HEALTH AND INJURY STUDY OF JANITORIAL SERVICE EMPLOYEES

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DEDICATION

This dissertation is dedicated to my grandfather, Sherman Walker Jr. Although you weren't able to see me to the finish line, thank you for always encouraging me to always go above and beyond, and to dream a bigger dream. I hope I've made you proud.

ABSTRACT

INTRODUCTION

Janitorial service work is typically labor-intensive and demands heavy workloads. Despite the exposures to numerous occupational risks and resulting high injury occurrences, there is a lack of research addressing the burden of injuries and associated risk factors in this population. The aims of this study were to: 1) Determine the injury incidence and severity of injury occurrences in janitors and identify associated risk factors; 2) Analyze the effects of workload exposures on injury occurrence. Our central hypothesis was that, based on the varying occupational exposures, injury incidence and severity in this population is high, and that an increased workload contributes to these elevated injury occurrences. Additionally, conversations with local janitors highlighted a need for education on workers' rights and responsibilities for reporting injuries; thus, a final aim of this study was to: 3) Evaluate and improve janitors' knowledge of workers' rights and responsibilities for assessing and reporting work-related injuries through an intervention.

METHODS

A prospective cohort study was conducted to collect data among janitors in the SEIU Local 26 from May 1, 2016 to April 30, 2017. Injury- and exposure- related data were collected through specially designed questionnaires while workload data were collected using both fitness tracker bracelets and questionnaires. Upon completion of this study, the varying workloads and other exposures experienced by janitors were analyzed to determine their potential relations to injury occurrences. Additionally, an intervention

study was implemented and a potential change in workers' perceived barriers for reporting injuries was identified between the two six-month reporting periods.

RESULTS

A total of 390 janitors participated in the study (response rate = 33%); among them, 34% reported experiencing at least one injury. The most common injury reported was pain (66%), and 16% of injury cases resulted in hospital admittance. The most common body parts injured involved primarily the back and lower extremities. There was a significant increase in risk based on age, ethnicity, shift start time and depression. Of the janitors, 37% reported an increase in workload over the study period. Adjusted analyses indicated a significant relation between change in workload and duration of sleep and occupational injury. Through analyses of workload and injury, stratified by sleep quality, there was a significant association among those with sleep disturbances.

At baseline, in the intervention and non-intervention groups, approximately 25% reported perceived barriers to reporting an injury to their employer. Reported barriers included "fear," "reporting takes too long," "being unsure of the reporting process," and an "understanding that injuries are a part of the job." At follow-up, among the intervention group, there was an important reduction (24% to 12%) in having perceived barriers for "reporting an injury to your employer."

CONCLUSIONS

Knowledge of specific risk and protective factors are extremely important. They serve as a basis for further in-depth studies. In the long term, these study findings will

serve as a basis for development of interventions that can be used to generate policies and interventions for safer working environments among janitors.

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ORGANIZATION

The organization of this thesis provides initial chapters including an introduction, a comprehensive literature review, and presentation of the research design and methods. These chapters are followed by three major papers (Chapters IV, V, and VI) that report the major findings from the study; because these papers are prepared for publication in peer-reviewed journals, there is some redundancy pertinent to the literature cited and the methods presented. A final chapter provides a discussion of study validity and the results of the study.

CHAPTER I

INTRODUCTION

In 2017, according to the Bureau of Labor Statistics (BLS), janitors and building-cleaning workers (SOC 37.000) held about 2.1 million jobs. Approximately 41% were employed in the services to the building and dwellings industry, and another 4% were employed in elementary and secondary schools (Bureau of Labor Statistics, 2018). Janitors are among the occupations exposed to a variety of occupational hazards, including high musculoskeletal loads, and are associated with the greatest number of cardiovascular conditions and other health outcomes and disabilities (European Agency for Safety and Health, 2009; Leigh & Miller, 1998; Woods & Buckle, 2000; Charles, Loomis, & Demissie, 2009; Koehoorn, Ostry, Hossain, & Village, 2011).

Occupational injury is a major safety and health issue among workers in the service industry, specifically those employed in janitorial and cleaning services (Alamgir & Yu, 2008; Scherzer, Rugulies, & Krause, 2005; Smith & Anderson, 2017; Leigh & Miller, 1998; Woods & Buckle, 2000; Environmental and Occupational Health Sciences Department at University of Washington, 2013; Charles, Loomis, & Demissie, 2009). Through labor-intensive cleaning, grounds keeping and building maintenance, janitorial service work demands result in high injury rates (Koehoorn, Ostry, Hossain, & Village, 2011; Bureau of Labor Statistics, 2014). In the United States, during the year 2016, workers classified as janitors and cleaners (N= 2,384,600) incurred more than 36,000 work-related injuries resulting in days away from work and an incidence-rate of 235.4

nonfatal occupational injuries and illnesses per 10,000 full-time workers requiring days away from work (Bureau of Labor Statistics, 2017).

The prevalence of health problems in the cleaning workforce is high (Charles, Loomis, & Demissie, 2009); however, few studies provide a comprehensive assessment of the occupation including the evaluation of specific tasks, the work environment, and the working conditions in a more comprehensive manner (Seixas, Dominguez, Stover, & Simcox, 2013). Literature reviews have revealed that janitors are exposed to numerous physical risks, resulting in high rates of injury and illness. Unfortunately, there is limited research addressing the relations between these exposures and injuries and other health effects.

Recently, unionized janitors have become increasingly concerned with their workloads and how their health has been affected by these workloads. In the state of Washington, the Department of Environmental and Occupational Health Sciences at the University of Washington attempted to address these concerns and link workload to health outcomes, the first study of this kind. That study, conducted from 2010 to 2013, found that, amongst 276 union janitors, reporting of work-related injuries remained steady at about 30% of these janitors. Specifically, they found that janitors had increasing frequencies of injury, poor and declining overall health, high levels of upper extremity disability, and increasing levels of musculoskeletal pain (Seixas, Dominguez, Stover, & Simcox, 2013).

Janitorial service work is typically labor-intensive, requiring high intensity cleaning, grounds keeping and building maintenance, resulting in high injury rates and musculoskeletal loads (Koehoorn, Ostry, Hossain, & Village, 2011). Based on the

specific job duties of each janitor, workers may have different workloads, depending on specific tasks and job titles; thus, it is important to characterize the workload of each individual janitor and identify how that may affect their health and safety over time. Previous studies, evaluating workload exposures in janitors have used self-reported questionnaires to characterize the burden. In these questionnaires, workload was defined using work-intensity scales (Seixas, Dominguez, Stover, & Simcox, 2013), ergonomic assessment (Koehoorn, Ostry, Hossain, & Village, 2011) and square footage (Seixas, Dominguez, Stover, & Simcox, 2013). However, these studies did not account for physio-activity, with quantification of heart rate, a potential predictor of workload (Roscoe, 1982). While these studies provided a general indication of workload, they did not represent the exposures of highly mobile workers and did not include quantitative measures of their exposures throughout the workday.

The current study incorporates personal sampling to quantify these workers' exposures, which will provide an important contribution to the literature and injury prevention, in general. From results of this study, interventions to control these exposures can be investigated. This study addresses a National Occupational Research Agenda (NORA) aim to stimulate improved work practices and innovative research. From results of this study, interventions to control these exposures can be developed. After identifying the injury incidence and severity in the population, the relation between workload and these injuries will be assessed. Findings from this study will aid in reducing the incidence and severity of occupational injuries, measured in number of occupational injuries and lost workdays among janitors. Then, using tools and training materials for recognizing and reporting occupational injuries, the effect of interventions can be evaluated.

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CHAPTER II

LITERATURE REVIEW

DATA ON THE PROBLEM – AN OVERVIEW

Injuries among Janitors:

Occupational injury is a major safety and health issue among workers in the service industry, specifically those employed in janitorial services (Koehoorn, Ostry, Hossain, & Village, 2011; Seixas, Dominguez, Stover, & Simcox, 2013; Charles, Loomis, & Demissie, 2009). This has been further confirmed by the Bureau of Labor Statistics (BLS) through reported nonfatal occupational injury and illness cases, involving days away from work or job transfer/restriction (Bureau of Labor Statistics (BLS, 2013; Bureau of Labor Statistics (BLS, 2014; Bureau of Labor Statistics (BLS, 2015; Bureau of Labor Statistics (BLS, 2016). Since 2012, janitors and building cleaners have been associated with some of the highest incidence rates for nonfatal occupational injuries and illnesses per 10,000 full-time workers and median days away from work between 2012 and 2016 (**Tables 1-4)**.

While the incidence rates for nonfatal occupational injuries and illnesses among "janitors and building cleaners" were decreased in 2013 and 2014, the rate increased in 2015. On average, injury incidence rates among janitors and building cleaners were approximately two times greater than for all occupations combined; analyzed by "nature of injury," incidence rates were approximately two to three times higher than for all occupations combined (**Table 2**). Among the injuries, sprains, strains and tears had the highest incidence rates for non-fatal occupational injuries among janitors; these were followed by bruises and fractures. **Table 3** identifies the incidence rates by events leading

to the injuries; the categories of "struck by an object" and "fall to same level" had the most prevalent injury rates, which were two to three times higher than for all occupations combined. **Table 4** identifies incidence rates by events or exposures that lead to injuries; the "Exposure to Harmful Substances or Environments" category, had the highest incidence rates for nonfatal occupational injuries and illnesses, which were two to four times higher than for all occupations combined. For all other exposures and events, the rates were comparable to all occupations combined.

POTENTIAL RISK FACTORS

Work-related Health

Janitors and building cleaners are an important group of workers who are exposed to a variety of occupational hazards, resulting in health problems (Charles, Loomis, & Demissie, 2009), and are one of the occupational classifications associated with the largest number of permanent partial disabilities (Leigh & Miller, 1998). An epidemiologic literature review of 35 studies, conducted by Charles et al. (2009), between 1981 and 2005, identified respiratory diseases (n = 17) and dermatologic diseases (n = 9) as the most common health outcomes that were associated primarily with exposures to cleaning agents, wet work, and rubber latex. In addition to the hazards associated with chemical exposures, cleaning also involves extensive muscular work when using various types of equipment.

Janitors are among the occupations that demand both high musculoskeletal loads and are associated with the greatest number of cardiovascular conditions (European Agency for Safety and Health, 2009; Leigh & Miller, 1998; Woods & Buckle, 2000; Charles, Loomis, & Demissie, 2009). Literature reviews conducted by Charles et al.

(2009) found musculoskeletal disorders were associated with several physical stressors (e.g., awkward postures, prolonged standing) and psychosocial stressors (e.g., monotonous job, low potential for promotion). Additional studies have quantified ergonomic exposures related to workload and elevated physical demands. A study conducted in the United Kingdom found that the main injury-related anatomical locations affected were elbows, knees, wrists, hands, lower back, neck and shoulders; 23% of these injuries resulted in lost work time in the prior year (Woods & Buckle, 2000).

Workload:

Janitorial service work is typically labor-intensive, requiring high intensity cleaning, grounds keeping, and building maintenance, that may result in high injury rates and musculoskeletal loads (Koehoorn, Ostry, Hossain, & Village, 2011). Based on the specific job duties of each janitor, workers may be exposed to varying workloads that differ, based on specific tasks and job classifications. A cross-sectional questionnaire-based study, conducted in the state of Washington, by the Department of Environmental and Occupational Health and the University of Washington, attempted to address janitor concerns and link workload to health outcomes -- the first study of this kind. This study, conducted from 2010 to 2013, found that, amongst 276 union janitors, self-reported work intensity was strongly related to health, injury, pain and stress (Seixas, Dominguez, Stover, & Simcox, 2013). A range of exposures, including musculoskeletal stressors, chemical use, and psychosocial risks and outcomes, including injuries, musculoskeletal pain, pulmonary and dermatological symptoms, and stress were evaluated. A workload scale was developed to assess changes in work intensity over a three-year period. Study results indicated a reported workload by the janitors of >7 on a 10-point scale that

increased from 28.5% to 35% between 2010 and 2012. An associated increase in injuries and stress was similarly observed. Approximately 70% of union and non-union workers reported performing tasks with repetitive motion on all days. The percentage of union workers with moderate back pain doubled over the three-year period, increasing from 15.3% to 30.4%.

Previous studies, evaluating workload exposures in janitors have used self-reported questionnaires to characterize the burden. In these questionnaires, workload has been defined, using work-intensity scales (Seixas, Dominguez, Stover, & Simcox, 2013), ergonomic assessment (Koehoorn, Ostry, Hossain, & Village, 2011), and square footage (Seixas, Dominguez, Stover, & Simcox, 2013) While these studies provided a general indication of workload, they did not represent the exposures of high mobile workers or directly measure their exposures throughout the workday; thus, there was an apparent need for application of personal sampling to quantify these workers' exposures.

Sleep:

High work demands and physical effort at work are both risk factors for disturbed sleep and extreme tiredness or exhaustion (Dorrian, Baulk, & Dawson, 2010; Akerstedt, et al., 2002). Sleep disturbances, such as difficulty initiating sleep, sleeping poorly at night, sleep insufficiency and insomnia symptoms are moderately, but significantly, associated with the occurrence of occupational injuries (Nakata, et al., 2005). In a comprehensive study of veterinarians (Gabel & Gerberich, 2002), injuries were more common for individuals who slept less than six hours in a 24-hour period. In studies of sleep quality (Akerstedt, Fredlund, Gillberg, & Jansson, 2002; Ulfberg, Carter, & Edling, 2000), sleep-disordered breathing and insomnia symptoms were found to be associated

with occupational injuries in the general working population. A study of Finnish public sector employees, found the risk of an occupational injury was 1.19 (95% CI 1.01–1.41) times higher for those reporting any kind of sleep disturbance, compared to those sleeping well (Salminen, et al., 2010).

A systematic literature review, including 27 observational studies, published between 1982 and 2011, found that workers with sleep problems versus those with no sleep problems, had a risk 1.62 times higher of being injured (RR: 1.62, 95% CI: 1.43 – 1.84) (Uehli, et al., 2014). Moreover, each aspect of the sleep problems (i.e., sleep medication, breathing-related sleep problems, multiple symptoms, sleep quality and sufficiency, sleep quantity, daytime sleepiness), significantly increased the risk for work-related injuries. A subsequent meta-analysis among studies, using the same sleep problem measure, revealed the largest effects for the use of sleep medication and for breathing-related sleep problems (i.e., snoring difficulties or stopping breathing), while the smallest effect was observed for daytime sleepiness; intermediate effects were reported for multiple symptoms, sleep quality and sufficiency, and sleep quantity. Among the 268,332 participants analyzed, approximately 13% of associated work-related injuries could be attributed to sleep problems (Uehli, et al., 2014). Using workload to characterize work demands and physical effort at work, sleep patterns can be evaluated; thus, it is important to determine the relation between workload and injuries through sleep quality.

Injury Underreporting

Injury surveillance is an important step in injury prevention (Weddle, 1996). In the United States, the major sources of occupational health data include: the Bureau of Labor Statistics (BLS) annual survey of occupational injuries and illnesses; workers'

compensation records; and physician-reporting systems. Data produced by these systems have been described as fragmentary, unreliable, and inconsistent and have been shown to underestimate the incidence of work-related injuries, illnesses, and even fatalities (Azaroff, Levenstein, & Wegman, 2002; Weddle, 1996; Pransky, Snyder, Dembe, & Himmelstein, 1999). The United States Bureau of Labor Statistics (BLS) significantly underestimates the incidence of work-related injuries and illnesses and causes many researchers to rely on data from other systems (i.e., Workers' Compensation claim data, medical records, physician-reporting systems) (Azaroff, Levenstein, & Wegman, 2002) which are also limited in completeness and quality. The under-reporting of injuries compromises the accuracy of surveillance data and creates a major problem for intervention purposes (Pransky, Snyder, Dembe, & Himmelstein, 1999; Weddle, 1996; Moore, Cigularov, Sampson, Rosecrance, & Chen, 2013; Azaroff, Levenstein, & Wegman, 2002), specifically among building cleaners (Scherzer, Rugulies, & Krause, 2005). A recent study found that up to 68% of work-related injuries and illnesses may not be captured by the national injury surveillance system (Rosenman, et al., 2006). Among building cleaners at a Las Vegas hotel, 75% of workers experienced work-related pain, but only 31% reported it to management (Scherzer, Rugulies, & Krause, 2005).

There is a series of sequences necessary to accurately capture work-related health problems from the data sources currently used to capture occupational injuries (Azaroff, Levenstein, & Wegman, 2002; Webb, Redman, Wilkinson, & Sanson-Fisher, 1989). The current reporting systems, utilized today for recording occupational injuries, involve obstacles that filter out work-related health problems at each step (Webb, Redman, Wilkinson, & Sanson-Fisher, 1989). Such filters particularly block documentation of

health problems affecting populations, including immigrant and low wage workers, especially vulnerable to work-related hazards (Azaroff, Levenstein, & Wegman, 2002). A recent case study revealed workers have several reasons for not reporting their injuries, including fear of reprisal, a belief that pain was an ordinary consequence of work activity or aging, lack of management responsiveness after prior reports, and a desire to not lose their usual job (Pransky, Snyder, Dembe, & Himmelstein, 1999). Interviews with management representatives revealed administrative and other barriers to reporting, stemming from their desire to attain a goal of no reported injuries, and misconceptions about requirements for recordability (Pransky, Snyder, Dembe, & Himmelstein, 1999). Scherzer, Rugulies, and Krause (2005) investigated barriers to reporting work-related injuries among hotel room cleaners. Among the workers who had work-related pain, 67% had not reported it to management. The most frequently cited reasons were, “I thought it would get better” (44%), “I didn’t know I should” (35%), “too many steps to reporting” (23%), and fear of getting “in trouble” (13%) or “fired” (13%). Thus, it appears essential to determine barriers for reporting occupational injuries among janitors and work to eliminate these barriers through customized intervention.

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Table 1. Incidence Rates for Nonfatal Occupational Injuries and Illnesses Requiring Days Away from Work per 10,000 Full-Time Workers, 2012-2016, BLS[a]

Year	**Janitors and Cleaners, except maids and housekeeping cleaners**		**Total Occupations**	
	Incidence Rate per 10,000 Full-time workers	Median Days away from Work	Incidence Rate per 10,000 Full-time workers	Median Days away from Work
2012	**262.6**	**11**	**112.4**	**9**
2013	**258.8**	**8**	**109.4**	**8**
2014	**258.1**	**9**	**107.1**	**9**
2015	**277.4**	**10**	**104.0**	**8**

[a] Nonfatal Occupational Injuries and Illnesses Requiring Days Away from Work, 2012-2016, Bureau of Labor Statistics.

Table 2. Incidence Rates for Nonfatal Occupational Injuries and Illnesses Requiring Days Away from Work per 10,000 Full-Time Workers by Nature of Injury, 2012-2016, BLS[a]

Year	Sprains, Strains, Tears		Fractures		Cuts, Lacerations, Punctures		Bruises, Contusions	
	Janitors*	Total	Janitors*	Total	Janitors*	Total	Janitors*	Total
2012	**113.4**	**43.2**	**17.6**	**8.2**	**15.2**	**9.6**	**22.9**	**9.5**
2013	**99.6**	**40.2**	**18.5**	**8.6**	**16.7**	**9.3**	**21.7**	**8.9**
2014	**96.8**	**38.9**	**19.9**	**8.8**	**13.9**	**8.8**	**24.4**	**9.0**
2015	**113.1**	**38**	**23.3**	**8.9**	**20.0**	**9.6**	**26.5**	**9.1**

*Janitors: Janitors and Cleaners, except maids and housekeeping cleaners

[a] Nonfatal Occupational Injuries and Illnesses Requiring Days Away from Work, 2012-2016, Bureau of Labor Statistics.

Table 3. Incidence Rates for Nonfatal Occupational Injuries and Illnesses Requiring Days Away from Work per 10,000 Full-Time Workers by Events Leading to Injury, 2012-2016, BLS[a]

	Struck by Object		Struck Against Object		Caught in or Compressed or Crushed		Fall to Lower Level		Fall to Same Level		Slips or Tips without Fall		Repetitive Motion	
Year	Janitors*	Total	Janitors*	Total	Janitors*	Total	Janitors*	Total	Janitors*	Total	Janitors*	Total	Janitors*	Total
2012	**30.6**	**14.3**	**16.3**	**6.1**	**4.9**	**3.7**	**17.7**	**5.4**	**48.0**	**16.8**	**11.1**	**4.7**	**4.5**	**3.0**
2013	**30.3**	**14.4**	**15.3**	**5.9**	**6.3**	**3.5**	**15.4**	**5.4**	**50.1**	**17.4**	**12.1**	**4.4**	**4.3**	**2.7**
2014	**25.2**	**13.4**	**17.1**	**5.5**	**5.3**	**3.5**	**14.3**	**5.4**	**56.7**	**18.8**	**13.0**	**4.4**	**7.0**	**2.7**
2015	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**3.3**	**2.2**

*Janitors: Janitors and Cleaners, except maids and housekeeping cleaners

[a] Nonfatal Occupational Injuries and Illnesses Requiring Days Away from Work, 2012-2016, Bureau of Labor Statistics.

Table 4. Incidence Rates for Nonfatal Occupational Injuries and Illnesses Requiring Days Away from Work per 10,000 Full-Time Workers by Events or Exposures to Injury, 2012-2016, BLS[a]

Year	Exposure to Harmful Substances or Environments		Transportation Incidents		Fires and Explosions		Violence and Other Injuries by Persons or Animals					
			Roadway Incidents				Intentional Injury by Other Person		Injury by person-Unintentional or intent known		Animal and Insect Related	
	Janitors*	Total	Janitors*	Total	Janitors*	Total	Janitors*	Total	Janitors*	Total	Janitors*	Total
2012	**10.0**	**5.0**	**4.0**	**4.0**	**0.2**	**0.2**	**1.4**	**2.9**	**0.6**	**2.9**	**1.2**	**1.3**
2013	**12.1**	**4.8**	**3.2**	**4.1**	**0.1**	**0.2**	**0.7**	**2.8**	**0.5**	**2.8**	**3.2**	**1.4**
2014	**10.3**	**4.3**	**3.6**	**4.2**	**0.3**	**0.2**	**0.5**	**2.9**	**0.2**	**2.5**	**1.1**	**1.3**
2015	**19.0**	**4.7**	**2.8**	**4.0**	**0.2**	**0.2**	**0.6**	**3.1**	**0.2**	**2.3**	**2.1**	**1.3**

*Janitors: Janitors and Cleaners, except maids and housekeeping cleaners

[a] Nonfatal Occupational Injuries and Illnesses Requiring Days Away from Work, 2012-2016, Bureau of Labor Statistics.

Table 5. Summary of Literature for Janitors and Overall Occupations: Injury and Illness and Associated Risk Factors

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
Koehoorn, M., Ostry, A., Hossain, S., Village, J.	2011	To examine ergonomic factors associated with injury risk among custodial school workers.	581 custodial workers employed for at least one month during the study follow-up period (2003–2006), in one school district, located in a large urban region in the Canadian province of British Columbia	Custodial workers eligible for inclusion were selected from employment records maintained by the school board and were classified as – building engineer, assistant building engineer, head custodian and custodian. Employment records provided information on start and end date of employment with the School Board, start and end date by occupation codes, date of birth (age), gender, school of employment and monthly hours of work. Reports of occupational incidents filed by custodial workers were available in a central	A total of 222 injuries were reported by workers in custodial occupations during the study period for an overall rate of 11.3 work injuries per 100 FTEs. The risk of injury was associated with time spent in pushing/pulling tasks in a dose–response manner increasing to a five-fold risk among the highest quartile of exposure (RR = 5.15, 95% CI 1.00, 26.5). Increased injury risk is associated with working during the school year compared to the summer, working in a school with grass versus gravel grounds, and working in a school with detached classrooms.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
				database maintained by the School Board. School environment characteristics and occupational physical demands were identified from focus groups with custodians conducted by a certified ergonomist. The work injury and musculoskeletal injury rates were calculated per 100 full-time equivalent employees (FTEs) and compared by year of follow-up, occupation group, type of school and the season.	*Critique:* **Exposures:** • Exposures variables were obtained from employment records. • 44 ergonomic assessments of 25 workers were conducted, including almost 100 hours of 1-minute observations. **Outcome:** • Injury outcomes were provided by the school board. **Selection:** • All janitors employed for at least one month in the selected school district were included. **Comparability:** • Results are applicable to school custodians in large urban regions. There may be differences in those in rural regions or those not employed in schools.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
Uehli, K., Mehta, A., Miedinger, D., Hug, K., Schindler, C., Holsboer-Trachsler, E., Leuppi, J. D., Kunzli, N.	2014	To conduct a broad systematic review and a meta-analysis to quantify the relationship between sleep problems and work injuries.	42 studies that quantified the relation between sleep problems and work injuries were eligible for the systematic review. For the meta-analysis, 27 studies with 54 estimates were included.	Literature Review A systematic literature search, using several databases, was performed using a developed search strategy to identify eligible articles. Sleep problems of any duration or frequency as well as work injuries of any severity were of interest. Workers in any trade were considered. Authors worked in pairs to assess different elements of identified articles. Newcastle-Ottawa scale was used for quality assessment. The effect estimates of the individual studies were pooled and relative risks (RR) and 95% confidence intervals (CI)	Meta-analysis results suggested that workers with sleep problems had a 1.62 times higher risk of being injured than workers without sleep problems (RR: 1.62, 95% CI: 1.43–1.84). Approximately 13% of work injuries can be attributed to sleep problems. This systematic review confirmed the association between sleep problems and work injuries and, for the first time, quantified its magnitude. *Critique:* **Exposures:** • A strong search strategy was developed using guidelines from previous studies on systematic reviews and meta-analysis. • Included studies were published between 1982

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
				were calculated through random effects models.	and 2011, had various occupational settings, and collected sleep information via self-report or physician diagnosis. **Outcome:** • Authors noted that they relied exclusively on observational studies. **Selection:** • There may some bias in the selection of studies included for the meta-analysis. **Comparability:** • The variation between study assessment methods may cause studies to not be comparable, specifically involving sleep problems.
Charles, L., Loomis, D., Demissie, Z.	2009	To describe, summarize, and discuss the epidemiologic research assessing the	All building cleaners included in 35 eligible epidemiologic studies involving health	Literature Review A review of epidemiologic studies conducted between 1981	Respiratory diseases and dermatologic diseases were the most common health outcomes and were associated with exposures to

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
		job-related health outcomes and hazards of cleaners and to highlight gaps and research needs.	outcomes associated with cleaners between 1981 and 2005.	and 2005 was performed using PubMed and PsychLit, to identify health outcomes and the associated hazards in the work environment of cleaners. The terms occupational hazards, occupational exposures, shift work, job demands, ergonomics, detergents, latex, sharps and asthma were used in conjunction with janitors, custodians, housemaids, housekeepers or housekeeping. 35 epidemiological studies were included.	cleaning agents, wet work, and rubber latex. The potential for infectious diseases was identified among cleaners in medical laboratories and was associated with exposures to broken glass and uncapped needles in the trash. Musculoskeletal disorders were associated with awkward postures and other ergonomic hazards and psychosocial stressors. *Critique:* **<u>Exposure/Outcome:</u>** • The search strategy used key terms related to janitorial service work. • The study designs differed. Definitions of exposures may vary and may not be appropriately combined for analysis.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					Selection: • Articles were selected if they reported on an aspect of the work environment and were identified through the search terms. • Selection was limited to English language. • Case reports and risk assessments were excluded.
Akerstedt, T., Fredlund, P., Gillberg, M., Jansson, B.	2002	To evaluate potential effects of sleep against other possible contributors to injury risk at work, such as non-day work, overtime work, stress, physical work load, and being a blue- or white-collar worker.	47,860 workers in Sweden	Open cohort study with repeated national cross-sectional surveys. A national sample of 47,860 individuals was selected at regular intervals over a period of 20 years, and interviewed over the telephone on issues related to work and health. The responses were linked to the cause of death register and the	166 fatal occupational events occurred, and the significant predictors were: male versus female: RR=2.30 (95% CI = 1.56–3.38); difficulties in sleeping: RR=1.89 (95% CI =1.22–2.94); and non-daytime work: RR=1.63 (95% CI =1.09–2.45). It was concluded that self-reported disturbed sleep is a predictor of unintentional death at work, in addition to non-day work and male gender.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
				data were analyzed using cox regression survival analysis.	*Critique:* **Exposure:** • Data were obtained from a national survey conducted annually in which all participants participated in a one-hour face-to-face interview. • Potential for information bias (interviewer bias). **Outcome:** • Surveys were linked with the Swedish Cause-of Death register providing outcome measures of: injury death and underlying cause of death. **Selection:** • Strong nationally representative sample. All gainfully employed persons in Sweden were contacted. **Comparability:** • Overall, this is a good representation of those gainfully employed in

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					Sweden, but there is a potential that those who participated may differ from those who did not.
Akerstedt, T., Knutsson, A., Westerholm, P., Theorell, T., Alfredsson, L., Kecklund, G.	2002	To examine the multivariable relationship between disturbed sleep and different work-related and background/life style factors.	5,720 healthy employed men and women living in the greater Stockholm area.	Database used for the study was the Work, Lipids, Fibrinogen(WOLF) Study, comprised of 20 heath care units among 40 companies in Central Sweden. Participants were asked to complete a questionnaire including demographics, work exposure variables, sleep and more. Using measures of disturbed sleep, the data were first analyzed using logistic regression analysis. The significant predictors were then analyzed using multivariable logistic regression.	The risk of reporting disturbed sleep was related to high work demands, low social support at work, high physical work load, being unmarried, being female, being older, having a high body mass index, not exercising and doing most of the household work. High work demands [odds ratio (OR)=2.15] and physical effort at work (OR=1.94) were the strongest risk indicators for disturbed sleep. *Critique:* **<u>Exposure:</u>** • The database used focused on cardiovascular risk factors.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					• Questionnaires were self-reported and completed at home, which introduces potential information bias. **Outcome:** • The extensive questionnaire provided strong information on sleep patterns, work-related variables and demographics. **Selection:** • All employees from different companies or parts of companies in the Stockholm area and from northern Sweden were invited to participate in the project (WOLF Study). • Selection bias: Those who participated in initial study may have participated due their cardiovascular conditions.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					<u>Comparability:</u> • The data used for analysis were collected from a large data set of persons who represent a wide range of occupational health care units. These people may not be representative of those in different sectors.
Dorrian, J., Baulk, S., Dawson, D.	2011	To examine the impact of workload on the relation between reduced sleep, increased wakefulness and longer work hours and work-related fatigue.	Australian Rail Industry Employees	Participants were selected from four Australian Rail companies and included drivers, controllers, guards, resurfacing crews, signalers, and terminal operators. Participants completed sleep and work diaries for 14 days. Additionally, subjects wore actigraphs. They also completed the Samn–Perelli Fatigue Scale at the beginning and end of shifts, and the National Aeronautics and Space Administration (NASA)-Task Load	Average (±SD) sleep length (7.2 ± 2.6 h), prior wake at shift end (12.0 ± 4.7 h), shift duration (8.0 ± 1.3) and fatigue (4.1 ± 1.3), were within limits generally considered acceptable from a fatigue perspective. Subjects reported that they felt "extremely tired, very difficult to concentrate," or "completely exhausted, unable to function effectively" on 13% of shifts. Sleep length (OR = 0.88, $p < 0.01$), shift duration (OR = 1.18, $p < 0.05$), night shift (REF = morning shift, OR =

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
				Index (TLX) workload scale at least twice during each shift. From the 90 participants, 713 shifts were analyzed.	2.12, $p < 0.05$) and workload ratings (OR = 1.2, $p < 0.05$) were significant predictors of ratings of extreme tiredness/exhaustion (yes/no). *Critique:* **Exposure:** • Workload was evaluated using the NASA TLX scale. **Outcome:** • Sleep and work were self-reported via diaries. Sleep was supplemented with actigraphs. • Actual performance records were not included or assessed for performance issues. **Selection/ Comparability:** • Many participants came from a single control room and thus may not be comparable to others with similar job titles.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					• No information on how participants were selected within the Australian rail industry
Ulfberg, J., Carter, N., Edling, C.	2000	To determine the relation between a common type of sleep disturbance, sleep-disordered breathing, and the risk of becoming involved in an occupational injury event.	704 patients, aged 30-64 years, who resided in Dalecarlia County (Sweden) experiencing sleep-disordered breathing and 580 matched referents.	Case-Control Study Patients were determined from sleep problems as reported to their personal physician and underwent sleep apnea screening to determine obstructive sleep apnea syndrome (OSAS). Reference group was selected at random from the general population in the same county as the patients. A 10-year retrospective comparison was made of occupational injuries reported to the Occupational Injury Statistics Division of the Swedish National Board of Occupational Safety and Health.	The risk of being involved in an occupational injury event was about two-fold (OR 1.8; 95% CI 1.1-2.9) among male heavy snorers and increased by 50% among men experiencing OSAS. The risk increased by at least three-fold (fold (OR 3.3; 95% CI 0.98-11.0) among female heavy snorers and OSAS patients. Reduced vigilance and attention due to sleep disordered breathing are the proposed mechanisms behind the results. *Critique:* **Exposure:** • Initial sleep patterns were assessed via survey, but all patients underwent sleep apnea screening.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
				The injury rates for 704 consecutive patients experiencing sleep-disordered breathing were compared with the rates for an employed, age-matched random sample of 580 subjects, drawn from the general population.	• OSAS was determined via clinical assessment. **Outcome:** • Nonfatal occupational injuries were determined via the Swedish National Board of Occupational Safety and Health. • Injuries included all occupational accidents and diseases in Sweden including near injury events and injuries not requiring sick leave. **Selection:** • Patients were selected from the sleep laboratory of the Avesta Hospital in mid-Sweden and were referred by a physician. • Referents were randomly selected from the same counties as the patients. • Selection bias: Reference group response rates were low, potentially because they did not experience sleep problems.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					<u>Comparability:</u> • The study population was a good representation of Dalecarlia County. • To be considered as a patient required physician recommendation and thus many people with sleep problems who were not reported may not be comparable to those selected for the study.
Salimen, S., Oksanen, T., Vahtera, J., Sallinen, M., Harma, M., Salo, P., Virtanen, M., Kivimaki, M.	2009	To determine whether sleep disturbances predicted occupational injuries in a large population of Finnish public sector employees.	A total of 48,598 employees working in 10 municipalities and 21 hospitals in various parts of Finland were included.	Data were derived from the Finnish Public Sector Study. Sleep disturbances were assessed with the four-item Jenkins Sleep Problems Scale. Records of occupational injuries were obtained from employers' sickness absence registers.	A total of 9,076 (22%) participants reported disturbed sleep, and 978 (2.4%) had a recorded occupational injury. The crude OR for occupational injury was 1.19 (95%CI 1.01–1.41) times higher for those reporting any kind of sleep disturbance than for those sleeping well. After adjustment for socio-demographic characteristics, the odds ratio (OR) for occupational injury was 1.38

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					[95% confidence interval (CI) 1.02-1.87] times higher for men with experiences of disturbed sleep than for those without sleep disturbances; it was not significant for women. From study results, it is suggested that self-reported sleep disturbances are a significant predictor of occupational injuries. *Critique:* **Exposure:** • Information bias: Information on sleep, and other covariates, was self –reported. **Outcome:** • Occupational injuries were reported via employers in a register, resulting in potential underreporting. • All medically certified absence due to sickness caused by occupational injury was used to form a

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					binary variable of occupational injury. **Selection:** • The final cohort did not substantially differ from the eligible population???? in terms of age, gender or occupational status. **Comparability:** • This study was representative of the workers in the Finnish Public Sector. They may not be representative of those in government or private industry.
Nakata, A., Ikeda, T., Takahashi, M., Haratani, T., Fujioka, Y., Fukui, S., Swanson, N.G., Hojou, M., Araki, S.	2005	To evaluate the contribution of daily sleep habits to occupational injuries	2,903 workers between the ages of 16-83 (mean 45) years in small and medium-scale enterprises	Cross-sectional study Sleep, symptoms of depression, occupational injury, demographics, presence of diseases and lifestyle factors were collected via self-administered questionnaire.	One-third of workers answered that they had experienced injury. Workers with sleep features of difficulty initiating sleep (DIS) (OR 1.5, 95% CI 1.2-1.8), sleeping poorly at night (OR 1.5, 95% CI 1.1-2.0), insufficient sleep (OR 1.3, 95% CI 1.1-1.7), and insomnia (OR 1.5, 95% CI

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
				Eight sleep habits were queried and dichotomized. Occupational injury was assessed by asking subjects 'Have you ever been injured during your work, including minor scratches and cuts (Yes/No)?' Both sleep and injury were assessed over the previous one-year period.	1.1-1.9), had a significantly higher prevalence for injury after adjusting for multiple confounders. The findings suggested that poor nocturnal sleep habits are associated with self-reported occupational injury. *Critique:* **Exposure/Outcome:** • Information bias: Data were collected via self-reported survey. **Selection:** • Subjects were randomly selected from city directory for group "A." • Group A – Selection bias: Of those who were randomly selected to participate 923 didn't receive the questionnaire for various reasons.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					• Subjects from group "B" were all invited to participate. **<u>Comparability:</u>** • Subjects were from only small or medium scale enterprises. Large scales were not included. • Both participating groups were from different cities.
Leigh, J.P., Miller, T.R.	1998	To describe workers' job-related diseases and the occupations associated with those diseases.	All people with Workers' Compensation (WC) claims reported to the Bureau of Labor Statistics' Supplementary Data System (SDS) in 1985 and 1986 from Arkansas, Delaware, Iowa, New York, North Carolina, Oregon, and Wisconsin, and Colorado (1985 only).	Job-related disease and occupation data from the SDS for 1985 and 1986 were aggregated using different categories. Analysis included comparing number of people who experienced various diseases within four WC categories: Occupational deaths, Permanent total disability, permanent partial disability, and temporary total and partial disability.	Heart attacks, asbestosis, silicosis, and stroke comprised the greatest number of deaths. Occupations with greatest number of heart conditions leading to death included heavy truck drivers (7.6%), managers and administrators (6.8%), janitors and cleaners (6.8%), sales supervisors and proprietors (5.2%). Laborers (both in and out of construction), janitors, nursing aides, truck drivers, and general machine operatives are highly ranked

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
				Diseases were ranked within the four WC categories and also ranked within occupations according to the number of cases. Occupations were ranked according to the prevalence of specific diseases within one of the four categories.	in total numbers of WC cases. *Critique:* **Exposure/ Outcome:** • Exposure and outcome was determined from WC claim data. • Many diseases, injuries and illnesses are not included in WC. • Injuries and illnesses that went unreported to WC and insurance were not captured. **Selection/ Comparability:** • Participants in the SDS only contributed to approximately 16-17% of the national employment, and, thus, may not be comparable to all of the US. • The SDS relies solely on WC data.
Gabel, C.L., Gerberich, S.G.	2002	To identify risk factors for job-related	1,023 Practicing Minnesota veterinarians	Nested- Case Control Study	There were increased rates for prior injuries (RR = 1.7, 95% CI = 1.1-2.6),

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
		injuries among Veterinarians		Cases (N = 193) were questioned on exposures occurring in the month before their injury, and controls (N = 495) were questioned on exposures occurring in a randomly selected month. Logistic regression was used to model the dependence of veterinary work-related injury on each exposure of interest and associated confounders.	participation in sports (RR = 1.7, 95% CI = 1.05-2.6), no sharps boxes present (RR = 1.8, 95% CI = 1.01-3.2), current smoking (RR = 4.1, 95% CI = 1.8-9.1), and 6 or fewer hours of sleep (RR = 1.8, 95% CI = 1.0-3.3). There was a dose response for lifting patients, as follows: lifting 41-75 pounds (lb) (RR = 3.1, 95% CI = 1.6-5.9), lifting 76-100 lb (RR = 3.2, 95% CI = 1.6-5.9), and lifting more than 100 lb (RR = 6.1, 95% CI = 2.5-15.0). Decreased rates were observed for participation in aerobic activities (RR = 0.6, 95% CI = 0.4-0.99), perception of lower risk (RR = 0.4, 95% CI = 0.2-0.9), and experience (RR = 0.6, 95% CI = 0.4-0.9).

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					Critique: **Exposure/ Outcome:** • A conceptual model was used in developing the comprehensive survey instruments and in analyzing and interpreting the data. • Information bias: Information on injuries was self-reported via survey and collected retrospectively. • Cases were more likely to recall specifics regarding their injuries compared to controls who were randomly assigned a month in 1996. **Selection:** • Participants were chosen from all practicing veterinarians in the state of Minnesota. • Cases were selected based on self-reported animal injury events.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					<u>Comparability:</u> • Participants are representative of Minnesota veterinarians, but may not represent veterinarians in other states.
European Agency for Safety and Health at Work	2009	1) To provide an overview of the most important issues related to occupational safety and health for cleaning workers, 2) to highlight the main trends and issues regarding the working conditions, hazard exposure and health outcomes, 3) to identify gaps in knowledge and information available, and 4) to formulate recommendations for future studies.	Cleaning workers in Europe	Literature Review Researchers reviewed literature through from ~1989 to 2008 regarding the most important issues to occupational health among cleaners.	Cleaning working conditions are poor, often times due to the contractual situation. Cleaners are exposed to dangerous chemicals generate during the cleaning process but also in the cleaning agents often through dermal exposure or inhalation. Cleaners are exposed to many ergonomic risk factors due to their awkward working postures, application of high forces, repetitive movements and lifting loads. Cleaners have high levels of morbidity and disability.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					Critique: **Exposure:** • Many janitor exposures were summarized. **Outcome:** • There's very limited data on occupational injuries/diseases and thus estimates can't be extrapolated to the European level. • National data on health outcomes are scarce, especially for the cleaning subsectors; therefore, it is hard to draw conclusions. Often data are extrapolated from one sub-sector to others and used to describe the cleaning sector as a whole, which leads to biases in the conclusions. **Selection/Comparability:** • Study does a good job of comparing literature on cleaners throughout Europe and includes

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					studies from other regions in the world.
Department of Environmental and Occupational Health Sciences, University of Washington	2013	To determine the associated risk factors for occupational injury and illness among janitors	430 janitorial workers and security guards in the Seattle area	Cross-Sectional Survey Work-related exposures and other health-related outcomes were collected via questionnaire. Questionnaires were developed using focus groups and were administered by trained union and non-union janitors and security officers. Analysis compared the experiences of union and non-union janitors, and security officers, using security officers as a comparison group. A workload scale was developed to assess changes in work intensity over a three-year period.	The most common tasks among janitors are vacuuming, trash and recycling work, sweeping and mopping, and bathroom cleaning. Union janitors have a higher frequency of pain symptoms in the back, legs and arms. Work intensity is the highest among non-union janitors. Over the three-year study period, union janitors had the highest increase in work intensity. Over the three-year study period, union janitors reported a steady increase from ~6% to 13.5%. *Critique:* **Exposure/Outcome:** • Exposure and outcome measurements were self-reported via

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					questionnaire -- potential for information bias. **Selection:** • Union janitors and security officers were selected by the union organization (potential for selection bias). • Non-union janitors were recruited using an outside organization and outreach at places such as shopping malls, movie theaters, and office buildings. • There was difficulty in recruiting non-union janitors and recruitment efforts include selection bias. **Comparability:** • Study compares both union and non-union janitors as well as security officers

Table 6. Summary of Literature for Occupational Injury: Injury Reporting

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
Moore, J.T., Cigularov, K.P., Sampson, J.M., Rosecrance, J.C., Chen, P.Y.	2013	To identify reasons for not reporting work-related injuries among construction workers.	A total of 614 union members from a labor union in the Northwest U.S. were mailed a paper survey and a return addressed, stamped envelope. Completed surveys were returned by 135 workers, for a response rate of 22%.	Exploratory Study Qualitative and quantitative methods were used in this study to identify reasons why construction workers may choose not to report work-related injuries, and to investigate the frequency of the identified reasons.	Of the 135 participants, 36 (27%) indicated that they had failed to report a work-related injury at some point during their career in construction work. The most frequent reasons given were related to perceptions of injuries as "small" and "part of the "job" as well as fear of negative consequences. There were no significant differences in reasons for not reporting work-related injuries among workers in different trades, areas, ages and experience levels. *Critique:* **Exposure:** • A portion of the 21 selected reasons for not reporting injuries was identified via focus groups which was structured using the Delphi technique.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					• Information bias: Data were collected via self-reported surveys. Information on failure to report injury or reasons may be inaccurate due to fear of reprisal. **Outcome:** • The five most common reasons for not reporting injuries among construction workers were identified. • Differences in reasons for not reporting work-related injuries were not compared among those who were injured versus not injured. **Selection:** • Reasons for not reporting injuries was determined ONLY from focus groups of participants who reported at least one work-related injury. **Comparability:**

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					• Study used only unionized participants. May not be comparable to non-unionized
Scherzer, T., Rugulies, R., Krause, N.	2005	To examine the prevalence of work-related pain and injury and explore barriers to and experiences of reporting among workers.	Of the 1,276 eligible study participants, 941 unionized hotel room cleaners completed the survey (response rate = 74%).	Cross-sectional study The survey instrument was developed with the results of focus group discussions. Surveyed hotel room cleaners were asked about work-related pain, injury, disability, and reporting. Participant characteristics, working conditions, health outcomes, and barriers to reporting were analyzed with descriptive statistics.	75% of workers experienced work-related pain; 31% reported it to management; 20% filed claims for workers' compensation as a result of work-related injury, and 35% of their claims were denied. Barriers to reporting injury included, "It would be too much trouble" (43%), "I was afraid" (26%), and "I didn't know how" (18%). Of the 430 workers who visited a doctor for work-related pain, only 128 (31%) filed any claim with workers' compensation. In effect, this shifts 69% of medical care costs from employers to workers. *Critique:*

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					Exposure: • A comprehensive survey tool was created and pilot tested among the cleaners. • Cleaners who participated in focus groups and pilot testing may not be representative of the entire union. Barriers were solely identified via focus groups. **Outcome:** • Strength: Relevant barriers among this population were identified. • Information bias: Data were collected via self-reported survey. Participants may be from hotels with poor working conditions and thus introduce recall bias. • WC claim data were not collected. Participants self-reported. **Selection:** • A large sample was eligible to participate. • Only one unionized hotel from each of five hotel

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					types (upscale, mid-level, all-suite, convention, and older economy) was selected by union leaders to participate, which may introduce selection bias. **<u>Comparability:</u>** • Study was initiated by union based on concerns of working conditions. This group may not be comparable to other union janitors or non-union janitors.
Rosenman, K., Kalush, A., Reilly, M., Gardiner, J.C., Reeves, M., Luo, Z.	2006	To estimate the undercount in the existing national surveillance system of occupational injuries and illnesses.	All companies and individuals who reported work-related injuries and illnesses to the Bureau of Labor Statistics in 1999, 2000, and 2001 in Michigan and companies and individuals who reported in four other Michigan data bases	Injury and illness data were captured from five data systems (BLS, Workers' compensation (WC), OSHA Annual Survey (OSHA), OSHA Integrated Management Information System (IMIS), and the Occupational Disease Report (OD).	The current national system for work-related injuries and illnesses underestimates the magnitude of these conditions. The BLS survey only captures 31% to 33.5% of the total estimate of annual injuries and illness. The BLS undercount, of work-related injuries and ill-nesses per year ranges from 512,149 to 645,484. Using capture-recapture analysis the estimated number

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
				Matching was performed at two levels: person-to-person matching (BLS, WC, and OD) and company-level matching (BLS, OSHA, WC, OD, IMIS) for the years 1999, 2000 and 2001. Capture–recapture analyses were performed to estimate the number of cases missed by the combined systems.	of work-related injuries and illnesses in Michigan is three times greater (869,034) than the official estimate derived from the BLS annual survey (281,567). The BLS underestimates the magnitude of work-related injuries and illnesses. A more comprehensive surveillance system is needed. *Critique:* **<u>Exposure/Outcome:</u>** • Strong comparison of captured work-related injuries and illnesses among five data sources. • The estimate of the undercount of injuries reported to BLS estimate may may be inaccurate. The large difference in under- count for injuries and illnesses may be partly explained by the differences in recording by companies and the difficultly in person-matching across the five data sources.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					<u>Comparability:</u> • BLS data were Michigan-specific, however BLS is a national system used by all states. • Using Michigan-specific data, such as WC, is not comparable to all states. WC varies by state and, thus, what is captured will differ.
Weddle, M	1996	To evaluate injury reporting practices among hospital workers	372 hospital environmental service workers from five hospitals in the Baltimore, Maryland area	Cross- Sectional Study During a two-week period, anonymous survey forms were returned directly to a "ballot-box" style collection box at the study site hospitals. Demographic data analyses were performed for injury experiences.	29.2% (108 of 372) of hospital environmental workers recalled having been injured in the previous year, and of those, 38.9% (42 of 108) had not reported one or more injuries. Among those injured, older workers (mean age 40.6 years versus 36.2 years; $p = 0.024$) and those having worked longer at the same job (mean duration 6.7 years vs. 4.3 years; $p = 0.032$) were more likely to not report an injury. The most frequently cited reason for not reporting was

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					that the injury had seemed too minor. *Critique:* **Exposure:** • Limited demographic data were collected; therefore, injury outcomes were not adjusted for many potential risk factors (confounding bias). • Limited barriers were presented to the participants. No information on how barriers were selected. **Outcome:** • Injury magnitude and severity data were collected. • Demographic and injury data were compared among those who reported and didn't report an injury. • Information bias: All information was collected via self-report. **Selection:**

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					• Participants from hospital departments in Baltimore and outlying community hospitals were invited to participate. Five agreed. • Of the hospitals that declined participation, many feared litigation. • Authors list illiteracy among workers that prevented participation. **Comparability:** • Study was among hospital environmental service/ housekeeping workers. This group may not be representative of all housekeeping workers. • No information was provided on hospitals that were invited to participate, but did not.
Azaroff, L.S., Levenstein, C., Wegman, D.H.	2002	To determine and describe the mechanisms for the loss of injury cases at successive steps of documentation	All workers with work-related injuries and illnesses recorded to the Bureau of Labor Statistics (BLS) and physician-based surveillance	The authors apply the filter model of (Webb, Redman, Wilkinson, & Sanson-Fisher, 1989) developed to describe the documentation of work-related injuries in	Health data collection system in the United States involve obstacles that filter out work-related health problems. Filters or barriers to reporting injuries occur at the following events: reporting to

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
			systems in the United States	Australia, to the Bureau of Labor Statistics, workers' compensation wage replacement documents, physician reporting systems, and medical records of treatment charged to workers' compensation in order to determine "filters" for underreporting. Mechanisms are described for the loss of cases at successive steps of documentation.	supervisors, lost work time due to work-related illness and injuries, medical care for work-related injuries and illnesses, recognition of work-related injuries and illnesses, changing medical care to workers' compensation, reporting incidents in OSHA logs, fillings reports of injury to state workers' compensation agencies, participation in physician reporting systems, and medical records data in hospital databases. *Critique:* **Exposure/Outcome:** • Filters are analyzed at four different US reporting systems • Filters were developed using Webb et al., model. **Selection:** • Filters are applied to various systems, but for WC only for Massachusetts. **Comparability:**

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					• Study strongly represents filters for reporting in the United States.
Pransky, G., Snyder, T., Dembe, A., Himmelstein, J.	1999	To determine reasons for under-reporting, determine the role of safety incentive programs on under-reporting, and suggest alternative approaches to minimize under-reporting	Employees at manufacturing facilities	Case Study To evaluate causes of under-reporting, OSHA log data were compiled for a case study from several manufacturing companies. A questionnaire and interview survey were administered to 110 workers at a large children's product manufacturer. A total of 98 packers responded.	85% of workers experienced symptoms caused or aggravated by work. 50% had persistent work-related problems and 30% reported either lost time from work or work restrictions because of their ailment. Workers described several reasons for not reporting their injuries, including fear of reprisal, a belief that pain was an ordinary consequence of work activity or aging, lack of management responsiveness after prior reports, and a desire not to lose their usual job. Interviews with management representatives revealed administrative and other barriers to reporting, stemming from their desire to attain a goal of no reported injuries,

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					and misconceptions about requirements for recordability. The corporate and facility safety incentives appeared to have an indirect, but significant negative influence on the proper reporting of workplace injuries by workers. *Critique:* **Exposure/Outcome:** • Data were collected via survey -- potential for information bias • Survey data were compared to OSHA log data. **Selection:** • Only workers at one company participated in the case study. • The selected company contacted study authors to participate **Comparability:** • Data were collected from only one large manufacturing company.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
Webb, G.R., Redman, S., Wilkinson, C., Sanson-Fisher, R.W.	1989	To explore some of the factors related to loss of information about work, injuries and propose a descriptive model of the information processing system	Workers with work-related injuries and illnesses recorded to reporting systems in the United States	Factors related to loss of information about work and injuries were summarized. Based on identified factors, a descriptive model of the information processing system was developed. The model describes the way in which information about a given injury proceeds through a series of levels, from true prevalence of injuries in the workplace, to prevalence as indicated by national aggregate statistics.	There are 6 levels and 5 filters of the injury reporting process. Levels of injury reporting must first go through the worksite -- then, to company administration and then the government. There are five filters between each level including (1) an individual reporting the injury to supervisor, (2) the supervisor referring the injured worker to medical care, (3) medical centers reporting the injury, (4) injuries being included in company records and (5) injuries being reported to government agencies. *Critique:* **Exposure/Outcome:** • Model to determine filters in work injury reporting was supported through literature review.

Author(s)	Year	Purpose of Study	Population	Methods	Findings, Conclusions
					Selection/Comparability: • Study represents filters for reporting in the United States. • Barriers are not identified for WC claim data.

CHAPTER III

RESEARCH DESIGN AND METHODS

SPECIFIC AIMS

The long-term goal of this study is to determine the burden of injury occurrences, and relevant work-related risk factors, among janitors and how workload impacts these injury occurrences. To address the gap in knowledge associated with these occupational risk factors, the proposed overall objective is to examine the burden of injuries with particular attention to individual workload, using a prospective cohort design and direct physical measurements of both sleep quality and workload among the same janitors over time. To accomplish the overall objective, the following three specific aims of the proposed investigation are to:

Aim 1: Determine the magnitude, incidence, and potential associated risk factors for occupational injuries among janitors in the metropolitan area.

The hypothesis was that the incidence of injuries among janitors is high due to their varying personal (age, gender, ethnicity, marital status, education, income, and language), health (physical, mental) and work-related exposures (job title, work experience, other jobs, work start time). Using survey methodology, this was accomplished by determining the associations between occupational injury and exposures of interest to facilitate identification of relevant risk and protective factors. This provided more accurate information on janitors' injuries and determined which exposures may have the greatest impact, if any, on injury occurrences.

Aim 2: Examine the relation between workload and injury occurrence through sleep quality.

The hypothesis was that employees with greater workloads will have reduced sleep quality and increased injury occurrences. The objective for this aim was to determine the effect of workload variables on injury occurrences by defining the role workload may have on sleep quality and, subsequently, occupational injuries. This was accomplished by determining the associations between workload and sleep exposures and occupational injury and further examining the relation between workload and injury by adjusting for sleep quality, assuming effect modification.

Aim 3. Evaluate and improve janitors' knowledge of workers' rights and responsibilities for assessing and reporting work-related injuries through intervention.

The hypothesis was that through intervention, the reporting of injury occurrences will increase and the quality of recognizing and communicating work-related injuries will improve. The objective for this aim was to first assess the janitors' knowledge of their rights and then determine what barriers existed for reporting occupational injuries and, finally, proceeding to eliminate these barriers through a customized intervention. To accomplish this, data collection of janitors' perceptions of barriers to reporting work-related injuries and knowledge of workers' rights, enabled subsequent development of a relevant intervention; pre-post-data analysis of janitors' changes in perception of barriers to reporting work-related injuries and knowledge of workers' rights facilitated evaluation

of this intervention, thus, providing a basis for developing strategies to eliminate those barriers.

Relevant to overall goals, the purpose of this study was to determine the varying workloads of janitors and identify how occupational and other exposures may affect their injury occurrences. In addition, both the magnitude of the problem and risk factors associated with occupational injuries among janitors, including workload, were addressed. Finally, implementation of an intervention strategy was used to evaluate janitor's perceptions of barriers to reporting work-related injuries and their knowledge of workers' rights and ultimately provide them with the tools and knowledge that would enable them to report their injury occurrences with confidence.

Few studies have examined occupational exposures to janitors and their related injury outcomes. Results of this study will provide a basis for development of interventions to control the risk factors identified through analyses of the exposures associated with the injury outcomes.

TARGET POPULATION AND STUDY POPULATION

The University of Minnesota School of Public Health and the Service Employees International Union (SEIU) Local 26, a labor union focused on workers in health care, property services, and public services, collaborated on the study. Across North America, SEIU includes more than 386,000 members in property services, including those who work as janitors, security officers, maintenance and custodial workers, stadium and arena workers, and window cleaners. SEIU Local 26 is Minnesota's Property Services Union comprised of approximately 6,000 janitors, security officers and window cleaners in the

Twin Cities metropolitan area; among these members, the target population included the 1,200 members employed as full-time janitors.

DATA COLLECTION

A multi-method study was conducted, including a combination of direct and indirect measurements, consisting of a survey of all local SEIU 26 members paired with direct sampling measurements of workload and sleep quality from a selected subgroup. Injury incidence and associated risk factors among the entire study cohort were identified using a specially designed and pre-tested questionnaire. Questionnaires enabled collection of information on overall health status, including history of disease, understanding of rights and responsibilities for reporting injuries, workload, and sleep quality. Data, collected from the questionnaires, was later paired with direct sampling measurements to provide an overall assessment of workload.

Survey Design

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 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 survey 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 administration 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 included information on work-related exposures, personal exposures, demographics, injury occurrences, and general health information. The research team, following the focus group meeting, assessed participant feedback and modified the questionnaire, accordingly, based on the questions. The questionnaire document can be found in Appendix A.

Survey Data Collection

Following questionnaire development and pilot pre-testing, resulting in relevant modifications, the survey of injury occurrence, as well as various work-related exposures, was conducted over one year, divided into two time periods. For data collection between May 2016 and April 2017, two specially designed questionnaires were disseminated to all full-time janitors (n=1200), one at baseline and one at follow-up, each collecting data for the respective six-month periods. Immediately following the initial baseline questionnaire administration, a randomly selected sub-group of janitors (n=600) received information on workers' rights for reporting injury events; six-months later, a subsequent comparable questionnaire for the second six-month period was administered to all janitors. The questionnaires were distributed through union representatives, referred to as stewards, who served as leaders for different clusters of janitors employed throughout the Twin Cities. These stewards received comprehensive training from the research team during a major union meeting on questionnaire content and how to distribute and collect the

questionnaires from the janitors in their clusters.

The questionnaires were distributed to all employees who agreed to participate in the study and had signed the attached informed consent document (Appendix A). 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. This study was approved by the Institutional Review Board at the University of Minnesota (Appendix B).

FitBit Data Collection

In addition to the survey measurements, workload and sleep exposure measurements, were collected using FitBit Technologies FitBit Charge HR fitness bands (FitBit Technologies, San Francisco, CA), from a subset of the 1,200 full-time janitors who agreed to also complete the questionnaires. FitBit Charge HR utilizes an optical heart rate monitor, 3- axis accelerometer, altimeter, and vibration monitor and an organic light-emitting diode (OLED) display, which displays instantaneous readouts of heart rate, steps taken, miles walked, floors climbed, and calories burned. Heart rate data are stored at one-second intervals during exercise tracking and at five-second intervals during all other times. Active minutes are calculated using metabolic equivalents (METs), which measure the energy expenditure of various activities that make them comparable among persons of different weights. Algorithms that assume that sleep has begun, are confirmed by the length of time the wearer's movements are indicative of sleep behavior, while morning movement informs the tracker that the operator is awake.

FitBit tracker observations were planned to occur over 24-hour periods, for a total of 28 days, both at baseline and follow-up. While the devices were to be worn throughout the day and during all sleep hours for accuracy, specific workload measurements utilized data only relevant for the janitors' shifts.

Each janitor was visited one to two times during the study period: once to provide the direct sampling devices and specific use instructions, and once to correct any device issues and ensure proper syncing if issues had developed. During the initial visit, the fitness bands were placed on the workers' wrists and synced with their Smart Phones and the Fitabase system (n = 58), in order to monitor continuously during each worker's shift and while they were sleeping. Workload levels were recorded every minute, and full-shift workload exposures were computed from the data recorded. All Fitbit measurements were analyzed and exported using Fitabase LLC (Small Steps Labs, LLC, San Diego, CA) software, a secure third-party data service provider, which enables continuous collection of participants steps, intensity, calories burned, sleep patterns and heart rate data throughout the observed wear-periods.

Intervention Development and Distribution:

To address the apparent underreporting of injuries by this industry, an educational intervention strategy was developed and implemented (Appendix A). In order to determine the most effective intervention for this population, a customized plan was developed, based on the barriers identified in the initial focus-group discussion. Immediately following the baseline survey, half of the janitors were randomly selected and provided with a fact sheet intervention that was based on information provided from

the Occupational Safety and Health Administration (OSHA). This one-page intervention tool (Appendix A) provided janitors with information on OSHA, workers' rights under the OSH Act, employer responsibilities, and contact information for OSHA.

Measurements and Definitions

Dependent variable: Occupational Injury

The definition used for work-related injury was consistent with the National Center for Health Statistics (NCHS) and Bureau of Labor Statistics (Bureau of Labor Statistics (BLS), 2016). "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 four hours; and/or the use of professional medical care; and/or loss of consciousness, loss of awareness, or amnesia for any length of time. However, the members of the janitors' focus group consistently identified work-related pain as a major concern and associated that pain as a type of occupational injury. Thus, because of the adamant request of this population, "pain" was included in the injury description and, subsequently, as an injury type. 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.

Survey Measures

Independent variables

Personal Characteristics

Janitors' demographic information collected for this study included: age; gender; ethnicity; marital status; education; income; and language.

Physical and Mental Health Conditions

Physical health: Health status information, including doctor-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 experience 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.

Change in Workload: This self-reported measure was based on work-related activities and energy expenditure, this involved any changes to workload, including an increase, decrease or no change.

Moderate/Vigorous Physical Activity Days: Moderate or Vigorous physical activity (MVPA) was defined as activity equivalent to heavy lifting, vacuuming, cleaning, walking or climbing up the stairs for at least 10 minutes a day during work hours.

Sleep Hours: This included the average hours of sleep in a given 24-hour period for the previous week. Participants were asked about sleep duration and sleep quality for the previous seven days and the previous six-months. If sleep duration differed in the previous week, compared to the previous six-months, the hours reported for the six-month period were used.

Sleep Disturbance: Sleep disturbance was determined using the Patient-Reported Outcomes Measurement Information System (PROMIS) Sleep Disturbance, four-question short form, instrument, used to assess self-reported perceptions of sleep quality and restoration associated with sleep. Participants were asked to rank their sleep quality, i.e., if their sleep was refreshing, if they had a problem with their sleep, and if they had difficulty falling asleep. Due to the length of this PROMIS form, in order to determine a sleep disturbance score, participants had to answer all questions. Each question had five response options, ranging in value from one to five, and the score was the sum of these

responses. Based on scores, participants were assigned a given t-score and classified as having a none to slight (less than 55), mild (55.0-59.9), moderate (60.0-69.9) or severe (70 and over) sleep disturbance.

FitBit Measures

Metabolic Equivalent (MET): A metabolic equivalent (MET) is a measure of energy expenditure, defined as the resting metabolic rate. One metabolic equivalent is defined as the amount of oxygen consumed while sitting at rest and is equal to 3.5 ml O_2/kg/min (1.2 kcal/min for a 70-kg person) (Jetté, Sidney, & Blümchen, 1990). This energy expenditure can be determined by dividing the relative oxygen cost of the activity by 3.5. For example, work at 3 METs requires three times the resting metabolism or 10.5 ml O_2/kg/min. In accordance with the Centers for Disease Control (CDC) and American College of Sports Medicine (ACSM) guidelines, moderate physical activity occurs between 3.0 to 6.0 METs (3.5 to 7 kcal/min), and vigorous activity occurs when activity exceeds 6.0 METs (more than 7kcal/min). The FitBit device estimates the MET value in any given minute by calculating the intensity, using steps taken, heart rate data, and calories burned, for the activity.

- *Steps taken*: Fitbit trackers utilize a 3-axis accelerometer that provides acceleration data used to determine steps taken, distance traveled, calories burned, and sleep quality. Using a finely tuned algorithm, step counting is measured based on motion patterns most indicative of people walking. One condition for a motion pattern to be recognized as a step is that the motion must be large enough. The algorithm implements this by setting a threshold. If a motion and its subsequent

acceleration measurement data meet the threshold, the motion will be counted as a step. If that threshold is not met, the algorithm won't count the motion as a step.

- *Heart Rate*: When the heart beats, the capillaries expand and contract based on blood volume changes. PurePulse™ LED lights on the FitBit tracker reflect onto the skin to detect blood volume changes and finely-tuned algorithms are applied to measure heart rate automatically and continuously. FitBit trackers use heart rate data from the time when the participant is awake to the time he /she is asleep to estimate the resting heart rate.
- *Calories Burned*: Fitbit devices estimate calories burned based on participant age, gender, height, weight (entered during device set-up), and given heart rate during activity.

If METs were at or above 3 for at least 10 minutes for a given day, during their work time, the participant was determined to have had a moderate/vigorous physical activity day.

Sleep duration: Sleep autodetection is based on movement. When the participant has not moved in over an hour, algorithms assume that sleep has begun, which is confirmed by the length of time the movements are indicative of sleep behavior only.

Injury Reporting Measures

Janitors' knowledge of injury reporting was measured by asking: (1) "Do you know what an OSHA 300 log is?" (2) "Have you ever seen the OSHA 300, which is the Log Summary of Occupational Injuries and Illnesses for your establishment/workplace?" and (3) "Did you ever have an injury recorded on the OSHA log?" To determine the

janitors' knowledge of Workers' Compensation, they were asked: (1) "Do you know what Workers' Compensation is?" and (2) "Have you or your employer filed for Workers' Compensation for any injury or illness you had?"

Barriers to reporting injuries or illnesses to their employers were identified during the initial focus group session. Each barrier was presented in a checklist on the questionnaire where janitors could select all that applied. Janitors were asked, "In the designated six-month period (specified on the questionnaire), did you report any injury or illness to your employer?" If the janitors responded "no," they were provided with a list of 16 potential barriers to reporting injuries to their employer and asked to select all that applied. Barriers were categorized into four groups including: fear of legal action or getting in trouble with their employer; reporting takes too much time; unaware of the reporting process; and the understanding that injuries are a part of the job.

CAUSAL MODELS

An overall causal model was developed, based on relevant literature and expert knowledge, to determine the variables to be measured and controlled for in the study analyses. From the model, individual Directed Acyclic Graphs (DAGs) were developed to determine the minimum sufficient set of potential confounders for the relevant exposures of interest. When selecting potential confounders, the DAG allows a choice of only those variables believed to be causal to the exposure of interest while excluding variables that are believed not to be causal, following the methods described by (Greenland, Pearl, & Robins, 1999) and illustrated by (Hernan, Hernandez-Diaz, Werler, & Mitchell, 2002). In Figure 1 an example of a DAG for one exposure of interest—shift

start time, is identified. All DAGs for each of the exposures of interest are presented in Appendix C.

DATA ANALYSES

Aim 1: Determine the incidence, magnitude, and potential associated risk factors for occupational injuries among janitors in the metropolitan area.

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 (Zou, 2004). 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 (six-months recall) versus those who completed both surveys (two six-month recalls). To determine the strength of associations between exposures of interest and occupational injury, relative risks were calculated using Poisson regression models with robust variance estimators (Zou, 2004).

Multivariable models were adjusted based on a select set of confounding factors for each exposure of interest, identified *a priori* using Directed Acyclic Graphs (DAGs). Estimates of rates, and associated 95% confidence intervals (CI), were generated 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 the dependency between and within subjects and independency between subjects. 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.

Aim 2: Examine the relation between workload and injury occurrence through sleep quality.

Descriptive statistics were utilized to summarize the frequencies of participant workload intensities and sleep quality. Relative risks were calculated using Poisson regression models with robust variance estimators (Zou, 2004) to determine the strength of associations between workload and sleep exposures and occupational injury. Estimates of rates, and associated 95% confidence intervals (CI), were generated using generalized estimating equations (GEEs) with exchangeable working correlation matrices.

To determine the magnitude of the effect of workload and sleep, sleep duration and sleep quality were tested for effect modification. To achieve this, a stratified analysis was conducted to determine if the relative risk differed by sleep measurements. Similarly, these risks were calculated using Poisson regression models with robust variance estimators (Zou, 2004).

Correlation analyses were used to examine the relations between the survey measures and FitBit measures. Specifically, the relation between sleep hours and moderate/vigorous physical activity was examined. Additionally, descriptive statistics were used to determine the frequencies of FitBit measures. To determine the association between of FitBit measures of workload and occupational injury, relative risks were calculated using similar Poisson regression models and GEEs with exchangeable working correlation matrices.

Aim 1 & 2 Additional Bias Analyses:

Non-Response bias resulting in 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 for response bias by weighting observed responses by probabilities of response, estimated as a function of characteristics from all SEIU Local 26 janitors available from the union; these characteristics included birth year, gender, and contractors associated with the janitors' worksites. This method reweights estimates by using group response characteristics to account for potential differences in responses.

Aim 3. Evaluate and improve janitors' knowledge of workers' rights and responsibilities for assessing and reporting work-related injuries through intervention.

Injury reporting knowledge and barriers to reporting were analyzed with descriptive statistics. Frequency distributions were examined in order to establish baseline understanding of janitors' reporting and potential changes in reporting subsequent to the intervention of education about workers' rights and responsibilities. The categorical data for assessing differences in proportions of janitors in agreement with job-specific reporting barriers pre- and post-intervention were analyzed using McNemar's test of marginal homogeneity (McNemar, 1947). All data analysis was conducted with SAS statistical software, version 9.4 using the SAS system for Windows (SAS, Cary, NC).

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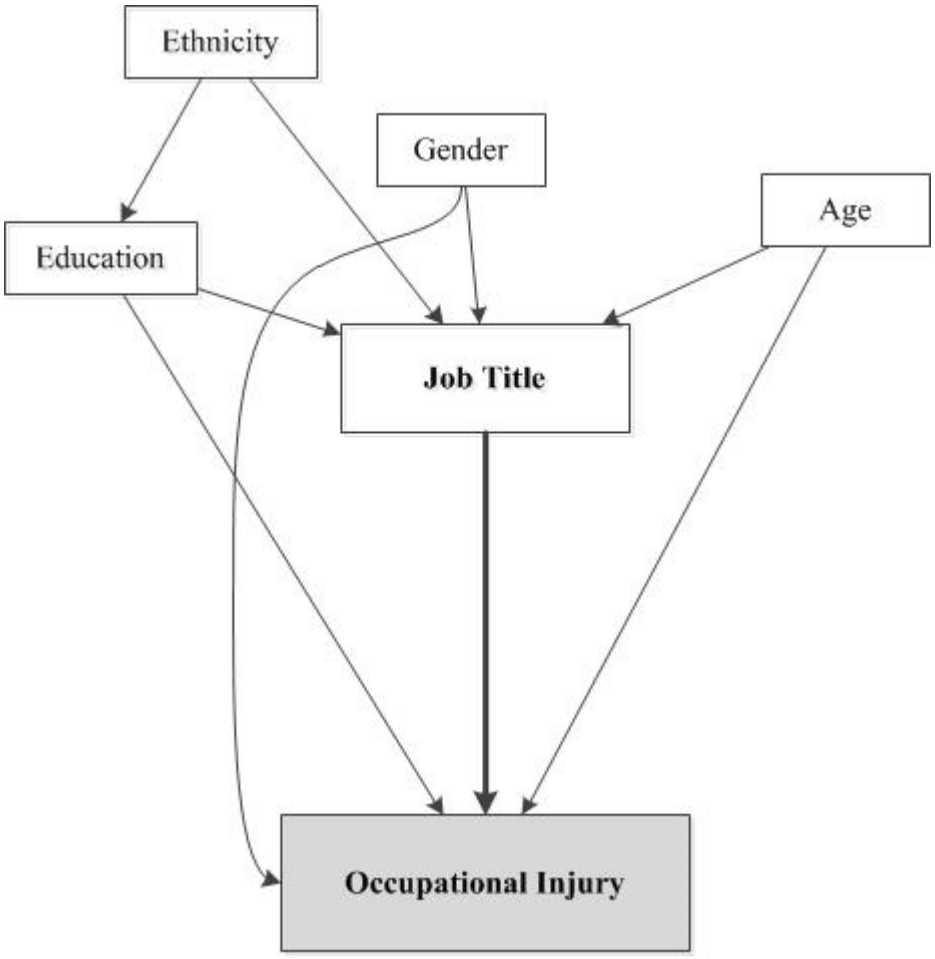
Figure 1. Sample DAG for the Association between Job Title and Occupational Injury: Health and Injury Study of Janitorial Service Employees



CHAPTER IV – Manuscript 1

OCCUPATIONAL INJURY AMONG JANITORS: INJURY INCIDENCE, SEVERITY AND ASSOCIATED RISK FACTORS

ABSTRACT

INTRODUCTION

The goal of this study was to determine incidence and severity and identify potential associated risk factors for occupational injuries among janitors in the Twin Cities metropolitan area.

METHODS

Questionnaires were disseminated to 1,200 full-time janitors in the SEIU Local 26 union; 390 responded (33%) and provided information on their injury experiences and associated risks based on personal and work-related exposures. Analyses included basic descriptive analyses; multivariable analyses, including bias adjustment, used Poisson regression techniques to determine associations between exposures of interest and occupational injury.

RESULTS

Among janitors, 34% reported experiencing at least one injury. The adjusted injury event rate was 0.92 per janitor per year. The most common injury reported was pain (66%); 16% of injury cases resulted in hospital admittance. The most common injuries involved the back and lower extremities. There was a significant increase in injury risk based on age, ethnicity, shift start time and depression diagnosis.

CONCLUSIONS

Knowledge of specific risk and protective factors is very important. These factors 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.

1. Introduction

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 (Bureau of Labor Statistics, U.S. Department of Labor, 2018).

Occupational injury is a major safety and health issue among workers in the service industry, specifically those employed in janitorial and cleaning services (Alamgir & Yu, 2008; Scherzer, Rugulies, & Krause, 2005; Smith & Anderson, 2017; Leigh & Miller, 1998; Woods & Buckle, 2000; Seixas, Dominguez, Stover, & Simcox, 2013; Charles, Loomis, & Demissie, 2009; Koehoorn, Ostry, Hossain, & Village, 2011; Bureau of Labor Statistics, U.S. Department of Labor, 2018; Krause, Scherzer, & Ruguiles, 2005). Janitors are among the occupations that demand high musculoskeletal loads and are associated with the greatest number of cardiovascular conditions (Woods & Buckle, 2000; Leigh & Miller, 1998; European Agency for Safety and Health, 2009). The main injury-related anatomical locations affected among janitors include elbows, knees, wrists, hands, lower back, neck and shoulder (Woods & Buckle, 2000). In addition to physical hazards, janitors are also exposed to various chemical exposures resulting in respiratory diseases and dermatologic disorders (Charles, Loomis, & Demissie, 2009).

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 (Bureau of Labor Statistics, 2016). Approximately 42,740 lost-time injuries and illnesses were reported for the janitorial industry in 2015 (Bureau of Labor Statistics, 2015), compared to only 39,290 in 2014. 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) (Bureau of Labor Statistics, 2016).

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 (European Agency for Safety and Health, 2009). 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. Recently, unionized janitors have become increasingly concerned with their workloads and how their health has been affected by these workloads. 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.

2. Methods:

2.1 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 4,000 janitors, represents a major portion of janitors, security officers and window cleaners in the Twin Cities metropolitan area. Among these janitors, the target population included the 1,200 janitors who were classified as full-time (i.e., working ≥30 hours per week). This study was approved by the Institutional Review Board at the University of Minnesota.

2.2 Data Collection:

To achieve the goal of this study—to determine injury incidence and severity and identify potential associated risk factors based on janitors' exposures—data were collected via survey. 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 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 survey 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 administration 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 included information on work-related exposures, personal exposures, demographics, injury, and general health information. The research team, following the focus group meeting, assessed participant feedback and modified the questionnaire, accordingly, based on the questions.

Following relevant modifications of the questionnaire after development and pilot pre-testing, the survey of injury occurrence, as well as various work-related exposures, was conducted in two phases, six months apart. Questionnaires were disseminated to participating janitors to collect data for each preceding six-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 six-month period between May 1st and October 31st 2016. The follow-up questionnaire was then administered six months later, during May 2017, and collected information regarding the six-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 three-hour session

during which they received training on how to distribute the questionnaires, answer questions that could arise during questionnaires 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.

2.3 Measures:

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 (Bureau of Labor Statistics (BLS), 2016). "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 four 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, gender, 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.

2.4 Data Analyses:

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 (Zou, 2004). 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 (six-months recall) versus those who completed both surveys (two six-month recalls). To determine the strength of associations between exposures of interest and occupational injury, relative risks were calculated using Poisson regression models with robust variance estimators (Zou, 2004).

Rates and associated 95% confidence intervals (CIs) 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 between and within subjects and independence between

subjects. 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 weighting (Horvitz & Thompson, 1952). This method provides greater upweighting for those categories of subjects with low response rates compared to those with higher response rates to account for potential differences in responses and exposures between responders and non-responders. These characteristics included birth year, gender, 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 to determine the minimum sufficient set of potential confounders for the relevant 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, Pearl, & Robins, 1999) and illustrated by (Hernan, Hernandez-Diaz, Werler, & Mitchell, 2002). Figure 1 presents an example of a DAG for one exposure of interest—shift start time.

3. Results

Of the approximately 1,200 full-time eligible participants, 390 participated in the study and completed at least one of the questionnaires (response rate = 33%) (Figure 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 >60 years, with most (60%) of the janitors between 31 and 50 years of age, followed by age 51-60 (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 five years or less and 38% for between six and 10 years. Approximately half (53%) had been with their current company for less than five years. Shift start times involved all hours of the day; however, the majority (68%) reported at start time and shift of 5:00 p.m. – 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).

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 one week; 5% reported being restricted from 7-14 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. Decreased risks of injury were shown for: men, compared to women; those with an annual household income greater than $25,000, compared to less than $25,000; those who were divorced/separated or never married/single, compared to married; those who graduated from high school or college versus those who did not. Risk of injury was increased for those aged 41-50 years and 51-60 years, compared to 31-40 years; in particular, risk of injury was 2.3 times greater among those less than 30 versus those aged 31-40 years. In addition, those who identified as Hispanic, compared with non-Hispanic, also experienced a significant increased risk of injury. Risks of injury were also increased for janitors: who reported English proficiency, compared to those who did not; who were widowed, compared to those who were married; and who completed some school but less than grade 12, compared to those who reported not completing any school (Table 5).

Among work characteristics identified by the janitors, risks of injury were increased among those who: classified themselves as special projects or general cleaners, compared to floor cleaners; and had other jobs, compared to those who did not (Table 5). Risks of injury were decreased: among those who had been a janitor for more than five, compared to less than five years; and for those who started work anytime between 6:00 a.m. and 11:59 a.m. compared to other shifts (12:00 a.m. to 5:59 a.m., 12:00 p.m. to 4:59 p.m., 5:00 p.m. to 11:59 p.m.). Finally, risks of injury were increased for those who reported that they experienced diagnosed depression, compared to those who did not.

4. Discussion

Previous research among janitors and cleaners have identified janitors as being at increased risk of occupational injury compared to other occupational sectors (Alamgir & Yu, 2008; Scherzer, Rugulies, & Krause, 2005; Smith & Anderson, 2017; Leigh & Miller, 1998; Woods & Buckle, 2000; Seixas, Dominguez, Stover, & Simcox, 2013; Charles, Loomis, & Demissie, 2009; Koehoorn, Ostry, Hossain, & Village, 2011; Bureau of Labor Statistics, U.S. Department of Labor, 2018; Krause, Scherzer, & Ruguiles, 2005). 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 one-year period. When accounting for multiple injury events, the adjusted rate of injury events is 0.92 per person per year (i.e. 92 injury events per 100 janitors per year). Due to different study methods and populations, it is 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 three-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). 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.

Among janitors and cleaners who incur an injury, work-related pain is a major

problem, as identified in previous studies (Woods & Buckle, 2000; Salwe, Kumar, & Hood, 2011; Scherzer, Rugulies, & Krause, 2005). Woods and Buckle (2006), reported that 74% of janitors experienced aches or pain during a one-year period, which is consistent with current study results indicating that 66% of janitors experienced pain. In another study among Las-Vegas cleaners (Scherzer, Rugulies, & Krause, 2005), 75% reported experiencing work-related pain. Similarly, a study among cleaners in a Texas hospital, 82% complained of pain in the previous 12 months that was related to work (Salwe, Kumar, & Hood, 2011). In addition to pain, consistent with previous research (Bureau of Labor Statistics, 2016; Alamgir & Yu, 2008; Seixas, Dominguez, Stover, & Simcox, 2013; Woods & Buckle, 2000; Salwe, Kumar, & Hood, 2011; Koehoorn, Ostry, Hossain, & Village, 2011), the major injury 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 ergonomic-related injuries among United Kingdom cleaners, indicated the main injury locations were elbows, knees, wrists, hands, lower back, neck and shoulder (Woods & Buckle, 2000). 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%) (Koehoorn, Ostry, Hossain, & Village, 2011). These findings are consistent with the current results, indicating the burden of injuries to 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 (Koehoorn, Ostry, Hossain, & Village, 2011; Alamgir & Yu, 2008; Woods & Buckle, 2000) 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 (Smith & Anderson, 2017). The current findings that 28% of janitors reported lost work time, and another 27% reported restricted work days, is slightly higher than recent research (Seixas, Dominguez, Stover, & Simcox, 2013). Previous research has identified that the majority of injuries, resulting in lost work time, among cleaners is attributable to musculoskeletal injuries and contusions/bruises (Alamgir & Yu, 2008). 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 gender (females versus males), age (19-30, 41-50, 51-60 versus 31-40), ethnicity (Hispanic versus not Hispanic), English proficiency (well versus not well), marital status (widowed versus married), and education (less than

grade 12 versus no schooling completed). Consistent with previous research, male janitors, those who were single or never married, and those who had a higher household income were less likely to have a work-related injury (Smith & Anderson, 2017; Alamgir & Yu, 2008). Also consistent with some previous research (Koehoorn, Ostry, Hossain, & Village, 2011; Smith & Anderson, 2017), the risk of injury was associated with increasing age, with a doubling of risk for janitors under 30, compared to those aged 31-40, and those in the oldest age group (>60 years) having a reduced risk. The apparent protective effect of the older age group is likely due to a healthy worker effect, suggesting janitors with a history of injury may stop working in the occupation, or perhaps, the older janitors have increased overall physical fitness.

Also important was the increased risk of injury among janitors who were reported as Hispanic, compared to non-Hispanic. Previous research has highlighted disparities in injury rates among Hispanic/Latino workers in the United States (Byler, 2013; Anderson, Hunting, & Welch, 2000; Centers for Disease Control and Prevention, 2008; Zierold & Andersen, 2006; Schenker, 2008; Dong, Ringen, Men, & Fujimoto, 2007; Robinson, 1989), which may be attributable to factors including language barriers, more hazardous working conditions, and immigration status. An unexpected finding, in contrast to previous studies (Smith & Anderson, 2017), was the increased risk of injury for those who reported being proficient in English, compared to 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 to a more general training provided to those who spoke English.

Previous research among janitors and cleaners has indicated a relation between

various work-related characteristics and occupational injury. In the current study, janitors who were special project or general cleaners, compared to floor cleaners, had an increased risk of injury. Previous research has suggested that differences in lifting, bending, pushing/pulling tasks can increase the risk of injury (Koehoorn, Ostry, Hossain, & Village, 2011), which likely explains the difference in risk by job titles, based on the differences in task-specific responsibilities. Also of importance in the current study is having an additional job. Compared to those who had no additional jobs, janitors with one or more additional jobs had an increased risk of injury. This adds to the literature and suggests that introducing other occupational roles, outside jobs, or increased overall workload may increase the risk of injury; additional research is need to assess this impact.

In contrast to previous studies (Alamgir & Yu, 2008), the current study showed an increase in overall injury risk for janitors who had 11-15 years (versus less than 5 years) experience, and a decreased risk with more than 16 years, compared to less than five-years of experience. As suggested by length of time working at their current company, the difference in lifetime janitor experience risk may be due to training provided at each company or potential differences in hazards based on activities in which they are engaged. Similar to age, the decreased risk of injury among the janitors with the greatest experience may be attributable to the Healthy Worker Effect, suggesting that those with a greater history of injury may have left the occupation.

Of particular interest was the decreased risk of injury among janitors who started work in early morning, morning or afternoon hours compared to 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 am (versus 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 to 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 (Gabel & Gerberich, 2002; Salminen, et al., 2010; Ulfberg, Carter, & Edling, 2000; Akerstedt, Fredlund, Gillberg, & Jansson, 2002). 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 depression and occupational injury among janitors, with a risk of injury 1.9 times higher among those who reported being depressed compared to 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 (Peele & Tollerud, 2005); however this topic warrants further research. This association contributes to the literature and indicates the importance of mental wellness relevant to the occupational health and safety of janitors.

4.1 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.

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 exposures through self-report. Previous survey research involving non-fatal injuries have found that recall periods, longer than six-months, typically yield less accurate reported measures (Mock, Acheampong, Adjei, & Koepsell, 1999; Cash & Moss, 1972; Braun, Gerberich, & Sidney, 1994). Therefore, to decrease potential information bias, the recall period was restricted to the two respective six-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 (i.e., 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 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 exposures of interest relevant to injury outcomes could potentially result in different levels of risk.

5. 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.

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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 to $34,999	202	57.6
$35,000 to $49,999	74	21.1
$50,000 to $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

PARTICIPANT DEMOGRAPHICS	N	%
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 am – 5:59 am	46	12.9
6 am – 11:59 am	47	12.5
12 pm – 4:59 pm	20	6.3
5 pm – 11:59 pm	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

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

Injury (yes) per 100 persons	Unadjusted Rate (95% Confidence Interval)	Adjusted Rate (95% Confidence Interval)*
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

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 >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 >100%

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

	Occupational Injury			
DEMOGRAPHICS	**RR**	**95% CI**	**RR**	**95% CI**
	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 to $34,999	0.84	0.58-1.22	0.79	0.51-1.22
$35,000 to $49,999	0.74	0.47-1.18	0.77	0.44-1.34
$50,000 to $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
WORK CHARACTERISTICS	**RR**	**95% CI**	**RR**	**95% CI**
	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 am – 5:59 am	0.77	0.51-1.16	0.57	0.31-1.04
6 am – 11:59 am	**0.34**	**0.13-0.87**	0.33	0.11-1.01
12 pm – 4:59 pm	0.66	0.29-1.53	1.18	0.54-2.58
5 pm – 11:59 pm	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				
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

*No Additional covariates

† Adjusted for ethnicity and education

¶ Adjusted for age and education

++ Adjusted for job title and other jobs

‡‡ Adjusted for sex, ethnicity and age

‡ Adjusted for sex, ethnicity, age and education

§§ Adjusted for smoking status, age, ethnicity and sex

¥ Adjusted for sex, ethnicity, age and marriage

†† Adjusted for sex, ethnicity, age, education
¥¥ Adjusted for education, age, and lifetime janitor experience
¶¶ Adjusted for sex, ethnicity, age, smoking status and mental health condition
*** Adjusted for education, marital status, and other household members
§ Adjusted for marital status, ethnicity, age, sex, other household members, smoking status, education, and pre-existing health condition

Figure 1. Sample DAG for the Association between Shift Start Time and Occupational Injury: Health and Injury Study of Janitorial Service Employees

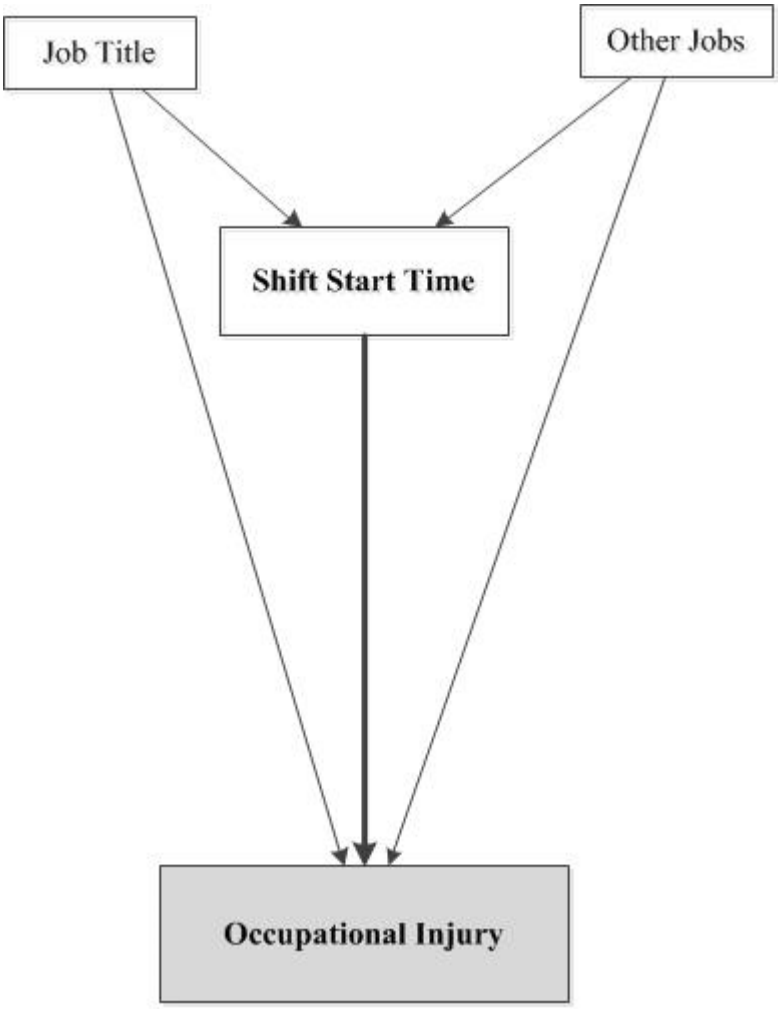
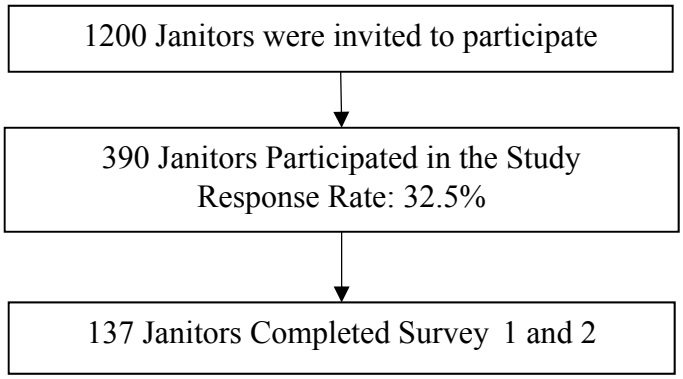


Figure 2. Sampling Frame: Health and Injury Study of Janitorial Service Employees



CHAPTER V – Manuscript 2

JANITOR WORKLOAD AND OCCUPATIONAL INJURIES

ABSTRACT

BACKGROUND

The goal of this study was to identify the potential effects of workload and sleep exposures on injury occurrence.

METHODS

To collect data over two six-month sequential periods on workload, sleep exposures and injury outcomes, specially designed and pre-tested questionnaires were disseminated to 1,200 full-time janitors in the SEIU Local 26 union. Quantitative measurements of workload and sleep exposures, utilizing FitBit Charge HR tracking devices enabled activity monitoring among a subset of 100 janitors. For the questionnaire, there were 390 respondents who provided information on their injury experiences and potential associated risks, based on personal- and work-related exposures. Workload data from the questionnaire were also linked with the FitBit measurements from the subset of 58 participating janitors. Regression techniques were implemented to identify potential risks and correlation analyses were used to determine the relations between questionnaire and FitBit measures.

RESULTS

Of the janitors, 37% reported an increase in workload over the study period. Adjusted analyses indicated a significant relation between change in workload (*increased versus*

no change; RR: 1.94; 95% CI: 1.40-2.70) and sleep hours (*less than six hours compared to eight or more*; RR: 2.21; 95% CI: 1.33-3.66) and occupational injury. Through analyses of workload and injury, stratified by sleep quality, there was a significant association among those with sleep disturbance *less than five, versus more than five days of moderate to vigorous physical activity*; RR: 2.77; 95% CI: 1.16-6.59).

CONCLUSIONS

Using both self-reported questionnaire data and FitBit measurement data enhanced the analyses to identify risks for injury occurrence. Knowledge of these risks is important not only to the janitors, but, also, to the employers and contractors who have the responsibility of determining appropriate workloads for their employees that can ensure safe and healthy work environments.

1. Introduction

The prevalence of health problems, including occupational injury, in the cleaning workforce is high (Alamgir & Yu, 2008; Smith & Anderson, 2017; Woods & Buckle, 2000; Krause, Scherzer, & Ruguiles, 2005; Scherzer, Rugulies, & Krause, 2005; Leigh & Miller, 1998; Village, Koehoorn, Hossain, & Ostry, 2009); however, few studies provide a comprehensive assessment of the occupation, including evaluation of their work environments, working conditions, and their specific tasks (European Agency for Safety and Health, 2009). Literature reviews have revealed that janitors are exposed to numerous physical risks, resulting in high rates of injury and illness. Unfortunately, there is limited research addressing the relations between their exposures and injuries and other health effects. Recently, unionized janitors have become increasingly concerned with their workloads and how their health has been affected by these workloads (Seixas, Dominguez, Stover, & Simcox, 2013).

Janitorial service work typically requires high intensity cleaning, grounds keeping and building maintenance, resulting in high injury rates and musculoskeletal loads (Koehoorn, Ostry, Hossain, & Village, 2011). Previous studies, evaluating workload exposures in janitors have used self-reported questionnaires to characterize their burden. In those questionnaires, workload has been defined using work-intensity scales (Seixas, Dominguez, Stover, & Simcox, 2013), ergonomic assessment (Koehoorn, Ostry, Hossain, & Village, 2011) and square footage (Seixas, Dominguez, Stover, & Simcox, 2013). A 2013 study in the state of Washington assessed workload and work intensity among union and non-union janitors and found trends to suggest that workload contributed to increased rates of injury, illness, and stress (Seixas et al. 2013); from that study it was

reported that, amongst 276 union janitors, self-reported work intensity was strongly related with health, injury, pain and stress (Seixas, Dominguez, Stover, & Simcox, 2013).

High work demands and physical effort at work were both identified risk factors for disturbed sleep and extreme tiredness or exhaustion (Akerstedt, et al., 2002; Dorrian, Baulk, & Dawson, 2010). Sleep disturbances, such as difficulty initiating sleep, sleeping poorly at night, and having sleep insufficiency and insomnia symptoms were moderately, but significantly, associated with the occurrence of occupational injuries (Nakata, et al., 2005). A systematic literature review, including 27 observational studies published between 1982 and 2011 (Uehli, et al., 2014), found that workers with sleep problems, versus none, had a risk 1.62 times greater of being injured (RR: 1.62, 95% CI: 1.43 – 1.84). Moreover, each aspect of the sleep problems (i.e., sleep medication, breathing-related sleep problems, multiple symptoms, sleep quality and sufficiency, sleep quantity, daytime sleepiness) significantly increased the risk for work-related injuries. Among the 268,332 participants analyzed, approximately 13% of work-related injuries could be attributed to sleep problems (Uehli, et al., 2014). In studies of sleep quality (Akerstedt, Fredlund, Gillberg, & Jansson, 2002; Ulfberg, Carter, & Edling, 2000), sleep-disordered breathing and insomnia symptoms were found to be associated with occupational injuries in the general working population. From a study of 48,598 Finnish public sector employees, the reported risk of an occupational injury was 1.19 times higher for those reporting any kind of sleep disturbance, compared to those sleeping well (Salminen, et al., 2010).

Using workload to characterize work demands and physical effort at work, sleep patterns can be evaluated and the relation between workload and injuries can be analyzed.

Based on the specific job classifications and duties of each janitor, workers may be exposed to varying workloads. While past studies have provided a general indication of workload, they have not represented exposures of highly mobile workers by directly measuring their exposures. The current study incorporated personal sampling to quantify these workers' exposures, by having janitors wear fitness bracelets that monitored workload factors throughout the duration of the day, and specifically, for each shift. These direct measurements, paired with questionnaire data, enabled a more comprehensive evaluation of workload. In addition, sleep quality data, collected from the fitness bracelets provided an opportunity to analyze the relation to injury occurrence. Through this project, individual janitor exposures were more directly examined and enabled evaluation of potential risk factors that could affect this population.

2. Methods

2.1 Study Population:

The study population included janitors who were members of the Service Employees International Union (SEIU), Local 26 chapter, a population selected after personnel from the Union approached researchers in the Division of Environmental Health Sciences at the University of Minnesota with occupational health and safety concerns. SEIU Local 26 is comprised of approximately 4,000 janitors, in the Twin Cities metropolitan area. Among these janitors, the target population included the 1,200 janitors who were classified as full-time. Full-time janitors were selected because of higher turnover rates and difficulty in accessing the part-time janitor community.

2.2 Data Collection:

The goal of this study was to examine the relation between workload and injury occurrence through sleep quality -- specifically, to determine the effect of workload variables on injury occurrences by defining the role workload has on sleep quality and, subsequently, occupational injuries. To accomplish this, questionnaires were distributed to the janitors to collect data on injury occurrences, workload, and sleep quality; this distribution was initiated for two six-month sequential periods. Questionnaire data collected, retrospectively, were then paired with direct sampling measurements to provide an overall assessment of workload.

Questionnaire Data Collection:

A specially designed questionnaire, including questions pertinent to demographics, injury occurrence, workload and sleep quality, was developed in coordination with SEIU Local 26, based on feedback from initial focus group discussions with janitors and union representatives; this was accomplished in collaboration with experts from the fields of injury prevention, survey design, and epidemiology at the University of Minnesota to ensure an optimal data collection tool. Questionnaires were pilot tested using a focus group of approximately 30 full-time SEIU Local 26 janitors to obtain feedback and assess the administration of the questionnaire. Based on janitor feedback, the questionnaire was modified, accordingly. Following the piloting, questionnaires were translated into the languages of the study participants (English, Spanish, and Somali) and validated by professionals to ensure accuracy.

Following development, pilot pre-testing, and modification, questionnaires were

distributed to participating janitors in November 2016. Data were collected for two, sequential, six-month periods. The initial questionnaire collected data regarding the six-month period between May 1st and October 31st 2016 and the follow-up questionnaire was then administered six months later, to collect data for the period between November 1st 2016 and April 30th 2017, thus, accounting for a full-year of data collection.

Questionnaire distribution was conducted, using SEIU Local 26 steward representatives who were responsible for the respective janitors' employment locations. At the onset of the study period, these union stewards received comprehensive training on questionnaire content and distribution, providing relevant feedback to janitor inquiries, and collecting and returning the completed questionnaires in the envelopes addressed to the research team that were to be sealed by the respondents. Participation in this study was voluntary and questionnaires were distributed to all full-time janitors who agreed to participate in the study and had signed the informed consent document on the first page of the questionnaire.

FitBit Data Collection:

In addition to the survey measurements, workload and sleep exposure measurements, were collected using FitBit Technologies FitBit Charge HR fitness bands (FitBit Technologies, San Francisco, CA), from a subset of the 1,200 full-time janitors who agreed to also complete the questionnaires. FitBit Charge HR utilizes an optical heart rate monitor, 3- axis accelerometer, altimeter, and vibration monitor and an organic light-emitting diode (OLED) display, which displays instantaneous readouts of heart rate, steps taken, miles walked, floors climbed, and calories burned. Heart rate data are stored at

one-second intervals during exercise tracking and at five-second intervals during all other times. Active minutes are calculated using metabolic equivalents (METs), which measure the energy expenditure of various activities that make them comparable among persons of different weights. Algorithms that assume that sleep has begun, are confirmed by the length of time the wearer's movements are indicative of sleep behavior, while morning movement informs the tracker that the operator is awake.

FitBit tracker observations were planned to occur over 24-hour periods, for a total of 28 days, both at baseline and follow-up. While the devices were to be worn throughout the day and during all sleep hours for accuracy, specific workload measurements utilized data only relevant to the janitors' shifts.

Each janitor was visited one to two times during the study period: once to provide the direct sampling devices and specific use instructions, and once to correct any device issues and ensure proper syncing if issues had developed. During the initial visit, the fitness bands were placed on the workers' wrists and synced with their Smart Phones and the Fitabase system (n = 58), in order to monitor continuously during each worker's shift and while they were sleeping. Workload levels were recorded every minute, and full-shift workload exposures were computed from the data recorded. All Fitbit measurements were analyzed and exported using Fitabase LLC (Small Steps Labs, LLC, San Diego, CA) software, a secure third-party data service provider, which enables continuous collection of participants steps, intensity, calories burned, sleep patterns and heart rate data throughout the observed wear-periods.

2.3 Definitions and Measurements of Variables:

Survey Measures:

Injury: The definition used for work-related injury was consistent with the National Center for Health Statistics (NCHS) and Bureau of Labor Statistics (Bureau of Labor Statistics (BLS), 2016). "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 four hours; and/or the use of professional medical care; and/or loss of consciousness, loss of awareness, or amnesia for any length of time. When the participant did not directly report an injury in response to the initial injury question, but indicated having an event, an imputed injury measure was used; this was based on relevant information from other responses in 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 ensure accuracy and minimize any potential biases, the injury measure was only imputed with information that could be directly linked to the injury outcome as determined by the research team, comprised of experts in the field of injury prevention and survey measures.

Change in Workload: This self-reported measure was based on work-related activities and energy expenditure and involved any changes to workload, including an increase, decrease or no change.

Moderate/Vigorous Physical Activity Days: Moderate or Vigorous physical activity (MVPA) was defined as activity equivalent to heavy lifting, vacuuming, cleaning, walking or climbing up the stairs for at least 10 minutes a day during work hours.

Sleep Hours: This included the average hours of sleep in a given 24-hour period for the previous week. Participants were asked about sleep duration and sleep quality for the previous seven days and the previous six-months. If sleep duration differed in the previous week, compared to the previous six-months, the hours reported for the six-month period were used.

Sleep Disturbance: Sleep disturbance was determined using the Patient-Reported Outcomes Measurement Information System (PROMIS) Sleep Disturbance, four-question short form, instrument, used to assess self-reported perceptions of sleep quality and restoration associated with sleep. Participants were asked to rank their sleep quality, i.e., if their sleep was refreshing, if they had a problem with their sleep, and if they had difficulty falling asleep. Due to the length of this PROMIS form, in order to determine a sleep disturbance score, participants had to answer all questions. Each question had five response options, ranging in value from one to five, and the score was the sum of these responses. Based on scores, participants were assigned a given t-score and classified as having a none to slight (less than 55), mild (55.0-59.9), moderate (60.0-69.9) or severe (70 and over) sleep disturbance.

<u>FitBit Measures:</u>

Metabolic Equivalent (MET): A metabolic equivalent (MET) is a measure of energy expenditure, defined as the resting metabolic rate. One metabolic equivalent is defined as

the amount of oxygen consumed while sitting at rest and is equal to 3.5 ml O_2/kg/min (1.2 kcal/min for a 70-kg person) (Jetté, Sidney, & Blümchen, 1990). This energy expenditure can be determined by dividing the relative oxygen cost of the activity by 3.5. For example, work at 3 METs requires three times the resting metabolism or 10.5 ml O_2/kg/min. In accordance with the Centers for Disease Control (CDC) and American College of Sports Medicine (ACSM) guidelines, moderate physical activity occurs between 3.0 to 6.0 METs (3.5 to 7 kcal/min), and vigorous activity occurs when activity exceeds 6.0 METs (more than 7kcal/min). The FitBit device estimates the MET value in any given minute by calculating the intensity, using steps taken, heart rate data, and calories burned, for the activity.

- *Steps taken*: Fitbit trackers utilize a 3-axis accelerometer that provides acceleration data used to determine steps taken, distance traveled, calories burned, and sleep quality. Using a finely tuned algorithm, step counting is measured based on motion patterns most indicative of people walking. One condition for a motion pattern to be recognized as a step is that the motion must be large enough. The algorithm implements this by setting a threshold. If a motion and its subsequent acceleration measurement data meet the threshold, the motion will be counted as a step. If that threshold is not met, the algorithm won't count the motion as a step.
- *Heart Rate*: When the heart beats, the capillaries expand and contract based on blood volume changes. PurePulse™ LED lights on the FitBit tracker reflect onto the skin to detect blood volume changes and finely-tuned algorithms are applied to measure heart rate automatically and continuously. FitBit trackers use heart rate

data from the time when the participant is awake to the time he /she is asleep to estimate the resting heart rate.

- *Calories Burned*: Fitbit devices estimate calories burned based on participant age, gender, height, weight (entered during device set-up), and given heart rate during activity.

If METs were at or above 3 for at least 10 minutes for a given day, during their work time, the participant was determined to have had a moderate/vigorous physical activity day.

Sleep duration: Sleep autodetection is based on movement. When the participant has not moved in over an hour, algorithms assume that sleep has begun, which is confirmed by the length of time the movements are indicative of sleep behavior only.

2.4 Data Analyses:

Descriptive statistics were utilized to summarize the frequencies of participant demographics, workload intensities and sleep quality. Relative risks were calculated using Poisson regression models with robust variance estimators (Zou, 2004) to determine the strength of associations between workload and sleep exposures and occupational injury. Estimates of rates, and associated 95% confidence intervals (CI), were generated 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 the dependency between and within subjects and independency between subjects. In this study, janitors could have completed both a

baseline and a follow-up survey or, possibly, 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.

To determine the magnitude of the effect of workload and sleep, sleep duration and sleep quality were tested for effect modification. To achieve this, a stratified analysis was conducted to determine if the relative risk differed by sleep measurements. Similarly, these risks were calculated using Poisson regression models with robust variance estimators (Zou, 2004) to determine the strength of associations between workload and sleep exposures and occupational injury. Estimates of rates, and associated 95% confidence intervals (CI), were generated using generalized estimating equations (GEEs) with exchangeable working correlation matrices

Correlation analyses were used to examine the relations between the survey measures and FitBit measures. Specifically, the relation between sleep hours and moderate/vigorous physical activity was examined. Additionally, descriptive statistics were used to determine the frequencies of FitBit measures. To determine the association between of FitBit measures of workload and occupational injury, relative risks were calculated using similar Poisson regression models and GEEs with exchangeable working correlation matrices.

Bias Analyses

Non-Response bias, arising from missing data was a potential concern. To account for any missing data following survey collection, and to minimize possible non-response bias, models were adjusted for response bias by weighting observed responses by probabilities of response, estimated as a function of characteristics (birth year, gender, and contractor) from all SEIU Local 26 janitors available from the union. This method reweighs estimates by using group response characteristics to account for potential differences in responses.

Selection of Variables

A causal model was developed, based on relevant literature and expert knowledge, to determine the variables to be measured and controlled for in the study analyses. From the model, Directed Acyclic Graphs (DAGs) were derived to determine the minimum sufficient set of potential confounders for the relevant exposures of interest. When selecting potential confounders, the DAG allows a choice of only those variables believed to be causal to the exposure of interest while excluding variables that are believed not to be causal, following the methods described by (Greenland, Pearl, & Robins, 1999) and illustrated by (Hernan, Hernandez-Diaz, Werler, & Mitchell, 2002). Figure 1 presents an example of a DAG for one exposure of interest—shift start time.

3. 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%) (Figure 2). Among the 390 participants, 334 completed the baseline survey, 193 completed the follow-up survey, and 137 completed both the baseline and follow-up surveys. Over half (55%) of the respondents were female and mostly Hispanic (68%). Ages ranged from 19 to >60 years, with most (60%) of the janitors between 31 and 50 years of age, followed by ages 51-60 (23%). The vast majority (72%) of the participants were married, living as married or living with a domestic partner. The highest level of education completed was some form of college; however most participants reported a high school diploma (36%) followed by less than grade 12 (35%). Among the participants, less than half (42%) reported English proficiency.

Table 1 shows the distribution of sleep and workload exposures among all survey participants. The majority of janitors reported five or more days of MVPA per week (69%). On average, 38% of janitors reported an increase in workload over the past year. Many janitors reported a difference in sleep between survey 1 and survey 2; however, on average approximately half (53%) of janitors reported sleeping between 6 and 7.99 hours per night, followed by 26% of janitors sleeping less than 6 hours. Sleep disturbances ranged from none to severe, with most (79%) reporting none to slight sleep disturbances at night.

A total of 58 janitors were FitBit participants. Among them, the majority were female (60%) and Hispanic (72%). Ages ranged from 21 to greater than 60 years of age

with the majority between ages 31 and 40 (33%) followed by ages 41-50 (26%) and 51-60 (26%).

Over the course of the study period, 34% of janitors reported having at least one injury. Among the FitBit participants, 54% reported an injury. An increase in workload, over the study period, was reported by 38% of janitors; several reasons were identified for this increase (Table 2). The most common reasons included: more job duties (30%); change in intensity of work (22%); and fewer staff (16%).

In table 3, results of multivariable, weighted analyses identify associated relative risks and 95% CIs. Among the workload measures, the risk of injury was 1.9 times greater for janitors who reported increases in workload, and 2.6 times greater for janitors who reported a decrease in workload, compared to those who reported no change. There was an increased risk of injury for janitors who reported engaging in one to two or three to four days of MVPA compared to those who reported five or more days.

Relevant to sleep duration and occupational injury, there was an increased risk of injury for those who slept less than six hours (RR:2.21; 95% CI:1.33-3.66) compared to those who slept eight hours or more. For those who reported a moderate to severe sleep disturbance, the unadjusted risk of injury was 1.6 times greater (95% CI: 1.02-2.43), compared to those who had no or only a slight sleep disturbance; while the adjusted risk was not statistically significant it also appeared highly important.

In the multivariable analyses presented in Table 4, the associations between workload and injury with sleep quality or duration as an effect modifier are identified. When accounting for sleep disturbance, the risk of injury was much greater for those who

engaged in less than five, compared to more than five days of MVPA and reported a sleep disturbance (RR:2.77; 95% CI: 1.16-6.59). Similarly, for sleep duration, the increased risk of injury was highly suggestive for those who engaged in less than five, versus five or more, days of MVPA and slept less than eight hours.

Among the FitBit participants, METs ranged from 1.0, indicating light physical activity, to 14.4 indicating extremely vigorous physical activity during workshifts. The average METs recorded during workshifts were 2.2. Work shift METs were analyzed to determine the relations with occupational injury, and results were not important; but, they indicated that, as METS increased, the risk of injury trend increased (RR: 1.07; 95% CI: 0.53-2.15; data not shown).

Correlation results (Table 5), indicated a non-significant, inverse relation between workload measures collected through the questionnaire, compared to those collected through the FitBit device. However, there was a slightly positive relation between sleep duration reported on the questionnaire compared to the FitBit device (0.2).

4. Discussion

The current study measured changes in workload over a one-year period; 38% of janitors reported an increase in workload, attributable mostly to more job duties, a change in intensity of work and fewer staff. Due to different study methods and populations, it is difficult to compare these results to other studies. However, a previous study of janitors in Washington State assessed a change in work intensity, and found that among union janitors, reported work intensity increased by 8.6% over the three-year period between 2010 and 2013. The current study did not measure the percent increase in workload, but did conclude that, among those who reported an increase in workload, 22% was

attributable to intensity of work. Additionally, those who reported any change, compared to no change, in workload had at least a two-fold increase in risk of injury; those who reported a decrease in workload had the higher risk of injury (RR: 2.58; 95% CI: 1.67-4.01). This increased risk of injury for those with an increase in workload may be attributable to having more job duties or a change in work intensity, and thus more opportunity for injury occurrence.

Previous research among janitors and cleaners have indicated a relation between work intensity and injury occurrence. From the study of janitors in Washington, it was reported that union janitors who rated their work as high, compared with low, intensity were 2.03 (p=0.036) times as likely to report an injury (Seixas, Dominguez, Stover, & Simcox, 2013). Specifically, results from the Washington Study indicated an increase in injury, poor/fair general health, back, leg and arm pain and work stress, with increased work intensity. Among those union janitors in Washington, occurrence of an occupational injury within a year was highest among janitors who reported high work intensity. Similarly, study results among custodial workers in Canada (Koehoorn, Ostry, Hossain, & Village, 2011) identified that, with an increased percentage of time exposed to pushing and pulling activities, there was an increased risk of injury; those who reported pushing or pulling tasks for 47% of the day, versus those involved for 24% of the workday, had a risk of injury five times greater. Consistent with these findings, janitors in the current study who reported no days of MVPA had a lower risk for reporting an injury compared to those who reported five or more days per week of MVPA. However, contrary to previous research, the risk of injury was greater for those who reported 1-2 or 3-4 days of moderate to vigorous physical work compared to 5-7

moderate or vigorous physical work days. This decreased risk of injury among janitors who reported more than five days of MVPA may be attributable to the healthy worker effect, suggesting that those with who reported more days of MVPA may have had an increased overall physical fitness and, thus, were less likely to have an injury while those who were not fit at that level were no longer working.

Short sleep duration and poor quality of sleep are both risk factors for occupational injury (Akerstedt, Fredlund, Gillberg, & Jansson, 2002; Nakata, et al., 2005; Uehli, et al., 2014; Ulfberg, Carter, & Edling, 2000). Previous research of SEIU janitors found that they reported having low sleep quality and getting less than six hours of sleep per night (Seixas, Dominguez, Stover, & Simcox, 2013; Terriquez, Rogers, Blasi, Shadduck Hernandez, & Appelbaum, 2009). In the current study, adjusted analyses indicated an increased risk of injury for those who slept less than six hours, compared to eight or more hours, and for those who reported moderate to severe sleep disturbance compared to none or slight. There is limited research evaluating sleep exposures and injuries among janitors; however, research among other occupations supports these findings. Among veterinarians, injuries were more common for individuals who slept less than six hours in a 24-hour period (Gabel & Gerberich, 2002). Among the general working population, from studies of sleep quality it was reported that sleep-disordered breathing and insomnia were both associated with occupational injuries (Ulfberg, Carter, & Edling, 2000; Akerstedt, Fredlund, Gillberg, & Jansson, 2002). Similarly, among Japanese medium-scale enterprise workers, poor nocturnal sleep habits were associated with self-reported occupational injury (Nakata, et al., 2005).

After evaluating the relation between workload and sleep with occupational injury, separately, the relation between workload and injury was evaluated to assess the impact of sleep. Among those with no sleep disturbance, there was no significant association between workload and injury. However, for those who reported any sleep disturbance, there was a significant increase in risk of injury among those reporting less than five, versus five or more MVPA working days. Specifically, when adjusting for sleep, the effect of workload on injury was significantly more substantial among those who reported a sleep disturbance, compared to those who did not. When testing the association between workload and injury, results of this study indicated that the risk of injury was greater for those who reported less than five MVPA working days compared to five or more; this was likely due to the healthy worker effect among those who remained working and reported five or more MVPA, days indicating overall higher physical fitness levels. When adjusting for sleep disturbance, this relation was more substantial among those who reported sleep disturbances and, thus, indicated a greater risk for injury among those workers with reduced overall physical fitness (i.e., reporting less than five MVPA days) who also reported difficulty sleeping.

Previous research assessing the validity of questionnaire assessments versus direct measures among cleaners reported that questionnaire measures had low validity among custodians and suggested that direct measures are necessary to improve exposure assessment (Hansson, et al., 2001). Consistent with current study findings, the correlation between survey measures of workload MVPA and Fitbit measures using METs were low. Previous research assessing the validity of the FitBit in measuring METs have produced conflicting results, with some research suggesting the FitBit is a moderately valid

measure when compared to research grade activity trackers such as the ActiGraph (Brewer, Swanson, & Ortiz, 2017; Ferguson, Rowlands, Olds, & Maher, 2015), and some suggest that the device over- (Dominick, Winfree, Pohlig, & Papas, 2016; Alharbi, Bauman, Neubeck, & Gallagher, 2016) or under-estimates (Sushames, Edwards, Thompson, McDermott, & Gebel, 2016) measures. However, these results can differ based on the type of FitBit device utilized and any updated changes to the software by FitBit on how METs are determined. Similarly, with sleep, research has conflicting results on the accuracy of FitBit trackers in determining sleep quality and duration. Studies have shown that the Fitbit is moderately accurate at measuring sleep duration, but tends to overestimate sleep hours (Mantua, Gravel, & Spencer, 2016; Montgomery-Downs, Insana, & Bond, 2012; Rosenberger, Buman, Haskell, McConnell, & Carstensen, 2016).

In addition to correlation analyses, regression analyses were conducted to assess the relations between workload measures from the FitBit and occupational injury (data not shown) and to determine if the risk differed, based on FitBit measures. Although measures of workload from the survey and the FitBit were not correlated, findings from the FitBit regression analyses supported findings from the questionnaires – there was a non-important increased risk of injury as MVPA increased during work. Results of the current study suggested that findings from questionnaire data differ from direct measure; however, the validity of the FitBit warrants additional research to determine if the FitBit Charge HR tracker device, utilized in the current study provides accurate measures of physical activity.

4.1 Advantages and Limitations

This study provides valuable information on the burden of workload among janitors, and the impact on occupational injury. Further, the impact of sleep was assessed in relation to workload and analyzed to determine how the risk of injury differs, based on shift-related workload and sleeping patterns at night. This relation was further investigated by incorporating direct sampling measurements to gain an overall enhanced understanding of workload and sleep patterns among this cohort.

Although this study provided valuable information, there were several potential limitations. One of the limitations of the study was the low response rate. To enhance survey response, and ultimately minimize non-response bias, the questionnaire was provided in three relevant languages; English, Somali and Spanish. Additionally, focus groups were implemented for pre-testing and discussion of relevant modifications regarding the questionnaire and the research team worked with the union to determine the best dissemination methods. Further, 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. These efforts yielded a response rate of 33%, indicating the difficulty of accessing this population. As described earlier, following data collection, potential response bias was controlled by inversely weighting (Horvitz & Thompson, 1952) observed responses by probabilities of response, estimated as a function of population characteristics available from the union.

A potential for bias was also introduced by collecting information on injury experiences and relevant exposures through self-report. To decrease potential information

bias, the recall period was restricted to the respective previous six-months. Studies of non-fatal injuries have shown that the longer the recall period, the less accurate the reported estimates (Mock, Acheampong, Adjei, & Koepsell, 1999; Cash & Moss, 1972; Braun, Gerberich, & Sidney, 1994), and, therefore, a shorter recall period of six months was utilized, a recall period also used in previous research by study investigators (Gerberich, et al., 1998). In addition, janitors were provided with some assistance regarding survey completion to clarify any unclear information and to minimize missing data. To ensure that interviewer bias was not introduced through this method, those who provided guidance with survey completion (i.e., union representatives) were trained comprehensively on the questionnaire content as well as how to encourage survey completion, address any ambiguous information, and translate information as necessary, without 'leading' the respondent.

Missing data was a major issue among the self-reported surveys. As mentioned previously, significant efforts were made to avoid this during data collection periods, including survey translation and utilization of union representatives for survey guidance. While follow-up and attrition was a problem among this study population, there was no opportunity to collect any missing information following initial data collection. Despite this potential bias, missing data were included in logistic regression models and indicated no significant associations between any missing information on exposures of interest and injury outcomes and, thus, were excluded. Regardless of potential missing data in the descriptive analyses, summary information provides some understanding of this population and the relevant injury burden and severity.

It is also possible that results from this study may lack generalizability to other

populations of janitors, including non-unionized janitors, those responsible for cleaning school buildings, and those who are located in different regions. Therefore, the workload among those different groups may vary and, subsequently, could potentially result in different levels of risk for injury and sleep patterns.

In addition to limitations with self-reported questionnaire data, there were many complications regarding the use of FitBits among the study population. However, the most prevalent issues included technology issues, study participation, and language barriers.

Technology Issues: The FitBit device stores data for a 28-day period, prior to it being erased by the device technology; hence, a 28-day period sampling period was utilized. The plan was to begin the sampling period the day immediately following FitBit set-up. However, following the FitBit set-up, a large portion of the janitors frequently experienced complications with the FitBit devices and did not synchronize data for a consecutive 28-day period. This resulted in some incomplete or lost data from the users. While all FitBit participants were required to synchronize their devices with their phones daily in order to prevent lost data, there were many related issues during initial set-up and, again, over the duration of the study. The problems with synchronizing devices resulted in additional lost data because, although the participant was wearing the device, often the measurements were not downloaded properly. Finally, there were issues with properly charging the devices. The FitBit devices need to be charged every two to three days and, frequently, participants would allow the battery to die and did not charge it, again, for several days.

Study Participation: Despite the janitors' initial enthusiasm to use the FitBit devices, over the study period, many stopped using the devices for various reasons that included losing the FitBit device, loss of interest in the study, and discomfort with the FitBit bands. Additionally, to set up the FitBits, janitors were required to meet the research team for a 30-minute session to educate them about the device and the proper way to use the device. It was particularly difficult to arrange sessions with the janitors to set up the FitBits outside of work hours; thus, this complicated participation.

Language Barriers: The majority of the janitors in the SEIU Local 26 either speak Spanish or Somali; therefore, it was difficult for them to communicate with the research team when there were issues, due to limited availability of relevant translators. Often, participants would have to contact leadership at the SEIU Local 26 who would then communicate issues relevant to the devices to the research team. The limited ability to communicate with participants in the study made initial device set-up, synchronizing the devices, tracking the participants, and discussing device problems especially challenging.

5. Conclusions

This study was among the first to conduct a comprehensive analysis of the impact of physical workload and sleep quality on injury occurrence among janitors. Use of self-reported questionnaire data and FitBit measurement data enhanced the analyses to determine how the quantified exposures impacted the causal relation between workload and injury occurrence. Of importance was the impact that sleep had on this relation, and how poor sleep quality and sleep duration can greatly increase the risk of injury among janitors. Results of this study warrant further in-depth investigation of the impact of workload and sleep quality on occupational injury. Knowledge of these risks is important

not only to the janitors but, also, to the employers and contractors who have the responsibility for determining the appropriate workloads for their employees.

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Figure 1. Sample Directed Acyclic Graph for the Association between Change in Workload and Occupational Injury: Janitor Workload and Occupational Injury Study

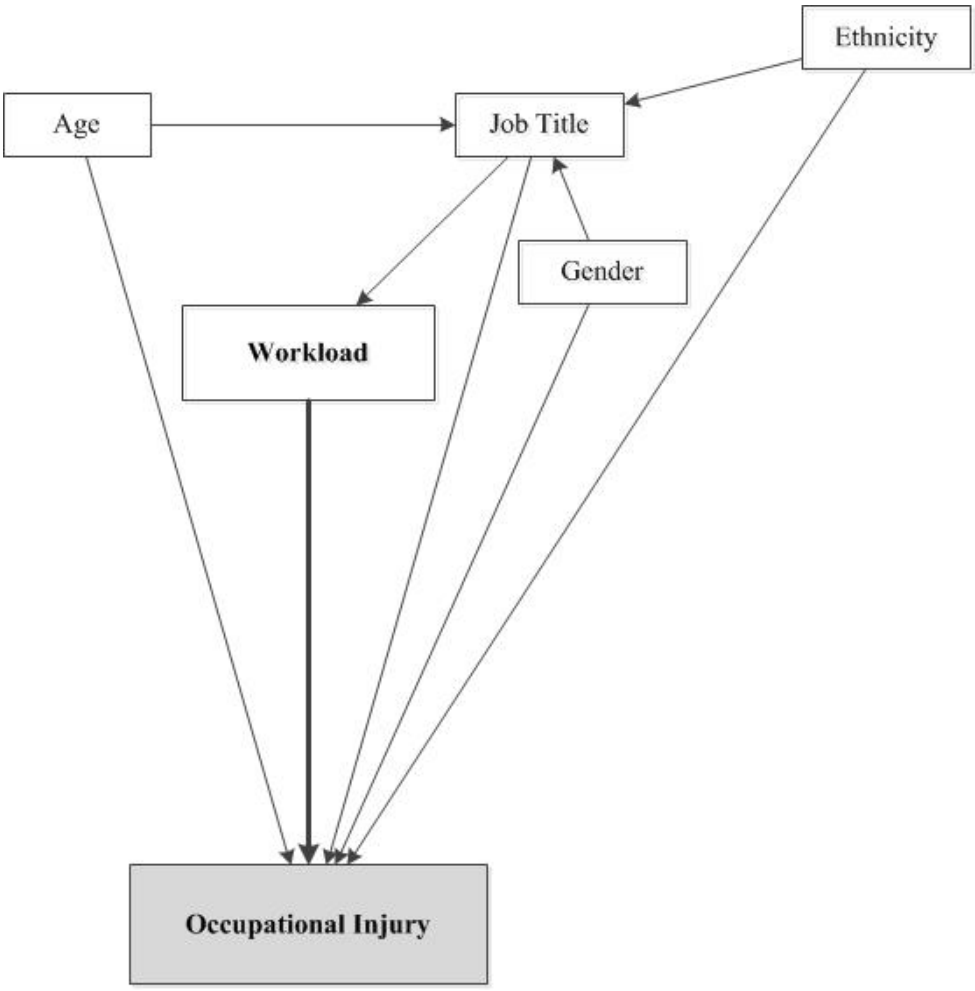

Figure 2. Sampling Frame: Janitor Workload and Occupational Injury Study

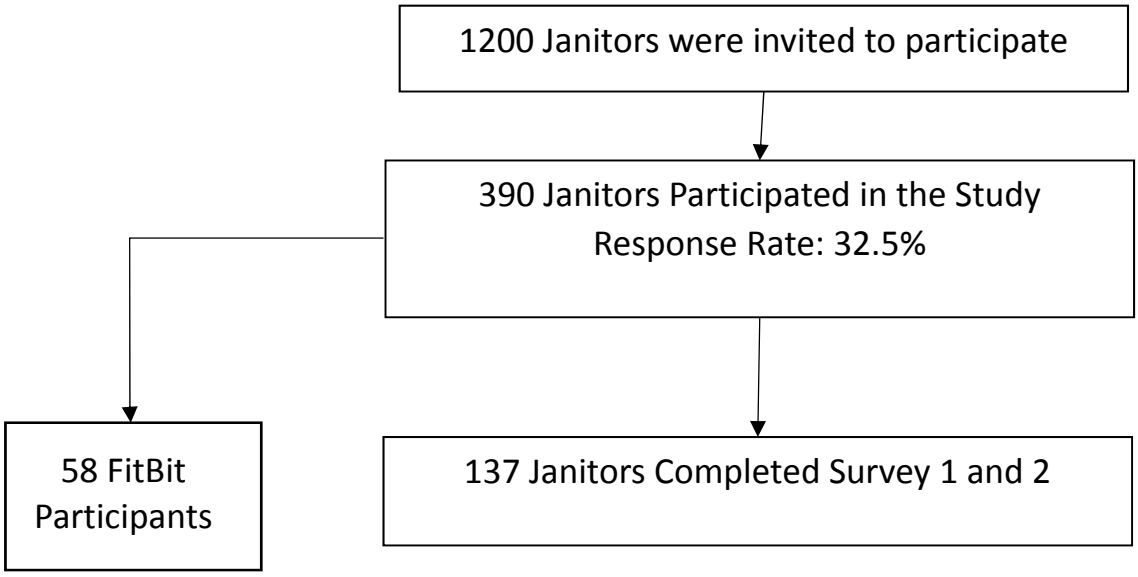

Table 1. Sleep and Workload Exposures among participants: Janitor Workload and Occupational Injury Study

	Survey 1		Survey 2		Overall	
WORKLOAD and SLEEP	**N**	**%**	**N**	**%**	**N**	**%**
Change in Workload (self-report)*						
No Change	156	59.3	118	71.5	156	59.3
Increased	99	37.6	36	21.8	99	37.6
Decreased	8	3.0	11	6.7	8	3.0
Moderate/Vigorous Physical Activity						
None	35	16.4	9	8.4	36	14.7
1-2	23	10.8	8	7.5	25	10.2
3-4	14	6.6	7	6.5	16	6.5
5-7	141	66.2	83	77.6	168	68.6
Sleep Hours*						
<6 hours	59	21.0	52	30.4	91	26.1
6-8 hours	153	54.4	87	50.9	183	52.6
≥8 hours	69	24.6	32	18.7	74	21.3
Sleep Disturbance						
None to Slight	224	77.0	137	81.5	268	78.6
Mild	50	17.2	22	13.1	54	15.8
Moderate	17	5.8	9	5.4	19	5.6

Table 2: Reasons for Increase in Workload: Janitor Workload and Occupational Injury Study

Reason	Increased		No Change	
	n	%	n	%
Fewer Staff	20	15.9	10	31.3
More Job Duties	38	30.2	4	12.5
Training other Employees	2	1.6	0	0.0
Less Funding	2	1.6	0	0.0
Lack of Supplies or Equipment	2	1.6	3	9.4
New Equipment	4	3.2	3	9.4
Intensity of Work	28	22.2	5	15.6
Complaints from Customers Coworkers, Management	16	12.7	4	12.5
Other	14	11.1	3	9.4

*Missing 309, 32 people reported a "reason" but marked no change

Table 3: Multivariable Analyses of Workload and Sleep Exposures and Injury: Janitor Workload and Occupational Injury Study

	Occupational Injury	
WORKLOAD and SLEEP	**Unadjusted RR and CI**	**Adjusted RR and CI**
Change in Self- Reported Workload ¶		
No Change	--	--
Increased	**1.76 (1.34-2.32)**	**1.94 (1.40-2.70)**
Decreased	**1.91 (1.30-2.81)**	**2.58 (1.67-4.01)**
Moderate/Vigorous Physical Activity Days¶		
None	0.91 (0.58-1.43)	0.98 (0.58-1.67)
1-2	1.28 (0.79-2.07)	1.56 (0.95-2.57)
3-4	1.45 (0.88-2.37)	1.64 (0.89-3.03)
5-7	--	--
Sleep Hours **		
<6 hours	**1.84 (1.14-2.95)**	**2.21 (1.33-3.66)**
6-8 hours	1.39 (0.93-2.09)	1.61 (1.03-2.50)
≥8 hours	--	--
Sleep Disturbance **		
None to Slight	--	--
Mild	0.95 (0.65-1.39)	1.02 (0.60-1.75)
Moderate to Severe	**1.57 (1.02-2.43)**	1.36 (0.83-2.34)

*Adjusted for non-response

¶ Adjusted by sex, age, ethnicity, and job title

**Adjusted by sex, age, smoking status, education, shift start time, job title, other jobs, diagnosed depression, and previous injury

Table 4: Multivariable Analyses of Workload and Injury Adjusted by Sleep Quality and Duration: Janitor Workload and Occupational Injury Study

Moderate/Vigorous Physical Activity Days‡		
All Sleep	***Unadjusted Rates***	***Adjusted Rates¶***
<5 days	1.14 (0.83-1.57)	1.29 (0.89-1.87)
≥5 days	--	--
Moderate/Vigorous Physical Activity Days*		
No Sleep Disturbance		
<5 days	1.14 (0.80-1.61)	1.24 (0.80-1.91)
≥5 days	--	
Any Sleep Disturbance		
<5 days	**2.52 (1.07-5.93)**	**2.77 (1.16-6.59)**
≥5 days	--	--
Moderate/Vigorous Physical Activity Days‡		
Less than 8 hours		
<5 days	1.11 (0.76-1.60)	1.25 (0.81-1.91)
≥5 days	--	--
Greater than (or equal to) 8 hours		
<5 days	0.89 (0.37-2.17)	0.93 (0.39-2.23)
≥5 days	--	--

¶ Adjusted for non-response

*Adjusted by sex, ethnicity, and job title

‡ Adjusted by sex, age, ethnicity, and job title

Table 5. Correlation Analyses between Questionnaire and FitBit Measures: Janitor Workload and Occupational Injury Study

		FitBit Sleep Hours	FitBit Workload (Average)
Self-Reported Sleep Hours	*Pearson Correlation*	0.198	
	Sig. (2-tailed)	0.22	
	N	40	
Self-Reported Workload	*Pearson Correlation*		-0.11
	Sig. (2-tailed)		0.52
	N		39

CHAPTER VI – Manuscript 3

KNOWLEDGE OF WORK-RELATED INJURY REPORTING AND PERCEIVED BARRIERS AMONG JANITORS

ABSTRACT

INTRODUCTION

The goal of this study was to evaluate and improve janitors' knowledge of workers' rights and responsibilities for assessing and reporting work-related injuries, and to determine the barriers for reporting occupational injuries among janitors and to mitigate these barriers through a customized intervention.

METHODS

Questionnaires, designed to collect data retrospectively for two, sequential six-month periods, were disseminated to 1,200 full-time janitors in the Twin Cities. Immediately following the baseline questionnaire administration, a randomly selected sub-group of janitors (~600) received information on workers' rights and responsibilities for reporting injuries; six-months later a questionnaire comparable to the baseline questionnaire was disseminated to the 1,200 janitors. Analyses included basic descriptive analyses and identification of potential differences in proportions of job-specific reporting barriers pre-post-intervention, using McNemar's test of marginal homogeneity.

RESULTS

Among the participating janitors (n=390), approximately half (53%) were initially unsure of what an OSHA 300 Log was; 56% reported not knowing what Workers' Compensation was. At baseline, in the intervention and non-intervention groups,

approximately 25% reported having a perceived barrier to reporting an injury to their employer. Reported barriers included “fear,” “reporting takes too long,” “being unsure of the reporting process,” and an “understanding that injuries are a part of the job.” At follow-up, among the intervention group, there was an important reduction (24% to 12%) in having a perceived barrier for “reporting an injury to your employer.”

CONCLUSIONS

A majority of janitors lack knowledge and awareness of both OSHA injury reporting and Workers’ Compensation. In order to improve reporting, it is essential to educate employees on OSHA and Workers’ Compensation and inform janitors of the injury reporting process through training.

1. Introduction:

In 2016, according to the Bureau of Labor Statistics, janitors and building-cleaning workers (SOC 37.000) held about 2.4 million jobs. Approximately 36% were employed in the services to the building and dwellings industry, and another 13% were employed in elementary and secondary schools (Bureau of Labor Statistics, U.S. Department of Labor, 2018). Through labor-intensive cleaning, grounds keeping and building maintenance, janitorial service work demands result in high musculoskeletal loads and resulting injury rates (Koehoorn, Ostry, Hossain, & Village, 2011; Bureau of Labor Statistics, U.S. Department of Labor, 2018). In the United States, during the year 2010, workers classified as janitors and cleaners incurred more than 46,000 work-related injuries, resulting in days away from work that accounted for the 16th highest injury rate among all occupations (Seixas, Dominguez, Stover, & Simcox, 2013).

Injury surveillance is an important step in injury prevention (Weddle, 1996); however, there are a number of sequences necessary to accurately capture work-related health problems from the data sources currently used to capture occupational injuries (Azaroff, Levenstein, & Wegman, 2002; Webb, Redman, Wilkinson, & Sanson-Fisher, Filtering effects in reporting work injuries, 1989). In the United States, the major sources of occupational health data include: the Bureau of Labor Statistics (BLS) annual survey of occupational injuries and illnesses; Workers' Compensation records; and physician-reporting systems. Data produced by these systems have been described as fragmentary, unreliable, and inconsistent and have been shown to underestimate the incidence of work-related injuries, illnesses, and even fatalities (Azaroff, Levenstein, & Wegman, 2002; Weddle, 1996; Pransky, Snyder, Dembe, & Himmelstein, 1999; Moore, Cigularov,

Sampson, Rosecrance, & Chen, 2013; Rosenman, et al., 2006).

In Minnesota, The Minnesota Department of Labor and Industry (MDLI) tracks injuries and illnesses through Workers' Compensation claims filed by employers. However, there are limitations to the use of accepted claims data for indicators of injury incidence including underreporting, that includes aversion to filing Workers' Compensation claims, disciplinary action by supervisors, inability to afford lost work time, lack of medical payment and the inability to confirm the relations between their jobs and their health problems (Azaroff, Levenstein, & Wegman, 2002; Scherzer, Rugulies, & Krause, 2005). Due to these limitations, the injury data for janitors in Minnesota is incomplete and not comprehensive. Reviews of Minnesota Workers' Compensation data revealed extremely low injury rates for companies in which the proposed population of janitors were employed; several associated large companies reported no injuries for the 2014 calendar year.

While there have been studies investigating the broad scope of occupational safety and health of cleaning workers (European Agency for Safety and Health, 2009; Seixas, Dominguez, Stover, & Simcox, 2013), there is a deficiency in studies that have identified the barriers to reporting injuries among janitors. Previous studies showed that among cleaners, reasons for not reporting injuries included: the complicated reporting process; potential risks to job security; and fear of disciplinary or punitive reaction from management (Scherzer, Rugulies, & Krause, 2005). To determine the true prevalence and magnitude of injuries among this population, additional research to understand the specific barriers that discourage janitors from reporting injuries and how to mitigate them is needed.

Discussions with the local union members, from whom the current study population was derived, highlighted the lack of knowledge about workers' rights and obligations for assessing and reporting work-related injuries, including knowledge of the Occupational Health and Safety Administration (OSHA), OSHA 300 Log for reporting work-related injuries, and the Workers' Compensation reporting system. The current study characterized janitors' knowledge of workers' rights and, ultimately, utilized an intervention strategy to provide them with the tools and knowledge with which to properly report their injuries and to understand the responsibilities of their employers. This objective of this study was to identify perceived barriers to the reporting of work-related injuries, a potential factor associated with inequalities in the provision of health care, and to mitigate these barriers through a customized intervention.

2. Methods:

2.1 Study Population:

The University of Minnesota School of Public Health and the Service Employees International Union (SEIU) Local 26, a labor union focused on workers in health care, property services, and public services, collaborated on the study. Across North America, SEIU includes more than 386,000 members in property services, including those who work as janitors, security officers, maintenance and custodial workers, stadium and arena workers, and window cleaners. SEIU Local 26 is Minnesota's Property Services Union comprised of approximately 6,000 janitors, security officers and window cleaners in the Twin Cities metropolitan area; among these members, the target population included the 1,200 members employed as full-time janitors.

2.2 Data Collection:

To determine janitors' knowledge of workers' rights and responsibilities for assessing and reporting work-related injuries, a survey methodology was used. Between May 2016 and April 2017, two specially designed questionnaires were disseminated to all full-time janitors (n=1200), one at baseline and one at follow-up, each covering the prior six-month period, accounting for a full year of data collection. Immediately following the initial baseline questionnaire administration, a randomly selected sub-group of janitors (n=600) received information on workers' rights for reporting injury events; six-months later, a subsequent comparable questionnaire for the second six-month period was administered to all janitors. The questionnaires were distributed through union representatives, referred to as stewards, who served as leaders for different clusters of janitors employed throughout the Twin Cities. These stewards received comprehensive training from the research team during a major union meeting on questionnaire content and how to distribute and collect the questionnaires from the janitors in their clusters. Questionnaires were to be disseminated during the janitors' work shifts and, following completion, were to be returned to each assigned union representative in individual sealed envelopes addressed to the University research team. Completion of questionnaires, designed at a sixth-grade reading level, required between 30 and 45 minutes to complete. The questionnaires were distributed to all employees who agreed to participate in the study and had signed the informed consent document.

2.3 Instrument Development:

The questionnaire, administered at both baseline and follow-up, was developed in

collaboration with experts from the fields of injury prevention, survey design, and epidemiology, incorporating modifications based on discussions with the janitors and union representatives and initial focus-group pilot testing. The focus group, comprised of approximately 30 janitors, was used to determine the likelihood that the study population would understand the questions, to assess the effectiveness of educational materials provided prior to survey questioning, and to estimate a response rate. The final questionnaire, administered to all SEIU Local 26 members, collected information on overall health status, including history of disease and injury, factors on workload and sleep quality, and understanding of rights and responsibilities for reporting injuries. The questions related to injury reporting and knowledge of injury reporting systems are identified in Figure 1. Questionnaires were translated into the primary languages of the study participants, English, Spanish, and Somali accordingly, and validated by professionals to ensure accuracy.

2.4 Intervention Development:

To address the apparent underreporting of injuries by this industry, an educational intervention strategy was developed and implemented (Figure 2). In order to determine the most effective intervention for this population, a customized plan was developed, based on the barriers identified in the initial focus-group discussion. Immediately following the baseline survey, half of the janitors were randomly selected and provided with a fact sheet intervention that was based on information provided from the Occupational Safety and Health Administration (OSHA). The one-page intervention tool (Figure 2) provided janitors with information on OSHA, workers' rights under the OSH Act, employer responsibilities, and contact information for OSHA.

2.5 Measures:

Janitors' knowledge of injury reporting was measured by asking: (1) "Do you know what an OSHA 300 log is?" (2) "Have you ever seen the OSHA 300, which is the Log Summary of Occupational Injuries and Illnesses for your establishment/workplace?" and (3) "Did you ever have an injury recorded on the OSHA log?" To determine the janitors' knowledge of Workers' Compensation, they were asked: (1) "Do you know what Workers' Compensation is?" and (2) "Have you or your employer filed for Workers' Compensation for any injury or illness you had?"

Barriers to reporting injuries or illnesses to their employers were identified during the initial focus group session. Each barrier was presented in a checklist where janitors could select all that applied. Janitors were asked, "In the designated six-month period, did you report any injury or illness to your employer?" If the janitors responded "no," they were provided with a list of 16 potential barriers to reporting injuries to their employer and asked to select all that applied. Barriers were categorized into four groups (Table 1) including: fear of legal action or getting in trouble with their employer; reporting takes too much time; unaware of the reporting process; and the understanding that injuries are a part of the job.

2.6 Data Analyses:

Participant demographics, work characteristics, injury reporting knowledge, and barriers to reporting were analyzed with descriptive statistics. Frequency distributions were examined in order to establish baseline understanding of janitors' reporting and potential changes in reporting subsequent to the intervention of education about workers'

rights and responsibilities. The categorical data for assessing differences in proportions of janitors in agreement with job-specific reporting barriers pre- and post-intervention were analyzed using McNemar's test of marginal homogeneity (McNemar, 1947). All data analysis was conducted with SAS statistical software, version 9.4 using the SAS system for Windows (SAS, Cary, NC).

3. Results

3.1 Participation Rate and Characteristics of the Study Population:

Of the approximately 1,200 eligible participants, 390 participated in the study and completed at least one of the questionnaires (response rate = 33%) (Figure 3). Among the 390 participants, 334 completed the baseline survey, 193 completed the follow-up survey, and 137 completed both the baseline and follow-up surveys. Table 2 shows the demographic distribution of all survey participants. Over half (55%) of the respondents were female. The majority (60%) of the janitors were between 31 and 50 years of age and mostly Hispanic (68%). 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. The vast majority (72%) of the participants were married, living as married or living with a domestic partner. Approximately 71% of the janitors had completed some form of schooling with most being high school graduates (36%) or having completed less than grade 12 (35%).

A total of 137 janitors (35% of study participants) completed both survey 1 and 2, accounting for an entire year of follow-up. Of the 137 janitors who participated in both surveys, 67 received the intervention and 70 did not. Demographics among the 137

janitors were similar to the overall group, with the majority being female (64%), between ages 31and 50 (62%), Hispanic (77%) and married (72%).

3.2 Injury Reporting and Workers' Compensation Knowledge:

Table 3 shows janitors' baseline understanding of injury reporting and Workers' Compensation. At baseline, regardless of intervention, approximately half (53%) of the janitors were unsure of what an OSHA 300 Log was and only 39% had ever seen the OSHA 300 log at their workplace. Among the total population, only a small proportion of janitors (16%) had ever had an injury recorded on the OSHA 300 Log. The majority of the janitors (56%) did not know what Workers' Compensation was, with a smaller portion (16%) having ever filed for Workers' Compensation. Among the janitors who reported knowledge of the OSHA 300 Log, the majority held second jobs as well (75%) and worked at the current company for less than five years (50%). Similarly, for janitors who had knowledge of Workers' Compensation, 70% also held other jobs and 51% worked at their current company for less than five years.

3.3 Perceived Barriers:

At baseline, approximately 24% and 26% of janitors, in the intervention and non-intervention groups, respectively, perceived barriers to reporting an injury to their employer (Table 4). Among the intervention group, the percentage perceiving a barrier for "reporting an injury to your employer" decreased from 24% in Survey 1 to only 12% in Survey 2. Among those who did not receive the intervention, there was a smaller reduction (26% to 16%) in perceiving a barrier. When individual barriers were examined, between Surveys 1 and 2, there were significant reductions in 'fear' being perceived as a

barrier among janitors in the intervention (15% to 5%) and non-intervention groups (19% to 6%) (Table 4). For janitors in the intervention group, there was also a significant reduction (8% to 2%) in perceiving 'injuries as part of the job.' For janitors in the intervention group, there was a more substantial reduction in 'reporting takes too much time' for those in the intervention group (8% to 2%) compared to those in the non-intervention group (6% to 3%). The percentage differences for each barrier reported between surveys 1 and survey 2 were compared between intervention and non-intervention groups. Using Fisher's exact test, these differences of differences, were found to not be important.

4. Discussion

4.1 Injury Reporting and Workers' Compensation Knowledge:

Lack of knowledge of injury reporting, including OSHA 300 Logs and Workers' Compensation claims, is an important problem among janitors. Under OSHA's recordkeeping regulation, certain covered employers are required to prepare and maintain records of serious occupational injuries and illnesses, using the OSHA 300 Log and post summary (OSHA 300A) of those injuries and illnesses, annually. More than half (53%) of janitors reported that they did not know what an OSHA 300 Log is, and three out of five workers had never seen an OSHA 300 Log. Despite the lack of knowledge, a survey of employers in the various industries, including the service industry, found that most respondents (94%) indicated their establishment kept an OSHA 300 Log (Rappin, Wuellner, & Bonauto, 2016). The lack of knowledge of OSHA 300 Logs, among janitors, may be due to poor record keeping by employers (Conway & Svenson, 1998; McCurdy,

Schenker, & Samuels, 1991; Azaroff, Levenstein, & Wegman, 2002). A study on occupational injury and illness rates between 1992-1996 (Conway & Svenson, 1998) suggested that companies perpetuate a variety of policies and management techniques that lead to poor record keeping including: neglect for the records with no emphasis on proper maintenance; poor communications resulting in injuries not being recorded even when employees have reported them to their supervisors; management bonuses and opportunities for promotion tied negatively to injury and illness rates; employees denied overtime or promotion opportunities for reporting an injury; and subjection of employees who report injuries or illnesses to overly aggressive and personal accident/injury investigations. A study of injury reporting of large companies in the semiconductor manufacturing industry in 1991 (McCurdy, Schenker, & Samuels, 1991) randomly selected 416 work-related cases and found that 101 met the reporting requirements for the OSHA Log form, but only 61 (60%) were actually recorded. Besides the deficient recordkeeping and incentives to maintain an injury-free establishment that result in employees not knowing the process of properly recording injuries and the associated forms, this lack of awareness may also be a result of certain employees not having experienced occupational injuries, particularly of a more serious nature.

Similarly, for Workers' Compensation knowledge, 56% of janitors in the current study reported having no knowledge of Workers' Compensation and four of five reported having never filed a claim. These findings are similar to a previous study among low-wage immigrant workers (Panikkar et al., 2013), reporting that cleaners and janitors have limited knowledge of the Workers' Compensation system. Research has shown that workers who have had an occupational injury have several reasons for not filing a

Workers' Compensation claim including: medical costs were paid by the employer; inability to afford lost time and having a low annual income; fear of retaliation; severity of injury; and administrative obstacles that discourage workers from completing the claim filing process (Azaroff, Levenstein, & Wegman, 2002; Fan, Bonauto, Foley, & Silverstein, 2006; Rosenman, et al., 2000; Shannon & Lowe, 2002; Scherzer, Rugulies, & Krause, 2005; Pransky, Snyder, Dembe, & Himmelstein, 1999). With approximately 80% of janitors having never filed for Workers' Compensation, these may be some of the reasons for not filing a claim. However, with the majority of janitors lacking awareness of the Workers' Compensation system, many may not have filed a claim because they were unaware of the relevance of Workers' Compensation.

4.2 Barriers to Reporting an Injury to Employer:

A previous study (Azaroff, Levenstein, & Wegman, 2002) suggested that there is a sequence of events necessary to capture a work-related injury, and that there are conceptual filters or "barriers" that prevent accurate data collection. In the current study, about one in four janitors reported having a perceived barrier that prevented them from reporting an injury or illness to their employer. Azaroff et al. (2002), suggested that one of the primary filters to capture occupational injuries is reporting injuries to supervisors. However, workers fear that, by reporting injuries to their employers, they risk disciplinary action, denial of overtime or promotion opportunities, stigmatization, drug testing, harassment, or job loss -- findings consistent with the current study findings. The most common reason among janitors for not reporting an injury to an employer was fear of getting into trouble and the associated consequences, followed by confusion of the reporting process and the belief that injuries are a part of the job. These findings are

similar to a previous study on barriers to reporting injuries among cleaners reporting the most frequent reasons as, “I thought it would get better,” “I didn’t know I should,” “too many steps to reporting,” and fear of getting in “trouble or fired” (Scherzer, Rugulies, & Krause, 2005).

Results of the current study indicated that, by providing janitors with some information on employer and employee rights for reporting injuries, there was a reduction in perceived barriers to reporting an injury. Through intervention, there was a significant reduction in “fear” and for “injuries being part of the job” as perceived barriers. Janitors in both groups had a reduction in all categories of perceived barriers to reporting an injury. Through participation in the study, janitors’ knowledge of rights and responsibilities for reporting occupational injuries appeared to be increased.

4.3 Study Advantages and Limitations:

This study had several advantages, including being among the first to highlight a lack of knowledge regarding reporting of injuries and examining some reasons for not reporting a work-related injury - specifically among janitorial service workers. In order to improve injury reporting by this population, it is necessary to understand the barriers that lead to underreporting. Results of this study highlighted the lack of knowledge regarding injury reporting and identified the perceived barriers to reporting an injury that are likely contributors to the underreporting of injuries among janitors.

Another major advantage of this study was being able to access these unionized janitors, a neglected and underserved population, that has received inadequate attention. This was primarily driven by the collaboration with the SEIU Local 26, a valuable

partnership that facilitated communication with the janitors by assembling a representative group of members to meet in a focus group and encouraging participation by all janitorial union members to complete baseline and follow-up surveys. This partnership fostered open communication with unionized janitors about their health and safety concerns and allowed for valuable data collection from this population.

Key findings of this study were the identification of the perceived barriers that prevent janitors from reporting injuries and that, through intervention, a reduction in these barriers is possible. Intervention efforts highlighted that a change in perception of barriers to reporting injuries is possible by providing general information relevant to reporting of occupational injuries and employers' responsibilities. This study is a first step towards better understanding the reasons that janitors do not report their injuries and the lack of knowledge regarding properly reporting a work-related injury. Furthermore, this study emphasized the deficiencies in properly reporting injuries and provides a framework for developing more customized interventions to further improve janitors' knowledge of injury reporting and eliminate the perceived barriers to reporting injuries.

There are several potential limitations in the current study. One of the limitations of the study was the low response rates. Previous surveys conducted by the SEIU Local 26 yielded low response rates and, therefore, the goal of this study was to optimize participation. To enhance survey response, and ultimately minimize non-response bias: 1) the questionnaire was provided in three relevant languages; 2) focus groups were implemented for pre-testing and discussion of relevant modifications; 3) the research team worked with the union to determine the best 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. These efforts yielded a response rate of 33%, indicating the difficulty of accessing this population. Despite the low response rate, results identified the perceived barriers to the reporting of work-related injuries and highlighted the effectiveness of the intervention among this study population. Results may not be generalizable to the entire target population, and therefore the effectiveness of the intervention cannot be applied outside of the study population. However, results can be used to design customized interventions that can be utilized and tested among a larger population of janitors.

In addition to low response rates, findings from this study may not be generalizable to populations of non-unionized janitors. The barriers for reporting injuries among non-unionized janitors may be greater due to lack of protection from a union from disciplinary action. Additionally, unionized janitors may have additional support from the union and be better educated on rights and responsibilities for reporting work-related injuries. Therefore, barriers and, subsequently, consequences of reporting injuries to employers may be much more substantial among janitors with fewer resources and support systems.

There were also limitations regarding the intervention effort. First, the intervention was developed, based on information provided by OSHA and not tailored specifically to this population of janitors. The language and education demographics of this population may have made the intervention less understandable and not optimal in its ability to increase knowledge and awareness of injury reporting and minimize barriers to reporting an occupational injury. Additionally, dissemination efforts for the intervention were limited due to janitors' schedules and access to this population; necessarily,

intervention information was included in the survey packet provided to janitors at baseline. Ideally, janitors were supposed to complete the survey, first, and then read the attached document on workers' rights and responsibilities. However, workers may have read the document prior to completing the survey which could have influenced their responses. Additionally, there was no way to ensure that participants who received the intervention did not share the information with their fellow colleagues who potentially did not receive the intervention. Results suggested that there was a reduction in perceived barriers among both intervention and non-intervention groups, which may have been partly due to the dissemination manner of the intervention information. Finally, some survey packets were returned with the intervention tool still inside, indicating the participants, while they may have read it, did not retain that information for their ongoing knowledge, as intended. Future intervention efforts in this population should go beyond simply providing general information and, additionally, include group trainings and information tailored to the specific needs of the population; however, this approach was not possible, given available access and resources, in the current study.

Language differences were a major obstacle in survey administration and response. Over 80% of the responding janitor population was Hispanic, with 50% having completed less than grade 12; a smaller proportion included Somali participants. Because of these implications, many of the surveys were completed in groups and required an interviewer to guide participants through the survey, although the original design was for individual administration. The baseline survey was completed by approximately 350 janitors; despite preliminary pre-testing of the data collection instruments, feedback following the survey included comments that the questions were difficult to understand

and the translations of the questions were sometimes confusing, leading to some incomplete responses. To improve the responses for the follow-up survey, union representatives frequently administered the surveys and guided the participating janitors through the questions. The addition of the union representatives' involvement during the second survey potentially introduced bias to the follow-up survey, and may have minimized the effect of the intervention on perceived barriers for reporting injuries to their employers. For example, by completing Survey 2, in a group setting with an interviewer present, if members from both the intervention and non-intervention groups were present, it may have been more likely to have reductions in barriers to reporting injuries; however, based on observations, it was typical to have no more than one or two persons in such a setting at any one time. Although the reduction effect was more substantial in the intervention group, the change in the non-intervention may possibly be explained by interviewer bias.

5. Conclusions

The objective of this study was to evaluate and improve janitors' knowledge of workers' rights and responsibilities for assessing and reporting work-related injuries through intervention. Results indicated that a large proportion of janitors lacked knowledge and awareness of both OSHA injury reporting and Workers' Compensation. Although these systems are used by the majority of employers, many employees are unaware of their existence. Employers must educate employees on OSHA and Workers' Compensation and inform janitors of the injury reporting process through training.

Additional efforts on record keeping and employee trainings are needed to

improve janitors' knowledge and subsequently improve their reporting of work-related injuries. Most injury reporting systems underreport workers' injuries (Azaroff, Levenstein, & Wegman, 2002; Weddle, 1996; Pransky, Snyder, Dembe, & Himmelstein, 1999; Moore, Cigularov, Sampson, Rosecrance, & Chen, 2013; Rosenman, et al., 2006), and this has been attributed to lack of reporting by workers. However, this study indicated that, in order to improve reporting, it is essential to first educate employees on how to properly report injuries and encourage employers to minimize or eliminate the barriers that prevent employees from reporting their injuries. Additional research is needed to determine how to improve knowledge of injury reporting, and the research should include the perspectives of the janitors in addition to their employers and other management staff.

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Table 1. Injury Reporting and Perceived Barriers: Categories of Barriers to Reporting Injuries among Janitors

Barrier Category	Barriers that prevent janitors from reporting injuries
Fear	*I don't feel that the form is kept anonymous (private)* *I am afraid of the consequences* *I don't want to get into trouble* *I am worried about legal action* *I feel I will be blamed for raising concerns* *I am afraid it will affect my career and reputation*
Reporting takes too much time	*I am too busy to fill out the form* *Reporting takes too much time* *The incident form takes too long to fill out*
Unsure of Reporting Process	*I believe it is pointless and nothing will be done about it* *If I discuss the incident with the person involved, nothing else needs to be done* *I am unaware of the reporting process*
Injuries are a part of the Job	*Injuries are a part of the job*

Table 2. Injury Reporting and Perceived Barriers: Demographics of Janitor Study Participants

	OVERALL Group N (%)	Survey 1 AND 2 Group N (%)	Intervention N (%)	Non-Intervention N (%)
Gender				
Male	160 (44.6)	49 (36.3)	25 (38.5)	24 (34.3)
Female	199 (55.4)	86 (63.7)	40 (61.5)	46 (65.7)
Age				
19-30	25 (10.3)	8 (8.1)	2 (4.4)	6 (11.3)
31-40	74 (30.3)	30 (30.3)	18 (39.1)	12 (22.6)
41-50	74 (30.3)	31 (31.3)	15 (32.6)	16 (30.2)
51-60	56 (23.0)	23 (23.2)	10 (21.7)	13 (24.5)
>60	15 (6.1)	7 (7.1)	1 (2.2)	6 (11.3)
Ethnicity				
Hispanic	240 (68.0)	103 (76.9)	48 (75.0)	55 (78.6)
Not Hispanic	113 (32.0)	31 (23.1)	16 (25.0)	15 (21.4)
Household Income				
Less than $25,000	55 (15.7)	13 (9.8)	9 (14.1)	4 (5.9)
$25,000 to $34,999	202 (57.6)	92 (69.7)	43 (67.2)	49 (72.1)
$35,000 to $49,999	74 (21.1)	24 (18.2)	12 (18.7)	12 (17.6)
$50,000 to $74,999	18 (5.1)	3 (2.3)	0 (0.0)	3 (4.4)
More than $75,000	2 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)
Marital Status				
Married/ Living as Married/ Living with Domestic Partner	257 (72.0)	97 (72.4)	46 (71.9)	51 (72.9)
Never Married/Single	43 (12.0)	9 (6.7)	3 (4.7)	6 (8.6)
Separated/Divorced	49 (13.7)	25 (18.7)	13 (20.3)	12 (17.1)
Widowed	8 (2.2)	3 (2.2)	2 (3.1)	1 (1.4)
Race				
White	52 (30.1)	20 (39.2)	12 (42.8)	8 (34.8)
Black or African American	98 (56.6)	25 (49.0)	15 (53.6)	10 (43.5)
Other	23 (13.3)	6 (11.8)	1 (3.6)	5 (21.7)
Education				

	OVERALL Group N (%)	Survey 1 AND 2 Group N (%)	Intervention N (%)	Non-Intervention N (%)
No Schooling Completed	32 (18.5)	20 (16.4)	13 (23.2)	7 (10.6)
Less than Grade 12	60 (34.7)	43 (35.3)	16 (28.6)	27 (40.9)
High School Graduate	63 (36.4)	47 (38.5)	21 (37.5)	26 (39.4)
College or Some College	18 (10.4)	12 (9.8)	6 (10.7)	6 (9.1)

Table 3. Injury Reporting and Perceived Barriers: Baseline Knowledge of Injury Reporting and Workers' Compensation Knowledge among Janitors

	Yes		No		Total
Injury Reporting Systems Questions	**N**	**%**	**N**	**%**	**N**
Do you know what OSHA 300 Log is?	145	47.5	160	52.5	305
Have you ever seen the OSHA 300 Log at your workplace?	119	39.4	183	60.6	302
Did you ever have an injury recorded on the OSHA Log?	48	16.2	248	83.8	296
Do you know what Workers' Compensation is?	135	44.4	169	55.6	304
Have you or your employer ever filed for Workers' Compensation?	48	16.2	248	83.8	296

Table 4. Injury Reporting and Perceived Barriers: Barriers to Reporting Work-related Injuries Identified among Janitors

	Intervention			Non-Intervention		
	Survey 1	**Survey2**	**p-value* (Survey1 versus Survey2)**	**Survey 1**	**Survey 2**	**p-value* (Survey1 versus Survey2)**
Barriers to Reporting Injuries	**N (%)**	**N (%)**		**N (%)**	**N (%)**	
Any	16 (23.9)	8 (11.9)	**0.06**	18 (25.7)	11 (15.7)	0.11
Fear/Afraid of Consequences	10 (14.9)	3 (4.5)	**0.02**	13 (18.6)	4 (5.7)	**0.01**
Too Busy/ Reporting Takes too much time	5 (7.5)	1 (1.5)	0.10	4 (5.7)	2 (2.9)	0.32
Unsure of Reporting Process	7 (10.4)	5 (7.5)	0.53	5 (7.1)	2 (2.9)	0.26
Injuries are a part of the job	5 (7.5)	1 (1.5)	**0.04**	7 (10.0)	3 (4.3)	0.10
Other	2 (3.0)	1 (1.5)	0.56	4 (5.7)	5 (7.1)	0.71
TOTAL	**67**	**67**		**70**	**70**	

Figure 1. Injury Reporting and Perceived Barriers: Initial Survey Questions Disseminated to Janitors Regarding Injury Reporting

PLEASE ANSWER THE NEXT QUESTIONS ABOUT INJURY/PAIN REPORTING

43. In the 6 months between May 1 and October 31, 2016, DID YOU REPORT ANY injury or illness or pain to your employer? *(Check ONE)*

☐ Yes ☐ No

If NO, did any of the following prevent you from reporting your injury or illness or pain to your employer? *(Check ALL THAT APPLY)*

I don't feel confident that the form is kept anonymous (private)	◯
I am too busy to fill out the form	◯
I am afraid of the consequences	◯
I don't want to get into trouble	◯
I am worried about legal action	◯
I feel I will be blamed for raising concerns	◯
I believe it's pointless (worthless) and nothing will be done about it	◯
I am afraid it will affect my career and reputation	◯
I am unsure who to report the incident to	◯
If I discuss the incident with the person involved, nothing else needs to be done	◯
I never get any feedback on action taken	◯
Reporting takes too much time	◯
The incident was too not that bad	◯
Injuries are a part of the job	◯
The incident form takes too long to fill out	◯
I am unaware of the reporting process	◯
Other (Please describe) _____	◯

44. Do you know what an OSHA 300 log is? *(Check one)*

☐ Yes ☐ No

45. Have you ever seen the OSHA 300, which is the Log Summary of Occupational Injuries and Illnesses for your establishment/workplace? *(Check one)*

☐ Yes ☐ No

If YES, did you see it by *(Check one)?*

☐ Viewing the summary portion of the log posted by the employer

☐ Requesting access to see the entire OSHA log

46. Did you ever have an injury recorded on the OSHA log? *(Check one)*

☐ Yes ☐ No

47. Do you know what WORKERS' COMPENSATION is? *(Check one)*

☐ Yes ☐ No

48. Have you or your employer filed for Workers' Compensation FOR ANY INJURY OR ILLNESS YOU HAD? *(Check one)*

☐ Yes ☐ No

Figure 2. Injury Reporting and Perceived Barriers: Intervention Tool Utilized in Study of Janitors

Workers' Rights and Responsibilities for Injury Reporting

Worker Protection is the Law of the Land

You have the right to a safe workplace. The **Occupational Safety and Health Act of 1970** (OSH Act) was passed to prevent workers from being killed or otherwise hurt at work. The law makes employers give their employees with working conditions that are free of known dangers. The OSH Act created the **Occupational Safety and Health Administration** (OSHA), which sets and enforces protective workplace safety and health standards. OSHA gives information, training and help to employers and workers.

Workers' Rights under the OSH Act

The OSH Act gives workers the right to safe and healthful working conditions. It is the duty of employers to provide workplaces that are free of known dangers that could harm their employees. This law also gives workers important rights to participate in activities to ensure their protection from job hazards**. This sheet explains workers' rights to:**

- File a **confidential** complaint with OSHA to have their workplace inspected.
- Get **information and training about hazards**, **methods to prevent harm**, and the **OSHA rules** that apply to their workplace. This must be done in a language and vocabulary workers can understand.
- Review records of **work-related injuries and illnesses** that happen in their workplace.
- Get **copies of the results** from tests and monitoring done to find and measure hazards in the workplace.
- Get copies of their workplace medical records.
- Participate in an **OSHA inspection** and speak in private with the inspector.
- File a complaint with OSHA if they are punished by their employer for asking for an inspection or using any of their other rights under the OSH Act.
- File a complaint if **punished or retaliated against** for acting as a "whistleblower".

Employer Responsibilities

Employers have the duty to provide a safe workplace. Employers **MUST** provide their employees with a workplace that does not have serious hazards and must follow all OSHA safety and health rules. Employers must find and fix safety and health problems. OSHA further requires that employers must try to eliminate or reduce hazards first by making feasible changes in working conditions. Employers **MUST** also:

- Clearly display the official OSHA poster that describes rights and responsibilities under the OSH Act.
- **Tell workers about hazards** through training, labels, alarms, color-coded systems, chemical information sheets and other ways.
- Train workers in a **language and words** they can understand.
- Keep **accurate records** of work-related injuries and illnesses.
- Perform tests in the workplace, such as air sampling, required by some OSHA standards.
- Provide hearing exams or other medical tests required by OSHA standards.
- Post OSHA citations and injury and illness data where workers can see them.
- Tell OSHA **within 8 hours** of a workplace death **within 24 hours** of any work-related inpatient hospitalization, amputation or loss of an eye.
- Not **punish workers for using their rights** under the law, including their right to report a work-related injury or illness

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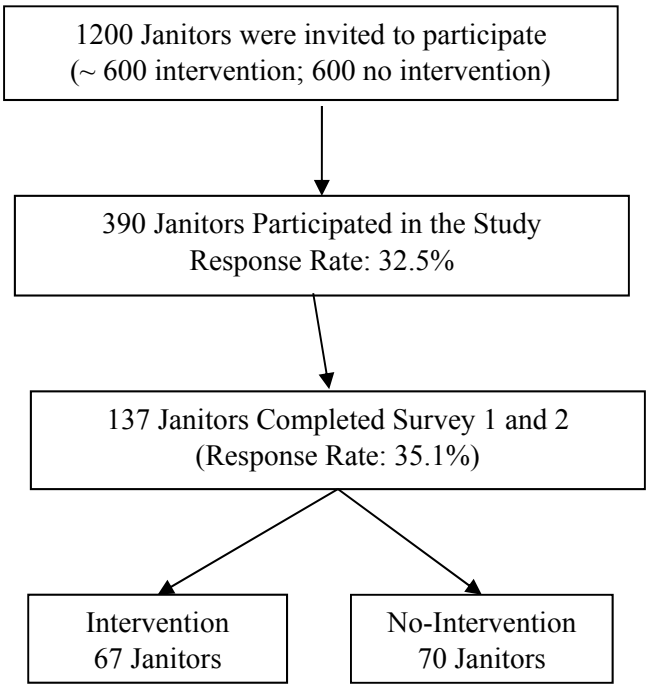
Figure 3. Injury Reporting and Perceived Barriers: Sampling Frame of Janitor Population



CHAPTER VII

DISCUSSION

OVERVIEW

Occupational injury is a major safety and health issue among workers in the service industry, specifically those employed in janitorial and cleaning services (Alamgir & Yu, 2008; Scherzer, Rugulies, & Krause, 2005; Smith & Anderson, 2017; Leigh & Miller, 1998; Woods & Buckle, 2000; Seixas, Dominguez, Stover, & Simcox, 2013; Charles, Loomis, & Demissie, 2009). Through labor-intensive cleaning, grounds keeping and building maintenance, janitorial service work demands result in high injury rates (Koehoorn, Ostry, Hossain, & Village, 2011; Bureau of Labor Statistics, 2014). Although the prevalence of health problems, including occupational injury, in the cleaning workforce is high, few studies have provided a comprehensive assessment of the occupation, including evaluation of their work environments, working conditions, and their specific tasks (European Agency for Safety and Health, 2009). Literature reviews have revealed that janitors are exposed to numerous physical risks, resulting in high rates of injury and illness. Unfortunately, there is limited research addressing the relations between their exposures and injuries and other health effects. Recently, unionized janitors have become increasingly concerned with their workloads and how their health has been affected by these workloads (Seixas, Dominguez, Stover, & Simcox, 2013).

The goal of this study was to determine the injury occurrence, and associated risk factors, among janitors and to determine how workload impacts these injuries. To address the gap in knowledge associated with the potential occupational risk factors, the objective was to examine injuries with particular attention to individual workload, using

prospective survey methodologies and direct physical measurements of both sleep quality and workload. Another goal of this study was to determine barriers to reporting injuries among janitors and improve knowledge of workers' rights by providing them with the tools and knowledge to properly report their injuries.

The study population consisted of janitor members of the Service Employees International Union (SEIU) Local 26, a labor union focused on workers in health care, property services, and public services, collaborated on the study. SEIU Local 26 is Minnesota's Property Services Union comprised of approximately 6,000 janitors, security officers and window cleaners in the Twin Cities metropolitan area; among these members, the target population included the 1,200 members employed as full-time janitors. A prospective cohort study was conducted among janitors in the SEIU Local 26 from May 1, 2016 to April 30, 2017. Injury- and exposure- related data were collected for two six-month periods through a specially designed questionnaire while workload data was collected using both fitness bracelets and questionnaire information. Upon completion of this study, the varying workloads and other exposures experienced by janitors were analyzed to determine their potential relations to injury occurrences. An intervention study was also implemented and a potential change in workers' perceived barriers for reporting injuries was identified between the two six-month reporting periods. The sections below provide an overview of findings for each of the study aims respectively, and also compare these to the existing literature to derive conclusions.

OCCUPATIONAL INJURY AMONG JANITORS: INJURY INCIDENCE, SEVERITY AND ASSOCIATED RISK FACTORS

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). When accounting for multiple injury events, the adjusted rate of injury events was 0.92 per 100 janitors per year.

Among janitors and cleaners who incur an injury, work-related pain is a major problem, as identified in previous studies (Woods & Buckle, 2000; Salwe, Kumar, & Hood, 2011; Scherzer, Rugulies, & Krause, 2005). Woods and Buckle (2006), reported that 74% of janitors experienced aches or pain during a one-year period, which is consistent with current study results indicating that 66% of janitors experienced pain.

For janitors and cleaners who experienced a work-related injury, lost work time and compensable claims are major issues (Smith & Anderson, 2017). The current findings that 28% of janitors reported lost work time, and another 27% reported restricted work days, is slightly higher than recent research (Seixas, Dominguez, Stover, & Simcox, 2013). Previous research has identified that the majority of injuries, resulting in lost work time among cleaners, was attributable to musculoskeletal injuries and contusions/bruises (Alamgir & Yu, 2008). 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, that involved hands as the primary body parts injured in relation to restricted work.

In the adjusted multivariable models, the factors associated with increased risk of injury were gender (females versus males), age (19-30, 41-50, 51-60 versus 31-40), ethnicity (Hispanic versus not Hispanic), English proficiency (well versus not well), marital status (widowed versus married), and education (less than grade 12 versus no

schooling completed). Consistent with previous research, male janitors, those who were single or never married, and those who had a higher household income were less likely to have a work-related injury (Smith & Anderson, 2017; Alamgir & Yu, 2008). Also consistent with some previous research (Koehoorn, Ostry, Hossain, & Village, 2011; Smith & Anderson, 2017), the risk of injury was associated with increasing age, with a doubling of risk for janitors under 30, compared to those aged 31-40, and those in the oldest age group (>60 years).

Of particular interest was the decreased risk of injury among janitors who started work in early morning (12:00 a.m. to 5:59 a.m.), morning (6:00 a.m. to 11:59 a.m.) or afternoon (12:00 p.m. to 4:59 p.m.) hours compared to those who started in the evening. Moreover, there was an important decrease in risk for those who started between 6:00 a.m. and 11:59 am (versus 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 to those who start and work in the late evening hours. Previous research supports the findings that short sleep length and poor sleep quality are associated with increased risks of occupational injury (Gabel & Gerberich, 2002; Salminen, et al., 2010; Ulfberg, Carter, & Edling, 2000; Akerstedt, Fredlund, Gillberg, & Jansson, 2002).

Also important, was the strong association between depression and occupational injury among janitors, with a risk of injury 1.9 times higher among those who reported being depressed compared to those who did not. This is among the first studies to address mental health issues among janitors. Previous research suggested that there may be an association between preexisting depression and occupational injury (Peele & Tollerud,

2005); however, this finding warrants further research.

JANITOR WORKLOAD AND OCCUPATIONAL INJURIES

Among the janitors, 38% reported an increase in workload, attributable mostly to more job duties, a change in intensity of work and fewer staff. Additionally, those who reported any change, compared to no change, in workload had at least a two-fold increase in risk of injury; those who reported a decrease in workload had a higher risk of injury (RR: 2.58; 95% CI: 1.67-4.01). This increased risk of injury for those with an increase in workload may be attributable to having more job duties or a change in work intensity, and, thus, more opportunity for injury occurrence.

Previous research efforts among janitors and cleaners have indicated a relation between work intensity and injury occurrence. From a study of janitors in Washington, it was reported that increased work intensity results in increased risk of injury, poor/fair general health, back, leg and arm pain and work stress. Similarly, study results among custodial workers in Canada (Koehoorn, Ostry, Hossain, & Village, 2011) identified that, with an increased workload, there was an increased risk of injury. Consistent with these findings, janitors in the current study who reported no days of moderate to vigorous physical activity had a lower risk for reporting an injury compared to those who reported five or more days per week of moderate to vigorous physical activity.

Previous research of SEIU janitors reported these workers having low sleep quality and getting less than six hours of sleep per night (Seixas, Dominguez, Stover, & Simcox, 2013; Terriquez, Rogers, Blasi, Shadduck Hernandez, & Appelbaum, 2009). In the current study, adjusted analyses indicated an increased risk of injury for those who slept less than six hours, compared to eight or more hours, and for those who reported

moderate to severe sleep disturbance compared to none or slight. Among janitors in the current study with no sleep disturbance, there was no significant association between workload and injury. However, for those who reported any sleep disturbance, there was a significant increase in risk of injury among those reporting less than five, versus five or more moderate to vigorous physical activity working days. When adjusting for sleep disturbance, this relation was more substantial among those who reported sleep disturbances; a greater risk of injury was identified among those who reported less than five days of moderate to vigorous physical activity working days and who also reported difficulty sleeping.

In addition to correlation analyses, regression analyses were conducted to assess the relations between workload measures from the FitBit and occupational injury (data not shown) and to determine if the risk differed, based on FitBit measures. Although measures of workload from the survey and the FitBit were not correlated, findings from the FitBit regression analyses supported findings from the questionnaires; there was a non-important increased risk of injury as moderate to vigorous physical activity increased during work. Results of the current study suggested that findings from questionnaire data differ from direct measure; however, the validity of the FitBit warrants additional research to determine if the FitBit Charge HR tracker device, utilized in the current study, provides accurate measures of physical activity.

KNOWLEDGE OF WORK-RELATED INJURY REPORTING AND PERCEIVED BARRIERS AMONG JANITORS

Lack of knowledge of injury reporting, including OSHA 300 Logs and Workers' Compensation claims, is an important problem among janitors. More than half (53%) of janitors reported that they did not know what an OSHA 300 Log is, and three out of five

workers had never seen an OSHA 300 Log. The lack of knowledge of OSHA 300 Logs, among janitors, may be due to poor record keeping by employers (Conway & Svenson, 1998; McCurdy, Schenker, & Samuels, 1991; Azaroff, Levenstein, & Wegman, 2002). Similarly, for Workers' Compensation knowledge, 56% of janitors in the current study reported having no knowledge of Workers' Compensation and four of five reported having never filed a claim. These findings are similar to a previous study among low-wage immigrant workers (Panikkar et al., 2013), reporting that cleaners and janitors have limited knowledge of the Workers' Compensation system. With approximately 80% of janitors having never filed for Workers' Compensation, these may be some of the reasons for not filing a claim. However, with the majority of janitors lacking awareness of the Workers' Compensation system, many may not have filed a claim because they were unaware of the relevance of Workers' Compensation.

A previous study (Azaroff, Levenstein, & Wegman, 2002) suggested that there is a sequence of events necessary to capture a work-related injury, and that there are conceptual filters or "barriers" that prevent accurate data collection. In the current study, about one in four janitors reported having a perceived barrier that prevented them from reporting an injury or illness to their employer. Azaroff et al. (2002), suggested that one of the primary filters to capture occupational injuries is reporting injuries to supervisors. However, workers fear that, by reporting injuries to their employers, they risk disciplinary action, denial of overtime or promotion opportunities, stigmatization, drug testing, harassment, or job loss (Azaroff, Levenstein, & Wegman, 2002) -- findings consistent with the current study findings. The most common reason among janitors for not reporting an injury to an employer was fear of getting into trouble and the associated

consequences, followed by confusion of the reporting process and the belief that injuries are a part of the job. These findings are similar to a previous study on barriers to reporting injuries among cleaners reporting the most frequent reasons as, "I thought it would get better," "I didn't know I should," "too many steps to reporting," and fear of getting in "trouble or fired" (Scherzer, Rugulies, & Krause, 2005).

Strengths and Limitations

A major advantage of this study was being able to access these unionized janitors, a neglected and underserved population, that has received inadequate attention. This was primarily driven by the collaboration with the SEIU Local 26, a valuable partnership that facilitated communication with the janitors by assembling a representative group of members to meet in a focus group and encouraging participation by all janitorial union members to complete baseline and follow-up surveys. This partnership fostered open communication with unionized janitors about their health and safety concerns and allowed for valuable data collection from this population.

An additional 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.

Additionally, this study provides valuable information on the burden of workload among janitors, and the impact on occupational injury. Further, the impact of sleep was

assessed in relation to workload and analyzed to determine how the risk of injury differs, based on shift-related workload and sleeping patterns at night. This relation was further investigated by incorporating direct sampling measurements to gain an overall enhanced understanding of workload and sleep patterns among this cohort.

Finally, this study was among the first to highlight a lack of knowledge regarding reporting of injuries and examining some reasons for not reporting a work-related injury - specifically among janitorial service workers. In order to improve injury reporting by this population, it is necessary to understand the barriers that lead to underreporting. Results of this study highlighted the lack of knowledge regarding injury reporting and identified the perceived barriers to reporting an injury that are likely contributors to the underreporting of injuries among janitors.

There are several potential limitations regarding study findings including potential for biases introduced by collecting information on injury experiences and relevant exposures through self-report. Missing data created a major issue among the self-reported surveys. Significant efforts were made to avoid this during data collection periods including survey translation and utilization of union representatives for survey guidance. Follow-up and attrition was a problem among this study population and, thus, there was no opportunity to collect any missing information following initial data collection. Additionally, some survey measures required imputation from other collected variables.

Regardless of potential missing data in the descriptive analyses, summary information provides some understanding of this population and the relevant injury burden and severity. To address the low response of this population, 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 weighting (Horvitz & Thompson, 1952). 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 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 injury burden and, subsequently, exposures of interest could potentially reflect different levels of risk for injury.

CONCLUSIONS

Because janitors are at high risk for occupational injury, knowledge of specific risk and protective factors is extremely important and provides a basis for further in-depth studies and development of targeted intervention strategies aimed to reduce occurrence of these injuries. Particular attention should be paid to shift start time, depression, and changes in workload and sleep quality when assessing occupational injuries among janitors. Additionally, it is important to note that a majority of janitors lack knowledge and awareness of both OSHA injury reporting and Workers' Compensation. In order to improve reporting, it is essential to educate employees on OSHA and Workers' Compensation and inform janitors of the injury reporting process through training. Knowledge of the barriers that prevent injury reporting among janitors is critical to improvement in injury reporting; this, in turn, can facilitate enhanced

opportunities for investigating risk factors for those injuries and ultimate implementation of relevant intervention strategies.

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APPENDICES

APPENDIX A

Questionnaire and Consent Document

CONSENT FORM

Janitors' Workload and Injury Study

You are invited to join a cooperative project between the University of Minnesota and the SEIU Local 26 that is planned to assess workload, health, and injury experience as well as injury reporting, using the attached questionnaire. You were selected for this opportunity because the SEIU L26 identified you as a janitor. We ask you to read this form and ask any questions you may have before agreeing to join this project. This project is being conducted by Deirdre Green and Adam Schwartz, graduate students in Environmental Health Sciences, University of Minnesota, together with a faculty research team from the University of Minnesota.

Background Information

The purpose of this project is to: identify factors that may contribute to injuries. To identify the injury problem, the following questionnaire asks about your employment, health status, injuries, workload, sleep quality, and your work environment. To address issues with injury reporting, this questionnaire asks about your experience with injuries and reporting; for some, this will be followed with information about how to recognize and report work-related injuries. Six months later, you will be asked to complete a second questionnaire that asks the same questions. This is important so there will be a complete year of information about your workload and injury experience - for the best results! ***To provide accurate information, that is not unfair, it is important to complete the questionnaire <u>whether or not</u> you had any injuries during the reporting period.***

Approximately one hundred janitors will be asked to participate in a smaller portion of the project that measures workload using FitBit bands. Another small portion of janitors will also be observed on the job to assess physical workload.

Procedures:

If you agree to join in this project, you will be asked to do the following things:

- Complete the following questionnaire, both at the beginning of the project and 6-months later, for follow-up.
- Review the information. If information is unclear or you have additional questions, please contact Adam Schwartz and Deirdre Green [contact information below].
- *If you are participating in the workload assessment projects, including the FitBit study, separate information will be provided to you for your review, before you participate in those assessments.*

Risks and Benefits of Participating in the Project

The project has <u>minimal risks and several benefits</u>:

You will be asked to remember information about injuries that happened during the six-month period, identified, while employed as a janitor. **<u>You are NOT required to answer any questions with which you are uncomfortable; just mark an "X" on any question number you do not wish to answer, and continue to the next question.</u>** All of your responses will remain confidential and will never be identified with you.

<u>The benefits of participating this project are</u>:

Janitors will benefit directly from the knowledge gained, **including new information,** about janitors' workload and potential risk of injury.

Compensation:

All participating janitors will have an opportunity to be entered into a <u>drawing for a $50 Target gift card</u>, providing them at least a 1 in 20 opportunity of receiving a gift card. <u>A total of 110 gift cards will be available</u> for this opportunity and will be provided following completion of the second questionnaire. All janitors who indicate that they want to be included in the drawing, whether or not they participate, will be among those randomly selected by the research team following completion of the study.

Page 1 **Please continue to next page** ➡

Confidentiality:
Your questionnaire records will be kept completely private. In any report or paper that is published, only group information is provided; no individual person can ever be identified. Project records will be stored securely at the University of Minnesota and only the research team will have access to the records. Project data will be coded according to current University of Minnesota policy for protection of confidentiality.

Voluntary Nature of the Project:
Participation in this project is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota or the SEIU Local 26. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:
The persons conducting this project are: Deirdre Green (gree1982@umn.edu) and Adam Schwartz (schw1562@umn.edu) (612-624-1296) and Dr. Susan Gerberich (gerbe001@umn.edu), together with other members of the research team. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact them at the University of Minnesota, through the email addresses or telephone number identified above. Rony Arauz is the Spanish language team member, who can be reached by telephone at 612-625-5887 or by email (arauz005@umn.edu).

If you have any questions or concerns regarding this project and would like to talk to someone other than those identified above, **you are encouraged** to contact the Research Subjects' Advocate Line, D528 Mayo, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455; (612) 625-1650.

You will be given a copy of this information to keep for your records.

Statement of Consent:

I have read the above information. I have asked questions and have received answers. I agree to participate in this project.

Full Name:_____

Signature:_____ **Date:** _____

Mailing Address:_____

Email Address:_____

Telephone Number:_____

Signature of Investigator:_____ **Date:** _____

UNIVERSITY OF MINNESOTA
School of Public Health

Janitor Workload Health and Injury Project: Phase I

Today's Date: _____

Confidentiality: The information that you provide will be kept strictly confidential and no information that could personally identify you or the facility in which you work(ed) will ever be made public. Only investigators at the University of Minnesota will ever have direct access to the information: any report or published paper will include only grouped information. If there is any question you do not wish to answer, please mark an X on the question number and continue to the next question.

Questionnaire and Envelope: When you have completed the questionnaire, please place it in the envelope and seal the envelope that includes the University of Minnesota address on the front. Then, return it to your Steward or the SEIU L26 representative who gave this to you. The Steward or representative who gave it to you, will return it to the SEIU L26 office where it will be placed in a large locked box until it is picked up by a member of the University of Minnesota research team member.

Gift Card Drawing: Remember! We are providing Target gift cards valued at $50, each, to a minimum of 110 randomly selected individuals. You are not required to complete the questionnaire to be eligible for this drawing; however, if you have not already indicated your interest, YOU DO NEED TO CHECK YES OR NO BELOW.

☐ *YES, include me in the gift card drawing*

☐ *NO, do not include me in the gift card drawing*

Remember to fill in the consent form on Page 2 before starting the following questions!

THE FOLLOWING QUESTIONS ASK ABOUT YOUR JOB AS A JANITOR.
PLEASE ANSWER THE FOLLOWING QUESTIONS IN ORDER BY NUMBER.

1. OVER YOUR LIFETIME, how long have you been employed as a janitor? (Please indicate the number of years and/or months)

If Less than one year:

- Number of months? _____

If One or More years:

- Number of years? _____

2. HOW LONG HAVE YOU WORKED with your current company? (Please indicate the number of years and/or months)

If Less than one year:

- Number of months? _____

If One or More years:

- Number of years? _____

3. What was your JOB TITLE at the building where you worked most of the time in the 6 months between May 1 and October 31, 2016? (Check all that apply)

- ☐ Bathroom Cleaner
- ☐ Floor Cleaner
- ☐ Special Projects
- ☐ Other Job Title
  Please Describe_____

4. Did you work FULL-TIME OR PART-TIME, or other: *(Check one)*?

- ☐ Full-Time
- ☐ Part-Time
- ☐ Other
  Please Describe_____

5. About HOW MANY HOURS PER WEEK did you work in the 6 months between May 1 and October 31, 2016?

_____ hours per week

6. What were your USUAL WORK TIMES in the 6 months between May 1 and October 31, 2016? (Please fill in start and end times and circle a.m. or p.m.).

a.m. is midnight to noon; p.m. is noon to midnight.

____:____ (a.m./p.m.)

to

____:____ (a.m./p.m.)

7. During those 6 months, did you have OTHER JOBS besides this job? *(Check one)*

☐ Yes ☐ No → *(if NO, skip to question 9)*

8. HOW MANY OTHER JOBS did you have?

_____ number of other jobs

For these other jobs, in the 6 months between May 1 and October 31, 2016, about HOW MANY HOURS per week did you work?

_____ hours per week

For the following questions, think about YOUR WORKLOAD in the 6 months between May 1 and October 31, 2016:

9. On an AVERAGE SHIFT how many SMALL TRASH/RECYCLING CANS (up to 25lbs) did you empty? _____

10. On an AVERAGE SHIFT how many LARGE TRASH/RECYCLING CANS (over 25lbs) did you empty? _____

11. On an AVERAGE SHIFT how much TIME DID YOU SPEND VACUUMING?
    If less than 1 hour, how many minutes? _____ MINUTES
    If 1 hour or more, how many hours? _____HOURS

12. On an AVERAGE SHIFT how much TIME DID YOU SPEND SWEEPING or MOPPING?
    If less than 1 hour, how many minutes? _____ MINUTES
    If 1 hour or more, how many hours? _____HOURS

13. On an AVERAGE SHIFT how much TIME DID YOU SPEND DUSTING?
    If less than 1 hour, how many minutes? _____ MINUTES
    If 1 hour or more, how many hours? _____HOURS

14. On an AVERAGE SHIFT how many SINKS did you clean? _____

15. On an AVERAGE SHIFT how many TOILETS did you clean? _____

16. On an AVERAGE SHIFT, how many MIRRORS did you clean? _____

17. How did your WORKLOAD CHANGE in the 6 months between May 1 and October 31, 2016? *(Check one)*

☐ Increased ☐ Decreased ☐ No change

If workload increased, which of the following caused CHANGES in your workload? (Check all that apply)

- ☐ Fewer staff
- ☐ More job duties
- ☐ Training other employees
- ☐ Less funding
- ☐ Lack of supplies or equipment (resources)
- ☐ New equipment
- ☐ Intensity of work
- ☐ Complaints from customers, coworkers, management
- ☐ Other, please describe_____

The next questions are about MODERATE OR VIGOROUS PHYSICAL ACTIVITY you did in the past 7 days as part of your PAID OR UNPAID WORK. This does not include traveling to and from work.

18. During YOUR WORK TIME, in the past 7 days, ON HOW MANY DAYS did you do moderate or vigorous physical activities like heavy lifting, vacuuming, cleaning, walking, or climbing up stairs? Think about only those physical activities that you did for at least 10 minutes at a time.

_____ days per week
_____No vigorous job-related physical activity → Skip to question 20.

19. On average, HOW MUCH TIME DID YOU SPEND on one of those days doing moderate or vigorous physical activities as part of your work?
_____ hours per day
_____ minutes per day

An ACCIDENT or INJURY, INCLUDING PAIN;

Is one that involves any of the following:
(1) Restricted normal activities for at least 4 hours
and/or
(2) Resulted in loss of consciousness/being knocked out/,
and/or
(3) Required professional healthcare, including care by doctors, nurses, chiropractors, dentists or other healthcare professionals.

20. Did you have ANY WORK-RELATED INJURIES in the 6 months between May 1 and October 31 2016?

☐ YES ☐ No ---> If NO, skip to Question 39, Page 12

21. How MANY TIMES in the 6 months between May 1 and October 31, 2016 were you injured at work? _____#

Please provide the following information for EACH work-related injury/pain event that happened to you between May 1 and October 31 2016. Please fill in the date of injury/pain (if unsure of exact month, please give your best guess) and check the work shift time(s) of injury/pain. If you had one or more injuries/pains – up to 4 events, please tell us about EACH event (1-4) below.

DURING THE PAST 6-MONTHS (between May 1 and October 31, 2016):	Injury/Pain 1	Injury/Pain 2	Injury/Pain 3	Injury/Pain 4
22. Date(s) of injury(s) (*Fill in month and year. If unsure of exact month, please give your best guess)*	____/____ Month/Year	____/____ Month/Year	____/____ Month/Year	____/____ Month/Year
23. Time(s) of injury(s) *(Check all that apply for each event)*				
Beginning of Shift	○	○	○	○
Middle of Shift	○	○	○	○
End of Shift	○	○	○	○

Please DESCRIBE how each event occurred. What were you doing just before the event? What started the event?
Please use the back of this paper if needed.

24. Injury/Pain 1:_____
_____
_____

25. Injury/Pain 2:_____
_____
_____

26. Injury/Pain 3:_____
_____
_____

27. Injury/Pain 4:_____
_____
_____

28. What was (were) the TYPE(S) of injury? CHECK ALL THAT APPLY FOR EACH EVENT.

See picture examples below also	Injury/Pain 1	Injury/Pain 2	Injury/Pain 3	Injury/Pain 4
A. Abrasion/Bruise	○	○	○	○
B. Amputation/loss of body part	○	○	○	○
C. Asphyxia/loss of breath/loss of oxygen	○	○	○	○
D. Bite	○	○	○	○
E. Burn	○	○	○	○
F. Concussion (Loss of consciousness / "knocked out")	○	○	○	○
G. Crushing/mangling	○	○	○	○
H. Cut/laceration/scratch	○	○	○	○
I. Fracture	○	○	○	○
J. Dislocation	○	○	○	○
K. Nerve injury	○	○	○	○
L. Pain	○	○	○	○
M. Penetration injury, including puncture	○	○	○	○
N. Poisoning	○	○	○	○
O. Sprain/strain/rupture	○	○	○	○
P. Torn ligament	○	○	○	○
Q. Varicose Veins	○	○	○	○
R. Other (Specify_____)	○	○	○	○


A. Abrasion/Bruise


B. Loss of Body Part


C. Loss of breath


D. Bite


E. Burn


F. Concussion


G. Crushing/Mangling


H. Cut/Scratch


I. Fracture


J. Dislocation


K. Nerve injury


L. Pain


M. Puncture


N. Poisoning


O. Sprain/Strain

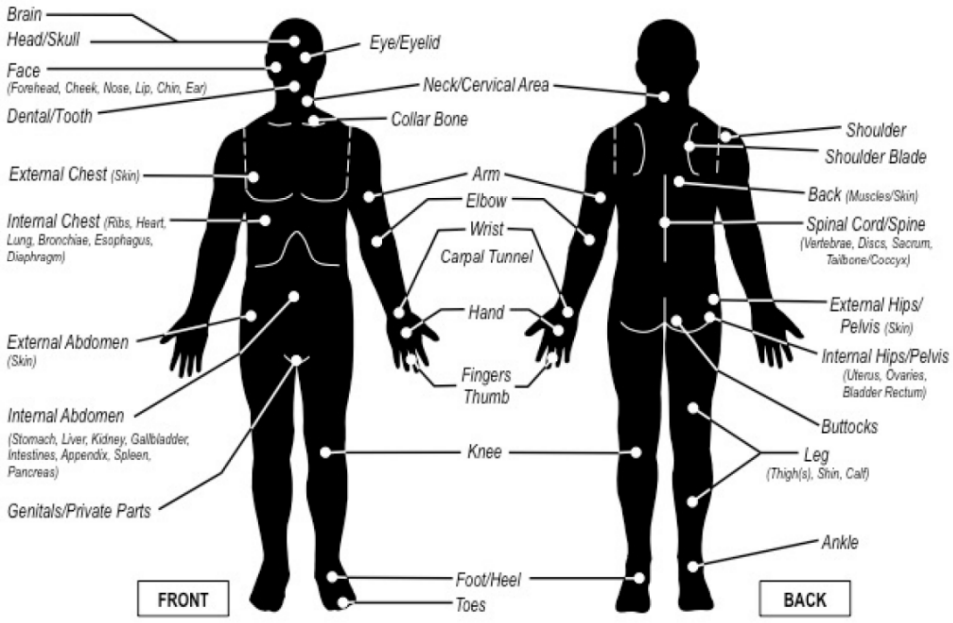

P. Torn ligament

Q. Varicose veins

R. Other type

29. What BODY PART(S) were injured? CHECK ALL THAT APPLY FOR EACH EVENT.

	Injury/Pain 1	Injury/Pain 2	Injury/Pain 3	Injury/Pain 4
Head/skull/brain	○	○	○	○
Face (forehead, cheek, nose, lip, jaw, ear)	○	○	○	○
Eye/eyelid	○	○	○	○
Teeth	○	○	○	○
Neck/cervical area	○	○	○	○
Back (muscles, skin)	○	○	○	○
Chest	○	○	○	○
Spinal cord/spine	○	○	○	○
Abdomen/Stomach	○	○	○	○
Shoulder	○	○	○	○
Arm/elbow/wrist	○	○	○	○
Hand/fingers/thumb(s)	○	○	○	○
Hips	○	○	○	○
Buttocks	○	○	○	○
Genitalia/private body parts	○	○	○	○
Leg (thigh, shin, calf, knee, ankle)	○	○	○	○
Foot/heel, toes	○	○	○	○
Other (Specify_____)	○	○	○	○



Includes internal and external injuries

30. What CAUSED your injury event? CHECK ALL THAT APPLY

	Injury/Pain 1	Injury/Pain 2	Injury/Pain 3	Injury/Pain 4
A. Contact with object, equipment	○	○	○	○
B. Overexertion	○	○	○	○
C. Struck by object	○	○	○	○
D. Struck against object	○	○	○	○
E. Caught in object, equipment, material	○	○	○	○
F. Fall to lower level	○	○	○	○
G. Fall to same level	○	○	○	○
H. Slip, trip	○	○	○	○
I. Repetitive Motion	○	○	○	○
J. Exposed to Harmful Substance	○	○	○	○
K. Fires, explosions	○	○	○	○
L. Other Cause (specify)_____	○	○	○	○

A. Contact with object/equipment

B. Overexertion: *Injuries related to pulling, pushing, holding, carrying and throwing.*

C. Struck by object: *Objects that fall from shelves or dropped by another person*

D. Struck against an object: *When a person runs into concrete objects such as walls, doors cabinets, tables, chairs, etc.*

E. Caught in object or equipment

F. Fall to lower level: *Falling to a level below one that you walk or stand on (i.e. ladder, stairs, etc.)*

G. Fall to same level: Falling to a surface you are walking on

H. Slip, Trip

I. Repetitive motion:

J. Exposed to harmful substance:

K. Fires, explosions:

L. Other cause

31. Were you TREATED BY any of the following as a result of this (these) events?

CHECK ALL THAT APPLY FOR EACH INJURY/PAIN EVENT

	Injury/Pain 1	Injury/Pain 2	Injury/Pain 3	Injury/Pain 4
A. No treatment	○	○	○	○
B. Physician (non-Psychiatrist)	○	○	○	○
C. Dentist	○	○	○	○
D. Chiropractor	○	○	○	○
E. Nurse/Nurse Practitioner/Nurse Clinician/Physician's Assistant	○	○	○	○
F. Psychiatrist/Psychologist/Therapist	○	○	○	○
G. Paramedics/Emergency Medical Technician	○	○	○	○
H. Holistic, Alternative, or Non-traditional medical provider	○	○	○	○
I. Treated yourself	○	○	○	○
J. Other (Specify)_____	○	○	○	○

A. No treatment

B. Physician

C. Dentist

D. Chiropractor

E. Nurse/Nurse practitioner / Nurse clinician/ Physician assistant

F. Psychiatrist/ Psychologist/ Therapist

G. Paramedics/ Emergency medical technician

H. Holistic, Alternative, OR Non-traditional medical provider

I. Treated yourself

J. Other not listed

32. Were you ADMITTED TO A HOSPITAL as a result of this (these) event(s)? (*Check one for each event*)	Injury/Pain 1	Injury/Pain 2	Injury/Pain 3	Injury/Pain 4
No	○	○	○	○
Yes **If YES, for how many days?**	○ _____ days	○ _____ days	○ _____ days	○ _____ **days**
33. Did you have LOST WORK DAYS as a result of this (these) event(s)? (*Check one for each event*)	**Injury/Pain 1**	**Injury/Pain 2**	**Injury/Pain 3**	**Injury/Pain 4**
No	○	○	○	○
Yes **If YES, how many days?**	○ _____ days	○ _____ days	○ _____ days	○ _____ days
34. Were your REGULAR WORK ACTIVITIES RESTRICTED as a result of this (these) event(s)? (*Check one for each event*)	**Injury/Pain 1**	**Injury/Pain 2**	**Injury/Pain 3**	**Injury/Pain 4**
No	○	○	○	○
Yes **If YES, for how long?**	○	○	○	○
Less than 4 hours	○	○	○	○
4 hours to less than 1 day	○	○	○	○
1 day to less than 3 days	○	○	○	○
3 days to less than 7 days	○	○	○	○
7 days to less than 14 days	○	○	○	○
14 days to less than 1 month	○	○	○	○
1 month to less than 3 months	○	○	○	○
3 months or more	○	○	○	○
35. Were your REGULAR NON-WORK ACTIVITIES RESTRICTED as a result of this (these) event(s)? (*Check one for each event*)	**Injury/Pain 1**	**Injury/Pain 2**	**Injury/Pain 3**	**Injury/Pain 4**
No	○	○	○	○
Yes **If YES, for how long?**	○	○	○	○
Less than 4 hours	○	○	○	○
4 hours to less than 1 day	○	○	○	○
1 day to less than 3 days	○	○	○	○
3 days to less than 7 days	○	○	○	○
7 days to less than 14 days	○	○	○	○
14 days to less than 1 month	○	○	○	○
1 month to less than 3 months	○	○	○	○
3 months or more	○	○	○	○
36. Are your regular ACTIVITIES STILL RESTRICTED as a result of this (these) event(s)? (*Check one for each event*)	**Injury/Pain 1**	**Injury/Pain 2**	**Injury/Pain 3**	**Injury/Pain 4**
No	○	○	○	○
Yes	○	○	○	○

37. Do you HAVE ANY CONTINUING PROBLEMS OR SYMPTOMS related to this (these) event(s)? (*Check one for each event*)	Injury/Pain 1	Injury/Pain 2	Injury/Pain 3	Injury/Pain 4
No	○	○	○	○
Yes	○	○	○	○
38. Did you file a WORKERS' COMPENSATION CLAIM for this problem?	**Injury/Pain 1**	**Injury/Pain 2**	**Injury/Pain 3**	**Injury/Pain 4**
No	○	○	○	○
Yes	○	○	○	○

39. Before May 1, 2016, did you have ANY INJURIES AT WORK? *(Check one)* ☐ Yes ☐ No

40. Before May 1, 2016, did you have ANY INJURIES NOT AT WORK? *(Check one)* ☐ Yes ☐ No

41. Between May 1 and October 31, 2016, did you usually experience pain while working? (Check one)

☐ Yes ☐ No

↓

If YES, check the box that shows your usual level of pain while working.

					
☐ No Pain	☐ Little Pain	☐ Some Pain	☐ Medium Pain	☐ Lots of Pain	☐ Extreme Pain

42. IF YES, Did you take medicine, either from a doctor or over the counter, for this pain? *(Check one)*

☐ Yes ☐ No

PLEASE ANSWER THE NEXT QUESTIONS ABOUT INJURY/PAIN REPORTING

43. In the 6 months between May 1 and October 31, 2016, DID YOU REPORT ANY injury or illness or pain to your employer? *(Check ONE)*

☐ Yes ☐ No

If NO, did any of the following prevent you from reporting your injury or illness or pain to your employer? *(Check ALL THAT APPLY)*

I don't feel confident that the form is kept anonymous (private)	○
I am too busy to fill out the form	○
I am afraid of the consequences	○
I don't want to get into trouble	○
I am worried about legal action	○
I feel I will be blamed for raising concerns	○
I believe it's pointless (worthless) and nothing will be done about it	○
I am afraid it will affect my career and reputation	○
I am unsure who to report the incident to	○
If I discuss the incident with the person involved, nothing else needs to be done	○
I never get any feedback on action taken	○
Reporting takes too much time	○
The incident was too not that bad	○
Injuries are a part of the job	○
The incident form takes too long to fill out	○
I am unaware of the reporting process	○
Other (Please describe) _____	○

44. Do you know what an OSHA 300 log is? *(Check one)*

☐ Yes ☐ No

45. Have you ever seen the OSHA 300, which is the Log Summary of Occupational Injuries and Illnesses for your establishment/workplace? *(Check one)*

☐ Yes ☐ No

If YES, did you see it by *(Check one)*?

☐ Viewing the summary portion of the log posted by the employer

☐ Requesting access to see the entire OSHA log

46. Did you ever have an injury recorded on the OSHA log? *(Check one)*

☐ Yes ☐ No

47. Do you know what WORKERS' COMPENSATION is? *(Check one)*

☐ Yes ☐ No

48. Have you or your employer filed for Workers' Compensation FOR ANY INJURY OR ILLNESS YOU HAD? *(Check one)*

☐ Yes ☐ No

For your work in the 6 months between May 1 and October 31, 2016, please circle one answer:

49. How MENTALLY DEMANDING has it been working as a janitor? *(Circle one)*

1	2	3	4	5
Very Low Demand	Low Demand	Medium Demand	High Demand	Very High Demand

50. How PHYSICALLY DEMANDING has it been working as a janitor? *(Circle one)*

1	2	3	4	5
Very Low Demand	Low Demand	Medium Demand	High Demand	Very High Demand

51. How HURRIED OR RUSHED have you been working as a janitor? *(Circle one)*

1	2	3	4	5
Very Low Rush	Low Rush	Medium Rush	Highly Rushed	Very Highly Rushed

52. How SUCCESSFUL were you in completing what you were asked to do? *(Circle one)*

1	2	3	4	5
Very Low Success	Low Success	Medium Success	High Success	Very High Success

53. How HARD DID YOU HAVE TO WORK to do your job? *(Circle one)*

1	2	3	4	5
Not Very Hard	Somewhat Hard	Medium Hard	Hard	Very Hard

54. How FRUSTRATED have you been with your work as a janitor? *(Circle one)*

1	2	3	4	5
Very Low Frustration	Low Frustration	Medium Frustration	High Frustration	Very High Frustration

The next question is about moderate or vigorous physical activity during the WHOLE day (DURING WORK OR IN YOUR FREE TIME) that caused at least light sweating or a slight increase in your breathing or heart rate.

55. During either YOUR WORK OR FREE TIME, in the past 7 days, ON HOW MANY DAYS did you do moderate or vigorous physical activities like fast walking, pushing a lawn mower, or moving heavy boxes by hand for at least 30 minutes at a time?

_____ Days per week

PLEASE ANSWER THE NEXT QUESTIONS ABOUT STRESS YOU MAY HAVE HAD IN THE 6 MONTHS BETWEEN MAY 1 AND OCTOBER 31, 2016.

56. STRESS means a situation in which a person feels tense, restless, nervous or anxious or is unable to sleep at night because his/her mind is troubled all the time. Did you feel any STRESS? *(Check one)*

□ Not at all □ Very little □ Sometimes □ Often □ Very Much

57. How did you feel about YOUR JOB? *(Check one)*

□ Terrible/Unhappy □ Mostly Dissatisfied □ Mixed Feelings □ Mostly Satisfied □ Pleased/Delighted

58. How did you feel about the PEOPLE YOU WORKED WITH -- your co-workers? *(Check one)*

□ Terrible/Unhappy □ Mostly Dissatisfied □ Mixed Feelings □ Mostly Satisfied □ Pleased/Delighted

59. How did you feel about the WORK YOU DID ON YOUR JOB – the work itself? *(Check one)*

□ Terrible/Unhappy □ Mostly Dissatisfied □ Mixed Feelings □ Mostly Satisfied □ Pleased/Delighted

60. How did you feel about WHERE YOU WORKED --- the physical surroundings, the hours, the amount of work you were asked to do? *(Check one)*

□ Terrible/Unhappy □ Mostly Dissatisfied □ Mixed Feelings □ Mostly Satisfied □ Pleased/Delighted

61. How did you feel about the RESOURCES (equipment, tools, information, supervision, etc.) you had available for doing your job? *(Check one)*

□ Terrible/Unhappy □ Mostly Dissatisfied □ Mixed Feelings □ Mostly Satisfied □ Pleased/Delighted

PLEASE ANSWER THE NEXT QUESTIONS ABOUT THE PAST MONTH (October 2016).

62. In the PAST MONTH, how often have you felt that you were unable to control the important things in your life? *(Check one)*

□ Never □ Almost Never □ Sometimes □ Fairly Often □ Very Often

63. In the PAST MONTH, how often have you felt confident about your ability to handle your personal problems? *(Check one)*

□ Never □ Almost Never □ Sometimes □ Fairly Often □ Very Often

64. In the PAST MONTH, how often have you felt that things were going your way? *(Check one)*

□ Never □ Almost Never □ Sometimes □ Fairly Often □ Very Often

65. In the PAST MONTH, how often have you felt difficulties were piling up so high that you could not overcome them? *(Check one)*

□ Never □ Almost Never □ Sometimes □ Fairly Often □ Very Often

PLEASE ANSWER THE NEXT QUESTIONS ABOUT YOUR SLEEP EXPERIENCE AND QUALITY

The following questions refer to sleep quality DURING THE PAST 7 DAYS.

66. On average, I got _____ HOURS OF SLEEP in a 24-hour period.

67. On average, my sleep quality was (*Check one*)

☐ Very Poor ☐ Poor ☐ Fair ☐ Good ☐ Very Good

68. On average, my sleep was refreshing (*Check one*)

☐ Not at All ☐ A little bit ☐ Somewhat ☐ Quite a Bit ☐ Very Much

69. On average, I had a problem with my sleep (*Check one*)

☐ Not at All ☐ A little bit ☐ Somewhat ☐ Quite a Bit ☐ Very Much

70. On average, I had difficulty falling asleep (*Check one*)

☐ Not at All ☐ A little bit ☐ Somewhat ☐ Quite a Bit ☐ Very Much

Was your SLEEP IN THE PAST 7 DAYS SIMILAR TO YOUR SLEEP IN THE 6 MONTHS between May 1st and October 31st, 2016?

☐ **Yes → IF YES , SKIP TO PAGE 17** ☐ **NO - IF NO, PLEASE ANSWER QUESTIONS BELOW:**

The following questions refer to sleep quality IN THE 6 MONTHS between May 1st and October 31st, 2016.

71. On average, I got _____ HOURS OF SLEEP did you get in a 24-hour period.

72. On average, my sleep quality was (*Check one*)

☐ Very Poor ☐ Poor ☐ Fair ☐ Good ☐ Very Good

73. On average, my sleep was refreshing (*Check one*)

☐ Not at All ☐ A little bit ☐ Somewhat ☐ Quite a Bit ☐ Very Much

74. On average, I had a problem with my sleep (*Check one*)

☐ Not at All ☐ A little bit ☐ Somewhat ☐ Quite a Bit ☐ Very Much

75. On average, I had difficulty falling asleep (*Check one*)

☐ Not at All ☐ A little bit ☐ Somewhat ☐ Quite a Bit ☐ Very Much

76. Has a doctor, nurse, or other health professional EVER told you that you had any of the following? (Check all that apply)

	Yes	No	Unsure
a. Heart Attack (i.e., myocardial infarction)?	☐	☐	☐
b. Angina or Coronary Heart Disease?	☐	☐	☐
c. Stroke?	☐	☐	☐
d. Asthma? ↓	☐	☐	☐
If YES, do you still have asthma?	☐	☐	☐
e. Cancer?	☐	☐	☐
f. Lung Disease (e.g., emphysema or chronic bronchitis)?	☐	☐	☐
g. Arthritis?	☐	☐	☐
h. Depression? ↓	☐	☐	☐
If YES, are you currently being treated for depression, for example, taking medication or seeing a health professional for counseling?	☐	☐	☐
i. Diabetes?	☐	☐	☐

77. In general, how would you RATE YOUR PHYSICAL HEALTH (PAST 7 DAYS AND FOR 6-MONTH PERIOD)?

a. In the PAST 7 DAYS (Check one)	AND→	*b. BETWEEN MAY 1 AND OCTOBER 31, 2016 (Check one)*
☐ *Poor*		☐ *Poor*
☐ *Fair*		☐ *Fair*
☐ *Good*		☐ *Good*
☐ *Very Good*		☐ *Very Good*
☐ *Excellent*		☐ *Excellent*

78. In general, how would you RATE YOUR MENTAL HEALTH, including your mood and your ability to think?

a. In the PAST 7 DAYS (Check one)	AND→	*B. BETWEEN MAY 1 AND OCTOBER 31, 2016 (Check one)*
☐ *Poor*		☐ *Poor*
☐ *Fair*		☐ *Fair*
☐ *Good*		☐ *Good*
☐ *Very Good*		☐ *Very Good*
☐ *Excellent*		☐ *Excellent*

79. In general, how would you RATE YOUR SATISFACTION with your social activities and relationships?

a. In THE PAST 7 DAYS (Check one)	AND→	*b. BETWEEN MAY 1 AND OCTOBER 31, 2016 (Check one)*
☐ *Poor*		☐ *Poor*
☐ *Fair*		☐ *Fair*
☐ *Good*		☐ *Good*
☐ *Very Good*		☐ *Very Good*
☐ *Excellent*		☐ *Excellent*

80. During your ENTIRE LIFE HAVE YOU SMOKED AT LEAST 100 CIGARETTES, which is about 5 packs? *(Check one)*

☐ Yes ☐ No ☐ Unsure

81. Do you NOW SMOKE CIGARETTES? *(Check one)*

☐ Everyday ☐ Some Days ☐ Not at all

82. What is YOUR GENDER? *(Check one)*

☐ Male ☐ Female ☐Other

83. As of today's date, what is YOUR AGE?

_____ (years)

84. Which of the following best describes YOUR ETHNIC BACKGROUND? *(Check one)*

☐ Hispanic ☐ Not Hispanic

85. Which of the following best describes YOUR RACE? *(Check all that apply)*

☐ American Indian
☐ Alaska Native
☐ Asian
☐ Black or African American
☐ Native Hawaiian or Other Pacific Islander
☐ White

86. What is YOUR HIGHEST LEVEL OF EDUCATION COMPLETED? *(Check one)*

☐ No Schooling Completed
☐ Less Than grade 12
☐ High School Graduate (High school diploma, GED or alternative credential)
☐ College or Some College
☐ Graduate or Professional School

87. What is your CURRENT MARITAL STATUS? *(Check one)*

☐ Married
☐ Living as Married
☐ Living with a domestic partner
☐ Never married
☐ Separated
☐ Divorced
☐ Widowed

88. What category best describes your ANNUAL HOUSEHOLD INCOME? *(Check one)*

☐ Less than $25,000
☐ $25,000 to $34,999
☐ $35,000 to $49,999
☐ $50,000 to $74,999
☐ $75,000 or more

89. Do you SPEAK a LANGUAGE OTHER THAN ENGLISH? *(Check one)*

☐ Yes ☐ No

If yes, what is this language? *(Check all that apply)*

☐ Spanish ☐ Somali ☐ Arabic
☐ French ☐ Amharic
☐ Other (please describe below)

_____

90. HOW WELL do you speak English? *(Check one)*

☐ Very well ☐ Well ☐ Not well
☐ Not at All

91. What is the total number of PERSONS WHO LIVE IN YOUR HOUSEHOLD, INCLUDING YOURSELF?

_____persons

92. ARE YOU THE PRIMARY WAGE EARNER in your household? *(Check one)*

☐ Yes ☐ No

93. For WHICH COMPANY do you work? *(Check one)*

☐ Aramark
☐ ABLE
☐ ABM
☐ Best Way
☐ Capital
☐ Contract Cleaners
☐ F&F
☐ Harvard
☐ Mid-City
☐ ISS Managed Services
☐ Marsden
☐ Peterson
☐ Preferred
☐ SBM
☐ SCC
☐ Triangle
☐ Turtle Bay
☐ Other (Specify)_____

94. What is your height?

_____ feet ____inches **OR** _____centimeters

95. What is your current body weight?

_____ pounds **OR** _____ kilograms

This is the end of the questionnaire. Thank you for participating in this important effort!

Workers' Rights and Responsibilities for Injury Reporting

Worker Protection is the Law of the Land

You have the right to a safe workplace. The **Occupational Safety and Health Act of 1970** (OSH Act) was passed to prevent workers from being killed or otherwise hurt at work. The law makes employers give their employees with working conditions that are free of known dangers. The OSH Act created the **Occupational Safety and Health Administration** (OSHA), which sets and enforces protective workplace safety and health standards. OSHA gives information, training and help to employers and workers.

Workers' Rights under the OSH Act

The OSH Act gives workers the right to safe and healthful working conditions. It is the duty of employers to provide workplaces that are free of known dangers that could harm their employees. This law also gives workers important rights to participate in activities to ensure their protection from job hazards**. This sheet explains workers' rights to:**

- File a **confidential** complaint with OSHA to have their workplace inspected.
- Get **information and training about hazards**, **methods to prevent harm**, and the **OSHA rules** that apply to their workplace. This must be done in a language and vocabulary workers can understand.
- Review records of **work-related injuries and illnesses** that happen in their workplace.
- Get **copies of the results** from tests and monitoring done to find and measure hazards in the workplace.
- Get copies of their workplace medical records.
- Participate in an **OSHA inspection** and speak in private with the inspector.
- File a complaint with OSHA if they are punished by their employer for asking for an inspection or using any of their other rights under the OSH Act.
- File a complaint if **punished or retaliated against** for acting as a "whistleblower".

Employer Responsibilities

Employers have the duty to provide a safe workplace. Employers **MUST** provide their employees with a workplace that does not have serious hazards and must follow all OSHA safety and health rules. Employers must find and fix safety and health problems. OSHA further requires that employers must try to eliminate or reduce hazards first by making feasible changes in working conditions. Employers **MUST** also:

- Clearly display the official OSHA poster that describes rights and responsibilities under the OSH Act.
- **Tell workers about hazards** through training, labels, alarms, color-coded systems, chemical information sheets and other ways.
- Train workers in a **language and words** they can understand.
- Keep **accurate records** of work-related injuries and illnesses.
- Perform tests in the workplace, such as air sampling, required by some OSHA standards.
- Provide hearing exams or other medical tests required by OSHA standards.
- Post OSHA citations and injury and illness data where workers can see them.
- Tell OSHA **within 8 hours** of a workplace death **within 24 hours** of any work-related inpatient hospitalization, amputation or loss of an eye.
- Not **punish workers for using their rights** under the law, including their right to report a work-related injury or illness

CONTACT OSHA. THEY CAN HELP.

1-800-321-OSHA (6742) • TTY 1-877-889-5627 • www.osha.gov

APPENDIX B

IRB Approval

UNIVERSITY OF MINNESOTA

Twin Cities Campus

Human Research Protection Program
Office of the Vice President for Research

D528 Mayo Memorial Building
420 Delaware Street S.E.
MMC 820
Minneapolis, MN 55455

Office: 612-626-5654
Fax: 612-626-6061
E-mail: irb@umn.edu or ibc@umn.edu
Website: http://research.umn.edu/subjects/

June 23, 2016

Deirdre R Green
515 Huron Blvd SE
Apt 514
Minneapolis, MN 55414-3588

RE: "Health and Injury Study of Janitorial Service Employees"
IRB Code Number: **1605P87743**

Dear Ms. Green

The Institutional Review Board (IRB) received your response to its stipulations. Since this information satisfies the federal criteria for approval at 45CFR46.111 and the requirements set by the IRB, final approval for the project is noted in our files. Upon receipt of this letter, you may begin your research.

IRB approval of this study includes the consent form received June 15, 2016 and Fitbit consent form and recruitment materials received May 13, 2016.

The IRB would like to stress that subjects who go through the consent process are considered enrolled participants and are counted toward the total number of subjects, even if they have no further participation in the study. Please keep this in mind when calculating the number of subjects you request. This study is currently approved for 4000 subjects. If you desire an increase in the number of approved subjects, you will need to make a formal request to the IRB.

On June 3, 2016 the IRB approved the referenced study through June 2, 2017 inclusive.

The Assurance of Compliance number is FWA00000312 (Fairview Health Systems Research FWA00000325, Gillette Children's Specialty Healthcare FWA00004003). Research projects are subject to continuing review and renewal. You will receive a report form two months before the expiration date. If you would like us to send certification of approval to a funding agency, please tell us the name and address of your contact person at the agency.

As Principal Investigator of this project, you are required by federal regulations to:
*Inform the IRB of any proposed changes in your research that will affect human subjects, changes should not be initiated until written IRB approval is received.
*Report to the IRB subject complaints and unanticipated problems involving risks to subjects or others as they occur.
*Inform the IRB immediately of results of inspections by any external regulatory agency (i.e. FDA).

*Respond to notices for continuing review prior to the study's expiration date.
*Cooperate with post-approval monitoring activities.

Notify the IRB when you intend to close this study by submitting the Study Inactivation Request Form.

Information on the IRB process is available in the form of a guide for researchers entitled, What Every Researcher Needs to Know, found at http://www.research.umn.edu/irb/WERNK/index.cfm

The IRB wishes you success with this research. If you have questions, please call the IRB office at 612-626-5654.

Sincerely,

Jeffery Perkey, MLS, CIP
Research Compliance Supervisor
JP/bw

CC: Susan Gerberich

Jeffery Perkey

Digitally signed by Jeffery Perkey
DN: c=US, st=Minnesota, l=Minneapolis, ou=Human Research Protection Program, email=perke001@umn.edu, o=University of Minnesota, cn=Jeffery Perkey
Date: 2016.06.23 15:50:12 -05'00'

APPENDIX C

Directed Acyclic Graphs (DAGs)

Figure 1. Directed Acyclic Graph (DAG) for Job Title: Health and Injury Study of Janitorial Service Employees

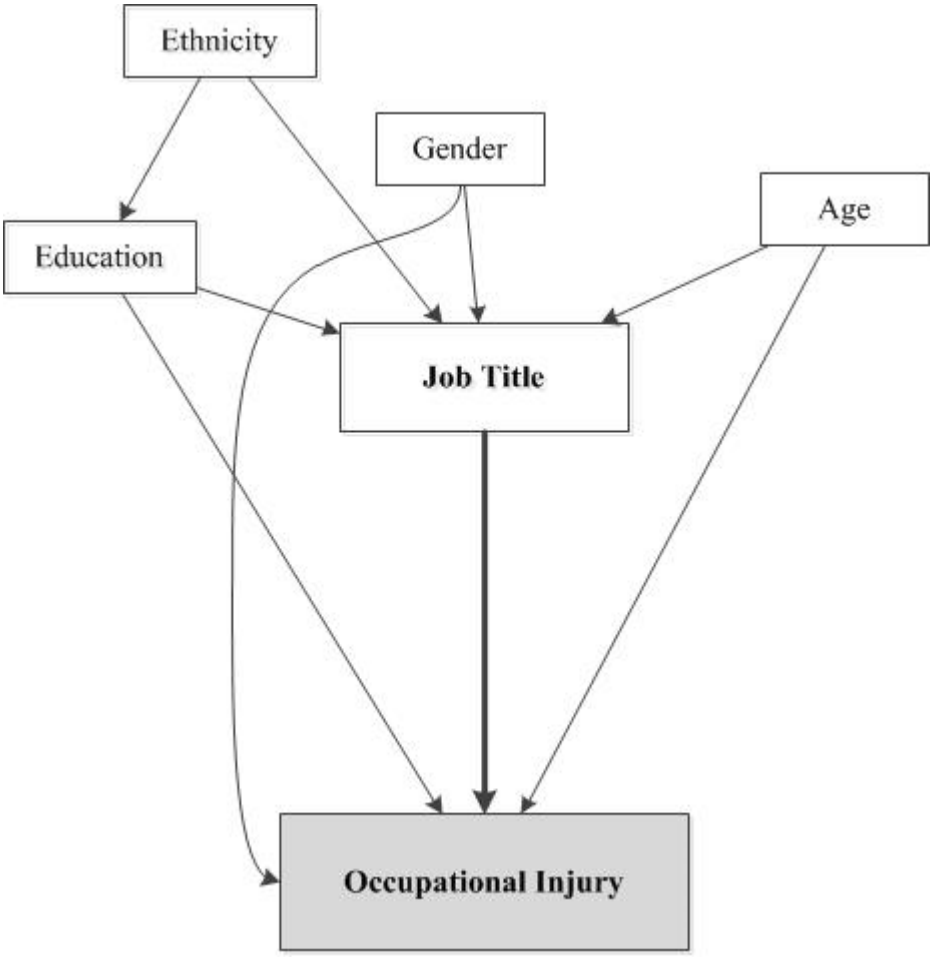


Figure 2. Directed Acyclic Graph (DAG) for Lifetime Janitor Duration: Health and Injury Study of Janitorial Service Employees

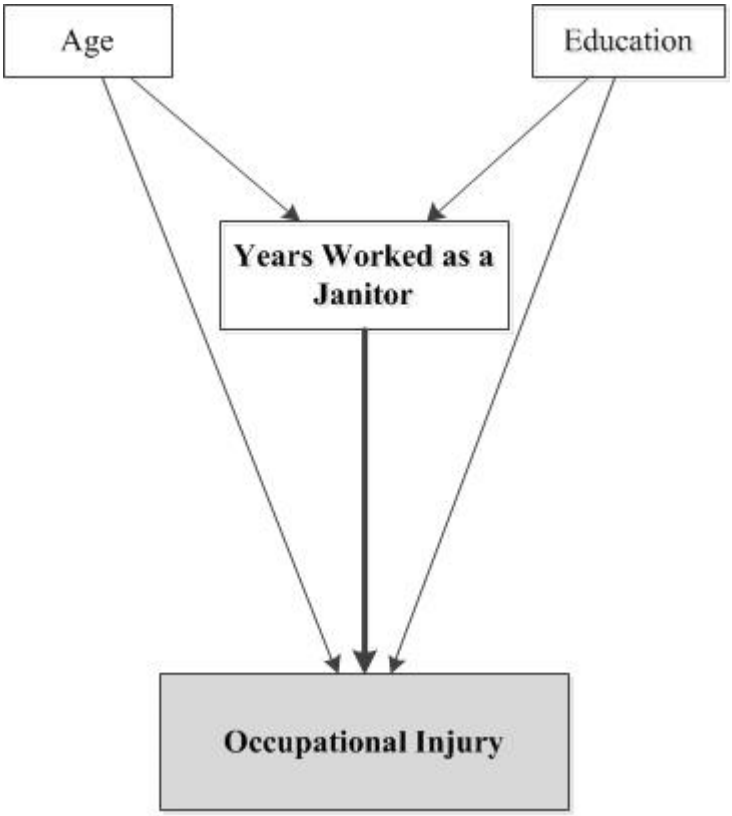


Figure 3. Directed Acyclic Graph (DAG) for Current Company Janitor Duration: Health and Injury Study of Janitorial Service Employees

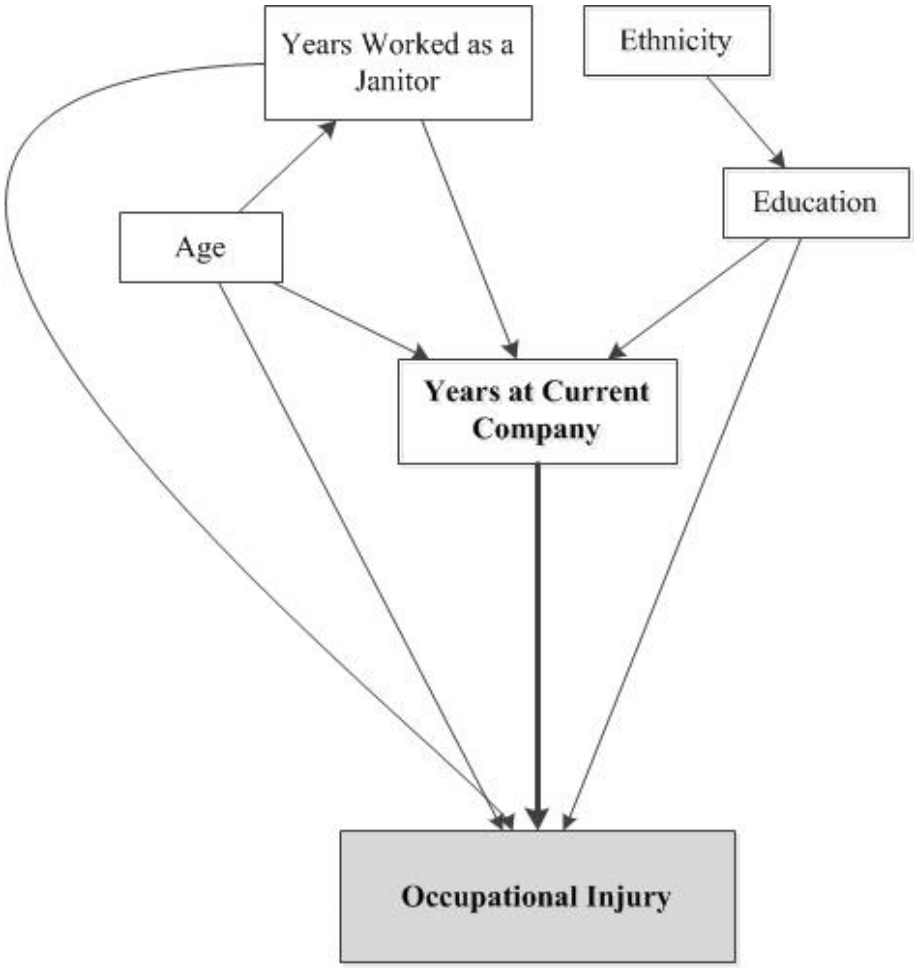


Figure 4. Directed Acyclic Graph (DAG) for Other Jobs: Health and Injury Study of Janitorial Service Employees

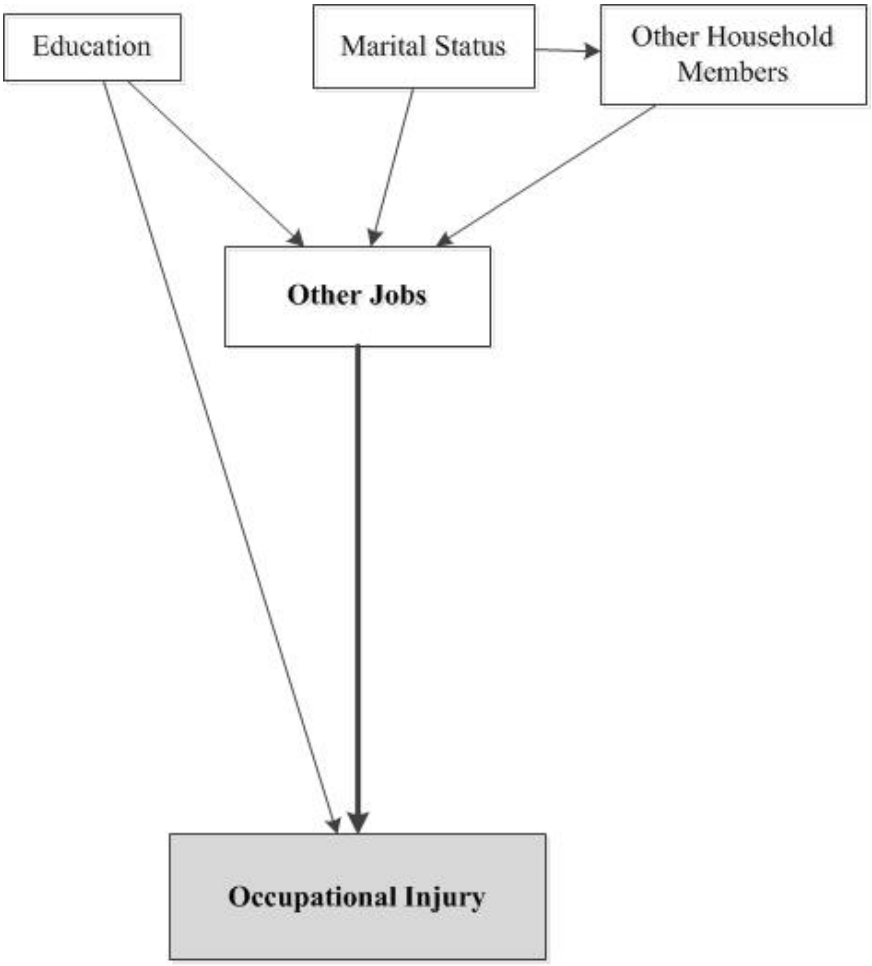


Figure 5. Directed Acyclic Graph (DAG) for Shift Start Time: Health and Injury Study of Janitorial Service Employees

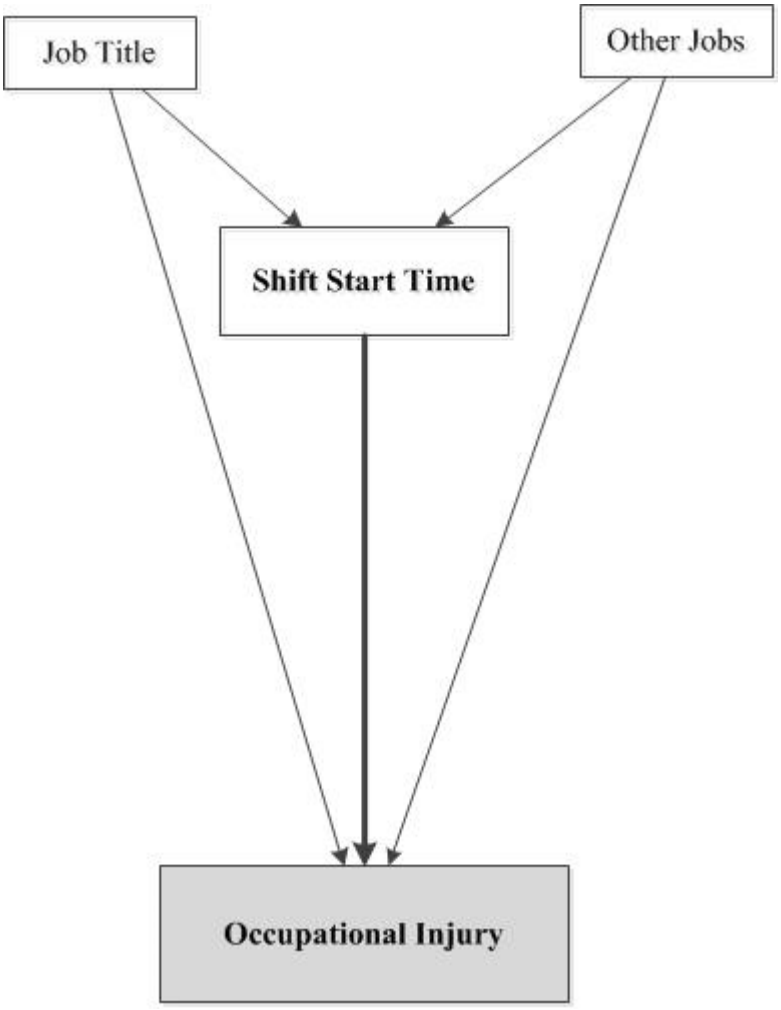


Figure 6. Directed Acyclic Graph (DAG) for Pre-Existing Health Condition: Health and Injury Study of Janitorial Service Employees

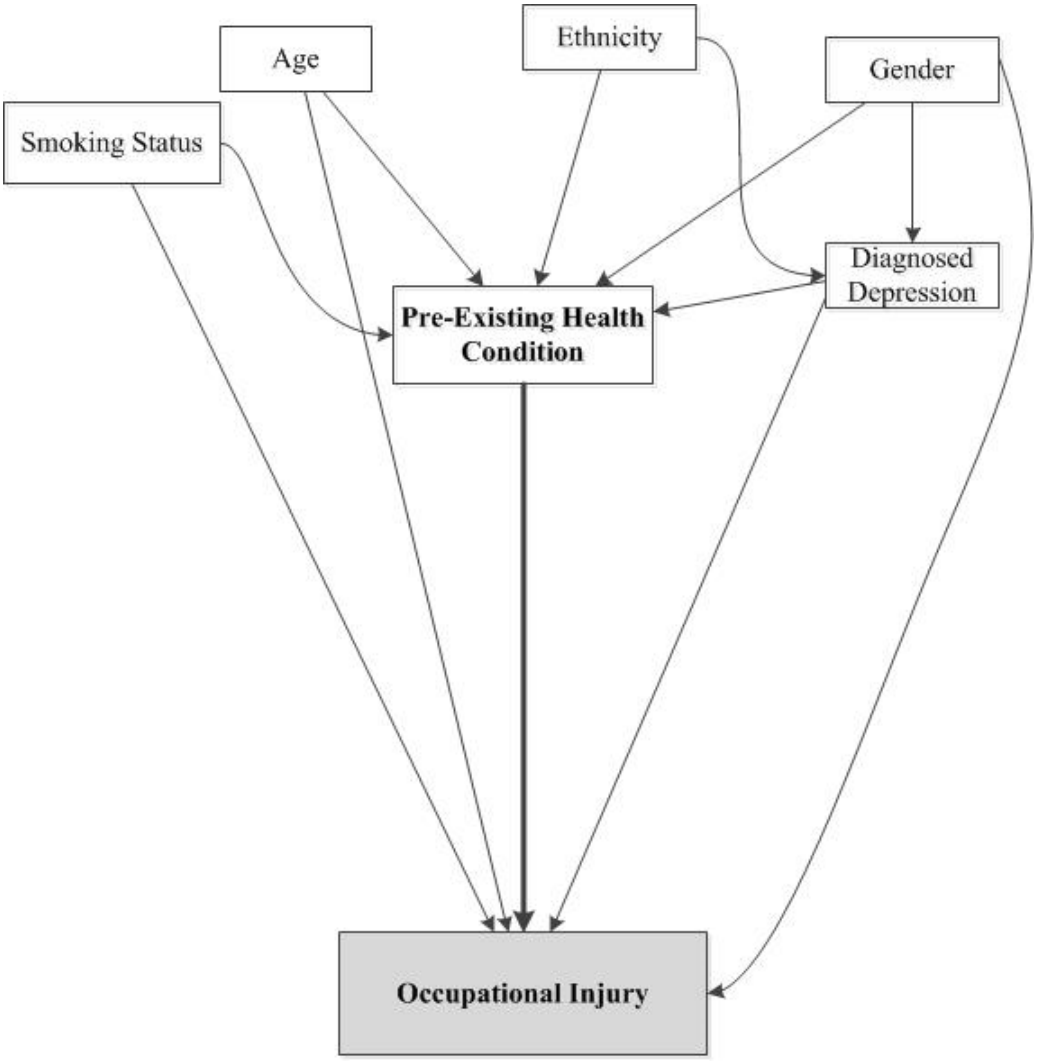


Figure 7. Directed Acyclic Graph (DAG) for Pre-Existing Mental Health Condition: Health and Injury Study of Janitorial Service Employees

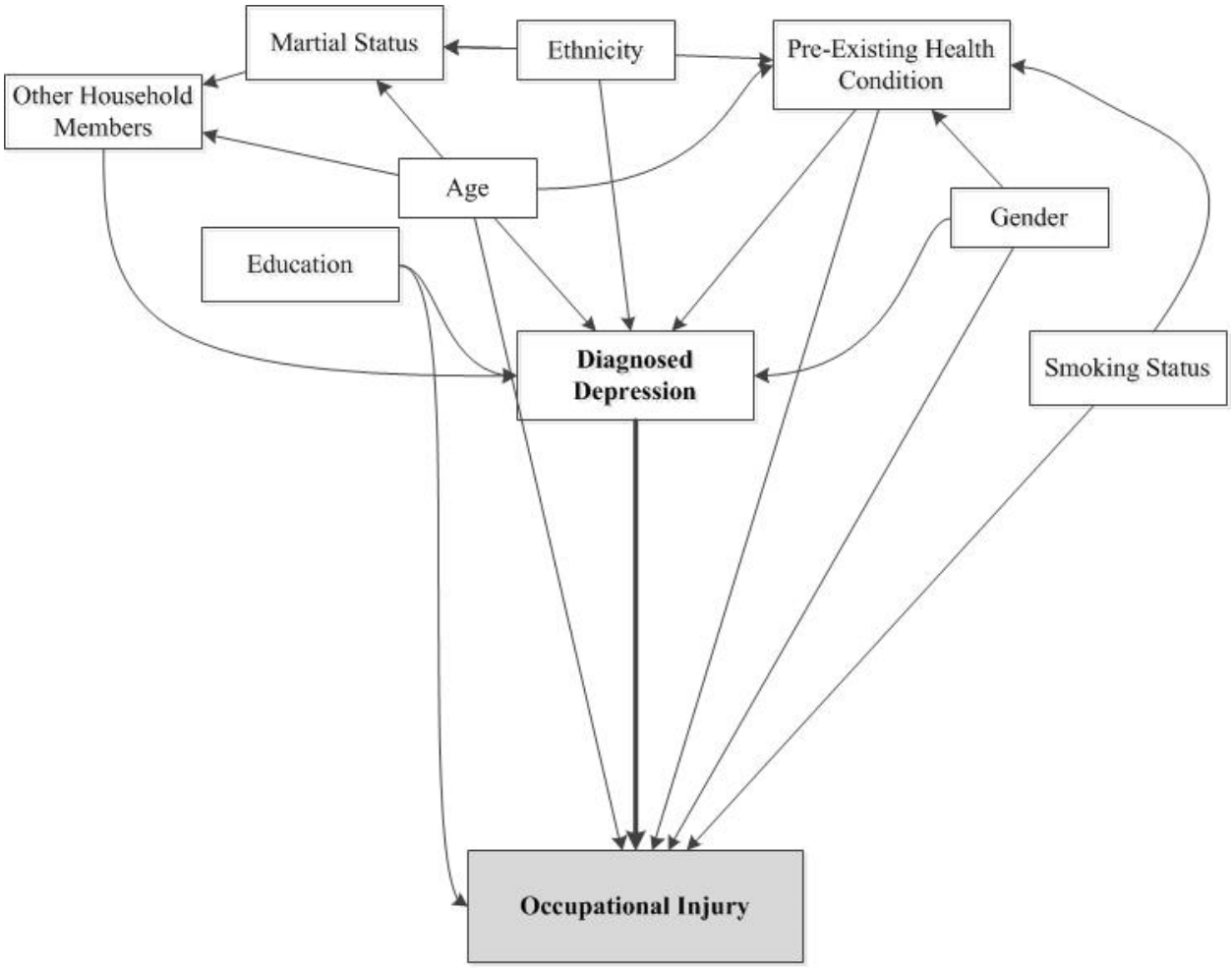


Figure 8. Directed Acyclic Graph (DAG) for Workload: Health and Injury Study of Janitorial Service Employees

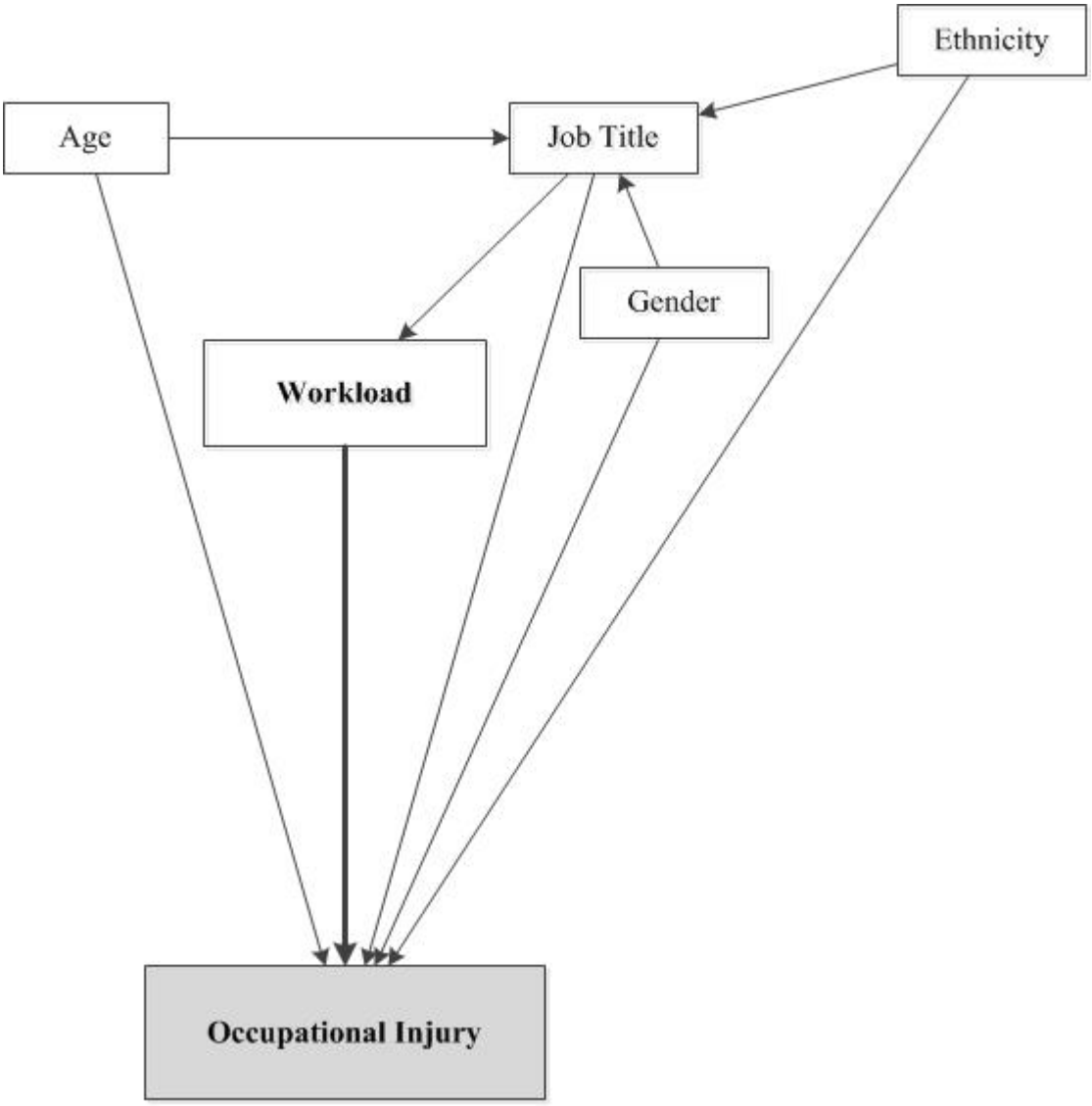


Figure 9. Directed Acyclic Graph (DAG) for Sleep Quality: Health and Injury Study of Janitorial Service Employees