RISK OF VIOLENCE AMONG HEALTHCARE STAFF AND RETURN-TO-WORK OUTCOMES

by

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Abstract

Healthcare workers are at-risk for a time-loss injury due to violence and organizational factors such as staffing ratios. There is little understanding how workers return-to-work (RTW) after violence-related injury and how staffing ratios can improve RTW outcomes. The first objective of this thesis explores RTW outcomes of healthcare workers with violence-related injuries (WVI) compared to healthcare workers with nonviolence-related injuries (WNVI). The study then seeks to examine differences in the likelihood of violence and RTW by staffing ratio, and if violence modifies the relationship between staffing ratios and RTW.

The first retrospective cohort study used British Columbia (BC) workers' compensation data from 2009 to 2014. After matching on age, gender, injury type, care setting, and occupation, 5,762 healthcare workers with at least one day off-work were included. Cox regression and piecewise models were stratified for injury types and adjusted for age, sex, wage, occupation, injury types, history of violence, care setting, and shift type.

The second retrospective cohort study used BC workers' compensation data and long-term care (LTC) staffing data in 2014. The cohort included 1,590 injured LTC workers with at least one day off-work. Negative binomial regression models were adjusted for health region, bed count, and public versus private funding. Cox regression models stratified by WVIs and WNVIs were adjusted for health region, bed count, public versus private funding, sex, age, wage, injury types and occupations.

In the first study, RTW was more likely within one month, less likely from two to six months, and just as likely after six months post-injury for WVIs compared to WNVIs. WVIs with mental health injuries were less likely to RTW anytime one-year post-injury compared to WNVIs with mental health injuries. In the second study, higher staffing ratios was associated with lower risk of violence-related injuries compared to lower staffing ratios. For both WVIs and WNVIs, RTW was more likely at higher staffing ratios. However, WVIs had a higher likelihood of RTW compared to WNVIs at high staffing ratios. Findings suggest targeting interventions toward WVIs with mental health injuries and increasing staffing ratio to reduce the risk of violence and improve RTW outcomes.

Lay Summary

Improving return-to-work (RTW) outcomes after a work injury is a priority for employers and stakeholders in healthcare. Healthcare workers have a high risk of work disability due to workplace violence associated with injuries. However, it is unknown if violence-related injuries result in a lower likelihood of RTW compared to other injuries. Using British Columbia workers' compensation data this thesis research found that violence-related injuries were associated with higher likelihood of RTW within one-month post-injury, but slower RTW after one-month compared to nonviolence-related injuries. Healthcare workers with mental health conditions related to violent-related injury were also less likely to RTW compared to other occupations and compared to those without mental health comorbidity. In an exploratory analysis restricted to long-term care facilities, higher staff-to-patient ratios were associated with faster RTW, but this relationship was stronger for healthcare workers with violence-related injuries compared to those with nonviolence-related injuries.

Preface

This dissertation is an original intellectual product of the author, Kelvin Choi. All research including concept formation and data analysis were done by me under the supervision of the thesis committee. The work reported in Chapter 3 was covered by UBC Ethics Certificate ID H16-01575 and the work reported in Chapter 4 was covered by UBC Ethics Certificate ID H16-01622. The use of administrative data was approved by WorkSafeBC and covered by a data sharing agreement for the use of the data for research purposes.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

BC – British Columbia

CEM – Coarsened Exact Matching

FTE – full-time equivalent

HR – hazard ratio

LTC – long-term care

OR – odds ratio

RTW – return-to-work

WVIs – workers with violent-related injuries

WNVIs – workers with nonviolent-related injuries

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I would like to thank WorkSafeBC for awarding me a Research Training Award, and The Partnership for Work, Health and Safety for providing a graduate research assistantship. I would also like to thank WorkSafeBC for allowing access to their data for research purposes. All inferences, opinions, and conclusions drawn in this thesis are those of the author, and do not reflect the opinions or policies of the data steward.

Lastly, thanks to my mom, dad, and my brother Robin for supporting me in my academic endeavors.

Dedication

I dedicate this thesis to my grandfather.

Chapter 1: Introduction

Overview

Workplace violence has been highlighted as a main cause for work disability in the healthcare industry. To examine work disability among workers with violence-related injuries, management and compensation boards use time-loss claims that compensate a worker for the period they are unable to work due to a work-related injury or illness (WorkSafeBC, 2017c). From 2009 to 2015, the rate of compensated injury claims due to workplace violence in British Columbia increased by 38%, from 0.37 to 0.51 per 100 person-years. By 2015, workplace violence accounted for 13% of time-loss injury claims in the Health Care and Social Services sector, with compensation benefits for violence-related injuries totaling approximately $65 million over five years (WorkSafeBC, 2015).

There is a lack of empirical evidence on the relationship between violence and work disability. Only two studies have examined this relationship and neither study found that violence was associated with longer time to RTW (Hartley et al., 2012; Campolieti et al., 2008). These studies examined types of injury or types of violence only among time-loss injury claims due to violence and did not have a control group (i.e. time-loss injury claims due to nonviolence).

Staffing ratios have been a focus among stakeholders and in the literature as an amenable organizational factor effective in improving RTW outcomes. Guidelines on staffing ratios in particular were published by the BC Ministry of Health and the BC Nurses' Union as it could help improve patient outcomes and staff outcomes such as staff illness, injury, and disability in residential care (Ministry of Health, 2017; BC Nurses' Union, 2015). A review of the literature

identified that among organizational factors that may be amenable to intervention, higher staffing ratios has been shown to reduce work disability by reducing role stress (Buchanan and Considine, 2002; Garrett, 2008; Chang, 2005). Staffing ratios were highlighted among other management interventions and strategies as a factor that can reduce workload and job stress, leading to a decrease in the incidence and costs of time-loss claims (O'Brien-Pallas et al., 2004).

Currently there is a lack of consensus on appropriate staffing ratios among local stakeholders. The BC Ministry of Health established a guideline of 3.36 hours of direct care per resident day and this guideline has been in place for all BC Health Authorities since 2009 (BC Ministry of Health, 2017). The BC Nurses' Union (2015) advocated for 4.55 nursing staff hours per resident day in order to improve patient outcomes, mitigate work pressure and injury, and support BC nurses who are under long-term disability. In 2014, BC LTC facilities operated with an average of 3.11 total direct care hours per resident day ranging from 2.33 to 5.74 direct hours per resident day, or 2.82 total nursing hours per resident day ranging from 2.25 to 4.86 nursing hours per resident day (Office of the Seniors Advocate, 2015).

Study Aims

This thesis has two aims. The first is to explore the differences in RTW among healthcare workers in British Columbia with violence-related injuries and nonviolence-related injuries, and whether this difference varies by injury type or occupation. The second aim is to examine differences in RTW among employees working with different staffing ratios in the LTC sector, and if violence-related injuries modify this relationship.

Outline of the Thesis

Chapter 2 presents a literature review of empirical and theoretical studies regarding RTW, RTW-related factors, workplace violence, risk factors of workplace violence, and staffing ratios. A conceptual model is provided that summarizes the evidence and the relationships between these factors and provides the framework for the study hypotheses.

Chapter 3 presents a study that examines the relationship between violence-related injuries and RTW among healthcare workers injured between 2010 and 2014, using BC workers' compensation data. Differences were examined in the relationship between RTW outcomes and workers with violence-related injuries (WVIs) versus workers with nonviolence-related injuries (WNVIs), and whether injury types and occupations modified this relationship.

Chapter 4 presents a pilot study that examines the second aim of the thesis to investigate the effect of staffing ratios on RTW outcomes. The pilot study used BC workers' compensation data and Office of the Seniors Advocate's facility staffing data for the long-term care sector in 2014. Differences in RTW outcomes for long-term care workers were examined by different facility staffing ratios, and whether this relationship was modified by violence-related work injuries.

Chapter 5 synthesizes the findings from the two preceding studies within the context of the existing literature and evidence; and concludes with a discussion of the strengths and limitations, policy implications, and future research directions of the findings.

Chapter 2: Literature review

2.1 Violence-related injury in British Columbia

The rate of violence-related work injuries compensated among healthcare workers in BC have increased in recent years (WorkSafeBC, 2016). From 2009 to 2015, the rate of violence-related work injuries has increased from 0.37 to 0.51 injuries per 100 person-years of employment in the Healthcare and Social Services sector (WorkSafeBC, 2016). During this period, the rate of violence-related injury in this sector was three to ten times higher than in other sectors.

2.2 The relationship between violence and return-to-work

The following summary of the research literature explores the factors associated with workplace violence and RTW following a work-related injury related to workplace violence.

While a comprehensive literature review (Krause et al., 2001b) identified approximately 100 different determinants of RTW, there is little research examining whether and how violence, as a contributing factor, affects the likelihood of RTW. Two studies have examined RTW after workplace violence (Hartley et al., 2012; Campolieti et al., 2008); however, neither of these compared RTW after violent-related injuries with similar injuries due to other causes. As such there is no direct evidence that violence as a contributing cause of work-related injury could affect RTW outcomes. However, other studies have identified associations between workplace violence and factors that are known to be determinants of RTW, suggesting an indirect relationship.

One explanation linking violence and RTW is the degree to which violence leads to psychological trauma (Franz et al., 2010; Hensel et al., 2012; Roche et al., 2010; Tak et al., 2010; Zampieron et al., 2010) and perceived psychological job demands (Baillien et al., 2011; Tuckey et al., 2009; Demir & Rodwell, 2012), both of which were found to be associated with RTW (Krause et al., 2001a; Polatin, 1991). A retrospective cohort study by Krause et al. (2001a) showed that high psychological job demands were associated with a 26% reduction in the RTW rate among workers injured with lower back pain. In the context of injuries related to the musculoskeletal system, the authors found psychological job demands were associated with increased muscle tension, as well as exacerbating pain in the back, neck, and shoulders, leading to lower RTW rates among workers in their study. High psychological job demands influence job stress and anxiety, factors that are known be important determinants of lower back pain chronicity (Polatin, 1991), that in turn lower RTW outcomes (Hansson, 2004; Detaille, 2009; Steenstra, 2005; Verkerk, 2012; Cornelius, 2011). Preceding evidence suggests that violence and violence-related injuries could be associated with lower likelihood of RTW through psychological trauma and increased psychological job demands.

2.3 Risk factors for violence

While not the focus of this thesis research, examining broader risk factors related to violence may help in understanding why violence may lead to longer time to RTW. Adapting models used by the World Health Organization and Arnetz et al. (2015), McLeod et al. (2017a) developed a systems framework identifying five main domains of risk factors associated with violence, using both qualitative and quantitative literature reviews, and consultation with stakeholders:

individual caregiver factors, patient factors, environment factors, organization factors, and socio-political context factors.

2.3.1 Caregiver factors

2.3.1.1 Sociodemographic/socioeconomic factors

Associations between sociodemographic factors of the caregiver and risk of workplace violence were mixed in the literature. In several studies, a relationship was observed with both younger workers (Camerino et al., 2008; Hegney et al., 2006; Lawoko et al., 2004; Thomas et al., 2006; Jiao et al., 2015) and older workers (Campbell et al., 2011; Zuzelo et al., 2012) having a higher risk of violence. The majority of evidence pointed toward older healthcare workers having a lower risk of violence as they were more adaptable, patient, and empathetic than younger workers, and more effective in de-escalating situations that could result in patient violence (Gates et al.; 2002).

While the relationship with sex or gender and risk of violence was also found to be mixed, evidence generally suggest male sex has a higher likelihood of workplace violence. A review by Campbell et al. (2011) found male nurses were more likely to face violence from patients than female nurses due to a number of reasons: male staff feel more protective of female staff, male staff were less likely to work the day shift, and males were more likely to work in the psychiatric unit, leading to a greater exposure to violence by patients (Campbell et al., 2011; Gillespie et al., 2010).

While wage was found to be associated with workplace violence, wage is more likely a surrogate measure for job tasks or occupations that have an increased exposure to violence. For example, Kristen et al. (2015) found many workers with lower wages are undocumented workers with language and cultural barriers and the study by Hodgson et al. (2004) found that workers with higher rates of physical contact with patients are more likely to be workers with lower wages. Low-wage workers were susceptible to workplace violence in the restaurant, agriculture, and long-term care sectors (Kristen et al., 2015; Hodgson et al., 2004).

2.3.1.2 Occupation

Among healthcare occupations, nurses and nursing aides were associated with a higher risk of violence (Fujita et al., 2012; Tak et al., 2010; Chen et al., 2008; Hodgson et al., 2004). Specific nursing specialities such as emergency care nurses, psychiatric nurses, and nurses in geriatric care were also found to have a higher risk of violence compared to general (i.e. non-specialty) nurses (Hills and Joyce, 2013). A proposed mechanism for this increase in risk of violence is patients being more likely to experience higher levels of frustration, distress, or cognitive impairment or arousal in these settings (Beech & Leather, 2006; Hahn et al., 2008).

Little evidence was found showing differences in RTW outcomes by occupation. In a study done by Gluck and Oleinick (1998), no differences in RTW were found between white collar occupations, blue collar occupations, and service occupations. Wiemer et al. (2017) showed occupational characteristics, rather than the occupation itself, affected the chances of RTW. A lower likelihood of RTW was found for workers with mental illness returning to work involving emotional labour.

2.3.1.3 History of violence

Healthcare staff with previous exposure to violence have a higher risk of future violence (Stevenson et al., 2015; Zuzelo et al., 2012; Renker et al., 2015; Whittington, 2002). Repeated experiences of patient violence increased the likelihood of lower tolerance toward patient behavior, leading to situations that escalate to violent incidents by patients (Wittington, 2002). However, another study explains workers who have experienced recurring violent events were in job environments with high risk of violence or had job duties having close physical contact with the patient/client (Hogh et al.., 2008).

2.3.2 Organizational factors

2.3.2.1 Care settings

Psychiatric, emergency, intensive care, geriatrics, and long-term care (LTC) units were identified as having an increased risk of workplace violence compared to other hospital units (Tak et al.., 2010; Fujita et al.., 2012; Camerino et al.., 2008; Magnavita et al., 2012; Gacki-Smith et al., 2009; Wei et al., 2016; Llor-Esteban, 2017; Qi et al., 2013; Jackson et al., 2002). In addition to the type of patients that are admitted to these units, authors postulated that care setting factors that are determinants of violence include crowding, long wait times, unit environment, and unit policies (Gacki-Smith et al., 2009; Llor-Esteban, 2017).

2.3.2.2 Shift types

Rotating shift work was found to be a significant risk factor for workplace violence in healthcare (Fisekovic et al., 2015; Hills & Joyce, 2011; Jiao et al., 2015; Hodgson et al., 2004; Camerino et

al., 2008). A systematic review of job stress found that shift work was associated with increasing job stress that may affect workers' job competency, and in turn interactions with patients and the risk of violence (Edwards and Burnard, 2003).

While shift types are characteristics of the job, they may also be a surrogate measure of the organizational climate that increases the risk of violence (Edwards and Burnard, 2003). For example, some authors indicate that permanent night shifts were associated with lower workplace cohesion and involvement that in turn were significant predictors of somatic problems, compared to rotating shifts (von Treuer et al., 2014). Organizational climate, related to shift types, may be associated with risk of violence rather than shift type itself.

2.3.2.3 Staffing ratios

Research examining the relationship between violence and staffing ratios found positive (Lanza et al., 1994; Bowers et al., 2009), negative (Bowers et al., 2007, Shin et al., 2015; Shields & Wilkins, 2009), non-linear (Staggs, 2013), and no associations (Lee et al., 1999; Staggs, 2016). However, all studies had limitations that affects the precision of results, such as small sample size, reporting bias, underreporting, and the inability to infer a temporal association between staffing ratios and violence. As a consequence, observational studies on staffing ratios and violence remain limited with mixed findings.

While there are limitations to conclusions on the relationship between staffing ratios and violence, a rigorous study conducted by Staggs (2013), using spline graphs, showed a curvilinear relationship. Using data collected from 351 adult psychiatric units, a curvilinear relationship was

found where low staffing ratios had low risk of assaults, moderate staffing ratios had high risk of assaults, and high staffing ratios had moderate risk of assaults (Staggs, 2013).

2.3.2.4 Firm size

While no studies found an association between risk of violence and firm size, firm size was associated with work disability. Studies have found large firm size to be associated with both shorter (Habeck et al., 1991; Hunt & Habeck, 1993; Cheadle et al., 1994) and longer (Dasinger et al., 2000; Krause et al., 2001b) duration of work disability. Smaller firms were also found to have shorter and longer RTW. Galizzi et al. (2016) found that blue-collar workers from smaller firms RTW sooner but Prang et al. (2016) found workers with mental health conditions working in a small organization was associated with a delayed RTW. Overall, the association with firm size is mixed.

2.4 Staffing ratio and RTW

Stakeholders and literature highlight staffing ratios as an amenable organizational factor that could address work disability among healthcare workers. A study on Canadian nurses suggested that among management interventions and strategies, sufficient daily staffing levels in particular can reduce workload and job stress, leading to a decrease in the incidence and costs of time-loss claims (O'Brien-Pallas et al., 2004). Both the BC Ministry of Health (2017) and BC Nurses' Union (2015) have published guidelines on staffing ratio specifically that would improve patient outcomes and staff outcomes such as staff illness, injury, and disability.

There is a lack of direct evidence on the association between staffing ratios and RTW but other factors related to RTW such as stress, workload, and job demands are associated with staffing ratios (Buchanan and Considine, 2002; Cornelius et al., 2011; Lake, 1998). For example, Buchanan and Considine (2002) conducted an Australian qualitative focus group study and found that the lack of appropriate staffing levels given patient acuity was a source of role stress for Registered Nurses (RNs). Lower nurse-to-patient ratios were also associated with unrealistic workloads, overtime, job demand, and stress, that in turn were associated with higher rates of sickness absences (Garrett, 2008; Lake, 1998).

2.5 Violence as an effect modifier between staffing ratio and RTW

Overall, the literature review suggests a relationship between staffing ratios and risk of violence, staffing ratios and RTW outcomes (albeit indirectly), and workplace violence and RTW outcomes. It is plausible that these relationships are all linked in one conceptual pathway, with violence playing an effect modifying role in the relationship between staffing ratios and RTW following a workplace injury.

Violence has not been examined as an effect moderator between RTW and organizational factors. In this study, it is hypothesized that the relationship between staffing ratios and RTW outcomes, specifically that lower ratios are associated with longer disability durations, would be larger for workers injured due to violence versus workers injured due to other causes. In other words, violence modifies the relationship, and this occurs because of the stress and sickness absences associated with both workplace violence and working with less than optimal staffing ratios (Jackson et al., 2002; Chang et al., 2005). Alternatively, workers in facilities with higher

staffing ratios are more likely to RTW, but the likelihood of RTW is lower for workers with violence-related injuries compared to workers with nonviolence-related injuries working in similar staffing ratios. Staffing ratios may have a greater effect on RTW outcomes for workers with violence-related injuries as higher staffing ratios may be a marker of greater social support in the workplace (MacKenzie et al, 1998), which can buffer the stress and psychological trauma that result from violence (Pinar and Ucmak, 2010).

2.6 Summary

Current research provides evidence of an association between violence, staffing ratios and RTW-related factors, but there is a lack of evidence examining violence and staffing ratios directly with RTW outcomes. Further, the type of injury is a potential effect modifier of the relationship between violence and RTW outcomes through psychological injury. Finally, the relationship between staffing ratios and RTW outcomes may be stronger or weaker depending upon the nature of injury (violence-related or nonviolence-related) through role stress and sickness absence mechanisms.

2.7 Research objective and hypotheses

This thesis has three objectives. The first objective is to examine differences in the proportions of injury types in violence-related injuries compared to nonviolence-related injuries among healthcare workers in British Columbia. The second objective is to investigate differences in likelihood of return-to-work among violence-related injuries and nonviolence-related injuries and if different injury types affect this relationship. The last objective of this research is to provide evidence of the relationship between staffing ratios and RTW outcomes in long term

care and how this relationship varies for workers with violence-related injuries and by organizational characteristics. Objectives one and two are explored in Study I, and objective three is explored in Study II.

It is hypothesized that:

1: Healthcare workers with violence-related injuries will have a higher proportion of psychological injuries than healthcare workers with nonviolence-related injuries.

2: Healthcare workers with violence-related injuries have a lower likelihood of return-to-work than healthcare workers with nonviolence-related injuries. There will be a greater difference when stratifying for psychological injuries.

3: Low staffing ratio is associated with low rates, moderate staffing ratio is associated with high rates, and high staffing ratio is associated with moderate rates of violence-related injuries. Healthcare workers working in higher staffing ratios will have a higher likelihood of RTW following a workplace injury than those working in lower staffing ratios. A smaller effect will be observed for those with a violence-related injury compared to those with a nonviolence-related injury in similar staffing ratios.

2.8 Conceptual framework

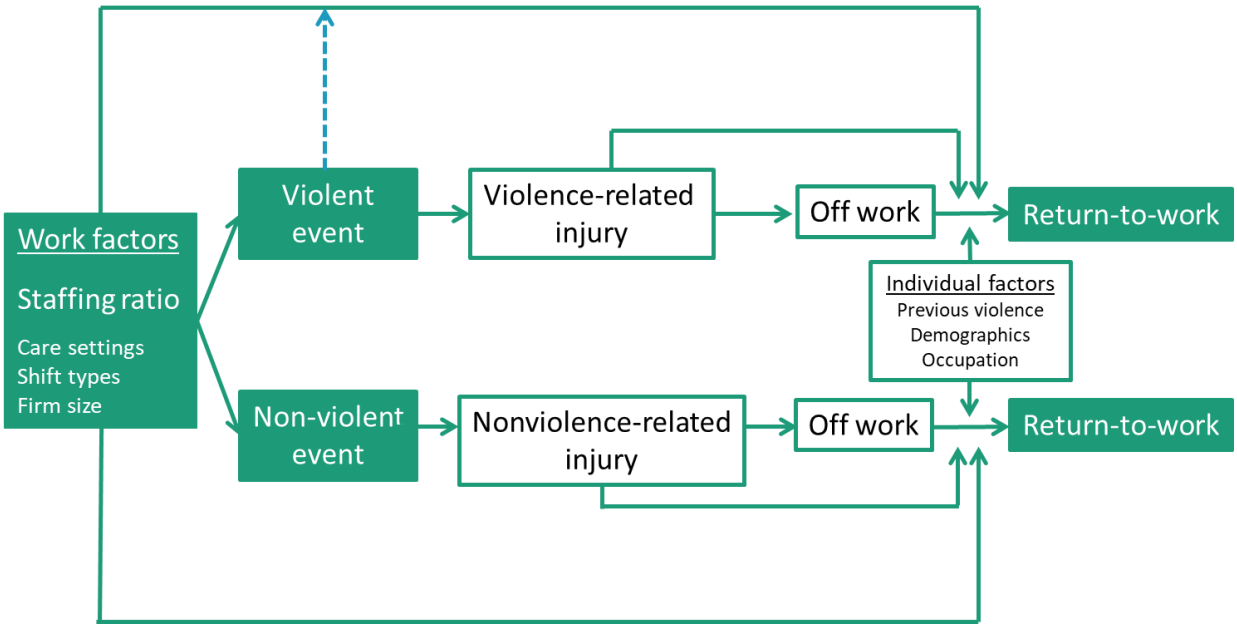


Figure 1 Conceptual model of impact of violence and organizational context on injured workers' return-to-work process.

The conceptual framework (Figure 1) shows the relationships between violence, staffing ratio and other organizational factors, individual factors, and RTW. The direct relationship supported by the literature between violence and RTW is shown in a solid green arrow, including the adjustment factors at the individual level (Research Questions 1 and 2). The moderating role of violence on the relationship between staffing ratio and RTW are shown by the dotted blue arrow, including the adjustment factors at the organizational level (Research Question 3) (Baloyi et al. 2014). Potential confounders include age, sex, wage, injury types, care settings, shift types, and firm size.

Chapter 3: "Injuries due to violence: how does this affect return-to-work?"

3.1 Introduction

This chapter presents the examination of objectives one and two as outlined in the previous chapter. Using workers' compensation data from the province of British Columbia (BC), we examined the proportions of injury types and differences in time to return-to-work (RTW) among healthcare workers in BC with violence-related injuries compared to nonviolence-related injuries.

It is hypothesized that

1: Healthcare workers with violence-related injuries will have a higher proportion of psychological injuries than healthcare workers with nonviolence-related injuries.

2: Healthcare workers with violence-related injuries have a lower likelihood of return-to-work than workers with nonviolence-related injuries. There will be a greater difference when stratifying for psychological injuries.

3.2 Methodology

3.2.1 Cohort

The study cohort included all accepted time-loss claims for healthcare workers with an injury date between January 1st, 2010 and December 31st, 2014 in BC with at least one day off work after injury.

Data was provided by WorkSafeBC, the provincial workers' compensation board of BC, Canada and includes detailed compensation claim records of approximately 98% of the workforce in BC

(AWCBC, 2017). WorkSafeBC maintains an administrative database containing information on compensation claims, including industry of employment (e.g. healthcare), type of benefit (e.g. time loss), type of injury (e.g. strain/sprain, psychological), nature of injury (e.g. violent incident), return-to-work (RTW) events, sociodemographic factors (e.g. age, sex), occupations (e.g. care aide, social worker), and employer characteristics (e.g. firm size).

Figure 2 depict a flowchart describing the construction of the cohort. Prior to any research decisions excluding claims for analysis, the cohort comprised 41,604 health care worker claims with lost time injuries for the period of 2010 and 2014. Workers under the age of 15 years and over the age of 64 years at the time of injury were excluded (representing 0.9% of claims). Occupations that provided direct care to patients and occupations with a suitable number of claims for analysis (composed more than 5% of total cohort) were included. Non-direct care occupations that were excluded were technicians, administrators, security, and hospitality workers. Occupations that had claim numbers below 5% of the total cohort included first responders, allied health professionals (e.g. occupational therapists, respiratory therapists) and physicians. Counselors and social workers, registered nurses, and nursing assistants/aides were the three occupation groups remaining in the final cohort.

Injury types not typically associated with violence were excluded from the cohort. A total of 14.9% of the cohort were excluded and these claims included burns, connective and musculoskeletal diseases, infectious and parasitic diseases, and diseases of organ systems. Six injury types remained in the final cohort: serious traumatic injury, spine and back sprains and strains, torso sprains and strains, upper extremities sprains and strains, non-traumatic non-sprain

injuries (contusions and cuts), and mental health injuries. Lastly, 9.3% of the cohort were excluded where two or more exclusions regarding age, occupation, or injury type would apply (for example, a food service worker over 65).

Claims with missing data for any of the study variables were excluded (N=32). One claim was excluded due to missing sex and 30 claims were excluded due to missing RTW data. The final cohort included 21,178 injured workers with accepted time-loss claims; 18,021 workers were workers with nonviolence-related injuries (WNVI) and 3,157 workers were workers with violence-related injuries (WVI).

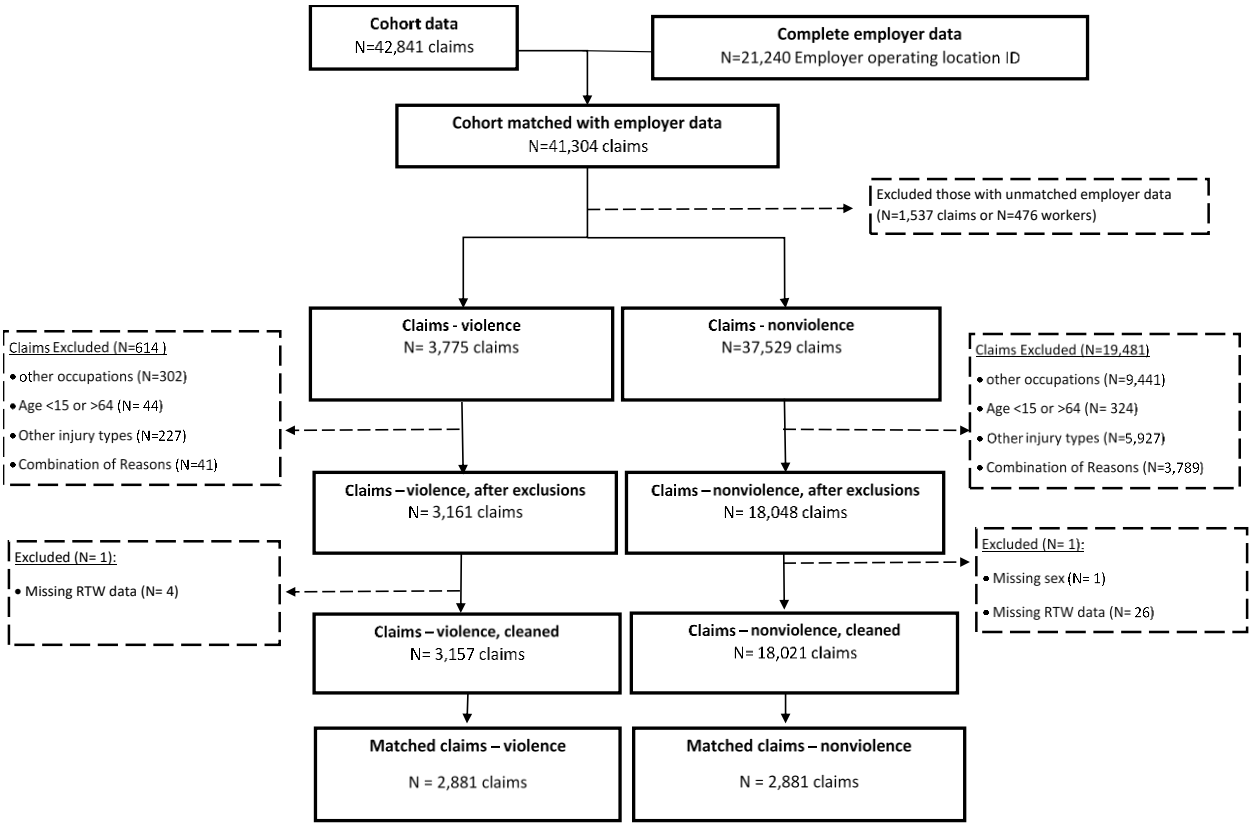


Figure 2 Cohort construction flowchart

3.2.2 Matching

Using methods applied in Maas et al. (2018), Coarsened Exact Matching (CEM) was used to balance differences between the non-exposed group (WNVIs) and the exposed group (WVIs) on observed characteristics that may be related to violence and RTW. For example, if violence-related injuries are more likely to occur during rotating shifts, there is a risk of potential bias due to an unequal distribution of workers in rotating shifts between WVIs and WNVIs. WVIs and WNVIs have different distributions of characteristics such as age, gender, and occupation, but matching allows for the comparison of WVIs and WNVIs with characteristics as similar as possible in order to examine the effect of violence on RTW.

Chi-square tests were conducted to identify matching variables, or covariates that had different distribution across WVIs and WNVIs. Matching variables included sex, age, injury types, occupations, and care settings. Covariates that did not have significantly different distributions across WVIs and WNVIs were shift types, wage, and firm size. These covariates were not used for matching purposes but were controlled for in the multiple regression analysis.

While previous violent injury and employer covariates were identified as having significantly different distributions across WVIs and WNVIs, they were not used for matching. Only a small number of WVIs had previous violent injury and most WVIs worked in LTC or social services. As a result, matching on these covariates would lead to considerable exclusions in the cohort. The final cohort was composed of 2,881 WVIs and 2,881 matched WNVIs.

3.2.3 Data linkage and privacy

Access to the administrative claims data was provided to approved members of the research team by the data steward WorkSafeBC.

3.2.4 Study design

A retrospective cohort study was used to examine the differences in RTW outcomes between healthcare staff with violence-related injuries and nonviolence-related injuries in British Columbia. Time-loss compensation claims between 2010 and 2014 were analyzed with one-year follow-up.

3.2.5 Study variables

3.2.5.1 Explanatory variable: violence

The primary explanatory variable of interest was "violence", defined as

> "the attempted or actual exercise by a person, other than a worker, of any physical force so as to cause injury to a worker, and includes any threatening statement or behaviour which gives a worker reasonable cause to believe that he or she is at risk of injury." (WorkSafeBC, 2016, p. 16)

If a worker was injured by an incident meeting WorkSafeBC's definition of violence, the accident type field of the injury claim was coded as a violence-related injury. Otherwise, the claim was coded as a nonviolent-related injury.

3.2.5.2 Outcome variable: Time to RTW

The primary outcome was time to RTW that measures the number of days an employee was off work, from the first day off work after injury to one year after injury. Time to RTW was constructed by counting the number of calendar days it took for an injured worker to RTW and remain at work up to one year after injury. Other events such as non-RTW and modified RTW days were considered off work.

3.2.5.3 Covariates

Sex - Sex was identified for each injured worker as either male or female.

Age - Age of the injured worker was determined by subtracting their year of birth year from their year of injury. The variable was then categorized into five 10-year categories: 15-24 years, 25-34 years, 35-44 years, 45-54 years, and 54-64 years.

Wage - Wage of the injured worker at the time of the injury was given in Canadian dollars and categorized into four categories: <$20,000, $20,000-$39,999, $40,000-$59,999, and >$60,000.

Occupation - WorkSafeBC claims data records occupation at the time of injury according to the Standard Occupational Classification developed by Statistics Canada (Statistics Canada, 2016). Three occupation groups were used for this study of healthcare workers: Counsellors/Social Workers/Therapists, Nursing Aides/Assistants, and Registered Nurses.

Injury Type - Injuries were coded in the workers' compensation claims data using the International Classification of Diseases-version 9. The six injury groups included in the cohort are: serious traumatic injuries (fractures, dislocations, open wounds, and amputations), spine and back sprains and strains, torso sprains and strains, upper extremities sprains and strains, non-traumatic non-sprain injuries (internal injuries, bruises, and contusions), and mental health injuries (stress, anxiety, and adjustment disorder).

Care Settings – Workers' compensation claims were coded for the classification unit of the employer at the time of the workers' injury. Classification units are assigned to employers covered by premium rate setting based on similar products, services, or processes produced or provided (WorkSafeBC, 2003). Care settings were grouped as follows: Acute Care, Community Health Support Services, Counselling or Social Services, Long-Term Care, Short-Term Care, Residential Social Service Facility, Life and Job Skills Training, and Retirement or Seniors' Home (accommodations only).

Previous violent injury - Some workers had multiple time-loss claims due to violence. Workers in the cohort with a time-loss claim due to violence within the past five years at the time of injury included in the analyses were coded as having had a previous violent injury.

Firm size – each claim was linked with the firm size of the worker's employer, which was given as person-years. Firm size was categorized into four categories: <100 person-years, 100-999.9 person-years, 1,000-9,999.9 person-years, and >=10,000 person-years.

Employer – worker's employers were grouped by the BC health authorities and remaining employers were grouped by care setting. For the purposes of the study, Health Authorities were de-identified. Categories included Health Authority 1, Health Authority 2, Health Authority 3, Health Authority 4, Health Authority 5, Forensic Psychiatric Services Commission, other long-term care, other social services, and other.

3.2.6 Analysis methodology

Differences in proportion of injury types by WVI and WNVI in the matched cohort were reported to answer research question 1. For research question 2, Kaplan-Meier survival curves were used to examine the effect of violence on time to RTW in the matched cohort. Cox regression models were used to examine the effect of violence on RTW relative to the other covariates and after adjusting for the effect of these covariates. Cox regression models used hazard ratios (HR) as the measure of association that can be interpreted as the likelihood of 'exiting injury disability' to RTW at a given time point, conditional on remaining off work in the previous time period. An HR greater than 1 indicates a higher likelihood of RTW in WVI compared to WNVI. Eight Cox regression models were created, starting with an unadjusted model with only violence as the explanatory variable for RTW. Covariates were added sequentially and monitored for changes in the HR in the following order: sociodemographics (age, wage, and sex), occupation groups, injury types, care settings, previous violence, and person years of the injured worker's employer. Adjusted models were stratified by injury types and occupations to answer research question 2, but models stratified for age, sex, and care settings were also conducted for exploratory purposes.

All Cox regression models including unadjusted, fully adjusted, and stratifications were tested for the assumption of proportionality. The assumption is met if survival curves for WVIs and WNVIs have hazards that are proportional over time, or constant relative to each other. This was done by testing for a non-zero slope of Schoenfeld residuals, the residuals of the model, over time (Cleves, 2008).

Piecewise hazard models were used to address the relationship between violence-related injuries and the likelihood of RTW in case of the violation of proportionality. These models split the one-year follow-up period and estimate separate HRs for each time interval defined by the split time. Cutoffs for time intervals were adapted from previous work that used piecewise hazards models to compare work disability duration across provinces in Canada (McLeod et al., 2017b). HRs were calculated for the following time intervals after injury: 0-30 days, 31-60 days, 61-90 days, 91-180 days, 181-270 days, and 271-365 days. Unadjusted and adjusted piecewise hazard models for the matched cohort as well as fully adjusted stratified models were conducted.

Results for several stratified piecewise models had low claim counts beyond six months after injury. As a result of these small sample sizes, stratified models for community health services, torso sprains and strains, and spine and back sprains and strains for the 180-270 days and 270-365 days after injury time intervals were not reported below in the results section[1].

[1] torso sprains and strains are located at ventral surfaces or the front of the body, while spine and back sprains and strains are located at dorsal surfaces or the back of the body.

3.3 Results

3.3.1 Descriptive statistics

Descriptive statistics are shown in Table 1 for both the matched and unmatched cohort. The cohort reflected similar proportions of covariates in the matched cohort. Among the matched cohort and as expected based on the matching process, Chi-squared tests indicated no significant differences (p value =1.0) in the distribution of sex, age, injury types, occupations, and care settings between WVIs and WNVIs. The proportion of workers with a previous violence related claim and the proportion of workers by employer size was significantly different for WVIs compared to WNVIs; this is not unexpected given these were unmatched covariates.

Using Chi-square tests, significant differences were found in the proportion of injury types among WVIs compared to WNVIs in the unmatched cohort ($p<0.00$). WVIs had a higher proportion of upper extremities sprains and strains (30.8%) and mental health injuries (7.3%) compared to WNVIs (25.3% and 0.7% respectively).

There were significant differences ($p<0.00$) in the proportion of workers with previous violence claims between WVIs and WNVIs. There was a larger proportion of WVIs with previous violent claims within the last five years compared to WNVIs. No other significant differences in proportions of covariates were found between WVIs and WNVIs in the matched cohort.

Most the matched cohort was female (89%) and older than 35 years of age (76%). The number of injured workers increased as age increased among the working age population from 15 to 24 years, but then decreased for the oldest age group of 55-64 years.

One-third of the matched cohort had upper extremities sprains and strains, the most common injury. The least common injury was mental health injuries that was found in only 3.6% of the matched cohort.

Nursing Aides/Assistants were the most common occupation group making up 48.8% of the matched cohort, followed by Registered Nurses at 28.9% and then Counsellor/Social Workers/Therapists at 22.3%.

Almost half (47.0%) of the matched cohort were injured in long-term care settings, followed by 28.2% of injuries in Acute Care, 10.7% in Residential Social Service Facilities, 5.6% in Counselling or Social Services, and 3.0% of injuries occurred in Community Health Support Services. More than 60% of injuries took place in non-hospital or non-acute care settings.

Table 1 Descriptive statistics of the matched cohort and unmatched cohort of health care workers to investigate the relationship between workplace violence and return to work

	Matched cohort (N=5,762)			**Unmatched cohort (N=21,178)**		
	Nonviolence Claims N= 2,881 (50.0%)	Violence Claims N= 2,881 (50.0%)	Chi-squared P-value	Nonviolence Claims N= 18,047 (85.1%)	Violence Claims N=3,161 (14.9%)	Chi-squared P-value
Sex			1.00			<0.00
- Male	316 (11.0%)	316 (11.0%)		1,600 (8.9%)	427 (13.5%)	
- Female	2,565 (89.0%)	2,565 (89.0%)		16,421 (91.1%)	2,730 (86.5%)	
Age in years			1.00			<0.00
- 15-24	114 (4.0%)	114 (4.0%)		566 (3.1%)	153 (4.8%)	
- 25-34	579 (20.1%)	579 (20.1%)		3,399 (18.9%)	650 (20.6%)	
- 35-44	772 (26.8%)	772 (26.8%)		4,500 (25.0%)	832 (26.3%)	
- 45-54	949 (32.9%)	949 (32.9%)		5,936 (32.9%)	1,019 (32.3%)	
- 55-64	467 (16.2%)	467 (16.2%)		3,620 (20.1%)	503 (15.9%)	
Injury Types			1.00			<0.00
- Serious Traumatic Injuries	130 (4.5%)	130 (4.5%)		853 (4.7%)	155 (4.9%)	
- Spine and Back Sprains & Strains	584 (20.3%)	584 (20.3%)		6,165 (34.2%)	592 (18.7%)	
- Torso Sprains & Strains	348 (12.1%)	348 (12.1%)		4,608 (25.6%)	352 (11.1%)	
- Upper Extremities Sprains & Strains	959 (33.3%)	959 (33.3%)		4,558 (25.3%)	974 (30.8%)	
- Non-Traumatic Non-Sprain Injuries	756 (26.2%)	756 (26.2%)		1,710 (9.5%)	854 (27.0%)	
- Mental Health Injuries	104 (3.6%)	104 (3.6%)		127 (0.7%)	230 (7.3%)	
Occupation			1.00			<0.00
- Counsellor/Social Workers/Therapists	642 (22.3%)	642 (22.3%)		2,310 (12.8%)	773 (24.5%)	
- Nursing Aides/Assistants	1,405 (48.8%)	1,405 (48.8%)		9,834 (54.6%)	1,479 (46.8%)	
- Nurses	834 (28.9%)	834 (28.9%)		5,877 (32.6%)	905 (28.7%)	
Care Setting			1.00			<0.00
- Acute Care	813 (28.2%)	813 (28.2%)		5,798 (32.2%)	872 (27.6%)	
- Community Health Support Services	87 (3.0%)	87 (3.0%)		2,107 (11.7%)	106 (3.4%)	

-	Nonviolence Claims N= 2,881 (50.0%)	Violence Claims N= 2,881 (50.0%)	Chi-squared P-value	Nonviolence Claims N= 18,047 (85.1%)	Violence Claims N=3,161 (14.9%)	Chi-squared P-value
- Counselling or Social Services	161 (5.6%)	161 (5.6%)		683 (3.8%)	187 (5.9%)	
- Life and Job Skills Training	48 (1.7%)	48 (1.7%)		195 (1.1%)	58 (1.8%)	
- Long-Term Care	1,354 (47.0%)	1,354 (47.0%)		7,773 (43.1%)	1,404 (44.4%)	
- Residential Social Service Facility	308 (10.7%)	308 (10.7%)		705 (3.9%)	369 (11.7%)	
- Retirement or Seniors' Home (accommodation only)	11 (0.4%)	11 (0.4%)		182 (1.0%)	14 (0.4%)	
- Short-Term Care	85 (2.9%)	85 (2.9%)		401 (2.2%)	121 (3.8%)	
- Other	14 (0.5%)	14 (0.5%)		177 (1.0%)	26 (0.8%)	
Person Years			0.075			<0.00
- <100 person years	654 (22.7%)	640 (22.2%)		3,315 (18.4%)	730 (23.1%)	
- 100-999.9 person years	941 (32.7%)	1,024 (35.5%)		5,336 (29.6%)	1,121 (35.5%)	
- 1,000-9,999.9 person years	790 (27.4%)	720 (25.0%)		5,881 (32.6%)	779 (24.6%)	
- >=10,000 person years	496 (17.2%)	497 (17.2%)		3,515 (19.5%)	531 (16.8%)	
Shift Type			0.11			0.01
- Fixed	467 (16.2%)	412 (14.3%)		2,496 (13.8%)	489 (15.5%)	
- Rotating	649 (22.5%)	681 (23.6%)		3,931 (21.8%)	726 (23.0%)	
- Variable	1,765 (61.3%)	1,788 (62.1%)		11,594 (64.3%)	1,942 (61.5%)	
Wage per annum ($ Canadian)			0.14			0.96
- <$20,000	115 (4.0%)	96 (3.3%)		641 (3.6%)	113 (3.6%)	
- $20,000-$39,999	1,061 (36.8%)	1,016 (35.3%)		6,448 (35.7%)	1,127 (35.7%)	
- $40,000-$59,999	1,140 (39.6%)	1,146 (39.8%)		6,945 (38.5%)	1.230 (40.0%)	
- >$59,999	565 (19.6%)	623 (21.6%)		3,994 (22.2%)	687 (21.8%)	
Previous Violence Claims			<0.00			<0.0
- Previous violence claim exists within last 5 years	226 (7.8%)	540 (18.7%)		1,294 (7.2%)	586 (18.6%)	
- No previous violence claim within last 5 years	2,655 (92.2%)	2,341 (81.3%)		16,727 (92.8%)	2,571 (81.4%)	
Employer			<0.00			<0.0

-		Nonviolence Claims N= 2,881 (50.0%)	Violence Claims N= 2,881 (50.0%)	Chi-squared P-value	Nonviolence Claims N= 18,047 (85.1%)	Violence Claims N=3,161 (14.9%)	Chi-squared P-value
-	Health Authority 1[2]	350 (12.1%)	442 (15.3%)		2,760 (15.3%)	482 (15.3%)	
-	Health Authority 2	326 (11.3%)	255 (8.8%)		2,151 (11.9%)	267 (8.5%)	
-	Health Authority 3	271 (9.4%)	210 (7.3 %)		2,047 (11.4%)	239 (7.6%)	
-	Health Authority 4	290 (10.1%)	271 (9.4%)		1,980 (11.0%)	286 (9.1%)	
-	Health Authority 5	81 (2.8%)	65 (2.3%)		583 (3.2%)	71 (2.2%)	
-	Forensic Psychiatric Services Commission	14 (0.5%)	53 (1.8%)		48 (0.3%)	63 (2.0%)	
-	Other Long-Term Care	860 (29.8%)	898 (31.2%)		5,027 (27.9%)	919 (29.1%)	
-	Other Social Services	510 (17.7%)	497 (17.2%)		2,281 (12.6%)	583 (18.5%)	
-	Other	179 (6.2%)	190 (6.6%)		1,147 (6.4%)	247 (7.8%)	

3.3.2 Cox regression model results

Results for the unadjusted and adjusted Cox regression models using the matched cohort are shown in Table 2. The HR for the likelihood of RTW associated with WVIs compared to WNVIs was 0.98 (95% CI: 0.93-1.04) in the unadjusted model, and 1.00 (95% CI: 0.94-1.05) in the adjusted model. There was no significant difference in their likelihood of RTW within one year after injury. Covariates that were significantly associated with a decreased likelihood of RTW included older age compared to the youngest age group, mental health and upper extremity injuries compared to traumatic injuries, and rotating or variable shifts compared to fixed shifts.

[2] Employers were anonymized for privacy reasons, and Health Authorities as the largest employers were numbered randomly.

Covariates that were significantly associated with an increased likelihood of RTW included male sex, and nursing occupations compared to counselling and therapy occupations. Covariates that had no significant association with RTW included employee wage, employer size and care setting.

Table 2 Differences in Hazard Ratio of Time to RTW for adjusted and unadjusted models in the matched cohort

	Variable value	Hazard ratio (95% CI)
Unadjusted Model		
Violence	Non-Violence	Ref
	Violence	0.98 [0.93-1.04]
Fully adjusted model		
Violence	Non-Violence	Ref
	Violence	1.00 [0.94-1.05]
Age	15-24	Ref
	25-34	0.93 [0.80-1.07]
	35-44	0.78 [0.67-0.90]
	45-54	0.75 [0.65-0.86]
	55-64	0.74 [0.64-0.87]
Sex	Female	Ref
	Male	1.13 [1.03-1.23]
Wage	<$20,000	Ref
	$20,000-$39,999	1.08 [0.93-1.26]
	$40,000-$59,999	1.11 [0.95-1.30]
	>=$60,000	1.10 [0.93-1.31]
Occupation	Counselors and Social Workers	Ref
	Nursing Aides/Assistants	1.17 [1.04-1.31]

	Hazard ratio (95% CI)	Variable value
	Registered Nurses	1.15 [1.01-1.32]
Injury Types	Serious Traumatic Injuries	Ref
	Spine and Back Sprains & Strains	0.93 [0.81-1.07]
	Torso Sprains & Strains	0.99 [0.85-1.15]
	Upper Extremities Sprains & Strains	0.84 [0.74-0.97]
	Non-Traumatic Non-Sprain Injuries	1.38 [1.20-1.59]
	Mental Health Injuries	0.56 [0.46-0.69]
Presence of Previous Violence Claims	No	Ref
	Yes	0.92 [0.85-1.00]
Care Setting	Acute Care	Ref
	Community Health Support Services	0.98 [0.82-1.19]
	Counselling or Social Services	1.00 [0.82-1.21]
	Long-Term Care	0.99 [0.89-1.11]
	Short-Term Care	1.15 [0.94-1.40]
	Residential Social Service Facility	1.10 [0.93-1.30]
	Life and Job Skills Training	1.07 [0.82-1.39]
	Retirement or Seniors' Home (accommodation only)	1.09 [0.70-1.70]
	Others	0.97 [0.64-1.49]
Shift Types	Fixed	Ref
	Rotating	0.84 [0.76-0.93]
	Variable	0.77 [0.71-0.86]
Person years of employer	<100 person years	Ref
	100-999.9 person years	0.98 [0.90-1.06]
	1,000-9,999.9 person years	1.08 [0.98-1.20]
	>=10,000 person years	1.05 0.91-1.21]

3.3.3 Stratified Cox regression results

Stratifications of the fully adjusted model were conducted to investigate if the HR for the relationship between violence related injuries and the likelihood of RTW varied by levels of covariates. HRs for the stratification models among the matched cohort are shown in Table 3.

In the stratified model for counselors/social workers, violence-related injuries were associated with a lower likelihood of RTW compared to nonviolence related injuries (HR=0.88 (95% CI: 0.78-1.00)). This relationship was not observed for registered nursing and nursing aid occupation groups.

In the model stratified for workers with upper extremities sprains and strains, violence-related injuries were associated with a higher likelihood of RTW compared to nonviolence-injuries (HR=1.12 (95% CI: 1.02-1.23). Conversely, for workers with mental health injuries, there was a lower likelihood of RTW if these injuries were violence-related compared to nonviolence-related (HR=0.61 (95% CI: 0.43-0.86)). Differences by violence-related injuries and RTW was not observed for stratified models by other injury types.

The model stratified for workers in residential social service facilities showed an HR of 0.81 (95% CI: 0.68-0.96), indicating that injuries due to violence are less likely to RTW compared to injuries due to nonviolence in these types of facilities. This was not observed for workers in the other types of care settings. There were also no observed associations between violence-related injuries and likelihood of RTW within shiftwork, wage, prior violence, or gender strata.

Table 3: Cox regression Hazard Ratios for likelihood of RTW for WVI versus WNVI in adjusted stratified models

Strata		**Violence Hazard Ratio [95% CI]**	***N***
Socio-demographics	Age >35	1.00 [0.94-1.07]	4,215
	Age =<35	0.99 [0.89-1.10]	1,547
	Males	1.03 [0.86-1.22]	632
	Females	1.00 [0.94-1.06]	5,130
	Wage <$20,000	1.09 [0.80-1.50]	211
	Wage $20,000-39,999	0.99 [0.90-1.09]	2,077
	Wage $40,000-59,999	0.97 [0.89-1.06]	2,286
	Wage >$60,000	1.06 [0.94-1.20]	1,188
Occupation	Counselors/Social Workers	0.88 [0.78-1.00]	1,284
	Nursing Aides/Assistants	1.05 [0.97-1.14]	2,810
	Nurses	1.03 [0.93-1.14]	1,668
Injury Type	Serious Traumatic Injuries	1.08 [0.83-1.41]	260
	Spine and Back Sprains & Strains	0.96 [0.84-1.08]	1,168
	Torso Sprains & Strains	0.88 [0.75-1.03]	696
	Upper Extremities Sprains & Strains	1.12 [1.02-1.23]	1,918
	Non-Traumatic Non-Sprain Injuries	0.99 [0.89-1.10]	1,512
	Mental Health Injuries	0.61 [0.43-0.86]	208
Care Setting	Acute Care	1.06 [0.95-1.17]	1,626
	Community Health Support Services	0.98 [0.70-1.37]	174
	Counselling or Social Services	0.88 [0.68-1.13]	322
	Long-Term Care	1.04 [0.96-1.13]	2,708
	Residential Social Service Facility	0.81 [0.68-0.96]	616
Presence of Previous	No	1.00 [0.95-1.06]	4,996
Violence Claims	Yes	0.99 [0.84-1.17]	766
Shift types	Fixed	0.94 [0.81-1.10]	879
	Rotating	1.08 [0.96-1.21]	1,330
	Variable	0.99 [0.93-1.07]	3,553

3.3.4 Piecewise hazard regression model results

3.3.4.1 Overall cohort

Unadjusted and fully adjusted piecewise hazard models for the overall matched cohort are shown in Figure 3. Little change was observed in the HRs between the adjusted and unadjusted piecewise models. In the first 30 days, the adjusted model showed a 10% higher likelihood of RTW (HR: 1.10, 95% CI:1.03-1.18) for WVIs compared to WNVIs. Between 31-60 days after injury, there was no significant difference in the likelihood of RTW between WVIs versus WNVIs (HR:0.95, 95% CI: 0.83-1.09). Between 61-90 days and 91-180 days after injury, WVIs versus WNVIs had a lower likelihood of RTW (HR: 0.76, 95% CI: 0.63-0.90 and HR: 0.74, 95% CI: 0.62-0.88 respectively). After 180 days post injury, no statistically significant differences were found in the likelihood of RTW between WVIs and WNVIs.

3.3.4.2 Stratifications

Most stratification models had similar results as the fully adjusted model described above for all matched injuries. Adjusted piecewise models stratified for injury types, occupations, care settings, and shift types are shown in Figures 4, 5, 6, and 7 respectively. Full tabular regression results can be found in Appendix B.

Among injury types, upper extremities sprains and strains showed a trend similar to the full cohort. However, serious traumatic injuries showed no differences in the likelihood of RTW among violence-related injuries versus nonviolence-related injuries, except at 180-270 days after injury where violence-related injuries were less likely to RTW. Non-traumatic non-sprain injuries also showed no differences in the likelihood of RTW in violence-related injuries

compared to nonviolence-related injuries, except at 270-365 days after injury where violence-related injuries were more likely to RTW.

Counselors and social workers showed a lower likelihood of RTW for violence-related injuries at 31-60 days (HR: 0.67, 95% CI: 0.48-0.95), 61-90 days (HR: 0.46, 95% CI: 0.30-0.69), and at 91-180 days (HR: 0.69, 95% CI:0.46-1.02) after injury.

Both long term care and residential social services facility stratifications showed a lower likelihood of RTW for WVIs at 91-180 days after injury. At 91-180 days after injury, there was a HR of 0.73 (95% CI: 0.57-0.94) in long term care and a HR of 0.23 (95% CI: 0.12-0.44) in residential social service facilities.

There were lower likelihoods of RTW if a WVI occurred when a worker was working fixed shifts and variable shifts, but not rotating shifts. Among fixed shifts, an HR of 0.55 (95% CI: 0.33-0.91) and a HR of 0.49 (95% CI: 0.29-0.84) was found at 61-90 days and 91-180 days after injury respectively. In the variable shifts stratification, a HR of 0.80 (95% CI: 0.65-1.00) and a HR of 0.79 (95% CI: 0.64-0.97) was found at 61-90 days and 91-180 days after injury respectively. No differences in likelihood of RTW were observed in rotating shifts at any time interval.

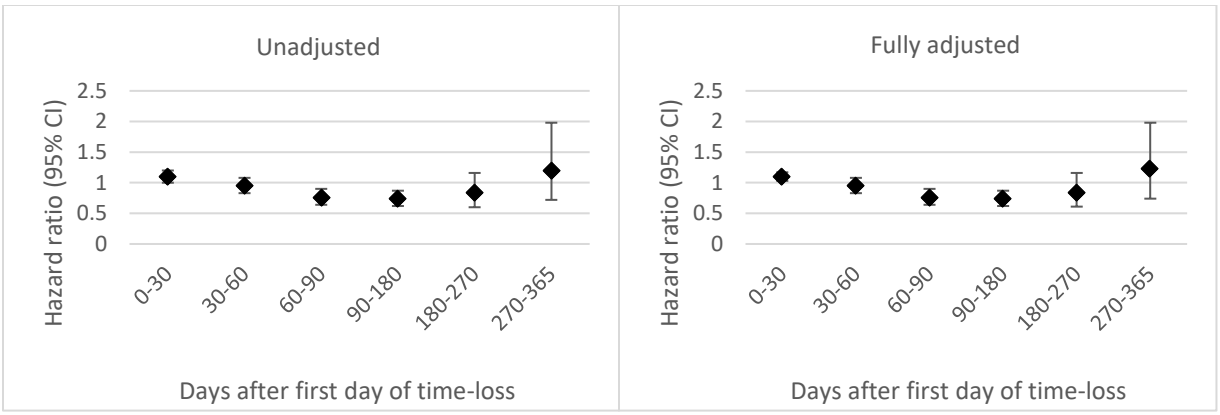


Figure 3 Unadjusted and fully adjusted piecewise hazard models for the matched cohort

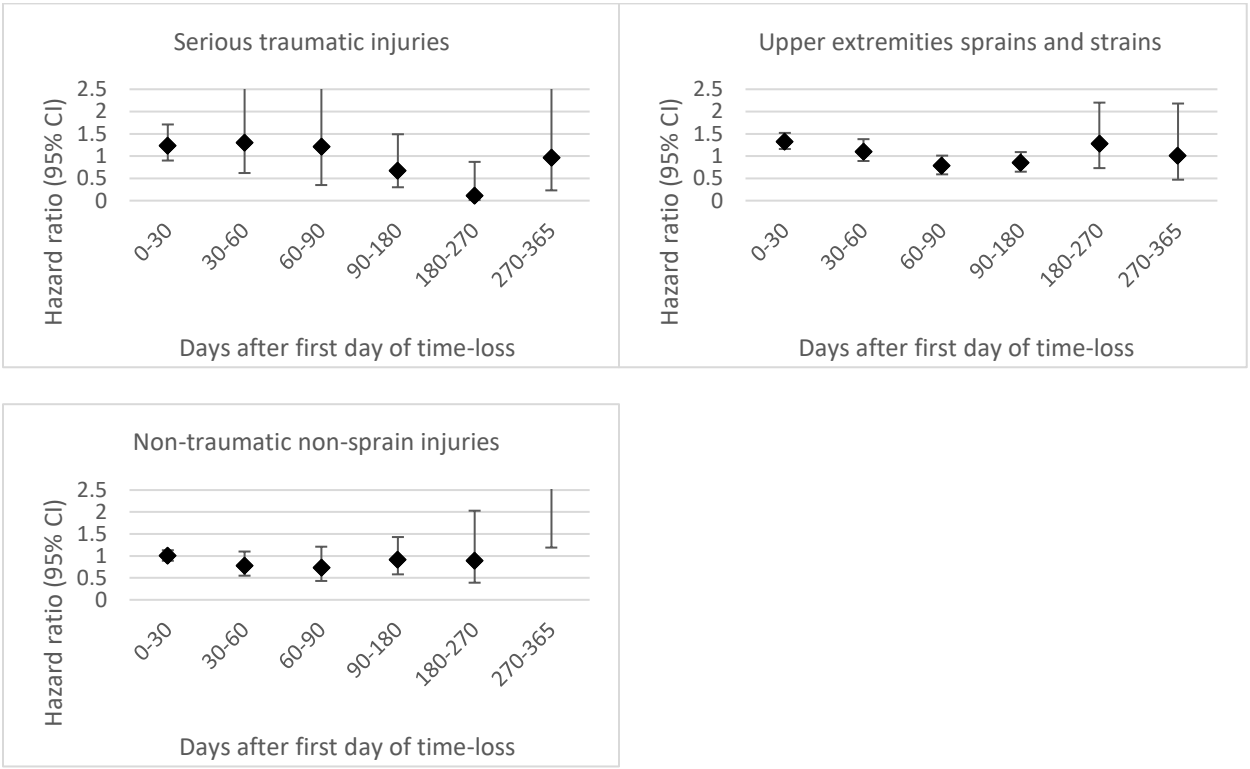


Figure 4 Adjusted piecewise hazard models stratified by injury type

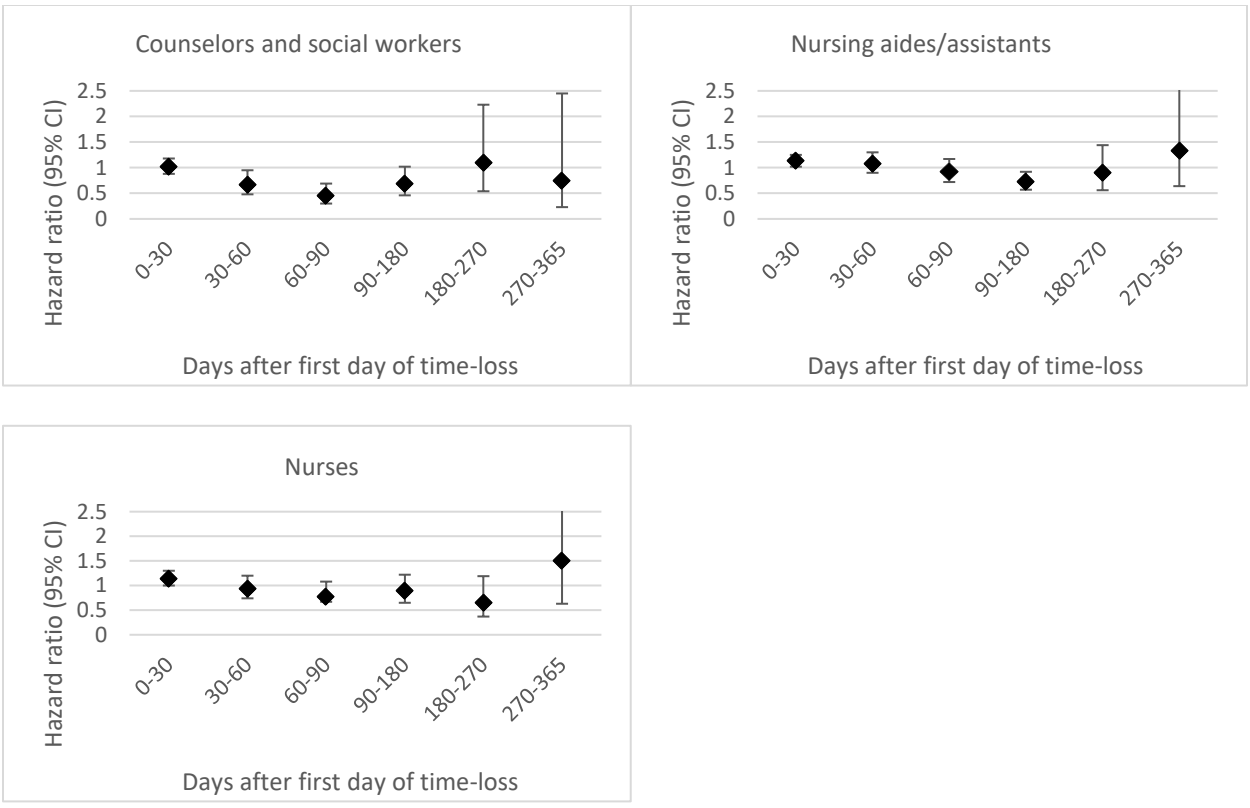


Figure 5 Adjusted piecewise hazard models stratified by occupations

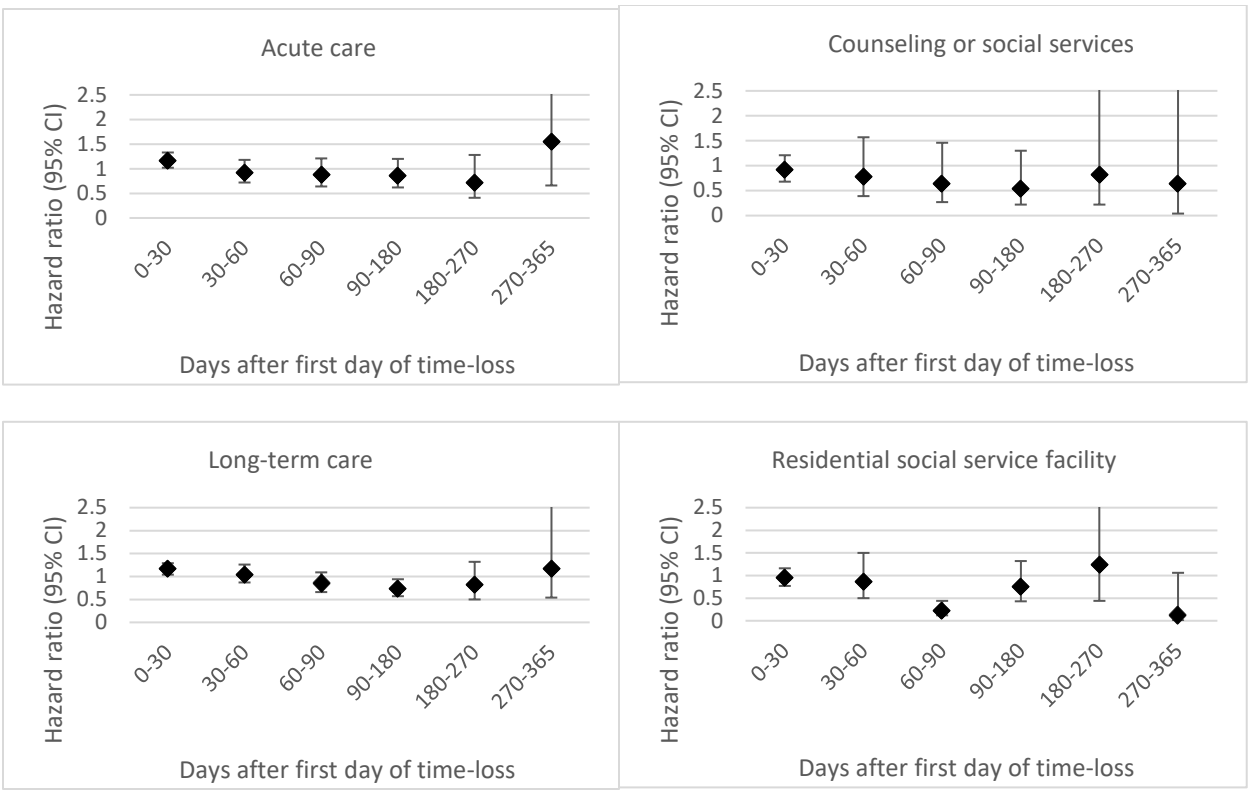


Figure 6 Adjusted piecewise hazard models stratified by care settings

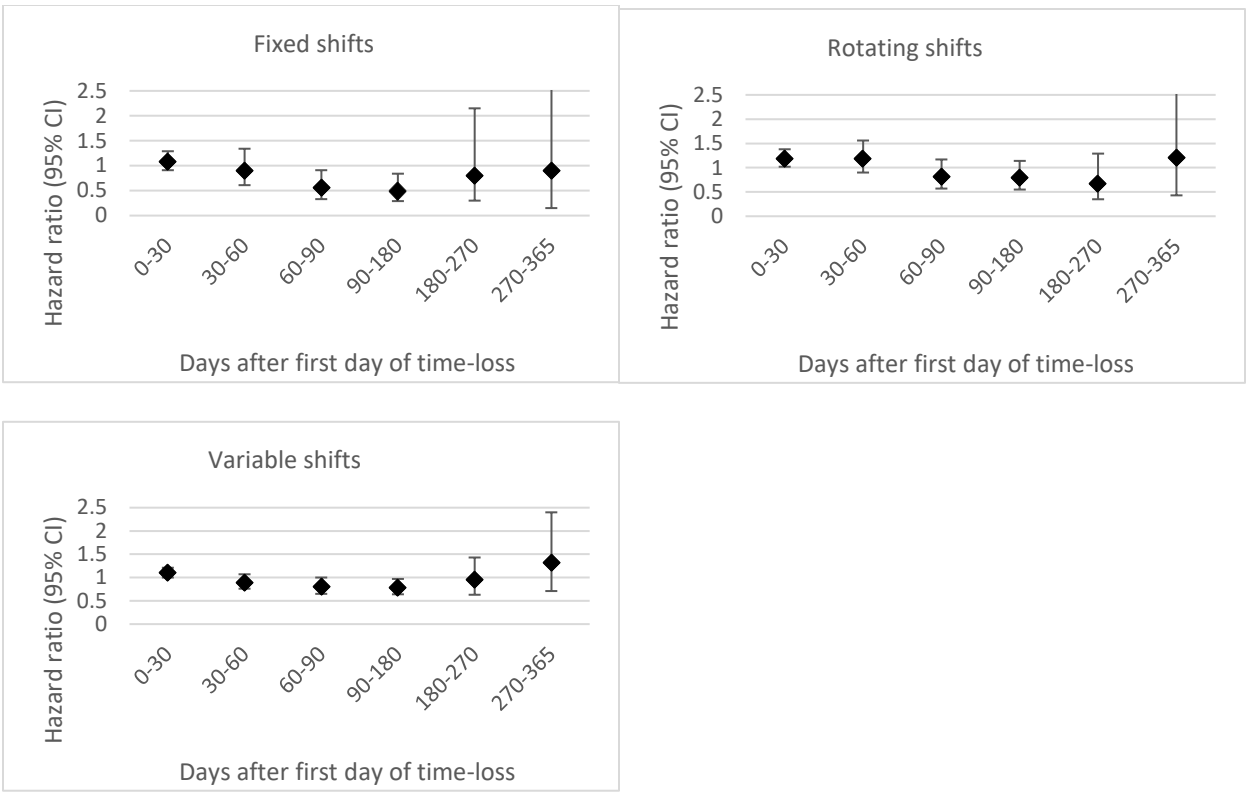


Figure 7 Adjusted piecewise hazard models stratified by shift types

3.4 Discussion

3.4.1 Injury types associated with violence

WVIs had a higher proportion of mental health injuries, supporting the first study hypothesis. Other studies havefound similar results that support this finding. A study by Hashemi and Webster (1998) found compensation claims (16.7%) due to nonfatal workplace violence had had a high proportion of mental stress among workers in healthcare, education, banking, security, retail, and restaurants. Hogh et al. (2003) found Danish workers who were exposed to physical violence or verbal threats were three times more likely to be stressed and fatigued compared to non-exposed workers. Higher relative risks of depression and stress have also been found among workers with potential exposure to occupational violence, possibly due to similarities with post-

traumatic stress disorder that translate stressful events into emotional disorders (Wieclaw et al., 2006).

In the current study, there were observed differences in the proportions of other injuries resulting from violence. WVIs had a higher proportion of upper extremities sprains and strains and non-traumatic non-sprain injuries (contusions and bruises) than WNVIs. A study on workers' compensation claims among nurses in Ontario in 1994 support these findings; contusions were the most common injury type among violence-related compensation claims, followed by sprains and strains (Liss, 1994).

3.4.2 Violence and RTW

While there was no relationship in the Cox proportional hazard model between RTW and violence and nonviolence injuries, a relationship was found in the piecewise hazard models. In the overall cohort, WVIs had a higher likelihood of RTW 30 days after injury, but then lower likelihood of RTW 30 to 180 days after injury, compared to WNVIs. After 180 days, no differences were seen as many workers still off work remained off work up until the end of the study follow-up of 365 days.

Fully adjusted Cox regression models stratified for mental health injuries showed a HR of 0.61, indicating that WVIs were 39% less likely to RTW compared to WNVIs. Workers with mental health injuries were associated with lower likelihood of RTW regardless of whether it was due to violence or nonviolence. However, WVIs with mental health injuries were associated with an

even lower likelihood of RTW compared to WNVIs with mental health injuries, supporting the second hypothesis.

There may be a risk of immortal time bias among workers with mental health injuries, which could have lead the results toward the null. Immortal time bias occurs when there is a delay in the determination of an individual's treatment status in which follow-up time is accrued (Levesque et al., 2010). For example, in order to be diagnosed with a mental health claim an injured worker must stay off-work for a period of time. Delays in diagnosis and accepting compensation claims due to mental health injuries are common because of cross-checking claims and conflicting medical opinions (Brijnath et al., 2014). However, this delay may affect WVIs more in particular because WVIs are likely to have mental health injuries, as shown in the research literature (Hashemi and Webster, 1998; Hogh et al., 2003). More WVIs with mental health injuries that would have stayed off-work would not be included in analysis and the actual HR for mental health injuries may be smaller than reported.

Time-dependent RTW is not new in the RTW literature. A review conducted by Krause et al. (2001b) that examined factors associated with RTW distinguished work disability duration by three disability phases: acute (up to 30 days of work disability), subacute (30-90 days), and chronic disability (more than 90 days). One study by Dasinger et al. (2010) found WVIs who RTW within the first 30 days may possibly have minor injuries and less severe violent interactions, allowing faster RTW. However, those who have more severe injuries requiring more time for treatment or severe violent events that result in chronic pain and/or psychological trauma are less likely to RTW and are more likely to stay off work. Minor sprains and strains

related to violence could result in mainly short-term sickness absence but anxiety, depression, and stress could result in longer sickness absence.

There is a lack of literature that can explain time-dependent differences in the likelihood of RTW between WVIs and WNVIs. One possible explanation can be due to the differences in compensation by the nature of injury. For example, a minor physical nonviolence-related injury may not require time-loss compensation. However, the same physical injury due to violence may qualify for time-loss compensation because of a minor secondary injury diagnosis such as mental health injuries. Both minor injuries may have similar times to RTW but workers with minor nonviolence-related injuries did not have time off work and were excluded, showing more WVIs who RTW faster within the first 30 days after injury. WVIs who RTW more than 30 days after injury may have severe secondary mental health injuries in addition to severe physical injury such as post-traumatic stress disorder and major depressive disorder that could take longer to RTW compared to WNVIs with severe physical injuries.

After 180 days of work disability, no differences in likelihood of RTW between WVIs and WNVIs were observed. By 180 days it is likely that the majority of the cohort has already RTW and very few WVIs and WNVIs RTW as a result. Studies have found similar findings where the probability of RTW decreases as length of time away from work increases (Krause et al., 2001b; McIntosh et al., 2000). In the study conducted by McIntosh et al. (2000), the authors postulated that the lower probability of RTW could be due to longer lag time from injury to treatment, which led to longer cumulative time receiving benefits. However, neither studies address why no differences in likelihood of RTW were observed between WVIs and WNVIs. A reason why both

WNVIs and WVIs are just as unlikely to RTW could be due to chronic conditions, delaying their ability to RTW. Violence as the source of injury becomes less relevant the longer an injured worker remains off-work.

WVIs in counseling or social services occupations were less likely to RTW at 30-60 and 61-90 days compared to WNVIs in counseling or social services occupations. The awareness of violence in healthcare by work environments such as hospitals and long-term care facilities has steadily improved support systems and preventative measures for nurses and nursing assistants who are affected by violence. Working in other care settings, such as where the majority of social services or counseling may take place on out-patient basis, may not have the same resources to address the risk of violence, resulting in more severe injuries, challenges returning to the same work environment, and more detrimental effect of violence on RTW.

While violence-related claims were more likely to RTW within the first 30 days after injury, interventions could be focused on workers likely to stay off work after the first 30 days as they may remain off work permanently. A study examining psychosocial job factors and RTW found that high job control was associated with a 30% increase in RTW rates but only during the subacute/chronic disability phase of 30 days after injury (Krause et al., 2001a). High job control was determined by low job strain and having good control over work scheduling. Workers in Krause's study who had high psychological work burden were less likely to RTW, similar to how workers with mental health injuries due to violence in our study were less likely to RTW.

Among shift types, WVIs working in fixed shifts had a significantly lower likelihood of RTW compared to WNVIs working in fixed shifts, specifically after the first 30 days after injury. There is no literature to help explain why violence has a negative effect among fixed shift workers on RTW outcomes compared to fixed shift workers injured due to other causes. The finding in the current study of a decreased likelihood of RTW among fixed shift could be related to occupations as most injured workers working in fixed shifts were counselors and social workers. Rather than different shift types, they may have had different sets of patients and resources available compared to nurses and nursing assistants that may have affected their likelihood of violence and likelihood of RTW.

Musculoskeletal injuries due to violence with lower likelihood of RTW compared to musculoskeletal injuries due to nonviolence may be explained by a secondary diagnosis of mental health injuries. Studies show that workplace violence has been associated with stress and mental health problems in addition to physical injury (Barling, 1996; Budd et al., 1996; Rogers & Kelloway, 1997; Campolieti et al., 2008) and workers with physical injuries and comorbid mental health injuries are less likely to RTW. In a study using administrative data from a workers' compensation board psychological trauma program in Toronto, having a secondary psychiatric diagnosis was significantly associated with not working at time of assessment (Hensel et al., 2011). The presence of secondary mental health injuries could identify musculoskeletal injuries that may have longer duration due to co-morbid issues, providing a more accurate analysis of the role of injury types as a modifier in violence and RTW. Secondary diagnosis was not available for this study but warrants investigation in future studies.

3.4.3 Strengths

This study has several strengths. It is one of the first studies to directly examine RTW outcomes with violence and staffing ratios as the independent variables. It is also one of the first studies to show injury type as an effect modifier between violence and RTW.

The current study utilized large comprehensive workers' compensation data with limited exclusions and broad inclusion criteria, allowing the study population to be representative as much as possible to other healthcare workers injured due to workplace violence. Using a provincial-wide dataset al.so provided a large study cohort, providing the ability to create multiple stratification groups to investigate the effect of violence-relate injuries on RTW among sub-groups of the health care population.

Coarsened Exact Matching methods allowed for the reduction of bias and estimation error by matching or balancing health care workers with violence and non-violence injuries included in the analysis on key study covariates. Matching violence and nonviolence-injured workers on covariates such as care settings and occupations served as a method to examine RTW by differences attributed to the presence of violence.

3.4.4 Limitations

Several limitations exist in the methodology that reduce the generalizability of the study's findings beyond the current study cohort of healthcare workers in BC. The statistical power of piecewise and Cox regression analysis was reduced for the longest disability duration windows, especially the 181-365 day window as less workers remain off work for this time. Reduced

sample size increased the confidence intervals around the estimates for the effect of violence on RTW, decreasing the accuracy of results near the end of the one-year follow-up period. Results were more stable for the piecewise models up to 180 days after injury.

While we controlled for a rich set of covariates, confounding was reduced only as much as there were covariates for the determinants of RTW and factors associated with workplace violence and injuries. Most covariates in the adjusted model did not affect the effect size of the main outcome significantly. There are other relevant variables that may affect RTW outcomes, such as severity of violence/severity of injury and employer interventions, which were not available for the current study. Severity of injury would result in different treatment times affecting time to RTW (Campolieti et al., 2008). Timing of employer offers of accommodations to RTW to the injured employee were found to have influenced time off work in previous studies (Krause et al., 2001a; Cancelliere, 2016). Taken together, an employer could respond differently depending on violence and nonviolence-related injuries in order to increase RTW rates.

While the study cohort involved all injured workers in the healthcare and social services sector of BC, measures of associations should always be interpreted with contextual information. For example, WorkSafeBC may have a different definition of violence, RTW events, and covariates compared to other workers' compensation boards in different provinces. WorkSafeBC's definition of violence emphasizes a physical aspect, while SafeWork Manitoba includes verbal assaults in addition to physical assaults in their definition of violence. Different contextual factors related to disability compensation benefits, RTW programs, and workplace organization of health units in different provinces can vary and could lead to different results.

3.5 Conclusion

Findings from the study provide evidence that violence is more likely to be associated with mental health injuries and that mental health injuries exacerbate the negative effect that violence has on the likelihood of RTW. Intervention efforts should be focused on workers with mental health injuries especially if it was due to violence, and on strategies identifying workers who are likely to stay off work after the first 30 days after violent injury. Other important factors that affect the relationship between violence and RTW include care settings, shift types and occupation.

Further research with additional relevant covariates would supplement workers' compensation data and strengthen study findings. Identifying important variables not included in the study such as severity of injury or violence may be key to identifying those workers who will not RTW until after 30 days after injury and are more likely to remain off work.

Chapter 4: "A pilot study of staffing ratio, violence, and return-to-work after work injury in the long-term care sector"

4.1 Introduction

Different guidelines on staffing ratios, or staff-to-patient ratios, were suggested to provide adequate patient care and decrease work pressure among local stakeholders (BCCPA, 2009; Ministry of Health, 2017; BC Nurses' Union, 2015). Staffing ratios are organizational workplace factors that may be related to the risk of violence-related injury and RTW after these injuries. The literature suggests that staffing ratio have a positive linear relationship with RTW and a non-linear relationship with risk of violence. At low staffing ratios, risk of violence increases as staffing ratio increases but this relationship is reversed at high staffing ratios. Further, the literature suggests that violence may play an effect modifying role in the association between staffing ratio and RTW, where WVIs may have a lower likelihood of RTW than WNVIs working in facilities with similar staffing ratio (Jackson et al., 2002; Chang et al., 2005).

A relationship between lower staffing ratios, violence, and longer RTW is hypothesized as lower staffing ratios are associated with higher workload, job demands and stress (Buchanan and Considine, 2002; Garrett, 2008; Cornelius et al., 2011). Further, we hypothesize that staffing ratio will be greater among WVIs than WNVIs as WVIs may be more sensitive to staffing ratio due to increased social support.

We hypothesize that both lower and higher staffing ratios in an employee's workplace will be associated with a lower risk of violence compared to moderate staffing ratios. We also hypothesize that working in a workplace with high staffing ratio will be associated with higher likelihood of RTW after a workplace injury, and that the likelihood will be lower if the workplace injury was due to violence. Linking publicly available data on LTC facilities with local workers' compensation claims data, we examined the preceding relationships among injured workers in LTC facilities in BC in 2014. The study was restricted to LTC facilities as staffing ratio data was only available for these facilities.

4.2 Methodology

4.2.1 Study design

A retrospective cohort study examined the difference in RTW outcomes by staffing ratio and if violence moderates this relationship among injured workers working in LTC facilities in British Columbia for the year 2014.

4.2.2 Data preparation

De-identified claim and employer data from WorkSafeBC for workers injured in LTC facilities in 2014 was accessed via the Secure Research Environment at Population Data BC. Data from the Office of the Seniors Advocate (OSA) was publicly available and was used to extract key variables on staff and patient counts for LTC facilities in 2014. Permission was obtained to link data from the OSA to WorkSafeBC data by Population Data BC from WorkSafeBC. LTC facility names were identified strictly for linkage purposes, to link a workers' compensation

claim at that facility with their staffing ratio, and were not identified in the database provided to the researchers or in the results presented here.

Derivation of the employer cohort

Several steps were taken to prepare the final analytic dataset as shown in Appendix C that included data from the Office of the Seniors Advocate (OSA), WorkSafeBC employer data, and WorkSafeBC claim data. Using the statistical software package Stata (StataCorp, 2013), facility names in the WorkSafeBC employer data were matched with LTC facility names in the OSA data. In the case of mismatches, addresses and Google searches were used to match employers across databases. A total of 269 of 292 LTC facilities from the OSA data were successfully identified in the WorkSafeBC data, representing a 92.4% match.

A total of 9 of the 269 matched facilities had missing values on total care hours in the OSA data. After reviewing the matched facilities, 15 facilities were not considered LTC facilities under WorkSafeBC employer classification. Some facilities had multiple classifications assigned to them by WorkSafeBC as a result of conducting different types of health care work. For example, in the WorkSafeBC employer data, a hospital could have an acute care unit, a long-term care unit, and a community health support service unit. Only those operating locations (and associated worker injuries/compensation claims) classified as a long-term care facility were kept in the matched data. The final number of LTC facilities included 245 unique facilities with full employer data, of which 196 facilities had workers with workers' compensation claims in 2014 and 49 facilities had no compensation claims during this year.

Derivation of the claims cohort

There was a total of 1,993 workers' compensation claims in 2014 among workers in the 196 LTC facilities with at least one claim. Research decisions were made to exclude some claims for the purposes of the current analyses focused on violence-related injuries and staffing ratios in LTC. Nurses and nursing assistants were included in this study in order to focus on occupations providing direct care in LTC facilities. Exclusion criteria included injured workers outside the working age of 15 to 64 years (1.7%), and occupations not related to direct patient care (18%). The final analytic sample included a total of 1,590 time-loss claims among direct health care workers in 245 long-term care facilities.

4.2.3 Variables

4.2.3.1 Main independent variable

The main independent variable for this study was facility-level staffing ratio with a range between 2.33 to 5.74 direct care hours per resident day. Staffing ratio was categorized into the following quartiles for analyses:

0-25th percentile: =<2.86 direct care hours per resident day

25-50th percentile: 2.86-3.13 direct care hours per resident day

50-75th percentile: 3.13-3.24 direct care hours per resident day

75-100th percentile: >3.24 direct care hours per resident day

Staffing ratio was constructed from total annual funded care hours in each facility recorded in the OSA database. Total funded care hours were defined by the hours for direct care services funded

for each facility per resident, per day. It did not include hospitality services such as meals, laundry, or housekeeping (Office of the Seniors Advocate, 2016, p. iv).

4.2.3.2 Main outcome variables

There are two outcomes for this study. The first outcome was violence-related incident count and nonviolence-related incident count per bed per 100 FTEs to investigate the association between staffing ratios and risk of violence. Derivation of the outcome is explained in section 4.2.4.

The second outcome was time to RTW in days from the date of injury up to 365 days stratified by violence-related injury and nonviolence-related injury.

4.2.3.3 Covariates

Similar covariates for injured worker characteristics used in Study I were used in Study II and included age at time of injury, wage at time of injury, sex, occupation at time of injury, and injury types (See Table 4). Injury types with too few claims suitable for analysis included mental health injuries, burns, connective diseases, infectious and parasitic diseases, and diseases of organ systems, and were combined in one group named other injuries. Additional covariates for this study focused on staffing ratios were constructed at the facility-level and included:

Bed count quartiles: quartiles based on the total bed count (public and privately funded) by facility. Number of beds ranged from 4 to 300 among BC LTC facilities in 2014. Bed count quartiles are as follows:

0-25th percentile: =<67.5 beds

25-50th percentile: 67.5-92 beds

50-75th percentile: 93-122.5 beds

75-100th percentile: >122.5 beds

Health region: the health region in which the long-term facility is located in British Columbia. This variable included five health regions across the province that ranged from urban areas to mixed urban/rural to rural areas.

Public versus private funding: variable indicating if the long-term care facility is funded publicly or privately. Facilities were considered publicly funded if all beds were funded by the Government of British Columbia. A facility that had at least one privately funded bed was categorized as a privately funded facility.

Table 4 Additional covariates included in study of relationship between violence, staffing ratios and return-to-work outcomes among long-term care facilities in British Columbia, 2014

Covariates[3]	**Values**
Sex	Male
	Female
Age Category	15-24 years
	25-34 years
	35-44 years
	45-54 years
	55-64 years
Annual Wage (CA dollars)	<$20,000
	$20,000-39,999
	$40,000-59,999
	>$60,000
Injury types	Spine and back sprains and strains
	Torso sprains and strains
	Upper extremities sprains and strains
	Other sprains and strains
	Non-traumatic non-sprain injuries
	Other injuries
	Musculoskeletal diseases
	Other diseases
Occupations	Nursing assistants
	Nurses

4.2.4 Analysis methodology

Descriptive statistics, including chi-square tests with staffing ratio as the dependent variable, were conducted on all study variables to inform modeling strategies.

[3] As measured at the time of workers' compensation claim

Unadjusted analyses were conducted to detect relationships between staffing ratio quartiles and the facility-level rate of violence-related workplace injuries. Unadjusted facility-level injury rate analyses were also stratified by facility covariates: staffing ratio, bed count, and health region.

Incidence rate ratios (IRR) were calculated as the number of workers' compensation claims per total number of full-time equivalent direct care workers at the facility level using negative binomial regression models, for each staffing ratio quartile and covariates. Many facilities had very low claim counts and few facilities had large claim counts, indicating overdispersion or a mean not equal to the variance in the number of claims. Accordingly, negative binomial regression models were used for rate calculations that were appropriate for count data with overdispersion (Gardner, 1995). Unadjusted and fully adjusted negative binomial regression models were conducted to determine the effect of staffing ratio on violence-related injury rates compared to nonviolence-related rates. FTE was used as the denominator for the count of injuries (i.e. exposure offset) in the model.

Descriptive analysis using Kaplan-Meier curves examining staffing ratios and time to RTW after violence and nonviolence-related injury and Cox regression models associating staffing ratio with likelihood of RTW after violence or nonviolence-related injury were conducted. Models were adjusted for bed counts, health region, public versus private facility, sex, wage, age, and injury types. Unadjusted and adjusted models stratified for violence and nonviolence-related injuries were conducted for healthcare workers in LTC facilities, noting the changes in effect size and significance of HR of the independent variable across models.

4.3 Results

4.3.1 Facility-level descriptive statistics

Facility-level descriptive statistics can be found in Table 5. There was a significant difference in the staffing ratio for publicly and privately funded facilities ($p<0.00$). Publicly funded facilities were more likely to be in a higher staffing ratio quartile than privately funded facilities. No significant differences were observed in the distribution of bed counts across staffing ratio quartiles.

Table 5 Distribution of British Columbia Long-term care facility characteristics in 2014, n=245 facilities

Facility-level (N=245)					
	Staffing ratio quartiles				
	0-25th percentile (N=61)	25-50th percentile (N=63)	50-75th percentile (N=62)	75-100th percentile (N=59)	P-value
Bed count quartiles					0.387
- 0-25th percentile	9 (14.7%)	18 (28.6%)	18 (29.0%)	16 (27.1%)	
- 25-50th percentile	14 (22.9%)	14 (22.2%)	19 (30.6%)	17 (28.8%)	
- 50-75th percentile	17 (27.9%)	18 (28.6%)	12 (19.3%)	12 (20.3%)	
- 75-100th percentile	21 (34.4%)	13 (20.6%)	13 (21.0%)	14 (23.7%)	
Public vs Private					<0.00
- Private facilities	30 (49.2%)	28 (44.4%)	15 (24.2%)	7 (11.9%)	
- Public facilities	31 (50.8%)	35 (55.6%)	47 (75.8%)	52 (88.1%)	

Unadjusted counts of violence and nonviolence-related injury claims are shown in Appendix C. A higher proportion of nonviolence-related claims were reported in the upper two staffing quartiles, while there were higher proportions of violence-related claims reported in the lowest

two staffing quartile. A higher proportion of injured workers in nursing occupations versus nursing aide occupations were also found in the highest staffing ratio quartile. Lastly, there was a higher proportion of workers earning $40,000-59,999 and >$60,000 who had time-loss claims working in the lowest staffing ratio quartile.

4.3.2 Rate analysis results

In the stratified model for violence-related injuries, there was a reduced rate of violence-related injuries with higher staffing ratio quartiles relative to the lowest quartile in both the unadjusted and fully adjusted models, as shown in Table 6. Conversely, in the unadjusted model for nonviolence-related injuries only, there was an increased rate of nonviolence-related injuries with increasing staffing ratio quartiles relative to the lowest quartile. After adjusting for covariates however, the rate of nonviolence-related injuries was not significantly different across staffing ratio quartiles.

The rate of violence and nonviolence-related injuries decreased as number of beds increased. In the fully adjusted negative binomial regression model, a decreased rate of violence-related injuries was found at the highest bed count quartile compared to the lowest bed count quartile. The nonviolence-related injury rate was also lower at the highest bed count quartile relative to the lowest quartile but this was not statistically significant.

Table 6 Unadjusted and adjusted negative binomial regression model of staffing ratio and violence. Numbers indicate incidence rate ratio and 95% CI.

		Violence-related injury	Nonviolent-related injury
Unadjusted model			
Staffing ratio quartiles	0-25th %	Ref	Ref
	25-50th %	0.61 [0.38-0.97]	1.46 [1.06-2.01]
	50-75th %	0.68 [0.44-1.05]	1.80 [1.36-2.38]
	75-100th %	0.58 [0.35-0.96]	1.78 [1.30-2.46]
Fully adjusted model			
Staffing ratio quartiles	0-25th %	Ref	Ref
	25-50th %	0.64 [0.38-1.08]	0.99 [0.70-1.40]
	50-75th %	0.71 [0.43-1.18]	1.11 [0.86-1.45]
	75-100%	0.57 [0.33-0.99]	1.15 [0.87-1.54]
Health region	Health region 1	Ref	Ref
	Health region 2	0.93 [0.59-1.46]	0.80 [0.63-1.03]
	Health region 3	0.86 [0.50-1.48]	1.49 [1.15-1.94]
	Health region 4	0.68 [0.38-1.21]	1.30 [0.96-1.76]
	Health region 5	0.36 [0.11-1.15]	1.37 [0.91-2.06]
Number of beds quartiles	0-25th %	Ref	Ref
	25-50th %	0.65 [0.38-1.11]	0.97 [0.72-1.31]
	50-75th %	0.37 [0.19-0.73]	0.77 [0.58-1.01]
	75-100%	0.41 [0.24-0.72]	0.74 [0.53-1.03]
Public vs private	Private	Ref	Ref
	Public	1.24 [0.73-2.10]	1.25 [0.94-1.64]

4.3.3 Stratified Cox regression results with RTW

Unadjusted and adjusted Cox regression models stratified for WVIs and WNVIs with likelihood of RTW within one year after violence or nonviolence-related injury as the outcome are shown in Table 7. In the final adjusted model among WNVIs, there were no differences in the effects of staffing ratio on likelihood of RTW within one year except at the highest staffing ratio percentile where the HR was 1.23 (95% CI: 1.00-1.51), indicating an increased likelihood of RTW with the higher staffing ratios.

Unadjusted and adjusted Cox regression models stratified for violence-related injury did not violate the proportionality assumption. However, unadjusted and adjusted Cox regression models stratified for nonviolence-related injury violated the proportionality assumption. Piecewise hazard models were not conducted for this study as sample sizes were too low to extract meaningful results.

The unadjusted and adjusted model stratified for WVIs showed a significant difference in the likelihood of RTW after a violence-related injury for the highest staffing ratio quartile relative to the lowest quartile where the HR was 1.65 (95% CI: 1.13-2.41) and 1.83 (95% CI: 1.15-2.89) respectively. The middle quartiles (the 25-50th and 50-75th) also showed higher HRs compared to the reference lowest staffing ratio quartile, suggesting a dose response relationship. The likelihood of RTW after violence-related injuries increased as staffing ratios increased.

Other facility-level claims such as health region, bed count, and private versus public funding showed no differences in likelihood of RTW for both WVIs and WNVIs.

Table 7 Unadjusted and adjusted Cox regression models examining staffing ratio and time to RTW, stratified by violence and nonviolence claims. Results show hazard ratio and 95% CI.

		Workers with violence-related injuries only	Workers with nonviolence-related injuries only
Unadjusted model			
Staffing ratio quartiles	0-25th %	Ref	Ref
	25-50th %	1.09 [0.72-1.64]	0.92 [0.76-1.11]
	50-75th %	1.11 [0.76-1.64]	1.05 [0.89-1.24]
	75-100%	1.65 [1.13-2.41]	1.38 [1.17-1.63]

Fully adjusted model		Workers with violence-related injuries only	Workers with nonviolence-related injuries only
Staffing ratio quartiles	0-25th %	Ref	Ref
	25-50th %	1.26 [0.76-2.10]	0.92 [0.74-1.14]
	50-75th %	1.26 [0.74-2.13]	0.96 [0.77-1.19]
	75-100%	1.83 [1.15-2.89]	1.23 [1.00-1.51]
Health region	Health region 1	Ref	Ref
	Health region 2	0.93 [0.62-1.41]	0.93 [0.77-1.13]
	Health region 3	0.85 [0.51-1.40]	0.92 [0.75-1.12]
	Health region 4	1.09 [0.65-1.83]	0.96 [0.79-1.18]
	Health region 5	0.81 [0.28-2.3]	0.96 [0.71-1.30]
Number of beds quartiles	0-25th %	Ref	Ref
	25-50th %	1.19 [0.72-1.96]	1.06 [0.87-1.29]
	50-75th %	1.20 [0.69-2.06]	0.98 [0.80-1.19]
	75-100%	1.20 [0.74-1.94]	1.05 [0.87-1.27]
Public vs private funding	Private	Ref	Ref
	Public	1.24 [0.82-1.89]	1.13 [0.96-1.33]
Sex	Female	Ref	Ref
	Male	1.78 [0.99-3.22]	1.48 [1.21-1.81]
Age	15-24	Ref	Ref
	25-34	0.81 [0.33-2.00]	0.74 [0.52-1.06]
	35-44	0.67 [0.28-1.61]	0.75 [0.53-1.05]
	45-54	0.65 [0.27-1.58]	0.63 [0.45-0.89]
	55-64	0.96 [0.38-2.43]	0.69 [0.48-0.98]
Wage	<$20,000	Ref	Ref
	$20,000-39,999	0.28 [0.12-0.70]	0.77 [0.55-1.09]
	$40,000-59,999	0.33 [0.14-0.79]	0.78 [0.55-1.09]
	≥$60,000	0.23 [0.08-0.62]	0.75 [0.51-1.10]
Injury types	Spine and back sprains and strains	Ref	Ref
	Torso sprains and strains	1.27 [0.64-2.51]	1.06 [0.89-1.27]
	Upper extremities sprains and strains	1.10 [0.69-1.76]	0.83 [0.70-0.97]
	Other sprains and strains	0.65 [0.18-2.29]	0.82 [0.65-1.04]
	Non-traumatic non-sprain injuries	1.90 [1.10-3.27]	1.39 [1.10-1.76]
	Musculoskeletal diseases	0.51 [0.22-1.16]	0.82 [0.64-1.05]
	Other injuries	1.22 [0.54-2.73]	1.00 [0.73-1.38]
	Other diseases	None observed	1.84 [1.48-2.28]
Occupations	Nursing assistants/aides	Ref	Ref
	Nurses	1.12 [0.71-1.76]	0.95 [0.80-1.12]

4.4 Discussion

4.4.1 Staffing ratio and violence

Adjusted negative binomial regression models suggest a negative relationship showing high staffing ratios with a decreased risk of violence. This is contrary to previous studies showing a positive association (Lanza et al., 1994; Bowers et al., 2009) and a non-linear association (Staggs, 2013).

Findings did not support the study conducted by Staggs (2013) perhaps due to a difference in staffing ratios. Staggs's spline model showing a non-linear association had staffing ratios ranging from approximately 2 to 19 total nursing hours per patient day, but this included care hours provided by Registered Nurses, Licensed Practical Nurses, assistive personnel, and mental health technicians. Staffing ratio in our study ranged from 2.33 to 5.74 hours per patient day and was primarily care hours provided by nurses and nursing assistants. The range of staffing ratio in our study may reflect the level where a negative relationship between staffing ratio and violence was found in Staggs's study. Staggs also includes many additional types of healthcare workers that may influence the relationship between staffing ratio and risk of violence.

While the unadjusted model for nonviolence-related injuries showed significant increase in the rate at higher staffing ratios, the effect was not significant after adjustment for covariates. In contrast, the incidence rate ratio remained significant at the highest staffing ratio quartile after adjustment. This could be due to the differences in the cause of injury where violence-related

injury is due to patient interaction which is affected by staffing ratio, while nonviolence-related injury is due to job duties and tasks and can be explained by adjusted covariates.

In terms of this study's findings, staffing ratio may have a threshold effect that reduces work pressure and stress. After reaching 3.24 direct care hours per resident day, staff may have had more time to deliver care to patients in a way that reduces the triggers for patient frustration, aggression and ultimately violent behavior (Robinson & Tappen, 2008).

4.4.2 Staffing ratio and RTW

Higher staffing ratios were associated with a higher likelihood of RTW for both WVIs and WNVIs, supporting our hypothesis. However, while WNVIs were 23% more likely to RTW, WVIs were 83% more likely to RTW. Violence as the cause of injury was found to modify the effect between staffing ratio and likelihood of RTW, but the direction of effect modification was reversed and contrary to our hypothesis. The results showed the likelihood of RTW was higher for WVIs rather than lower at higher staffing ratios compared to WNVIs working at similar staffing ratios.

With an increased number of staff, injured workers may have more social support available from coworkers which increases their likelihood of RTW for any type of injury (MacKenzie et al., 1998; Bergquist and Larsson, 1977). It is possible that through social support, higher staffing ratios increased the likelihood of RTW of both WVIs and WNVIs in our study.

Differences in likelihood of RTW among WVIs and WNVIs at the highest staffing ratio may be explained by how high staffing ratios provide more effective support to WVIs at the workplace. WVIs may be expected to RTW at the place of the violent incident, where they may have stress and fear of another incident (Pinar and Ucmak, 2010). Having colleagues and coworkers at the place of the violent incident provide support to WVIs can alleviate their traumatic experiences, improving their transition to RTW.

4.4.3 Strengths

To our knowledge, this is the first study to examine differences in likelihood of RTW by staffing ratios and examine violence as an effect modifier. This study has demonstrated that staffing ratio not only affect RTW but also influence the nature of injury where at high staffing ratio, risk of violence-related injury decreased. Other studies have examined only a part of the relationship between staffing ratio, violence, and RTW, giving a limited perspective on the complexity of RTW research.

The study showed the capability of performing such analysis by linking workers' compensation data and publicly available data on the majority of LTC facilities in the province of British Columbia. The information in both datasets allowed for the construction of worker-level and facility-level covariates, minimizing confounding effects as much as possible for a retrospective cohort study.

4.4.4 Limitations

The study sample only examined LTC facility data for the year 2014, limiting the internal validity of our study due to a small sample size. Comparing sub-groups by covariates was difficult due to the low number of injured workers and low variability of staffing ratio among facilities. Outcome measures could have been attributable to covariates in our study as a result.

Limiting the study to LTC facilities also limits external validity, and study findings should only be applied to BC LTC facilities in 2014. Other health care units and health care systems in other provinces may have different organizational factors that were not adjusted for in this study such as staffing mix that may interact with or confound the relationship between staffing ratio, risk of violence, and RTW. Obtaining data in different settings would increase the generalizability of the results.

Other variables such as severity of injury and severity of violence would have helped in teasing out the relationship further with staffing ratio and RTW. Severity of injury was found to prolong disability duration among injured workers (Krause et al., 2011). Taking severity of injury and severity of violence into consideration may indicate the extent of psychological job demands and job stress, factors associated with delayed RTW. Severity of injury can be measured using health care expenditures and severity of violence can be measured by type of violence such as biting, beating, stabbing, and shooting as measured in a study of healthcare workers by Campolieti et al. (2008).

Future research would benefit from larger sample sizes to provide more robust measures. Piecewise hazard models could not be conducted for this pilot study to address non-proportional hazards due to small sample size. As there was a small cohort to begin with, splitting the cohort further by time intervals did not allow for meaningful measures of association.

4.5 Conclusion

Workers employed in LTC facilities with higher staffing ratios are less likely to have a violence-related injury, compared to those working in LTC facilities with lower staffing ratios. WVIs and WNVIs employed in LTC facilities with higher staffing ratios are more likely to RTW after injury but more so for WVIs. In conjunction with Study 1, the findings of the pilot study provide a justification for future research to further investigate staffing ratios to reduce the risk of violence and related injury disability in the healthcare industry.

Chapter 5: Conclusion

Using workers' compensation data, this thesis examined the relationship between violence and RTW outcomes, injury types modifying the relationship between violence and RTW, and if violence plays an effect modifying role in the relationship between staffing ratios and RTW.

This thesis tested the following hypotheses:

1: Healthcare workers with violence-related injuries will have a higher proportion of psychological injuries than healthcare workers with nonviolence-related injuries.

2: Healthcare workers with violence-related injuries have a lower likelihood of return-to-work than healthcare workers with nonviolence-related injuries. There will be a greater difference when stratifying for psychological injuries.

3: Low staffing ratio is associated with low rates, moderate staffing ratio is associated with high rates, and high staffing ratio is associated with moderate rates of violence-related injuries. Healthcare workers working in higher staffing ratios will have a higher likelihood of RTW following a workplace injury than those working in lower staffing ratios. A smaller effect will be observed for those with a violence-related injury compared to those with a nonviolence-related injury in similar staffing ratios.

5.1 Summary of Study I findings

Violence-related injuries were different than nonviolence-related injuries. Study I findings showed a higher proportion of mental health injuries, contusions, and bruises among WVIs than WNVIs. This supported our first hypothesis.

The study findings suggest violence does not have an overall effect on RTW. No significant differences on time to RTW were found among WVIs compared to WNVIs. While Cox regression models used to examine the overall effect of violence did not meet the assumption of proportionality, piecewise hazard models were used to determine differences on RTW among WVIs compared to WNVIs by time.

Evidence was shown supporting mental health injuries modifying the relationship between violence and RTW. Violence was associated with a lower likelihood of RTW compared to nonviolence among those with mental health injuries. WVIs with mental health injuries were approximately 40% less likely to RTW compared to WNVIs with mental health injuries.

Violence was found to be associated with differing likelihoods of RTW depending on time after injury. Overall, WVIs were most likely to RTW within the first 30 days after injury compared to WNVIs, but the association reversed and WVIs were less likely to RTW after the first 30 days and up to 180 days after injury compared to WNVIs. No significant differences in likelihood were shown after 180 days after injury.

There was evidence of occupation affecting the relationship between violence and RTW. Most stratified results show similar results to the overall model, but counselors and social workers showed lower likelihood of RTW at 30-60 and 61-90 days after injury.

5.2 Summary of Study II findings

High staffing ratios showed an association with lower likelihood of violent incidents. In contrast, no differences were detected in likelihood of nonviolent incidents across different levels of staffing ratios.

Overall, the pilot study suggests higher staffing ratios are associated with higher likelihood of RTW compared to lower staffing ratios among WVIs. For WNVIs, evidence suggests there was higher likelihood of RTW at high staffing ratios, though this model did not meet the proportionality assumption. The effect of staffing ratio and RTW differed between violence and nonviolence, suggesting violence has an effect modifying role but requires an alternative valid model such as spline regression or piecewise regression for WNVIs to confirm this comparison. This may be possible when data in future years can be provided by the OSA.

5.3 Significance

The findings of this thesis contribute to our understanding of violence among the largest occupations employed in the healthcare and social services subsector today and occupations at the highest risk of violence. The complex relationship between staffing ratios, violence, and RTW demonstrate the need to understand additional interactions between RTW determinants and time-dependent RTW in order to reduce work disability for healthcare workers.

While preventing inpatient violence and improving RTW is a concern for employers and employees, preventing violence may also improve patient outcomes. A review found assaults upon nurses were associated with delayed nursing interventions and increased medication errors (Duffield et al., 2011). Understanding the consequences of workplace violence on worker outcomes such as RTW as well as patient outcomes can motivate violence prevention strategies for the benefit of both healthcare workers and patients.

Healthcare managers and employers can benefit from this research by identifying those who will remain off-work for extended periods of time to effectively improve RTW for WVIs. The BC Health Authorities, WorkSafeBC, and unions can work with RTW case managers to improve work disability management programs tailored towards violence-injured workers with comorbid mental health injuries and low staffing resources. Employers can also use the study findings to improve work environments to promote faster RTW among WVIs, and potentially to lever changes to staffing levels with funding bodies to reduce the risk of violence as feasibly possible.

5.4 Strengths and limitations

This thesis addressed three gaps in the literature relating to violence and RTW. Study I is the first study to compare WVIs and WNVIs in time to RTW. This study also examined injury types as an effect modifier in the relationship between violence and RTW. Lastly, Study II is the first study to examine staffing ratio and likelihood of RTW as well as the role of violence as an effect modifier in this relationship, portraying a possible comprehensive relationship between risk factors of violence, violence-related injuries, and RTW outcomes.

In Study I, many Cox regression models examining violence and time to RTW violated the assumption of proportionality, indicating the models were unsuitable for that particular subpopulation. Hazards changed over time, and piecewise hazard models were used to overcome the assumption violation. Piecewise hazard models showed that likelihood of RTW were phase specific, which was supported in other studies (Krause et al., 2001b).

Measuring severity of violence, severity of injury, and secondary injury diagnosis could have served as a covariate or effect modifier in the relationship between violence and RTW. Measurement tools such as the New Injury Severity Score or Anatomic Profile (Sacco, 1999) could improve future studies and findings by controlling for the potentially residual confounding effect of severe injuries or severe violent events. Secondary injury diagnosis, in particular mental health injuries, were not included in the current analyses as they were not available in the dataset. The literature suggests psychological distress exacerbates musculoskeletal injuries by inducing chronic pain and lowering likelihood of RTW. Addition of these covariates to our studies may tease out the relationship between violence and RTW in greater detail.

Study II findings were based on a small study sample only in the LTC sector, limiting precision of results and generalization to other healthcare-related sectors. The highest staffing ratio quartile showed associations with faster RTW among violent-related claims. The second and third quartiles also showed faster RTW but were nonsignificant. However, the overall direction of effects showed evidence of a dose-response relationship, and future studies with larger sample size could strengthen and support these findings.

5.5 Policy implications

In British Columbia, violence is recognized as an important work-related hazard in health care. WorkSafeBC emphasizes efforts to reduce the risk of workplace violence and related injuries to healthcare workers (WorkSafeBC, 2017a). Research findings suggest organizational factors such as staffing ratio can decrease the risk of violence and improve RTW among WVIs.

Current RTW policies in the healthcare and social services sector will need to identify and target RTW strategies to workers with violence-related injuries who also have mental health injuries and those with a higher likelihood of remaining on long-term disability claim (more than 30 days after injury). In a review paper, Schultz and Warren (2013) found studies on RTW that suggest disability and delayed RTW are not related to medical factors but rather to psychosocial and system-related factors. Specifically, for workers with a high-risk of violence-related injury, interventions integrating clinical, occupational, and case management components that included interview sessions, communication with the family physician, and case coordination showed higher efficiency for RTW outcomes compared to moderate-risk workers (Schultz et al., 2007). Schultz and Warren (2013) emphasize the transdisciplinary nature of these RTW programs that are necessary to improve RTW outcomes for injured workers by addressing the multidimensional and temporal aspects of occupational disability. Using our study findings, stakeholders and policy makers can implement specialized and comprehensive RTW programs to effectively target workers likely to be in long-term disability after injury.

Finally, findings provide additional support to staffing ratio guidelines set by local stakeholders that all LTC facilities should achieve. A significant reduction of violence-related injury rate and significant increase in likelihood of RTW for WVIs were found for the highest staffing ratio quartile. The highest quartile corresponds to staffing ratios above 3.245 funded direct care hours per resident per day, just below the BC Ministry of Health's guideline of providing 3.36 hours per resident day (Ministry of Health, 2017). By highlighting the real-world consequences of improvements in RTW outcomes associated with higher staffing ratio, this pilot study can be used to justify further research to see if there are consistent results.

5.6 Future research

Differences in the effect of violence and RTW are shown among different injury types, but it is not known whether the effect is attributed to primarily mental health injuries or severe injury or violence. Future research should include secondary injury diagnoses and a measure of injury severity to better understand mechanisms behind RTW.

Organizational factors such as staffing ratios and violence were shown to have an effect on RTW, and prior studies pinpoints stress as a common symptom when workers work in low staffing ratios or after dealing with violence. Additional research could examine RTW outcomes with other organizational factors associated with role stress such as work overload, management support, and staff mix to confirm this pathway, bringing the ability to accurately predict RTW after injury one step closer.

Higher staffing ratios were associated with improved RTW for workers who were injured due to violence in LTC facilities, but future research can expand to examine this relationship in other clinical settings with high incidences of violence. Not only would this improve external validity but also identify clinical settings that may need additional support to address barriers to RTW and lower disability duration.

Modified RTW was not included in our analysis, yet it can influence the decision of an employee when deciding to RTW (Krause et al., 1998). The availability of modified RTW such as reduced physical tasks or temporary different job duties can improve RTW outcomes among employees as it can reduce pain or difficulty accompanied with a disabling injury, or may ease the transition back to a work environment associated with a violence related incident. Future studies could examine if WVIs are less likely to be offered modified RTW and if this explains longer RTW for WVIs after the first 30 days after injury.

Violence or organizational factors can affect an employee's RTW outcomes, but the literature is beginning to acknowledge that RTW is no longer conceptualized as a single event and is more of a trajectory composing of multiple RTW events (Pransky et al., 2005; Kausto et al., 2008; Pedersen et al., 2012; McLeod et al., 2018). Some workers may undergo a long, complex process of cycling through different and recurrent states such as receiving different social security benefits or working, and workers may shift between these states (Lie et al., 2008). In a study done by Oyeflaten et al. (2012) on patients who participated in a work-related rehabilitation program, it was found that patients transitioned between different benefits and work at an average of 3.7 times in a 4-year follow-up period with a maximum number of 18 transitions.

Follow-up research can focus on identifying how RTW trajectories differ among violence and other injury types, and if these differences are related to time to RTW. This thesis and future research may contribute towards the understanding of the complex nature of RTW and violence to address one of the biggest occupational health issues in BC healthcare.

Bibliography

Arnetz, J. E., Hamblin, L., Essenmacher, L., Upfal, M. J., Ager, J., & Luborsky, M. (2015). Understanding patient-to-worker violence in hospitals: a qualitative analysis of documented incident reports. *Journal of Advanced Nursing*, *71*(2), 338–348.

AWCBC. (2017). *Canadian Workers' Compensation System – 2015 Year at a Glance.* Retrieved from http://awcbc.org/?page_id=11803

Aydin, B., Kartal, M., Midik, O., & Buyukakkus, A. (2009). Violence against general practitioners in Turkey. *Journal of Interpersonal Violence*, *24*(12), 1980–1995.

Baillien, E., Rodríguez- Muñoz, A., de Witte, H., Notelaers, G., & Moreno-Jiménez, B. (2011). The Demand-Control Model and target's reports of bullying at work: A test within Spanish and Belgian blue-collar workers. *European Journal of Work and Organizational Psychology*, *20*(2), 157-177.

Baloyi, S., van Waveren, C. C., & Chan, K. (2014). The role of supervisor support in predicting employee job satisfaction from their perception of the performance management system: A test of competing models in engineering environments. *South African Journal of Industrial Engineering, 25*(1), 85-95.

Barling, J. (1996). "The prediction, experience and consequence of workplace violence." *Violence on the Job: Identifying Risks and Developing Solutions.* Washington, D. C.: American Psychological Association, p.29-41.

Beech, B., & Leather, P. (2006). Workplace violence in the health care sector: A review of staff training and integration of training evaluation models. *Aggression and Violent Behavior*, *11*(1), 27–43.

Bergquist, U. M., & Larsson, U. (1977). Acute low back pain in industry. *Acta Orthop Scand,*

170(9), 1-117.

BC Care Providers Association. (2009). *Residential Care Health and Safety Guidelines*. Retrieved from http://bccare.ca/wp-content/uploads/bccare_safety_grid_v11.pdf

BC Nurses' Union. (2015). *BCNU Position Statement on Mandated Nurse-Patient Ratios.* Retrieved from https://www.bcnu.org/AboutBcnu/Documents/position-statement-nurse-patient-ratio.pdf

Bowers, L., Allan, T., Simpson, A., Nijman, H., & Warren, J. (2007). Adverse incidents, patient flow and nursing workforce variables on acute psychiatric wards: The Tompkins Acute Ward Study. *International Journal of Social Psychiatry*, *53*, 75–84.

Bowers, L., Allan, T., Simpson, A., Jones, J., Van Der Merwe, M., & Jeffery, D. (2009). Identifying Key Factors Associated with Aggression on Acute Inpatient Psychiatric Wards. *Issues in Mental Health Nursing, 30*(4*)*, 260-271.

Brijnath, B., Mazza, D., Singh, N., Kosny, A., Ruseckaite, R., & Collie, A. (2014). Mental health claims management and return to work: qualitative insights from Melbourne, Australia. *J Occup Rehabil 24*, 766-776.

Buchanan, J., & Considine, G. (2002). *Stop Telling Us to Cope! A report for the NSW Nurses Association*. Sydney: Australian Centre for Industrial Relations Research and Training (ACIRRT), University of Sydney.

Budd, J. W., Arvey, R. D., & Lawless, P. (1996). Correlates and consequences of workplace violence. *Journal of Occupational Health Psychology*, *1*(2), 197-210.

Camerino, D., Estryn-Behar, M., Conway, P. M., van Der Heijden, B. I. J. M., & Hasselhorn, H. (2008). Work-related factors and violence among nursing staff in the European NEXT study: A longitudinal cohort study. *International Journal of Nursing Studies*, *45*, 35-50.

Campbell, J. C., Messing, J. T., Kub, J., Agnew, J., Fitzgerald, S., Fowler, B., Sheridan, D., Lindauer, C., Deaton, J., & Bolyard, R. (2011). Workplace Violence: Prevalence and Risk Factors in the Safe at Work Study. *Journal of Occupational and Environmental Medicine*, *53*(1), 82-89.

Campolieti, M., Goldenberg, J., & Hyatt, D. (2008). Workplace violence and the duration of Workers' Compensation Claims. *Relations Industrielles*, *63*(1), 57-161.

Cancelliere, C., Donovan, J., Stochkendahl, M. J., Biscardi, M., Ammendolia, C., Myburgh, C., & Cassidy, J. D. (2016). Factors affecting return to work after injury or illness: best evidence synthesis of systematic reviews. *Chiropractic & Manual Therapies*, *24*, 32.

Chang, E. M., Hancock, K. M., Johnson, A., Daly, J., & Jackson, D. (2005). Role stress in nurses: Review of related factors and strategies for moving forward. *Nursing and Health Sciences, 7*, 57-65.

Cheadle, A., Franklin, G., Wolfhagen, C., Savarino, J., Liu, P.Y., Salley, C., & Weaver, M. (1994). Factors influencing the duration of work-related disability: a population-based study of Washington State workers' compensation. *American Journal of Public Health, 84*(2),190-196.

Chen, W., Hwu, H., Kung, S., Chiu, H., & Wang, J. (2008). Prevalence and Determinants of Workplace Violence of Health Care Workers in a Psychiatric Hospital in Taiwan. *Journal of Occupational Health*, *50*, 288-293.

Cleves, M. A., Gould, W. W., Gutierrez, R. G., & Marchenko, Y. U. (2008). *An Introduction to Survival Analysis Using Stata* (2nd ed.). StataCorp: College Station.

Cornelius, L. R., van der Klink, J. J., Groothoff, J. W., & Brouwer, S. (2011). Prognostic factors

of long term disability due to mental disorders: a systematic review. *Journal of Occupational Rehabilitation, 21*(2), 259–274.

Dasinger, L.K., Krause, N., Deegan, L.J., Brand, J.B., & Rudolph, L. (2000). Physical workplace factors and return to work after compensated low back injury: a disability phase-specific analysis. *Journal of Occupational and Environmental Medicine, 42*(3), 323-333.

Demir, D., & Rodwell, J. (2012). Psychosocial antecedents and consequences of workplace aggression for hospital nurses. *Journal of Nursing Scholarship, 44*(4), 376-384.

Detaille, S. I., Heerkens, Y. F., Engels, J. A., van der Gulden, J. W., & van Dijk, F. J. (2009). Common prognostic factors of work disability among employees with a chronic somatic disease: a systematic review of cohort studies. *Scandinavian Journal of Work and Environmental Health, 35*(4), 261–81.

Duffield, C., Diers, D., O'Brien-Pallas, L., Aisbett, C., Roche, M., King, M., & Aisbett, K. (2011). Nursing staffing, nursing workload, the work environment and patient outcomes. *Applied Nursing Research, 24*(4), 244-255.

Edwards, D., & Burnard, P. (2003). A systematic review of stress and stress management interventions for mental health nurses. *Journal of Advanced Nursing, 42*(2), 169-200.

Fisekovic, M. B., Trajkovic, G. Z., Bjegovic-Mikanovic, V. M., & Terzic-Supic, Z. J. (2015). Does workplace violence exist in primary health care? Evidence from Serbia. *European Journal of Public Health*, *25*(4), 693-698.

Franz, S., Zeh, A., & Schablon, A. (2010). Aggression and violence against health care workers in Germany—A cross sectional retrospective survey. *BMC Health Services Research, 10*, 1-9.

Fujita, S., Ito, S., Seto, K., Kitazawa, T., Matsumoto, K., & Hasegawa, T. (2012). Risk Factors of

Workplace Violence at Hospitals in Japan. *Journal of Hospital Medicine, 7*(2*)*, 79-84.

Gacki-Smith, J., Juarez, A. M., Boyett, L., Homeyer, C., Robinson, L., & MacLean, S. L. (2009). Violence against nurses working in US emergency departments. *The Journal of Nursing Administration*, *39*(7/8*)*, 340-349.

Galizzi, M., Leombruni, R., Pacelli, L., & Bena, A. (2016). Injured workers and their return to work beyond individual disability and economic incentives. *Evidence-based HRM-A Global Forum for Empirical Scholarship*, *4*(1), 2-29.

Gardner, W., Mulvey, E. P., Shaw, E. C. (1995). Regression analyses of counts and rates: Poisson, overdispersed Poisson, and negative binomial models. *Psychol Bull*, *118*(3), 392-404.

Garrett, C. (2008). The Effect of Nurse Staffing Patterns on Medical Errors and Nurse Burnout. *Association of Perioperative Registered Nurses Journal*, *87*(6*)*, 1191-1204.

Gates, D., Fitzwater, E., Telintelo, S., Succop, P., & Sommers, M. S. (2002). Preventing assaults by nursing home residents: Nursing assistants' knowledge and confidence–a pilot study. *Journal of the American Medical Directors Association*, *3*(6), 366–370.

Gillespie, G. L., Gates, D. M., Miller, M., & Howard, P. K. (2011). Workplace violence in healthcare settings: risk factors and protective strategies. *Rehabilitation Nursing*, *35*(5), 177-184.

Gluck, J. V., and Oleinick, A. (1998). Claim Rates of Compensable Back Injuries by Age, Gender, Occupation, and Industry: Do They Relate to Return-to-Work Experience? *Spine, 23*(14), 1572-1587.

Habeck, R.V., Leahy, M.J., Hunt, H.A., & Chan, F. (1991). Employer factors related to workers'

compensation claims and disability management. *Rehabilitation Counselling Bulletin 34*(3), 210-226.

Hahn, S., Zeller, A., Needham, I., Kok, G., Dassen, T., & Halfens, R. J. G. (2008). Patient and visitor violence in general hospitals: A systematic review of the literature. *Aggression and Violent Behavior, 13*(6), 431–441.

Hansson, T., & Jensen, I. (2004). Swedish Council on Technology Assessment in Health Care (SBU). Chapter 6. Sickness absence due to back and neck disorders. *Scandinavian Journal of Public Health Supplementary, 63,* 109–51.

Hartley, D., Doman, B., Hendricks, S. A., & Jenkins, E. L. (2012). Non-fatal workplace violence injuries in the United States 2003-2004: a follow back study. *Work, 42,* 125-135.

Hashemi, L., & Webster, B. S. (1998). Non-fatal workplace violence workers' compensation claims (1993-1996). *Journal of Occupational & Environmental Medicine, 40*(6), 561-567.

Hegney, D., Eley, R., Plank, A., Buikstra, E., & Parker, V. (2006). Workplace violence in Queensland, Australia: The results of a comparative study. *International Journal of Nursing Practice, 12,* 220–231.

Hensel, J. M., Bender, A., Bacchiochi, J., & Dewa, C. S. (2011). Factors associated with working status among workers assessed at a specialized worker's compensation board psychological trauma program. *American Journal of Industrial Medicine, 54,* 552-559.

Hensel, J. M., Lunsky, Y., & Dewa, C. S. (2012). Exposure to client aggression and burnout among community staff who support adults with intellectual disabilities in Ontario, Canada. *Journal of Intellectual Disability Research, 56,* 910-915.

Hills, D., & Joyce, C. (2013). A review of research on the prevalence, antecedents, consequences

and prevention of workplace aggression in clinical medical practice. *Aggression and Violent Behavior, 18*(5), 554-569.

Hodgson, M. J., Reed, R., Craig, T., Murphy, F., Lehmann, L., Belton, L., & Warren, N. (2004). Violence in Healthcare Facilities: Lessons from the Veterans Health Administration. *Journal of Environmental Medicine, 46*(11), 1158-1165.

Hogh, A., Borg, V., & Mikkelsen, K. L. (2003). Work-related violence as a predictor of fatigue: a 5-year follow-up of the Danish Work Environment Cohort Study. *Work & Stress, 17*(2), 182-194.

Hogh, A., Sharipova, M., & Borg, V. (2008). Incidence and recurrent work-related violence towards healthcare workers and subsequent health effects. A one-year follow-up study. *Scandinavian Journal of Public Health, 36*, 706-712.

Hunt, H.A., & Habeck, R.V. (1993). *The Michigan disability prevention study*. Kalamazoo, MI: Upjohn Institute for Employment Research.

Jackson, D., Clare, J., & Mannix, J. (2002). Who would want to be a nurse? Violence in the workplace – a factor in recruitment and retention. J*ournal of Nursing Management, 10*, 13-20.

Jiao, M., Ning, N., Li, Y., Gao, L., Cui, Y., Sun, H., Kang, Z., Liang, L., Wu, Q., & Hao, Y. (2015). Workplace violence against nurses in Chinese hospitals: a cross-sectional survey. *BMJ Open*, *5*, e006719.

Kausto, J., Miranda, H., Martimo, K. P., & Viikari-Juntura, E. (2008). Partial sick leave–review of its use, effects and feasibility in the Nordic countries. *Scandinavian Journal of Work, Environment, and Health, 34*, 239–249.

Krause, N., Dasinger, L. K., & Neuhauser, F. (1998). Modified work and return to work: a

review of the literature. *Journal of Occupational Rehabilitation, 8*(2), 179-186.

Krause, N., Dasinger, L. K., Deegan, L. J., Rudolph, L., & Brand, R. J. (2001a). Psychosocial job factors and Return-to-Work after compensated low back injury: a disability phase-specific analysis. *American Journal of Industrial Medicine, 40,* 372-392.

Krause, N., Frank, J. W., Dasinger, L. K., Sullivan, T. J., & Sinclair, S. J. (2001b). Determinants of Duration of Disability and Return-to-Work After Work-Related Injury and Illness: Challenges for Future Research. *American Journal of Industrial Medicine, 40,* 464-484.

Kristen, E., Banuelos, B., & Urban, D. (2015). Workplace violence and harassment of low-wage workers. *Berkeley Journal of Employment & Labor Law, 36*(1), 169-213.

Lake, E. T. (1998). Advances in understanding and predicting nurse turnover. *Research in the Sociology of Health Care, 15,* 145-171.

Lanza, M. L., Kayne, H. L., & Hicks, C. (1994). Environmental characteristics related to patient assault. *Issues in Mental Health Nursing, 15,* 319–335.

Lawoko, S., Soares, J. J. F., & Nolan, P. (2004). Violence towards psychiatric staff: A comparison of sex, job and environmental characteristics in England and Sweden. *Work & Stress, 18*(1), 39–55.

Lee, S. S., Gerberich, S. G., Waller, L. A., Anderson, A., & McGovern, P. (1999). Work-Related Assault Injuries among Nurses. *Epidemiology, 10*(6), 685-691.

Levesque, L. E., Hanley, J. A., Kezouh, A., & Suissa, S. (2010). Problem of immortal time bias in cohort studies: example using statins for preventing progression of diabetes. *BMJ 340,* b5087.

Lie, S. A., Eriksen, H.R., Ursin, H., & Hagen, E.M. (2008). A multi-state model for sick-leave

data applied to a randomized control trial study of low back pain. *Scandinavian Journal of Public Health, 36,* 279–283.

Liss, G. M., & McCaskell, L. (1994). Injuries due to violence: workers' compensation claims among nurses in Ontario. *AAOHN Journal, 42*(8), 384-390.

Llor-Esteban, B., Sanchez-Munoz, M., Ruiz-Hernandez, J. A., & Jimenez-Barbero, J. A. (2017). User violence towards nursing professionals in mental health services and emergency units. *The European Journal of Psychology Applied to Legal Context, 9,* 33-40.

Maas, E., Koehoorn, M., McLeod, C. (2017). Return-to-work for multiple jobholders with a work-related musculoskeletal disorder: a population-based, matched cohort in British Columbia. *PLoS ONE 13*(4), e0193618.

MacKenzie, E. J., Morris, J. A., Jurkovich, G. J., Yasui, Y., Cushing, B. M., Burgess, A. R., DeLateur, B. J., McAndrew, M. P., and Swiontkowski, M. F. (1998). Return to work following injury: the role of economic, social, and job-related factors. *Am J Public Health, 88*(11), 1630-1637.

Magnavita, N., and Heponiemi, T. (2012). Violence towards health care workers in a Public Health Care Facility in Italy: a repeated cross-sectional study. *BMC Health Services Research, 12,* 108.

McIntosh, G., Frank, J., Hogg-Johnson, S., Bombardier, C., & Hall, H. (2000). 1999 Young Investigator Research Award Winner: Prognostic Factors for Time Receiving Workers' Compensation Benefits in a Cohort of Patients With Low Back Pain. *Spine, 25*(2), 147.

McLeod, C., Provost, S., Choi, K., Amick, B., Astrakianakis, G. (2017a). Leading and lagging indicators for the prevention of violence towards workers in health care. *Occup Environ Med, 74*:A142-A144.

McLeod, C., Quirke, W., Koehoorn, M. (2017b). *Work Disability Duration: A Comparative Analysis of Three Canadian Provinces*. Vancouver: Partnership for Work, Health and Safety.

McLeod, C., Reiff, E., Maas, E., Bultmann U. (2018). Identifying return-to-work trajectories using sequence analysis in a cohort of workers with work-related musculoskeletal disorders. *Scand J Work Environ Health, 44*(2), 147-155.

Ministry of Health. (2017). *Residential Care Staffing Review*. Retrieved from http://www.health.gov.bc.ca/library/publications/year/2017/residential-care-staffing-review.pdf

O'Brien-Pallas, L., Shamian, J., Thomson, D., Alksnis, C., Koehoorn, M., Kerr, M., & Bruce, S. (2004). Work-related disability in Canadian nurses. *J Nurs Scholarsh, 36*(4), 352-357.

Office of the Seniors Advocate. (2015). *British Columbia Residential Care Facilities Quick Facts Directory*. Retrieved from https://www.seniorsadvocatebc.ca/app/uploads/sites/4/2015/05/BC-Residential-Care-Quick-Facts-Directory-May-2015.pdf

Owen, C., Tarantello, C., Jones, M., & Tennant, C. (1998). Violence and Aggression in Psychiatric Units. *Psychiatric Services, 49*(11), 1452-1457.

Oyeflaten, I., Lie, S. A., Ihlebaek, C. M., & Eriksen, H. R. (2012). Multiple transitions in sick leave, disability benefits, and return to work. - A 4-year follow-up of patients participating in a work-related rehabilitation program. *BMC Public Health, 12, 748.*

Pedersen, J., Bjorner, J. B., Burr, H., & Christensen, K.B. (2012). Transitions between sickness absence, work, unemployment, and disability in Denmark 2004–2008. *Scandinavian Journal of Work, Environment, and Health*, *38*(6*)*, 516-526.

Pinar, R., & Ucmak, F. (2010). Verbal and physical violence in emergency departments: a survey of nurses in Istanbul, Turkey. *Journal of Clinical Nursing, 20*(3-4), 510-517.

Polatin, P. B. (1991). *Predictors of low back pain disability* (pp. 265-273). Baltimore: Williams & Wilkins.

Prang, K. H., Bohensky, M., Smith, P., & Collie, A. (2016). Return to work outcomes for workers with mental health conditions: A retrospective cohort study. *Injury - International Journal of the Care of the Injured, 47*(1), 257-265.

Pransky, G., Gatchel, R., Linton, S. J., & Loisel, P. (2005). Improving return to work research. *Journal of Occupational Rehabilitation, 15,* 453–457.

Qi, Y., Xiang, Y., An, F., Wang, J., Zeng, J., Ungvari, G. S., Newhouse, R., Yu, D. S. F., Lai, K. Y. C., Ding, Y., Yu, L., Zhang, X., & Chiu, H. F. K. (2013). Nurses' Work-Related Stress in China: A Comparison Between Psychiatric and General Hospitals. *Perspectives in Psychiatric Care, 50,* 27-32.

Renker, P., Scribner, S. A., & Huff, P. (2015). Staff perspectives of violence in the emergency department: Appeals for consequences, collaboration, and consistency. *Work, 51*, 5-18.

Robinson, K. M., & Tappen, R. M. (2008). Policy recommendations on the prevention of violence in long-term care facilities. *Journal of Gerontological Nursing, 34*(3), 10-14.

Roche, M., Diers, D., Duffield, C., & Catling-Paull, C. (2010). Violence toward nurses, the work environment, and patient outcomes. *Journal of Nursing Scholarship, 42,* 13-22.

Rogers, K., & Kelloway, E. K. (1997). Violence at work: personal and organizational outcomes. *Journal of Occupational Health Psychology, 2*(1), 63-71.

Sacco, W. J. (1999). Comparison of alternative methods for assessing injury severity based on anatomic descriptors. *The Journal of Trauma, 47*(3), 441.

Schultz, I. Z., Stowell, A. W., Feuerstein, M., & Gatchel, R. J. (2007). Models of Return to Work for Musculoskeletal Disorders. *Journal of Occupational Rehabilitation, 17*(2), 327-352.

Schultz, I. Z. & Warren, P. (2013). Advances in improving Return-to-Work Outcomes in Disability Compensation Contexts: from Research to Practice. *Psychological Injury and Law, 6*(3), 161-163.

Shields, M., & Wilkins, K. (2009). Factors related to on-the-job abuse of nurses by patients. *Health Reports, 20*(2), 7-19.

Shin, J. H., & Hyun, T. K. (2015). Nurse Staffing and Quality of Care of Nursing Home Residents in Korea. *Journal of Nursing Scholarship, 47*(6), 555-564.

Staggs, V. S. (2013). Nurse Staffing, RN Mix, and Assault Rates on Psychiatric Units. *Research in Nursing & Health, 36*, 26-37.

Staggs, V. S. (2016). Deviations in Monthly Staffing and Injurious Assaults Against Staff and Patients on Psychiatric Units. *Research in Nursing & Health, 39*, 347-352.

StataCorp. 2013. *Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP.

Statistics Canada. (2016). Standard Occupational Classification (SOC) 1991. Retrieved from http://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getVD&TVD=143375

Steenstra, I. A., Verbeek, J. H., Heymans, M. W., & Bongers, P. M. (2005). Prognostic factors for duration of sick leave in patients sick listed with acute low back pain: a systematic review of the literature. *Occupational and Environmental Medicine, 62*(12), 851–60.

Stevenson, K. N., Jack, S. M., O'Mara, L., & LeGris, J. (2015). Registered nurses' experiences of patient violence on acute care psychiatric inpatient units: an interpretive descriptive study. *BMC Nursing, 14*, 1-13.

Tak, S., Sweeney, M. A., Alterman, T., Baron, S., & Calvert, G. M. (2010). Workplace assaults

on nursing assistants in US nursing homes: A multilevel analysis. *American Journal of Public Health, 100,* 1938-1945.

Thomas, N. I., Brown, N. D., Hodges, L. C., Gandy, J., Lawson, L. Lord, J. E., & Williams, D. K. (2006). Risk profiles for four types of work-related injury among hospital employees. *AAOHN Journal*, *54*(2), 61–68.

Tuckey, M. R., Dollard. M. F., Hosking, P. J., & Winefield, A. H. (2009). Workplace bullying: The role of psychosocial work environment factors. *International Journal of Stress Management, 6*(3), 215-232.

Verkerk, K., Luijsterburg, P. A., Miedema, H. S., Pool-Goudzwaard, A., & Koes, B. W. (2012). Prognostic factors for recovery in chronic nonspecific low back pain: a systematic review. *Physical Therapy*, *92*(9), 1093–108.

von Treuer, K., Fuller-Tyszkiewics, M., Little, G. (2014). The impact of shift work and organizational work climate on health outcomes in nurses. *Journal of Occupational Health Psychology, 19*(4), 453-461.

Wei, C., Chiou, S., Chien, L., & Huang, N. (2016). Workplace violence against nurses – Prevalence and association with hospital organizational characteristics and health-promotion efforts: Cross-sectional study. *International Journal of Nursing Studies*, *56,* 63-70.

Whittington, R. (2002). Attitudes toward patient aggression amongst mental health nurses in the 'zero tolerance' era: Associations with burnout and length of experience. *Journal of Clinical Nursing, 11,* 819-825.

Wieclaw, J., Agerbo, E., Mortensen, P. B., Burr, H., Tuchsen, F., & Bonde, J. P. (2006). Work

related violence and threats and the risk of depression and stress disorders. *Journal of Epidemiology and Community Health, 60*(9), 771-775.

Wiemer, A., Molders, C., Fischer, S., Kawohl, W., & Rossler, W. (2017). Effectiveness of Medical Rehabilitation of Return-to-Work Depends on the Interplay of Occupation Characteristics and Disease. *J Occup Rehabil, 27,* 59-69.

WorkSafeBC. (2003). *Assessment manual*. Retrieved from https://www.worksafebc.com/en/resources/law-policy/archived-policy-manuals-assessments/archive-assessment-manual-february-1-2015-march-31-2015?lang=en&direct

WorkSafeBC. (2015). *High Risk Strategy for Health Care*. Retrieved from https://www.worksafebc.com/en/resources/health-safety/books-guides/2015-high-risk-strategy-for-health-care?lang=en

WorkSafeBC. (2016). *2015 Statistics*. Retrieved from https://www.worksafebc.com/en/resources/about-us/annual-report-statistics/2015-stats?lang=en

WorkSafeBC. (2017a). *Health Care High Risk Strategy Overview*. Retrieved from https://www.worksafebc.com/en/resources/about-us/hrs/health-care-high-risk-strategy-overview?lang=en

WorkSafeBC. (2017b). *Policies Part 04.* Retrieved from https://www.worksafebc.com/en/law-policy/occupational-health-safety/searchable-ohs-regulation/ohs-policies/policies-part-04

WorkSafeBC. (2017c). *Wage-loss benefits*. Retrieved from https://www.worksafebc.com/en/claims/benefits-services/wage-loss-benefits

Zampieron, A., Galeazzo, M., Turra, S., & Buja, A. (2010). Perceived aggression towards

nurses: Study in two Italian health institutions. *Journal of Clinical Nursing*, *19*, 2329-2341.

Zuzelo, P. R., Curran, S. S., & Zeserman, M. A. (2012). Registered Nurses' and Behavior Health Associates' Responses to Violent Inpatient Interactions on Behavioral Health Units. *Journal of the American Psychiatric Nurses Association*, *18*(2), 112-126.

Appendix

Appendix A Piecewise hazard model tabular results

Table A1: Piecewise hazard models, overall matched cohort

Days after injury	Number of workers still on claim at end of time period (Violence N = 2,881, Non-Violence N=2,881)	Crude model (HR (95% CI))	Adjusted model (HR (95% CI))
0-30	V (N=1,292) NV (N=1,384)	1.09 (1.02-1.17)	1.10 (1.03-1.18)
31-60	V (N=884) NV (N=916)	0.95 (0.83-1.08)	0.95 (0.83-1.09)
61-90	V (N=657) NV (N=619)	0.76 (0.64-0.90)	0.76 (0.63-0.90)
91-180	V (N=417) NV (N=333)	0.74 (0.62-0.87)	0.74 (0.62-0.88)
181-270	V (N=342) NV (N=260)	0.84 (0.60-1.16)	0.84 (0.61-1.17)
271-365	V (N=302) NV (N=234)	1.20 (0.72-1.98)	1.22 (0.74-2.02)

Table A2 Piecewise hazard models, stratifications of matched cohort

Days after injury	Number of workers still on claim at end of time period	Adjusted model (HR (95% CI))
Serious traumatic injuries V (N=130) NV (N=130)		
0-30	V (N=51) NV (N=58)	1.24 (0.90-1.71)
31-60	V (N=36) NV (N=44)	1.30 (0.62-2.71)
61-90	V (N=31) NV (N=39)	1.21 (0.35-4.21)

91-180	V (N=21) NV (N=22)	0.67 (0.30-1.49)
181-270	V (N=20) NV (N=14)	0.11 (0.01-0.87)
271-365	V (N=14) NV (N=10)	0.96 (0.23-4.12)
Upper extremities sprains and strains V (N=959) NV (N=959)		
0-30	V (N=494) NV (N=577)	1.33 (1.16-1.52)
31-60	V (N=340) NV (N=408)	1.10 (0.89-1.38)
61-90	V (N=246) NV (N=269)	0.78 (0.59-1.01)
91-180	V (N=144) NV (N=138)	0.84 (0.65-1.09)
181-270	V (N=115) NV (N=115)	1.27 (0.73-2.20)
271-365	V (N=101) NV (N=101)	1.01 (0.47-2.18)
Non-traumatic non-sprain injuries V (N=756) NV (N=756)		
0-30	V (N=203) NV (N=217)	1.00 (0.89-1.13)
31-60	V (N=145) NV (N=138)	0.77 (0.55-1.10)
61-90	V (N=119) NV (N=105)	0.72 (0.43-1.21)
91-180	V (N=80) NV (N=68)	0.91 (0.58-1.43)
181-270	V (N=68) NV (N=56)	0.89 (0.39-2.03)
271-365	V (N=53) NV (N=52)	4.16 (1.19-14.48)
Counselor/Social workers V (N=642) NV (N=642)		
0-30	V (N=270) NV (N=267)	1.02 (0.88-1.18)

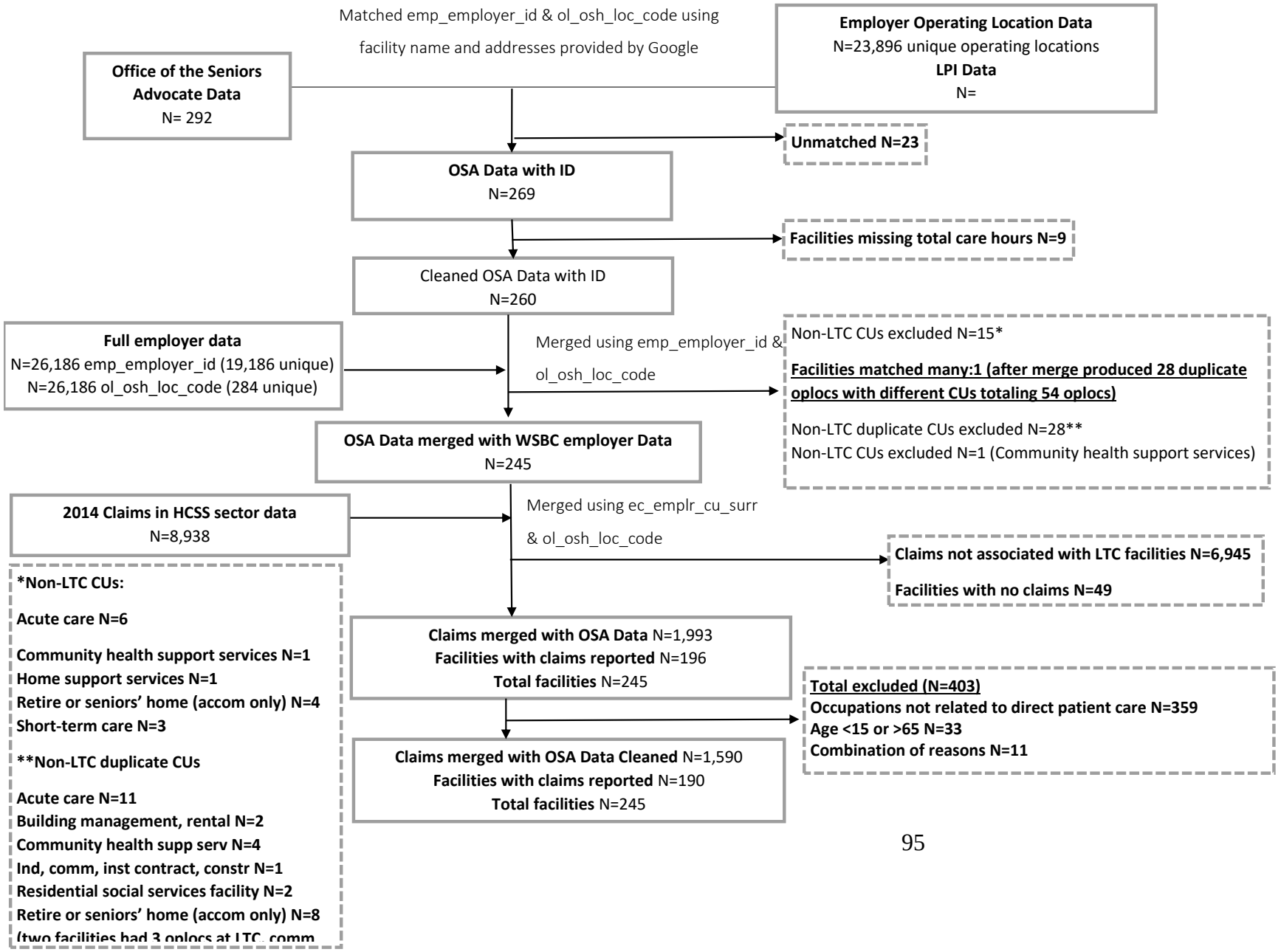
31-60	V (N=210) NV (N=185)	0.67 (0.48-0.95)
61-90	V (N=176) NV (N=122)	0.46 (0.30-0.69)
91-180	V (N=126) NV (N=73)	0.69 (0.46-1.02)
181-270	V (N=105) NV (N=61)	1.09 (0.54-2.23)
271-365	V (N=98) NV (N=55)	0.75 (0.23-2.45)
Nursing aides/assistants V (N=1,405) NV (N=1,405)		
0-30	V (N=644) NV (N=706)	1.13 (1.02-1.25)
31-60	V (N=420) NV (N=467)	1.08 (0.90-1.30)
61-90	V (N=297) NV (N=320)	0.92 (0.72-1.17)
91-180	V (N=183) NV (N=162)	0.72 (0.57-0.92)
181-270	V (N=149) NV (N=127)	0.90 (0.56-1.44)
271-365	V (N=130) NV (N=114)	1.34 (0.64-2.78)
Nurses V (N=834) NV (N=834)		
0-30	V (N=378) NV (N=411)	1.14 (1.00-1.30)
31-60	V (N=254) NV (N=264)	0.94 (0.74-1.20)
61-90	V (N=186) NV (N=180)	0.78 (0.67-1.08)
91-180	V (N=111) NV (N=101)	0.89 (0.65-1.22)
181-270	V (N=90) NV (N=74)	0.66 (0.37-1.19)
271-365	V (N=74) NV (N=65)	1.50 (0.63-3.53)

Acute care V (N=813) NV (N=813)		
0-30	V (N=373) NV (N=404)	1.16 (1.02-1.33)
31-60	V (N=250) NV (N=254)	0.92 (0.72-1.18)
61-90	V (N=177) NV (N=172)	0.88 (0.64-1.21)
91-180	V (N=109) NV (N=94)	0.86 (0.62-1.20)
181-270	V (N=87) NV (N=69)	0.72 (0.41-1.28)
271-365	V (N=71) NV (N=60)	1.56 (0.66-3.68)
Counseling or social services V (N=161) NV (N=161)		
0-30	V (N=70) NV (N=62)	0.91 (0.68-1.21)
31-60	V (N=54) NV (N=44)	0.78 (0.39-1.57)
61-90	V (N=44) NV (N=32)	0.63 (0.27-1.46)
91-180	V (N=35) NV (N=21)	0.53 (0.22-1.30)
181-270	V (N=30) NV (N=17)	0.83 (0.22-3.12)
271-365	V (N=28) NV (N=15)	0.63 (0.04-10.16)
Long-term care V (N=1,354) NV (N=1,354)		
0-30	V (N=621) NV (N=696)	1.16 (1.04-1.29)
31-60	V (N=403) NV (N=453)	1.05 (0.87-1.26)
61-90	V (N=294) NV (N=313)	0.85 (0.66-1.09)
91-180	V (N=180) NV (N=163)	0.73 (0.57-0.94)

181-270	V (N=149) NV (N=128)	0.81 (0.50-1.32)
271-365	V (N=133) NV (N=116)	1.17 (0.54-2.55)
Residential social service facility V (N=308) NV (N=308)		
0-30	V (N=127) NV (N=117)	0.95 (0.77-1.16)
31-60	V (N=101) NV (N=90)	0.87 (0.50-1.50)
61-90	V (N=89) NV (N=51)	0.23 (0.12-0.44)
91-180	V (N=59) NV (N=28)	0.75 (0.43-1.32)
181-270	V (N=47) NV (N=23)	1.24 (0.44-3.55)
271-365	V (N=45) NV (N=18)	0.12 (0.01-1.06)
Fixed shifts V (N=412) NV (N=467)		
0-30	V (N=150) NV (N=182)	1.08 (0.91-1.29)
31-60	V (N=104) NV (N=118)	0.90 (0.61-1.34)
61-90	V (N=81) NV (N=72)	0.55 (0.33-0.91)
91-180	V (N=59) NV (N=35)	0.49 (0.29-0.84)
181-270	V (N=50) NV (N=28)	0.80 (0.30-2.15)
271-365	V (N=46) NV (N=25)	0.89 (0.15-5.36)
Rotating shifts V (N=681) NV (N=649)		
0-30	V (N=300) NV (N=313)	1.19 (1.02-1.38)
31-60	V (N=195) NV (N=212)	1.18 (0.90-1.56)

61-90	V (N=142) NV (N=141)	0.81 (0.57-1.17)
91-180	V (N=90) NV (N=75)	0.79 (0.55-1.14)
181-270	V (N=74) NV (N=54)	0.67 (0.35-1.29)
271-365	V (N=64) NV (N=47)	1.20 (0.43-3.37)
Variable shifts V (N=1,765) NV (N=1,788)		
0-30	V (N=889) NV (N=842)	1.10 (1.00-1.21)
31-60	V (N=587) NV (N=585)	0.90 (0.76-1.07)
61-90	V (N=408) NV (N=435)	0.80 (0.65-1.00)
91-180	V (N=224) NV (N=270)	0.79 (0.64-0.97)
181-270	V (N=180) NV (N=220)	0.95 (0.63-1.43)
271-365	V (N=162) NV (N=192)	1.31 (0.71-2.40)

Appendix B Study II cohort construction flowchart



Appendix C Claim-level descriptives

Table A3 Injured worker statistics in long-term care settings in 2014

	Claim-level (N=1,590)				
		Staffing quartiles			
	0-25th percentile (N=293)	25-50th percentile (N=316)	50-75th percentile (N=489)	75-100th percentile (N=492)	P-value
Violence vs nonviolence					<0.00
- Nonviolence-related	224 (76.4%)	277 (87.7%)	441 (90.2%)	440 (89.4%)	
- Violence-related	69 (23.6%)	39 (12.3%)	48 (9.8%)	52 (10.6%)	
Age					0.09
- 15-34	40 (13.7%)	74 (23.4%)	92 (18.8%)	79 (16.1%)	
- 35-44	71 (24.2%)	73 (23.1%)	106 (21.7%)	120 (24.4%)	
- 45-54	111 (37.9%)	102 (32.3%)	179 (36.6%)	186 (37.8%)	
- 55-64	71 (24.2%)	67 (21.2%)	112 (22.9%)	107 (21.7%)	
Wage					0.00
- <$20,000	8 (2.7%)	7 (2.2%)	15 (3.1%)	16 (3.2%)	
- $20,000-39,999	68 (23.2%)	124 (39.2%)	190 (38.8%)	175 (35.6%)	
- $40,000-59,999	174 (59.4%)	154 (48.7%)	239 (48.9%)	242 (49.2%)	
- >$60,000	43 (14.7%)	31 (9.8%)	45 (9.2%)	59 (12.0%)	
Occupation					<0.00
- Nursing aides	244 (83.3%)	273 (86.4%)	432 (88.3%)	375 (76.2%)	
- Nurses	49 (16.7%)	43 (13.6%)	57 (11.7%)	117 (23.8%)	
Injury type					<0.00
- Spine and back sprains and strains	71 (24.2%)	79 (25.0%)	109 (22.3%)	98 (19.9%)	

-	Torso sprains and strains	58 (19.8%)	50 (15.8%)	81 (16.6%)	60 (12.2%)
-	Upper extremities sprains and strains	69 (23.6%)	101 (32.0%)	122 (24.9%)	109 (22.1%)
-	Other sprains and strains	23 (7.8%)	15 (4.7%)	37 (7.6%)	35 (7.1%)
-	Non-traumatic Non-sprain injuries	40 (13.6%)	31 (9.8%)	40 (8.2%)	39 (7.9%)
-	Musculoskeletal diseases	16 (5.5%)	23 (7.8%)	27 (5.5%)	36 (7.3%)
-	Other injuries	13 (4.4%)	12 (7.3%)	16 (3.3%)	19 (3.8%)