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Injuries among individuals with pre-existing spinal cord injury: understanding injury patterns, burdens, and prevention

Erin Ose Heiden
University of Iowa

INJURIES AMONG INDIVIDUALS WITH PRE-EXISTING SPINAL CORD INJURY: UNDERSTANDING INJURY PATTERNS, BURDENS, AND PREVENTION

by

Erin Ose Heiden

An Abstract

Of a thesis submitted in partial fulfillment of the
requirements for the Doctor of Philosophy degree
in Community and Behavioral Health (Health Communication)
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Thesis Supervisors: Associate Professor Jingzhen Yang
Professor Corinne Peek-Asa

ABSTRACT

As a growing body of research has focused on the individual, social, and environmental factors that facilitate life after spinal cord injury (SCI), particular emphasis has been placed on health conditions that are modifiable and preventable. Subsequent injuries are a serious health problem for individuals with SCI. They are a direct threat to further morbidity and mortality, and are both a cause and consequence other secondary health conditions.

As a first step toward understanding this public health problem, the purpose of this dissertation research was to describe the patterns, burdens, and prevention of subsequent injury among individuals with SCI. In three distinct, but related studies, this dissertation examined the characteristics of hospitalizations due to an injury among individuals with paraplegia, and compared the differences in length of stay (LOS) and hospital costs of injury hospitalizations between individuals with quadriplegia versus paraplegia. In addition, it explored the experience of subsequent injury among individuals with SCI who return to work and examined perceptions of threat and efficacy in preventing subsequent injury using the Extended Parallel Process Model. Using discharge level weighting available in the Nationwide Inpatient Sample, Study 1 calculated national estimates of injury hospitalizations for individuals with paraplegia by patient, hospital, and injury characteristics. Most injury hospitalizations occurred among males, to individuals 35-49 years, and were due to falls, poisonings, or motor vehicle traffic. With the same dataset, Study 2 used logistic regression to estimate the effect of patient characteristics on odds of hospitalized patients with quadriplegia versus paraplegia, and linear regression to estimate predicted differences in hospital costs for individuals with quadriplegia compared to paraplegia. Fewer injury hospitalizations but longer hospital stays, and higher hospital costs per discharge were found for individuals with quadriplegia compared to individuals with paraplegia. Males, younger age, and the uninsured were significant predictors of higher hospital costs. Finally, Study 3 used in-depth interviews to qualitatively explore the perceptions on subsequent injury among individuals with SCI who return to work, and found individuals with SCI who return to work recognized the importance of preventing subsequent injury, and were taking actions to prevent subsequent injury in their daily life and in the workplace.

The significance of this research is that it is the first description of injury hospitalizations for all causes of injury by specific type of SCI, and the associated medical outcomes of LOS and direct medical costs. Prevention of subsequent injury should be a priority. The perceptions of individuals with SCI about the severity of and their susceptibility to injury and the efficacy of individual and environmental actions to prevent subsequent injury described in this research should be used to inform the development of interventions that prevent subsequent injury.

Abstract Approved: ____________________________________

Jingzhen Yang

Associate Professor, Community and Behavioral Health

Title

____

Date

____

Corinne Peek-Asa

Professor, Occupational and Environmental Health

Title

____

Date

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Graduate College
The University of Iowa
Iowa City, Iowa

CERTIFICATE OF APPROVAL

PH.D. THESIS

This is to certify that the Ph.D. thesis of

Erin Ose Heiden

has been approved by the Examining Committee
for the thesis requirement for the Doctor of Philosophy degree
in Community and Behavioral Health (Health Communication)
at the May 2013 graduation.

Thesis Committee:

Jingzhen Yang (Thesis Supervisor)

Corinne Peek-Asa (Thesis Supervisor)

Michelle L. Campo

John B. Lowe

Marizen Ramirez

Richard K. Shields

To Magdalen and Hattie

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As a first step toward understanding this public health problem, the purpose of this dissertation research was to describe the patterns, burdens, and prevention of subsequent injury among individuals with SCI. In three distinct, but related studies, this dissertation examined the characteristics of hospitalizations due to an injury among individuals with paraplegia, and compared the differences in length of stay (LOS) and hospital costs of injury hospitalizations between individuals with quadriplegia versus paraplegia. In addition, it explored the experience of subsequent injury among individuals with SCI who return to work and examined perceptions of threat and efficacy in preventing subsequent injury using the Extended Parallel Process Model. Using discharge level weighting available in the Nationwide Inpatient Sample, Study 1 calculated national estimates of injury hospitalizations for individuals with paraplegia by patient, hospital, and injury characteristics. Most injury hospitalizations occurred among males, to individuals 35-49 years, and were due to falls, poisonings, or motor vehicle traffic. With the same dataset, Study 2 used logistic regression to estimate the effect of patient characteristics on odds of hospitalized patients with quadriplegia versus paraplegia, and linear regression to estimate predicted differences in hospital costs for individuals with

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The significance of this research is that it is the first description of injury hospitalizations for all causes of injury by specific type of SCI, and the associated medical outcomes of LOS and direct medical costs. Prevention of subsequent injury should be a priority. The perceptions of individuals with SCI about the severity of and their susceptibility to injury and the efficacy of individual and environmental actions to prevent subsequent injury described in this research should be used to inform the development of interventions that prevent subsequent injury.

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LIST OF ABBREVIATIONS

AHRQ	Agency for Healthcare Research and Quality
ANOVA	Analysis of variance
ASIA	American Spinal Injury Association
CCS	Clinical Classifications Software
Ecode	External cause of injury code
EPPM	Extended Parallel Process Model
HCUP	Healthcare Cost and Utilization Project
ICD-9-CM	International Classification of Diseases, 9^{th} revision, Clinical Modification
LOC	Locus of control
LOS	Length of stay
MVT	Motor vehicle traffic
NIS	Nationwide Inpatient Sample
NSCISC	National Spinal Cord Injury Statistical Center
SCI	Spinal Cord Injury
SUDAAN	Survey Data Analysis
US	United States

CHAPTER 1

A REVIEW OF SUSBSEQUENT INJURY AMONG INDIVIDUALS WITH SPINAL CORD INJURY: A PUBLIC HEALTH APPROACH

Introduction

As acute survival and rehabilitation from spinal cord injury (SCI) has improved, there has been greater focus on the long term impact of SCI. A growing body of research has focused on societal participation and productivity following spinal cord injury, including the role of environmental facilitators and barriers, employment, secondary health conditions, and quality of life after SCI. (Whiteneck et al, 2004, Krause, DeVivo, & Jackson, 2004, Meyers, Mitra, Walker, Wilber, & Allen, 2000). However, few studies have investigated subsequent injuries among individuals with SCI. Evidence shows that subsequent injuries are a serious health problem for individuals with SCI (Krause, 2004, 2010). They are a direct threat to further morbidity and mortality, and are both a cause and consequence of other secondary health conditions, including autonomic dysreflexia, heterotopic ossification and osteoporosis (Mukand, Karlin, & Biener-Bergman, 2000). Most importantly subsequent injuries are preventable, thus understanding the patterns and burdens of subsequent injuries will help develop effective prevention strategies, and lead to better health for individuals living with SCI.

The problem

There are several reasons why subsequent injury among individuals with spinal cord injury is an important public health problem and deserves research attention. First, subsequent injuries add to the already substantial health care burden for individuals with SCI. Individuals with SCI have an average of 19.6 days hospital stay and $278,000 (2009 $US) in hospital charges during their initial acute care for SCI, and another 47.7 days and $157,000 (2009 $US) for rehabilitation care immediately following their SCI. (DeVivo, Chen, Mennemeyer, & Deutsch, 2011). In addition, they also incur other health care expenses in the first year and thereafter, including costs of emergency medical services, nursing home care, outpatient services, physician fees, equipment, environmental modifications, medications, supplies, attendant care, and vocational rehabilitation (DeVivo et al, 2011). These add another $65,200 in expenses during the first year, and $51,200 annually thereafter for individuals with SCI (DeVivo et al, 2011). Subsequent injuries increase both the burden of direct health care costs and indirect costs for these individuals, but have not been explicated in previous research.

Second, subsequent injuries are both a cause and consequence of other secondary conditions for individuals with SCI. For example, an injury, such as a burn or fracture, below the level of the SCI can cause autonomic dysreflexia, a serious, acute hypertensive event resulting in increased blood pressure, sweating, skin flushing, and headache that can lead to intracranial hemorrhage if not treated (Mukand et al, 2000). An injury may also cause a heterotopic bone ossification, which often occurs after a fracture, and leads to loss of range of motion (Kalpakjian, Scelza, Forchheimer, & Toussaint, 2007).

Individuals with SCI may also be susceptible to injury as a direct consequence of their SCI or indirectly due to other secondary health conditions. Physiologic sequelae of SCI place individuals at risk for subsequent injury. Loss of sensation below the level of spinal cord lesion decreases the ability of an individual with SCI to detect when they are about to be injured (e.g. feel pain as a precursor to a burn), and also detect an injury after it has occurred (Kalpakjian et al, 2007). In addition, secondary health conditions like osteoporosis, muscle spasticity, and contractures of the soft tissue around a joint may result in both spontaneous fractures and increased susceptibility to fractures from an external cause (Kalpakjian et al, 2007).

Third, subsequent injuries are an important public health problem for individuals with SCI because of their potential impact on reduced quality of life, including return to work and other social participation. Compared to other injured individuals, injuries take longer to heal in individuals with SCI (Ding, Jiang, Zhang, Jiang, & Dai, 2011), which may result in time loss from other activities, including work. Subsequent injuries may also result in greater functional impairment, more severe disability, or even another SCI at a higher level of the spinal cord (Pickelsimer, Shiroma, Wilson, 2010).

Finally, like injuries in the general population, subsequent injuries among individuals with SCI are largely preventable, therefore it is important to define when, why, and how they occur so that appropriate prevention programs can be developed and implemented. Previous studies have identified that impulsive-sensation seeking personality, binge drinking, and alcohol and prescription medication use are a cause of both first time SCI and subsequent injuries (Fordyce, 1964, Krause, 2004, 2010). Injury prevention programs should target the modifiable risk factors, such as health behaviors and personality traits, to prevent the initial SCI, as well as subsequent injury.

The rationale

No studies have described all causes of subsequent injury or the types of injuries sustained by individuals with SCI. Only two existing studies have examined subsequent injuries as a primary research focus. Both studies examined predictors of subsequent injury, and found being younger, greater functional ability, sensation-seeking personality, binge drinking, and prescription medication were associated with both subsequent injury and/or injury-related hospitalizations (Krause 2004, 2010). Other studies have been limited either to a single type of injury, such as falls (Brotherton, Krause, Nietert, 2007, Nelson et al, 2003) or suicides (DeVivo, Black, Scott Richards & Stover, 1991, Hartkopp, Bronnum-Hansen, Seidenschnur, & Biering-Sorensen, 1998) following SCI. Finally, some studies report subsequent injuries along with other findings for all-cause mortality or rehospitalizations where subsequent injuries account for 10-18% of deaths (National Spinal Cord Injury Statistical Center (NSCISC), 2012a, DeVivo, Krause, & Lammertse, 1999) and range from the third to eighth leading cause of rehospitalizations (Dryden et al, 2004, Cardenas, Hoffman, Kirshblum, & McKinley, 2004, NSCISC, 2012a) following SCI. However, no studies have described the differences between individuals with quadriplegia versus paraplegia by cause, type of injury, or associated hospital outcomes. Because the causes and types of subsequent injuries may vary by specific type of SCI, it is necessary to describe the types of injuries and their impact by either quadriplegia or paraplegia, so prevention strategies can be tailored by specific type of SCI if needed.

Individuals with quadriplegia and paraplegia differ in other health outcomes and the costs of care in the years following their initial SCI. Both first-year and annual health care expenses are generally more for individuals with quadriplegia versus paraplegia. Individuals with paraplegia average $465,000 (2009 $US) in first year charges, and another $62,000 annually thereafter; whereas, individuals with quadriplegia average

$821,000 in the first year, and $136,000 annually thereafter (DeVivo et al, 2011). In addition, individuals with paraplegia average 6 rehospitalization days and $26,000 (2009 $US) in rehospitalization charges per year compared to 7 days and $28,000 each year for individuals with quadriplegia (DeVivo et al, 2011). This suggests that direct medical costs of subsequent injuries may also differ by specific type of SCI, but this has not been confirmed through research.

While there are existing quantitative studies, a deeper understanding of subsequent injuries is still needed before developing intervention programs to prevent them. While increased life expectancy, quality of life, and workplace supports following SCI have resulted in more individuals who return to work following SCI, no studies have attempted to describe injuries to individuals with SCI in the workplace or how messages about subsequent injury prevention in daily life or the workplace are communicated. Previous studies have been quantitative in nature by focusing on risk factors, predictors, and circumstances of subsequent injury (Krause, 2004, 2010, Krause, Coker, Charlifue, & Whiteneck, 2000, Brotherton et al, 2007) or return to work (Lidal, Huynh, Biering-Sorensen, 2007, Ottomanelli & Lind, 2009), but none have explored the intersection where prevention of subsequent injury and return to work overlap. It is not known if individuals with SCI perceive subsequent injuries to be threat, if they feel susceptible, or their beliefs in the ability to prevent subsequent injury. The use of theory in research, specifically one that incorporates constructs of perceived severity, susceptibility, and efficacy, is needed for further understanding of subsequent injury and how to prevent them.

Clearly, research on subsequent injuries is needed. Understanding the causes, types, and burden of subsequent injury, as well as perceptions of threat and efficacy of individuals with SCI about preventing subsequent injury will help close the gap from research to prevention. This dissertation research aimed to describe the types and causes of injury by individual characteristics including sex, age, and specific type of SCI; and further examine differences in outcomes by specific type of SCI. In addition, both a qualitative and theory-driven approach was utilized to complement the quantitative work already being done, and inform the next step toward the development and implementation of interventions to prevent subsequent injury.

Specific aims

The main objective of this dissertation research was to gain a better understanding of subsequent injury among individuals with SCI, by describing the types and causes of injury hospitalizations experienced by individuals with pre-existing paraplegia, comparing differences in the burden of injury hospitalizations between individuals with quadriplegia versus paraplegia, and exploring perceptions of threat and communication about subsequent injury among individuals with SCI in daily life and the workplace. The long term goal of this dissertation research is to develop effective intervention strategies that target the prevention of subsequent injuries among individuals with SCI.

The three specific aims of this dissertation research were:

Aim 1: Describe injury hospitalizations among individuals with pre-existing paraplegia by injury characteristic, length of stay, and hospital charges;

This study examined the number of injuries, nationwide, that result in hospitalizations for individuals with a pre-existing paraplegia. Patient and hospital characteristics of these injuries were described. Main outcome measures included number, type, and cause of injuries that result in hospitalizations and national estimates of in-hospital mortality, length of stay, and hospital charges. Results generated from Aim 1 provided a picture of injury burden among individuals with pre-existing paraplegia.

Aim 2: Compare the difference in injury hospitalizations and associated costs between individual with pre-existing quadriplegia versus paraplegia;

This study compared the burden of injury measured by hospital costs per discharge between individuals with quadriplegia versus paraplegia. The central hypothesis was that patients with quadriplegia have a higher mortality, higher hospital costs per discharge, and longer lengths of stay than patients with paraplegia.

Aim 3: Explore the perceived threat of and communication about subsequent injury among individuals with spinal cord injury who return to work.

This study described the perceptions of threat and efficacy for preventing subsequent injury following SCI using constructs from the Extended Parallel Process Model (Witte, 1992) and Health Locus of Control (Wallston & Wallston, 1982) in a guiding conceptual model. In addition, it explored the experience of subsequent injury and communication about preventing subsequent injury when individuals with SCI return to work. Results may be used as a first step toward developing intervention to prevent injuries in this population.

Literature Review

Definition of spinal cord injury

Spinal cord injury is categorized by the level and completeness of injury to the spinal cord, with better outcomes associated with lower, incomplete injuries (NSCISC, 2012a). Quadriplegia is defined as injury to one of the eight cervical vertebrae and typically results in paralysis of all four limbs. Paraplegia is defined as injury to one of the thoracic, lumbar, or sacral vertebrae and is characterized by paralysis in the two lower limbs. SCI is also categorized as complete or incomplete as determined whether the spinal cord is completely severed. By neurologic level, the most common SCI is incomplete quadriplegia (40.8%), followed by complete paraplegia (21.6%), incomplete paraplegia (21.4%), and complete quadriplegia (15.8%), respectively (NSCISC, 2012b). Higher levels of injury (e.g. complete quadriplegia) are associated with higher lifetime costs and shorter life expectancy. Level of injury also affects return to work, rehospitalizations, secondary conditions, and life satisfaction with more severe SCI generally associated with poorer outcomes.

Demographic profile of individuals with spinal cord injury

Each year, approximately 12,000 individuals experience a spinal cord injury (SCI), with an estimated annual incidence rate of 40 cases per million population in the U.S. (NSCISC, 2012b). SCI occurs most often among males (81% male v. 19% female), and between the ages 25-35 years. The average age at injury is 34.2 years, however, from 2005 to 2011 the average age of SCI has increased to 41 years.

By race, most SCI occurs among individuals who are Caucasian (67%), with 23% among Black/ African American, and 10% other. The majority of SCI are caused by motor vehicle crashes (39.2%), followed by falls (28.3%) acts of violence (14.6%), and sports (8.2 %). Key differences by age group and race/ethnicity include a greater proportion of violence related etiologies among 16-30 year olds (23.7%), and African Americans (43.8%).

In contrast, the prevalent population of individuals living with spinal cord injury reflects an older average age (45 years), slightly greater proportion of women (21%), and more evenly distributed by neurologic level of SCI (Table 1.1.). Extrapolating from the most recent prevalence studies conducted in the 1990s (Lasfargues, Custis, Morrone, Carswell, & Nguyen, 1995), the predicted population of individuals with SCI in 2012 is 270,000 persons (DeVivo & Chen, 2011).

For each subsequent year post-injury, individuals with SCI report higher perceived health status, community participation, life satisfaction, and return to work (NSCISC, 2012a, DeVivo & Chen, 2011). The life expectancy for persons with paraplegia surviving at least 1 year post-injury ranges from an additional 45 years for 20 year olds, 28years for 40 year olds, and 13 years for 60 year olds (NCSISC, 2012b). For individuals with quadriplegia, the life expectancy for persons surviving at least 1 year is an additional 39 years for 20 year olds, 23 years for 30 year olds, and 10 years for 60 year olds.

An individual experiences many life changes following traumatic spinal cord injury. Immediate emphasis is placed on acute rehabilitation, followed by a more long-term and permanent adjustment of environmental modifications, daily activities, personal care, and their new role of living with a permanent disability. SCI impacts an individual's emotional well-being, community participation, and quality of life (Whiteneck et al, 2004, Krause et al, 2004, Charlifue, Lammertse, & Adkins, 2004). Individuals with SCI are also at risk for many secondary conditions that can compromise their overall health and general well-being. Pressure sores, respiratory problems, genitourinary problems (e.g. urinary tract infections), spasticity and skeletal degeneration (e.g. scoliosis) threaten early mortality and further disability (DeVivo et al, 1999, Dryden et al, 2004). Sometimes subsequent injuries are included in the research on health outcomes, but not always. This makes it a challenge to get a clear understanding of the types, causes, and risk of subsequent injuries to individuals with SCI and the associated impact of injuries on health and well-being.

Subsequent injuries to individuals with pre-existing spinal cord injury

Specific and comprehensive research on the types and causes of subsequent injuries to individuals with SCI is challenging to find. Some studies have focused on a single type of injury (e.g. fractures (Nelson et al, 2003)), and others on a specific external cause (e.g. falls (Brotherton et al, 2007), suicides (DeVivo et al, 1991, Hartkopp et al, 1998), or burns (Formal, Goodman, Jacobs, & McMonigle, 1989)). Information on subsequent injuries can also be found as a secondary result in research with a broader focus, such as from surveillance of all-cause mortality following SCI (DeVivo et al, 1999, Krause, Carter, Pickelsimer, & Wilson, 2008), on secondary conditions among individuals with SCI (Kalpakjian et al, 2007), or on reasons for rehospitalization following SCI (Dryden et al, 2004, Cardenas et al, 2004). The ability to tease it out from previous research findings is complicated further by the following issues:

1. The topic requires a nuanced key word search of the literature since the main topic of interest, i.e. subsequent INJURY, is also used to define the population of interest, i.e. individuals with spinal cord INJURY;
2. There is no specific term to describe the time period that follows the acute injury and rehabilitation from SCI, e.g. "postrehabilitation outcomes", "individuals with chronic SCI", "living with SCI", and "aging after SCI";
3. Research is not consistent on how subsequent injuries are classified across general categories of outcomes after SCI, e.g. as a "secondary condition", a "late complication", or a "health outcome"; and
4. The definition of subsequent injury is not consistent across studies that capture subsequent injury-related outcomes.

The central challenge across these observations is the definition of subsequent injury.

Definition of subsequent injury

There have long been methodological challenges in injury epidemiology and injury prevention research (Cummings, Koepsell, & Mueller, 1995). According to *Injury Surveillance Guidelines* (Holder et al, 2001), "an injury is the physical damage that results when a human body is suddenly or briefly subjected to intolerable levels of energy. Injury can be a bodily lesion resulting from acute exposure to energy in amounts that exceed the threshold of physiological tolerance, or it can be an impairment of function resulting from a lack of one or more vital elements (e.g., air, water, or warmth), as in strangulation, drowning, or freezing" (p. 5). It is an acute, physical condition that results in the short time between exposure to the energy and the appearance of the injury. The energy causing an injury may be mechanical (e.g. struck by or against an object), radiant (e.g. shock wave from an explosion), thermal (e.g. air or water that is too hot or too cold), electrical, or chemical (e.g. a poison). It does not include conditions that result from continual, chronic, or overuse stress. It also does not include complications of medical or surgical care and adverse events.

Injuries are described by two dimensions: the external cause (e.g. fall) and the diagnosis (e.g., fracture). Each dimension has two axes. “The external cause is categorized by the mechanism (e.g., firearm) and the intent (e.g., homicide). The diagnosis is categorized by the nature of the injury (e.g. open wound) and the body region of the injury (e.g., chest)” (Bergen, Chen, Warner, & Fingerhut, 2008, p. 5). Injuries are often categorized by the intent as to whether or not they were deliberately inflicted. Intent is categorized as unintentional (i.e. accidental), intentional (e.g. homicide, suicide, interpersonal violence, self harm, legal intervention, war), and undetermined intent (Holder et al., 2001).

Spinal cord injury is an injury to the spinal cord. Therefore it is necessary to clearly distinguish subsequent injury from the initial spinal cord injury. Subsequent injuries are defined as injuries that occur after, or subsequent (but not secondary), to the initial SCI, and do not include multiple injuries sustained during the original event that caused the initial SCI (NSCISC, 2012a, Krause, 2004, 2010, Pickelsimer et al, 2010)

In the context of subsequent injuries among individuals with spinal cord injury, several studies provide a window into injuries in this population despite not being the primary focus of the study.

Subsequent injury-related mortality

Fatal subsequent injuries are captured in surveillance of all-cause mortality following SCI, where unintentional subsequent injuries rank sixth and intentional subsequent injuries (e.g. homicides and suicides) rank seventh, accounting for 7% and 5% of deaths, respectively (NSCISC, 2012a). When intent is combined (i.e. subsequent injury death from any external cause, whether unintentional, suicide, or homicide), subsequent injuries are the second leading cause of death among individuals with SCI (NSCISC, 2012a). In another study, DeVivo and colleagues (1999) found that all external causes of death, inclusive of suicide, homicides, and unintentional injuries, accounted for 3.6% (eighth leading cause) of deaths during the first year after SCI, but increased dramatically to the second leading cause of death, representing 18.3% of deaths, beyond the first year following SCI.

Subsequent injuries may also be an underlying or contributing cause to mortality following spinal cord injury from other causes. One study found subsequent injuries to be an underlying or contributing cause of death in 44% of deaths in a cohort of 401 individuals with SCI followed for up to 50 years post-injury (Hagen, Lie, Rekand, Gilhus, & Gronning 2010). Individuals with SCI who have experienced subsequent injury may also be at higher risk of death compared to the general population. In prospective studies of mortality, a history of fracture among individuals with SCI resulted in a 78% higher risk of mortality for any reason ($HR=1.78$, $P<.01$) (Krause et al, 2008).

Subsequent injury-related hospitalizations

Non-fatal subsequent injuries rank from the third to eighth leading reason for rehospitalizations among individuals with SCI (DeVivo & Farris, 2011, Dryden et al, 2004, NSCIS, 2012a, Cardenas et al, 2004). Approximately 6% (DeVivo & Farris, 2011) to 9% (NSCIS, 2012a) of rehospitalizations following SCI are due to subsequent injuries, and like mortality, a greater proportion of rehospitalizations are due to subsequent injuries with each additional year up to 30 years post-injury, from 5.6% in year one to 10.2% in year 30 (NSCIS, 2012a). In Dryden's et al (2004) matched cohort study of health care utilization following SCI, subsequent injuries were the third leading cause of hospital admissions in the first 6 years post-injury accounting for 2.75 hospitalizations per 100 person years compared to 1.4 hospitalizations per 100 person years in the control group.

Subsequent injury as a secondary condition

Across research on secondary conditions following spinal cord injury, some studies include subsequent injury (Kalpakjian et al, 2007, Meyers et al, 2000), while other studies do not (Dudley-Javoroski & Shields, 2006, Johnson, Gerhart, McCray, Menconi, & Whiteneck, 1998). The issue is further complicated by how the researcher defines "injury" and "secondary condition". A 1991 Institute of Medicine report defined secondary condition as "any additional physical or mental health condition that occurs as a result of having a primary disabling condition" (Pope & Tarlov, 1991, p. 35) (A "disabling condition" is any mental or physical health condition that can lead to disability.) However, there is disagreement as to whether secondary conditions must be causally related to the primary disability, and how they differ from sequelae and comorbidities (Field & Jette, 2007). Applying a conservative interpretation of this definition, only subsequent injuries that result directly from having SCI are considered secondary conditions, and presumably injuries that could happen to anybody are not. For example, the Spinal Cord Injury Secondary Conditions Scale (SCI-SCS) (Kalpakjian et al, 2007) includes “injury caused by loss of sensation”, defined as an injury that occurs “because of a lack of sensation, such as burns from carrying hot liquids in the lap or sitting too close to a heater or fire” (p. 138). Research on subsequent injuries as a secondary condition is also complicated by how injury is defined. In a survey of 17 secondary conditions, Meyers and colleagues (2000) differentiated “falls or other types of injury” from “burns”. It is unclear whether the survey captured any fall event or only falls that resulted in an injury. Overall, the definition is problematic because falls may occur without resulting in injury, and are by definition an event, or external cause, but not an injury. However, some studies adopt a more broad definition of secondary conditions, by including behavioral and environmental complications (Johnson et al, 1998), in which case “falls” may qualify.

Subsequent injury by a specific cause

Some research exists on a single type or cause of subsequent injury to individuals with SCI. For example, in research on falls, 30% of veterans with spinal cord injury had experienced a wheelchair-related fall, and 14% of falls resulted in an injury (Nelson et al., 2010). Brotherton and colleagues (2007) found 18% of falls resulted in fractures, and Nelson and colleagues (2003) found 97% of fall-related fractures were lower-extremity, often the result of transfer activities (44%), vehicle-related activities (30%), bed-related activities (e.g. re-positioning) (22%), or propelling wheelchairs over uneven surfaces (15%) (categories not mutually exclusive). Fall-related fractures resulted in high health care utilization averaging 66 days per patient which the authors attributed to additional medical complications, lack of home care, and inability to navigate wheelchair with legs extended.

In research specific to suicide, which is an intentional injury, rates of suicide among individuals with SCI were higher than expected in the general population (SMR of 5.79(95% CI 3.11,10.75) (Hartkopp et al, 1998; Hagen et al, 2010). In an early study, 6.3% of deaths were caused by suicide, and was the leading cause of death for people with complete paraplegia versus other types of SCI (DeVivo et al, 1991).

Individuals with spinal cord injury are also susceptible to burns from external causes due to loss of sensation. In a sample of 117 adults with SCI, 20% reported burns in the previous year (Meyers et al, 2000) Burns among individuals with SCI are known to happen from showering or bathing, food and beverages, or therapeutic and environmental heating devices (Formal et al, 1989).

Subsequent injuries as a primary research focus

Only two studies have been identified that examined subsequent injuries to individuals with SCI as a primary research focus. Krause (2004, 2010) studied factors associated with risk for subsequent injuries and found that 23% of participants reported subsequent injuries over a 12-month period, and 7% reported 1 or more injury-related hospitalizations over the one year period. Younger age and less severe SCI were significantly associated with subsequent injury (OR=0.81 and 1.73, respectively). In addition, one personality factor, impulsive sensation seeking, and two behavioral factors, heavy drinking (5 or more drinks) and prescription medication use, were associated with greater risk for subsequent injury.

Based on Krause's research (2004, 2010) and the information gleaned from the broader studies described above, research on subsequent injuries to individuals with pre-existing SCI suggests the following:

- Research is limited to broad studies where subsequent injury is included with other causes of mortality, secondary conditions, and rehospitalizations or narrow studies where only a single cause (e.g. falls or suicides) or type of injury (e.g. fractures or "injury due to loss of sensations") are examined.
- The definition of subsequent injury differs across studies. Definitions are variable in whether they include: a) unintentional, intentional, or both injuries; and/or b) all types of subsequent injuries or of only a specific type or cause.
- Subsequent injuries rank between the second to eighth leading cause of death depending on definition subsequent injury and time since SCI, accounting for up to 18% of deaths beyond the first year following SCI,
- Subsequent injuries increase the risk of mortality and decrease quality of life compared to other individuals with SCI who do not experience a subsequent injury, and result in rehospitalization more often and result in higher health care utilization than injuries that occur in the general population.
- Subsequent injuries vary by level of SCI, but no studies have described the differences in subsequent injury by specific type of SCI.

Findings from these studies suggest that more research on subsequent injuries is needed. Future research should aim to describe the types and causes of subsequent injury, and compare the differences in injury characteristics and burden of injury between individuals with quadriplegia versus paraplegia.

Economic burden of injury

Several methods exist for measuring the public health burden of injuries, including counts, rates, years of potential life lost, disability adjusted life years, and costs (Segui-Gomez & MacKenzie, 2003, Hendrie & Miller, 2004). Cost of injury studies may include both direct and indirect costs, and can be divided into medical costs (cost of treatment of medical outcomes), monetary or human capital costs (medical costs plus work loss and other financial outcomes), and comprehensive costs (medical costs, monetary costs, plus cost of quality of life outcomes) (Rice, 2000, Hendrie & Miller, 2004). Advantages to using costs to measure the burden of injury include that it is universal measure that can be compared against other health outcomes (e.g. illness), and that it is easy to understand (Rice, 2000, Hendrie & Miller, 2004). Thus, costs are useful for increasing comprehension of the problem, and for justifying the economic impact and need for interventions with policy makers, community members, and other stakeholders (Durand-Zaleski, 2008, Hendrie & Miller, 2004).

In-hospital mortality, length of stay, hospital charges, and hospital costs are three medical outcomes that can be used to measure the direct economic burden of injury hospitalizations. In-hospital mortality reflects patients who died after being admitted to the hospital. Length of stay is measured as the number of inpatient days from admission to discharge. Hospital charges represent what the hospital billed for the inpatient stay. Hospital costs represent what the hospital received in payment for treatment and services (AHRQ, 2010d). Hospital charges are reported more frequently to describe the financial burden of injury hospitalizations because they are readily available in the discharge record (DeVivo & Farris, 2011, Rowland et al, 1996, Alexander, Rivara, & Wolf, 1992).

When available, hospital costs are a better reflection of the burden because payment of charges varies widely due to discounts, negotiated rates and differences by payer (Finkler, 1982). However, calculating hospital costs is complex and requires charge-to-cost ratios that convert charge data to cost estimates that are unique to the database of discharge records (AHRQ, 2010d).

Burden of injury in terms of LOS, hospital charges, and hospital costs is a salient issue for individuals with SCI because of the overall lifetime costs associated with SCI. In a lifetime, a person with paraplegia injured at age 25 will accrue over $1.47 million ($2009, discounted at 2%) in estimated lifetime costs attributable to their SCI (Cao, Chen, & DeVivo, 2011). In addition, individuals with SCI were found to be rehospitalized 2.6 times more often (for any reason), and spend 3.3 more days in the hospital than individuals in the general population (Dryden et al, 2004). In the general population, a single nonfatal hospitalized injury averages over $20,000 (2005 $US) in medical costs, and an additional $46,000 in work loss costs (Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, n.d.). Existing literatures suggests there is need to quantify the hospital charges and costs associated with subsequent injury for individuals with SCI, and this dissertation addresses this gap with national estimates.

Return-to-work after spinal cord injury

Among all traumatic injury, individuals with spinal cord injuries are at particularly high risk of not returning to work post-injury (MacKenzie, et al, 1987). Only 7% of those with SCI returned to work at 1-month compared to 40% of individuals with less severe traumatic injuries. In-patient and out-patient rehabilitation, learning how to adapt activities of daily living, and adjusting to living with new physical limitations all precede the return to work. For many, the idea of returning to work is not seriously considered until 1 to 2 years post injury when they have re-negotiated their identity and the type of employment that accommodates their abilities (Chan & Man, 2005). An estimated 12% of individuals with SCI are employed and another 16% are students by one year post-injury and 31-36% are employed in years 15 to 35 post-injury (NCSISC, 2012a). In one study, participants averaged 4.8 years from SCI onset until their first post-injury job, and 6.3 years until their first full-time job (Krause, 2003). In addition, more individuals with paraplegia compared to quadriplegia return to work or school following their injury (Krause & Anson, 1996). Individuals who were older age, less than 5 years post-injury, lower functional mobility, higher level of injury, identify with a minority group, and have less education were less likely participate in occupation related activities (Whiteneck et al, 2004).

Barriers to return to work

Barriers to return to work can occur on three phases: during the pre-employment phase when an individual begins to contemplate entering the workforce, during job-seeking, and during job maintenance (Chan & Man, 2005). When evaluating whether to return to work following spinal cord injury, individuals are hindered by psychological barriers of low self-esteem, fear of poor work performance, and loss of disability income or financial assistance (Chan & Man, 2005). Receipt of worker's compensation and involvement in the legal system are common barriers to return to work following traumatic injury (MacKenzie et al, 1998). Barriers to actual job-seeking behavior include fear of or previous experience with discrimination, lack of self-confidence (self-efficacy) in identifying employment opportunities or meeting job requirements, and environmental factors like lack of accessible transportation and poor workspace design (Chan & Man, 2005). Barriers to maintaining employment include disability-related self-care like bowel management and preventing/treating pressure sores, psychological stress of working with co-workers, and loss of governmental financial assistance (Chan & Man, 2005).

Environmental barriers may limit life participation, including work, in persons with SCI. One study identified natural environment and transportation as the most frequent environmental barriers that prevent people with SCI from doing what they want to do (Krause et al, 2004). Business policies were reported less frequently as an environmental barrier, but they were a greater barrier in magnitude when they occurred. However, Chan and Man (2005) reported that environmental factors like transportation and work place design were not major barriers, because they could easily be addressed by allowing extra time to use public transportation or by rearranging their workspace. This suggests that more research is needed on environmental barriers and what factors may ameliorate the effect of environmental barriers in the workplace.

Predictors of return to work

Age, age at injury, Caucasian, level of injury and education are all related to employment post-SCI with younger age, more education, earlier injury onset, and longer time since injury, more likely to be employed (Ottomanelli & Lind, 2009). Individuals with quadriplegia are less likely than individuals with paraplegia to be employed following SCI. Male gender has predicted employment in one study (Krause et al, 1999), but not another (Pflaum, McCollister, Strauss, Shavelle, & DeVivo, 2006). One important predictor of returning to work was the use of an individual's interpersonal network in receiving a job offer or interview through a personal contact (Chan & Man, 2005). This also included negotiating re-employment with their previous employer. This is consistent with Mackenzie and colleagues (1987) research on all traumatic injuries (including spinal cord injury) which found, income, education, and social support predicted return to work. Individuals with some college, an income greater than $10,000, and one or more sources of social support had greater odds of being employed at one year (MacKenzie et al, 1998).

Workplace policies and vocational rehabilitation programs may promote return to work and also facilitate a safe work environment that prevents occupational injuries. The Supported Employment model has been used to facilitate return to work for persons with SCI and other more severe disabilities (Targett, Wehman, & Young, 2004). The Supported Employment approach utilizes an employment specialist who assists job seekers with job placement according to their strengths, abilities and support needs; provides on-the-job training, support, and advocacy until the worker is up-to-speed; and intervenes as needed over the course of employment to problem-solve new or unexpected barriers or support needs. For a person with SCI, this approach includes addressing personal care issues (e.g. any required assistance getting ready for work, toileting, or eating), transportation to and from work, personal mobility within the workplace, and accommodations and on-the-job supports (e.g. accessibility, assistive devices, positioning, and navigating resources that provide funding support for accommodations). Injury prevention may be inherent in several of these focus areas of Supported Employment, but is not emphasized and “safety” is only explicitly mentioned in the context of disaster preparedness and evacuation.

The literature is able to provide a good picture of barriers and predictors to return to work; however little is known about an individual's work-life once they are employed. Individuals with spinal cord injury have more lifetime exposure to potential external causes of injury than previously considered, due, in part, to longer life expectancy, better environmental accessibility, and more opportunities for adaptive activities including work and recreation. Previous research has found that workers with disability are significantly more likely to experience both nonoccupational injuries and occupational injuries compared to workers with no disability (Price et al, 2012), and that odds of injury increased with increasing severity of disability (Xiang, Leff, & Stallones, 2005, Brophy, Zhang, & Xiang, 2008). In the Price et al study (2012), workers with disabilities were more likely to be injured away from work than in the workplace, and were injured more often by falls in both nonoccupational and occupational settings than workers without disabilities. No previous studies have been identified that address the prevention of injuries in the workplace for individuals with SCI as a primary research focus. More research is needed on what happens during employment, and the role of communication in creating a safe workplace and preventing subsequent injury.

Role of communication in return to work and preventing subsequent injury

Interpersonal and organizational factors have been shown to influence the incidence of occupational injuries and the length of time to return-to-work (Shaw, Robertson, Pransky, & McLellan, 2003). Shaw and colleagues (2003) describe 11 common themes important in a supervisor's role in not only their response to workplace injuries when they happen, but also in their communicative responses as employees recover from their injuries. Accommodation, communication with workers, responsiveness, shared decision-making, concern for welfare, empathy/support, validation, fairness/respect, and coordinating with medical providers were interpersonal factors identified as important to workers who experienced an occupational injury resulting in short-term disability. This suggests that interpersonal and organizational factors may also be important in return to work, maintaining employment, and preventing occupational injuries for individuals with SCI when they return to work.

The Extended Parallel Process Model

Communication theory provides a useful theoretical basis for examining how individuals with SCI perceive the threat of subsequent injury when they return to work, and interpersonal and organizational factors that influence whether an individual with SCI takes action to prevent subsequent injury (Aldoory & Bonzo, 2005). The Extended Parallel Process Model (EPPM, Witte, 1992) is a communication theory that is based on theoretical explanations of how individuals respond to danger or fear (Leventhal, 1970, 1971, Rogers, 1975, 1983,). The EPPM includes both the cognitive and emotional factors that influence whether an individual accepts or rejects a message about risk, such as by ignoring it or taking action to mitigate the risk. Messages about risk, which are referred to as fear appeals, are persuasive messages that attempts to arouse the emotion fear by depicting a personally relevant and significant threat and then recommending a feasible and effective response to mitigate or deter the threat (Witte, 1992, 1994). When an individual receives a message about risk, they process it through a cognitive and emotional appraisal of three key constructs: threat, efficacy, and fear. *Threat* is the danger or harm that exists in the environment (Witte, 1992, 1994). Threat is evaluated according to two underlying dimensions *perceived severity*, the extent to which an individual believes that threat to be serious or harmful, and *perceived susceptibility*, the extent to which an individual feels at risk for a particular health threat. *Efficacy* is the "effectiveness, feasibility, and ease with which a recommended response impedes or averts a threat" (Witte, 1994, p. 114). Efficacy is also evaluated according to the underlying dimensions of *perceived self-efficacy*, the extent to which an individual is able to perform the recommended response, and *perceived response-efficacy*, the extent to which the recommended response effectively deters the threat. The third construct of EPPM, *fear*, is the emotional response when a serious and personally relevant threat is perceived (Witte, 1992, 1994).

In the context of EPPM, individuals with SCI will accept or reject a message about subsequent injury if they perceive the threat of subsequent injury is serious or harmful, and they feel they are at risk for subsequent injury. In addition, they will take action to prevent subsequent injury if they perceive they are capable of taking action, and if the recommended action effectively prevents subsequent injury.

The EPPM has been used in several applied health contexts, including injury prevention (e.g. Roberto, Meyer, Johnson, & Atkin, 2000), workplace safety (e.g. Basil, Basil, Deshpande, & Lavack, 2013, Smith et al, 2008, Murray-Johnson et al, 2004), and for individuals with SCI (e.g. LaVela, Cameron, Priebe, & Weaver, 2008, LaVela, Smith & Weaver, 2007).

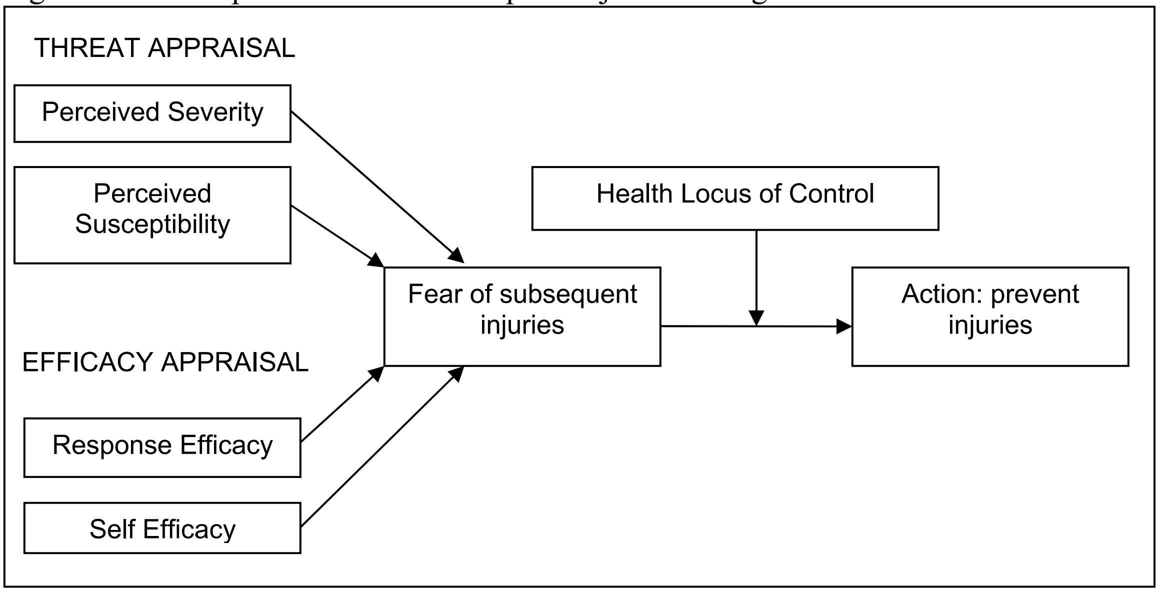
Previous research has found that the success of fear appeals is dependent on the amount of efficacy information (Aldoory & Bonzo, 2005). This suggests that the self-efficacy and response-efficacy of an action to prevent subsequent injury should take precedence over emphasizing messages about risk or threat. One study found that messages about workplace safety address self-efficacy most often, but response-efficacy the least. However, LaVela and colleagues (2008) found that messages about influenza risk among individuals with SCI needed to more fearful and convey greater severity, because individuals with SCI already face many challenges in their daily life that compete for their ability to act against a particular health threat. The perceptions of individuals with SCI toward the threat of subsequent injury or the efficacy in preventing them are not known, and form the premise of study 3.

Health Locus of Control

Early studies of fear appeals were criticized for failing to take into account perception about events being a consequence of one's own action or beyond personal control (Burnett, 1981). Health locus of control (HLOC) is the perception of "who is responsible for an individual's degree of health" (Wallston & Wallston, 1982, p. 65), and is categorized according to the belief that control is *internal*, due to *chance*, or the responsibility of *powerful others* (Wallston, Wallston, & DeVellis, 1978). In the context of preventing subsequent injury, an individual with SCI will take action relative to their belief the ability to prevent subsequent injuries is in their control, due to chance, or someone else's responsibility. HLOC has been used to understand adjustment (Thompson, Coker, Krause, & Henry, 2003) and employment outcomes (Krause & Broderick, 2006) after SCI. In these studies, higher internal locus of control was associated with better adjustment and more favorable employment outcomes following SCI.

A conceptual model applying the constructs and dimensions of EPPM and HLOC to the health threat of subsequent injury is presented in Figure 1.1.

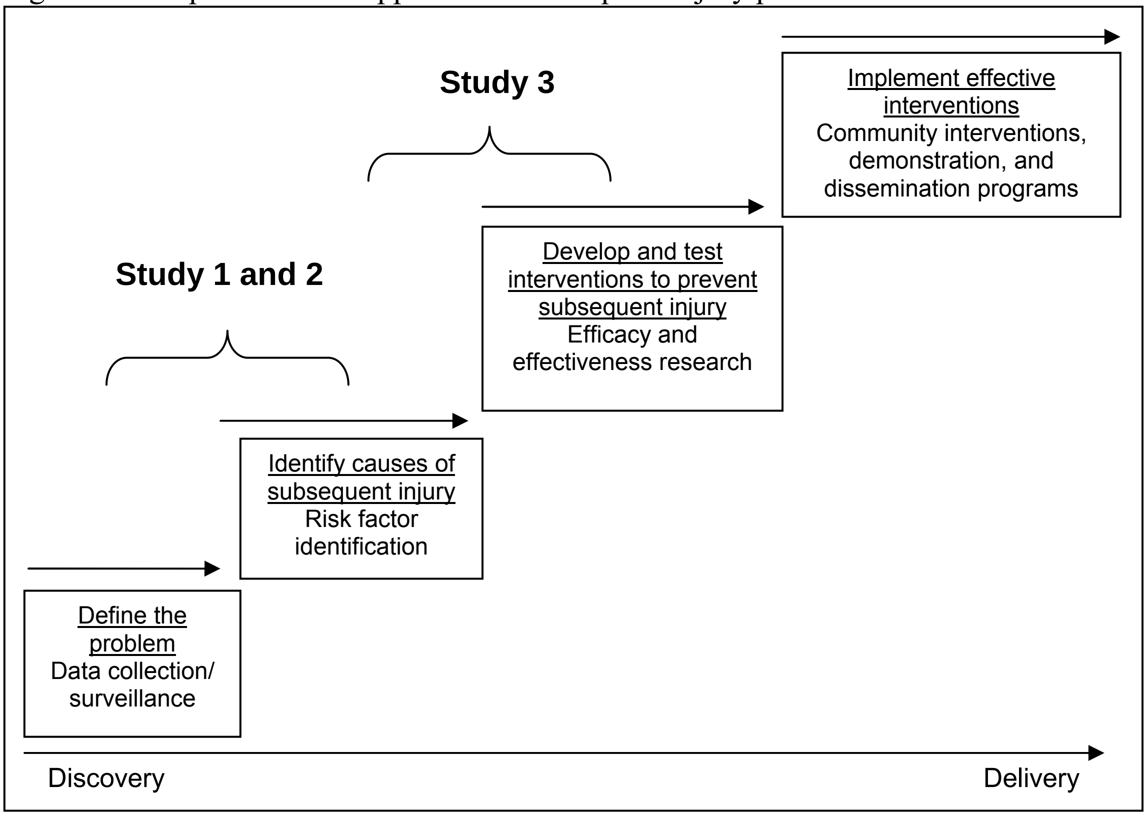
Figure 1.1. Conceptual model of subsequent injuries among individual's with SCI



A public health approach to injury prevention

The public health approach to injury prevention is based on the importance of applying what is learned through discovery of burden and mechanisms of injury to the delivery of effective interventions (Figure 1.2.) (Sleet, Hopkins, & Olson, 2003, Hanson, Finch, Allegrante, & Sleet, 2012). It progresses through four stages to define the problem, identify causes, develop and test interventions, and implement effective interventions. A public health approach is appropriate for both preventing initial SCI as well as subsequent injury among individuals with SCI. In the context of subsequent injury prevention for individuals with SCI, this approach outlines the steps for describing the causes and types of subsequent injury, identifying the risk factors that led to the initial SCI and the unique risk factors for subsequent injury, and developing and implementing interventions. In this dissertation research, study 1 and study 2 will address the first two stages of the public health approach to define the problem and identify the causes of subsequent injury among individuals with SCI. Results of study 3 will inform both the second and third stage of the public health approach to preventing subsequent injury by describing an individual's perceptions of threat (i.e. personal beliefs about risk and protective factors) and efficacy of actions they have taken to prevent subsequent injury as a first step toward developing interventions to prevent subsequent injury. The findings from this study will support future development of interventions, but are beyond the scope of this dissertation. Results from this dissertation research may inform how subsequent injury is the same or different from injuries in the general population, and if existing injury prevention programs can be adapted for individuals with SCI or need to be newly developed. Currently there are no formal programs or interventions that exist to prevent subsequent injury among individuals with SCI. This dissertation will address the important public health problem of subsequent injury among individuals with SCI, and close a gap not currently addressed in the literature.

Figure 1.2. A public health approach to subsequent injury prevention



Adapted from Sleet, Hopkins, & Olson, 2003

Dissertation Outline

The following chapters present the three stand alone, but related studies that formed the dissertation research. Chapter 2 describes injury hospitalizations among individuals with paraplegia, and the associated outcomes of length of stay and hospital charges. Chapter 3 compares the differences in injury hospitalizations and associated costs between individuals with quadriplegia versus paraplegia. Chapter 4 explores the perceptions of threat and communication about subsequent injury among individuals with spinal cord injury who return to work. Finally, Chapter 5 summarizes the findings from all three studies, and discusses implications for theory, research, and practice.

Table 1.1. Incident versus prevalent population by level of SCI[1]

	Paraplegia	Quadriplegia
Incident population		
1973-2011 (NSCISC, 2012a)	45.9%	53.4%
2005-2008 (DeVivo & Chen, 2011)	42.9%	56.2%
At one-year post injury, 1973-2011 (NSCISC, 2012a)	47.6%	50.8%
Prevalent population, 2008 (DeVivo & Chen, 2011)	49.0%	48.8%

1. Percentages not equal to 100% are due to other SCI, e.g. motor functional SCI.

CHAPTER 2

INJURY HOSPITALIZATIONS AMONG INDIVIDUALS WITH PRE-EXISTING PARAPLEGIA: LENGTH OF STAY AND HOSPITAL CHARGES

Abstract

Objective: To describe patient and hospital characteristics of injury hospitalizations among individuals with paraplegia, and describe length of stay (LOS) and total hospital charges per discharge for the three leading causes of hospitalized injuries: falls, poisonings, and motor vehicle traffic.

Methods: This study is a retrospective analysis of injury hospitalizations among patients with pre-existing paraplegia for years 2003-2009 from the Nationwide Inpatient Sample. National estimates of injury hospitalizations for all causes of injury and injury diagnosis were calculated. Length of stay (LOS) and hospital charges per discharge for the top three causes of injury due to falls, poisonings, and motor vehicle traffic were described by patient characteristics.

Results: An estimated 2,221 injury hospitalizations among individuals with paraplegia occurred annually, totaling 15,545 during the 7-study years. Patients were most often males (64.4%, 95% CI=62.5-66.2) and between the ages of 35-49 years (28.6%, 95% CI=27.0-30.2). Per discharge, injury admissions averaged $64,100 (2009 $US) in hospital charges and 8.0 days LOS, resulting in over $130 million in total hospital charges per year. Injury hospitalizations due to falls bore the greatest overall burden with $269 million in total charges during the study period, but injuries due to motor vehicle traffic incurred the highest burden per hospitalization averaging 14 (median=10) days LOS, and $154,000 (median=$108,000) in hospital charges per discharge.

Conclusions: The burden of injury among individuals with pre-existing paraplegia is significant with considerable number of hospitalizations due to injury, high hospital charges and long LOS. Efforts to educate individuals with paraplegia about their susceptibility to all causes of injury should be a priority, with special attention to preventing falls and associated fractures.

Introduction

Individuals with spinal cord injury (SCI) remain at risk for subsequent injuries following their SCI (Krause, 2004, 2010), with severe injuries threatening morbidity and mortality in the years following SCI. Unintentional injuries rank sixth and intentional injuries (e.g. homicides and suicides) rank seventh in surveillance of all-cause mortality following SCI, accounting for 7% and 5% of deaths, respectively (NSCISC, 2012a). The burden is even greater beyond the first year following initial SCI, considering unintentional injury, suicides, and homicides combined, account for almost one-fifth (18%) of deaths (DeVivo, Krause, & Lammertse, 1999) among individuals with SCI.

In addition, non-fatal injuries rank from the third to eighth leading reason for rehospitalizations among individuals with SCI (Dryden et al, 2004, NSCISC, 2012a, Cardenas, Hoffman, Kirshblum, & McKinley, 2004). Like mortality, the proportion of rehospitalizations due to injuries increases with each subsequent year up to 30 years post SCI, from 6.1 % in year one to 15.0% in year 35 (NSCISC, 2012a).

Subsequent injuries affect nearly one-quarter (23%) of individuals with SCI annually (Krause, 2004, 2010), with an even greater impact across the lifespan following SCI. During a decade of follow-up after SCI, 29% of men and 26.4% of women with SCI sustained an extremity fracture, dislocation, sprain, or amputation, and 10.9% of men and 10.3% of women were injured by poisoning (Pickelsimer, Shiroma, & Wilson, 2010).

Risk for subsequent injury varies across different levels of SCI (Krause, 2010). Individuals with paraplegia, defined as a SCI to the thoracic, lumbar, or sacral regions of the spinal cord, comprise 49% of the prevalent population of SCI (DeVivo & Chen, 2011), and have higher participation and return to work following SCI (NSCISC, 2012a). This is generally attributed to better functional outcomes associated with lower level SCI. Compared to individuals with quadriplegia, a higher level SCI to the cervical region of the spinal cord, deaths attributable to injuries are more prevalent among individuals with paraplegia. One study from Norway found unintentional and intentional injuries accounted for 25% and 8% of deaths, respectively for individuals with paraplegia (Hagen, Lie, Rekand, Gilhus, Gronning, 2010).

However, previous studies on injuries and injury-related deaths among individuals with SCI often have not distinguished results by specific type of SCI. Because of likely differences in functional capacity which may affect an individual's exposure or risk for subsequent injury, it is important to analyze injuries among individuals with paraplegia separate from other types of SCI. Empirical evidence of the causes and consequences of injury among individuals with paraplegia is important for providers, caregivers, and individuals with paraplegia during rehabilitation from initial SCI and beyond.

The ability to describe the types (e.g. fractures, sprains/strains, etc.) and external causes (e.g. falls, burns, poisonings, suicide, etc.) of injury hospitalizations in terms of length of stay, and hospital charges will allow a better understanding of the burden of injury among individuals with paraplegia, an important first step toward prevention of these injuries. Therefore, the objective of this study is to describe patient and hospital characteristics of injury hospitalizations among individuals with paraplegia, calculate national estimates of injury hospitalizations for all causes of injury and injury diagnoses, and describe length of stay (LOS) and total hospital charges per discharge for the three leading causes of hospitalized injuries by patient characteristics: falls, poisonings, and motor vehicle traffic.

Methods

Data source

This study is a retrospective analysis of injury hospitalizations among patients with paraplegia for years 2003-2009 from the Nationwide Inpatient Sample (NIS). Constructed under the Health Care Utilization Project (HCUP) provided by the Agency for Healthcare Research and Quality (AHRQ), the NIS approximates a 20% stratified sample of U.S. community hospitals based on five sampling strata: region, ownership-control, urban/rural location, teaching status, and bed size (Steiner, Elixhauser, & Schnaier, 2002). It is the largest publicly available database of hospital discharge records in the United States. For each of the study years, the NIS provided information on about 8 million inpatient stays from approximately 1,000 hospitals in 37-44 states depending on the study year (AHRQ, 2010c). Each discharge record contains patient demographics, up to 25 diagnosis codes, primary and secondary external cause of injury codes (E-codes), coded procedures, total charges, length of stay, discharge disposition, admission source, principal payer, and hospital characteristics. The NIS is useful for studying rare events in small populations using a nationwide, population-based sample (Steiner et al., 2002), with established reliability and utility for injury hospitalizations (Greenspan et al., 2006).

Selection criteria

Study cases were selected using the *International Classification of Diseases, 9th revision, Clinical Modification* (ICD-9-CM). Primary diagnosis codes of 800-904.9, 910-994.9, 995.5-995.59, and 995.80-995.85 were used to identify all hospitalizations due to an injury (Injury Surveillance Workgroup, 2003). Patients aged 18 years and older with paraplegia were selected using HCUP comorbidity software (Version 3.7) available with the NIS dataset (AHRQ, 2010b). The comorbidity software uses secondary diagnosis codes to identify 30 underlying, preexisting conditions that are not directly related to the reason for the current hospitalization, and were likely to exist before the patient's admission to the hospital (Elixhauser, Steiner, Harris, & Coffey, 1998, Stukenborg, Wagner, & Connors, 2001). This method of identifying pre-existing comorbidities has been established as a reliable alternative to chart review (Humphries et al., 2000) and used previously to describe mortality and LOS of burn injuries in adults with preexisting paralysis (Thombs, Singh, Halonen, Diallo, & Milner, 2007). Records with both a comorbidity of paralysis and a secondary diagnosis of paraplegia (ICD-9-CM = 344.1) anywhere in the second through fifteenth diagnosis fields for years 2003-2008 and second through twenty-fifth diagnosis fields for year 2009 were included in the analysis. Records with a comorbidity of paralysis, but no secondary diagnosis of paraplegia were excluded because the comorbidity software also identifies records where the pre-existing paralysis is due to other causes (e.g. quadriplegia).

A total of 4,987 records for injury-hospitalizations from 2003 to 2009 were identified. Records with no comorbidity of paralysis (n=28) or secondary diagnoses of both paraplegia and quadriplegia (n=8) were excluded. Next, records with a secondary diagnosis (n=1,419) or Ecode (n=98) of late effects of injury were excluded to ensure that the sample reflected a new, subsequent injury and not the initial SCI resulting in paraplegia. Additionally, 215 records coded for adverse effects from medical care or drugs were excluded. Finally, two records that were single records from a unique hospital, 41 records where the patient was discharged against medical advice, and 9 records where the external causes of injury due to falls, motor vehicle traffic (MVT), or poisonings were not mutually exclusive were excluded. Thus, a total of 3,167 records were included in the final sample.

Analysis

Descriptive statistics of patient and hospital characteristics were used to describe injury hospitalizations in patients with paraplegia for years 2003-2009, and for the subpopulations of the three leading causes of injury: falls, poisonings, and motor vehicle traffic (MVT). National estimates with 95% confidence intervals were calculated using discharge-level weights provided by the HCUP (AHRQ, 2010c). Both means and medians for the main outcomes of hospital charges per discharge and lengths of stay (LOS) were described by year, cause of injury, top ten principal diagnoses, and top ten principal procedures. The Clinical Classifications Software (CCS), a uniform and standardized coding system provided by HCUP that classifies ICD-9-CM diagnoses and procedures into clinically meaningful categories, was used to categorize external cause(s) of injury, primary diagnosis, and principal procedure (AHRQ, 2010a). Records of patients who transferred to short term hospitals or died were excluded from calculations of hospital outcomes. Subpopulation hospital charges were adjusted to the year 2009 (last quarter) levels to account for inflation using the consumer price index for inpatient hospital services provided by the Bureau of Labor Statistics (Bureau of Labor Statistics, 2008). Subgroup differences were tested for significance using Student's t-test or analysis of variance (ANOVA) as appropriate. Log transformation was used to account for the skewness of data in the significance tests. Significance level was set at $\alpha=0.05$. All analyses were conducted using SAS (version 9.2) callable SUDAAN (version 10.0.1) to account for the clustering of data inherent in the survey design of the NIS (Research Triangle Institute, 2009).

Results

Patient and hospital characteristics

An estimated 15,545 injury hospitalizations among individuals with pre-existing paraplegia were identified from 2003-2009. There was an average of 2,221 hospitalizations per year (Table 2.1). The majority of patients were male (64.4%), between the ages of 35-49 (28.6%; mean = 51.3 years), and white (69.0%). Most hospital admissions were admitted through the emergency department (73.2%) to large (68.2%), urban (87.9%) hospitals. Over half of all patients were discharged to either long term or home health care (42.4% and 17.9%, respectively), and one-third (33.0%) were routinely discharged. There were an estimated 361 (2.3%) deaths.

Length of stay and hospital charges

Hospital charges totaled over $911 million (2009 $US) for the seven year study period with average annual hospital charges of $130 million (Table 2.2). An injury hospitalization averaged $64,100 (median=$29,700) in hospital charges with an average LOS of 8 days (median=4.2) per discharge. The most common principal diagnosis was fracture of lower limb (26.5%), followed by a new SCI (subsequent to the pre-existing paraplegia) (13.4%), and hip fracture (11.6%). Overall, fractures accounted for three of the top five reasons for hospitalization.

External cause of injury codes were reported in 85.0% of records. The most common injuries occurred from falls (34.6%), followed by poisonings (10.8%), and motor vehicle traffic (7.9%). All other unintentional injuries accounted for 43.4% . Intentional injuries accounted for 3.3%, with the estimated 476 cases of suicide and self-inflicted injury regardless of the mechanism of injury (e.g. poisoning, firearm, or other). Eighty-five percent of diagnoses related to suicide and self-inflicted injury indicated intentional poisoning.

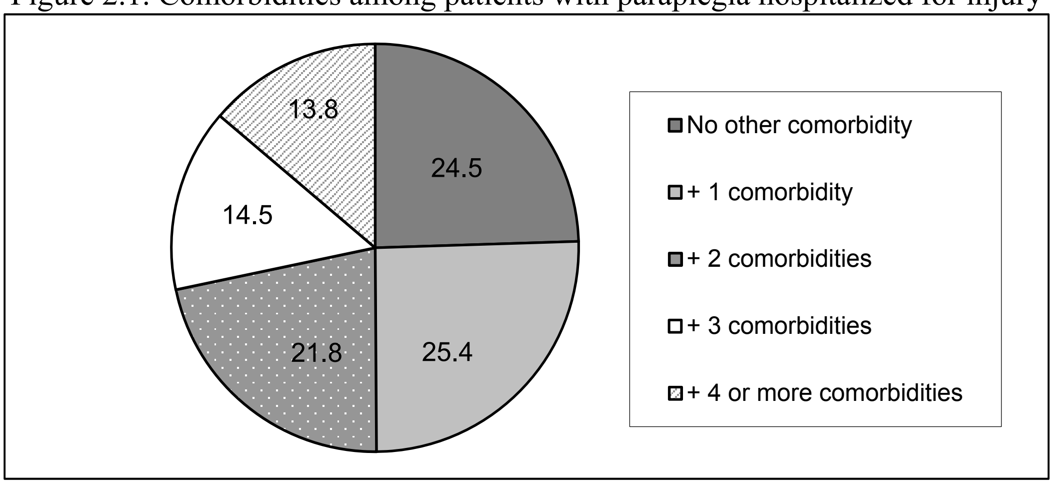
Length of stay (LOS) and total hospital charges per discharge were calculated for the three leading causes of hospitalized injuries: falls, poisonings, and motor vehicle traffic. Injuries from falls represented the greatest burden in total hospital charges accounting for $269 million in total hospital charges for the seven study years, with an average hospital charge of $54,500 and 7 days LOS per discharge. However, injuries from motor vehicle traffic had highest average hospital charge per discharge and second highest LOS with a mean hospital charge of $153,900 and 14 days per discharge.

Over two-thirds of hospitalized patients received at least one treatment procedure. Treatment for the fracture or dislocation of a hip, femur, or lower extremity accounted for 22.4% of all primary procedures. Spinal fusion was the second most common procedure (5.5%), and accounted for the greatest average hospital charge of $200,500 (median=$118,300) per discharge. Although one-quarter (28.2%) of injury hospitalizations recorded no treatment procedures, they still accumulated $20,288 in mean hospital charges (median=$12,576) and 4 days LOS (median=2.5 days) per discharge.

Estimates of co-morbid conditions

Three-quarters of patients hospitalized for injury had one or more additional comorbidities in addition to their paraplegia (Figure 2.1), and 13.8% had four or more comorbidities.

Figure 2.1. Comorbidities among patients with paraplegia hospitalized for injury



Notably, several known risk factors for injury were present including comorbidities of depression (13.6%), drug abuse (8.4%), and/or alcohol abuse (6.6%) (Table 2.3).

Injury hospitalizations due to falls, poisonings, and motor vehicle traffic

Similar to the pattern of injury hospitalizations combining all causes of injury, a greater proportion of men than women were hospitalized due to falls, poisonings, or motor vehicle traffic in subgroup analysis of the top three leading causes of injury (Table 2.4). Hospitalized patients injured in falls were older than those injured in poisonings or motor vehicle traffic, with 36.1% being 65 years or older. The greatest proportion of patients injured by poisoning were 25-49 years old (39.7%), and by motor vehicle traffic were 18-24 years old (36.4%). Over half of patients injured in falls (51.9%) and nearly three-quarters (74.1%) of patients injured by poisonings had two or more comorbidities in addition to their paraplegia. Hypertension was the most common comorbidity across all three causes. Compared to injury hospitalizations due to falls or motor MVT, a higher frequency of depression (25.8%), drug abuse (28.4%), and alcohol abuse (11.4%) was found among poisonings (Table 2.3). Comparatively, most patients injured by motor vehicle traffic had no comorbidities besides their paraplegia (36.4%) or just one additional comorbidity (31.1%). Most hospitalizations for falls and poisonings were paid by Medicare (57.7% and 54.2%, respectively), whereas 55.4% of hospitalizations for motor vehicle traffic were paid by private insurance. The majority of falls resulted in lower limb fractures (45.7%) or hip fractures (19.7%). Most poisonings were from medications or drugs (67.6%), rather than psychotropic agents, substance abuse, or nonmedicinal substances. Finally, almost half (44.8%) of injuries from motor vehicle traffic events were another SCI subsequent to the paraplegia.

Length of stay and hospital charges by cause of injury hospitalization

Injury hospitalizations caused by motor vehicle traffic had the highest mean hospital charges per discharge, followed by falls and poisonings (p<0.0001) (Table 2.5). Mean (median) hospital charges exceeded $153,900 ($108,100) for motor vehicle traffic, $54,500 ($30,700) for fall, and $36,200 ($18,200) for poisoning hospitalizations, respectively. The same trend followed average lengths of stay by cause of injury (Table 2.6), with an average 14 days for MVT, 7 days for fall, and 5 days for poisoning hospitalizations (p<0.0001).

Discussion

Subsequent injuries are a prevalent problem (Krause, 2004, 2010) among the estimated 130,000 individuals living with paraplegia in the United States today (DeVivo & Chen, 2011), and a frequent cause of death and rehospitalization (DeVivo et al, 1999, NSCISC, 2012a, Dryden et al, 2004, Cardenas et al, 2004). Using the data from the Nationwide Inpatient Sample, there were an estimated 15,545 injuries resulted in a hospital admission among individuals with paraplegia from 2003 to 2009 and caused over $911 million in total hospital charges for the same time period, an average of 2,221 injury hospitalizations and $130 million in hospital charges annually. The burden of injury among individuals with paraplegia is significant as they have substantial other direct health care costs. A previous study reported that individuals with paraplegia average $191,000 (2009 $US) in expenses the first year following their initial SCI, including direct health costs plus also equipment, environmental modifications, medications, supplies, attendant care, and/or vocational rehabilitation, and $49,100 (2009 $US) in total annual costs thereafter (DeVivo, Chen, Mennemeyer, & Deutsch, 2011). Krause (2010) reported almost one-quarter (23%) of individuals with SCI sustained at least one new injury in the previous year, and about 7% of new injuries resulted in hospitalization. Thus, the $130 million in annual hospital charges reported in this study reflects approximately one-third of the medical cost burden of injuries for individuals with pre-existing paraplegia, even without accounting for charges for less severe injuries treated in an outpatient visit or emergency department.

Subsequent injury hospitalizations and comparisons to the general population

Injury hospitalizations for individuals with paraplegia averaged $64,110 in hospital charges and 8 days LOS per discharge. Average hospital charges were higher than the $27,788 (2009 $US) per injury hospitalization for individuals with SCI (of any type) reported by DeVivo & Farris (2011). Whereas the sample for this study was selected from discharges with an ICD-9-CM primary diagnosis codes for injury from a nationwide database, DeVivo & Farris (2011) analyzed rehospitalizations for any reason following SCI to a single hospital in one Southern state using hospital admission sheets, self report, and Medicaid claims. Thus, the results from this study may be more representative of charges for injury hospitalizations in this population.

Length of stay for injury was consistent with the average 7 days LOS for any rehospitalization (Krause & Saunders, 2009) and the 8.2 days for rehospitalizations due to injury (DeVivo & Farris, 2011) among all individuals with SCI. However, LOS for injured patients with paraplegia is almost twice as long as the average 4.8 days for any injury resulting in hospitalization in the general population (Owens, Russo, & Stocks, 2006). Other comorbid conditions, which were identified in nearly three-quarters of records, are one possible explanation for prolonged hospital stays among individuals with paraplegia (Thombs et al., 2007). Other secondary medical complications may also contribute to longer hospital stays, but were not quantified in this study.

The results of this study indicated patients with comorbid conditions had longer LOS and higher hospital charges. Comorbid conditions place individuals with paraplegia at increased risk for injury and adversely affect hospital outcomes following injury (Matter, Sinclair, Hostetler, and Xiang, 2007). Depression, drug abuse, and alcohol abuse were comorbid conditions in 14%, 8% and/or 7% of records in the study sample, respectively. These findings are supported by DeVivo and Farris (2011) who found that psychosocial problems such as depression and substance abuse contributed to 7% of all hospitalizations. Psychosocial problems are known risk factors for potentially injurious events (e.g. falls without injury) (Nelson et al., 2010), subsequent injuries (Krause, 2004, 2010; Nelson et al., 2010) and overall mortality (Krause, Carter, Pickelsimer, Wilson, 2008) following SCI. Considering these are modifiable behavioral risk factors and their associations with both initial SCI and subsequent injury, comorbid conditions including psychological problems should be important targets for prevention.

The top three leading causes of injury hospitalizations for individuals with paraplegia were falls (34.6%), poisoning (10.8%), and MVT (7.9%), which is the same distribution of the leading causes of injury hospitalizations in the general population where 30% are due to falls, 10% poisoning, and 9% MVT (Heinen, Hall, Boudreault, & Fingerhut, 2005). Among all injury hospitalizations, fractures represent three of the top five primary diagnoses, and lower limb and hip fractures accounted for 65% of injuries from falls. Individuals with SCI lose bone density over time, putting them at risk for fractures due to both external causes and pathologic (i.e. spontaneous) fractures (Capoor & Stein, 2005). Unfortunately, time since initial spinal cord injury was not available in the dataset, and could not be considered as a covariate for the risk of subsequent injury. However, none of the principal diagnosis categories for fractures described in this study include ICD-9-CM diagnosis codes for pathologic fracture, thus the misclassification is likely limited although possible miscoding of pathologic fractures might exist in the hospital record. Among records with a diagnosis of fracture, 85% contained an Ecode, and 67% of Ecodes were for falls. Misclassification is unlikely among records that have an Ecode, but may be possible in up to 15% of records with a fracture injury. Poisoning is unique in that it describes both the cause and consequence of an injury event. An estimated 10.8% (N=1,559) of injury hospitalizations were due to poisonings. In another study that included a decade of follow-up, 10.9% of males and 10.3% of females reported a poisoning (Pickelsimer et al, 2010). Our results indicate most poisonings were from medication or drugs, which Krause (2010) found to be a risk factor for subsequent injury and an important target for injury prevention.

Overall, 14% of injury hospitalizations were for new SCI subsequent to the paraplegia. However, subsequent SCI has not received a lot of attention in the literature. Pickelsimer et al. (2010) reported that 13.8% of women and 11.1% of men sustained a traumatic brain injury (TBI), SCI, or fracture of the head, neck, face or spine over ten years after initial SCI. The observed higher proportion of subsequent SCI in the study sample may be largely due to a greater representation of severe injuries in a hospitalized sample compared to a sample that also included injuries treated in emergency departments, inpatient, or outpatient visits (Pickelsimer et al, 2010). Unfortunately, additional information on the subsequent SCI in relation to the pre-existing paraplegia was not possible in this study. More research is needed to describe subsequent SCI, and whether and how subsequent SCI is related to the initial SCI.

Finally, there were over 700 burn injuries. Burns among individuals with SCI are known to happen from showering or bathing, food and beverages, or therapeutic and environmental heating devices (Formal, Goodman, Jacobs, & McMonigle, 1989). Thombs et al. (2007) found individuals with paralysis had 90% longer length of stay for burn injuries compared to individuals with other comorbidities. Further study is needed on burn injuries considering individuals with SCI are especially susceptible due to loss of sensory and mobility function.

Study limitations

A few limitations should be considered. Hospital charges were used as a proxy for direct medical costs, but do not include indirect costs such as lost work, productivity, or quality of life. Thus, the results of this study are likely to underestimate the burden of injury among individuals with paraplegia. In addition, external cause of injury coding was missing in 15% of records (Barrett & Steiner, 2011); however, Greenspan et al (2006) suggests missing E-codes are similar in distribution to records that report E-codes. Finally, ICD-9-CM coding inconsistencies in the original dataset made some cases of subsequent SCI difficult to distinguish from the SCI that might be associated with the pre-existing paraplegia. These latter cases were excluded from the study sample through careful selection of records with primary diagnosis codes for injury, and no late effect codes in any primary or secondary diagnosis or E-code. Our results were consistent with national trends for injury hospitalizations in the general population, rather than national trends for first time SCI. For example, 1) the average age of initial SCI is 40.7 years, and the study sample mean is 51.3 years, 2) 80.7 % of first time SCI is among males, where this study sample is 65% males and 45% females overall, and 3) considering injury etiology, the leading causes of initial SCI are MVC (40%), falls (30%), and violence (15%), whereas the leading causes of injury hospitalizations reported here were falls (33%), poisoning (11%), and MVT (8%) (NSCISC, 2012a, DeVivo & Chen, 2011). Further, 5 of the top 9 principal procedures are for treatments of injuries considered less severe and less costly as a primary diagnosis than first-time SCI present. Presumably, the first listed ICD-code should always describe the primary diagnosis and procedure for the hospital stay (Hagen, Rekand, Gilhus, & Gronning, 2009)

Implications and future research

Despite these limitations, the findings from this study add to the empirical evidence in the literature on the burden of injury and have implications for preventing subsequent injury among individuals with paraplegia. These results demonstrate that injury prevention for individuals with paraplegia requires a broad public health approach to include all causes of injury and their consequences. Further study is needed to identify the risk factors for injuries as well as to develop evidence-based intervention strategies to prevent injury. Additional research is also recommended to comparatively describe injury hospitalizations among individuals with other types of SCI, e.g. quadriplegia, and to qualitatively study how, when and why subsequent injuries occur as a first step toward developing interventions to prevent injury in this population.

Conclusion

This study found a significant number of injury hospitalizations in a population of individuals with paraplegia, with the top three leading causes due to falls, unintentional poisonings, and motor vehicle traffic injuries. The burden of these injury hospitalizations measured through LOS and hospital charges is also very high. Efforts to educate individuals with paraplegia about their susceptibility to all causes of injury should be a priority. Special attention should be given to preventing falls and associated fractures, as well as the role of depression, drug abuse, and alcohol abuse in preventing poisonings.

Table 2.1. Patient and hospital characteristics of injury hospitalizations among individuals with paraplegia, Nationwide Inpatient Sample, 2003-2009 (n=3,167)

	Sample	National Estimate[1]		
	n	N	(%)	(95% CI)
Total	3,167	15,545		
Year				
2003	375	1,819	(11.7)	(10.1, 13.6)
2004	415	2,024	(13.0)	(11.3, 14.9)
2005	402	1,959	(12.6)	(10.8, 14.7)
2006	410	2,009	(12.9)	(11.2, 14.9)
2007	447	2,204	(14.2)	(12.2, 16.4)
2008	549	2,671	(17.2)	(15.1, 19.5)
2009	569	2,860	(18.4)	(16.3, 20.7)
Sex[2]				
Female	1,126	5,523	(35.6)	(33.8, 37.5)
Male	2,035	9,991	(64.4)	(62.5, 66.2)
Age Group[2]				
18-34	625	3,054	(19.7)	(18.0, 21.4)
35-49	907	4,440	(28.6)	(27.0, 30.2)
50-64	846	4,168	(26.8)	(25.1, 28.6)
65+	788	3,878	(25.0)	(23.2, 26.7)
Race[2]				
White	1,676	8,197	(69.0)	(66.3, 71.6)
Black	379	1,866	(15.7)	(13.8, 17.8)
Hispanic	259	1,259	(10.6)	(9.0, 12.4)
Asian or Pacific Islander	40	193	(1.6)	(1.1, 2.3)
Native American	20	97	(0.8)	(0.4, 1.6)
Other	54	268	(2.3)	(1.7, 3.0)
Admission Source				
Emergency department	2,318	11,383	(73.2)	(71.2, 75.2)
Transfer (another hospital or facility)	296	1,467	(9.4)	(8.3, 10.8)
Routine, birth, other	553	2,695	(17.3)	(15.7, 19.1)
Disposition of Patient[2]				
Routine/Discharge alive, destination unknown	1,045	5,116	(33.0)	(31.0, 35.0)
Transfer to short term hospitals	140	682	(4.4)	(3.7, 5.2)
Other transfers (long term)	1,344	6,581	(42.4)	(40.4, 44.5)
Home health care	558	2,778	(17.9)	(16.4, 19.5)
Died in hospital	74	361	(2.3)	(1.8, 2.9)
Insurance[2]				
Medicare	1,532	7,524	(48.5)	(46.3, 50.7)
Medicaid	608	2,991	(19.3)	(17.7, 20.9)
Private	693	3,397	(21.9)	(20.3, 23.6)
Uninsured (Self pay & No charge)	133	652	(4.2)	(3.4, 5.2)
Other	195	952	(6.1)	(5.3, 7.1)

Table 2.1. Continued

Hospital Bed Size[2]				
Small	266	1,242	(8.0)	(7.4, 8.8)
Medium	756	3,669	(23.7)	(21.9, 25.7)
Large	2,125	10,539	(68.2)	(66.1, 70.3)
Hospital Location[2]				
Urban	2,774	13,587	(87.9)	(86.7, 89.0)
Rural	373	1,863	(12.1)	(11.0, 13.3)
Hospital Region				
Northeast	488	2,488	(16.0)	(14.2, 18.0)
Midwest	660	3,339	(21.5)	(19.7, 23.3)
South	1,326	6,352	(40.9)	(38.2, 43.5)
West	693	3,366	(21.7)	(19.7, 23.8)
Hospital Teaching Status[2]				
Teaching	1,618	7,969	(51.6)	(49.0, 54.2)
Non-Teaching	1,529	7,480	(48.4)	(45.8, 51.0)

1. Weighted to discharges from all U.S. community, non-rehabilitation hospitals.

2. Sums less than n=3,167 are due to missing values.

Table 2.2. Length of stay (LOS) and hospital charges (2009 $US) for injury hospitalizations among individuals with paraplegia, Nationwide Inpatient Sample, 2003-2009 (n=2,951)[1]

	National Estimate[2]		Hospital Charges[3] (2009 $US)			LOS (days)	
	N	(%)	Mean	Median	Total charges (million)	Mean	Median
Total Estimated Cases[2]	14,489		64,110	29,741	911.5	8.0	4.2
YEAR							
2003	1,730	11.9	55,000	23,362	92.8	7.0	3.9
2004	1,945	13.4	55,382	29,590	105.7	7.3	4.1
2005	1,832	12.6	61,758	28,320	111.3	7.9	4.3
2006	1,861	12.8	55,997	28,339	104.0	7.3	3.9
2007	2,022	14.0	73,384	30,702	142.3	8.0	4.4
2008	2,430	16.8	77,400	31,983	185.1	9.4	4.6
2009	2,670	18.4	64,706	32,831	170.5	8.2	4.2
Top Ten Principal Ecodes							
Fall	5,011	34.6	54,500	30,677	268.8	6.8	4.1
Poisoning	1,559	10.8	36,231	18,232	55.2	5.4	2.7
Motor vehicle, traffic (MVT)	1,139	7.9	153,922	108,072	173.2	13.8	9.6
Overexertion	717	4.9	45,519	29,034	31.4	5.6	3.9
Fire/burn	618	4.3	46,795	19,713	28.9	9.3	4.1
Firearm	602	4.2	138,710	94,151	82.7	19.1	12.8
Suicide & self-inflicted injury	476	3.3	43,754	19,516	20.6	6.1	3.4
Non-motor vehicle transport (e.g. pedestrian)	307	2.1	99,420	72,458	29.0	9.0	6.3
Struck by, against	277	1.9	71,230	21,956	19.8	7.5	4.5
All Other[4]	1,609	11.1	43,648	22,556	69.2	5.7	3.3
Missing	2,174	15.0	63,006	28,968	132.7	8.8	4.6

Table 2.2. Continued

Top Ten Principal diagnoses								
1	Fracture of lower limb	3,838	26.5	33,797	25,087	128.5	4.8	3.4
2	Spinal cord injury	1,943	13.4	173,010	120,068	325.2	15.6	10.9
3	Fracture of neck of femur (hip)	1,677	11.6	48,048	33,494	79.6	6.9	4.6
4	Poisoning by other medications and drugs	1,369	9.4	36,811	16,988	49.3	4.9	2.7
5	Other fractures	817	5.6	82,749	39,508	66.8	9.6	5.2
6	Burns	726	5.0	51,934	20,956	37.7	9.2	4.2
7	Crushing injury or internal injury	694	4.8	97,745	57,782	65.4	13.2	7.3
8	Other injuries and conditions due to external causes	504	3.5	33,725	15,678	16.6	7.5	3.0
9	Poisoning by psychotropic agents	467	3.2	42,427	16,003	19.4	6.6	2.7
10	Intracranial injury	453	3.1	114,630	50,718	49.2	12.0	5.5
All Other diagnoses		2,002	13.8	37,655	19,968	73.7	6.1	3.3
Top Ten Principal procedures								
1	Treatment, fracture/dislocation of hip and femur	2,592	17.9	50,190	35,748	128.6	5.9	4.3
2	Spinal fusion	794	5.5	200,540	159,165	157.3	14.1	10.6
3	Treatment, fracture/ dislocation of lower extremity (not hip/femur)	658	4.5	36,754	30,231	23.9	6.6	2.9
4	Respiratory intubation and mechanical ventilation	482	3.3	82,850	40,484	38.0	7.5	4.6
5	Traction, splints, and other wound care	435	3.0	18,471	11,030	8.0	4.6	2.8
6	Debridement of wound, infection or burn	400	2.8	35,939	28,509	14.0	9.2	5.2
7	Other OR therapeutic nervous system procedures	383	2.6	215,261	176,123	79.2	15.6	12.7
8	Skin graft	333	2.3	74,500	38,860	24.8	13.2	7.1
9	Other O.R. procedures on vessels other than head and neck	273	1.9	138,329	81,820	37.0	14.9	10.0
10	All other procedures	4,053	28.0	81,271	40,555	320.6	10.5	5.6
No coded procedures		4,086	28.2	19,924	12,561	80.2	4.4	2.5

1. Excludes patients who died (n=74) or transferred to short-term hospitals (n=140), and 2 records from a single hospital per NIS user agreement.

2. Weighted to discharges from all U.S. community, non-rehabilitation hospitals.

3. Total hospital charges were weighted for national estimates of total charges and adjusted to the year 2009 inflation rates for in-hospital care.

4. Includes Ecodes for natural/environment, cut/pierce, suffocation, machinery, other specified & classifiable, not elsewhere classifiable, and unspecified.

Table 2.3. National estimates of co-morbid conditions[1] among individuals with paraplegia, Nationwide Inpatient Sample, 2003-2009 (n=3,167)

			Falls (n=1085)		Poisonings (n=340)		Motor Vehicle Traffic (n=265)	
Co-morbid condition	National Estimate[2] N	(%)	National Estimate[2] N	(%)	National Estimate[2] N	(%)	National Estimate[2] N	(%)
Total	15,545		5,354		1,658		1,286	
No other co-morbid condition	3,813	(24.5)	1,171	(21.9)	125	(7.5)	458	(35.6)
Hypertension	4,845	(31.2)	2,114	(39.5)	533	(32.1)	228	(17.8)
Fluid and electrolyte disorders	2,618	(16.8)	800	(14.9)	499	(30.1)	218	(16.9)
Deficiency anemias	2,616	(16.8)	1,163	(21.7)	246	(14.9)	145	(11.3)
Other Neurological disorders	2,162	(13.9)	791	(14.8)	442	(26.7)	83	(6.5)
Depression	2,108	(13.6)	653	(12.2)	428	(25.8)	96	(7.5)
Diabetes, uncomplicated	1,980	(12.7)	744	(13.9)	251	(15.2)	128	(10.0)
Chronic pulmonary disease	1,854	(11.9)	764	(14.3)	257	(15.5)	109	(8.5)
Drug abuse	1,304	(8.4)	141	(2.6)	471	(28.4)	94	(7.3)
Psychoses	1,062	(6.8)	169	(3.1)	242	(14.6)	DS	DS
Alcohol abuse	1,023	(6.6)	273	(5.1)	189	(11.4)	134	(10.4)
Obesity	831	(5.3)	374	(7.0)	70	(4.2)	54	(4.2)
Hypothyroidism	792	(5.1)	381	(7.1)	63	(3.8)	DS	DS
Congestive heart failure	746	(4.8)	386	(7.2)	115	(7.0)	DS	DS
Renal failure	610	(3.9)	292	(5.4)	100	(6.0)	DS	DS
Weight loss	530	(3.4)	122	(2.3)	108	(6.5)	DS	DS
Coagulopathy	410	(2.6)	176	(3.3)	DS	DS	DS	DS
Diabetes, with chronic complications	335	(2.2)	145	(2.7)	52	(3.2)	DS	DS
Peripheral vascular disorders	314	(2.0)	176	(3.3)	DS	DS	DS	DS
Valvular disease	312	(2.0)	169	(3.2)	DS	DS	DS	DS
Rheumatoid arthritis	269	(1.7)	139	(2.6)	DS	DS	DS	DS
Liver disease	214	(1.4)	DS	DS	56	(3.4)	DS	DS
Chronic blood loss anemia	212	(1.4)	DS	DS	DS	DS	DS	DS
Metastatic cancer	164	(1.1)	73	(1.4)	DS	DS	DS	DS
Pulmonary circulation disorders	153	(1.0)	DS	DS	DS	DS	DS	DS
Lymphoma	98	(0.6)	DS	DS	DS	DS	DS	DS
Tumor without metastasis	71	(0.5)	DS	DS	DS	DS	DS	DS
AIDS	DS	DS	DS	DS	DS	DS	DS	DS
Peptic ulcer disease excluding bleeding	DS	DS	DS	DS	DS	DS	DS	DS

Table. 2.3. Continued

1. Co-morbid conditions were not mutually exclusive.

2. Weighted to discharges from all U.S. community, non-rehabilitation hospitals.

DS = Discharge information suppressed since cell count is ≤ 10 (The Nationwide Inpatient Sample data user agreement precludes publishing cell counts ≤ 10).

Table 2.4. National estimates of injury hospitalizations for individuals with paraplegia by cause of injury, Nationwide Inpatient Sample, 2003-2009[1,2]

	Falls		Poisonings		Motor Vehicle Traffic		
	Sample n	National Estimate N(%)	Sample n	National Estimate N(%)	Sample n	National Estimate N(%)	
Total Estimated Cases	1,015	5,011	320	1,559	234	1,139	P-Value[3]
Sex							.0009
Female	419	2,062 (41.3)	136	660 (42.3)	64	311 (27.3)	
Male	593	2,935 (58.7)	184	899 (57.7)	170	829 (72.7)	
Age							<0.0001
18-24	85	412 (8.2)	55	263 (16.9)	85	413 (36.4)	
25-49	246	1,217 (24.3)	126	619 (39.7)	72	353 (31.1)	
50-64	318	1,572 (31.4)	96	467 (30.0)	54	262 (23.1)	
65+	366	1,811 (36.1)	43	210 (13.4)	22	107 (9.4)	
Race							0.0666
White	601	2,952 (74.8)	191	929 (74.2)	132	640 (68.0)	
Non-white	200	996 (25.2)	67	323 (25.8)	62	301 (32.0)	
Comorbidities							0.0104
Paraplegia only	228	1,128 (22.5)	25	120 (7.7)	86	415 (36.4)	
Paraplegia + 1 additional comorbidity	259	1,281 (25.6)	59	283 (18.2)	72	354 (31.1)	
Paraplegia + 2 or more comorbidities	528	2,603 (51.9)	236	1155 (74.1)	76	371 (32.5)	
Payer							<0.0001
Medicare	585	2,889 (57.7)	173	845 (54.2)	36	174 (15.4)	
Medicaid	143	706 (14.1)	80	392 (25.1)	34	164 (14.5)	
Private/HMO	193	950 (19.0)	56	272 (17.4)	128	626 (55.4)	
Self-pay/No charge	35	176 (3.5)	DS	DS DS	20	97 (8.6)	
Other	58	286 (5.7)	DS	DS DS	14	69 (6.1)	

Table 2.4. Continued

Top 3 Principal Diagnoses									
Fracture: lower limb	464	2,290	(45.7)				25	121	(10.6)
Fracture: neck of femur (hip)	201	987	(19.7)						
Spinal cord injury	111	546	(10.9)				105	511	(44.8)
Poisoning, other medications/drugs				215	1053	(67.6)			
Poisoning by psychotropic agents				59	287	(18.4)			
Substance related disorders & Poisoning, nonmedicinal substances				46	219	(14.0)			
Other fractures							25	121	(10.6)
All other diagnoses	239	1,189	(23.7)				79	387	(34.0)

1. Excludes patients who died (n=74) or transferred to short-term hospitals (n=140), and 2 records from a single hospital per NIS user agreement.

2. Weighted to discharges from all U.S. community, non-rehabilitation hospitals.

3. Tests of significance were conducted using chi-square test or Fisher's exact test where appropriate; significance level set at a=0.05.

DS = Discharge information suppressed since cell count is ≤ 10 (The Nationwide Inpatient Sample data user agreement precludes publishing cell counts ≤ 10)

Table 2.5. Mean and median hospital charges (2009 $US) for injury hospitalizations among individuals with paraplegia by cause of injury, Nationwide Inpatient Sample, 2003-2009 [1,2]

	Falls (n=1,015)			Poisonings (n=320)			Motor Vehicle Traffic (n=234)		
	Mean	Median	P-Value[3]	Mean	Median	P-Value[3]	Mean	Median	P-Value[3]
	54,500	30,677		36,231	18,232		153,922	108,072	
Sex			<.0001			0.7177			0.8047
Female	41,304	27,074		32,174	17,165		155,130	121,087	
Male	63,931	32,966		39,056	18,633		153,461	100,441	
Age			0.0034			0.3423			0.0542
18-24	84,464	40,327		23,158	13,731		166,501	127,557	
25-49	56,014	28,312		43,749	17,644		167,009	111,082	
50-64	48,746	29,282		33,731	19,815		110,101	57,585	
65+	51,963	31,763		35,618	20,227		172,637	87,946	
Race			0.8913			0.3560			0.5528
White	52,960	30,194		41,361	19,537		175,316	128,621	
Non-white	69,493	41,468		32,946	18,918		159,904	73,791	
Comorbidities			0.0022			0.0381			0.1503
Paralysis only	44,524	25,456		19,680	11,221		142,560	111,944	
Paralysis + 1 comorbidity	55,720	28,783		26,228	13,934		133,653	63,627	
Paralysis+ 2 or more comorbidities	58,150	33,085		40,462	19,602		185,319	123,088	
Payer			0.0151			0.1439			0.4585
Medicare	45,809	28,790		40,641	20,481		123,363	52,885	
Medicaid	58,779	32,482		30,440	14,823		146,942	104,354	
Private/HMO	62,058	31,691		30,330	14,891		154,325	114,146	
Self-pay/No charge	99,557	42,568		DS	DS		135,206	86,910	
Other	79,807	27,775		DS	DS		277,972	106,212	

Table 2.5. Continued

Top 3 Principal Diagnoses			<.0001			0.3984			<.0001
Fracture: lower limb	31,793	23,553					55,607	41,744	
Fracture: neck of femur (hip)	47,427	33,558							
Spinal cord injury	163,820	100,655					208,819	170,726	
Poisoning, other medications/drugs				35,356	17,481				
Poisoning by psychotropic agents				38,329	13,230				
Substance related disorders & Poisoning, nonmedicinal substances				37,735	20,175				
Other fractures							146,140	47,938	
All other diagnoses	54,678	27,457					115,501	56,231	

1. Excludes patients who died (n=74) or transferred to short-term hospitals (n=140), and 2 records from a single hospital per NIS user agreement.

2. Hospital charges were weighted for national estimates of total charges and adjusted to the year 2009 inflation rates for in-hospital care.

3. Tests of significance were conducted using Student's t-test or analysis of variance where appropriate; significance level set at a=0.05.

DS = Discharge information suppressed since cell count is ≤ 10 (The Nationwide Inpatient Sample data user agreement precludes publishing cell counts ≤ 10).

Table 2.6. Mean and median length of stay (in days) of injury hospitalizations among individuals with paraplegia by cause of injury, Nationwide Inpatient Sample, 2003-2009[1]

	Falls (n=1,015)			Poisonings (n=320)			Motor Vehicle (n=234)		
	Mean	Median	P-Value[2]	Mean	Median	P-Value[2]	Mean	Median	P-Value[2]
	6.8	4.1		5.4	2.7		13.8	9.6	
Sex			<.0001			0.0061			0.0047
Female	6.3	3.9		5.3	2.5		12.4	10.0	
Male	7.1	4.2		5.5	2.9		14.4	9.4	
Age			0.2385			0.2189			0.8272
18-24	7.4	4.2		4.4	2.4		13.9	12.1	
25-49	6.4	3.8		5.8	2.4		14.1	10.1	
50-64	7.1	3.8		4.8	2.7		13.5	6.7	
65+	6.6	4.4		7.0	3.7		12.9	9.3	
Race			<.0001			0.6849			<.0001
White	6.6	4.0		5.4	2.9		14.7	11.3	
Non-white	7.7	4.6		6.1	2.8		15.4	9.0	
Comorbidities			<.0001			0.8124			0.1011
Paralysis only	5.8	3.5		3.8	2.2		11.5	9.4	
Paralysis + 1 comorbidity	7.0	3.7		4.3	1.9		11.8	7.2	
Paralysis+ 2 or more comorbidities	7.1	4.6		5.9	2.9		18.4	10.9	
Payer			0.4520			0.7115			0.6790
Medicare	6.3	4.1		5.2	3.0		11.1	8.2	
Medicaid	7.7	4.0		6.5	2.4		12.3	9.6	
Private/HMO	7.1	3.8		4.5	2.0		14.6	9.7	
Self-pay/No charge	9.2	5.3		DS	DS		15.7	11.5	
Other	6.8	4.6		DS	DS		16.4	10.2	

Table 2.6. Continued

Top 3 Principal Diagnoses			<.0001			0.8024			0.0005
Fracture: lower limb	4.7	3.2					5.2	3.9	
Fracture: neck of femur (hip)	6.9	4.4							
Spinal cord injury	12.2	8.2					16.0	12.9	
Poisoning, other medications/drugs				4.8	2.7				
Poisoning by psychotropic agents				6.2	2.4				
Substance related disorders & Poisoning, nonmedicinal substances				7.5	2.9				
Other fractures							18.7	6.8	
All other diagnoses	8.1	4.1					12.1	7.6	

1. Excludes patients who died (n=74) or transferred to short-term hospitals (n=140), and 2 records from a single hospital per NIS user agreement.

2. Tests of significance conducted using Student's t-test or analysis of variance where appropriate; where appropriate; significance level set at a=0.05.

DS = Discharge information suppressed since cell count is ≤ 10 (The Nationwide Inpatient Sample data user agreement precludes publishing cell counts ≤ 10).

CHAPTER 3

INJURY HOSPITALIZATIONS AND ASSOCIATED COSTS BETWEEN INDIVIDUALS WITH PRE-EXISTING QUADRIPLEGIA VERSUS PARAPLEGIA

Abstract

Objectives: To compare the differences in injury hospitalizations including LOS and hospital costs between individuals with pre-existing quadriplegia versus paraplegia, and determine patient and injury characteristics associated with increased hospital costs among individuals with pre-existing quadriplegia versus paraplegia.

Methods: This study analyzed a retrospective cohort of injury hospitalizations among individuals with pre-existing quadriplegia or paraplegia in the Nationwide Inpatient Sample, 2003-2009. Differences in hospitalization, including LOS and hospital costs, were compared. Logistic regression was used to estimate the effect of patient characteristics on the odds of hospitalized patients with quadriplegia versus paraplegia by cause of injury. Multivariable linear regression was conducted to estimate predicted difference in hospital costs for injury hospitalizations among individuals with quadriplegia compared to paraplegia.

Results: Over the seven-year period, national injury hospitalizations were 12,565 and 15,551 for individuals with pre-existing quadriplegia and paraplegia, respectively (an average of 1,795 and 2,222 per year). Over one-third of injury hospitalizations were due to falls. Patients who died were significantly more likely to be individuals with quadriplegia versus paraplegia. Despite fewer injury hospitalizations overall, individuals with quadriplegia have longer LOS, and higher average and total costs for injury hospitalizations due to falls and motor vehicle traffic, but similar outcomes for poisonings compared to individuals with paraplegia. Males, younger age, and the uninsured were significant predictors of higher hospital costs. Poisonings cost significantly less than all other causes of injury.

Conclusions: Fewer injury hospitalizations but longer hospital stays, and higher hospital costs per discharge were found for individuals with quadriplegia compared to individuals with paraplegia. The burden is high with deaths from injury more likely to be among individuals with quadriplegia. Fall prevention should be a top priority, with special attention to males, young adults, and the uninsured.

Introduction

Most spinal cord injuries (SCI) result from a traumatic event with immediate and permanent consequences to an individual's sensory and motor function. The resulting impairments to sensation or mobility place an individual with SCI at risk of getting injured again in the future, such as from burns (Formal, Goodman, Jacobs, & McMonigle, 1989) or falls (Brotherton, Krause, & Neitert, 2007, Nelson et al, 2010, Nelson et al, 2003). These subsequent injuries are a known cause of rehospitalization (NSCISC, 2012a, Dryden et al, 2004, Cardenas, Hoffman, Kirschblum, & McKinley, 2004) and death (NSCISC, 2012a, DeVivo, Krause, Lammertse, 1999)). They not only have a negative impact on the individual living with SCI, including their level of disability, quality of life, and ability to participate in life activities including work

(Brotherton et al, 2007), but also place a significant burden on their caregivers, family, and society as a whole.

Previous studies have found that individuals with SCI are at increased risk of subsequent injury compared to the general population (Fordyce, 1964, Krause, 2004, 2010). Almost one-quarter (23%) of individuals with SCI reported sustaining at least one subsequent injury during the previous year (Krause, 2010), partly because behavioral risk factors that contributed to their initial SCI are still present (Fordyce, 1964, Krause, 2004, 2010). In addition, the neurologic level of the initial SCI may contribute to the risk of subsequent injury (Krause, 2010).

Individuals with quadriplegia, which results from SCI to the cervical region, are more severely injured in the neurologic level of damage to the spinal cord than those with paraplegia, which is a SCI to the thoracic, lumbar, or sacral regions of the spinal cord. Quadriplegia leads to decreased functional ability at higher levels of the spinal cord compared to paraplegia. These differences in rehabilitation and functional ability from initial SCI between individuals with quadriplegia and paraplegia, as well as the differential impact of the SCI on daily life and ability to return to work following the initial injury (NSCISC, 2012a) could affect an individual's exposure or risk for subsequent injuries. Previous research suggests that individuals with less severe SCI are at significantly greater risk for subsequent injury (Krause, 2010). However, higher rates of overall hospitalizations (for any reason), more physician contacts, and increased direct health care costs were found among individuals with quadriplegia in the years following their initial SCI (Dryden et al, 2004), suggesting the burden of subsequent injury may be greater for individuals with quadriplegia compared to those with paraplegia.

Despite known differences, there is a lack of epidemiological studies that describe or compare injury characteristics and hospital outcomes resulting from subsequent injury hospitalizations among individuals with pre-existing quadriplegia or paraplegia. Building on previous research findings (Krause, 2004, 2010, Dryden et al, 2004), the hypothesis of this study was that individuals with quadriplegia have different characteristics of subsequent injuries, and have longer lengths of stay (LOS) and higher hospital costs per injury hospitalization compared to individuals with paraplegia.

Hospital charges are often used as a proxy to describe the financial burden of injury hospitalizations because of their availability in the discharge record (DeVivo & Farris, 2011, Rowland et al, 1996, Alexander, Rivara, & Wolf, 1992). However, hospital charges only reflect the total billable charges incurred during a hospitalization, not what was actually received in payment. Hospital costs, on the other hand, are a better measure of the financial burden, because they reflect the amount collected by the hospital after discounts and reimbursements. However, hospital costs have not been used widely in the literature due to their complexity (Finkler, 1982). In 2005, the Agency for Healthcare Research and Quality (AHRQ) provided charge-to-cost ratios that convert charge data to cost estimates for select databases available from the Agency's Healthcare Cost and Utilizations Project (HCUP) (AHRQd, 2010c). This offers an opportunity to more accurately describe the burden of injury in the general population, and also in many unique or understudied populations, such as the one for this study - individuals with pre-existing SCI.

This study compared characteristics of injury hospitalizations including LOS and hospital costs, between individuals with quadriplegia versus paraplegia, and determined the factors associated with increased hospital costs resulting from subsequent injury among individuals with quadriplegia versus individuals with paraplegia. It also used estimated hospital costs as an outcome to predict differences in subsequent injury burden by patient and injury characteristics among individuals with pre-existing quadriplegia versus paraplegia. Findings may be used to inform the development of interventions to prevent injury, and target programs by type of SCI, patient characteristics, and cause of subsequent injury.

Methods

Data source

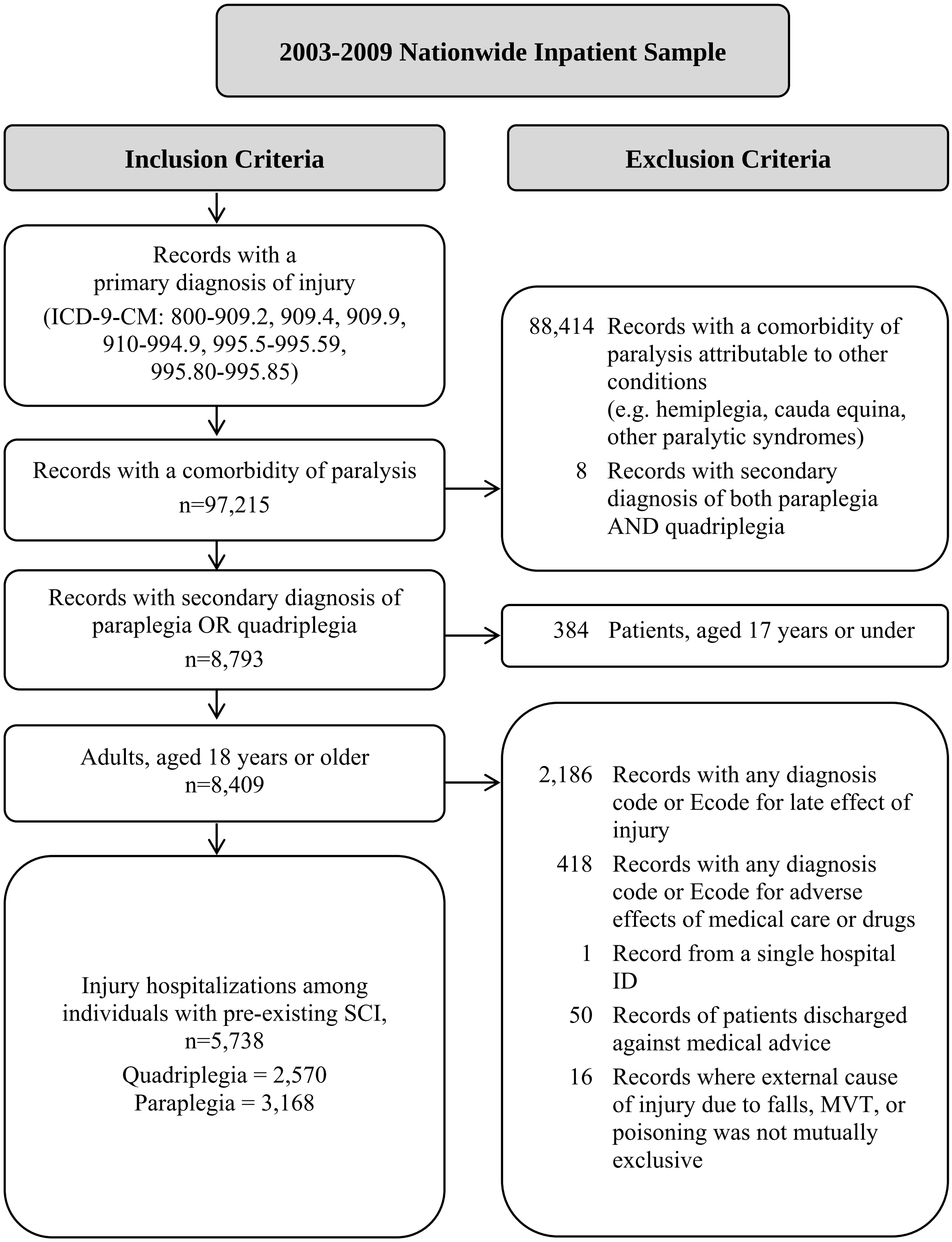
This study was a retrospective analysis of injury hospitalizations from 2003-2009 for a cohort of individuals with pre-existing quadriplegia or paraplegia using the Nationwide Inpatient Sample (NIS) of HCUP. The NIS is the largest publicly available database of hospital discharge records in United States with charge information for all patients regardless of payer, including discharges covered by Medicare, Medicaid, private insurance, and the uninsured (e.g. self-pay or no charge) (AHRQ, 2010d). For each study year, the NIS contains records on about 8 million inpatient stays from approximately 1,000 hospitals in 37-44 states. It uses a sampling strata of five hospital characteristics, including region, ownership-control, urban/rural location, teaching status, and bed size, to approximate a 20% stratified sample of all community, non-rehabilitation hospitals which can then be weighted to represent the total number of hospital discharges in the U.S. (Steiner, Elixhauser, & Schnaier, 2002). In addition, the NIS provides comorbidity software (AHRQ, 2010b) and cost-to-charge ratios (AHRQ, 2010c) that allow analysis of hospital costs for hospitalizations in special patient populations, such as hospital costs of injury hospitalizations for individuals with a pre-existing comorbidity of paralysis due to quadriplegia or paraplegia.

Subjects

The *International Classification of Diseases, 9th revision, Clinical Modification* (ICD-9-CM) was used to identify discharge records due to injury with a primary diagnosis code of 800-904.9, 910-994.9, 995.5-995.59, or 995.80-995.85 (Injury Surveillance Workgroup, 2003). Injured patients, aged 18 years or older, with pre-existing quadriplegia or paraplegia were selected using the HCUP Comorbidity Software (Version 3.7) by a set of secondary diagnosis codes to identify a comorbidity of ‘paralysis’. A pre-existing condition of quadriplegia or paraplegia was reflected by ICD-9-CM codes for quadriplegia (ICD-9-CM=344.0, 344.00-344.04, or 344.09) or paraplegia (ICD-9-CM = 344.1) anywhere in the second through fifteenth diagnosis fields for years 2003-2008 and second through twenty-fifth diagnosis fields for year 2009 (Elixhauser et al, 1998, Stukenborg, Wagner, & Connors, 2001). These codes are generally used when quadriplegia and paraplegia are reported without further specification or are stated to be old or long-standing but of unspecified cause (National Center for Health Statistics, 2012). Only records with a comorbidity of ‘paralysis’, and a secondary diagnosis of quadriplegia or paraplegia were included in the analysis. Records with a comorbidity of ‘paralysis’, but no secondary diagnosis of quadriplegia or paraplegia were excluded because the comorbidity software also identifies records where ‘paralysis’ is due to other pre-existing conditions, such as hemiplegia or other paralytic syndromes.

A total of 8,409 records for injury hospitalizations for adults aged 18 years or older with pre-existing quadriplegia or paraplegia were selected, excluding 8 records that contained a secondary diagnosis for both quadriplegia and paraplegia. In addition, 2,186 records that contained a secondary diagnosis or external cause of injury code (Ecode) for late effect of injury, and 418 records that contained any diagnosis code or Ecode for adverse effects of medical care or drugs were excluded. Last, one record that was the only record from a single hospital ID per NIS data user agreement, 50 records where patients were discharged against medical advice, and 16 records where the external causes of injury (Ecodes) due to falls, motor vehicle traffic (MVT), or poisonings were not mutually exclusive were excluded (each record contained up to 4 Ecodes). Thus, a total of 5,738 injury hospitalizations were included in the final analysis (Figure 3.1).

Figure 3.2. Case selection



Main variables and measures

The two main outcome measures in this study were length of stay (LOS) and hospital costs. *Length of stay* was calculated as the number of days from admission date to discharge date. *Hospital costs* represented an estimated amount in US dollars that hospitals received in payment per discharge. The NIS provides cost-to-charge ratios specific to their database that enable the conversion from hospital charges (i.e., the total billable charges per discharge in US dollars for the hospitalization) to cost estimates for nearly every hospital in the NIS. The ratios are based on all-payer inpatient costs in hospital accounting reports collected by the Centers for Medicare and Medicaid Services (CMS) (AHRQ, 2010c). Hospital costs were calculated by merging the group average all-payer inpatient cost-to-charge ratio using hospital ID as the link variable, and then multiplying the total hospital charges by the group ratio provided by AHRQ. Hospital costs reported in this study were adjusted to the year 2009 (last quarter) inflation rates using the consumer price index for in-hospital care provided by the Bureau of Labor Statistics (Bureau of Labor Statistics, 2012).

Injury characteristics were described using the Clinical Classifications Software (CCS) provided by NIS (AHRQ, 2010a). The CCS groups ICD-9-CM codes for external causes of injury and diagnoses into clinically meaningful categories. National estimates of the number and proportion of the first listed CCS Ecode and CCS principal diagnosis were calculated and used to identify the top three causes of injuries for further analysis: falls (CCS Ecode = 2603), MVT (CCS Ecode = 2607) and poisonings (CCS Ecode = 2613).

Patient characteristics were described by sex, age, race, and number of comorbidities. Race was categorized into four groups as white, black, other, and missing to preserve the almost 24% of records without race information in subsequent analyses. Number of comorbidities represent the sum of comorbidities identified in the hospital record by the Comorbidity Software (Version 3.7) provided by NIS (AHRQ, 2010b). The software identifies up to 30 morbidities which were summed and categorized into three groups: ‘no other comorbidities,’ ‘1 comorbidity,’ or ‘2 or more comorbidities.’ The sum of comorbidities does not count the comorbidity of ’paralysis’ since it was used as part of the selection criteria for this study. Clinical variables included discharge disposition and insurance information. Hospital characteristics were not reported due to little difference in hospital region, teaching status, bed-size, and urban versus rural location between patients with quadriplegia versus paraplegia.

Analysis

This study described the number and proportion of injury hospitalizations for individuals with quadriplegia versus paraplegia and compared the difference in proportions of hospitalization (quadriplegia versus paraplegia) by patient characteristics, principal external cause of injury, and top 10 principal diagnosis using chi-square tests. National estimates, along with 95% CI, were calculated using discharge-level weighting provided in the dataset to estimate the total number of discharges from all U.S. community, non-rehabilitation hospitals. For the top three causes of injury of falls, motor vehicle traffic, and poisonings, multivariable logistic regression models were built for each, respectively, to estimate the effect of patient characteristics on odds of hospitalized patients with quadriplegia versus paraplegia due to falls, MVT, or poisoning.

Cook's D statistics were used to identify and remove 256 (5.1%) potentially influential observations on hospital costs. Mean and median hospital costs were calculated with outliers and without outliers. The outliers largely influenced the average costs per discharge and model fit, which reduced the ability to interpret the results (See Appendix A). Thus, the decision was made to report results of hospital costs with outliers removed. With outliers removed, mean and median hospital costs were calculated comparing injury hospitalizations for individuals with quadriplegia versus paraplegia by patient characteristics and cause of injury. Multivariable linear regression was conducted to estimate the percent change and adjusted mean difference of hospital costs for injury hospitalizations among individuals with quadriplegia compared to paraplegia. Log transformation of hospital costs were used as the main outcome for the regression models to improve the normality of the residuals from the regression models. All the estimates from the regression models were log-transferred back and presented in the results. Models were adjusted for patient characteristics (e.g. sex, age group, and race), clinical variables (e.g. discharge status and payer) and cause of injury (e.g. falls, motor vehicle traffic, and poisoning). All analyses were conducted using SAS (version 9.2) callable SUDAAN (version 10.0.1) to account for the clustering of data inherent in the survey design of the NIS (Research Triangle Institute, 2009).

Results

Patient characteristics

Among the estimated 28,116 (unweighted n=5,738) inpatient injury hospitalizations from 2003-2009, approximately 44.8% (n=2,570, N=12,565) were to patients with pre-existing quadriplegia compared to 55.2% (n=3,168, N=15,551) to patients with pre-existing paraplegia (Table 3.1). Overall, more men than women were admitted for injury for both types of SCI. Compared to individuals with paraplegia, men were injured in greater proportion to women for individuals with quadriplegia. (X^2=20.83, p<0.001). Individuals with quadriplegia were also more often discharged to other locations besides home, including other short term hospitals or long term facilities (X^2=386.64, p<0.001). In addition, a greater proportion of individuals with quadriplegia died during a hospitalization for injury compared to individuals with paraplegia (X^2=20.82, p<0.001).

Injury type and injury cause

For individuals with quadriplegia, falls (35.6%), motor vehicle traffic (16.0%), and poisoning (5.8%) were the top three external causes of subsequent injury (Table 3.2). This is similar to the 34.4% of injury hospitalizations attributable to falls for individuals with paraplegia, but differs in rank order and proportion for the second and third leading causes of injury where 10.7% of injuries were due to poisoning and 8.3% to motor vehicle traffic, respectively. Compared to individuals with paraplegia, more individuals with quadriplegia were admitted due to subsequent spinal cord injury (that is, an additional SCI to their pre-existing condition) (43.3% v. 14.4%, respectively), but fewer fractures of any kind (including fractures of the lower limb, hip, or other) (21.6% v. 42.6%, respectively) or poisonings by medication or drugs (5.2% v. 9.1%, respectively).

Odds of injury hospitalizations for individuals with pre-existing quadriplegia versus paraplegia

Logistic regression was used to estimate the effect of patient characteristics on the odds of hospitalized patients with quadriplegia versus paraplegia due to falls, MVT, or poisoning. The adjusted odds ratio showed that for patients admitted to the hospital due to a falls, males were significantly more likely to have pre-existing quadriplegia versus paraplegia compared to females (OR = 1.42; 95% CI (1.17, 1.76)) (Table 3.3). However, no gender differences were found for injury hospitalizations due to motor vehicle traffic or poisonings. There was also no age difference for the top three causes of injuries among individuals with quadriplegia versus paraplegia. Among patients who died, deaths from injury hospitalizations due to falls were 10 times (OR = 9.89, 95% CI (6.11, 16.01)) more likely to be among individuals with quadriplegia versus paraplegia. Deaths from injury hospitalizations due to MVT or poisoning were at nearly 8 times (OR = 7.87, 95% CI (3.83, 16.18)) and 4 times (OR = 3.71, 95% CI (1.07, 12.92) increased odds for individuals with quadriplegia compared to paraplegia, respectively.

Hospital costs and lengths of stay for injury hospitalizations

Overall, mean and total hospital costs ranged from about 35-40% of hospital charges. From 2003-2009, there was over $566 million in hospital costs for injury hospitalizations for individuals with quadriplegia compared to $347 million in hospital costs for injury hospitalizations for individuals with paraplegia for the seven study years. An annual average of $81 million in hospital costs for individuals with quadriplegia and $50 million for individuals with paraplegia, respectively.

Individuals with quadriplegia had higher average LOS and hospital costs per discharge than individuals with paraplegia both overall and for hospitalizations due to falls, motor vehicle traffic or poisonings (Table 3.4). On average, individuals with quadriplegia were hospitalized twice as long as individuals with paraplegia, with an average of 16.8 inpatient days per injury hospitalization (median=7.8 days) for individuals with quadriplegia compared to 8.0 days (median =4.2 days) for individuals with paraplegia. Across the top three causes of injury, the greatest burden was for motor vehicle traffic which averaged 26.7 inpatient days and $103,612 in hospital costs per injury hospitalization for individuals with quadriplegia, and about half that for individuals with paraplegia (13.8 days, and $59,547 in hospital costs, respectively). Whereas LOS and hospital costs were nearly double for fall or motor vehicle traffic injuries to individuals with quadriplegia compared to individuals with paraplegia, similar LOS and hospital costs were found between the two groups for injury hospitalizations due to poisonings.

Even after removing potentially influential observations, average hospital costs remained nearly double for individuals with quadriplegia both overall and by individual patient characteristics, compared to individuals with paraplegia (Table 3.5). The highest average hospital costs per discharge were for males and patients aged 18-34 years. For an individual with quadriplegia, the average cost for an injury hospitalization was $48,500 for males and $32,800 for females, compared to $24,400 for males and $17,400 for females for an individual with paraplegia, respectively. By age group, hospital costs were highest for patients aged 18-34 years, averaging $66,200 for individuals with quadriplegia, and $31,300 for individuals with paraplegia. For individuals with quadriplegia, injury hospitalizations averaged $57,000 in hospital costs for both the uninsured and those paying with private insurance, compared to $34,700 for hospitalizations covered through Medicare/Medicaid. During the seven study years, hospital costs totaled over $130.3 million for fall injuries, $137.0 million for motor vehicle traffic injuries, and $8.1 million for poisonings for individuals with quadriplegia. In that same time, individuals with paraplegia incurred $93.1 million in hospital costs for fall injuries, $61.4 million for motor vehicle traffic injuries, and $15.5 million for poisonings, respectively.

Factors associated with increased hospital costs

Results from adjusted learner regression model showed that, after adjusting for patient characteristics, clinical variables (discharge and payer), and cause of injury, males had significantly higher hospital costs compared to females, with a predicted mean difference of $7,491 more than females with quadriplegia, and $4,151 more than females with paraplegia ($p<0.001$) (Table 3.6). Young adults, aged 18-34 years, also had significantly higher hospital costs for injury compared to older adults 65 years and older. In particular, injury hospitalizations were predicted to be $20,368 ($p<0.001$) more in hospital costs for young adults with quadriplegia than adults over 65 years. Hospital costs also increased significantly in the presence of 2 or more comorbidities compared to individuals with no other comorbidities, a predicted increase of 29% ($p<0.001$) for individuals with quadriplegia, and 10% ($p<0.05$) for individuals with paraplegia, respectively. Notably the uninsured, which includes those who self-pay or were not charged, incurred over 60% ($p<0.001$) more in average hospital costs for both SCI groups than hospitalizations covered by Medicare/Medicaid.

Discussion

Burden of injury

For individuals with quadriplegia, injury hospitalizations resulted in an estimated $566 million (2009 $US) in hospital costs during the seven study years compared to $347 million in hospital costs for individuals with paraplegia. This totals $913 million with an average annual burden of $130 million in hospital costs for individuals with pre-existing quadriplegia or paraplegia, which not only significantly impacts the quality of life of these individuals and their families, but also adds significant burden to the health care system. While reported hospital costs are a fraction of the $19.5 billion (2004 $US) in total costs for all injury hospitalizations in the US population annually (Owens, Russo, & Stocks, 2006), the average costs per hospitalization is greater for individuals with SCI compared to the general population. Within the same dataset, the mean hospital cost for injury hospitalizations among individuals with quadriplegia or paraplegia is $43,000 and $22,000 (2009 $US), respectively, compared to $10,300 (2004 $US) in the general U.S. population (Russo, Owens, & Stocks, 2006). Our findings suggest there is an urgent need for the design and implementation of effective intervention programs to prevent subsequent injuries for individuals with SCI, and that different intervention strategies should be tailored for individuals with pre-existing quadriplegia or paraplegia, respectively.

Differences by level of SCI

Individuals with quadriplegia sustained an estimated 12,565 injury hospitalizations nationwide during the seven study years compared to 15,551 injury hospitalization among individuals with paraplegia in that same time. Using these estimates with estimates of the prevalent population of individuals living with SCI (NSCISC, 2012b, DeVivo & Chen, 2011, Lasfargues, Custis, Morrone, Carswell, & Nguyen, 1995), the approximate number of injury hospitalizations annually is 1 in 72 for individuals living with quadriplegia in the United States today, and 1 in 59 for individuals living with paraplegia.

Although the injury hospitalization rate is lower for individuals living with quadriplegia compared to those with paraplegia in the United States, the median LOS for individuals with quadriplegia was double the median LOS per injury hospitalization for individuals with paraplegia (8 versus 4 days, respectively). Further, the median LOS for hospitalization due to an injury following either quadriplegia or paraplegia is almost doubled the median LOS for rehospitalizations for any reason (Dryden et al, 2004). The relative burden of longer inpatient stays for injury hospitalizations supports the importance of targeting subsequent injury in prevention efforts following initial SCI. Krause (2004, 2010) raises the salient point that although urinary tract infections and pressure ulcers are a primary focus of prevention following SCI, they are not predictive of any other health outcomes whereas subsequent injuries were predictive of multiple health outcomes, but have not been the primary target of prevention efforts.

Differences by cause of injury

The results of this study indicate the external causes of injury hospitalizations are similar for individuals with quadriplegia and paraplegia, but result in significantly different health care outcomes by type of SCI. Deaths from fall injuries were 10 times more likely to be among patients with quadriplegia compared to those with paraplegia.

Further, individuals with quadriplegia have longer LOS, and higher average and total costs for injury hospitalizations due to falls compared to individuals with paraplegia. However, despite an almost 10% increase in new SCI among persons older than 60 years, and falls as a leading cause of initial SCI among persons older than 65 (DeVivo, 2012), there was no difference in injury resulting from fall by age group. The differences in mortality, LOS, and hospital costs for hospitalizations due to falls by type of SCI suggest that there may be differences in the underlying physiologic conditions, the severity of the fall injury, or the circumstances surrounding the fall event. With one-third of injury hospitalizations attributable to falls for both individuals with quadriplegia or paraplegia, interventions to prevent falls for all individuals with SCI should be priority. Individuals with quadriplegia (N=2715 (21.6%)) sustained fewer fractures compared to individuals with paraplegia (N=6,724 (42.6%)). Individuals with spinal cord injury may be more likely to be injured in a fall, especially bone fracture injuries, due to loss of bone density over time (Capoor & Stein, 2005). Fractures may result from external causes, but also for pathologic (i.e. spontaneous) reasons. Special attention is needed when investigating and reporting falls and fractures to distinguish records with an ICD-9-CM diagnosis codes for pathologic fractures (which were not included in this study), and fractures due to external causes which may also contain an Ecode. Additional fall prevention efforts may need to target individuals with quadriplegia as they seem to sustain more severe injuries or have more complications while hospitalized compared to individuals with paraplegia (Dryden et al, 2004). Future research should also explore the reasons why the differences in health care outcomes exist by type of SCI.

In contrast, there were similar LOS and mean costs per admission of hospitalizations due to poisoning by type of SCI, which may reflect that the severity or treatment of poisoning injuries are similar for individuals with either quadriplegia or paraplegia. Most poisonings were caused by medications or drugs (as opposed to psychotropic agents) which other studies have found to be a risk factor for all subsequent injury (Krause, 2004, 2010, Brotherton et al, 2007), rehospitalization for any reason (Krause & Saunders, 2009), and death (Krause & Saunders, 2010, Krause, Carter, & Pickelsimer, 2009). More research is needed on poisoning injuries as it was not possible to determine in the dataset if poisonings were due to lack of coordination, overdose, or interaction effects. This suggests that interventions to prevent poisoning may help prevent other types of injuries as well as other negative health outcomes associated with prescription drug use.

Hospital charges versus hospital costs

While most previous studies have used hospital charges as an outcome measure, this study used hospital costs to estimate the burden of subsequent injuries among individuals with pre-existing SCI. Results showed that charge-to-cost comparisons were very similar by type of spinal cord injury or mechanism of injury. Hospital costs ranged from 2.5-2.7 times less than hospital charges per admission. This is comparable to the 2.5 charge-to-cost ratios (CCR) for surgical patients with cancer (Shulkin et al, 1993), but slightly greater than the 1.9 CCR for a small cohort (n=27) of injury hospitalizations in a single state described by DeVivo and Farris (2011). Hospital charges and costs estimates can vary widely depending on the reason for hospitalization and the department providing the care (Finkler, 1982). DeVivo and colleagues (2011) calculated that individuals with

SCI will incur $22,531 (2009 $US) in annual charges for rehospitalizations (of any kind) every year following their initial SCI, with an estimated annual cost of $11,587 (2009 $US) – a CCR of 1.9. These findings, along with those of others, suggest that individuals with SCI with their unique comorbidities and underlying physiologic conditions may incur different CCRs for injury hospitalizations compared to the general population.

Hospital costs are a better reflection of the medical cost burden of injury hospitalizations compared to hospital charges because they estimate the amount the hospital was paid for the in-patient stay rather than what was billed (AHRQ, 2010c). Using the Nationwide Inpatient Sample database with the associated CCRs allowed us to estimate the hospital costs of subsequent injuries for individuals with pre-existing quadriplegia or paraplegia. As an important tool for understanding the economic consequences and burden of injuries, the NIS has utility for injury research because results can be weighted to represent national, regional, and state-based estimates, and provide a broader understanding of injuries and their associated outcomes than currently offered in the literature. Last, the NIS may be particularly appropriate for studying injuries among individuals with underlying comorbidities who may be more likely to require hospitalization versus similar injuries among individuals without comorbidities.

Study limitations

This study has several limitations. The NIS data definitions allow for identifying records where quadriplegia or paraplegia is a pre-existing condition. However, it is not possible to rule out that some cases of initial spinal cord injury may be captured in this study. In addition, time since initial spinal cord injury is not available in the NIS dataset. Therefore, it was not possible to consider it as a possible covariate in the current study.

Finally, hospital costs represent only a fraction of the total medical costs of injury, and do not include medical costs for treating non-hospitalized injuries, non-facility costs incurred during an inpatient admission (e.g. physician charges, professional fees), medium term medical costs associated with follow-up treatment after discharge, or long term rehabilitation costs (Corso, Finkelstein, Miller, Fiebelkorn, & Zaloshnja, 2006). They also do not include indirect costs of decreased quality of life, lost time and wages from work or daily activities, or additional burden on informal caregivers.

Conclusion

The economic costs of injury are significant for individuals with pre-existing SCI. Individuals with quadriplegia had fewer injury hospitalizations compared to individuals with paraplegia, but the burden of injury is greater with longer LOS and higher hospital costs per discharge. The development and implementation of interventions to prevent injury is warranted. Programs should be tailored by type of SCI, patient characteristics, and cause of injury.

Table 3.1. Characteristics of injury hospitalizations among individuals with pre-existing paraplegia or quadriplegia, Nationwide Inpatient Sample, 2003-2009 (n=5,738)

	Paraplegia			Quadriplegia			
	Sample n	National Estimate[1] N	(%)	Sample n	National Estimate[1] N	(%)	p-value[2]
Total	3,168	15,551		2,570	12,565		
Sex[2]							<0.001
Female	1,126	5,523	(35.6)	768	3,750	(29.9)	
Male	2,036	9,997	(64.4)	1,800	8,805	(70.1)	
Age Group[3]							<0.001
18-34	625	3,054	(19.6)	486	2,371	(18.9)	
35-49	908	4,446	(28.6)	628	3,059	(24.4)	
50-64	846	4,168	(26.8)	699	3,416	(27.2)	
65+	788	3,878	(24.9)	756	3,714	(29.6)	
Race							0.500
White	1,677	8,203	(52.7)	1,345	6,565	(52.2)	
Black	379	1,866	(12.0)	340	1,650	(13.1)	
Other	373	1,817	(11.7)	287	1,397	(11.1)	
Missing	739	3,664	(23.6)	598	2,952	(23.5)	
Comorbidity							0.042
No other comorbidity	781	3,819	(24.6)	569	2,769	(22.0)	
+1 Comorbidity	801	3,941	(25.3)	705	3,447	(27.4)	
+2 or more comorbidity	1,586	7,791	(50.1)	1,296	6,349	(50.5)	
Disposition of Patient[3]							<0.001
Routine/Discharge alive, destination unknown	1,046	5,122	(33.0)	488	2,356	(18.8)	
Transfer to short term hospitals	140	682	(4.4)	172	853	(6.8)	
Other transfers (long term)	1,344	6,581	(42.4)	1,360	6,674	(53.3)	
Home health care	558	2,778	(17.9)	253	1,237	(9.9)	
Died in hospital	74	361	(2.3)	286	1,397	(11.2)	

Table 3.1. Continued

Insurance[3]					<0.001
Medicare / Medicaid	2,141	10,521 (67.8)	1,556	7,601 (60.7)	
Private	888	4,349 (28.0)	862	4,235 (33.8)	
Uninsured (Self pay / No charge)	133	652 (4.2)	144	690 (5.5)	

1. Weighted to discharges from all U.S. community, non-rehabilitation hospitals.

2. P-values based on unweighted Chi-square tests.

3. Sums less than n=3,168 for paraplegia and n=2,570 for quadriplegia are due to missing values.

Table 3.2. National estimates of injury hospitalizations among individuals with paraplegia or quadriplegia, by external cause of injury and principal diagnosis, Nationwide Inpatient Sample, 2003-2009 (n=5,738)[1]

	Paraplegia (n=3,168)			Quadriplegia (n=2,570)	
	National Estimate[1]			National Estimate[1]	
	N	(%)		N	(%)
Total Estimated Cases	15,551		Total Estimated Cases	12,565	
Top Ten External Causes of Injury[2] (p <0.001)[3]					
Fall	5,354	(34.4)	Fall	4,475	(35.6)
Poisoning	1,664	(10.7)	Motor vehicle traffic (MVT)	2,005	(16.0)
Motor vehicle traffic (MVT)	1,286	(8.3)	Poisoning	724	(5.8)
Overexertion	742	(4.8)	Non-motor vehicle transport (e.g. pedestrian)	337	(2.7)
Firearm	663	(4.3)	Struck by, against	312	(2.5)
Fire/burn	638	(4.1)	Suffocation	290	(2.3)
Suicide & self-inflicted injury	526	(3.4)	Firearm	243	(1.9)
Non-motor vehicle transport (e.g. pedestrian)	337	(2.2)	Overexertion	222	(1.8)
Struck by, against	287	(1.8)	Fire/Burn	164	(1.3)
All Other[4]	1,947	(12.5)	All Other[5]	1,475	(11.7)
Missing	2,108	(13.6)	Missing	2,316	(18.4)

Table 3.2. Continued

Top Ten Principal Diagnoses[2] (p <0.001)[3]					
Fracture of lower limb	3,921	(25.2)	Secondary spinal cord injury	5,457	(43.3)
Secondary spinal cord injury	2,243	(14.4)	Fracture of lower limb	1,264	(10.1)
Fracture of neck of femur (hip)	1,759	(11.3)	Intracranial injury	1,055	(8.4)
Poisoning by other medications and drugs	1,421	(9.1)	Fracture of neck of femur (hip)	781	(6.2)
Other fractures	944	(6.1)	Other injuries and conditions due to external causes	735	(5.8)
Crushing injury or internal injury	796	(5.1)	Other fractures	670	(5.3)
Burns	756	(4.9)	Poisoning by other medications and drugs	654	(5.2)
Other injuries and conditions due to external causes	556	(3.6)	Joint disorder and dislocations; trauma-related	408	(3.2)
Intracranial injury	530	(3.4)	Crushing injury or internal injury	336	(2.7)
Poisoning by psychotropic agents	507	(3.3)	Burns	202	(1.6)
All other diagnoses	2,118	(13.6)	All other diagnoses	1,003	(8.0)

1. Weighted to discharges from all U.S. community, non-rehabilitation hospitals.

2. Principal E-codes and diagnoses were grouped using Clinical Classification Software (CCS) provided by the Nationwide Inpatient Sample.

3. P-values based on Chi-square tests.

4. Includes E-codes for natural/environment, cut/pierce, suffocation, machinery, other specified & classifiable, not elsewhere classifiable, and unspecified.

5. Includes E-codes for suicide, natural/environment, machinery, cut/pierce, other specified & classifiable, not elsewhere classifiable, and unspecified.

Table 3.3. Factors associated with injury hospitalizations due to falls, motor vehicle traffic and poisonings among individuals with quadriplegia versus paraplegia, Nationwide Inpatient Sample, 2003-2009 (n=5,738) [1,2]

	All Causes of Injury (n=5,738)		Falls (n=1,994)		Motor Vehicle Traffic (n=676)		Poisoning (n=489)	
	Adjusted OR	(95% CI)	Adjusted OR	(95% CI)	Adjusted OR	(95% CI)	Adjusted OR	(95% CI)
Sex								
Female	1.00		1.00		1.00		1.00	
Male	1.30	(1.14,1.47)	1.43	(1.17,1.76)	1.26	(0.88,1.79)	0.99	(0.63,1.53)
Age Group								
18-34	0.84	(0.70,1.00)	1.04	(0.69,1.56)	0.84	(0.47,1.50)	1.00	(0.43,2.32)
35-49	0.87	(0.73,1.03)	0.76	(0.56,1.03)	0.84	(0.46,1.51)	1.68	(0.81,3.52)
50-64	0.97	(0.82,1.13)	0.86	(0.67,1.10)	0.99	(0.55,1.77)	1.71	(0.81,3.61)
65+	1.00		1.00		1.00		1.00	
Race								
White	1.00		1.00		1.00		1.00	
Black	1.19	(0.99,1.44)	1.98	(1.44,2.72)	1.61	(0.90,2.86)	1.33	(0.66,2.69)
Other	0.97	(0.80,1.17)	1.12	(0.83,1.52)	0.95	(0.56,1.63)	1.38	(0.71,2.69)
Missing	1.06	(0.91,1.23)	1.19	(0.92,1.54)	1.24	(0.77,2.00)	1.65	(1.00,2.73)
Comorbidity								
No other comorbidity	1.00		1.00		1.00		1.00	
+1 comorbidity	1.18	(1.02,1.38)	1.03	(0.77,1.39)	1.29	(0.88,1.88)	0.53	(0.25,1.13)
+2 or more comorbidity	1.04	(0.90,1.21)	1.07	(0.82,1.40)	1.10	(0.74,1.62)	0.31	(0.16,0.62)
Disposition of Patient								
Routine/Discharge alive, destination unknown	1.00		1.00		1.00		1.00	
Transfer to short term hospitals	2.61	(2.00,3.42)	3.80	(2.37,6.12)	2.82	(1.31,6.03)	0.17	(0.02,1.23)
Other transfers (long term)	2.20	(1.90,2.55)	2.45	(1.87,3.20)	3.48	(2.19,5.54)	1.31	(0.81,2.13)
Home health care	1.01	(0.83,1.23)	0.96	(0.67,1.38)	1.62	(0.76,3.45)	0.83	(0.47,1.46)
Died in hospital	8.07	(6.00,10.86)	9.89	(6.11,16.01)	7.87	(3.83,16.18)	3.71	(1.07,12.92)

Table 3.3. Continued

Insurance								
Medicare / Medicaid	1.00		1.00		1.00		1.00	
Private (incl HMO / other)	1.33	(1.18,1.52)	1.24	(1.00,1.55)	0.84	(0.59,1.20)	0.89	(0.53,1.51)
Uninsured (Self pay & No charge)	1.33	(0.99,1.79)	1.52	(0.96,2.40)	0.93	(0.44,1.95)	1.04	(0.19,5.66)

1. The predicted outcome in this model is quadriplegia versus paraplegia. The reference group is injury hospitalizations to individuals with paraplegia.

2. Analyses adjusted for all the variables listed in the table, and weighted to discharges from all community, non-rehabilitation hospitals the US.

Table 3.4. Mean and median of hospital outcomes for injury hospitalizations among individuals with pre-existing spinal cord injury, Nationwide Inpatient Sample, 2003-2009 (n=5,066)[1]

	Length of Stay (days)		Hospital Charges (per discharge)[2] (2009 $US)			Hospital Costs (per discharge)[2,3] (2009 $US)		
	Mean	Median	Mean	Median	Total (million)	Mean	Median	Total (million)
Total	11.6	5.2	99,330	38,090	2,413.0	36,557	14,507	913.3
Type of Spinal Cord Injury								
Quadriplegia	16.8	7.8	149,301	64,946	1,501.3	54,754	24,139	566.1
Paraplegia	8.0	4.2	64,035	29,696	911.7	23,709	11,719	347.2
Cause of Injury								
Falls								
Quadriplegia	14.7	7.6	135,885	67,161	476.0	48,582	24,166	176.2
Paraplegia	6.8	4.1	54,380	30,638	269.0	19,747	11,739	101.0
Motor Vehicle Traffic								
Quadriplegia	26.7	18.1	272,665	197,689	416.4	103,612	78,800	162.7
Paraplegia	13.8	9.6	153,922	108,072	173.2	59,547	40,939	66.8
Poisoning								
Quadriplegia	6.7	2.9	41,881	20,276	28.7	16,551	7,945	12.1
Paraplegia	5.4	2.7	36,110	18,180	55.3	14,482	7,181	22.9

1. Patients who died (n=360) or transferred to short-term hospitals (n=312) were excluded.

2. Hospital charges and costs were weighted for national estimates of hospital charges/costs and adjusted to the year 2009 inflation rates for in-hospital care.

3. Hospital costs calculated using charge-to-cost ratios provided by Nationwide Inpatient Sample.

Table 3.5. Mean hospital costs (2009 $US) by type of spinal cord injury and cause of injury, Nationwide Inpatient Sample, 2003-2009 (n=4,810)

	Paraplegia					
	Falls (n=992)		Motor Vehicle Traffic (n=200)		Poisonings (n=304)	
	Mean	Total (million)	Mean	Total (million)	Mean	Total (million)
Total	18,449	91.7	57,122	60.7	10,410	15.5
Sex[2]						
Female	14,574	30.7	57,948	17.1	10,120	6.3
Male	21,331	60.8	56,803	43.6	10,616	9.2
Age Group[2]						
18-34	25,832	10.2	58,880	21.8	9,131	2.0
35-49	17,873	21.3	71,316	23.7	10,909	6.9
50-64	17,399	27.4	35,239	8.8	10,662	4.6
65+	18,124	32.7	58,856	6.2	9,718	2.1
Race[2]						
White	17,355	50.0	60,944	35.9	10,200	8.9
Black	16,467	6.6	43,530	5.7	7,897	1.5
Other	26,094	13.9	91,565	12.6	14,774	1.9
Missing	18,324	21.2	31,919	6.7	10,676	3.2
Comorbidity						
No other comorbidity	16,592	17.8	54,639	21.6	8,225	1.0
+1 comorbidity	19,495	24.9	52,896	16.4	10,021	2.6
+2 or more comorbidity	18,702	49.0	63,520	22.8	10,749	11.9
Disposition of Patient[2]						
Routine	11,926	17.9	24,087	9.0	8,108	5.5
Other transfers (long term)	23,893	59.5	81,292	49.4	14,051	6.1
Home health care	14,583	14.2	28,365	2.3	10,365	3.9
Insurance						
Medicare / Medicaid	16,753	60.9	48,023	15.7	10,419	12.6
Private (incl HMO /Other)	23,023	27.8	61,393	39.8	10,151	2.7
Uninsured (Self pay & No charge)	23,474	3.0	62,194	5.2	DS	DS

Table 3.5. Continued

	Quadriplegia					
	Falls (n=684)		Motor Vehicle Traffic (n=302)		Poisonings (n=130)	
	Mean	Total (million)	Mean	Total (million)	Mean	Total (million)
Total	38,123	128.7	93,975	136.1	11,916	8.1
Sex[2]						
Female	28,669	33.4	89,677	29.5	13,202	3.4
Male	43,093	95.4	95,239	106.6	11,120	4.7
Age Group[2]						
18-34	44,808	15.5	112,846	59.9	12,217	1.0
35-49	40,895	26.7	84,472	38.6	10,999	3.3
50-64	36,393	36.0	80,613	25.2	14,116	3.1
65+	36,387	50.6	83,904	12.4	8,471	0.6
Race[2]						
White	39,394	70.7	91,240	70.7	12,296	4.3
Black	43,292	16.4	95,630	21.8	11,786	.9
Other	42,948	15.4	123,065	19.9	16,550	.9
Missing	31,060	26.2	83,551	23.8	9,978	2.0
Comorbidity						
No other comorbidity	32,044	21.4	94,326	38.9	6,710	.7
+1 comorbidity	37,968	31.2	94,821	48.6	9,607	1.5
+2 or more comorbidity	40,343	76.1	92,871	48.6	14,099	5.9
Disposition of Patient[2]						
Routine	17,198	10.3	30,911	5.4	7,435	2.4
Other transfers (long term)	46,217	112.4	104,461	124.7	16,614	3.8
Home health care	17,513	6.1	75,666	6.0	14,636	1.9
Insurance						
Medicare / Medicaid	32,997	75.2	103,339	43.5	10,511	5.6
Private (incl HMO /Other)	49,931	47.6	88,606	79.9	15,446	2.0
Uninsured (Self pay & No charge)	41125	5.0	100334	11.0	DS	DS

1. Patients who died (n=360) or transferred to short-term hospitals (n=312) were excluded.

2. Influential outliers (n=256, 5.1%) were removed using Cook's D diagnostics.

3. Hospital costs were calculated using cost-to-charge ratios provided by NIS, weighted for national estimates of hospital costs, and adjusted to the year 2009 inflation rates for in-hospital care.

DS = Discharge information suppressed since cell count is ≤ 10 (The Nationwide Inpatient Sample data user agreement precludes publishing cell counts ≤ 10).

Table 3.6. Predicted differences in hospital costs (2009 $US) for injury hospitalizations for individuals with pre-existing quadriplegia versus paraplegia, Nationwide Inpatient Sample, 2003-2009 (n=4,810)[1,2,3,4]

	Paraplegia (n=2,844)				Quadriplegia (n=1,966)			
	Mean	Total (million)	Δ%	Predicted difference[5]	Mean	Total (million)	Δ%	Predicted difference[5]
Total	21,827	306.1			43,462	414.0		
Sex								
Female	17,366	89.5	Ref		32,781	99.5	Ref	
Male	24,433	216.1	23.9	$4,151**	48,457	314.5	22.9	$7,491**
Age Group								
18-34	31,336	80.2	49.2	$8,589**	66,201	120.9	56.8	$20,368**
35-49	23,809	99.3	25.6	$4,471**	41,998	106.9	12.4	$4,461
50-64	17,212	65.7	3.2	$564	36,404	96.6	-5.8	-$2,062
65+	17,467	60.5	Ref		35,832	89.6	Ref	
Race[6]								
White	20,596	150.1	Ref		42,949	212.3	Ref	
Black	21,977	37.5	16.9	$3,486*	49,844	57.2	4.6	$1,961
Other	35,447	50.6	57.2	$11,777**	54,506	48.3	27.6	$11,871*
Missing	18,840	67.8	4.2	$868	37,745	96.2	-4.5	-$1,946
Comorbidity								
No other comorbidity	24,219	83.1	Ref		41,731	85.7	Ref	
+1 comorbidity	23,076	81.5	5.1	$1,244	46,247	122.8	18.0	$7,513*
+2 or more comorbidity	20,038	141.4	10.1	$2,454*	42,665	205.4	29.3	$12,245**
Disposition of Patient								
Routine	12,795	62.6	Ref		16,770	35.8	Ref	
Other transfers (long term)	31,673	203.5	122.2	$15,632**	56,942	351.8	173.1	$29,028**
Home health care	14,746	39.8	45.0	$5,755**	21,308	25.6	45.5	$7,634**
Insurance								
Medicare / Medicaid	17,686	173.8	Ref		34,683	205.7	Ref	
Private (incl HMO /Other)	30,747	114.7	36.1	$6,380**	57,843	183.7	52.1	$18,080**
Uninsured (Self pay /No charge)	38,320	16.9	62.5	$11,057**	57,783	21.9	68.6	$23,790**

Table 3.6. Continued

Falls								
Fall injuries	18,420	93.1	3.5	$835	37,831	130.3	15.3	$7,145**
All other injuries	23,747	212.9	Ref		46,653	283.6	Ref	
Motor Vehicle Traffic (MVT)								
MVT injuries	56,567	61.4	127.2	$29,512**	93,844	137.0	124.3	$57,048**
All other injuries	18,912	244.6	Ref		34,339	276.9	Ref	
Poisoning								
Poisoning injuries	10,358	15.5	-28.1	-$5,309**	11,915	8.1	-37.9	-$13,013**
All other injuries	23,197	290.5	Ref		45,893	405.8	Ref	

* $p < 0.05$ ** $p < 0.001$

1. Patients who died (n=360) or transferred to short-term hospitals (n=312) were excluded.

2. The models were adjusted on patient characteristics, clinical variables (discharge and payer), and cause of injury, and were clustered on hospital and variables used for hospital weighting strata (ownership/control, bed size, teaching status, urban/rural location, and region).

3. Regression models were based on 4,801 observations after 256 (5.1%) potentially influential outliers were removed (outcome is log transformed hospital costs).

4. Hospital costs were calculated using cost-to-charge ratios provided by NIS, weighted for national estimates of hospital costs, and adjusted to the year 2009 inflation rates for in-hospital care.

5. The Student's t-test was used to test significance.

6. Observations with missing values for race were included to preserve 23.6% of records with missing race information in the model. Observations with missing values for other variables were removed in the analysis.

CHAPTER 4

PERCEIVED THREAT OF AND COMMUNICATION ABOUT SUBSEQUENT INJURY AMONG INDIVIDUALS WITH SPINAL CORD INJURY

Abstract

Subsequent injuries are a threat to morbidity and mortality following spinal cord injury (SCI), however little is known about the experience and perceptions of subsequent injury among individuals with SCI, or how messages about preventing subsequent injury are communicated with individuals with SCI. The aim of this study was to explore perceived threat of and communication about subsequent injuries, and examine the perceived threat, perceived efficacy, and locus of control in preventing subsequent injury among individuals with SCI who return to work. Semi-structured, in-person interviews were conducted with 14 individuals with SCI. Guided by the Extended Parallel Process Model, an interactive qualitative approach was used to code the data into substantive and theoretical categories to describe the participants' concepts and beliefs related to subsequent injury. All participants described at least one injury or near-injury event since their initial SCI. Most participants perceived injuries as a threat, particularly to time loss and loss of independence. Participants described feeling susceptible due to their individual functional ability and sensory impairments, as well as due to the conditions of their environment related to accessibility, weather, and emergencies. Having the self-efficacy to prevent subsequent injury was linked to better motor function, more time since injury, confidence in oneself, and knowing your limits. The response-efficacy of

formal and informal policies to prevent workplace injury was mixed, especially when implemented without participant input. Overall, individuals with SCI recognized the importance of preventing subsequent injury, and were willing to take action to prevent injuries. Perceptions of threat and efficacy are important considerations in the development of messages and communication about preventing subsequent injury.

Introduction

Spinal cord injury (SCI) does not diminish the need for messages about prevention, health, and safety among individuals with SCI (Johnston, Diab, Bong-Chul, & Kirshblum, 2005, Dreer, Elliott, & Tucker, 2004). This is particularly relevant for subsequent injuries, which are both preventable and modifiable. Longer life expectancy (NSCISC, 2012b, DeVivo, Kraus, & Lammertse, 1999), increased participation (Whiteneck et al, 2004), and return to work (Lidal, Huynh, & Biering-Sorensen, 2007, Ottomanelli & Lind, 2009) after spinal cord injury may also affect an individual's exposure to external causes of subsequent injury. Evidence suggests disparities exist in both nonoccupational and occupational injuries among individuals with disabilities compared to workers without disabilities (Price et al, 2012), and risk of injury increases with increasing severity of disability (Xiang, Leff, & Stallones, 2005, Brophy, Zhang, & Xiang, 2008),

Subsequent injuries among individuals with SCI have become the principal topic in a growing body of literature in recent years. Most studies are quantitative in nature by focusing on risk factors, predictors, and circumstances of subsequent injury (Krause, 2004, 2010, Krause, Coker, Charlifue, & Whiteneck, 2000, Brotherton, Krause, &

Nietert, 2007). Findings showed that over one-fifth of individuals with SCI experience subsequent injury in the previous 12 months, with one-third of injuries resulting in hospitalizations (Krause, 2004, 2010). Subsequent injuries were related to multiple health outcomes, including lower overall health, more poor physical or mental health days, and negative change in health during the past year (Krause et al, 2000). However, no studies have examined if individuals with spinal cord injury are aware of their risk for subsequent injury, if messages about preventing subsequent injury are communicated with individuals with SCI, or the perceptions of individuals with SCI in preventing subsequent injury.

There is still much to learn about subsequent injury before effective intervention strategies can be developed to prevent these injures. To complement the quantitative work already being done, a theory-driven, qualitative approach (Maxwell, 2005) may help understand the context, e.g. the “how”, “when”, and “why”, in which subsequent injuries occur, explore what messages (if any) individuals with SCI receive about how to prevent subsequent injury, and explore an individual’s perceptions of threat and efficacy to prevent subsequent injury. Qualitative work may also guide the development of appropriate measures of subsequent injury in this population, identify areas to target for pre- and post-discharge injury prevention programs, and inform the development of persuasive messages about prevention of subsequent injuries that are salient to individuals with SCI.

The purpose of this study is to describe the experiences and perceptions of subsequent injury among individuals with SCI and explore how messages to prevent subsequent injuries at home and at work are communicated to individuals with SCI. To focus on perceptions of threat and efficacy, the Extended Parallel Process Model (EPPM) and Health Locus of Control were used as guiding theoretical frameworks to examine two research questions: 1) What are the perceptions of subsequent injury (threat and efficacy) among individuals with SCI who return to work? and 2) What and how are injury prevention strategies communicated with individuals with SCI when they return to work?

Theoretical Framework and Conceptual Model

The Extended Parallel Process Model

Communication theory is useful for understanding how messages about injury prevention are communicated and received, particularly in the context of subsequent injury and messages about risk (Aldoory & Bonzo, 2005, Maloney, Lapinski, & Witte, 2011). The Extended Parallel Process Model (EPPM) (Witte, 1992, Gore & Bracken, 2005, Maloney et al, 2011) is a communication theory, based on fear appeals research (Rogers, 1975, 1983, Leventhal, 1970, 1971). This theory is appropriate to examine preventing subsequent injuries in people with an SCI, because fear appeals are often used to communicate persuasive messages about risk, particularly when the desired outcome is to alter an attitude, intention, or behavior in order to avoid a future threat (Witte, 1992). Messages regarding the threat focus on the severity of the threat and on the target population’s susceptibility to the threat (Witte, 1992, Gore & Bracken, 2005, Maloney et al, 2011). Correspondingly, the receiver of the health message evaluates the personal relevance of the threat, according to their *perceived severity*, the extent the individual believes the threat to be personally serious or harmful, and *perceived susceptibility*, the extent the individual feels at risk for experiencing a particular health threat. In addition, messages contain an efficacy component that serves as an environmental or message cue to trigger the receiver's cognitive evaluation of *perceived self-efficacy*, the belief in their ability to perform the recommended response, and *perceived response-efficacy*, their belief in whether the recommended response effectively avoids the theat. The EPPM incorporates these four central constructs of threat and efficacy in a framework for understanding the success or failure of persuasive messages, and has been used in several applied health contexts, including injury prevention (e.g. Roberto, Meyer, Johnson, & Atkin, 2000), workplace safety (e.g. Basil, Basil, Deshpande, & Lavack, 2013, Smith et al, 2008, Murray-Johnson et al, 2004), and for individuals with SCI (e.g. LaVela, Cameron, Priebe, & Weaver, 2008, LaVela, Smith & Weaver, 2007).

In the context of preventing subsequent injury among individuals with SCI, the EPPM suggests that individuals with SCI would engage in behaviors or strategies to prevent future injury if 1) they feel the costs or consequences of subsequent injury are serious or harmful, 2) they feel personally susceptible to subsequent injury, 3) they believe there are actions or strategies that effectively mitigate the risk for subsequent injury, and 4) they are capable of taking action or implementing strategies to reduce risk or prevent subsequent injury.

Alternatively, if an individual with SCI does not believe that subsequent injury is severe or that they are personally susceptible to subsequent injury, they will ignore messages to reduce the risk for subsequent injury. In addition, they may ignore messages to prevent subsequent injury if they believe subsequent injuries are due to chance, are not confident in the effectiveness of the recommended action(s) or strategies, or are not confident in their ability to take actions or implement prevention strategies.

It is not known if individuals with SCI experience higher perceived severity of subsequent injury due to increased sensitivity to having already experienced a disabling condition, or have lower perceived severity due to perceptions of the relative consequence relative to the SCI they have already experienced (e.g. I'm already paralyzed, what could be worse?). This may be compounded by injury prevention messages in the general population that stigmatize disabling conditions (e.g. the campaign message that warns "Is your back really worth upgrading to a new set of wheels?" accompanied by the image of a wheelchair) (Basil et al, 2013, Guttman & Salmon, 2004, Wang, 1998). Other research has found that individuals may have lower self-efficacy following disability due to loss of autonomy and environmental barriers that prevent behavior change (Stuifbergen, Seraphine, Harrison, & Adachi, 2005). In addition, individuals with SCI may have lower efficacy appraisal, because the behavioral risk factors that led to the initial SCI may still be present (Fordyce, 1964, Krause, 2004, 2010), or because perceptions of failed efficacy to prevent the initial SCI may affect future beliefs about preventing injury (Ravesloot et al, 2011).

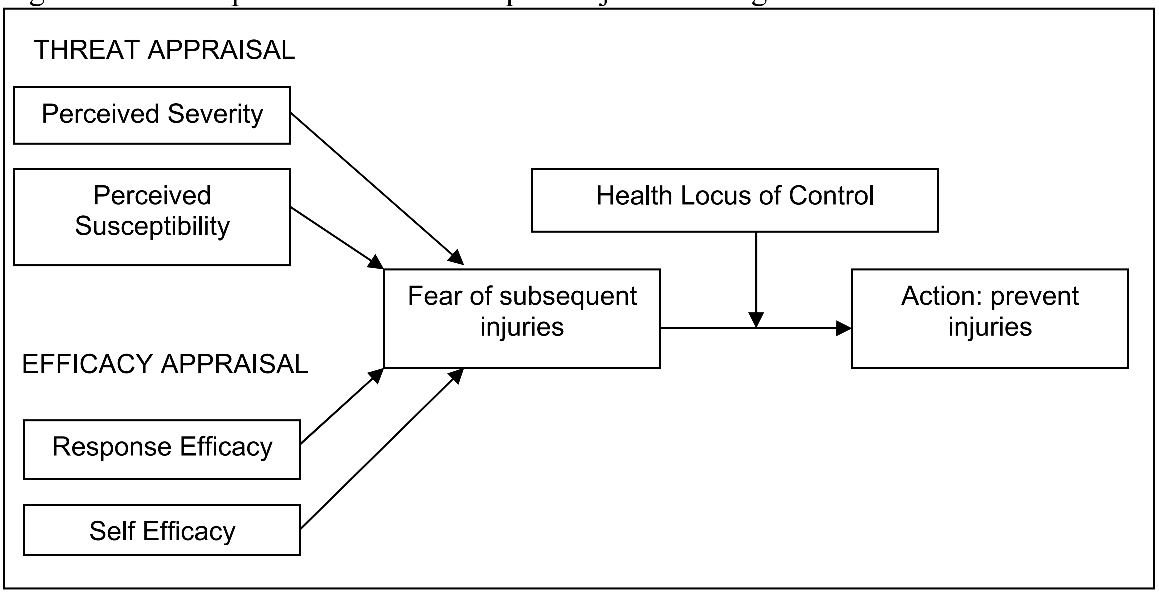
Health Locus of Control

One criticism of fear appeals is the lack of consideration for the perception of events being a consequence of one's own action or beyond personal control (Burnett, 1981). Locus of control (LOC) reflects an individual's beliefs about responsibility for or control over events (Rotter, 1966). Rotter (1966) conceived two categories: *internal locus of control* reflecting high degree of personal control over events and situations, and *external locus of control* reflecting little personal control. In the context of health and illness, Wallston and Wallston (1982) defined Health Locus of Control (HLOC) as the degree to which individuals believe that their health is controlled by internal versus external factors, but divided beliefs about external factors into the categories of *Chance* and *Powerful Others* (Wallston, Wallston, & DeVellis, 1978). Previous research has shown that internal locus of control is associated with better psychological health outcomes following SCI, including less depression, better life adjustment, and higher purpose in life (Krause, Stanwyck, & Maides, 1998, Frank & Elliott, 1989, Thompson, Coker, Krause, Henry, 2003). In addition, individuals with SCI with higher internal locus of control were more likely to be employed (Krause & Broderick, 2006). Locus of control is particularly relevant in the context of injury prevention given the history of beliefs about unintentional injuries as accidental, unpredictable, and unavoidable. In the context of preventing subsequent injury, an individual with SCI might choose to take actions to prevent subsequent injury based on the extent to which they feel preventing subsequent injury is in their control, due to chance, or the responsibility of others.

Conceptual model

A conceptual model for understanding subsequent injury among individuals with SCI guided by EPPM and Health Locus of Control is depicted in Figure 4.1. A conceptual model is a “diagram of proposed causal linkages among a set of concepts believed to be related to a specific problem” (Earp & Ennett, 1991). In the context of preventing subsequent injury among individuals with SCI, perceptions of threat and efficacy may affect an individual’s fear of subsequent injury which determines whether an individual takes action to prevent injury. However, health locus of control may mediate the relationship from fear to action, because individuals may differ in the belief that preventing subsequent injury is in their control.

Figure 4.1. Conceptual model of subsequent injuries among individual's with SCI



Methods

Participants

Individuals with SCI from a single Midwestern state were recruited to participate in research interviews about their perceptions of threat for subsequent injury and actions they take to prevent future injury at home and/or work. Thirteen males and 1 female were recruited through convenience sampling. This included 1) posting recruitment flyers in local hospitals where individuals with spinal cord injury received rehabilitation therapy; 2) providing key informants in the spinal cord injury field with recruitment flyers to distribute in person, by email, or via newsletter or membership lists; and, 3) using snowball sampling among enrolled participants to share information about the study with personal contacts who may also be eligible (Appendix B). Key informants included practitioners, statewide SCI support group facilitators, and the leadership of the statewide Spinal Cord Injury Association.

Inclusion criteria included English-speaking, males or females who experienced a traumatic SCI, were at least one year post-acute SCI with no co-existing cognitive impairment, and were employed continuously or non-consecutively for at least 90 days in the previous 12 months. Employment was defined as any work performed for monetary payment, or work in return for any type of compensation, such as housing, food, or trade for the time or product of work. Employment could be employer-based or self-employed. Individuals who were less than one year post-acute traumatic SCI, who were not employed for at least 90 days in the previous 12 months, who were non-English speaking, or who had a cognitive impairment were ineligible to participate.

Study design and protocol

This study utilized an interactive qualitative research design (Maxwell, 2005). An interactive qualitative approach considers the goals of the study, applicable theories and prior research findings in a guiding conceptual framework, and specific research question(s) to describe the subjective experiences of people in particular settings and to understand their individual perceptions (Maxwell, 2005, Jongbloed, 2000). After obtaining informed consent, semi-structured, in-person interviews were conducted by the first author using open-ended questions with similar probes for all participants. This approach was chosen because EPPM and/or HLOC has not been used to understand the perceived threat of subsequent injury among individuals with SCI. The semi-structured format allowed the interview to be guided by participant's answers to questions from their own personal experience, but remain in the range of the main topic (Maxwell, 2005). At the end of the interview, participants completed a short, written demographic questionnaire, and received a $50 gift card for their participation in the study. Study protocol and consent process was approved by the Institutional Review Board at the University of Iowa (Appendix B).

Materials

The interview guide was developed using constructs of the Extended Parallel Process Model as a guiding framework for questions to elicit information about subsequent injuries since their initial SCI, perceived threat of injury, and perceived efficacy of actions they take to prevent injuries (Appendix C). The interview guide was reviewed by experts in the field, and pilot tested with two individuals with SCI who met eligibility criteria. The interview guide was then modified based on the feedback from expert review and the results from pilot interviews (Maxwell, 2005). The final interview protocol included 6 main questions with multiple probes. Questions centered on work history since the initial SCI, conversations about workplace safety, safety concerns while participating in life activities including work, subsequent injury history, perceptions of threat of future injury, and actions taken to prevent future injury. Results of the pilot interviews were not included in this study.

In addition, participants completed a short survey to collect demographic information (age, sex, race/ethnicity, educational level, employment status), SCI related information (level of SCI, completeness of injury, date of injury onset), and general health status.

Data collection and analysis

Interviews were conducted in participants' homes or private meeting rooms in public libraries from February through July 2011. Each interview took approximately 60 to 90 minutes to complete. Interviews were voice recorded and transcribed verbatim into text. Fourteen interviews were conducted to reach saturation. Saturation occurs when no new themes emerge from subsequent interviews and responses become similar across multiple participants (Strauss & Corbin, 1998).

Pseudonyms were used and demographic information was summarized to protect the confidentiality of participants. Qualitative data was analyzed through content analysis of transcripts. First, "organizational" coding, which categorizes broad areas established prior to interviews and functions to sort data for further analysis (Maxwell, 2005, p. 97), was used to develop a preliminary codebook based on the interview guide and conceptual framework. Next, "open coding" (Strauss & Corbin, 1998) was used to code the data into "substantive" and "theoretical" categories (Maxwell, 2005, p. 97-98) to describe the participants' concepts and beliefs related to the organizational codes as well as the theoretical constructs of EPPM and HLOC. The first author read and reread all transcripts multiple times and coded sentences, parts of a sentence, or several sentences by topic. Additional codes were created when new concepts or ideas emerged related to subsequent injury. To check for consistency, a second coder independently coded seven (50%) transcripts, and results were compared (Onwuegbuzie & Leech, 2007). Discrepancies were resolved through discussion. Remaining transcripts were coded using the codebook. Codes were organized using categorizing and connecting strategies, the former serving to reorganize the data into categories, and the latter serving to understand the data in a contextual relationship across interviews (Maxwell, 2005). Categorizing and connecting was an inductive process to identify common themes across all interviews and identify relationships across major categories of themes. Data analysis was conducted using NVivo version 9 (QSR International, 2011), a computer software for qualitative data management and analysis.

Results

Results are organized and presented in four sections based on the themes generated from the interview data. Within each section, themes are described and supported with quotes from the data. The first section describes the characteristics of participants and their experience of subsequent injury or near-injury events. The next two sections describe themes related to threat appraisal and efficacy appraisal of subsequent injuries in relation to the constructs of EPPM. In section two and three, the results are organized by 1) construct-related themes, and 2) how messages related to the themes were communicated or received. The fourth section describes health locus of control. When relevant, differences in results between occupational and nonoccupational settings are highlighted.

Section 1. Participants and their experience of subsequent injury

A total of 14 individuals (13 males, 1 female) with spinal cord injury participated in the study (Table 4.1). Age of participants ranged from 23 to 60 years, with a mean age of 37 years. An average of 12 years had passed since their initial SCI (range=2-31 years). All participants were non-ambulatory and used wheelchairs. Participants were employed in a variety of occupations representing both full-time and part-time work (Table 4.2). Three participants were self-employed, and 2 were also currently part-time students.

All participants described at least one injury or near-injury event (e.g. fall without getting hurt) since their initial SCI. More participants talked about near-injury events rather than an actual injury. Of the 14 participants, 11 described one or more injury events, including 9 participants who sought medical care at least once for an injury. Most injuries were minor and included sprains/strains, burns, cuts, and fractures (specifically, broken toes). Injuries that required medical care included stitches for a cut that resulted from a fall, chiropractic care following getting hit by a car and thrown from their wheelchair in the parking garage at work, and getting “checked out” or x-rays to rule out injuries from other various causes (e.g. following a minor traffic crash or getting their ankle/foot caught under their wheelchair).

Near-injury events were often described as “close calls” and were coded by the cause or activity at the time of the event and categorized into themes of falls/near falls, leisure-time and recreation, driving, and near misses at work. Falls/near falls were described by all participants, and were usually occasions when their wheelchairs tipped over or nearly tipped, when they fell or nearly fell from their wheelchairs, or during transfers to or from their wheelchair.

> I was going and the sidewalk wasn’t even, and it dipped really quick. … I was driving [electric wheelchair] and then I just started falling. I let go of the [joystick] and I hang on to my chair with both arms, cause I really don’t have grip but I can squeeze with my arms and my wrists, luckily my chair kind of leveled itself out, so I was ok. But that was kind of scary. (Stacey, quadriplegia)

Several participants described close calls during leisure-time or recreational activities, such as while taking the dog for a walk, hunting, snow-mobiling, snow-skiing, water-skiing, or riding a dirt bike. Nearly all of these close calls were related to falls, such as falling from a snow-mobile or dirt-bike, or falling and getting hit by a chair lift or slide board. In addition, participants also described close calls they experienced while driving, particularly in relation to having their center-of-balance unexpectedly shift while they were driving (among those with weaker trunk control), or in the process of re-learning how to drive, negotiating speed and anticipating stopping/starting distance using hand controls.

A few participants mentioned near misses while at work. Near misses at work were described more often by individuals with paraplegia in higher risk occupations (e.g. agricultural/agricultural services and engineering/technical/trade). They were commonly related to working around or operating motorized equipment, such as fork trucks, skid loaders, or passenger vehicles, and how sitting lower in a wheelchair decreased their visibility of being seen by the driver. One participant described a close call while operating a skid loader:

> When I got in the skid loader, I would get in the bucket sideways, and I would swing over on top of the boom, I would grab the cage and drag myself up to the seat … When you pull the safety bar down, it…lets you run the boom and bucket. When it is up,…they are supposed to be disengaged. Well, the one on the left side was stuck and that runs the boom. I was getting in, and my belt caught my rod, pushed back, and the boom came up about 2 feet.…Luckily, the buddy of mine was standing right on the side of it helping me get in, and I kind of freak, and am trying to grab—but my belt is stuck…my buddy reaches across, and he wouldn't have been able to reach it, [but] I see he is going for the key. It's like, oh duh, so I turn it off. You just imagine, at that point, you've got 6 to 8 inches, that would have busted me right in two and I would have probably been dead. (Michael, paraplegia)

Section 2. Threat appraisal

Threat appraisal is categorized into perceived severity, with 2 subthemes of time loss and loss of independence, and perceived susceptibility, with 5 subthemes of functional ability, sensory limitations, accessibility, weather, and emergencies (Table 4.3).

Perceived severity of subsequent injury

Across all participants, injuries were perceived as something to be avoided. Most indicated they were not afraid or fearful of getting injured in the future. However, two subthemes emerged as the reasons that injuries should be considered serious or harmful (i.e. a threat), and were universal to occupational and nonoccupational settings. The first was the concept of time and time loss. An injury would require time to heal and may result in time loss from work. Several participants mentioned the longer time required for healing after SCI, as one participant described, “my body doesn’t heal so well.” Others described time in the context of time loss from work or other activities:

> Ever since I spent the first 3 and a half months in the hospital, I don’t do anything to try to get myself back in there. (Greg, paraplegia), or

> If I were to break a leg…I would be pretty much immobilized. I wouldn’t be able to do anything, whether it be work, I just imagine I would be stuck somewhere. (Mark, paraplegia)

The second subtheme is the loss of independence, particularly regarding threat of further disability. Participants all described working hard in rehabilitation after SCI, and subsequent injury would threaten what they were currently able to do without having to rely on others, and/or also threaten the severity of their disability. Grant (paraplegia) explained, “What the heck am I going to do if I can’t do nothing…what I’m scared of now is that I’m going to break my neck and lose my hands because that [would] be no good at all!”

Perceived susceptibility of subsequent injury

Participants described perceived susceptibility in terms of two individual level themes, and three environmental level themes that put them at risk for injury. Functional ability and sensory impairments were individual level themes that increased susceptibility to injury. Several participants indicated they felt susceptible to injury or they perceived others with higher level SCI to be more susceptible to injury particularly if they were not able to independently get themselves back in their wheelchair after a fall.

> I know a lot of my friends, they are very scared to do certain tasks, because that's a big issue because they are scared if they fall out of their chair, they're not able to get back to their chair, and they have to ask somebody for help.(Dan, paraplegia)

The second individual level theme was sensory impairments, which increased susceptibility to burns or the ability to detect when any kind of injury occurs below the level of their SCI. The following quote supports the theme:

> You know, just basic everyday, make sure you watch, like if I'm in the kitchen or whatever, because I have, I cannot feel most of my body so I have to see my body to know if I'm being injured. So this is why I don't cook, because I'm not good at it, and I could burn myself, and my kitchen is not accessible. (Stacey, quadriplegia)

Three environmental-level subthemes related to perceived susceptibility were also identified. Specific subthemes included when an environment is not accessible, during inclement weather, or in an emergency. Accessibility, or more specifically the environments that lacked accessibility, increased participant's perceived susceptibility of injury. Weather also influenced an individual's perception of their susceptibility. Many described not going to work when the weather was bad, or how bad weather made them nervous. One participant described:

> Just crossing the parking lot sometimes I get stuck in the snow in the parking lot going to my car. I always worry about that—that somebody is

> going to—I'm stuck in the snow and somebody's going to hit me with a car. (Paul, paraplegia)

Perceived susceptibility was also felt in the event of an emergency, particularly among participants who worked in offices with multiple floors, or in the context of natural disasters.

> I have thought about it at home, but I have not done anything about it whatsoever. But yeah. It's something I think about. If we're at a hotel, if we're going to a sporting event or something for work, I always worry about that. [I ask myself] Man, if this place catches on fire, 'how do I get out of here?' kind of deal. (Joe, paraplegia)

Emergency preparedness and evacuation was also the most cited circumstance when participants described their employers as being aware of their susceptibility:

> As far as fire drills and tornado drills. That is one thing that the safety committee was concerned about- what do I do because I'm on the third floor. When I worked at [EmployerA], their remedy to the whole thing was you know, we'll just have a group of people take you down the steps during a fire drill. That was like a nightmare. But, at [EmployerB], they—we talked about what I'm comfortable with. To make sure I have my cell phone with me, and there is a secure place in the building for tornadoes. (Paul, paraplegia)

Participants described perceived susceptibility of the two individual level themes of functional ability and sensory impairments mostly in the context of nonoccupational settings, e.g. burns in the home. Environmental level themes were relevant in both occupational and nonoccupational settings.

Communication about threat of subsequent injury

Almost all participants indicated that the severity and susceptibility to subsequent injury due to sensory impairments was something that was communicated to them by rehabilitation therapists during inpatient, outpatient, and vocational rehabilitation following SCI. Participant's described their employers as being largely unaware of their increased susceptibility to injury, and they often needed to educate their employers about

SCI beyond just getting around in a wheelchair. These conversations were often described as a “learning curve” for employers, and often occurred proactively before and/or early in return to work:

> Yes, there was a little bit of an education curve there.… I don’t know that they are very well educated on what comes with the injury [SCI]… I’ve had conversations with him a little bit about that. (Joe, paraplegia)

Conversations with their employers, if they occurred, took place at multiple time points during return to work, depending if the participant was returning to the same job as before their SCI, had started a new job, and/or was precipitated by a non-emergent event. Conversations with employers about preventing injury at work centered on the environmental level themes of susceptibility: accessibility, weather, and emergency preparedness. For participants who returned to the same job as before their SCI, the conversations were ongoing throughout the rehabilitation period and often included an informal meeting at work before actually starting back. In new jobs or change of jobs, conversations usually occurred after the offer of employment but before starting work. Conversations also occurred at “teachable moments” such as after an unexpected power outage or during an annual safety review. With great variation across participants, conversations occurred with human resources, supervisors, and sometimes an external resource, such as occupational therapists, vocational rehabilitation specialists, or disability advocates (e.g. Easter Seals, others with SCI or who used a wheelchair):

> Well I met with the head of HR [human resources] and like I said, I brought along the … occupational therapist….And, she went through everything that I would typically do during the day and had me sit down, just like was normally doing , like a normally function, and just went through to make sure that she didn’t see anything was an issue. Likewise my supervisor, as well as the HR person, were there listening and seeing if there was any more accommodations to be accomplished. It was probably the occupational therapist that uh, was the person um, observed the most I guest. (Ken, paraplegia)

Section 3. Efficacy appraisal

Efficacy appraisal was conceptualized through discussion of specific actions the participant had been told to do to prevent injury. Efficacy appraisal is categorized into perceived self-efficacy and perceived response-efficacy. Perceived self-efficacy contained 4 subthemes of conscientious awareness, tricks of the trade, confidence and common sense, and knowing your limits. Perceived response-efficacy contained 3 subthemes of self-reliance, formal policies, and informal policies.

Perceived self-efficacy

Four subthemes emerged in relation the participant's perceived self-efficacy in their ability to take action to prevent subsequent injury: conscientious awareness, tricks of the trade, confidence/common sense, and knowing your limits. Almost all participants described being extra-vigilant and extremely aware of their surroundings. Many described a process of "constantly scanning" their environment for safety issues or thinking "ten steps ahead". The subtheme of tricks-of-the-trade reflected things an individual had been taught to do or had learned through trial and error to prevent injury or near misses. This is reflected in statements about learning how to "brace myself" to keep from sliding out of their wheelchair or losing their center of balance while driving. Several participants described bracing themselves with their elbow or arm. Oscar (paraplegia) described this in the context of driving "when I turn, I don't have the best balance you know, so I always have to try to lean on something or just turn gradually where I don't lose my balance." Another participant described how he kept himself from falling forward in his wheelchair:

> I was having a few problems…tipping forward when its going down on an incline…if I came out too fast, I would potentially fall forward. It would

> tip, but it wouldn't necessarily tip over. I would go forward, but I would have to have someone help me pull back…. I did figure out I could raise it [tilt the seat] up just enough that I could rock myself back. (Ken, paraplegia)

The subtheme of confidence and common sense was evident in comments such as "anymore it's so second nature, I don't really think anything of it" and "a lot of it just comes down to common sense stuff; you have to know your limits", and in having the self confidence to [bring] "it up if there was something I needed or if I couldn't do something I needed to do." Last, many participants reflected perceived self-efficacy in the context of knowing their own individual limitations, specifically "I may have to figure out how to adapt something new, but I know what the limitations are and I know what I can do" (Justin, paraplegia).

Perceived response-efficacy

Perceptions about the response-efficacy of specific actions to prevent injuries at home or at work was mixed, and categorized into subthemes based how the individual perceived the response-efficacy of self-reliance, formal policies, and informal policies. The response-efficacy of self-reliance suggested that most individuals felt that if they maintained a heightened awareness of their surroundings, knew their limitations, and used common sense, their actions would do a good job of preventing subsequent injuries. The response-efficacy of formal and informal policies to prevent injuries was less favorable. When formal polices were in place, some had been practiced through drills and others had not, which appeared to be dependent on the size of the employer. Even among participants who had practiced safety drills, the participants questioned the perceived response-efficacy of some formal policies. Several participants described frustration at policies that were implemented without participant input. One employer implemented a formal, written policy that required wheelchairs to have a flag when on the manufacturing floor. The participant described being really upset, because he was not involved in the policy-making process, and effectively singled out in a company-wide formal policy. He explained:

> Well to me it's like man, that's awful degrading when people are going to make fun of you all day long, in which I did it for a little while, then I kinda, just ignored the rule, threw the flag in the trash. (Dan, paraplegia)

Not being included in the policy-making process was common among both formal or informal emergency preparedness and evacuation procedures. One participant described how he learned a formal policy had been implemented:

> It was kind of weird because I had somebody who works on my floor who was on the safety committee at the time. He came up and says 'you know, there's never a guarantee on life.' And I was just like- what are you saying? What do you mean? He says, 'well, you know, we're just here day by day'…after that I went back to my desk and I talked to a coworker and said 'you know, I just had the weirdest conversation.' [The coworker said], 'He's just on the safety committee and we were talking about in the event of a tornado, where would you go?' And he just was so weird about the thing. If I wouldn't have asked somebody, I would have wondered. …So that is when I became aware of their tornado drills and their fire drills. We got in the loop and talked about it. (Paul, paraplegia)

A few participants described the policies as not realistic because they prescribed a designated location for the employee to wait until emergency personnel arrived. However, in reality, one stated "my wheelchair isn't going to stop me from getting out of the building", and another said he felt his coworkers would not leave him to wait it out, and would likely help him evacuate. However, reliance on coworkers was often based on assumption and one participant admitted it did not come with a guarantee. He described the unwritten, informal policy at his place of employment:

> The plan is that they would just have two designated people, or four actually, carry me down the stairs if needed. If there was a fire type situation…two of the them are from general services and, another is from

> our department, and I don't know necessarily the fourth one but, well they would grab another person that would be available.…that is really the only concern, or untested issue at this point. And it's a risk that I'm willing to accept too. (Ken, paraplegia)

Communication about efficacy to prevent subsequent injury

Similar to messages about threat, participants first described learning about ways to prevent injury in conversations with their rehabilitation therapists. Participants often described "taking the things you learned in rehab" and applying it in their everyday lives:

> At [rehabilitation1] it was an OT and down here at [rehabilitation2] it was a PT for outpatient stuff. I think that's a big part of it, as far as falling out, [and determining] whether the seat belt is needed or not needed, and general positioning and comfort level (Mark, paraplegia).

Participants also had conversations about efficacy with others who had SCI. These occurred in SCI support group settings, and also among personal contacts with other individuals with SCI. Several participants described being very appreciative of conversations they had with other individuals with SCI:

> He's a very knowledgeable guy, he's got his own business, I've really drew a lot on him….I depend on him a lot for advice. He's been through the ranks. If you get to talk with, it won't be time wasted, I can tell you that. (Ken, paraplegia)

Communication about formal and informal policies typically occurred between participants, and their supervisors, or human resources. Since formal and informal policies usually centered on emergency preparedness that were often reactive to an atypical, non-emergent event or planned safety review, these conversations occurred after the participant had been working for a while. There seemed to be a relationship that formal policies were associated with larger employers and did not seek feedback from the participant (i.e. one way communication), and informal policies were more common among smaller employers, and often involved the participant in the (informal) policy-making process (i.e. two way communication). One participant described how a power outage prompted a conversation and plan for emergency preparedness:

> The electricity went off; actually it has gone off twice now since we've moved into this new building. The first time a snow plow cut a wire somehow and knocked it off, and there was a concern, but what happened was, only half the building went out, the other half didn't, and of course I was able to use the elevator on the other half of the building…after the first one went out, they got to thinking they do have a backup generator that automatically kicks that will start generating electricity, that was primarily for computer equipment, well what they did was make sure that it also functioned for one of the elevators and, within this last month, I don't remember the exact date, the electricity went off again, and it wasn't just our building it was entire section of [city]. And, the basically, it was a test to see if the elevator was going to work, and everything worked fine. The only thing was they didn't have a flash light and there weren't any lights in the elevator … they actually did find a flash light that someone had, and really there was enough lights from the buttons on the elevator that you could see going down. (Ken, paraplegia)

Section 4. Locus of control

Locus of control (LOC) resulted in 3 subthemes: internal LOC, external LOC-employer, and external LOC-social network. Note that the 3 subthemes reflect who took responsibility for preventing injury which was derived from codes that evolved from the interview data, and do not reflect who the participant believes is ultimately responsible for preventing injury (as Wallston et al (1978) conceived Health Locus of Control). All participants described at least one circumstance where they placed the responsibility of preventing subsequent injury on themselves, suggesting an internal locus of control. The way they described the actions they take to prevent injuries was often in the first person, e.g. "I tell them what I need" or "I take [ramps] with me for getting into a house without a ramp system". Internal locus of control was also explicitly described:

> Probably myself I would say. Making sure that my caregivers do everything the way they are supposed to and that kind of thing. Making sure transferring is correct. Various cares on the way they are supposed to. I'd say primarily me. (Thomas, quadriplegia), and

> I don’t trust anybody….I am always watching and very aware of my surroundings…I don’t trust anybody to watch my back. (Paul, paraplegia)

Several participants described an internal LOC in the way they applied what they learned about injury prevention during rehabilitation:

> I just kind of took that upon myself. I don’t think the employers or really anybody for that matter probably thinks about…somebody in a wheelchair …because they never had any experience with this. You take what you got out of rehab and put it towards that [safety]” (Mark, paraplegia)

About half of participants described scenarios where their employer took responsibility for their safety. However, no participants had the expectation that it was their employer’s responsibility to keep them safe. Several participants described occasions where their employers assumed responsibility for participant’s safety at work, primarily in the context of emergency preparedness.

Last, nearly all participants described at least one incident where individuals in their social network were concerned about their safety. Participants’ social networks included spouses, parents, and even concerned strangers. Notably, these were not occasions where the participant believed the responsibility to prevent injury was someone else’s responsibility; rather these were occasions when others had assumed that role. Examples of comments include: “my wife tends to think she plays a role,” “[My parents are] always looking out a ton, more than I realize. They are always concerned about things more so than I am,” and “There’s probably more safety concerns that others have about me. I think that’s their lack of knowledge about what I’m capable of doing.”

Discussion

This study explored the perceptions of and communication about subsequent injury among individuals with SCI. It is the first study to use a qualitative approach and apply a communication theory to understand the perceptions about threat of subsequent injury, the efficacy of actions taken to prevent future injury, and how messages about preventing subsequent injury are communicated. The main findings indicate individuals with SCI recognize the threat of subsequent injury, but that the efficacy of actions to prevent injuries varied in the workplace. These findings have implications for the development of interventions to prevent subsequent injury, specifically in the improvement of persuasive messages, and communication about subsequent injury prevention.

Threat appraisal

According to EPPM, threat appraisal is the cognitions about danger or harm that exist in an environment, and is comprised of perceptions of severity and susceptibility (Witte, 1992, Popova, 2012). The results showed all participants recognized the threat of subsequent injury when they return to work or participate in other activities. Participants described the perceived severity of subsequent injury in the context of time loss and loss of independence. Fractures and wounds require extended healing time following SCI (Ding, Jiang, Zhang, Jiang, & Dai, 2011), and other research has shown that of loss of independence is a common consequence of injury. In a study of falls among individuals with incomplete spinal cord injury, 45% reported reduced ability to get out into the community and engage in productive activity following a fall event (Brotherton, Krause, & Nietert, 2007). Most participants recognized their susceptibility to subsequent injuries at both the individual and environmental level. Previous literature confirms both individual and environmental factors affect susceptibility to injury. In one study, decreased strength and trunk control, loss of balance, and hazards in the environment contributed to falls among individuals with incomplete spinal cord injury (Brotherton et al, 2007). Further, Nelson and colleagues (2010) found that an inaccessible home entrance significantly predicted injurious falls among veterans with SCI. Awareness and recognition of the risk for subsequent injury is an important first step for injury prevention, but may not be sufficient to motivate an individual with SCI to take action to prevent subsequent injury. LaVela and colleagues (2008) found that messages about vaccinations targeting individuals with SCI needed to be more fearful related to severity, because life for individuals with SCI was already difficult, and messages that merely inform were not enough motivation to act. This suggests that communication messages about subsequent injury need to strongly address the negative consequences of subsequent injury, and heighten the salience of subsequent injuries using the threats identified in this study: time loss, loss of independence and the individual and environmental factors that increase susceptibility to injury.

Efficacy appraisal

Efficacy appraisal is the cognitions about effectiveness, feasibility, and ease of actions prevents a threat, and is comprised of perceptions of self-efficacy and response-efficacy (Witte, 1992, Popova, 2012). In this study, while participants described high perceived self-efficacy, the perceived response-efficacy of actions to prevent subsequent injury varied, particularly in the workplace.

Informal and formal policies of workplace safety

Several participants described formal and informal policies related to injury prevention and safety in the workplace. Formal policies were characteristic of larger employers and were often developed and implemented without participant input.

Informal policies were characteristic of smaller employers and often included the participant in the decision-making process. In a study of workers who returned to work following short-term disability, communication with workers, and shared decision-making were two important factors on the role of supervisors following injury (Shaw, Robertson, Pransky, & McLellan, 2003). This suggests that perceived response-efficacy of informal and formal policies would improve if shared decision-making preceded the implementation of workplace safety policies. Results of this study found that even after formal policies were implemented or tested through drills, participants were not asked about their effectiveness. This is consistent with Ramirez and colleagues (2009) who found drills were not used to improve procedures.

The most common formal policy identified by participants was emergency preparedness in the workplace. The results of this study indicate that emergency procedures are one of the few scenarios that individuals with SCI talk to their employers about safety. This was characteristic of medium and large employers and less common or non-existent among small employers or the self-employed. Previous research suggests high self-efficacy and response-efficacy of emergency preparedness in the workplace. McClure and colleagues (2011) found that the 94% of wheelchair users with SCI felt they could evacuate their places of work in an emergency, and 80% had a plan in place to do so. This may be the result of federal policies and resources for addressing the needs of employees with disabilities in preparedness planning. In 2004, Executive Order 13347 was issued directing governments and organizations to address the needs of Individuals with Disabilities in Emergency Preparedness (Exec. Order No. 13347, 2004). In response, the U.S. Department of Labor has developed several resources for employers to assist them in planning for the safety of their employees with disabilities in an emergency (Department of Labor, 2005).

In this study, no participants described a plan for emergencies outside of work. Previous research also found a discrepancy in emergency preparedness between home and work (McClure et al, 2011). In the home, 85% of wheelchair users with SCI felt they would be able to evacuate in an emergency, but only 64% actually had a plan in place (McClure et al, 2011). In addition, half of home emergency plans relied on assistance from others (McClure et al, 2011). This may be problematic if no formal plan exists, and if others are not aware of the expectation of assistance. Future interventions should also address emergency preparedness in nonoccupational settings, emphasizing self-efficacy of individuals to be able to evacuate in an emergency, and the response-efficacy of formal and informal plans. Advocacy organizations (e.g. Paralyzed Veterans of America, National Spinal Cord Injury Association, etc.), and specialty rehabilitation and research centers for people with SCI (e.g. Craig Hospital) have brochures and publications that address the needs of individuals with SCI in an emergency that emphasize carrying a "communicator", anticipating needs unique to SCI (e.g. leg bag emptying, or responding to autonomic dysreflexia), and practicing plans (Gerhart, 2001a, Gerhart, 2001b).

Communication about subsequent injury and implications for prevention

In this study, communication about workplace safety occurred mostly with supervisors, sometimes involving human resources or vocational rehabilitation. Conversations occurred pre-employment, in response to near-injury or unexpected, non-emergent events (e.g. power outage), or during annual safety reviews. Communication between an individual with SCI and their employer is an essential component of return to work following SCI (Targett, Wehman, & Young, 2004). Department of Labor guidelines suggest three opportunities to obtain disability information for emergency planning purposes: after a job offer but before employment begins, asking employees to self-identify on the job, or approaching employees with known disabilities to ask if they require assistance (but not assuming they will need assistance) (Department of Labor, 2005). Regardless, emergency preparedness should happen before an emergency occurs. A Supported Employment (Targett et al, 2004) approach emphasizes shared decision-making and provides vocational interventions that complement the employer's existing practices, including accessibility and safety needs. In addition, employers need to consider how a policy is implemented and communicated with employees with SCI, so it is accepted by the employees who are affected by the policy. If employers do not seek input, messages about subsequent injury prevention might be rejected. This was evident in this study in one participant's description of rejecting a policy that required wearing a flag on the manufacturing floor. The EPPM suggests that if the perceived response efficacy of an action is low, persuasive messages will be ignored (Witte, 1992, Popova, 2012). Previous research found that 64% of workplace safety communication materials did not include messages of response efficacy at all (Basil et al, 2013). Further, the effectiveness of workplace safety messages was maximized when all EPPM constructs were present (Basil et al, 2013).

Results from this study suggest a discrepancy in workplace safety communication with most messages about policies for rare events (e.g. an emergency evacuation), and little or no communication or policies about situations that are much more likely to result in subsequent injury for individuals with SCI (e.g. falls). Participants described individual (e.g. functional ability, self-efficacy), interpersonal (e.g. rehabilitation therapists, supervisors), and environmental factors (e.g. accessibility, policies) that affect their ability to prevent subsequent injury, which is consistent with an ecological approach to injury prevention (Allegrante, Hanson, Sleet, & Marks, 2010). Environmental facilitators and barriers in both the physical and social environment may encourage or discourage injury prevention behavior (Ravesloot et al, 2011). This suggests an important implication for practice both in workplace settings and in the daily lives of individuals with SCI, with the need to increase messages about the threat of and efficacy to prevent subsequent injuries in other contexts besides emergencies. According to EPPM, when efficacy is stronger than threat, messages should increase perceptions of severity and susceptibility to positively affect behavior change; when no threat is perceived, messages need both a high-threat and high-efficacy approach (Witte, Meyer, & Martell, 2001, LaVela et al, 2007). Future research is needed to develop and test, theory based messages to effectively prevent subsequent injury among individuals with SCI.

Limitations

This study has a few limitations. A convenience sample of individuals with SCI from a single Midwestern state may differ in other settings. However, participants included both individuals with quadriplegia and paraplegia, with a variety of full time or part time employment experience and job type. In addition, all participants described either a subsequent injury or near-injury event since their SCI. Therefore, interviews included participants with broad experiences and conditions, and appeared to reach saturation regarding the aim of study 3. A second limitation is that results are based on qualitative interviews with a small sample of individuals who were at least 1 year post-SCI, and who had returned to work. Experiences and perceptions of subsequent injury may differ for individuals in their first year post-SCI, and who have not returned to work. Another limitation of study 3 is the implied subjective measurement of qualitative data using descriptions such as “most”, “all”, or “a few”. Using rich data and searching for discrepant evidence were two methods that were used to offset this limitation (Maxwell, 2005).

Conclusion

Individuals with SCI recognized the importance of preventing subsequent injury, and were willing to take action to prevent injuries. Perceptions of threat and efficacy are important considerations in the development of messages and communication about preventing subsequent injury.

Table 4.1. Participant demographics (n=14)

Total	14
Sex	
Female	1
Male	13
Age (years)	
Mean (SD)	37 (11)
Range	23-60
Age range	
18-34	8 (57%)
35-49	3 (21%)
50-64	3 (21%)
Level of SCI	
Paraplegia	10 (71%)
Quadriplegia	4 (29%)
Time since SCI (years)	
Mean (SD)	12 (9)
Range	2-31
Health status[1]	
Excellent/ Very good	9 (69%)
Good/ Fair	4 (31%)
Poor	0
Education	
High school graduate	2 (14%)
Some college/Technical school/Associate degree	8 (57%)
Bachelor/Graduate degree	4 (29%)
Employment status[2]	
Full-time	7 (50%)
Part-time	5 (36%)
Self-employed	3 (21%)
Student	2 (14%)
Employment type[2]	
Administrative support	5 (36%)
Agricultural/ag services	3 (21%)
Administration/management	2 (14%)
Engineering/technical/trade	2 (14%)
Information technology	2 (21%)
Independent sales/subcontractor	3 (21%)

1. Counts less than 14 due to missing information.

2. Employment status and type do not equal 100% because participants could indicate more than one status or type of employment.

Table 4.2. Participant descriptions

	Name (alias)	Sex	Level of Injury	Employment	Type
1	Ken	Male	Paraplegia	Part-time	Administration/management
2	Stacey	Female	Quadriplegia	Part-time, self-employed	Independent sales/subcontractor
3	Thomas	Male	Quadriplegia	Self-employed, student	Information technology
4	Dan	Male	Paraplegia	Full-time	Engineering/technical/trade
5	Randy	Male	Quadriplegia	Part-time	Administrative support
6	Mark	Male	Paraplegia	Full-time	Administrative support
7	Grant	Male	Paraplegia	Student, unemployed (previously full-time)	Engineering/technical/trade
8	Oscar	Male	Paraplegia	Part-time	Administrative support
9	Jeff	Male	Quadriplegia	Part-time, self-employed	Administrative support, independent sales/subcontractor
10	Joe	Male	Paraplegia	Full-time	Administration/management
11	Paul	Male	Paraplegia	Full-time	Engineering/technical/trade
12	Greg	Male	Paraplegia	Full-time	Agriculture/ag services
13	Justin	Male	Paraplegia	Full-time	Information technology
14	Michael	Male	Paraplegia	Full-time	Agriculture/ag services

Table 4.3. Summary of themes

	Theme	Definition	Example quotes
THREAT APPRAISAL	**Perceived severity**	Reflections related to the threat of the consequences of experiencing an injury	
	Time loss	Any concept or idea that implies loss of time or implications of time loss, e.g. the increased time it takes to recover, or job loss from missed work	"my body doesn't heal so well" "I worry that if I break a femur, am I going to be out for 6 months again?"
	Loss of independence	Fear of further loss of function or higher level SCI that would result in loss of independence	"if I can't use my arms, that would be bad"
	Perceived susceptibility	Reflections related to the threat an individual personally feels about experiencing an injury	
	Individual level		
	Functional ability	Perceived threat of injury in situations where the individual can't protect themselves due functional limitations	"I don't worry about it too much, because if I fall out of my chair, I know I can get back in"
	Sensory impairments	Perceived threat of injury due to decreased ability to detect injury or pain below the level of their SCI	"That is potentially there. Usually I pick it up, or like when I go to a restaurant as well, the potential is there, but the fact that I can feel with my fingers, if it's too hot I leave it on the table until it cools off."
	Environmental level		
	Accessibility	Perceived threat of injury when environments are not accessible	Well, when I worked for this private engineering company, their basic—their expertise was in solid waste—dealing with landfills. That got in the way of my injury because I would not--- because we would have to walk the site, and as far as me getting out and walking around a dump, yeah that didn't [work].
	Weather	Perceived threat of injury when the weather is bad	"Like where you were parking at, how accessible , the guys were great they were like, yeah, just pull right into the garage there like if it was in the winter...They would always accommodate me, make sure that I would get in the door wait, for me to come in, you know get me all suited. Make sure I wouldn't have to park in the rain…"
	Emergency/evacuation	Perceived threat of injury in an emergency	"The guys would carry me up the stairs with me in the chair, just man it all the way up to the second floor. And there were like two flights it was pretty high second floor. … if they left me up there…I wouldn't be able to get down. That would be a concern. That's probably why they suggested I shouldn't be working up there, too."

Table 4.3. Continued

	Theme	Definition	Example quotes
EFFICACY APPRAISAL	Perceived self-efficacy	Beliefs as to whether or not the participant has the ability to perform desired action to prevent subsequent injury	
	Conscientious awareness	Concept of hyperawareness of their surroundings	"I'm always watching, my body, where I'm driving, what I'm doing. So I would say that I'm a cautious person, …I'm a cautious driver most of the time. Drive in my van, or my chair, I'm pretty cautious I'm always watching my feet or other people's feet because I don't want to run them over. I'm pretty aware of my surroundings and pretty observant.
	Tricks of the trade	Tricks or unique behaviors an individual describes to prevent injury	"brace myself with my elbows" or "tip my chair a little back"
	Confidence / common sense	Concept or idea that if an individual has confidence in themselves and uses common sense they will prevent injury; and/or having gained confidence in their efficacy over time	"I'm getting a lot more confident, um, un know, it was just a matter of learning the process, of learning of what I'm capable of doing, and just knowing how the chair acts and things like that. '
	Knowing your limits	Concept or idea of knowing your own limitations and not taking risks beyond what you are able to do	"You have to know your limits. Fortunately I haven't pushed my limits and found out what they are, but that would be the main thing,just knowing what you can do without compromising stuff."
	Perceived response-efficacy	Beliefs about the effectiveness of actions taken to prevent subsequent injury	
	Self-reliance	Concept or idea of the effectiveness of relying on their own abilities to prevent injury	*"There'll be instances where you know you might put yourself in a pinch point, work around robotic equipment sometimes. You might be in a pinch point. Just pay attention to your surroundings,nothing specialized for myself to make it any safer."*
	Formal policies	Reflections about a formal policy or protocol used by an employer to prevent injury	*"So they ruled that if I was going to be on the shop floor, I was going to have to have a flag on my wheelchair. Well to me it's like man, that's awful degrading when people are going to make fun of you all day long, in which I did it for a little while, then I kinda, just ignored the rule, threw the flag in the trash."*
	Informal policies	Reflections about an informal policy to prevent injury	*"I would get my coworkers to help"* *"my coworkers would probably help me"*

Table 4.3. Continued

Theme	Definition	Example quotes
Locus of control (LOC)	Reflections related to who took responsibility to prevent injury	
Internal LOC	Reflections of personal responsibility	*"A lot of time I figure it out on my own then I go to them and say hey, this what I think I need and we go from there."*
External LOC-Employer	Reflections of employer responsibility	*"My boss went into a long spiel of data and OSHA* [Occupational Safety and Health Association] *regulations and all"*
External LOC-Social network	Reflections about the role of caregivers, family, friends, concerned others (including strangers), or others with SCI in preventing subsequent injury	*"I think especially my mom and dad worry more about me than they did before. Our relationship changed. I don't know how to explain it. Obviously I was a lot more independent prior to and you know they check on me more that kind of thing."*

CHAPTER 5

DISCUSSION AND CONCLUSIONS

The purpose of this dissertation research was to describe the patterns, burdens, and prevention of subsequent injury among individuals with spinal cord injury (SCI). Specifically, this dissertation examined the characteristics of injury hospitalizations among individuals with paraplegia, and compared the differences in length of stay and hospital costs of injury hospitalizations between individuals with quadriplegia versus paraplegia. In addition, it explored the experience of subsequent injury among individuals with SCI and their perceptions of and communication about preventing subsequent injury when they return to work. This dissertation research was significant because it is the first to calculate a nationally representative estimate of subsequent injuries among individuals with pre-existing SCI, the first to report the types and etiology of subsequent injury, the first to describe the economic burden of subsequent injury by cause of injury among individuals with pre-exiting SCI using hospital costs, and the first to apply a communication theory to explore perceptions of threat and efficacy in preventing subsequent injury among individuals with SCI who return to work.

This dissertation resulted in three stand alone, but related studies that are presented in Chapters 2, 3, and 4. Study 1 used the Nationwide Inpatient Sample to describe patient, hospital, and injury characteristics of injury hospitalizations among individuals with paraplegia. Study 2 used the same dataset to compare the differences in injury hospitalizations, as well as the economic burden of injury, measured as hospital costs, between individuals with quadriplegia versus paraplegia. Finally, Study 3 used in-depth interviews to qualitatively explore the experiences, perceptions of, and communication about subsequent injury among individuals with SCI who return to work. This chapter synthesizes the findings and limitations from all three studies, and discusses the implications for future research and practice.

Synthesis of Results

This research was informed by the public health approach to injury prevention research (Sleet, Hopkins, & Olson, 2003, Hanson, Finch, Allegrante, & Sleet, 2012), and the use of communication theory in injury prevention campaigns (Aldoory & Bonzo, 2005).

Patterns of subsequent injury among individuals with SCI

Following the first two steps of the public health approach to define the problem and identify risk factors (Sleet et al, 2003), the aims of study 1 and study 2 were to describe the patterns of subsequent injury hospitalizations by specific type of SCI and examine the effects of patient characteristics on injury hospitalizations by cause of injury using a quantitative approach. The main findings showed that among the estimated 28,000 injury hospitalizations from 2003-2009, 45% were to patients with quadriplegia and 55% were to patients with paraplegia. The results from study 2 revealed that compared to individuals with paraplegia, individuals with quadriplegia had a greater proportion of injury hospitalizations that occurred among men, were discharged to other locations besides homes, or ended in death in hospital. The top three external causes of subsequent injury were the same, but differed in rank order for individuals with quadriplegia compared to paraplegia. The most significant difference in injury hospitalizations between these two groups was found among patients who died with deaths from injury hospitalizations due to falls, MVT, or poisoning, more likely to be among individuals with quadriplegia compared to paraplegia. In studies 1 and 2, falls were the most common cause of subsequent injury hospitalizations. And this finding was confirmed by the results of study 3, in that all participants described having fallen or almost fallen at some point since their SCI. The results of the dissertation work adds to the empirical data describing the types and etiology of subsequent injury for individuals with SCI, an area of needed research suggested by Krause (2004), and suggests that falls are a serious public health problem for individuals with SCI. With subsequent injury-related mortality as the second leading cause of death after the first year following SCI (DeVivo, Krause, & Lammertse, 1999), it is important to understand the patterns of subsequent injuries as well as the causes of these injuries.

Burden of subsequent injury among individuals with SCI

This dissertation also examined the differences in the burden of subsequent injury between individuals with quadriplegia versus paraplegia. Krause suggests the reason "[subsequent] injuries have not been more front and center after SCI…is that the economic consequences have never been identified" (p. 1746, 2010). Study 1 and study 2 focused on the economic burden of injury hospitalizations using hospital charges and hospital costs, respectively. In study 1, the economic burden measured as hospital charges was significant, with an average $130 million in injury hospital charges annually for individuals with paraplegia. Study 2 built on study 1 by using hospital costs, instead of hospital charges, to measure the economic burden of subsequent injury hospitalizations. Despite fewer number of injury hospitalizations, individuals with quadriplegia had longer LOS, higher hospital costs per discharge, and greater total hospital costs compared to individuals with paraplegia, both overall and by cause of injury. These findings suggest that while injury hospitalizations occur more often among individuals with paraplegia, the burden is greater for individuals with quadriplegia. In addition, the burden of injury is higher for individuals with quadriplegia or paraplegia than the general population. Injury hospitalizations among individuals with quadriplegia or paraplegia averaged $43,000 and $22,000 (2009 $US) in hospital costs per discharge, respectively), compared to the general US population in the same dataset ($10,300 (2004 $US) per injury discharge) (Russo, Owens, & Stocks, 2006). The findings also help frame the burden of injury relative to burden of secondary conditions that are studied previously and emphasized in SCI practice and research, such as urinary tract infections and pressure ulcers (Cardenas et al, 2004, DeVivo & Farris, 2011). Another significant contribution of this research is in the empirical evidence of the burden of subsequent injury with $80 million in annual hospital costs for individuals with quadriplegia, and $50 million in annual hospital costs for individuals with paraplegia.

In addition, study 3 provided a unique perspective of individuals with SCI on the burden of subsequent injury in terms of time loss and loss of independence. Time loss reflects the indirect cost burden associated with lost wages due to time loss from work. Loss of independence may result in further disability which incurs indirect costs through decreased quality of life. Indirect costs of subsequent injury, although sometimes intangible and difficult to capture, could have a long-lasting and significant impact for individuals with SCI, their families, and the health care system. To reduce this burden, the public health approach to tertiary prevention to improve rehabilitation outcomes and quality of life is important.

Prevention of subsequent injury among individuals with SCI

Subsequent injury due to falls was cross-cutting across all three studies, which suggests that interventions to prevent falls among this population should be a priority as they were attributable to one-third of injuries and highest total burden. As a first step towards the development and testing of interventions to prevent subsequent injury, which is the third stage of the public health approach to injury prevention injury (Sleet et al, 2003), study 3 used the Extended Parallel Process Model (EPPM) (Witte, 1992) and Health Locus of Control (Wallston & Wallston, 1982) to explore the perceptions of threat and efficacy in preventing subsequent injury among individuals with SCI who return to work. Results from study 3 suggest that time loss, loss of independence, and individual and environmental risk factors are relevant threats for individuals with SCI regarding subsequent injury. This is consistent with previous research which found reduced ability to get out into the community following a fall event, and that individual and environmental factors influence risk for falls (Brotherton et al, 2007, Nelson et al, 2010). Further, results of study 3 indicate that communication with employers about preventing subsequent injury centers around emergency preparedness and evacuation in the workplace. However, perceptions of the response efficacy of formal and informal policies were mixed, with more negative perceptions when policies were implemented without their input or feedback. Previous research found communication between supervisors and workers and shared-decision making are important factors for return to work following disability (Shaw et al, 2003). The EPPM suggests that if the perceived response efficacy of an action is low, individuals will ignore the message and reject the desired protective action (Witte, 1992, Popova, 2012). Gore & Bracken (2005) found that low threat was enough to improve message acceptance in the presence of an efficacy component, but LaVela et al (2008) found high threat was necessary for individuals with SCI in order to increase the salience of the message relative to other health conditions associated with SCI. Unfortunately, workplace safety communication materials frequently do not address response-efficacy (Basil et al, 2013). Shared decision-making and messages about response-efficacy may improve acceptance of workplace safety policies for individuals with SCI.

Taken together, the findings of all three studies show a need for more communication about and messages on subsequent injury prevention. There is a discrepancy between the relative availability of resources on emergency preparedness for workers with disabilities (Department of Labor, 2005, Federal Emergency Management Agency, n.d.) versus the paucity of resources for preventing injuries for which individuals with SCI may be more susceptible and/or for events that are more common (e.g. falls, poisonings, burns). This suggests an urgent need to close the gap between research-to-practice, and efficacy-to-effectiveness (Hanson et al, 2012). There are multiple occasions where communication about subsequent injury can occur, and there are multiple points where interventions to prevent subsequent injury may be implemented. During in-patient and out-patient rehabilitation, post-SCI when assessing and making accommodations in the home, at adaptive sporting and recreation events, at other group or social network events for individuals with SCI and their families, and during return-to-work are all potential occasions when messages about subsequent injury may be communicated. Further, it is important to consider prevention at the individual, environmental, and policy levels (Allegrante, Hanson, Sleet, & Marks, 2010). Increasing efficacy of individuals, removing barriers and increasing accessibility in the environment, and implementing policies that address the needs of individuals with SCI are important first steps toward prevention.

Limitations

Results of this dissertation research should be interpreted with consideration of a few limitations. Due to differences in study objectives and data sources across all three studies, results cannot be triangulated across all 3 studies. Triangulation is strategy for addressing the reliability and validity of research findings by utilizing multiple qualitative and/or quantitative data sources (e.g. surveys, focus groups, interviews) (Golafshani, 2003). Consistencies and contradictions in study findings were described above, but triangulation across all three studies was not possible due to inherent differences in study design and methods.

Second, limitations in study design limited the ability to include some factors related to subsequent SCI in the analysis, or investigate other findings in greater detail. For example, in study 1 and study 2 information on time since initial SCI was not available in the dataset. In addition, information on subsequent SCI relative to the pre-existing quadriplegia or paraplegia was also not available. Because of the limitations of secondary data analysis and the differences between the purpose of the original dataset versus the goals of study 1 and study 2, some important factors such as severity (e.g. ASIA impairment scale or completeness of spinal cord lesion), injury history and time since initial SCI could not be considered as covariates or predictors of subsequent injury. In addition, the dataset did not include behavior, exposure, or activity that occurred right before the injury, so it was not possible to quantify the risk of subsequent injury relative to behavioral and environmental risk factors. However, the benefit of secondary data analysis in this case provided the opportunity to estimate subsequent injury in a nationally representative sample, which had not been previously reported.

Finally, qualitative results from study 3 using a convenience sample of individuals with SCI who return to work from a single Midwestern state may differ in other settings or among individuals with SCI who do not return to work. Many individuals with SCI do not return to work for several years if at all following SCI (NSCISC, 2012a), and their perceptions of and ability to prevent subsequent injury may differ from participants in study 3 who had returned to work. In addition, individuals with SCI who do not return to work may receive communication and messages about subsequent injury from different sources or at different time points that were not described in study 3. Therefore, results of study 3 should be interpreted with caution particularly if applying them in other settings or to individuals with SCI who do not work.

Despite these limitations, results from this dissertation research provide new insight, from both qualitative and quantitative perspectives, into the patterns and burdens of subsequent injury among individuals with SCI, and highlights the important role of communication in subsequent injury prevention.

Implications for Research

Methods and measurement

By using the NIS, this dissertation research was able to 1) compare the differences in cause and diagnosis of subsequent injury by specific type of SCI, and 2) estimate average and total hospital costs for subsequent injury hospitalizations by cause of injury and specific type of SCI in a nationally representative sample. The NIS has implications for future injury research among individuals with other underlying comorbidities, or for investigating rare injuries that are relatively rare in occurrence. As the largest, all-payer database of hospital discharges in the U.S., the NIS is useful for rare conditions or populations, and includes comorbidity software to select hospitalized patients with pre-existing conditions. Future research should examine the comorbidities of obesity, drug abuse, alcohol abuse, and depression available in the dataset on subsequent injury hospitalizations. In addition, the NIS can be weighted to national estimates, and calculate hospital outcomes (e.g. LOS and hospital costs) not afforded in other smaller datasets.

Second, results from study 1 and study 2 demonstrated there are leading causes of subsequent injury that have not been the focus of previous research including motor vehicle traffic, poisonings, and burns. This has implications for future research to be inclusive of all causes of injury, both unintentional and intentional (acts of violence or self harm), and to ensure that existing measures are collecting comprehensive information on subsequent injury. In study 3, it was necessary to use multiple probes to ask about injuries, or “accidents”, or “times you got hurt”, and probe by specific cause, such as “have you ever been poisoned by any of your medications?” or “have you had any car accidents?” or “have you ever tried to hurt yourself or been assaulted by someone else?”.

In addition, future research needs to distinguish between acute and chronic injuries. Individuals with SCI are susceptible to musculoskeletal conditions, chronic and overuse injuries (e.g. pain, tendinitis, etc.) (Capoor & Stein, 2005) that may be misclassified as acute injuries, particularly in studies that rely on self-report of subsequent injury.

Use of communication theory in subsequent injury research

Another area where the results of this dissertation have implications for research is in the use of communication theory in research on the prevention of subsequent injury. Study 3 described perceptions of threat about subsequent injury that are personally relevant to individuals with SCI. In addition, participants of study 3 described perceptions of self-efficacy, and shared experiences about the response-efficacy of formal and informal policies for subsequent injury prevention. The results of study 3 suggest that both the threat and efficacy component of messages about subsequent injury prevention are salient for individuals with SCI, which has implications for research and testing of prevention messages.

Future research

This dissertation also highlighted a few areas of potential research. In study 1 and study 2, 14% of injury hospitalizations were for subsequent SCI for individuals with paraplegia, and 43% of injury hospitalizations were for subsequent SCI for individuals with quadriplegia, respectively. Very few studies have previously described subsequent SCI. Pickelsimer et al. (2010) reported that 13.8% of women and 11.1% of men sustained a traumatic brain injury, SCI, or fracture of the head, neck, face or spine over ten years after initial SCI. More research is needed to understand subsequent SCI in this population, particularly in relation to the pre-existing SCI. Important factors to consider are characteristics of the initial SCI, e.g. instability of the spine, completeness of spinal cord lesion for the initial injury (Brotherton, Krause, & Neitert, 2007), degree of motor impairment (Logan et al., 2008), and if subsequent SCI is a re-injury of the initial SCI, or occurs above or below the level of initial SCI.

Second, future research is needed to measure the economic burden of other direct and indirect costs associated with subsequent injuries. Individuals with SCI have substantial health care and living expenses following SCI without the burden of subsequent injury (NSCISC, 2012a, DeVivo, Chen, Mennemeyer, & Deutsch, 2011). Costs associated with subsequent injury include the cost of treatment of minor injuries treated in outpatient clinics and in emergency departments, as well as indirect costs from lost work, productivity, quality of life, and independence. Further, individuals with SCI are more often discharged to long-term facilities for rehabilitation compared to the general population (Heinen, Hall, Boudreault, & Fingerhut, 2005), which suggests a large portion of costs for rehabilitation that should be enumerated.

Third, more research is needed using mixed methods to document both the behavioral and environmental level risk factors for subsequent injury among individuals with SCI when they return to work. Future research should build on the qualitative results in study 3, by assessing individual, behavioral, and environmental risk factors in a quantitative way. Study 3 found individuals with SCI are at risk for injury and near injury events, and both individual and environmental factors contribute to an individual's perceived susceptibility to injury when they return to work. Quantitative methods with a representative, larger sample size, may triangulate qualitative findings.

Finally, the EPPM should be used to guide future research questions based on the conceptual model for subsequent injury prevention among individuals with SCI, and test theory constructs using quantitative methods in the context of subsequent injury. Witte (1996) developed a quantitative measure of the constructs of EPPM toward a particular health issue using ratings on a 5 point scale that may be used to validate the findings in study 3 in a larger sample (also available at www.msu.edu/~wittek/rbd.htm). In addition, the results of study 3 provide a qualitative foundation to use EPPM to guide intervention studies on which messages are most effective to prevent subsequent injury in the workplace for individuals with SCI. Previous research found that self-efficacy was used most frequently, and response-efficacy was used the least in workplace safety messages (Basil et al, 2013). In addition, there may be a multiplicative effects when all EPPM constructs are present, and that messages with high levels of threat and efficacy maximize message acceptance and minimize rejection (Lewis, Watson, White, 2013, Basil, Basil, Deshpande, & Lavack, 2013). Future research should test these findings in the context of subsequent injury prevention in the workplace.

Implications for Public Health Practice

Results of all 3 studies suggest there is an urgent need for the design and implementation of effective intervention programs to prevent all subsequent injury due to a large number of injury hospitalizations and the associated burden on individuals with SCI and society. Preventing falls should be a priority as they are leading causes of injury hospitalizations for both individuals with pre-existing paraplegia and quadriplegia in study 1 and study 2, and all participants in study 3 described a history of fall or near-fall event. Interventions should consider level of SCI (Nelson et al, 2010, Brotherton et al, 2010), fall history (Nelson et al, 2010) and the activity the precedes the fall event, e.g. transfers, moving in bed, propelling, or reaching (Capoor & Stein, 2005, Nelson et al, 2003). Intervention strategies may also adapt those used for preventing falls in other populations, such as older adults, and tailor them to fit the needs of individuals with SCI (Gillespie et al, 2012, Cameron et al, 2012).

A second implication for practice is in using theory to guide interventions to prevent subsequent injury. EPPM may be used to develop messages that are tailored for individuals with pre-existing quadriplegia or paraplegia, respectively, and heighten the salience of preventing injury by increasing the perceived threat of subsequent injury and efficacy in prevention. Results from all three studies may be used to inform messages, educational materials, and policies to prevent subsequent injury.

A third implication for public health practice is in improving the communication between individuals with SCI and their employers about workplace safety and the risk for and prevention of occupational injuries. These efforts should be included as part of workplace safety and injury prevention initiatives for all workers. A Supported Employment approach may be useful for assisting persons with SCI when they return to work to address needs of accessibility and safety (Targett, Wehman, & Young, 2004). A Supported Employment approach emphasizes shared decision-making and provides vocational interventions that complement the employer's existing practices (Targett et al, 2004). It is also important that any drills or annual safety reviews be used as opportunities to adopt changes in procedures (Ramirez, Kubicek, Peek-Asa, & Wong, 2009). Further, if coworkers are enlisted to help an employee with SCI evacuate a building, they should receive skills training (Targett et al, 2004, Byzek & Gilmer, 2001).

Finally, a multi-level approach to preventing subsequent injury is needed to develop interventions that target injury prevention at the individual, social, environmental, and policy levels. Interventions may benefit by borrowing from the success of other programs to prevent injury (Gillespie et al, 2012, Cameron et al, 2012), and should emphasize the risk for and need to prevent subsequent injury in all settings (e.g. home and work) and contexts (e.g. emergencies and daily life). Further interventions, should also aim to prevent the severity of subsequent injury when they occur.

Conclusions

The results of this dissertation research demonstrate that injury prevention for individuals with SCI requires a broad public health approach to include all causes of injury and their consequences. Subsequent injury not only significantly impacts the quality of life of these individuals and their families, but also adds significant burden to the health care system. The consequences of subsequent injury are severe with long hospital stays and high hospital costs, as well as secondary consequences for loss of independence, loss of confidence, and susceptibility to future injury. The perceptions of individuals with SCI about the severity of and their susceptibility to injury, and the efficacy of individual and environmental actions to prevent subsequent injury described in this research should be used to inform the development and implementation of interventions and policies that prevent subsequent injury. Subsequent injuries are a health threat and burden for individuals with SCI, but prevention is possible and should be a priority.

APPENDIX A

STUDY 2: ADDITIONAL TABLES

Table A.1. Unadjusted factors associated with injury hospitalizations due to falls, motor vehicle traffic and poisonings among individuals with quadriplegia versus paraplegia, Nationwide Inpatient Sample, 2003-2009 (n=5,738) [1,2]

	All Causes of Injury (n=5,738)		Falls (n=1,994)		Motor Vehicle Traffic (n=676)		Poisoning (n=489)	
	Adjusted OR	(95% CI)	Adjusted OR	(95% CI)	Adjusted OR	(95% CI)	Adjusted OR	(95% CI)
Sex								
Female	1.00		1.00		1.00		1.00	
Male	1.30	(1.15,1.46)	1.45	(1.20,1.75)	1.20	(0.86,1.68)	1.21	(0.80,1.84)
Age Group								
18-34	0.81	(0.69,0.95)	0.90	(0.63,1.26)	0.63	(0.37,1.08)	1.24	(0.55,2.77)
35-49	0.72	(0.61,0.84)	0.59	(0.46,0.77)	0.65	(0.38,1.13)	1.68	(0.83,3.39)
50-64	0.86	(0.74,0.99)	0.75	(0.61,0.94)	0.68	(0.39,1.19)	1.54	(0.76,3.12)
65+	1.00		1.00		1.00		1.00	
Race								
White	1.00		1.00		1.00		1.00	
Black	1.10	(0.92,1.32)	1.67	(1.21,2.30)	1.47	(0.84,2.59)	1.12	(0.59,2.15)
Other	0.96	(0.80,1.15)	1.07	(0.80,1.43)	0.92	(0.56,1.51)	1.31	(0.66,2.59)
Missing	1.01	(0.87,1.17)	1.10	(0.86,1.40)	1.04	(0.65,1.67)	1.43	(0.87,2.35)
Comorbidity								
No other comorbidity	1.00		1.00		1.00		1.00	
+1 comorbidity	1.21	(1.04,1.40)	1.07	(0.81,1.40)	1.32	(0.92,1.91)	0.55	(0.27,1.15)
+2 or more comorbidity	1.12	(0.98,1.29)	1.24	(0.99,1.57)	1.26	(0.88,1.80)	0.36	(0.19,0.69)
Disposition of Patient								
Routine/Discharge alive, destination unknown	1.00		1.00		1.00		1.00	
Transfer to short term hospitals	2.72	(2.09,3.54)	3.76	(2.39,5.91)	2.74	(1.28,5.87)	0.19	(0.02,1.48)
Other transfers (long term)	2.20	(1.91,2.54)	2.38	(1.86,3.05)	3.33	(2.15,5.17)	1.23	(0.77,1.98)
Home health care	0.97	(0.80,1.17)	0.91	(0.64,1.28)	1.65	(0.79,3.46)	0.87	(0.51,1.47)
Died in hospital	8.41	(6.31,11.21)	10.17	(6.41,16.14)	8.08	(4.00,16.32)	2.99	(0.91,9.83)

Table A.1. Continued

Insurance								
Medicare / Medicaid	1.00		1.00		1.00		1.00	
Private (incl HMO / other)	1.35	(1.20,1.52)	1.15	(0.94,1.40)	0.92	(0.65,1.29)	0.93	(0.55,1.55)
Uninsured (Self pay & No charge)	1.46	(1.11,1.93)	1.47	(0.92,2.36)	0.91	(0.49,1.69)	1.47	(0.34,6.31)

1. The predicted outcome in this model is quadriplegia versus paraplegia. The reference group is injury hospitalizations to individuals with paraplegia.

2. Weighted to discharges from all community, non-rehabilitation hospitals the US.

Table A.2. Mean and median of hospital outcomes (excluding outliers) for injury hospitalizations among individuals with pre-existing spinal cord injury, Nationwide Inpatient Sample, 2003-2009 (n=4,810)[1,2]

	Length of Stay (days)		Hospital Charges (per discharge)[3] (2009 $US)			Hospital Costs (per discharge)[3,4] (2009 $US)		
	Mean	Median	Mean	Median	Total (million)	Mean	Median	Total (million)
Total	10.3	5.1	85,169	37,510	1,959.0	30,578	14,259	720.0
Type of Spinal Cord Injury								
Quadriplegia	14.2	7.4	121,941	59,622	1,137.1	43,462	22,649	414.0
Paraplegia	7.6	4.2	60,094	30,138	821.8	21,827	11,889	306.1
Cause of Injury								
Falls								
Quadriplegia	12.1	7.2	109,045	60,065	357.6	38,123	22,937	128.7
Paraplegia	6.5	4.1	51,342	30,903	247.2	18,449	11,800	91.7
Motor Vehicle Traffic								
Quadriplegia	24.8	17.5	251,381	193,205	356.7	93,975	77,136	136.1
Paraplegia	13.1	9.9	150,771	111,128	161.5	57,122	41,893	60.7
Poisoning								
Quadriplegia	5.7	2.9	30,426	19,261	19.3	11,916	7,813	8.1
Paraplegia	4.7	2.7	28,267	17,920	40.8	10,410	6,980	15.5

1. Patients who died (n=360) or transferred to short-term hospitals (n=312) were excluded.
2. Influential outliers on hospital costs (n=256, 5.1%) were removed using Cook's D diagnostics.
3. Hospital charges and costs were weighted for national estimates of hospital charges/costs and adjusted to the year 2009 inflation rates for in-hospital care.
4. Hospital costs calculated using charge-to-cost ratios provided by Nationwide Inpatient Sample.

Table A.3. Mean hospital costs (2009 $US) of total sample by type of spinal cord injury and cause of injury, Nationwide Inpatient Sample, 2003-2009, n=5,066[1,2]

	Paraplegia					
	Falls (n=1,017)		Motor Vehicle Traffic (n=234)		Poisonings (n=321)	
	Mean	Total (million)	Mean	Total (million)	Mean	Total (million)
Total	19,764	100.8	59,547	66.8	14,482	22.9
Sex						
Female	15,323	32.7	56,083	17.2	12,241	8.0
Male	22,962	68.1	60,848	49.6	16,066	14.9
Age Group						
18-34	32,815	14.0	64,500	24.9	8,280	2.0
35-49	19,527	24.0	67,377	23.8	18,885	12.5
50-64	17,752	29.0	42,952	11.7	11,724	5.3
65+	18,629	34.0	58,856	6.2	13,903	3.1
Race						
White	19,185	56.1	68,938	41.7	16,218	15.2
Black	16,854	7.0	39,392	5.8	7,897	1.5
Other	27,617	16.8	82,725	12.7	20,795	2.8
Missing	18,078	21.2	30,635	6.6	10,625	3.5
Comorbidity						
No other comorbidity	17,994	20.4	59,906	24.6	8,880	1.3
+1 comorbidity	19,762	26.1	50,590	16.6	9,751	2.6
+2 or more comorbidity	20,485	54.6	66,808	25.6	16,231	19.1
Disposition of Patient						
Routine	12,285	19.2	22,856	9.1	9,331	6.7
Other transfers (long term)	25,580	65.1	86,423	55.4	13,387	6.2
Home health care	16,612	16.7	28,365	2.3	24,864	10.1
Insurance						
Medicare / Medicaid	17,153	63.3	46,478	15.7	15,600	20.0
Private (incl HMO /Other)	24,600	30.7	67,370	45.7	9,754	2.7
Uninsured (Self pay & No charge)	39,968	7.0	53,057	5.3	DS	DS

Table A.3. Continued

	Quadriplegia					
	Falls (n=728)		Motor Vehicle Traffic (n=324)		Poisonings (n=140)	
	Mean	Total (million)	Mean	Total (million)	Mean	Total (million)
Total	48,582	176.2	103,612	162.7	16,551	12.1
Sex						
Female	39,192	49.4	97,267	34.0	15,957	4.5
Male	53,584	126.8	105,428	128.7	16,922	7.6
Age Group						
18-34	50,343	18.7	115,415	63.8	16,502	1.6
35-49	53,810	38.3	97,113	49.4	16,334	5.4
50-64	50,001	54.6	102,743	37.2	19,285	4.5
65+	44,498	64.6	83,904	12.4	8,471	0.6
Race						
White	52,224	100.4	92,241	76.1	17,114	6.6
Black	52,778	22.4	116,880	29.2	19,376	1.6
Other	53,743	21.4	165,818	32.3	15,259	0.9
Missing	36,295	32.0	83,524	25.1	14,737	3.0
Comorbidity						
No other comorbidity	44,195	31.5	95,799	43.3	9,212	1.2
+1 comorbidity	47,012	42.1	108,611	60.9	15,734	2.7
+2 or more comorbidity	50,826	102.6	104,920	58.5	19,056	8.3
Disposition of Patient[2]						
Routine	32,215	21.8	62,473	14.1	10,564	3.6
Other transfers (long term)	56,177	144.4	111,097	140.0	23,703	5.9
Home health care	26,314	10.0	101,721	8.5	18,289	2.6
Insurance						
Medicare / Medicaid	45,514	110.9	129,879	63.3	14,608	8.4
Private (incl HMO /Other)	56,263	57.5	90,443	85.5	23,310	3.3
Uninsured (Self pay & No charge)	47,211	6.9	100,306	12.1	DS	DS

1. Patients who died (n=360) or transferred to short-term hospitals (n=312) were excluded.

2. Hospital costs were calculated using cost-to-charge ratios provided by NIS, weighted for national estimates of hospital costs, and adjusted to the year 2009 inflation rates for in-hospital care.

DS = Discharge information suppressed since cell count is ≤ 10 (The Nationwide Inpatient Sample data user agreement precludes publishing cell counts ≤ 10).

Table A.4. Predicted differences in hospital costs (2009 $US) of total sample for injury hospitalizations for individuals with pre-existing quadriplegia versus paraplegia, Nationwide Inpatient Sample, 2003-2009, n=5,066[1,2,3]

	Paraplegia (n=2,954)				Quadriplegia (n=2,112)			
	Mean	Total (million)	Δ%	Predicted difference[4]	Mean	Total (million)	Δ%	Predicted difference[4]
Total	23,716	346.8			54,754	566.1		
Sex								
Female	18,127	96.1	Ref		41,858	136.8	Ref	
Male	26,894	250.7	22.6	$4,105**	60,713	429.3	20.9	$8,760**
Age Group								
18-34	34,278	95.5	46.5	$8,357**	77,956	157.1	55.8	$24,717**
35-49	26,195	113.6	27.9	$5,009**	55,564	155.5	14.0	$6,196
50-64	18,689	74.4	3.7	$671	47,340	136.6	-6.0	-$2,668
65+	17,957	63.4	Ref		44,292	116.9	Ref	
Race[5]								
White	23,010	172.1	Ref		52,012	275.0	Ref	
Black	23,175	42.0	11.7	$2,699	68,076	89.1	15.3	$7,949
Other	37,681	60.4	46.6	$10,718**	73,084	74.2	33.2	$17,284*
Missing	19,386	72.7	0.2	$57	46,860	127.9	-4.1	-$2,144
Comorbidity								
No other comorbidity	26,200	95.5	Ref		53,671	122.4	Ref	
+1 comorbidity	24,198	89.1	4.0	$1,043	58,148	168.1	13.3	$7,162
+2 or more comorbidity	22,222	162.6	11.0	$2,887*	53,333	275.6	27.8	$14,913*
Disposition of Patient								
Routine	13,897	71.6	Ref		30,554	72.8	Ref	
Other transfers (long term)	33,837	226.1	117.0	$16,256**	67,869	452.6	141.4	$43,201**
Home health care	17,596	49.5	45.6	$6,335**	31,238	40.0	34.7	$10,599*
Insurance								
Medicare / Medicaid	19,272	195.2	Ref		46,651	296.7	Ref	
Private,(incl HMO /Other)	32,582	127.7	30.6	$5,903**	67,894	236.7	51.4	$23,975**
Uninsured (Self pay /No charge)	41,306	23.6	37.8	$7,283*	66,199	30.1	66.7	$31,136**

Table A4. Continued

Falls								
Fall injuries	19,698	102.4	4.0	$1,030	48,116	177.8	16.1	$9,385*
All other injuries	25,918	244.8	Ref		58,445	388.4	Ref	
Motor Vehicle Traffic (MVT)								
MVT injuries	58,711	67.5	-23.9	-$5,923**	103,419	163.6	-41.4	-$19,019**
All other injuries	20,726	279.7	Ref		45,964	402.5	Ref	
Poisoning								
Poisoning injuries	15,014	24.0	123.8	$25,659**	17,140	12.7	108.6	$62,618**
All other injuries	24,776	323.5	Ref		57,658	553.4	Ref	

* p <0.05 ** p <0.001

1. Patients who died (n=360) or transferred to short-term hospitals (n=312) were excluded.

2. The models were clustered on hospital and variables used for hospital weighting strata (ownership/control, bed size, teaching status, urban/rural location, and region).

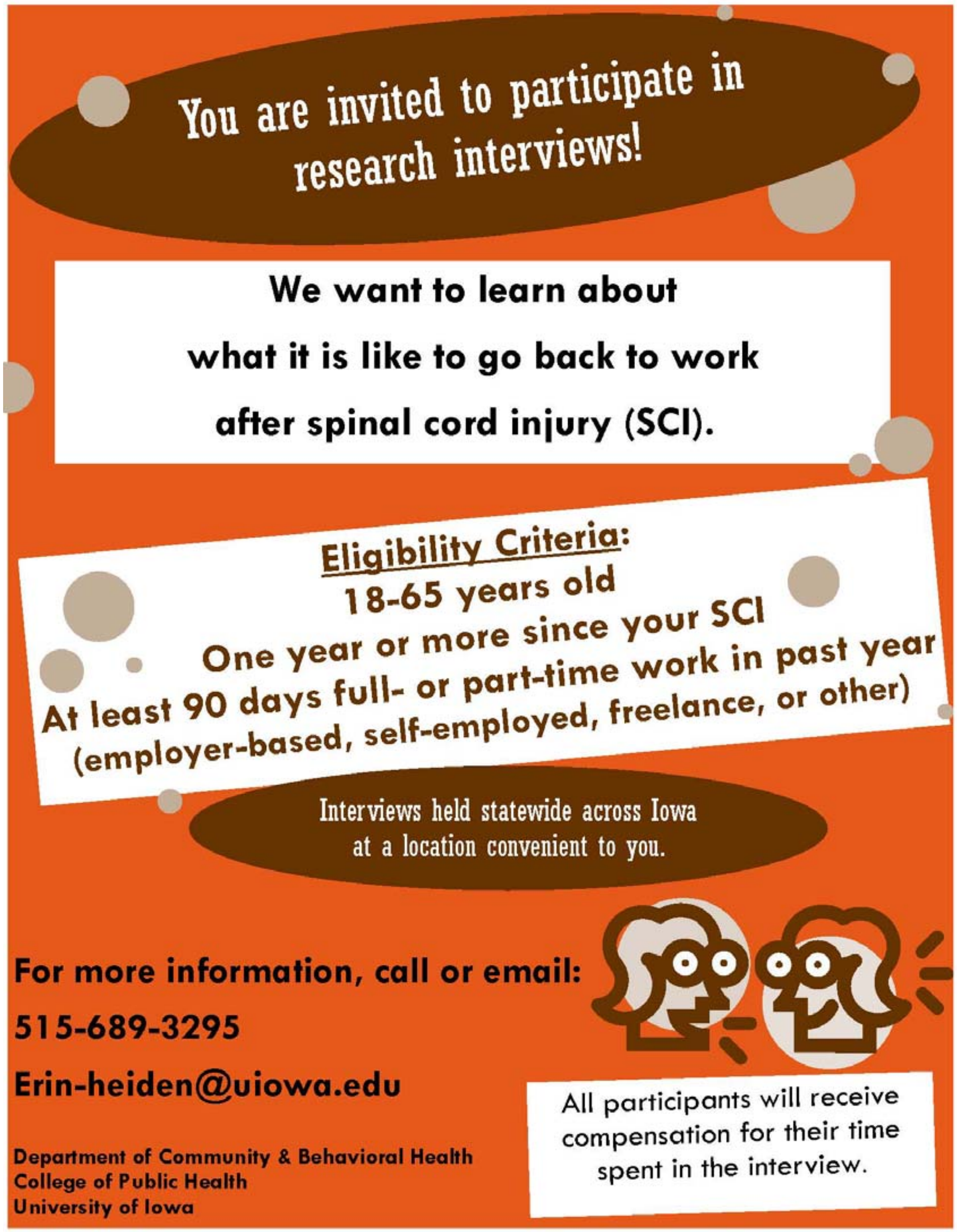
3. Hospital costs were calculated using cost-to-charge ratios provided by NIS, weighted for national estimates of hospital costs, and adjusted to the year 2009 inflation rates for in-hospital care.

4. The Student’s t-test was used to test significance.

5. Observations with missing values for race were included to preserve 23.6% of records with missing race information in the model. Observations with missing values for other variables were removed in the analysis.

APPENDIX B

STUDY 3: RECRUITMENT FLYER AND CONSENT



FOR IRB USE ONLY
APPROVED BY: IRB-01
IRB ID #: 201010760
APPROVAL DATE: 10/21/10
EXPIRATION DATE: 10/21/11

Letter of Consent

We invite you to participate in a research study because you have returned to work following a spinal cord injury (SCI). The purpose of this research study is to describe how SCI experience affects an individuals' work life and efforts to communicate the future prevention of subsequent injury or injuries. Approximately 20 people will take part in this study at the University of Iowa.

If you agree to participate, we would like you to:

1. Complete a short survey that asks questions about you and your SCI, such as your birth year, education, and level of SCI.
2. Answer questions in an in-person interview about your work experience after SCI, talking to an employer about your SCI, and preventing future injuries.

You may choose to skip any questions that you prefer not to answer in either the survey or interview. The interview will last approximately one hour.

Interviews will be audio recorded, so that we have an accurate record of what you said. The recordings are not connected to your name and they will be destroyed when the recording is transcribed. Only research staff will have access to the recordings. Pseudonyms and ID numbers will be used on all study documents.

We will keep the information you provide confidential, however federal regulatory agencies and the University of Iowa Institutional Review Board (a committee that reviews and approves research studies) may inspect and copy records pertaining to this research. If we write a report about this study we will do so in such a way that you cannot be identified.

There are no known risks from being in this study, and you will not benefit personally. However we hope that others may benefit in the future from what we learn as a result of this study.

You will not have any costs for being in this research study.

You will be paid for being in this research study. You will receive a $30 gift card for your participation even if you do not complete the interview. You will need to provide your social security number (SSN) in order for us to pay you. You may choose to participate without being paid if you do not wish to provide your social security number (SSN) for this purpose. If your social security number is obtained for payment purposes only, it will not be retained for research purposes.

Taking part in this research study is completely voluntary. If you decide not to be in this study, or if you stop participating at any time, you won't be penalized or lose any benefits for which you otherwise qualify.

FOR IRB USE ONLY
APPROVED BY: IRB-01
IRB ID #: 201010760
APPROVAL DATE: 10/21/10
EXPIRATION DATE: 10/21/11

If you have any questions about the research study itself, please contact: Erin Heiden at 515-689-3295**.** If you experience a research-related injury, please contact: Erin Heiden at 515-689-3295. If you have questions about the rights of research subjects, please contact the Human Subjects Office, 105 Hardin Library for the Health Sciences, 600 Newton Rd, The University of Iowa, Iowa City, IA 52242-1098, (319) 335-6564, or e-mail irb@uiowa.edu. To offer input about your experiences as a research subject or to speak to someone other than the research staff, call the Human Subjects Office at the number above.

Thank you very much for your consideration.

Sincerely,

Erin Heiden, MPH
Principal Investigator

APPENDIX C

STUDY 3: INTERVIEW PROTOCOL AND SURVEY

INTERVIEW PROTOCOL

INTRO & BRIEF OVERVIEW

"The purpose of this interview is to learn about your work experience following your SCI and any additional injuries you have experienced since your SCI. In addition, I'd like to learn more about how you protect yourself from future injury in your daily life and at work. I appreciate your willingness to share your thoughts and experiences, and hope you'll feel comfortable sharing them with me. There are no right or wrong answers. You may skip any of the questions you don't want to answer. Your responses will be recorded so that there is a complete record of what was said during the interview, and so I do not have to try to write down everything as we are talking. Your responses will remain confidential and you will not be identified by name on the recording. Do you have any questions before we begin?" [Answer questions].

"*I will start to recording now*." [Start recording]

WORK HISTORY

1) How has it been since going back to work after your SCI? What kind of work have you done since your SCI?

[All participants will be screened for current employment pre-interview. Work is defined as having done any work for pay, which includes compensation for your time or a product. Compensation may include housing, food, or money. Demographic survey will ask about details of current employment at the end of the interview. If the participant identifies more than one job, focus on the current job]

a. What jobs have you had since your SCI?
b. What other work have you done either for no pay, trade, or other compensation?

"Now I'd like you to think about the conversations you've had with your employer or supervisor about your SCI and how it might affect your job responsibilities."

WORKPLACE SAFETY & SCI (COMMUNICATION)

2) Do you remember a specific conversation when you talked to your supervisor/employer about your SCI? Would you tell me about it?

a. When did this conversation happen? When you interviewed for the job? When you were hired? Or later on during your employment? What was the conversation about? Who initiated the conversation? How did the conversation go?
b. What other conversations do you remember? (get a sense of how often or frequency)
c. What did your boss/supervisor ask you regarding safety needs specific to your SCI?
d. What, if any, safety training did you receive for your job?
    i. Was safety training general (i.e. same as safety training for all employees) or specific for you regarding your SCI?
    ii. Have any workplace safety procedures (e.g. manuals, training, etc) been adapted specifically to fit your needs? How were they adapted? Who took the initiative in adapting them?

WORKPLACE SAFETY (ENVIRONMENT)

3) What are your safety concerns at your current job?

a. What are your safety concerns at your current job? What were your safety concerns at any previous job?
b. What would you tell your employer about preventing injuries for someone with SCI in your current job?
c. Who is responsible for protecting you from injury at work? Why? How is this same or different from everyday life?
d. Do you have/use Personal Protective Equipment (PPE) for your job? When and how often do you use the PPE?

"*Now I'm going to ask you about any injuries you've had since your SCI. An injury is a time you got hurt after a specific event, such as a fall or motor vehicle crash, rather than over time, such as an overuse injury. Things like fractures, burns, sprains/strains, and poisonings are considered injuries*.

INJURIES

4) What injuries, if any, have you experienced since your spinal cord injury?

a. Have you been injured since your SCI? Was the injury work related? Other?
b. How many times have you been injured since your spinal cord injury?
c. How often do you get injured (e.g. weekly, monthly, rarely)?
d. What were you doing when you got injured?
e. What happened after you were injured? How serious were you hurt? What were the effects / consequences of your injury? (e.g., effect on daily life and /or work)
f. Tell me about any close calls or near misses you've had and not got injured? (e.g. a fall but not hurt)
g. Where did the close calls or near misses happen? At work or while you were going to work?

5) Do you feel you are at risk for getting injured in the future? Why?

a. How fearful are you of getting injured? Are you afraid of getting hurt?
b. What is it that makes you afraid of being injured? Loss of additional function? Need for more rehabilitation? Pain? Loss of job?
c. How did your injury change your perception of your risk of getting injured?
d. Did your injury change the way you think about your risk of getting hurt?

INJURY PREVENTION

6) What do you do to prevent future injury? In general? At Work? Can you give me any examples of things you've been able to modify in your workplace to accommodate your needs and/or make your job safer?

a. What do you do to protect yourself / minimize risk from injury in your everyday life? At work?

b. How easy or difficult is it to protect yourself from future injury?

c. What are some things you do that are easy to protect yourself from injury? What are some things you do that are difficult for you to protect yourself?

d. Is there anything you have been told to do to protect yourself from injury that you are not able to do because of your spinal cord injury? What could you be doing to prevent injury that you don't? Why?

e. Have you tried to get more information about preventing injuries? Where did you go to get more information? How helpful was the information you received?

f. Has anyone told you how you can prevent future injuries? If so, who was it? What did they tell you? How helpful is the information you received?

"Thank you for taking the time to meet with me. I really appreciate your insight and sharing your experience."

[Stop recording. Confirm that participant has completed demographic questionnaire prior to interview. If not, have participant complete questionnaire. Give participant gift card.]

DEMOGRAPHIC SURVEY

Interview Date:_______________________________

Participant ID:________________________________

Section A: About You

1. What year were you born?
2. Are you…
   ___ Male
   ___ Female
3. What is the highest grade or year of school you completed?
   ___ Never attended school or only attended kindergarten
   ___ Elementary or middle school
   ___ Some high school
   ___ High school graduate
   ___ Some college or technical school or associate's degree
   ___ Bachelors degree
   ___ Graduate or professional degree (e.g., MS, MA, MFA, MSW, PhD, JD, MD)
4. Are you currently employed? (please check all that apply)
   ___ Employed Full Time
   ___ Employed Part Time
   ___ Self-employed
   ___ Student
   ___ Unemployed
5. Which one or more of the following would you say is your race/ethnicity (please check all that apply)?
   ___ White
   ___ Hispanic or Latino
   ___ Black or African American
   ___ Asian
   ___ American Indian/Alaska Native
   ___ Other
6. What month and year did you get your spinal cord injury?
   Month _____________
   Year _____________
7. What is your level of spinal cord injury?
   ___ Paraplegia
   ___ Tetraplegia/Quadriplegia
8. Spinal Cord Injury status:
   ___ Complete
   ___ Incomplete

Section B: Health Survey

1. In general, would you say your health is:

Excellent	Very good	Good	Fair	Poor

The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, limited a lot	Yes limited a little	No, Not limited at all
2. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf			
a. Moderate activities, such as using your wheelchair around your home			
3. Climbing several flights of stairs			
a. Going rapidly in your wheelchair for several blocks			

During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	Yes	No
4. Accomplished less than you would like		
5. Were limited in the kind of work or other activities		

During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	Yes	No
6. Accomplished less than you would like		
7. Did work or activities less carefully than usual		

8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

Not at all	A little bit	Moderately	Quite a bit	Extremely

These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
9. Have you felt calm and peaceful?						
10. Did you have a lot of energy?						
11. Have you felt downhearted and blue?						

12. During the past 4 weeks, how much of the time has your physical health, or emotional problems interfered with you social activities (like visiting with friends, relatives, etc.)?

All of the time	Most of the time	Some of the time	A little of the time	None of the time

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