial janitors in Washington State, comparisons by gender. *J Safety Res*. 2017;62:199–207.
5. Leigh JP, Miller TR. Job-related diseases and occupations within a large workers' compensation data set. *Am J Ind Med*. 1998;33:197–211.
6. Woods V, Buckle P. Musculoskeletal ill health among UK cleaners. *Hum Fact Erg Soc Proc*. 2000;44:506–509.
7. Charles LE, Loomis D, Demissie Z. Occupational hazards experienced by cleaning workers and janitors: a review of the epidemiologic literature. *Work*. 2009;34:105–116.
8. Koehoorn M, Ostry A, Hossain S, Village J. Injury risk associated with physical demands and school environment characteristics among a cohort of custodial workers. *Ergonomics*. 2011;54:767–775.
9. Krause N, Scherzer T, Ruguiles R. Physical workload, work intensification, and prevalence of pain in low wage workers: results from a participatory research project with hotel room cleaners in Las Vegas. *Am J Ind Med*. 2005;48:326–337.
10. Seixas NS, Dominguez C, Stover B, Simcox N. *Janitors Workload and Health and Safety.* Department of Environmental and Occupational Health Sciences, University of Washington; 2013.
11. European Agency for Safety, Health. *The Occupational Safety and Health of Cleaning Workers.* European Agency for Safety and Health at Work; 2009.
12. Bureau of Labor Statistics, U.S. *Department of Labor. Nonfatal occupational injuries and illnesses requiring days away from work, 2015*; 2017. Available at: https://www.bls.gov/news.release/archives/osh2_11102016.pdf. Accessed July 16, 2018.

13. Bureau of Labor Statistics, U.S. Department of Labor. *Nonfatal occupational injury and illness cases requiring days away from work, 2014*; 2015. Available at: https://www.bls.gov/news.release/archives/osh2_11192015.pdf. Accessed July 16, 2018.
14. Bureau of Labor Statistics, U.S. Department of Labor. *Occupational Safety and Health Definitions*; 2016. Available at: https://www.bls.gov/iif/osh-def.htm. Accessed July 16, 2018.
15. Zou G. A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol*. 2004;159:702–706.
16. Liang K, Zeger SL. Longitudinal data analysis using generalized linear models. *Biometrika*. 1986;73:13–22.
17. Horvitz DG, Thompson D. A generalization of sampling without replacement from a finite universe. *J Am Stat Assoc*. 1952;47:663–685.
18. Greenland S, Pearl J, Robins JM. Causal diagrams for epidemiologic research. *Epidemiology.* 1999;10:37–48.
19. Hernan MA, Hernandez-Diaz S, Werler MM, Mitchell A. Causal knowledge as a prerequisite for confounding evaluation: an application to birth defects epidemiology. *Am J Epidemiol*. 2002;155:176–184.
20. Salwe K, Kumar S, Hood J. Nonfatal occupational injury rates and musculoskeletal symptoms among housekeeping employees of a hospital in Texas. *J Environ Public Health*. 2011;2011:382510.
21. Byler C. Hispanic/Latino fatal occupational injury rates. *Monthly Labor Review*;. 2013;14–23. Available at: https://www.bls.gov/opub/mlr/2013/02/art2full.pdf.
22. Anderson J, Hunting K, Welch L. Injury and employment patterns among Hispanic construction workers. *J Occup Environ Med*. 2000;42:176–186.
23. Centers for Disease Control and Prevention (CDC). Work-related injury deaths among Hispanics–United States, 1992-2006. *MMWR Morb Mortal Wkly Rep*. 2008;57:597–600.
24. Zierold K, Andersen H. Racial and Ethnic disparities in work-related injuries among teenagers. *J Adolescent Health*. 2006;39:422–426.
25. Schenker M. Work-related injuries among immigrants: a growing global health disparity. *Occup Environ Med*. 2008;65:717–718.
26. Dong X, Ringen K, Men Y, Fujimoto A. Medical costs and sources of payment for work-related injuries among Hispanic construction workers. *J Occup Environ Med*. 2007;49:1367–1375.
27. Robinson J. Exposure to occupational hazards among Hispanics, Blacks, and Non-Hispanic Whites in California. *Am J Public Health*. 1989;79:629–630.
28. Gabel CL, Gerberich S. Risk factors for injury among veterinarians. *Epidemiology.* 2002;13:80–86.
29. Salminen S, Oksanen T, Sallinen M, et al. Sleep disturbances as a predictor of occupational injuries among public sector workers. *J Sleep Res*. 2010;19(1 pt 2):207–213.
30. Ulfberg J, Carter N, Edling C. Sleep-disordered breathing and occupational accidents. *Scand J Work Environ Health*. 2000;26:237–242.
31. Akerstedt T, Fredlund P, Gillberg M, Jansson B. A prospective study of fatal occupational accidents – relationship to sleeping difficulties and occupational factors. *J Sleep Res*. 2002;11:69–71.
32. Peele PB, Tollerud DJ. Depression and occupational injury: results of a pilot investigation. *J Occup Environ Med*. 2005;47:424–427.
33. Braun BL, Gerberich SG, Sidney S. Injury events: utility of self report in retrospective identification in the USA. *J Epidemiol Community Health*. 1994;48:604–605.
34. Cash WS, Moss AJ. Optimum recall period for reporting persons injured in motor vehicle accidents. *Vital Health Stat 2*. 1972;50:1–33.
35. Mock C, Acheampong F, Adjei S, Koepsell T. The effect of recall on estimation of incidence rates for injury in Ghana. *Int J Epidemiol*. 1999;28:750–755.

