Older Workers with Musculoskeletal Injuries: Characteristics and Prognostic Factors

by

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ABSTRACT

Background: Older workers often require more recovery time than younger workers due to various considerations such as comorbidities, which may result in prolonged work disability. Work disability and its negative consequences may be reduced by identifying injured workers who are at increased risk of developing work disability. The question of whether older injured workers have the same characteristics and prognostic factors as younger injured workers, however, requires more investigation. **Objectives:** This thesis aimed to determine the characteristics and prognostic factors for occupational disability following musculoskeletal (MSK) injuries among older workers, and to determine whether these characteristics and prognostic factors are significantly different than those for younger injured workers. **Methods:** The present investigation comprises three studies: one cross-sectional study and two cohort studies. All studies utilized a dataset containing administrative and clinical data for claims from the Workers' Compensation Board of Alberta. This database provides information about injured workers who had incurred work-related MSK injuries in Alberta and underwent a comprehensive return to work (RTW) assessment, and includes many variables (i.e. demographic and social, occupational, health/injury, and health care utilization). The dataset also includes information on whether the claimant continued to receive compensation payments 3 months following the RTW assessment or after discharge from subsequent rehabilitation programs (i.e. Functional Restoration). The study's participants consisted of three age groups: younger and middle-aged working adults (25-54 years), adults nearing retirement (55-64 years), and adults past retirement age (65 years and older). Variables were compared between the age groups. In the two cohort studies, logistic regression analysis examined the relevant variables as prognostic factors for work disability, as indicated by the receipt of wage replacement benefits. In addition to

identifying prognostic factors, regression analysis determined whether these factors were the same in the younger and older age groups by considering the interaction between each predictor variable and a dichotomous variable indicating age group. **Results:** All three studies revealed differences in the characteristics of injured employees among the age groups. Injured workers aged 65 years or older had a greater likelihood of lower educational attainment, working in trades and labour occupations, and not having rehabilitation recommended despite incurring more severe injuries. Furthermore, six factors – SF-36 Role Physical, modified work availability, number of health care visits, time period between accident and comprehensive RTW assessment, sex, and age – appear to be important in predicting work disability. In the second study, interactions between health care factors and the categorized age variable were statistically significant, with more physician and physical therapy visits predictive of delayed recovery only in younger workers. In the third study of workers discharged from rehabilitation programs, no significant interactions were observed between age group and any of the prognostic factors. However, age was a predictor of work disability, with older workers more likely to receive wage replacement. **Conclusions:** The study results indicate the need for researchers, healthcare workers, and employers to distinguish younger and older employees with respect to RTW considerations. As a group, workers aged 65 or older with MSK injuries appear to experience disadvantages from a vocational rehabilitation perspective. The research also revealed significant differences in prognostic factors for wage replacement across different age groups, especially related to the number of physician and physical therapy visits. More primary health care visits were associated with increased risk of prolonged occupational disability in younger, but not older age groups, implying that different treatment and prevention approaches should be considered for the younger group, such as early referral to multidisciplinary health services and

rehabilitation. Finally, despite significant disparities between the traits of younger and older workers, these two groups did not display major differences in prognostic factors for wage replacement after undergoing occupational rehabilitation. However, the negative prognostic factor of age indicates that older employees had a greater likelihood of experiencing prolonged occupational disability; this result emphasizes the need to examine other as yet unmeasured prognostic factors.

Preface

The following thesis comprises an original work by Fahad S Algarni under the supervision of Professors: Michele Crites Battié and Douglas Gross at the University of Alberta. As the author, I was responsible for designing, analysing, and writing the manuscripts for these three studies, receiving assistance from my supervisors: Dr. Gross DP, Dr. Senthilselvan A., and Dr. Battié MC. The Introduction (Chapter 1) and Literature Review (Chapter 2) as well as the General Discussion and Conclusion (Chapter 6) sections represent original work by me. The first study of the thesis, documented in Chapter 3, has been published as the following: Algarni FS, Gross DP, Senthilselvan A., & Battié MC. "Ageing workers with work-related musculoskeletal injuries." Occupational Medicine. 2015 Apr; vol 65 issue (3):229-37. The second and third studies, contained in Chapters 4 and 5, have not been published. All research studies in this thesis have received approval by the University of Alberta's Health Research Ethics Board (No: Pro00045248, Date: January 6, 2014).

DEDICATION

This thesis is dedicated to my loving wife, Asma. I want to thank her especially for her love, patience, unselfishness, perseverance, and encouragement throughout the entire thesis process. Without her endless support, I would not have accomplished this project. I also want to recognize my three children, Abdulaziz, Revan, and Taleen. Their enthusiasm and cheer provides me with a great sense of accomplishment in my work. Finally, I appreciate the constant inspiration from my mother, brothers, and sisters, who all motivated me to pursue my dreams.

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LIST OF SYMBOLS AND ABBREVIATIONS

FR Functional Restoration
HWE Healthy Worker Effect
LBP Low Back Pain
MSK Musculoskeletal
PDI Pain Disability Index
RTW Return to Work
SF-36 Short Form (36) Health Survey
TD Temporary Disability
VAS Visual Analog Scale for pain
WCB Workers' Compensation Board
WRB Wage Replacement Benefit

Chapter 1

Introduction and Objectives

1.1. Introduction

The workforce is aging in Canada and other developed countries.[1] Older workers require a longer time to recover from work-related injury than younger workers and are more likely to experience work disability.[2] This thesis examines the characteristics and prognostic factors for experiencing work disability after work-related musculoskeletal (MSK) injuries among older injured workers. Specifically, older injured workers are compared to younger workers through an investigation of a set of characteristics derived from the Alberta Workers' Compensation Board (WCB). This chapter provides a brief introduction to this thesis, outlines the problem statement and identifies specific objectives of this thesis research. Chapter Two provides a literature review discussing the most relevant topics. The next three chapters describe primary research studies that have been published or submitted for publication. Finally, the last chapter discusses and synthesizes the most important findings of this research project. This brief introduction provides an overview of important issues related to work-related injuries, return to work (RTW), work disability and aging. Additional details are found in the full literature review in Chapter Two.

1.2.Work-related Injuries

On an international level, work-related injuries or disorders regularly cause temporary or even permanent work disability. In Canada, according to the Human Resources and Skills Development Department, "one in every 68 employed workers in 2010 was injured or harmed on the job and received workers' compensation as a result."[3] In the USA, researchers estimated that in 2010, 3.9 million workers in "private industry and state and local government" had a nonfatal work-related injury or illness.[4] The same report revealed that 2 million of those workers were "transferred, placed on work restrictions, or took time away from work."[4] Previous studies have also found, significantly, that older workers are more susceptible to experiencing work-related injuries. For example, these workers are more likely to lose work time, and they are less

likely to return to work after work-related injuries.[5-7] Research has also shown that work-related injuries are more common as age increases.[8,9]

Among work-related injuries, MSK injuries are one of the most common types. However, Loisel (2013) states that at the beginning of the 20th century, high rates of acute and fatal occupational injuries also occurred.[10] As these rates have declined, they have been offset by a greater increase in the incidence of compensated MSK and mental health disorders.[10] In Ontario, MSK claims form about 70% of all claims made by workers to the Workplace Safety & Insurance Board.[11] In British Columbia, research demonstrated that more than half of the total of lost-time claims and disability days resulted from MSK injuries (60%).[12] The consequences of MSK injuries, as the International Classification of Functioning and Disability reports, may affect body functions and structures leading to restrictions in participation in activities,[13] and the injured worker may ultimately lose the ability to work. Consequently, this may affect his or her health, self-respect, financial income and connections with the community.[14] Since MSK disorders are considered one of the main reasons for functional loss and activity limitations as well as short and long-term disability,[15] this injury type represents an important occupational health issue. Such injuries may not only have problematic impacts on workers, they may also create challenges for employers, health care systems, and compensation systems.[16] After such injuries, workers may experience obstacles when returning to work; and some workers may undergo longer periods of work disability.

1.3. Return to Work and Work Disability

Following work-related MSK injuries, a critical challenge facing employers and health providers involves the facilitation of RTW. According to previous studies,[17-19] RTW entails returning to the same, or a similar, level of work or education as that performed before injury. This often occurs within the first 4-6 weeks for non-complicated soft-tissue injuries. Research has shown that a delay in RTW creates significantly high costs for both compensation systems and rehabilitation programs.[20] A previous study (2007) in Washington State investigated predictors of work disability after MSK disorders.[21] These authors found that 48% of injured workers spent at least 30 days, 27% spent at least three months, and 18% spent at least six months away from work due

to work disability.[21] These long periods of work absence have detrimental effects on workers' health, self-respect, financial income, and community connections.[14] Moreover, these effects may involve more serious consequences among older workers.

The most serious consequence of work-related injuries is work disability. *Work disability* has been defined as the inability to work or return to work partially or completely due to the presence of a disease or injury.[10,22] Although work disability has significant implications for individual and public health, researchers have given limited attention to the problem.[10] Previous studies have reported that a long period of work disability increases the risk (by two to three times) of poor general health and mental health.[23,24] Long-term disability also has critical financial effects and costs. These expenses may occur directly through health care services, lost-time wage replacement, and disability settlements or pensions. Moreover, indirect costs may include training efforts to provide substitute workers, lost tax revenues, and decreased work productivity.[6] After work-related injuries occur, several factors affect the ability of injured workers to recover and continue working. The effects of aging can further impede recovery and the RTW process in older workers. While work disability represents an important issue for all injured workers, it may have particular importance in the context of older workers, who experience more difficulties in recovering from injuries.

1.4. An Aging Population

The proportion of older individuals (≥65) among the general population has increased substantially in recent decades,[25] and is expected to continue to increase in the future. In 2008, the number of people aged 65 years and older constituted 7% of the world's total population; this figure is expected to double to 14% by 2041. The mean age of the general population will increase at a rate faster than previous increases for a number of reasons, such as low birth rates and increased life expectancy. Newman and Cauley (2012)[25] state that in more than 45 countries, the life expectancy at birth may exceed 80 years.

1.5. An Aging Workforce

This increase in the number of older adults will be reflected in the workforce. In fact, increasingly higher numbers of Canadians are continuing to work beyond the typical retirement age of 65 years.[26] In 2013, the Canadian labour force consisted of 8 million Canadians aged 45 or older and 3.6 million Canadians aged 55 or older out of a total of 18.7 million workers.[27] Moreover, employment rates for older men and women (≥ 55 years) in 2010 were 44.9% and 36.6% respectively, while these rates were 37.6% and 22.3% in 1997.[27] According to the Canada Safety Council (2010), "the Canadian workforce is aging and older workers are making up a greater portion of the workforce."[28]

Assuming a retirement age of 65, people can expect to live approximately two decades beyond this age.[26] Researchers have estimated that male and female workers who retired at age 62 between 1990 and 1995 may live 17 and 21 more years, respectively.[29] Therefore, older workers may stay in the workforce longer today than they did in the 1990s.[30] Between 1995 and 2009, researchers screened a sample of the American population to reveal that, in early 2009, 14% of women and 24% of men between 70 and 74 were still working. In addition, approximately 25% of women and more than 33% of men between 65 and 69 were still employed.[30] This raises questions about injury rates, recovery and disability in adults who continue working well beyond what has been a typical retirement age, as this may become increasingly common. While "safe and productive work" plays an important role in the health and well-being of older adults,[31-33] work-related injuries may have particularly severe consequences for older workers.[34,35]

Studies suggest that older workers generally require a longer time for recovery and have additional missed work days after work-related injuries.[36] However, there is a paucity of research into post-injury outcomes specifically among older workers (≥55 years old). One study found that older workers between 55 and 64 missed a median number of 19 days, while workers aged 65 or older missed an average of 30 days; as age increased, the number of missed work days also increased.[37] In a 2012 study assessing the impact of an aging workforce on the incidence of work-related injuries or diseases, investigators found an increase in the overall incidence of such injuries and diseases as

workers' ages increased into their early 60s.[38] Another investigation reported that age was a significant predictor of RTW in both short-term and long-term follow-ups of five and ten years respectively.[39] Specifically, younger injured workers were more likely than older injured workers to return to work.[39]

1.6. Problem Statement

Studies have found that when injured workers cannot resume work for a period longer than 3 months after receiving work-related injuries, they may continue to experience work disability for at least 15 months.[7] Therefore, an appropriate intervention should be initiated within the first few months in order to avoid a longer period of disability. This intervention should ideally target individuals who are most at risk of prolonged disability. Consequently, early identification strategies should focus on recognizing injured workers who may develop prolonged work disability.[6] In this context, research should aim to understand why some injured workers recover and return to work while other workers experience chronic work disability.[40] While such questions are critical for all injured workers, they are particularly important for older workers, who represent a growing segment of the population. The RTW rate decreases when the age of injured workers increases, according to Dasinger et al.[41]

Accordingly, the individual characteristics and prognostic factors related to RTW and work disability among older injured workers should be examined in an effort to support rehabilitation strategies that decrease the likelihood of prolonged work disability. This research would also assist in the early identification of older injured workers at risk of a delayed RTW. To the best of this researcher's knowledge, no study has paid sufficient attention to the prognostic factors related to workers aged 55 or older. The majority of previous studies have included workers whose ages ranged from 18 to 55, and, at times, 65. Thus, the results from these studies cannot be considered as fully representative of either older workers or younger workers. In addition, while many studies have investigated the predictors of work disability in MSK disorders, such studies are usually limited to specific disorders, such as back pain or rheumatoid arthritis, or investigate narrow domains, such as occupational factors. Consequently, a need still exists to examine a broader range of potential prognostic factors, especially in samples

representing different occupations and different MSK disorders.[15] Other limitations of previous studies include short-term follow-ups, inconsistent definitions of RTW or work disability, and a focus on mainly younger injured workers. The current project aims to overcome these limitations and to provide relevant information for older injured workers by studying this age group in detail. Accordingly, the **primary objective** of this project involves determining whether the characteristics and prognostic factors for receiving Wage Replacement Benefit (WRB) among older injured workers differ from those of younger injured workers.

1.7. Specific Objectives

This project addressed the following specific objectives:

1) To characterize and compare the characteristics (demographic and social, occupational, health/injury, and health care) of individuals experiencing work-related musculoskeletal conditions across three age groups: younger and middle-aged working adults (25-54 years), adults nearing retirement age (55-64 years), and adults past typical retirement age (≥65 years).

2) To identify prognostic factors for continuing to receive Wage Replacement Benefits three months after assessment among injured workers, and determine whether these factors differ between young and middle-aged working adults (25-54), adults nearing retirement (55-64), and adults past typical retirement age (≥65) using a set of characteristics (demographic and social, occupational, health/injury, and health care) derived from workers' compensation claims data collected at the time of RTW assessment (the baseline measures).

3) To identify prognostic factors for Wage Replacement Benefits for injured workers in two age groups (25-54 years and ≥ 55 years) who underwent a Functional Restoration Rehabilitation Program after comprehensive RTW assessment. The prognostic factors were a set of characteristics derived from workers' compensation claims data collected at the time of comprehensive RTW assessment (the baseline measures).

1.8. Rationale

This thesis project has important implications for the prediction of RTW or work disability and patient care. Specifically, the project provides a unique opportunity to investigate both older and younger injured workers in a Canadian setting and population, thus representing a novel contribution to the literature. Given the high incidence and burden of work disability following work-related MSK injuries, the aging of the workforce, and the need to retain skilled and experienced older workers, this research seeks to identify injured workers at high risk of developing work disability through recognition of their characteristics and prognostic factors for receiving WRB and to determine whether older workers have different characteristics and prognostic factors than younger workers.

Indeed, the investigation of prognostic factors for work disability/RTW will be beneficial in many ways. First, this project may assist in determining whether older injured workers have the same characteristics and prognostic factors for WRB as younger injured workers. As a result, older injured workers may require a different approach as well as unique rehabilitation strategies and programs. Second, the project may provide insight into the reasons that some injured workers return to work while others develop long-term disability. Third, the thesis may help to prepare strategies for preventing disability by focusing on modifiable prognostic factors. Finally, this project may also contribute to developing predictive models and screening tools that may help occupational physicians and other health professionals to identify injured workers who are more likely to develop early disability and to provide necessary intervention. The third study was limited to claimants undergoing a provider site-based program (Functional Restoration Program), which represents the most commonly prescribed program. Studies have shown that the functional restoration approach is highly recommended for patients with chronic back pain and disability;[42] and that the early use of such an approach may help in avoiding the transition from acute to chronic stages.[43]

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Chapter 2

Literature Review

2.1. Introduction

In a recent book regarding work disability, Loisel and Anema (2013) asserted that "work is central in people's lives and well-being and positively impacts the physical, mental, financial, and social health of individuals and communities."[1] Indeed, the occupation of work encompasses more of one's life span than nearly any other activity. Work offers many advantages, such as financial security, the development of friendships, the provision of physical and intellectual stimulation, and life satisfaction. Consequently, it represents an activity necessary for the complete wellbeing of an individual.

Moreover, research suggests that work retains its importance throughout the human life span, as many individuals remain active even after retirement.[2] Studies have reported that experiencing "worklessness" may lead to long-term disability among older workers.[3] Thus, one of the most important challenges in the rehabilitation field involves the growing number of older people who experience disability;[4] seniors who lack the ability to work due to disabilities comprise the fastest growing segment of the population.[5] Such disabilities may result from work-related injuries. Among these injuries, musculoskeletal (MSK) disorders represent a particularly prevalent and serious issue. The effects of MSK injuries on individuals and society, particularly among the aging workforce, constitute critical research areas.

This is particularly important given that MSK disorders may ultimately affect the ability of injured employees to work. Due to the positive impact of employment on wellbeing, such disabilities may also affect workers' health, self-respect, financial income, and community connections.[6] In Australia, for example, 87% of all serious workers' compensation claims between 2003 and 2010 resulted from MSK injuries and disorders. Therefore, MSK injuries require the most expensive occupational health services.[7] In Sweden, for instance, the cost of certified sick leave and compensation for MSK disorders in 2005 totaled approximately €9,700 million Euros.[8] Research also reports that the prevalence of MSK complaints increases with age.[9] According to a

previous literature review (2012), older age was associated with an elevated risk of MSK disorders.[10] These studies underscore the importance of facilitating timely return to work (RTW) after work-related MSK injuries in order to avoid the detrimental effects of prolonged work disability.

2.2. Work Disability

Increasing numbers of workers are abandoning the workforce due to disability. Among workers aged 16-64 in Sweden, the proportion of employees who were granted disability pensions has increased. Between 1970 and 2000, this number rose from 3.7% to 7.8%. Five years later, in 2005, it had grown to 9.5%.[11] This significant upsurge in disabled injured workers may have been even more drastic among older workers. It has been reported that older workers are more likely to experience permanent work-related disabilities than younger workers.[12] A 2008 study reported that work disability represents the most common reason for retirement before the age of 60.[13] These results indicate that employers who neglect the disability management needs of their older workers may suffer by losing an important segment of their workers. Therefore, older workers should receive effective care to decrease the probability of their abandoning the workforce due to disability.

In seeking to find such solutions, it is important first to distinguish between pain and disability – a distinction that is often not made by patients or health professionals. Although the two terms are related, they contain different conceptual and clinical implications.[14] The Americans with Disabilities Act (ADA) defines a *disability* as:

> A physical or mental impairment that substantially limits a major life activity.' Recently the definition of 'major life activities' was broadened to include 'caring for oneself, performing manual tasks, seeing, hearing, eating, sleeping, walking, standing, lifting, bending, speaking, breathing, learning, reading, concentrating, thinking, communicating and working.[15]

While a disability entails long-term implications, pain begins as a short-term occurrence, and, if left untreated, may worsen into a disability. Specifically, *pain* involves "an unpleasant sensory emotional experience associated with actual or potential tissue

damage, or described in terms of such damage."[14] According to the disease model, a tissue injury that creates pain leads to some physical impairment that eventually causes disability. From this perspective, pain precedes disability, necessitating the treatment of pain in order to avoid the disability. Although this assumption explains some types of pain that occur due to injuries such as fractures, it fails to account for pain that results from a nonspecific cause, such as nonspecific low back pain (LBP). Many individuals experience LBP, but they still work without becoming disabled.[14]

From the perspective of these distinctions, the term *work disability* may indicate the inability to work due to the presence of either disease or injury.[16] Loisel (2013) defined work disability as "a person's inability to remain at or return to work during the course of or after an injury/illness."[1] The term has also been used to describe the partial or complete inability to perform work functions and to indicate compensated work absence.[1] In addition, a *disabled worker* is "unable to stay at work or return to work because of an injury or disease."[1] Although injured workers may experience an improvement in their condition and return to work, they may also possess a temporary or permanent disability.[1] After the occurrence of a work-related injury or disease, several factors affect the ability of injured employees to continue working. These factors can assist employers or healthcare professionals in identifying injured workers who may develop work disability. Overall, work disability involves an inability to work or RTW partially or completely due to the presence of a disease or injury in addition to the effects of other factors, such as biopsychosocial aspects.

The development of a chronic work disability is often described in three stages.[17,18] The first stage, the acute stage, begins at the time of the injury and lasts for up to four weeks. Subsequently, the sub-acute stage occurs from 4 to 12 weeks, and the chronic stage occurs after 12 weeks. Each stage entails different psychosocial issues, progression trajectories, illness behaviors, and interactions,[14] indicating the need for a different intervention at each phase. Moreover, the prognostic factors for RTW or work disability may vary from one stage to another. Due to the significant expenses involved in work disabilities, time comprises a critical concern for rehabilitation programs and health care.[14]

2.3. Return to Work

RTW represents the target outcome for injured workers, employers, compensation systems, health systems, and other stakeholders.[19] As the main outcome of occupational rehabilitation, RTW provides a meaningful measure of workers' function after injuries and an indicator of the efficacy of workers' compensation systems.[20] Not unlike work disability, RTW involves four phases: work absence, work re-integration, work maintenance, and job advancement.[1] Successful RTW programs require appropriate planning and effective communication between four groups: workers, employers, health providers, and insurers.[21,22] Although several studies have investigated RTW, there is no consensus on the definition of RTW. Each individual stakeholder often has a particular understanding of how to define and operationalize the definitions of RTW and disability.[23]

A systematic review conducted in 2006 revealed a need to develop consensus on a definition of RTW. The authors of this review recommended using a definition from Dutch social security laws, which described RTW as a "full return to regular work within a minimum duration of 6 weeks."[24] However, Fadyl and McPherson (2008) defined RTW outcome as "a return to paid work or not within a defined period of time, and the minimum time period considered appropriate for comparing 'returned to work' versus 'not returned' was four weeks after injury."[25] It should be noted that defining the RTW outcome as returning to the pre-injury level of work or education might be better than delimiting the definition to returning to a full time job because if the injured workers were originally working only part time, it might be easier to return to the same part-time job.[26] According to a previous review, [27] the use of different outcome definitions may create inconsistency among the results; consequently, researchers may struggle to compare or make valuable conclusions. Based on these various interpretations of RTW, this concept may be understood as a return to the same or similar level of work or education as that performed before the injury within a minimum time period of between four and six weeks. Finally, although studies reported that the predictors of RTW often differ from those of disability,[28,29] the inability to RTW after an injury may theoretically and operationally equate to occupational disability.[23]

Several strategies may assist RTW case managers in facilitating a successful RTW for their clients. These approaches include workplace evaluation, ergonomic intervention, clinical interviews and analyses, problem solving, and social environment coordination.[30] In developing these strategies, case managers must consider that every injured worker has unique reasons for RTW. These reasons arise, in part, from the demographic characteristics of each worker, such as age, gender, and financial status. Studies have reported that the most common reasons for RTW involve financial security (44%), medical ability to work (17.6%), and desire to "fill the day" (13.6%).[19] Despite the wide variety of reasons for RTW, the measurement process for the RTW outcome constitutes an important issue.

The measurements of RTW depend upon each stakeholder's definition of successful RTW.[31] Initially, the determination of RTW or employment status after work-related injuries may appear very simplistic; however, a consideration of its dimensions attests to its complexity. These dimensions include type of RTW, nature of responsibilities, duration of RTW, and wages.[1] The type of RTW distinguishes between full-time and part-time, while the nature of responsibilities measures the extent of work modifications.[1] While the duration of RTW involves the length of time that one remains at their occupation, wages measure the difference between pre-injury and post-injury.[1] Based on these dimensions, RTW comprises a spectrum rather than a clear-cut concept. RTW may indicate a full return to the pre-injury job and level of duties, but some injured workers require significant job modifications.[1] Moreover, the successful treatment of work-related disorders may fail to result in RTW when an employee has lost his/her job, [1] thus indicating that the inability for a partial or full RTW may result from factors other than health, such as issues with the employer or economy. [1]

In addition to these various dimensions, the complexity of assessing RTW involves a distinction between direct and indirect measurements. Direct measurements of RTW outcomes can entail a particular aspect, such as the end of disability benefits, while indirect measures may include an improvement in functioning or quality of life.[32] Loisel and Anema[1] assert that the ability to perform work duties can be measured by several methods, such as self-reports, health provider recommendations, and functional capacity

evaluations. However, these methods all have limitations. Some self-report questionnaires measure all tasks regardless of their relationship to the worker's occupation, which may skew study results. Moreover, health providers' RTW recommendations involve subjectivity, which may influence the generalizability and application of the study results. Finally, while functional capacity evaluations may entail accurate and objective measures of work ability, these assessments are weakly associated with actual work ability due to their poor relationship to real work duties and the fact that their performance typically occurs outside of the work environment.[1] Several authors have constructed specific measurement tools for assessing RTW. For instance, Franche et al. (2002) developed the readiness for RTW scale (RRTW), which involves a psychometrically validated 22-item scale.[33] This scale provides an effective assessment of a worker's readiness to RTW. Another 19-item validated RTW self-efficacy scale measures the confidence level of workers in communicating with colleagues, fulfilling job demands, and completing modified work duties.[34]

Furthermore, Loisel and Anema's (2013) textbook[1] states that administrative data may provide an objective outcome of work disability. Such data may include longitudinal information that assists in assessing the outcomes of work disability. Despite their benefits, administrative systems too contain limitations; for instance, the acceptance criteria for workers' compensation claims may differ among systems. Also, researchers who use the length of the disability period as an outcome should exercise caution, because some workers have reported their length of disability as longer than that shown in system records. This discrepancy may result from human or administrative error, failure to claim for all lost workdays, unofficial leave, or salary continuation arrangements. These authors[1] further add that researchers should exercise caution when considering the cessation of compensation payment, as this outcome fails to necessarily indicate that injured workers can RTW. The cessation of benefits may result from modified compensation systems or from the employee's return to school, choice to refrain from claiming benefits, or voluntary request of benefit cessation.[1] Moreover, the inability to RTW does not necessarily indicate a work disability because the injured worker may lack employment at the time of RTW, or their employer may not be able to

restore the worker's position due to financial issues or social factors rather than health factors that impede the RTW process.

2.4. An Aging Workforce

Researchers argue that the trend towards an aging global population, including the Canadian population, has been developing much faster than previously believed.[35] Studies reported that in 1996, the median age of the workforce was 35; however, researchers expect this median age to reach 45 by 2041.[36] In addition, the average Canadian life expectancy has been projected to reach 75.7 and 81.4 years for males and females respectively.[36] People who were 65 years old in 2000 should expect to live approximately 18 years longer.[37] According to Statistics Canada (2011), "Nearly one person in four in the labour force is projected to be 55 or more: The aging of the baby boomers, which is largely behind the projected decline in the overall participation rate, has had a major impact on the aging of the labour force."[38] The implications of this finding emphasize the necessity of maintaining the health and safety of older workers in the workplace in order to avoid labour and skills shortages.[39]

The workforce has been aging for many reasons, including a decrease in birth rates and an increased life expectancy.[35] Additionally, many younger adults focus on their education rather than immediately entering the labour market, and an increasing number of older women are participating in the labour market.[40] For these reasons, many countries have been developing policies that encourage older workers to remain in the workforce for longer periods of time[41] and discourage early retirement. Current research should attempt to derive an understanding of these polices and their impact on an aging workforce. In addition, studies should identify the characteristics of older workers who lack the ability to RTW or have become disabled due to work-related injuries.[42] Among these analyses, investigations may explore older workers' desire to continue working.

In a 2002 survey conducted by the American Association of Retired Persons, it was reported that eight out of ten people between 45 and 74 years of age showed a desire to continue working and failed to consider retirement regardless of their financial resources.[43] Hence, this survey indicates that older workers possess the desire to work.

Since employers also seek to retain the experience of older workers, employers and employees should collaborate on ways to facilitate delayed retirement. Older workers want and need to continue working for many reasons, which include both financial concerns and personal preferences. The economic aspects include the inadequacy or instability of pension programs, the insufficiency of personal savings, the lack of eligibility for social security benefits, the high cost of medication, and the inability to purchase health insurance.[44] In addition to these financial concerns, there are also a number of reasons why older workers may not be interested in retiring early. For example, they are currently living longer and are healthier than previous generations, and jobs have become less physically demanding.[45]

While these sources have highlighted the growing number of older people in the workforce, one should explore whether older workers are truly required in workplaces. The answer is clearly yes. Employers have realized the difficulty of replacing older workers with significant experience and skills; this attests to the critical nature of retaining skilled older employees.[46] The president of the American Society of Safety Engineers has stated in a press release "businesses must act now to accommodate and provide a safer work environment for the aging worker, a valuable and experienced group, or their bottom line will be impacted negatively."[47] This statement reflects the vital importance of older employees in the workforce. In fact, these individuals have decades of valuable experience and often possess high levels of skill.

The literature on older employees highlights the significant need to conduct additional studies on work-related MSK injuries among older workers. Despite the low to moderate rates of accidents and absenteeism among older workers,[48] these individuals take longer amounts of time to RTW after injuries or illnesses. This trend may result from the presence of other health problems or comorbidities as well as from the fact that older workers generally recover more slowly than younger workers.[49] Thus, while older workers may not necessarily file more workers' compensation claims than younger employees, the absence of older employees create high expenditures related to wage replacement, lost time, and health care costs.[46] The Association of Workers' Compensation Boards of Canada reports that compensation costs increase with age.[36]

Although younger workers incur more injuries than older workers, older workers usually experience more severe injuries and require a longer recovery period. For example, the average days lost per workplace injury varies from 11 for workers aged 19-29 to 47 for workers aged 50-59.[36] In addition, older workers may experience more serious consequences after work-related injuries than their younger counterparts due to the impact of aging-related changes.

2.5. The Effects of Aging

The process of aging has several effects that may impede injured workers' RTW or enhance work disability, which researchers should strive to understand. Individuals generally reach their full physical maturity and development at the age of 25, and, at the ages of 40 or 50, the signs of aging may begin to appear in people's bodies.[36] However, adults as young as 30 may begin to experience slight declines in their major bodily systems. Specifically, the functions of some organ systems, such as the cardiovascular, respiratory, metabolic, and muscular functions, decrease by < 2% annually after an individual reaches the age of 30 years old.[50] These physiological changes associated with aging may impair the working ability of older workers.[35] Such changes can occur as dysfunctions or decreases in muscular strength, range of motion, posture, sleep regulation, cognitive and mental functioning, thermoregulation, aerobic power, reflexes, reaction speed, and coordination as well as the acuity of special senses such as hearing, vision, smell, taste, and balance.[38,48,51,52]

However, these declines in human functioning may arise from factors unrelated to aging. An individual's physical, cognitive, and psychological status are related to several variables, including individual, physical, social, and psychosocial factors, which impact the chronological time at which individuals experience signs of aging.[53] Despite the individual influences on a person's functioning, many changes relate directly to aging, including functional capacity, cardiorespiratory fitness, musculoskeletal capacity, balance and reaction time, and psychosocial aspects. The following section of the literature review will discuss each of these aspects.

2.5.1. Functional Capacity

An association exists between aging and vital factors related to progressive deterioration. A decrease in these vital factors reduces overall functional capacity, which consequently affects the physical work ability of older workers. However, progressive deterioration resulting from aging depends on variables such as lifestyle, genetics, and chronic diseases.[54] One unavoidable problem of aging involves the imbalance between the functional capacity of older workers and work demands. While work demands may remain constant over time, the functional capacity of older workers declines with age.[54] The decline in functional capacity with aging constitutes a well-known phenomenon. One study reported that the highest peaks of functional capacity occurred between 20 and 30 years and subsequently declined after this period.[55]

The decreased functional capacity of older workers represents a problem because older and younger workers are often expected to complete the same task-related physical work demands. These requirements force older workers to work at or close to their maximum capacity. Studies have shown that employees who experience exposure to high levels of physical stress for long periods of time at maximal capacity may incur fatigue and health problems such as chronic MSK injuries/disorders.[56,57] The periods of high stress and subsequent injuries represent critical issues during the RTW process, as older injured workers usually possess a lower functional capacity after injuries. However, an aging-related decline in work ability may occur more frequently in occupations that require physical effort than in occupations that necessitate mental effort.[58] This finding shows the importance of understanding the nature of the job before assessing occupation as a prognostic factor for RTW/work disability. The imbalance between work demands and functional capacity may in all cases cause a new injury or aggravate recurrent work-related injuries or disabilities. For this reason, the goals of rehabilitation programs for RTW among older injured workers should likely focus on "reducing workload instead of regaining capacity."[59]

The decreased functional capacity of older workers may be expected to result in reduced productivity. Employers, insurance companies, and social security systems may therefore be expected to experience financial burdens due to the aging of older workers.

The suggested solutions may involve either decreasing the workload or increasing the functional capacity. Among these proposed solutions, the latter suggestion may be less feasible, given the unavoidable nature of changes resulting from aging.[59] Indeed, Ilmarinen (2002) demonstrated the need to decrease the physical work demands for older workers by 20-25% because of their reduced physical capacity and lower ability to recuperate from heavy physical demands.[58]

2.5.2. Cardiorespiratory Fitness

In addition to functional capacity, older workers also experience deterioration in cardiorespiratory fitness through a reduction in maximum oxygen consumption (VO_2 max).[35] Studies have reported that cardiovascular capacity decreases by approximately 5-15% per decade in both genders.[60-62] Although the deterioration of cardiac output occurs in a non-linear pattern, individuals experience a reduction of approximately 50% between the ages of 20 and 80 years.[35]

Pulmonary function also varies among older people.[35] Ventilation relies on the strength of respiratory muscles, which assist in the processes of inspiration and expiration by controlling the rib cage.[63] A decrease in pulmonary function may become more easily observed at the age of 60 because the elastic resistance of the chest doubles in comparison to that of younger people.[64] In addition, the reduced strength of respiratory muscles occurs at age 50 and affects both inspiration and expiration functions.[35] Limited respiratory functioning may represent a greater problem for older workers employed in a workplace with bad air quality.

2.5.3. Musculoskeletal Capacity

Furthermore, older workers may start experiencing a reduction in their aerobic fitness, muscular strength, bone quality, and bone density. These functional declines may increase their susceptibility to injuries and may delay recovery after such injuries; therefore, older workers who perform tasks requiring high levels of strength, rapid reactions, and repeated movements should enhance their caution in order to avoid injuries. According to Kenny et al. (2008), older workers should take longer rest periods

after intense work efforts and longer recovery time after injuries in comparison to younger workers.[35] Several biological changes related to the aging process may cause MSK disorders, such as degenerative changes in joints.[65] Moreover, studies have reported that the repetitive exposure to harmful work demands may increase the risk of disorders.[66] In sum, these changes may mean that older injured workers require a different approach than those typically used with young injured employees, as older workers experience several physiological changes that differentiate their needs from those of younger injured workers.

Kenney et al. reported in 2008, individuals between the ages of 30 and 65 years experienced a 25% decline in MSK capacity; however, these changes may not occur before the age of 45.[35] The ability to preserve muscular strength throughout an individual's lifetime may reduce functional limitations,[35] a fact that both workers and employers should acknowledge. Muscular strength reaches its peak between the ages of 20 and 35 years, plateaus around the age of 40, and begins to decline at the age of 50 years.[35] After the age of 50, muscular strength declines by an average rate of 12 to 15 % per decade; however, individuals experience a more rapid decline in strength after the age of 60 to 65 years.[35] As in the case of other functionalities, this trend reinforces the need to study workers over the age of 65 as a separate group. The same study by Kenney et al. found that after the age of 40, muscular strength in the lower extremities declines more rapidly than in the upper extremities.[35] In older age, the relatively weaker muscles of the lower extremities results in issues such as slower gait speed as well as impaired balance and stair climbing.[35]

In addition, another serious problem that often accompanies the reduction of muscle strength and other aging processes is the occurrence of bone fractures among older workers. These fractures result from reduced bone mineral density or from the progressive deterioration of bone microarchitecture. Furthermore, a reduction in bone mineral mass usually occurs with aging.[67] This reduction, together with other types of deterioration, may eventually lead to osteoporosis, which occurs more commonly after the age of 50.[35] Individuals may not be aware of osteoporosis until after the occurrence of fractures, and older workers may lack the ability to return to their previous quality of

life[35] or RTW. In addition, the deterioration of bone quality may be influenced by genetic factors, obesity, low calcium, and vitamin D deficiency.[35] Several authors have reported that the incidence of hip fractures increases with age in senior citizens, likely due to the increased prevalence of osteoporosis and risk of falls among older people.[68-70]

2.5.4. Balance and Reaction Time

Along with other factors, decreased muscle strength increases problems with balance and delays appropriate reaction time in older people. Reaction time is "conditioned by the speed of neural signal transmission to the central nervous system, decision making, motor program activation, and signal transmission to muscles."[71] Delayed reaction time in older adults may increase the risk of falls, which represent the most frequent cause of severe injury among older workers.[72] In fact, elderly people may suffer recurrent falls because they lack the ability to regain their balance rapidly upon stumbling.[54] As age increases, people may experience difficulties in maintaining the correct posture and balance. The Canadian Centre for Occupational Health and Safety reported that older workers are more prone to accidents that result from losing their balance.[38] Since initializating and executing fast movements require rapid reaction time, older people often suffer when muscular and nerve tissues weaken, thus influencing reaction and movement speed.[73-75] The decreased reaction time among older workers may directly or indirectly affect their RTW process following work-related injuries. Subsequently, this factor may cause new or recurrent work-related injuries and disabilities. Therefore, many physical factors appear to have a significant impact on older workers.

2.5.6. Psychosocial Factors and Aging

In addition to physical factors, psychosocial variables also impact the aging workforce. Psychosocial factors relate to "the influence of social factors on an individual's mind or behavior and to the interrelation of behavioral and social factors."[76] Within the community, senior citizens and their families comprise a very important portion of society. As a result, older workers may feel divided between two responsibilities: the duty of caring for their children and grandchildren as well as the task

of caring for their elderly parents. Such older workers are often referred to as members of the "sandwich generation." These multiple familial responsibilities may affect older workers' contribution to and productivity in the workplace[46] as well as increase the burden on older workers who have work injuries or disabilities.[46]

Moreover, older workers may experience changes in mental capacity, which manifests in the form of slower thinking. These decreased cognitive abilities result in longer periods of time required to perform new job related skills and increased difficulties in multi-tasking.[36] However, other studies show that older workers often perform tasks more accurately and make better decisions.[38] Thus, the increased accuracy of older workers mitigates the detrimental effects of their reduced speed. In addition to slower cognitive speed, the decreased mental capacity of older workers also results in the existence of depressive symptoms, which represents a common problem with aging.[48] Depression may also account for sleep problems among older people; in fact, one study found that sleep disorders and depression comprise common characteristics among older people.[48] Unfortunately, these two issues may affect the physical and cognitive functioning of older adults.[46,77] Another disorder that may occur alone or concurrently with other disorders, anxiety, has a prevalence rate of 15% among seniors.[78] These investigations suggest that psychological factors appear to fulfill an important role during the aging process.

Similar to psychological factors, social interactions also carry a significant influence during the aging process. It was found that morbidity rates of both physical and mental illness were reduced when a social support system was present.[79] Therefore, older individuals with strong social support networks demonstrated increased resiliency towards stressors and showed greater general emotional wellbeing.[80] Another study found that higher rates of depression and a decreased sense of wellbeing resulted from dysfunctional or non-supportive relationships among older people.[81] This result indicates the need for the inclusion of social networks in the RTW process for older injured workers.

The literature on aging has revealed many different types of age-related changes that have impacts on older people, especially older workers. These changes encompass

physical, social, and psychological developments, such as reduced functional capacity, cardiorespiratory fitness, and MSK capacity as well as several psychosocial disturbances. All of these changes require assessment as potential prognostic factors for RTW among older injured workers. Since the majority of these changes are not prevalent among younger workers, they suggest the necessity of studying older workers as a unique group. In fact, people of different ages possess diverse anatomical and physiological characteristics; this indicates the possibility of different injury tendencies despite the possession of similar injury mechanisms.[82] Consequently, research should aim to identify the characteristics of injured workers among different age groups for improving clinical assessment and intervention by increasing the focus on injured workers who may develop a work disability.[82] While scientific findings have revealed that aging creates several challenges for older people and health providers, encouraging advances in bio-psychosocial care may extend the lifespan of older workers by increasing their vitality and activity.[53] Only a limited number of studies have compared the characteristics of older injured workers with those of younger injured workers; thus, additional investigations are required to determine the existence of unique characteristics among older injured workers.

2.6. Characteristics of Older Injured Workers

Two studies have investigated the characteristics of older injured workers as well as the association between age and injury outcomes.[83,84] Berecki-Gisolf et al. (2012) found that as age increased, the period of work disability, which measured the time taken to the first RTW and the number of compensated days, increased.[84] Additionally, Pransky et al. (2005) reported that older workers experienced a longer duration of work absence and increased suffering from work disability after work-related injuries.[83] Due to the enormous implications that these studies have for identifying the characteristics of older injured workers, this review will analyze and discuss each study in detail.

2.6.1. Results from an Australian Study

Berecki-Gisolf et al. (2012)[84] aimed to assess the impact of an aging workforce on two factors: the incidence of work-related injuries or diseases and the RTW process. In

this prospective Australian study, these authors considered the personal characteristics, the afflictions, and the job characteristics of these workers. Berecki-Gisolf et al. followed 59,525 claimants for two years after the first income compensation payment. Older (≥ 50 years) and younger (< 50 years) injured workers demonstrated some notable differences. Among older workers, women were more likely than men to receive income compensation payments. However, younger employees demonstrated the inverse trend, as men were more likely to receive compensation payments. In addition, older workers possessed a higher pre-injury income and were more likely to work full-time jobs than younger employees. In contrast, younger workers had a greater likelihood to report their working status as apprentices or "other." Another finding revealed that while younger employees were more likely to work as tradespersons and laborers, as well as in administrative and support services, older workers had a greater likelihood of fulfilling roles as professionals and transport workers as well as working in fields such as education, training, health care, social assistance, and intermediate production.

These authors also presented notable results pertaining to injuries; younger workers were more likely to claim work-related injuries than older workers, especially for afflictions such as wounds, lacerations, amputations, and internal organ damage. The results also showed that older workers were more likely than their younger counterparts to have mental illnesses. Additionally, Berecki Gisolf et al. found that approximately equal proportions of older and younger workers appear to suffer from MSK injuries and disorders; however, these authors neglected to make multiple comparisons for these affliction categories. Another result revealed that the number of compensated days for work disability over two years increased with age. While the peak occurred between the ages of 50-59, the number of compensated work absences declined after the age of 60. However, the healthy worker effect (HWE) bias applicable to workers aged ≥ 60 years old may impact this finding. The authors also found that as age increased, the proportions of workers who failed to RTW increased. The odds of having at least one relapse following RTW increased with age up to the group of 50 to 54 year-old workers, and subsequently decreased with age. Finally, although some studies have reported that the highest work-related injury or illness rate occurs between the ages of 20 and 25,[85-87] this study found that the highest rates occurred between 45 and 55.[84] Although Berecki-Gisolf

et al. reported a decline in the incidence of work-related injury after age 55, this finding might be explained by the fact that workers with health problems choose to retire early.

2.6.2. Results from a US Study

A study conducted by Pransky et al. (2005)[83] aimed to "provide detailed information on occupational injury circumstances and outcomes" [83] among older workers (≥55) and younger workers (< 55). Pranksy et al. administered a self-report survey to selected participants in New Hampshire, USA. All participants had incurred a work-related injury in the past 2-8 weeks. The younger injured workers (<55) and older injured workers (≥55) possessed similarities in gender, injured body part, and date of injury. Study results also revealed similarities in some demographic characteristics, such education and annual income. However, older workers were more likely to be employed for a longer period, and more likely to be married. In comparison to younger workers, older workers experienced a higher probability of comorbidities. While only 12% of younger workers incurred hypertension, 35% of older workers reported this disorder. Similarly, other health problems occurred in 26% of older workers and in 16% of younger workers. Conversely, younger workers had a significantly higher prevalence of depression than their older counterparts. Both age groups demonstrated similar levels in physical job demands, rates of prior work-related injury, rapidity of injury onset, body part involved, and type of jobs and/or industry. Nevertheless, higher numbers of older workers reported their injury level as "severe": 34% vs. 24% of younger workers.

Pransky et al. (2005) also reported findings concerning workplace satisfaction. In comparison to older workers, younger workers provided significantly more negative views of their employers, more problems in RTW, lower satisfaction with the responses of workers' compensation insurers, and lower pre-injury job satisfaction. For example, job dissatisfaction was significantly worse among younger workers than among older workers. While younger workers provided a mean score for job dissatisfaction of 7.8, older employees, on average, rated their job dissatisfaction as 6.6. Younger workers also exhibited a greater likelihood to report negative employer responses, with their average rating for this aspect at 0.98 in comparison to older workers' average rating of 0.51. In addition, younger workers reported that their employers made fewer numbers of attempts

to communicate with them than was the case for older workers. While only 50% of younger workers' supervisors contacted them, 67% of older workers' managers maintained communication with them. Younger workers, in comparison to older workers, also expressed higher levels of dissatisfaction with their employers' communication, with 21% of younger workers and 12.5% of older workers reporting a lack of satisfaction. Likewise, 39% of younger workers expressed satisfaction with the workers' compensation insurer while 60% of older workers were satisfied with the insurer. Finally, 11.6% of younger workers reported that "co-workers resented having to do extra work to help them" [83] while only 4.7% of older workers reported the same phenomenon.

Furthermore, findings concerning workers' perceptions of medical care were reported. In general, older workers reported more positive responses than younger workers. In comparison to younger workers, for example, older employees reported higher levels of satisfaction with their medical care, with 91% of older workers and 82% of younger workers reporting satisfaction. The majority of the older workers, 86%, reported that "they received a clear explanation" about their injuries and treatment while only 79% of younger workers obtained such explanation. Older workers also had a greater likelihood of having surgical interventions for their work injuries, as 20% of older employees and 12% of younger workers had such interventions. However, older workers were less likely to be treated with prescription medications; only 78% of these workers received treatment while 86% of the younger employees were prescribed medications. The last finding concerned workers' approval of the service provider's recommendation. Fewer younger workers believed that their providers made the right RTW recommendation, as 80% of younger employees and 91% of older employees possessed this belief. Finally, older employees had a greater likelihood of believing that they should return to their work later than the recommended time, with 17% of such workers having this belief and 8% of younger workers possessing similar thoughts.

The majority of the outcomes examined, 9 out of 13, failed to show significant age-related differences between older and younger workers. These included "mean duration of work disability (days), mean decrease in work capacity scale pre-post injury, injury will prevent performance of all regular work tasks in next 4 week, injury will

prevent working regular hours in next 4 weeks, worry about future job loss due to work injury, worries about future work capacity, mean number of medical care visits for treatment of injury, injury-related pain in past 7 days, mean number of days taking medication for injury-related pain, last 7 days."[83] However, 13.7% of older workers reported that they were likely to work fewer hours due to injury, as compared to 10.2% of younger workers. Also, a statistically significantly greater number of younger workers reported that they experienced increased economic difficulties and detrimental changes in their quality of work life due to a work-related injury than older workers. According to the table presented in the results section, older workers were less likely to RTW at the time of the survey (79% vs. 84%; *p*-value <0.05); however, the authors failed to highlight this finding in their results and discussion sections possibly because the difference was modest. This result represents an important finding, especially considering the longer period of recovery facing older injured workers. Only four outcomes with significant age differences (RTW, financial problems, worked fewer hours and negative change in quality of work life) were selected for multivariate modeling. The factors selected for evaluation in each model had significant bivariate association with the outcome of interest. Age lacked a significant association with any of the outcomes except for injury-related financial problems. However, six factors had a significant association with RTW: pre-injury job satisfaction (OR=1.23), overall physical functioning (1.12), psychological functioning (1.02), physical job demands (0.60), severity of injury (0.46), and surgery for injury (0.35).

2.6.3. Some Comments on These Two Studies

While these two studies offered valuable results, they contained some limitations. Both investigations examined acute cases, when the majority of work-related injury claimants (70%) typically recover and return to work within one month.[88] Neither study[83,84] specified the type of injuries involved, which may have included non-MSK injuries. In addition, the authors neglected to use standardized measures of disability, pain, and health-related quality of life despite the availability of such measures, such as the Short Form (36) Health Survey (SF-36) and the Pain Disability Index (PDI). These clinical variables can assist clinicians in the triage process during assessment as well as in

other decision-making. Both studies also examine non-Canadian populations, those in USA and Australia. Whether the Canadian population has different results than these populations is still unknown.

In addition, certain limitations apply to each individual study. When Berecki-Gisolf and co-authors[84] used a gap size of 7 days, they were uncertain whether the payment resumption resulted from recurrent work disability rather than from other factors. Their sample included workers affected by both work-related injury and diseases, which limited the applicability of the results to only injured workers. Moreover, the sample captured only 85% of employed Victorian workers, since 15% of workers are not required to register with WorkSafe Victoria due to their national workers' compensation scheme. Thus, the results may have contained underestimated figures. Lastly, the authors lacked the ability to differentiate between RTW with full and modified work duties, which is an important issue in RTW. This lack of a distinction may have affected the meaning of the results.

In the other study, Pransky and co-authors achieved a survey response rate of only 44%. While this study compared some characteristics between younger and older workers, it failed to examine these characteristics as prognostic factors for RTW. In addition, the RTW outcome used in this study involved a question in a self-report survey administered between 2 and 8 weeks after the injury. Although this approach may constitute an effective measure for RTW, it failed in this case to determine the fitness of the injured employees to work because the study neglected to include a medical recommendation by a health provider that substantiated the readiness of the injured workers to RTW. The variation in the time between the injury and the administration of the survey, two to eight weeks, measured the outcome of RTW at different times, which skewed the results of the survey. In fact, the reliability of this outcome is unknown.[83] Moreover, the RTW outcome failed to differentiate between RTW with full or modified duties. Such characteristics comprise variables or factors in models to explain the mechanisms or progression of a disorder or disease; alternatively, these qualities constitute predictive factors for an outcome of interest. Such factors form the basis for

creating models that explain disability. The subsequent section of this paper will discuss some of the models that elucidate the disability process following work-related injuries.

2.7. Disability Models

According to Loisel and Anema (2013),[1] the last three decades have witnessed significant progress for understanding the development of work disability. Several models or conceptual frameworks have been created and converted from biomedical models to the bio-psychosocial model. Subsequently, Feuerstein (1991) added the concept of work demands, and Vlaeyen (2000) incorporated the concept of pain mechanisms. Finally, Loisel (2001) created a conceptual framework, which explained how stakeholders influence the disability process. This framework has been developed to integrate all stakeholders in an arena with four influential systems: personal, workplace, healthcare, and legislative and insurance. The following section of the review provides a brief discussion of some of these models.

2.7.1. Medical Model

The medical model, developed in the 19th century, initially omitted the aspect of work disability; it focused on patient disorders in order to explain disability.[1] Hence, this model considers the absence of signs and symptoms of a disorder as an indication of health. Specifically, the medical approach maintains that physicians and other healthcare workers improve a patient's health by treating the disorder. In the field of occupational injuries, this model perceives work-related injury as creating a physical pathology, such as tissue damage, that constitutes the main cause of pain and disability. Under the assumption of the medical model, the process of relieving the pain or treating the physical pathology should resolve the work disability. While this assumption may contain validity for known disorders or diseases, such as a disc prolapse, it fails to sufficiently explain other conditions, such as non-specific LBP.[89,90] In fact, Bloch & Prins (2001) reported that medical treatments such as surgery, physical therapy, and medication could provide some improvement in subjective health yet failed to reduce the level of pain intensity or change work status.[91] Thus, Nagi (1965) created another approach to compensate for the weaknesses of the medical model.

2.7.2. Nagi's Model

Nagi (1965) developed a model that presented a different conception: the idea of disablement.[92] This approach, which involves less dependency on medicine, considers the disablement process as a group of complicated effects or external factors that impact individuals and the environment. In fact, this model shows that the environment plays a major role in the disablement process. Nagi explained the environment as both social, including the reactions and expectations of individuals, and physical, in terms of its demands.[93] In 2000, Barnes created a model, the social model, which considers disability as a problem that occurs due to a lack of organization inherent in society.[94] Specifically, this approach envisions disability as a result of society's education, culture, and ideology, as well as the social organization of work. This model divided the causes of disability into the deficiency of social and environmental policies and practices that are responsible for providing individual rights and protecting those rights. Nagi's approach prompted researchers in the area of occupational injuries and disabilities to recognize the need to shift the investigation of mediating factors from a single aspect, such as physical, medical, social, or environmental factors, to a more comprehensive framework, which includes other aspects.[95] Since previous models fail to fully explain the work disability and RTW process,[28] a comprehensive model, such as a biopsychosocial model, is required.

2.7.3. Biopsychosocial Model

The biopsychosocial model assumes that illness, pain, and disability result from interactions occurring between physical/medical and psychological factors, which, in turn, are affected by other factors that arise from the environment and society.[90] The World Health Organization (WHO, 2001) has adopted this approach for classifying the factors of health, function, and disability.[96] Accordingly, this model can also apply to the field of work-related injuries. Since injured workers with similar physical pathologies report different levels of pain intensity and work disability,[97] other influences, such as psychological and/or social-environmental issues, account for these discrepancies.[96]

The origin of the biopsychosocial model dates back to 1977, when Engel reported that the symptoms of diseases result from a dynamic interaction between a group of factors: biological factors, such as genetics and chemical imbalances; psychological aspects, such as lifestyle and health beliefs; and social factors, such as cultural influences and social support. [98] Waddell (1987) further developed this model, and, in 2004, explained this approach from the perspective of back pain and disability.[14] The aspects of the model were classified into five clinical elements: physical dysfunction, beliefs and coping, psychological distress, illness behavior, and social interactions.[14]

First, physical dysfunction usually depends on factors such as work duties, level of stress, and the ability of MSK structures to maintain their balance.[14] The second clinical element of this model entails beliefs and coping. Pain can be affected by human thoughts, which may influence an individual's beliefs and coping strategies.[14] Some of these beliefs may relate to fear avoidance or to the fear of subsequent pain, self-efficacy, and treatment expectations.[14] Consequently, these variables can result in disability.[99,100] The third element involves psychological distress, which is linked to pain. Such distress may occur as anxiety, high bodily awareness, anger, or depressive symptoms. Psychological distress may fulfill an important function in raising the level of pain severity as well as decreasing an individual's tolerance of pain. Consequently, this distress may increase an individual's concerns about the pain, which may make the individual more likely to seek health care.[14] The fourth element in this model entails illness behavior. In addition to the actual physical problem, several factors impact a patient's behavior, including psychological distress, coping strategies, beliefs, and attitudes.[14] However, psychological issues may occupy a greater role in the illness behavior than the physical problem. Two studies by Waddell et al. (1993 & 1984)[101,102] reported that beliefs, distress, and illness behavior have a significant effect on lower back disability. The final element of the biopsychosocial model, social interactions, maintains that the patient's beliefs, coping strategies, and behavior are influenced by interactions in the patient's family, work, and social networks. Therefore, issues such as chronic lower back disability and illness behavior can change based on the presence, nature, and strength of these social factors. [14]

According to Waddell (2004),[14] the most important aspect of the biopsychosocial model involves the fact that pain and disability influence mental and psychological processes. In combination, these two processes account for a patient's altered behavior, which ultimately exacerbates or mitigates the dysfunction. For example, static muscle tension occurs as guarded movements due to a psychological issue called fear avoidance. Studies have shown the existence of physiological responses to pain from trauma, including altered behavior such as guarded movements. However, the persistence of this altered behavior results not only from the physiological processes, but also from the psychological processes. Thus, these processes can influence physical function and, consequently, the development of disability.[14]

2.7.4. Case-management Ecological Model

Loisel (2005)[103] created a case-management ecological model, which integrates all previous work disability research in order to explain the potential influences and causal factors of work disability. In addition, this model can guide case management operations by explaining how influential systems can affect a worker with a work disability. These systems include personal, workplace, healthcare, and compensation. This approach places the worker in the center of these systems. The personal system includes all personal dimensions and social relationships, while the health care system involves all health levels that a worker can access. The workplace system contains all sociotechnical structures, ranging from the job position to the external environment of the workplace. The final system, the compensation system, includes the local regulations and relevant stakeholders in this system. This model also considers the potential impact of sociopolitical and cultural context on a work-disabling situation. As the most current and comprehensive model, the ecological system includes many influential systems on work disability. The following section explores and discusses various studies examining prognostic factors influencing RTW and work disability.

2.8. Factors Influencing Work Disability and Return to Work

Loisel and Anema (2013)[1] report that for several decades the prevention of disability was focused on the treatment of the disorder that caused the temporary absence

from work. This may be attributed to the fact that health care providers and medical specialists did not have good training in evaluating functional limitations and work disability determinants. The triggering health condition does not explain the process of work disability because other factors (including psychosocial, environmental and workplace factors) have a greater effect on this process. Therefore, researchers and clinicians should stop linking disability with medical diagnoses and should focus on work disability through biopsychosocial factors.

Most injured workers who have pain originating from MSK disorders recover and RTW easily, but some of them may not and may develop work disability.[14] The important issue here is to understand why some injured workers do not recover, and why their conditions become chronic and may lead to long-term disability.[14] Therefore, to understand this and prevent the development of chronic pain and disability among injured workers, there is a need to identify those workers who are at a high risk of developing work disability. Consequently, it is important to know the prognostic factors that may cause work disability or delay RTW.[104] A good understanding of these predictive or prognostic factors may help occupational physicians and other health professionals to provide effective preventive strategies and treatment.

Prognostic studies require a multivariable approach to determine the important prognostic/predictive factors of a particular outcome (e.g. RTW or work disability). They aim to predict or estimate the probability or risk of an outcome.[105] Prognosis research in general can be defined as "the study of relations between occurrences of outcomes and predictors in defined populations of people with disease."[106] Thus, a prognostic factor is "any measure that, among people with a given health condition (that is, a start point), is associated with a subsequent clinical outcome (an endpoint)."[107] Such factors have also been defined as "variables that predict which patients are likely to do better or worse over time."[108]

Despite their value, however, these factors may be less helpful if they are studied at an inappropriate time. Indeed, it has been reported that each phase of disability has its unique probability of RTW, and has predictive factors that are different than those of the other phases of disability.[109] Thus, researchers and clinicians should be aware that the

influence of factors on RTW/work disability and intervention may change based on disability phases.[18,110,111]

It has been recommended that the best time to make an accurate prediction of work disability is at the sub-acute stage, specifically between four and six weeks post-work-related injuries.[112] It is true that Laisne et al (2012), who looked only at psychosocial factors, did not find strong evidence to distinguish between predictive factors for chronic and sub-acute phases of pain and disability.[113] However, it is still most appropriate to target the sub-acute stage, because the disability cost is still low at this time, and there is a high risk that a disability will develop.[114] If the injured worker is not able to return to his/her regular work after one month, he/she may need an interdisciplinary assessment or program to discover the reason(s) and to make sure that the severity of the disease or injury is not responsible.[115] In fact, the management of the sub-acute phase is very difficult and requires the expertise of professionals who can identify the reasons for disability. These reasons can be physical, occupational, psychosocial, or even administrative.[115] In sum, then, the ignorance of disability phases by researchers investigating factors of RTW/work disability may lead to an inability to detect the accurate risk factors/predictors or to inadequate results of interventions.[116,117]

Together, then, these prognostic factors have been studied extensively among workers in general, without considering workers' age. As concerns older workers, however, there remains a paucity of research. Previous studies have not sufficiently considered the prognostic factors as they apply to older injured workers (≥ 55 years). The majority of studies have included age categories such as 18 to 55, or up to 65, which made the use of this range of age very ambiguous, and it seems inappropriate to consider the results from these studies as representative results for either older or younger workers. Given the impacts of the aging process, it is therefore difficult to rely on these studies or to generalize their results. Moreover, in some studies, the percentage of injured workers 55 years or older was less than 5%.[118]

The previous studies that investigated the factors influencing RTW/work disability also had some restrictions. Some of them focused on specific injuries or body parts,[119-122] or those admitted to hospital emergency departments.[19,123,124] Therefore, there

is a need for comprehensive examination of a wide range of potential factors influencing work outcomes using a bio-psychosocial model, as was highlighted by Clay et al., (2010).[125] The inconsistency among studies that have examined the predictors of RTW/work disability outcome may be attributed to variations in inclusion and exclusion criteria, populations investigated, research designs, prognostic factors, RTW/work disability outcomes' measurements and definitions, follow up protocols and statistical analyses. Due to the paucity of studies focusing on prognostic factors for RTW/work disability among older injured workers (≥ 55 years), this section of this review focuses on the available information about all injured workers, including both younger and older workers.

The majority of previous studies have focused on health, personal, work and social/ legal context characteristics as the four main categories of predictive factors for RTW.[126] In this review, the factors (a term used interchangeably here with *characteristics*) of interest are classified based on the bio-psychosocial model into three main categories: biological (including health- and injury- related factors), psychological and social (including environmental and occupational characteristics). Factors in a fourth category (i.e. compensation status) cannot be classified under any of the previous three categories. As noted above, there has not been any study investigating the prognostic factors for RTW/work disability among older injured workers (≥ 55 years). Therefore, this section will present recent research findings on injured workers in general, and will relate these findings to the characteristics of older workers that have been previously identified. It is acknowledged that some factors may fall under more than one category in the model, but for the sake of simplicity the factors are listed only once.

2.8.1. Biological Factors

The factors classified under the biological category include biological, health-related and injury-related factors (see Tables 2.1 and 2.2). This category contains factors, such as age and gender, which are not modifiable, but are very helpful in predicting RTW outcomes or in identifying individuals who are at high risk of work disability.

Table 2.1: Biological factors of work disability and RTW

Biological Factors
Age
Gender
Health-related factors
Injury-related factors

Age is immutable and there is no preventive procedure to modify it, but it has to be considered in interventions.[127] Outcomes of RTW[128] and delayed RTW[129] have been predicted by age in different settings and at different times. It has been reported that there is an association between older age and worse RTW outcome, according to a 2002 review.[28] Moreover, it has been reported that one of the significant predictors of RTW on full duties after acute orthopedic injury was age (workers whose age was between 18-40 years were more likely to RTW compared to workers with ages between 41-62; OR= 3.16).[130] With respect to delayed RTW, a relationship between increasing age and delayed RTW[37,131] or a longer duration until RTW[132] has been found to exist after work-related injury or disease. In addition, age was negatively associated with RTW at 2-week, 12-week, and 6-month follow-ups post-acute orthopedic trauma; older age was thus a significant predictor of RTW.[19] Workers who were older were less likely to RTW;[19] this is consistent with previous studies.[128,133,134] Likewise, other studies have found a positive relationship between younger age and return to productive work.[135-137] Moreover, younger age was considered a predictor of RTW after three months[26] and in a one-year prospective study.[138] In brief, older workers are less likely to RTW, which confirms our concern about older injured workers and the necessity to conduct more research on this group.

With respect to work disability, according to a review done by Krause et al., (2001), the majority of studies have found that older age leads to longer work disability.[32] Stover et al. (2007) also found that older age (≥ 45 years old [OR=2.1]) was one of nine predictors of work disability among injured workers with MSK disorders.[139] It has also

been reported that workers in their late 40s and early 50s had the highest rates of experiencing at least one work disability recurrence.[84]

Although a large number of studies have demonstrated an association between age and work disability/RTW, some authors did not find enough evidence to show this association. According to Pransky et al. (2005), for example, after occupational injuries there was no relationship between age and many health and occupational outcomes.[83] Such findings, however, might be attributed to the use of age dichotomization and of various definitions and measurements of RTW.[27] Moreover, these studies may have had limitations that affected their statistical power and precision such as small sample sizes, or using a very wide age range.[27] In addition, the healthy worker effect was a difficult bias to control within most of these studies. In brief, then, there is strong and generally consistent evidence that age is a predictor of RTW and work disability, with most studies finding older workers less likely to RTW.

The literature appears to show relatively consistent evidence of the association between *gender* and RTW outcomes. With respect to RTW, Crook et al. (2002)[28] and Fan et al. (2010)[140] found that women were more likely to RTW partially (OR=2.55) or not to RTW (OR=2.61). They took 2.5 weeks longer to RTW than men. Likewise, Kucera et al. (2009) showed an association between delayed RTW and female gender (OR=2.7)[129] which had been supported previously.[141-143] Moreover, two studies with a five-year follow-up [8,144] and one study with a one-year[138] follow-up found that being male was a positive predictor of RTW.

Gender is also a key variable with respect to work disability. A 2002 review, for example, found that female gender was a significant predictor of persistent disability.[28] It has also been found that female injured workers were more likely to have work disability for more than 6 months,[140] which had been supported previously by Cheadle.[142] In addition, female workers were found to be at a greater risk of relapses of work disability[145] a finding that had been demonstrated previously,[146] although several previous studies did not support this finding.[147-149] To sum up, female gender appears to be a factor contributing to a lesser likelihood to RTW and to longer work disability. One potential explanation for these gender differences that has been postulated is that women

work in occupations that may expose them to specific injuries that lead to longer work disability. Whether the gender differences observed are applicable in older injured workers is still unknown.

Table 2.2: Health-related and Injury-related factors of work disability or RTW

Health-related factors	Injury-related factors
General health	Pain
Co-morbidity	Physical work duties
Previous history and claims	Causes of injuries
Exercise	Level of injury severity
Obesity	Hospitalization
Alcohol consumption	Affected body parts
Smoking	The need for surgery
	Amputation and Amputation level
	Diagnosis

2.8.1.1. Health-related Factors

This group of factors may include general health, co-morbidity, past medical or claims history, obesity, exercise, alcohol consumption and smoking. *General health and co-morbidity* are important factors in the RTW process and affect the outcomes of rehabilitation programs.[150] Workers with good health have been found to be more likely to RTW.[150] For example, workers with good health prior to injury were more likely to RTW; this was one of the significant predictors of RTW with modified duties after acute orthopedic injury.[130] Other studies have found an association between co-morbidity and both lower rates of RTW and longer periods of sickness absence,[151,152] because workers with co-morbidity complaints may have more complicated cases that require more time for diagnosis and recovery. Moreover, co-morbid mental health problems are often left without diagnosis, and consequently left without treatment. This complicates the cases and delays RTW.[153,154] As a result, general health and co-morbidity should not be ignored

when considering the RTW process and rehabilitation. These two factors appear to be significant predictors of RTW.

With respect to older workers, many suffer from co-morbidities and chronic diseases, such as hypertension, diabetes mellitus, chronic pain disorders, and arthritis, and negative lifestyle factors, including sedentariness, poor dietary habits, obesity, and long-term alcohol and tobacco usage.[51] Consequently, many older workers use medications, which may affect their cognitive or physical abilities. Moreover, if such workers have multiple medications, they may interact.[51] In brief, poor general health and the presence of co-morbidity may impede or delay RTW among injured workers and older injured workers, in particular.

Previous history of diseases, claims or absence due to sickness may be used as predictors of RTW outcome after injury. Previous episodes of LBP, radiating leg pain and widespread pain have been found to be associated with more disability and pain.[28] Also, not surprisingly, shorter periods of certified sick leave were found to be a significant predictor of RTW.[138,155] It has also been found that injured workers who had long-term sick leave did not have good prognoses to RTW, and were more likely to stay on social security until they moved to a disability pension.[156,157] In short- and long-term follow-ups of five and ten years, the number of sick listed days was found to be a predictor of RTW,[8] which was consistent with most previous studies.[138,155] However, no association between the duration of RTW and previous absence due to sickness during a period of 2 years was reported in one study.[132] Such discrepancies might be a result of differences in methods, populations, and definitions of previous sickness absence among those studies. The story may be somewhat more complex with respect to the influence of previous claims on RTW. According to Kucera et al. (2009), there was an association between delayed RTW and workers with previous claims.[129] This was found again by Stover et al. (2007), who observed that previous claims for workers' compensation in the last five years were one of nine significant predictors of work disability among injured workers with MSK disorders.[139] Overall, a previous history of pain episodes, claims, and sick days appear to be predictors in identifying injured workers who are at high risk of work disability according to the majority of previous studies.

Some other factors may also influence RTW/work disability, but they have not been sufficiently investigated. These factors are thought to include *exercise, obesity, smoking, and alcohol consumption.* Although one might expect that injured workers who exercised prior to their injury would return to work early, "higher levels of exercise prior to" work-related injury was not found to be a predictor of early RTW, as reported by Lilley et al. (2012).[158] However, *obesity* was found to contribute to delaying RTW. For example, obese workers were more likely not to be working three months after injury.[158] This finding is consistent with previous studies showing a relationship between illness-related work disability and obesity.[159-161] Regarding *smoking*, workers who were non-smokers had a higher rate of RTW.[119] Similarly, in a three-year follow up, it was found that *the absence of alcohol-related problems* was significantly associated with a positive RTW outcome.[162] However, alcohol consumption was found to be one of the predictors about which there was conflicting or limited evidence, according to a previous systematic review.[127] In brief, these factors still need more investigation due to the limited evidence among previous studies.

2.8.1.2. Injury-related Factors

This group of factors includes pain, physical work duties, level of injury severity, hospitalization, causes of injury, location of injury, injury diagnoses and surgical interventions. According to Waddell (2006), *pain* may not explain more than 5% of work disability resulting from back pain.[163] This does not, however, deny the fact that pain is an important factor in the course of disability. In fact, there are several factors related to pain that have more influence on work disability,[1] including pain mechanisms, the meaning of pain to a worker, and the worker's reaction to the environment. Also, it is known that pain may cause fear of movement (kinesiophobia), which eventually leads to disability.[164]

An association has been found between a longer period of disability and higher levels of both pain and observed pain behaviors.[165] In addition, several studies have reported that greater pain and functional disability[165,166] were significant predictors of chronic disability. Radiating pain, and pain that was exacerbated while the worker was standing or lying, had negative effects on RTW[28] as well. Even with different follow up

periods, pain had an association with RTW. After a 2-week follow up for post-acute orthopedic trauma, those who were unable to work with their current level of pain were less likely to RTW.[19] Moreover, acceptable pain was considered a predictor of RTW in a five-year follow up.[167]

It is also important to note that the number of pain sites may affect work disability. The number of painful sites was found to be a significant predictor of chronic disability in one study (2008), [168] which was supported by other evidence showing that more widespread MSK pain was associated with worse pain and disability.[169,170] However, a previous study (2004) contradicted these results by failing to find an association between pain of injury and RTW.[171] More investigation into factors related to pain using more consistent and valid measurements and methods is required.

With respect to *physical work duties* that may influence RTW, some work duties, such as those requiring painful and tiring body positions or standing, have been associated with a higher likelihood of not returning to work three months after injury.[158] This association was supported by previous studies.[27,125] In addition, injured workers affected by physical work environment factors, such as stooping, twisting or lifting more than 30 kg, and those who reported repetitive job tasks, were less likely to RTW within the first four weeks after an injury.[172] Moreover, it has previously been reported that lifting increased the risk of delayed RTW.[173] Vlasved et al. (2012) also found an association between long duration until RTW and such factors as high physical job demands.[132] Wasiak et al. (2004) also reported that the probability of a work disability increased when injured workers had more physical duties in their jobs.[146] However, the duration of work disability was found to be better predicted by self-reported job demands than by objective job assessment measures.[109] Therefore, workers should be asked about their job demands, and researchers should not rely only on job classifications and titles.

With respect to older workers, those in jobs with heavy physical demands are at higher risk of continuing to suffer from work disability after work-related MSK injuries.[174] It has also been reported that heavy physical loading is a potential cause for long-term disorders of the MSK system. Such disorders were observed among older workers in certain types of work, such as industrial work, service work and traffic

professions.[175] To sum up, it is obvious that high physical demands may affect the RTW process or lead to recurrent disability, especially in older injured workers. Physical job demands have been a consistent predictor of RTW/work disability.

It has been revealed that higher *injury severity* was one of the most common prognostic factors of longer periods of time away from work.[125] Several studies have reported that severe injuries were significant predictors of chronic disability.[147,148,176] Moreover, RTW has been successfully predicted by injury severity.[128] As injury severity decreases, the RTW rate increases, and the period of sickness absence also decreases, according to previous evidence (2010).[128] While Mackenzie did not find that injury severity score was a predictor of RTW,[177,178] others did find that injury severity predicted RTW after a three-month follow-up[26] and after a one-year follow-up.[118] Another indicator of injury severity, the Roland Disability Questionnaire (RDQ), has proven to be a significant predictor of one-year work disability after a work-related back injury.[168] With respect to older workers, previous studies have reported that older workers have more severe injuries.[179,180] Whether this can affect their RTW or not is still unknown. In brief, the importance of injury severity is in predicting RTW or work disability is obvious.

Hospitalization has been used to indicate the severity level of disability after occupational back injury and may be a helpful factor in predicting RTW.[142] Moreover, previous hospitalization has been found to be a negative factor for RTW.[28] Hospital admission has also been significantly associated with not working three months post-injury.[158] When "days of temporary disability (TD)" were used as an outcome, fewer days in acute care were one of the significant predictive factors of increased days of TD.[181] In sum, the literature provides consistent evidence that hospitalization is a predictive factor for RTW/work disability. However, hospitalization as a predictive factor still requires more investigation, especially among older injured workers who may be more likely to be hospitalized.

The potential *causes of injury* are innumerable, and appear to affect RTW. For example, an association between falls and delayed return to work has been found.[182] Delayed RTW has also been associated with causes of injury such as colliding with an

object or person (OR= 2.9), falling from different elevations (OR=2.7), or motor vehicle crashes (OR=13.9).[129] Workers who were injured in a transportation accident were found to be more likely to RTW at 12 months than those who were injured in different situations, such as falls or physical assaults.[26] A review of occupational injuries has also shown that bodily motion and overexertion are the most common causes of occupational injuries in Canada.[36] In brief, the causes of injury appear to be a predictive factor for RTW/work disability; however, such commonly noted causes still need more investigation, given that older workers are more likely to have fall injuries.

The *location of injury* may also affect RTW outcomes. It has been reported that patients with severe lower extremity injuries could not RTW, even after 12 months.[120,183] The most common injuries from motor vehicle accidents and work-related injuries occurred in the upper and lower extremities.[83,184] Other parts of the body may also be associated with RTW/work disability. For example, Stover et al. (2007) found that the category of neck and back injuries was one of nine significant predictors of work disability among injured workers (OR=1.53).[139] In Canada, a previous review (2004) of occupational injuries showed that the back is the most frequently injured part of the body.[36] Regarding the comparison between older and younger workers, Pransky et al. (2005) did not find a statistically significant, age-related difference in RTW outcomes with respect to the location of injury.[83] To sum up, it is clear that the question of which parts of the body are injured is very important in the RTW process, especially in the case of lower and upper extremity injuries. The location of injury may still need more investigation, especially among older injured workers.

It also appears that there is an association between various *diagnoses* and RTW/work disability. For example, a strong association was observed between delayed RTW and both the ICD-9 symptom descriptor (OR=5.8) and mixed back diagnoses (OR=5.8).[129] Certain diagnoses are more associated with work disability than others. Injured workers with radiculopathy were more likely to have work disability (OR=2.0).[168] This is consistent with previous studies that reported a significant association between workers who have back pain with radiating pain under the leg and longer work disability.[183,185-187] With respect to MSK diseases, inflammatory diseases

(HR=1.66) and peripheral osteoarthritis (HR=1.75) were the most common diagnoses associated with the highest risk of recurrent episodes of work disability.[188] On the other hand, tendinitis (HR=0.79), back pain (HR=0.82), and microcrystalline arthritis (HR=0.99) had a lower magnitude of association with recurrent work disability episodes.[188] Most of the above diagnoses appear to be more common among older injured workers; consequently, this factor may be more important among this age group. However, it has been reported that prolonged and costly cases of disability due to work injuries are rarely associated with medical diagnoses.[1]

The type of injury can also play an important role in the RTW process and work disability. Some injuries have been found to be less likely than others to lead to work disability for periods of more than six months; these include contusions, cuts, and scratches.[139] In cases involving follow-up times of 12 weeks and six months post-acute orthopedic trauma, an isolated injury has been a significant predictor of RTW.[19] Patients with isolated injuries have been found to be more likely to return to work (OR= 4.9).[130] Other injuries, such as dislocation (OR=6.3), multiple injury types (OR=5.4) and fractures (OR=3.9), have been associated with delayed RTW when compared to strains and sprains.[129] In Canada, a 2004 review of occupational injuries showed sprains and strains are the most common injury types.[36] With respect to older workers, it has been reported that they are more likely to have fractures than younger workers.[189] In fact, the most common injuries among older workers have been reported to be fractures or dislocations.[62] This might be explained by the prevalence of osteoporosis among older people. In addition, a recent study reported that older workers were more likely to report traumatic injuries (e.g. bones, nerves and the spinal cord) and less likely to report open wound injuries and sprain and strain injuries (e.g. trauma to muscles, tendons, ligaments and joints) than younger workers.[190] In brief, the literature has consistently shown type of injury to be a predictor of RTW. This factor may be particularly important among older workers.

Finally, the need for *surgical intervention*, and the number and type of such interventions, may affect RTW outcomes and work disability. For instance, the need for initial surgery (patients without need for surgery are more likely to RTW; OR= 4.84) was

one of the significant predictors of RTW with full duties after acute orthopedic injuries.[130] The same results were found in a two-week follow-up after acute orthopedic trauma.[19] According to a multivariate analysis using "days of TD" as an outcome, one of the significant predictive factors of increased days of TD was a higher number of surgical procedures.[181] With respect to older workers, it has been reported that they are more likely to have surgical interventions following work-related injuries than younger workers.[83] Whether this will impact their RTW is still unknown. *Amputation* is considered one of the surgical procedures that may affect this outcome. In a previous study, amputation level had an effect on RTW and days of TD.[181] A significant association between RTW and amputation levels was found (OR= 3.60 - 9.55; the higher the amputation level the less likely to RTW).[181] In brief, a surgical intervention may affect RTW outcomes; it has been consistently shown to be a predictive factor of RTW/work disability.

2.8.2. Psychosocial Factors

Psychosocial factors are considered more predictive of chronic pain and disability than biomedical, demographic and physical factors.[127] Waddell (2004) notes that an injured worker experiences a dynamic process involving pain before his or her condition reaches disability, which means that pain and disability do not occur simultaneously or suddenly.[14] Psychosocial factors, he states, have powerful effects on how pain can move from the acute to the chronic stage and result in disability.[14] Consequently, disability and the factors that influence it are in a dynamic process; this means that all of the psychosocial factors in addition to disability change over time.[14,127] Indeed, psychosocial factors may play a smaller role in the acute stage, but this role increases with time, so that they may play a major role in the chronic disability stage.[1] However, not all studies have shown an association between psychosocial factors and work status. This inconsistency might be attributed to variations in methods, measurements, and outcomes; and to confounders that were not controlled.

2.8.2.1. Psychological Factors

Loisel et al. reported that psychological factors are related to the length of time off work, but that it is not clear whether they occur before or after the disability.[115] In addition, a previous systematic review revealed that psychological measures can predict work disability.[27] It is important to note, however, that pain and disability themselves influence the mental and psychological processes. These processes together are responsible for the altered behavior. Consequently, they function together with the altered behavior to exacerbate the disorders.[14] Several factors are relevant here; they include fear avoidance, recovery expectations, motivation, self-efficacy, and depression (see Table 2.3).

Table 2.3: Psychological factors hypothesized to influence RTW or work disability

Psychological Factors
Fear avoidance
Recovery expectations
Self-efficacy
Motivation
Depression

Fear avoidance is one of the psychological factors that may delay RTW or lead to work disability. During the acute phase, fear avoidance behavior may be considered as a normal or protective response against the sensation of pain.[191] Some studies reported that fear of pain has a greater impact on RTW outcomes than does pain itself.[192,193] A 2002 review found that fear avoidance was a significant predictor of persistent disability.[28] Moreover, according to a 2008 review, fear avoidance beliefs were one of the psychosocial factors for which there was moderate evidence to predict poor work outcome.[191] On the other hand, another study failed to find a significant prediction of fear avoidance beliefs for work-related outcomes.[194] Similarly, it was reported by Turner et al. (2008) that fear avoidance was not a significant predictor of chronic disability.[168] This inconsistency with respect to fear avoidance may be attributed to the different methods

used to measure this characteristic or to the type of injury. In brief, the evidence related to this factor has been inconsistent, and more studies are required to prove its impact on RTW outcomes among injured workers.

Recovery expectations are very important for rapid RTW.[195] Several studies have indicated that the likelihood of RTW increases if injured workers have positive expectations for their future and a positive view of their possibilities.[195-197] Moreover, according to a 2008 systematic review, there is strong evidence showing that recovery expectation is a predictive factor of RTW.[191] This was also supported by studies of different health conditions, which came up with the same results for patients who have had total knee replacement, chronic non-specific LBP, after acute soft tissue injuries, and cardiac surgery.[198-201] At 12-week and six-month follow-ups after acute orthopedic trauma, strong recovery beliefs (OR=16.73 and OR=3.99; respectively) were one of the significant predictors of RTW; workers with strong recovery beliefs were more likely to RTW.[19] This was supported by several MSK studies involving traumatic or non-traumatic injuries.[19,191,202] In fact, recovery expectation is considered a form of self-efficacy, which is related to better coping and self-management.[19] In brief, there appears to be consistent evidence that recovery expectation is a predictive factor for RTW.

Self-efficacy also appears to play an important role in recovery and RTW processes. Self-efficacy was defined as "a person's belief in his or her ability to complete a future task or solve a future problem."[203] Previous studies have found that higher levels of self-efficacy among workers lead to earlier RTW.[126,204] Moreover, as revealed through a review of prognostic factors, one of the most common prognostic factors of longer periods of time away from work following acute orthopedic trauma was low self-efficacy.[125] It was also found that workers with lower levels of RTW self-efficacy experienced a longer duration until full RTW.[126] Similarly, in a subgroup with physical health problems as well as another subgroup with a combination of both physical and mental health problems, RTW self-efficacy was found to be a predictor of full RTW.[126] In another study, however, self-efficacy was not found to be significant in prediction of work status three months following injury.[158] As mentioned above, the literature appears to provide slightly consistent evidence that self-efficacy is a predictor of RTW.

Motivation and optimism also have an influence on the RTW process. Motivation can be understood as "the act or process of motivating" while optimism was defined as "an inclination to put the most favorable construction upon actions and events or to anticipate the best possible outcome."[205] It has been reported that motivation can affect RTW rates.[118] Motivation for change is considered a significant predictor of RTW and improved quality of life;[155,206] these findings were supported in a 2004 study using 2- and 6-year follow-ups.[207] Likewise, having an optimistic life orientation has been found to be a significant predictor of RTW outcome after one year.[26] On the other hand, a 2012 study found that optimism was not significant in the prediction of work status three months after an injury.[158] Regarding older workers, those who are close to retirement age are usually less concerned about their future work, as they do not require work capacity for a long period of time.[83] This might affect the RTW process; therefore, this issue should be taken into account. In brief, motivation appears to be a predictor of RTW according to relatively consistent evidence among previous studies. However, such motivation may not be found among workers who experience depression.

Depression has been defined as "a mood disorder marked especially by sadness, inactivity, difficulty with thinking and concentration, a significant increase or decrease in appetite and time spent sleeping, feelings of dejection and hopelessness, and sometimes suicidal thoughts or an attempt to commit suicide."[205] Depression may be one of the forms of psychological distress that is associated with RTW and work disability outcomes, but it is important to understand that depression may be more a result than a cause of work disability. Therefore, it is thought, for example, that depression may contribute to developing LBP from an acute to a chronic stage.[191] In addition, it has been found that depression may affect RTW processes and the time until RTW.[126] Similarly, a 2002 review found that depression was a predictor of persistent disability.[28] In addition, depression has been found to be a predictor of non-RTW outcomes.[19,119] (The literature has not been unanimous on this point, however; a prior depressive episode was not found to be significant in prediction work status three months following the injury.[158]) With respect to the levels of depression, according to Vlasved et al. (2012), "long duration until RTW" was associated with the characteristic of moderate to severe depressive symptoms in workers.[132] Moreover, a low Hospital, Anxiety and Depression Score

(HADS) for depression symptoms has been found to be a significant predictor of RTW outcome after three months and one year of follow up.[26]

Depression is also considered a problem that grows more common as people age.[48] Unfortunately, this may affect older workers' physical and cognitive functioning[46,77] and, consequently, their RTW process. In one comparison between younger and older workers, the former had a significantly higher prevalence of depression than the latter.[83] On the whole, depression should be considered in future studies, as it may affect the RTW process, especially among older injured workers. In brief, the literature shows relatively consistent evidence that depression is a predictor of worse RTW outcomes.

2.8.2.2. Social factors.

Several of the psychological factors described above are influenced by a worker's social interactions with family, coworkers, and social networks. Social factors thus have an important influence on clinical progress. In fact, some social factors, such as marital status, having children, level of education, and level of income, may have impacts on RTW processes (see Table 2.4). In addition, social factors include some occupational characteristics, which can be called social work-related factors. These factors may include occupation, number of days worked per week, employment contract, discrimination, social interaction with co-workers, supervisors, and so forth (see Table 2.5).

Table 2.4: Social factors of RTW and work disability

Social Factors
Marital status
Having children
Education
Income
Social work-related characteristics

According to conceptual and scientific review done by Waddell et al. (2003), there is conflicting evidence about whether *marital status* is a predictor of long-term incapacity, but the combination of marital status with other characteristics (i.e. psychosocial variables) may make the latter strong predictors.[127] According to previous studies,[128,208,209] marital status was not found to be a significant predictor of RTW. In contrast, it was found that workers who could return to their work rapidly had some specific characteristics; being married was one of them.[210] Finally, the *presence of children* may play an important role in the RTW process. For example, in one study (2012) examining a subgroup with a combination of both physical and mental health problems, there were some predictors of full RTW that were associated with a longer duration until full RTW; one of them was living with children (HR=1.57).[126] The role of both factors, marital status and having children, thus requires more investigation.

Education is a very important factor for RTW. It has been reported that education has an influence on RTW.[177] Indeed, several studies have shown that higher education is a predictor of RTW. [211-213] Moreover, a 2006 study found the same result among three RTW outcomes: return to a pre-injury job, (OR=2.29), self-employment (OR=3.47), and employment with a new firm (OR=1.38).[134] In one study, follow-up at 12 weeks after acute orthopedic trauma showed that a university level of education was a significant predictor of RTW (OR=6.27).[19] Elsewhere, RTW outcome has also been positively associated with high educational levels.[30] Although there have been many studies showing that a high level of education is a predictor of RTW, a recent study done by Toien et al. (2012) did not find this association at one- and three-year follow-ups.[26]

Supporting an association with education, two studies have found that workers with lower levels of education took longer to fully RTW.[19,126] This might be explained in part by the fact that injured workers with a lower education level might face more difficulties to change their pre-injury job.[133] It is also important to note that the factors enhancing the RTW process may differ from one disorder to another. It was reported that workers with a high level of education and mental health complaints returned earlier than workers who had the same level of education but suffered from physical complaints.[126]

Regarding older workers, it was found that workers who had more education were more likely to continue working in old age.[45] There are reasons why someone with a higher education level is more likely to work during old age. For example, they are usually in a better financial position, have a higher income, better health status, less physically demanding jobs, better prospects for employment, are liked more by employers, and are more likely to enjoy their work.[45] Hence, income may be an important predictor of RTW/work disability.

Income may also influence the RTW process.[177] Indeed, studies have consistently found that lower income may impede RTW, while higher income may encourage the RTW process. With respect to low income, consistent with previous studies,[125,214] a 2012 study found an association between work status and low income among workers (OR=2.11).[158] In addition, workers with low wages were less likely to RTW with full duties.[140] High income has been found to be associated with RTW.[120] Also, the RTW outcome was predicted in one study by monthly income pre-injury; as the monthly salary pre-injury increased, the likelihood of RTW also increased.[128] This finding was supported by other studies as well.[177,181]

2.8.2.2.1. Social Work-related Factors

This group of social factors specifically considers social interactions within the workplace. Such factors may include type of occupation, type of contract, company size and work experience (see Table 2.5).

Table 2.5: Social work-related factors of RTW or work disability.

Social Work-Related Factors
Occupation
Employment contract
Work experience
Company size
Job satisfaction

The *type of occupation* may play an important role in the RTW process. Type of pre-injury work has been reported to have an influence on RTW.[177] Indeed, while predictors of RTW vary among studies, the literature consistently reports that a white collar job is a significant predictor of RTW.[212,213] There are other important distinctions as well. Post et al. (2005) found that workers in occupations like construction, public administration, education, finance, and transport were less likely to RTW than health care workers.[215] With respect to delayed RTW, elementary clerical sales and service workers, intermediate production and transport workers and laborers were more often associated with a delayed final RTW (>13 weeks) than with early final RTW (≤13 weeks).[145] In addition, work in heavy construction and residual operative building industries has been associated with delayed RTW.[129] It should be noted, however, that two previous studies did not find a significant association between occupation and chronic disability.[148,216] The inconsistency in the association between RTW and work factors might be attributed to other issues such as injury characteristics, different populations, jurisdictions, and diverse compensation systems.[140]

As noted above, injured workers with blue-collar or manual occupations may experience delayed RTW or work disability. Blue-collar or manual workers have been reported to experience lower RTW rates than white-collar workers.[118,120] In a 2012 study, for example, blue-collar workers were more likely (OR=1.52 in comparison to white-collar) not to return to work three months after injury,[158] a finding which had been reported previously.[19] Moreover, according to Clay et al. (2010), the most common prognostic factors for a longer period of time away from work included employment in blue-collar jobs.[125] Six months after acute orthopedic trauma, workers with blue-collar occupations have been found to be less likely to RTW.[19] With respect to disability, construction work was reported to be a significant predictor of longer periods of time on disability benefits in a 2000 study of back injury in Ontario.[217] The type of occupation thus appears to be a relatively consistent predictor of RTW/work disability.

Type of contract was likewise a significant predictor of RTW.[126] Lilley et al. (2012) found an increased likelihood among two types of workers, temporary workers and long week workers, of not working three months after an injury.[158] Temporary

workers usually suffer weak social support, low employment protections, and higher risk of joblessness in comparison to permanent workers.[218] This may explain why temporary workers are more likely not to work after injuries; they may face difficulties in retaining their jobs after injury, asking for modified RTW conditions, or even finding a new job.[158] It has also been found that workers with a fixed-term contract were slower in fully returning to work than workers who were on permanent contracts.[126] One study (2010) found that two weeks after acute orthopedic trauma, self-employment was one of the significant predictors; workers who were self-employed were more likely to RTW.[19] Hence, the type of contract appears to be a helpful factor in predicting RTW/work disability among injured workers.

Company size may also influence RTW outcomes; however, the evidence is inconsistent and requires more investigation. According to a 2000 review, poorer outcomes were observed among workers with smaller rather than larger firms.[27] On the other hand, although some studies have reported that injured workers in small companies were more likely to have poorer outcomes, firm size was not a predictor of compensated work absence in a 1995 study.[148] In addition, it has been reported that there was no significant difference between large (≥50 employees) and small (<50 employees) workplace sizes, with respect to RTW and duration of sickness absence.[172] However, the large companies might have some ability to offer workers different jobs with different duties in order to facilitate RTW.

Work experience might also influence the RTW process after work-related injury. One previous study (2009) found that carpenters who were more experienced (>4 years) were more likely to have delayed RTW when they experienced an injury.[129] On the other hand, a 2012 study found that having more than two years on the job predicted a faster RTW.[28] In addition, it has been reported that shorter employment duration increased the risk of delayed RTW.[147] In brief, evidence suggests that work experience is associated with RTW, but whether this association is positive or negative is inconsistent.

Although there have not been enough studies investigating the association between psychosocial factors-related to the workplace and RTW, these factors do appear to play a critical role in RTW processes. Problems at work or with colleagues may have

negative effects on recovery and RTW.[28] A high level of supervisory support is associated with earlier RTW.[219] This has also been supported by evidence that lower supervisory support decreased RTW rates.[111] A 1999 study with a two-year follow-up found the presence of social and emotional support in the workplace had an important effect on RTW.[220] Moreover, injured workers may encounter difficulties when they try to return to work after injury. Therefore, it is necessary to take care of the workers' relationships in the workplace. For example, it has been reported that workers with LBP who did not feel welcomed by their co-workers faced difficulties with RTW;[109] new workers (< two years on the job) had the same difficulties.[109]

With respect to older workers, according to an expert case manager,[221] there are some obstacles that play important roles in the process of RTW duration and outcomes; there is a need for additional supervision and good administrative support. More care from the supervisors during the transitional phase of RTW is needed to ensure that tasks are appropriate to workers' abilities. In addition, the case manager should coordinate with the injured workers and their employers to facilitate RTW. In brief, social interactions in the workplace appear to be very important in RTW, especially among older injured workers.

There are other psychosocial factors which may affect work disability and RTW outcomes; these include *job satisfaction, job support, and job security*. It has been found that workers who returned to their work rapidly had *high job satisfaction* as one of the significant factors.[210] In addition, job satisfaction has been found to have an effect on RTW rates.[118] A 2002 review found that job dissatisfaction was a predictor of persistent disability.[28] In a different study (2008), it was reported that the perception among injured workers that their jobs were very hectic was significantly associated with chronic disability (OR= 2.16).[168] However, this association was contradicted by other studies. For instance, there was no evidence that job satisfaction was found to be a predictor of work outcome among non-specific LBP patients, according to Iles et al. (2008).[191] In addition, one study (2001) reported that the level of job satisfaction was not considered to be a factor of delayed RTW.[111] Other psychosocial factors related to employment, such as job

support and job security, have not been found to be significant in the prediction of work status three months after injuries.[158]

The absence of the association between these factors and RTW/work disability does not preclude the existence of their relationships; the number of studies that examined these factors as predictors of RTW/work disability is limited. In addition, such studies used different methods and measurements, as well as different definitions of RTW outcomes. In comparing younger and older workers, Pransky et al. (2005) found that job dissatisfaction was significantly worse among the former than among the latter.[83] In addition, younger workers were more likely to report negative employer responses,[83] and the number of attempts to communicate with the injured workers by their employer or supervisors was lower among younger than older workers (50% and 67%, respectively).[83] Moreover, dissatisfaction with these attempts was greater among younger than older workers (21% and 12.5%, respectively). Finally, older workers who are more than 55 years old appear to have been more satisfied with their pre-injury employment.[83] In brief, the evidence of these factors requires more investigation.

2.8.3. Other Factors

This category includes factors that may not fit or may not be classified appropriately under any of the previous categories. It may include such characteristics as compensation status, work accommodations or modifications, the duration between injury and treatment and vocational rehabilitation (see Table 2.6).

Table 2.6: Other factors of RTW or work disability.

Other Factors
Compensation status
Work modification
Partial RTW
Duration between injury and treatment
Vocational rehabilitation interventions

Compensation status may also be one of the factors influencing the RTW process. In fact, compensation status is the only significant factor that has been associated with both types of RTW (on full and modified work duties); workers without compensation were more likely to RTW.[130] This may suggest that this factor is not affected by the number of working hours or the type of work tasks.[130] However, the association between RTW and compensation status has been found to be inconsistent as some studies have found a negative effect of compensation status on RTW outcomes. This association still requires more investigation.

It has been reported that previous compensation claims within 5 years were associated with work disability (OR= 1.16).[139] In one study (2010), after 12-week and six-month follow-ups, one of the significant predictors of RTW was receiving compensation; workers who received compensation were less likely to RTW.[19] However, other studies did not find sufficient evidence for the association between compensation status and RTW/disability. For example, a 2005 review did not find an association between compensated LBP and longer periods of work disability.[222] In addition, a systematic review done by Iles et al. (2008) did not find sufficient evidence that compensation status is a predictor of work outcome.[191] The compensation systems are different from country to country; therefore, their effects on RTW are also different.[191] With respect to older workers, it has been reported that older workers who are over 55 appear to be more satisfied with workers' compensation insurers than younger workers under 55; (60% versus 39%, respectively).[83]

While compensation payment may be considered a predictor of temporary or permanent work disability, w*ork modification or accommodation* is considered one of the most helpful factors in facilitating RTW. The availability of modified jobs and light mobilization have been reported to be significant predictors of quick RTW,[28] and the availability of work accommodations or modifications have been associated significantly with shorter periods of work disability.[223] Moreover, it has been reported that physical accommodations are very important in decreasing the disability period among workers who are performing heavy labour;[166] therefore, the modified or altered jobs are critical for workers doing jobs with heavy physical demands.[109] Likewise, a 2008 study reported

that injured workers who did not have work accommodation, which reduces work hours or modifies duties, were more likely to have chronic work disability.[168] This may indicate that employers who can offer work accommodation may successfully facilitate the RTW process and avoid chronic disability.[168] Thus, abilities and job tasks should be assessed very carefully. Work modification is therefore considered a very effective factor in facilitating RTW, especially among older injured workers. Previous studies have consistently shown that a modified job is a predictive factor of RTW.

Partial RTW may also be considered as a predictive factor for RTW. Indeed, it was one of only two predictors (along with age) that were significant across all three subgroups, workers who have physical health problems, those with mental health problems and those who have both.[126] Partial RTW at baseline significantly predicted a shorter duration until RTW across all three groups (HR ranged from 1.60 to 2.52).[126] This may be explained on the grounds that a gradual exposure to work tasks benefits workers; for example, it has been found to be an effective treatment method for anxiety.[224,225] Eventually, it can encourage full RTW, as has been reported previously.[226,227] Given its effectiveness, this factor merits more investigation.

Longer duration between an injury and the receipt of medical care has been consistently shown to be a predictive factor of RTW; however, it still requires more investigation. It has been reported previously that "greater time between injury and rehabilitative treatment" was associated with the risk of delayed RTW.[129] In comparison to injured workers who received treatment within the first 10 days after an injury, those who did not receive treatment for more than 20 days were more likely to take longer to recover from their injuries.[139] One of the significant predictors of work disability found in this study (2007) was the period between injury and the first medical visit (>20 days compared with ≤10 days; OR=1.8).[139] It has also been found that delayed treatment was a predictor of a longer period of work absence.[109,228] Thus, the medical team should consider the importance of early treatment for injured workers in order to avoid delayed RTW.

Vocational rehabilitation interventions are very important in the RTW process. These programs vary from worker to worker, but they all aim to facilitate RTW. A

successful RTW might be influenced by some important intervention approaches, such as computer skills training (HR=1.5) and psychological counseling.[30] Computer skill training has also been found to be helpful in RTW processes.[30] Functional restoration program is a good example of such an intervention that can facilitate RTW. Previous studies have reported that 82-87% of patients who complete functional restoration programs successfully RTW.[229-231] According to two studies investigating workers with amputations, a vocational rehabilitation intervention was one of the factors that facilitated RTW.[232,233] Such vocational interventions are thus a very important area affecting the RTW process, but they fall outside of the scope of this review.

2.8.4. Summary of Prognostic Factors

In conclusion, to prevent the development of work disability, there is a need to identify injured workers who are at high risk by determining prognostic factors (biopsychosocial) of RTW/work disability. The prediction of disability should be done in the sub-acute phase of disability (four to six weeks after the injury) or earlier. However, researchers and clinicians should be aware that each phase of disability has specific factors, which change over time. Previous studies have shown consistent evidence for the influence of some factors (e.g. age, pain, depression, and level of education and income) and inconsistent evidence for that of others (e.g. gender, fear avoidance, work experience, and company size). However, some factors still require more investigation in order to substantiate their roles in the RTW process. These include receiving compensation, feeling anxiety, and being married (or not).

In addition, there needs to be more consensus on definitions and measurements of RTW and work disability in order to facilitate comparison among studies. Unfortunately, interventions currently offered to older workers are the same as those provided for younger workers; interventions should be tailored to each age group, according to McDermott et al. (2010).[234] Moreover, a deficiency in secondary and tertiary interventions for older workers has been reported by a previous review.[234] Such interventions may help in reducing the deterioration of health, work disability, and early retirement among older workers.[234] In addition, these factors still need to be examined

among older injured workers in order to test whether the same predictive factors of RTW/work disability apply to older workers as to younger workers. The answer to this question will tell us whether current approaches for older injured workers are appropriate or require changes to meet their needs.

2.9. Some Limitations and Gaps in Previous Studies

This review highlighted some limitations and restrictions among previous studies regarding the impact of aging and predictive (prognostic) factors of RTW/work disability, as well as the methods and statistical analyses employed in studies that targeted injured workers and older injured workers, in particular. These limitations and weaknesses include the following:

- Thus far, there have not been enough studies focusing on prognostic factors of RTW/work disability among older workers (> 55 years). Such research would support the accurate prediction of these outcomes among this age category. Most studies included age categories such as 18 to 55, or up to 65, so the generalization of results produced by such studies to older workers may be questionable.
- It is very important to note that most of studies that examine injured workers and older workers, in particular, are prone to the Healthy Worker Effect (HWE). The HWE is a selection or/and confounding bias which explains the fact that healthy workers are more likely to continue working, while workers with poor health may leave the workforce or may move to another job with less exposure. Thus, the selected older workers may be the healthiest, because the unhealthy workers may already have retired.
- There is no consensus on the exact age that should be used to determine the age of older workers. While some studies used ≥55 years to indicate older workers, others used ≥45 years.[38]
- It is not appropriate to consider RTW with full duties and RTW with modified duties as one outcome, because it has been found that the significant predictors of the former are not the same as the significant predictors for the latter after acute orthopedic trauma.[130]

- Most studies aimed to remove multiple claims from their data in order to avoid duplications. Whether this action has an impact on the RTW findings is still unknown.
- Some studies did not include all potential factors related to the different aspects (i.e. biopsychosocial) of RTW/work disability and did not use multivariate analysis in the prediction of these outcomes. Although multivariate analyses are better than univariate analyses because of the collinearity among the factors,[118] some papers did not use them. In addition, the interactions and confounding effects were neglected during multivariate analyses in some studies.[27] In fact, the interactions or confounding effects between gender and other variables such as marital status, number of dependents, occupation, injury severity, and job physical demands should be taken into account. This might explain the inconsistent results of the association between gender and work disability among previous studies. The marital status variable may also need to be taken into account with the same confounders and interactions.[27]
- The inconsistent findings among studies in this research area may be attributed to inconsistency in the operational definitions and categorizations of predictors such as company sizes and age categories, which differ among studies.[27] Moreover, the inconsistency among studies that examined the predictors of RTW outcome may be attributed to variation in the targeted population, inclusion and exclusion criteria, research design, prognostic indicators, RTW outcomes' measurements and definitions, statistical analyses, and follow up protocols.[128]
- The administrative data have been used extensively among previous studies, but that may be criticized because it might have involved miscoding, misclassification, or entry errors. As well such data usually do not include clinical or self-report information.
- In the USA, it has been reported that some injured workers with MSK disorders may not file their claims in workers' compensation systems, which may affect the sampling methods from such systems.[139,235,236] In addition, most studies have investigated work-related injuries and use data from workers' compensation boards. These studies have examined only the claims accepted by the compensation boards.

However, Canadian reports have revealed that workers' compensation claims are not entirely representative of all injuries and illnesses that may be eligible for compensation.[237-240] Consequently, the results might not be representative of the targeted population. Moreover, some studies did not differentiate between the participants who are on a sick list and those in rehabilitation programs. In fact, the sample of participants who were on sick leave and looking for RTW are different than participants who are already enrolled in intervention programs due to long term disability.[25]

2.10. General Conclusion

In conclusion, older workers experience a higher prevalence of MSK complaints and often take longer to recover from injury. Therefore, older injured workers may need a different approach to treatment and rehabilitation as they may have different characteristics than younger injured workers. However, the most important age-related changes and characteristics influencing work disability in older workers are unknown. Moreover, most injured workers who have pain originating from MSK disorders may recover and RTW easily, but some of them may not do so, and may develop work disability. As concerns older workers, however, there remains a paucity of research: previous studies have not sufficiently considered the prognostic factors as they apply to older injured workers (≥ 55 years). Therefore, it is important to study prognostic factors among older injured workers, and to determine whether such factors have the same impacts on RTW/work disability among older injured workers as among younger injured workers. Because older injured workers, at high risk of disability, may be identified by different prognostic factors, they may need different screening tools.

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Chapter 3

Ageing workers with work-related musculoskeletal injuries*[1]*

ABSTRACT

Background: Older workers often take longer to recover and experience more missed workdays after work-related injuries, but it is unclear why or how best to intervene. Knowing the characteristics of older injured workers may help in developing interventions to reduce the likelihood of work disability.

Aims: To describe and compare several characteristics between younger and middle-aged working adults (25-54 years), adults nearing retirement (55-64 years) and adults past typical retirement (≥65 years), who sustained work-related musculoskeletal injuries.

Methods: In this cross-sectional study, Alberta workers' compensation claimants with sub-acute and chronic work-related musculoskeletal injuries were studied. A wide range of demographic, employment, injury and clinical characteristics was investigated. Descriptive statistics were computed and compared between the age groups.

Results: Among 8003 claimants, adults 65 years or older, as compared to those 25-54 and 55-64 years, had lower education (16% vs. 10% and 12%, $p<0.001$) and were more likely to work in trades, transport and related occupations (50% vs. 46% and 44%, $p<0.001$), to have less offers of modified work (57% vs. 39% and 42%, $p<0.001$), more fractures (18% vs. 14% and 11%, $p<0.001$), and no further rehabilitation recommended after assessment (28%, vs. 18% and 20%, $p<0.01$)

Conclusions: Injured workers past typical retirement age appeared to be a disadvantaged group with significant challenges from a vocational rehabilitation perspective. They were less likely to have modified work options available or be offered rehabilitation, despite having more severe injuries.

Key words: Aging; older workers; Occupational injury; work-related disabilities; rehabilitation

3.1. INTRODUCTION

According to the Canada Safety Council, "the Canadian workforce is aging and older workers are making up a greater portion of the workforce." [1] The burgeoning labour force participation is due to improved life expectancy and functional ability of older adults, along with several other factors, such as financial considerations, desire to continue productive work, and employers' need to retain experienced employees. [2,3] In fact, more and more Canadians are continuing to work beyond what has been considered a typical retirement age of 65 years. [4] Policy changes to the Canadian Old Age Security pension will see the age of eligibility raise from 65 to 67 in 2029, which will result in more Canadians working beyond age 65. A number of reviews have highlighted the benefits of work participation and the importance of 'safe and productive work' to health and well-being. [5,6] However, the ageing workforce faces important challenges from work-related injuries, which can have especially severe consequences for older workers.[7,8]

Older workers experience a higher prevalence of musculoskeletal complaints and often take longer to recover from injury, experiencing more missed workdays after injury. [8,9] This may partially be due to ageing-related physical changes experienced by older workers. For example, Kenney et al. observed a 25% decline in musculoskeletal capacity between the ages of 30 and 65 years, with a more rapid decline between the ages of 60 to 65 years.[7] There are also several social, psychological, and cultural changes that accompany ageing which may have an influence on work ability. Work-related injuries present the potential for especially severe consequences for older workers.[10-12] Dasinger et al reported that when the age of injured workers increased by 10 years, the return to work (RTW) rate decreased by 15%. [13] Moreover, work disability is considered the most common reason for retirement among older workers before the age of 60.[14] Therefore, older injured workers may need a different approach to treatment and rehabilitation as they may have different characteristics than younger injured workers. However, the most important age-related changes and characteristics influencing work disability in older workers are unknown, as are the best strategies for intervening to avoid or reduce long-term work loss in this population.

Before developing interventions for ageing injured workers or examining prognostic factors for RTW, there is a need for foundational information about older injured workers' personal, psychosocial, occupational and other characteristics. It is important to know whether older injured workers' characteristics differ from younger injured workers. Knowing this would provide valuable information about whether the current approaches for assessing, treating, and rehabilitating injured workers (which are often similar across different age groups) are adequate. Potentially, novel strategies tailored to the needs and characteristics of older injured workers are needed.

Little is known about injured, older working adults, particularly those who remain in the workforce beyond what has previously been a typical retirement age (e.g. >65). Few studies have examined the characteristics of older injured workers and how they differ from younger injured workers. So far, there have been only two previous studies comparing older and younger workers.[15,16] Within a US jurisdiction, Pransky et al reported that older workers (≥55 years) experienced more severe injuries than younger workers (<55 years), but experienced comparable RTW outcomes.[15] They conclude that older workers may be advantaged due to longer workplace attachment and the healthy worker effect. Contrarily, Berecki-Gisolf et al studied workers' compensation claims in Victoria, Australia, and found that lost-time claims incidence, days until first return to work, and sum of compensated days all increased with age.[16] These two studies offer valuable but conflicting results and it remains unclear whether older injured workers are at risk of worse outcomes and, if so, why. The authors had limited access to important clinical information, such as nature of the injury/diagnosis or responses to patient-reported clinical measures that could provide additional insight. Additionally, whether the results from the USA and Australia apply to other countries is unknown.

We conducted a descriptive study to characterize and compare the characteristics of individuals experiencing work-related musculoskeletal conditions across three age groups: younger and middle-aged working adults (25-54 years), adults nearing retirement age (55-64 years), and adults past typical retirement age (≥65 years).

3.2. METHODS

This study used a descriptive cross-sectional design. Secondary analysis was conducted on a database previously created from clinical and administrative claims data from the Workers' Compensation Board of Alberta (WCB-Alberta) [17]. This dataset includes information on workers' compensation claimants with musculoskeletal injuries who received rehabilitation and underwent a comprehensive clinical work assessment. The University of Alberta's Health Research Ethics Board approved this study.

Data were available on all claimants receiving rehabilitation for predominately sub-acute musculoskeletal injuries between 1 December 2009 and 1 January 2011. We limited our study to claimants older than 25 to exclude students and ensure it represented working age adults.

Within the jurisdiction, claimants are sent for a comprehensive work/clinical assessment after undergoing required primary care treatment in the community (i.e. physician, physical therapy, or chiropractic care), but failing to RTW after a course of acute treatment. Claimants are systematically referred for work/clinical assessment based on a care pathway when they have not recovered within the anticipated healing time of their injury (typically between 4 to 8 weeks). [18] These claimants are assessed to (i) determine their readiness to RTW, (ii) identify barriers to recovery and/or (iii) be triaged to the most appropriate type of rehabilitation. Our research group has previously studied the work/clinical assessment and the tools used to assess readiness to return-to-work in this jurisdiction. [19] The measures and information available have proved trustworthy and acceptable for research purposes.

The database includes information on 38 descriptive variables including individual demographic and social factors (e.g. age, sex, language spoken, marital status, educational level, urban/rural status), occupational factors (e.g. occupational category according to the National Occupational Classification, employment and working status, modified work availability, reception of wage replacement benefits), health/injury factors (e.g. previous injuries, self-rated health status, pain intensity and perceived disability) and health care

(e.g. type of rehabilitation received, number of visits to primary care providers). The age variable was categorized into three groups: (i) younger and middle-aged adults (25-54), (ii) adults nearing retirement age (55-64) and (iii) adults working past typical retirement age (≥65 years).

Descriptive statistics were computed for each age group of interest and compared between the three groups. The main characteristics between groups were compared for continuous variables using ANOVA or the Kruskal-Wallis Test if assumptions were violated. For categorical variables, a chi-square test was used to make comparisons between groups. Fisher's exact test was used instead of the Chi-squared test if 80% of the cells had expected counts less than 5. The level of significance was set at α=0.05. All statistical analyses were done using IBM SPSSv20 (Chicago, IL).

3.3. RESULTS

A total of 8,003 claimants were included in this study. The means ± standard deviations (SD) of the age for younger and middle-aged working adults (25-54), adults nearing retirement (55-64), and adults past typical retirement age (≥65), were 40.9 ± 8.4, 58.5 ± 2.8 and 68.2 ± 3.1 respectively. Figure 3.1 demonstrates the histogram of age distribution for the three age groups: younger and middle-aged working adults (25-54 years), adults nearing retirement (55-64 years) and adults past typical retirement (≥65 years).

Marital status, education level, current working status, occupation as categorized by the National Occupational Classification (NOC), and modified work availability and its nature were significantly different across the three age groups (Table 3.1). Younger adults with injury claims were more likely to be single than those in the 55-65 or >65-year age groups (16% vs. 8% and 7% respectively, $p < 0.001$). The 25-54 and 55-64 age groups were more likely to be working at the time of assessment than the above typical retirement age group (47% and 44% vs 35% respectively, $p < 0.01$). Claimants 65 years or older had lower education levels, being more likely to have only completed grade 8 or less (7% vs. 2% and 5%, $p < 0.001$) or hold only a partial high school diploma (16% vs. 10% and 12%,

p <0.001) than those in the 25-54 or 55-64-year age groups. Workers over 65 years of age were also more likely to work in trades, transport and related occupations (50% vs. 46% and 44%, p <0.001) than the younger groups (25-54 years and 55-64 years). They were also less likely to have offers of modified work (58% no modified vs. 39% and 42%, p <0.001) than the younger groups (25-54 years and 55-64 years) while based on medical recommendations they were more likely to need modified duties and hours (49% vs. 35% and 36%, p<0.001).

There were several significant differences in injury and clinical characteristics (Table 3.2). Workers over typical retirement age were more likely to experience fractures (18% vs. 14% and 11%, p <0.001) and injuries to the lower extremities (25% vs. 20% and 21%, p <0.001) than the younger groups (25-54 years and 55-64 years). On the contrary, younger workers (25-54 years) were more likely to claim sprains/strain injuries (45% vs. 42% and 41%, p< 0.001) than the older groups (55-64 years and ≥65 years). Prior to the work/clinical assessment, workers past retirement age had the largest mean number of days between injury and assessment compared to 25-54 and 55-64 age groups (302 days vs. 273 and 209 respectively, p <0.001). Workers in the 'nearing retirement' group had the largest mean cost of health care before assessment ($991 vs. $490 and $361 in the oldest and youngest groups respectively, p <0.05). Workers aged ≥65 years were also more likely to have no further rehabilitation recommended after assessment than those 25-54 and 55-65 years (29%, vs. 18% and 21%, p <0.01). Although older workers (≥65 years) had a slightly lower mean on the Pain Disability Index (PDI) Occupation item (5.8 vs. 6.4 and 6.2, p<0.01) than younger age groups (25-54 years and 55-64 years), the overall PDI score was not significantly different between the three age groups.

More detailed examination of the workers who were not recommended further rehabilitation indicated those over typical retirement age were significantly more likely to have lower education levels, less likely to be currently working or have modified work available, more likely to be receiving wage replacement benefits, and reported slightly worse physical functioning and general health perceptions on the SF-36 (Table 3.3). However, the oldest workers (≥65 years) were not significantly different in terms of employment status, nature of the diagnosis, pain intensity levels, number of previous

physician visits, and had significantly fewer physical therapy visits, fewer previous WCB claims, and shorter injury durations than workers nearing retirement age.

3.4. DISCUSSION

This study identified several challenges faced by older workers experiencing work-related musculoskeletal injuries, especially those aged 65 years and older. Consistent with previous evidence, older injured workers were more likely to experience serious injuries, such as fractures,[20,21] and were less likely to be working in some capacity at the time of assessment. [15] In addition, we found that workers past typical retirement age had lower levels of education, worked more commonly in trades and transport industries, and were least likely to be offered modified work duties. Thus, they appear to be a disadvantaged group with significant challenges from a vocational rehabilitation perspective. Our results also identify some unique attributes of older injured workers that could potentially guide development of interventions or future studies within this population.

Injured workers often need cooperation and support from their employers to facilitate RTW, including provision of modified work duties or hours. This is especially true for older injured workers who may be experiencing age-related reductions in physical and functional capacity. However, our results and others' suggest that many employers may not be able to accommodate injured workers past typical retirement age due to the nature of their work. [7,22] Consistent with a previous study by Berecki-Gisolf,[16] older workers in our study were more likely to work in trades and transport occupations where employers may experience difficulties identifying suitable work. However, ageism and discrimination against individuals or groups on the basis of age has also been reported in the workplace, [23] and may partially explain the observed lower rate of modified work availability in the oldest workers. Identification of suitable modified work is one area that health care professionals may be able to intervene. Results of an exploratory subgroup analysis of a trial examining the effectiveness of a workplace intervention aimed at facilitating suitable modified work indicated that the intervention was especially effective in workers age 44 years and older. [24]

Consistent with previous research, we observed that older injured workers were more likely to experience fractures. [20,21] This might be explained by higher prevalence of osteoporosis among older people and may indicate the need for osteoporosis awareness or management strategies at the workplace. Additionally, a recent study reported that older workers were more likely to report traumatic injuries (e.g. bones, nerves and spinal cord), but less likely to report open wounds and sprain/strain injuries (e.g. trauma to muscles, tendons, ligaments and joints). [25] Consistent with these findings, our results showed that sprain and strain claims were less likely among older workers (≥65 years). This could be due to social or cultural differences across the different age groups.

In our study, older injured workers (≥65 years) were found to be lower educated than younger workers. While Pransky et al [15] did not find a significant difference in educational levels between older and younger groups, Berecki-Gisolf [16] indicated that older workers were more likely to be professionals, which is often used as an indication of higher levels of education. Therefore, older injured workers in our Canadian claimant population appear to be of lower educational level than those in the USA and Australia. Higher levels of education have been found to increase the likelihood that older workers stay longer in the workforce [2] However, further research is needed due to the important barrier low education poses to injured workers.

Regarding the clinical and health care variables in our study, some small, statistically significant differences in self-report and general health perceptions were seen across the three age groups. However, few of these differences appeared to reach levels of clinical importance. Unlike a previous US study [15] our study did not find any clinically or statistically significant differences between the three age groups with respect to comorbidity or general health scores.

Although there did not appear to be substantial clinical differences between the workers nearing or over typical retirement age, those nearing retirement had substantially higher overall health care costs prior to the clinical assessment and were more likely to have some form of rehabilitation recommended after the assessment. This is despite the oldest group being more likely to be receiving wage replacement benefits at time of

clinical assessment and reporting worse physical functioning. Older injured workers (≥65 years) also had the highest average duration of time between their injury and admission for assessment. It is unknown why the assessment was delayed or why these injured workers were less likely to be referred for rehabilitation. However, it has been reported previously that greater time between injury and rehabilitation is associated with higher risk of delayed return to work. [26] While older injured workers may respond more slowly to rehabilitation, there is often still potential for improvement. Previous research has highlighted that physicians may provide inadequate medical information to older patients and may apply less aggressive treatments based on non-medically related conceptions about age. [27] As with employers being less likely to offer modified duties, it is unclear whether these health care findings are due to 'medical ageism' or whether the age-related changes in older workers make them less likely to benefit from medical and rehabilitative care. Clearly, these factors require more investigation.

The limitations of this study include those inherent to secondary data analyses such as lack of control of the variables available or the quality of the data. However, this was a large, population-based database with a rich combination of personal, social, occupational and clinical/health care variables that has previously been used for research. The study was also limited to work-related injury claims accepted by a workers' compensation board, which likely do not represent all older workers with musculoskeletal conditions.

In conclusion, adults past typical retirement age with work-related musculoskeletal injuries appear to be a disadvantaged group from a vocational rehabilitation perspective, being more likely to have lower education levels, work in trades and associated occupations, and have less availability of modified work options. Older injured workers past typical retirement age also were less likely to be offered rehabilitation despite having more severe injuries.

3.5. References

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3.6. Tables

Table 3.1: Demographic and Employment Characteristics of Injured Workers Across Three Age Groups

	Categories	25-54 years n=6490	55-64 years n=1327	≥65 years n=186	*P-value*
			Count (%)		
Sex					
	Male	4147 (64)	840 (63)	134 (72)	NS
	Female	2343 (36)	487 (37)	52 (28)	
Marital Status					
	Single	1024 (16)	111 (8)	13 (7)	**<0.001**
	Married/ Common-Law	2437 (38)	595 (45)	74 (40)	
	Other or not specified	3029 (47)	621(47)	99 (53)	
Education Level					
	Grade 8 or less	148 (2)	66 (5)	14 (7)	**<0.001**
	Partial High School	665 (10)	158 (12)	29 (16)	
	High School or Partial/ Full Technical Diploma	2238 (35)	454 (34)	45 (24)	
	Partial/Full University Degree	502 (8)	104 (8)	15 (8)	
	Not Specified	2937 (45)	545 (41)	83 (45)	
Geographic region					
	Rural	1918 (30)	408 (31)	57 (31)	NS
	Urban	4572 (70)	919 (69)	129 (69)	
Employment status					
	Unemployed	962 (15)	213 (16)	34 (18)	NS
	Employed	5528 (85)	1114 (84)	152 (82)	
Currently Working					
	No	3450 (53)	740 (56)	121 (65)	<**0.01**
	Yes	3025 (47)	586 (44)	65 (35)	
	Unknown	15 (0)	1 (0)	0 (0)	
National Occupational Classification					
	Management	181 (3)	38 (3)	8 (4)	**<0.001**
	Business, finance and administration	447 (7)	111 (8)	11 (6)	
	Natural and applied sciences	159 (2)	27 (2)	1 (0)	
	Health occupations	548 (8)	106 (8)	13 (7)	
	Social science, education, government services and religion	95 (2)	19 (1)	1 (0)	
	Art, culture, recreation and sport	37 (1)	8 (1)	0 (0)	
	Sales and service	1306 (20)	339 (26)	46 (25)	
	Trades, transport and equipment operators	2990 (46)	578 (44)	93 (50)	
	Primary Industry	217 (3)	21 (2)	5 (3)	
	Processing	508 (8)	80 (6)	8 (4)	
	Unknown	2 (0)	0 (0)	0 (0)	
Is Modified Work Available?					
	No	2522 (39)	555 (42)	107 (58)	**<0.001**
	Yes - Full time	3174 (49)	620 (47)	56 (30)	
	Yes - Part time	429 (7)	89 (7)	16 (9)	
	Unknown	365 (6)	63 (5)	7 (4)	

Nature of Modified Work Available					
	Modified Duties	1799 (62)	321 (59)	27 (47)	**<0.001**
	Modified Hours	72 (3)	32 (6)	2 (4)	
	Modified Duties and Hours	1047 (36)	192 (35)	28 (49)	
Receiving Wage Replacement Benefits?					
	No	2737(42)	558 (42)	64 (34)	NS
	Yes	3753 (58)	769 (58)	122 (66)	

Statistical testing was done using either Chi-square or Fisher's exact test.

Table 3.2: Injury and Clinical Characteristics of Injured Workers Across Three Age Groups

Categories	25-54 years n=6490	55-64 years n=1327	≥65 years n=186	p value
	Count (%) or Mean±SD			
Diagnosis				
Fractures	698 (11)	189 (14)	34 (18)	**<0.001**
Dislocations	120 (2)	36 (3)	7 (4)	
Sprains/Strains	2920 (45)	559 (42)	76 (41)	
Lacerations	160 (3)	21 (2)	2 (1)	
Contusions	306 (5)	72 (5)	8 (4)	
Nerve Damage	98 (2)	19 (1)	0 (0)	
Joint disorders	1852 (29)	367 (28)	48 (26)	
Other	336 (5)	64 (5)	11 (6)	
Anatomical Site of Injury				
Head	159 (2)	34 (3)	6 (3)	<**0.01**
Neck	746 (12)	117 (9)	21 (11)	
Upper Back	64 (1)	6 (0)	0 (0)	
Lower Back	545 (8)	99 (8)	14 (8)	
Other Torso	518 (8)	75 (6)	13 (7)	
Upper Extremity	2451 (38)	550 (41)	69 (37)	
Lower Extremity	1266 (20)	273 (21)	46 (25)	
Multiple Site	20 (0)	5 (0)	0 (0)	
Not Specified	721 (11)	168 (13)	17 (9)	
Comorbidity as Indicated by Secondary Diagnosis				
No	4621 (71)	903 (68)	131 (70)	NS
Yes	1869 (29)	424 (32)	55 (30)	
Rehabilitation Program Recommended?				
No rehabilitation	1191 (18)	272 (21)	53 (29)	**<0.01**
Physical therapy	967 (15)	233 (18)	28 (15)	
Chronic Pain programme	253 (4)	51 (4)	8 (4)	
Functional restoration	3376 (52)	643 (49)	84 (45)	
Workplace-based rehab	91 (1)	18 (1)	2 (1)	
Functional restoration with Integrated workplace	612 (9)	110 (8)	11 (6)	
Days Accident to Admission	208.6±409.2	272.9±513.4	302.4±546.2	**<0.001**
Prior Compensation Claims	4.0±4.9	6.1±6.7	6.6±8.0	**<0.001**
Cost of Health Care for Injury ($CDN)	361.2±3093	990.5±14467	490.3±2573	**<0.05**
Number of Physician Visits	14.9±19.9	17.0±20.3	17.2±18.1	**<0.01**
Number of Physiotherapy Visits	19.2±24.7	23.2±26.9	22.9±23.2	**<0.001**
	25-54 N=5080	**55-64 N=1022**	**≥65 N=139**	***P-value***
SF-36 Domain Scores (all are out of 100)				
Physical Functioning	54.2±25.1	51.6±25.3	46.6±24.6	**<0.001**
Role-Physical	29.3±25.7	31.9±26.6	33.0±25.5	<**0.01**
Bodily Pain	25.7±20.2	27.3±21.0	27.5±20.8	NS
General Health	66.9±19.4	65.2±21.1	66.6±20.8	NS
Mental-Health	61.8±21.4	63.3±21.9	66.2±19.4	<**0.05**
Role-Emotional	57.0±33.3	56.2±32.8	51.0±34.0	NS
Social Functioning	51.5±27.1	54.7±28.6	53.0±25.9	<**0.01**
Vitality	48.4±20.9	49.9±21.7	53.0±22.8	<**0.01**

Pain Visual Analogue Scale (out of 10)	5.1±2.5	5.0±2.5	5.0±2.8	NS
Percent Pain Disability Index (out of 100)	48.2±22.2	48.1±22.6	46.1±23.0	NS
Pain Disability Index Occupation Item (out of 10)	6.4±2.6	6.2±2.6	5.8±2.7	<**0.01**

Statistical testing was done using either Chi-square (or Fisher's exact test), ANOVA (or Kruskal Wallis Test)

Table 3.3: Characteristics of Claimants Recommended for No Further Rehabilitation

	25-54 years n=1191	55-64 years n=272	≥65 years n=53	
Categories	**Count (%) or Mean±SD**			**p value**
Education Level				
Grade 8 or less	20(2)	15(6)	5(9)	<**0.01**
Partial High School	110(9)	31(11)	8(15)	
High School or Partial/ Full Technical Diploma	448 (38)	87(32)	15(28)	
Partial/ Full University Degree	84(7)	21(8)	4(8)	
Not Specified	529(44)	118(43)	21(40)	
Employment Status				
Unemployed	289(24)	80(29)	17(32)	NS
Employed	902(76)	192(71)	36(68)	
Is Modified Work Available?				
No	501(42)	125(46)	36(68)	**<0.001**
Yes - Full time	532(45)	113(42)	9(17)	
Yes - Part time	60(5)	14(5)	7(13)	
Unknown	98(8)	20(7)	1(2)	
Currently Working?				
No	602(51)	138(51)	38(72)	<**0.05**
Yes	586(49)	134(49)	15(28)	
Unknown	3(0)	0(0)	0(0)	
Nature of Modified Work Available				
Modified Duties	325(76)	72(76)	5(42)	NS
Modified Hours	16(4)	6(6)	1(8)	
Modified Duties and Hours	89(21)	17(18)	6(50)	
Diagnosis				
Fractures	168(14)	38(14)	14(26)	NS
Dislocations	26(2)	5(2)	0(0)	
Sprains/Strains	432(36)	114(42)	17(32)	
Lacerations	58(5)	7(3)	2(4)	
Contusions	74(6)	12(4)	3(6)	
Nerve Damage	29(2)	12(4)	0 (0)	
Joint disorders	304(26)	67(25)	11(21)	
Other	100(8)	17(6)	6(11)	
Receiving Total Temporary Disability Benefits?				
No	849(71)	208(77)	31(59)	<**0.05**
Yes	342(29)	64(24)	22(42)	
Receiving Partial Temporary Disability Benefits?				
No	1095(92)	247(91)	49(93)	NS
Yes	96(8)	25(9)	4(8)	
Days between Accident to Admission	381.7±622	518.9±767	466.8±617	**<0.001**
Prior Compensation Claims	4.1±5.0	6.3±7.4	5.6±5.7	**<0.001**
Number of Physician Visits	19.3±26.8	21.9±27.1	17.3±18.4	NS
Number of Physiotherapy Visits	15.7±25.0	20.0±28.7	17.1±20.9	<**0.05**
Pain Visual Analog Scale (out of 10)	4.7±2.7	4.9±2.7	4.7±3.1	NS
SF-36 Domain Scores (out of 100)				
Physical Functioning	59.1±26.4	52.7±25.7	49.2±26.9	**<0.001**
Role-Physical	36.2±29.5	35.9±28.7	36.3±28.7	NS
Bodily Pain	30.8±23.1	29.5±22.1	32.8±25.5	NS
General Health	65.8±20.7	60.4±22.6	59.9±22.3	<**0.01**
Mental Health	61.5±22.0	61.7±22.9	67.1±20.0	NS
Role-Emotional	59.9±33.0	55.0±33.4	57.8±38.5	NS

Social Functioning	53.5±28.3	54.0±28.6	52.9±29.5	NS
Vitality	50.3±22.0	48.0±22.9	51.9±21.8	NS

Statistical testing was done using either Chi-square (or Fisher's exact test), ANOVA (or Kruskal Wallis Test).

3.7. Figures

Figure 3.1: Histogram of age distribution for the three age groups: younger and middle-aged working adults (25-54 years), adults nearing retirement (55-64 years) and adults past typical retirement (≥65 years.

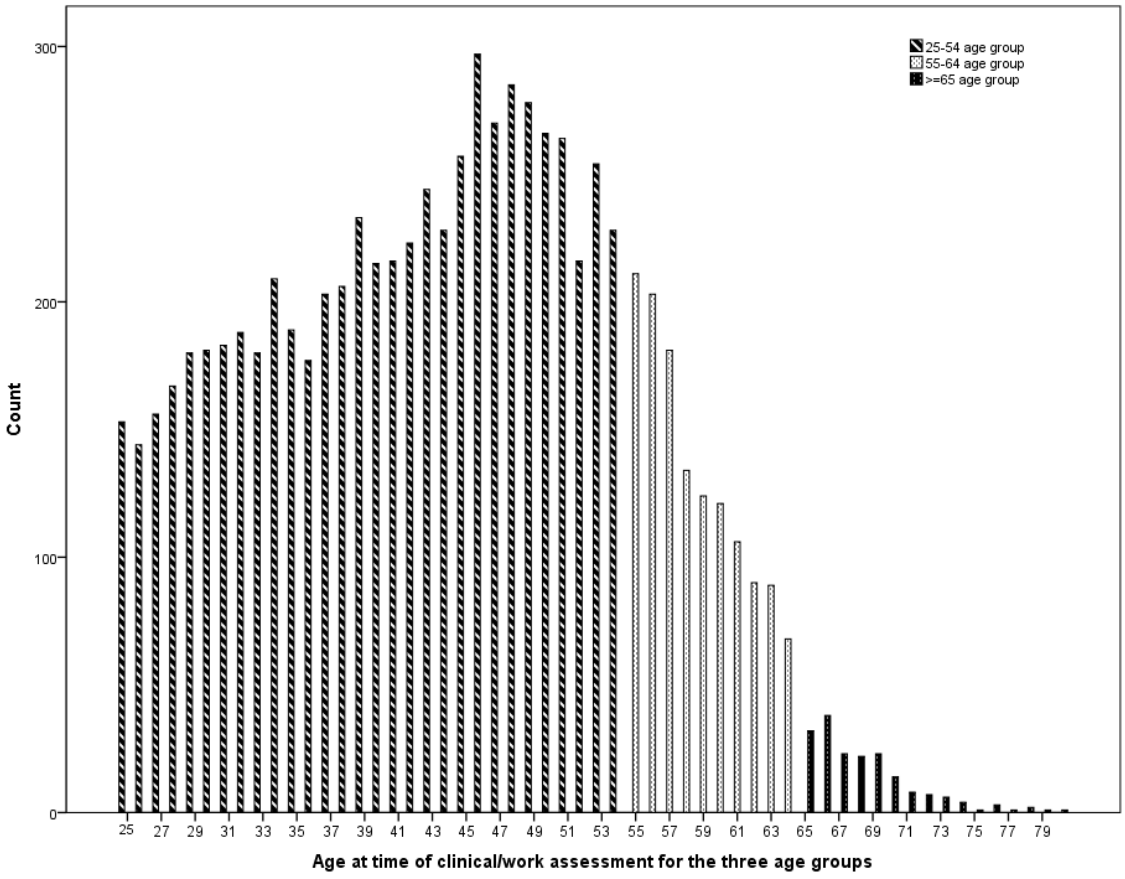
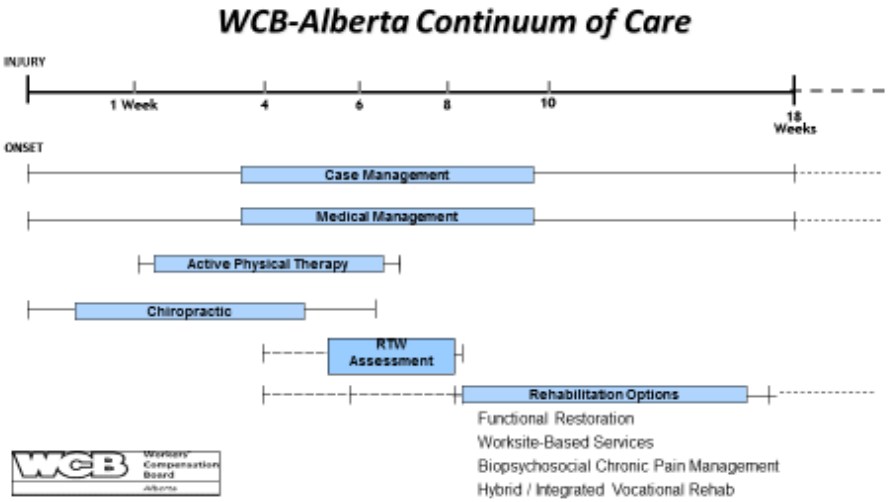


Figure 3.1: Workers' Compensation Board of Alberta Continuum of Care



- This figure demonstrates when claimants may start receiving health care services within the WCB-Alberta jurisdiction and comprehensive return to work assessment.
- Claimants may start receiving physician and community-based physical therapy visits from the time of injury until the time of receiving the comprehensive return to work assessment.
- RTW Assessment takes place at a separate, independent rehabilitation facility from the community physical therapy.
- The majority of baseline data for this study were collected at the time of RTW assessment, however we also had data on the number of days between injury and RTW Assessment and the number of physician and physical therapy visits between the injury and the RTW assessment.
- Claimants are triaged after the RTW Assessment to the most appropriate rehabilitation option.

3.8. Appendices

Appendix 3.1: List of variables

Variable	Description	This variable used in study…
Biological Characteristics **(including medical characteristics)**		
Diagnosis Group (8 categories)	Diagnosis Group at RTW assessment based on ICD9 codes: - Fractures (Bone fractures) - Dislocations (Dislocation of joints) - Sprains/strains (all sprains and strains of joints, muscles, tendons, ligaments, and capsules excluding complete ruptures) - Lacerations (open wounds) - Contusions (eg., contusion with intact skin surface, crushing injuries) - Nerve Damage (eg., inflammatory, hereditary and degenerative diseases of the central nervous system) - Joint Disorders (eg., osteoarthritis, injury to peripheral nerves to: shoulder girdle and upper limbs, or pelvic girdle and lower limbs) - Other (eg., osteopathies, chondropathies, and acquired MSK deformities)	1, 2, and 3
Anatomical Site Group (8 categories)	Anatomical Site Group at RTW assessment based on ICD9 coding: - head, - neck, - upper back, - lower back, - other torso, - upper extremity, - lower extremity, - Other (multiple site and not specified).	1, 2, and 3
Prior Claims	The number of Prior Claims Count for the claimants	1, 2, and 3
Comorbidity	Whether the claimant has comorbidity or not. (Comorbidity as indicated by secondary diagnosis) (Yes/No)	1, 2, and 3
SF-36 Physical Functioning	"A high score indicates the respondent's ability to perform all types of physical activities without limitations due to health." [i]	1, 2, and 3
SF-36 ROLE-PHYSICAL	"A high score indicates little or no problems with work or other activities due to physical health"[i]	1, 2, and 3

SF-36 GENERAL HEALTH	"A high score indicates positive perceptions of general health" [i]	1, 2, and 3
SF-36 Vitality	"A high score indicates more vitality"[i]	1, 2, and 3
SF-36 Bodily Pain	"A high score indicates little or no pain or limitations due to pain" [i]	1, 2, and 3
Visual Analog Scale (VAS) pain	Pain measurement	1, 2, and 3
Physician Visit	Number of visits to a Doctor paid for by the WCB-Alberta between the date of injury and the date that claimants undergo return to work assessment.	1, 2, and 3
Physiotherapy visit	Number of visits to a Physiotherapist paid for by the WCB-Alberta between the date of injury and the date that claimants undergo return to work assessment.	1, 2, and 3
Overall PDI (%)	Overall **PDI**, Pain Disability Index, in 100% based on the Half-scale Rule	1, 2, and 3
Rehabilitation Program (6 categories)	Rehabilitation program undertaken for the claimants after the injury : - "No rehabilitation" - "Single Service Community Physical Therapy" - "Complex RTWS" - "Provider - Based RTWS" - "Work Site-based RTWS" - "Hybrid"	1, 2, and 3
Amount of health care	Amount ($$) of health care spent to treat and rehabilitate the claimants	1
Gender	(Male/Female)	1, 2, and 3
Accident to admission	The number of days between the accident/injury until admission for the RTW assessment (Calendar Days)	1, 2, and 3
Psychological Characteristics		
SF-36 ROLE-EMOTIONAL	"A high score indicates little or no problems with social activities due to emotional problems" [i]	1, 2, and 3
SF-36 MENTAL HEALTH	"A high score indicates little or no feelings of depression or nervousness" [i]	1, 2, and 3
Social Characteristics **(including environmental and occupational)**		

Marital Status (7 categories)	The Marital Status at time of admission to RTW assessment.	1, 2, and 3
Education Level (8 categories)	The Education Level at time of RTW assessment.	1, 2, and 3
Geographic region	Geographic region of the claimants (Urban/Rural)	1, 2, and 3
PDI Family and Home	Pain Disability Index-Family and home –Assessment It indicates the level of disability due to pain in the family and home activities	1, 2, and 3
PDI Social	Pain Disability Index-Social It indicates the level of disability due to pain in the social activities	1, 2, and 3
PDI Life support	Pain Disability Index-Life-support It indicates the level of disability due to pain in the basic life support behaviors such as eating, sleeping and breathing.	1, 2, and 3
PDI Recreation	Pain Disability Index-Recreation It indicates the level of disability due to pain in the recreation activities (eg., hobbies, sports)	1, 2, and 3
PDI Sexual Relation	Pain Disability Index-Sexual-relation It indicates the level of disability due to pain in the sexual relation	1, 2, and 3
PDI Self-care	Pain Disability Index-Self-care It indicates the level of disability due to pain in the self-care	1, 2, and 3
SF-36 Social Functioning	"A high score indicates better social functioning" [i]	1, 2, and 3
PDI Occupation	Pain Disability Index-Occupation It indicates the level of disability due to pain in the paying and nonpaying jobs' activities	1, 2, and 3
Employment status	Whether the claimants have admission job attached at time of RTW assessment (Yes/No)	1, 2, and 3
Pre-Accident National Occupation (9 categories)	Pre-Accident National Occupational Code The initial source of the pre-accidental NOC (national occupational classification) comes from the claim Owner. The occupation is characterized by the type and the required level of skill for that occupation on the date of the accident.	1, 2, and 3
Working status (2 categories)	It indicates whether the claimant is working at the time of RTW assessment: (Yes or No)	1, 2, and 3

Modified Work Availability (3 categories)	Whether the claimant modified work available at time of RTW assessment: - No - Yes-(Full or Part time) - Unknown	1, 2, and 3
Nature of the Modification (3 categories)	Whether modified duties for work are available, the Nature of the Modification for the claimants are: - Modified duties - Modified hours - Modified duties and hours	1, 2, and 3
Other Characteristics		
Three Age Categories (3 categories)	The factor of three age categories includes: - Younger and middle aged working adults (25-54) - Adults nearing retirement (55-64) - Adults past typical retirement age (≥65)	2, 3

[i] Maruish ME. *User's manual for the SF-36v2 health survey.* Third Edition ed. United States: QualityMetric Health Incorporated; 2011.

Appendix 3.2: Short Form Health Survey (SF-36)

SF-36(tm) Health Survey

Instructions for completing the questionnaire: Please answer every question. Some questions may look like others, b ut each
one is different. Please take the time to read and answer each question carefully by filling in the bubble that best repr esents
your response.

Patient Name: _____

SSN#: _____ Date: _____

_

Person heling to complete this form: _____

_

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

   - ❑ Excellent
   - ❑ Very good
   - ❑ Good
   - ❑ Fair
   - ❑ Poor

2. Compared to one year ago, how would you rate your health in general now?

   - ❑ Much better now than a year ago
   - ❑ Somewhat better now than a year ago
   - ❑ About the same as one year ago
   - ❑ Somewhat worse now than one year ago
   - ❑ Much worse now than one year ago

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

   a. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.
      - ❑ Yes, limited a lot.
      - ❑ Yes, limited a little.
      - ❑ No, not limited at all.

   b. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf?
      - ❑ Yes, limited a lot.
      - ❑ Yes, limited a little.
      - ❑ No, not limited at all.

   c. Lifting or carrying groceries.
      - ❑ Yes, limited a lot.
      - ❑ Yes, limited a little.
      - ❑ No, not limited at all.

   d. Climbing several flights of stairs.
      - ❑ Yes, limited a lot.
      - ❑ Yes, limited a little.
      - ❑ No, not limited at all.

e. Climbing one flight of stairs.
- ❑ Yes, limited a lot.
- ❑ Yes, limited a little.
- ❑ No, not limited at all.

f. Bending, kneeling or stooping.
- ❑ Yes, limited a lot.
- ❑ Yes, limited a little.
- ❑ No, not limited at all.

g. Walking more than one mile.
- ❑ Yes, limited a lot.
- ❑ Yes, limited a little.
- ❑ No, not limited at all.

h. Walking several blocks.
- ❑ Yes, limited a lot.
- ❑ Yes, limited a little.
- ❑ No, not limited at all.

i. Walking one block.
- ❑ Yes, limited a lot.
- ❑ Yes, limited a little.
- ❑ No, not limited at all.

j. Bathing or dressing yourself.
- ❑ Yes, limited a lot.
- ❑ Yes, limited a little.
- ❑ No, not limited at all.

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

a. Cut down the amount of time you spent on work or other activities?
☐ Yes ☐ No

b. Accomplished less than you would like?
☐ Yes ☐ No

c. Were limited in the kind of work or other activities
☐ Yes ☐ No

d. Had difficulty performing the work or other activities (for example, it took extra time)
☐ Yes ☐ No

5. During the past 4 weeks, 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)?

a. Cut down the amount of time you spent on work or other activities?
☐ Yes ☐ No

b. Accomplished less than you would like
☐ Yes ☐ No

c. Didn't do work or other activities as carefully as usual
☐ Yes ☐ No

6. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

- ❑ Not at all
- ❑ Slightly
- ❑ Moderately
- ❑ Quite a bit
- ❑ Extremely

7. How much bodily pain have you had during the past 4 weeks?

- ❑ Not at all
- ❑ Slightly
- ❑ Moderately
- ❑ Quite a bit
- ❑ Extremely

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
- ❑ Slightly
- ❑ Moderately
- ❑ Quite a bit
- ❑ Extremely

9. 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.

a. did you feel full of pep?

- ❑ 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

b. have you been a very nervous person?

- ❑ 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

c. have you felt so down in the dumps nothing could cheer you up?

- ❑ 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

d. have you felt calm and peaceful?

- ❑ 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

e. did you have a lot of energy?

- ❑ 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

f. have you felt downhearted and blue?

- ❑ 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

g. did you feel worn out?

- ❑ 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

h. have you been a happy person?

- ❑ 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

i. did you feel tired?

- ❑ 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

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

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

11. How TRUE or FALSE is each of the following statements for you?

a. I seem to get sick a little easier than other people

- ❑ Definitely true
- ❑ Mostly true
- ❑ Don't know
- ❑ Mostly false
- ❑ Definitely false

b. I am as healthy as anybody I know

- ❑ Definitely true
- ❑ Mostly true
- ❑ Don't know
- ❑ Mostly false
- ❑ Definitely false

c. I expect my health to get worse

- ❑ Definitely true
- ❑ Mostly true
- ❑ Don't know
- ❑ Mostly false
- ❑ Definitely false

d. My health is excellent

- ❑ Definitely true
- ❑ Mostly true
- ❑ Don't know
- ❑ Mostly false
- ❑ Definitely false

Appendix 3.3: Pain Disability Index (PDI)

PAIN DISABILITY INDEX

Millard Health

Service Line_____ Program _____

Name	Millard file no.	Date
Program	Team/assessment type	☐ Admission ☐ Discharge

The rating scales below measure the impact of chronic pain in your everyday life. We want to know how much your pain is preventing you from doing your normal activities. For each of the seven categories of life activity listed, circle the one number that best reflects the level of disability you typically experience. A score of "0" means no disability at all. A score of "10" means that all the activities you would normally do have been disrupted or prevented by your pain.

Your rating should reflect the overall impact of pain in your life, not just when the pain is at its worst. Make a rating for every category. If you think a category does not apply to you, circle "0".

Family/home responsibilities. This category refers to activities related to the home or family. It includes chores and duties performed around the house (e.g., yard work) and errands or favours for other family members (e.g. driving the children to school).

0 1 2 3 4 5 6 7 8 9 10
no disability — mild — moderate — severe — total disability

Recreation. This category includes hobbies, sports and other similar leisure time activities.

0 1 2 3 4 5 6 7 8 9 10
no disability — mild — moderate — severe — total disability

Social activity. This category refers to activities which involve participation with friends and acquaintances other than family members. It includes parties, theatre, concerts, dining out and other social functions.

0 1 2 3 4 5 6 7 8 9 10
no disability — mild — moderate — severe — total disability

Occupation. This category refers to activities that are a part of or directly related to one's job. This includes non-paying jobs as well, such as that of a housewife or volunteer worker.

0 1 2 3 4 5 6 7 8 9 10
no disability — mild — moderate — severe — total disability

Sexual behaviour. This category refers to the frequency and quality of one's sex life.

0 1 2 3 4 5 6 7 8 9 10
no disability — mild — moderate — severe — total disability

Self-care. This category includes activities that involve personal maintenance and independent daily living (e.g., taking a shower, driving, getting dressed, etc.).

0 1 2 3 4 5 6 7 8 9 10
no disability — mild — moderate — severe — total disability

Life-support activity. This category refers to basic life supporting behaviours such as eating, sleeping and breathing.

0 1 2 3 4 5 6 7 8 9 10
no disability — mild — moderate — severe — total disability

VISUAL ANALOGUE SCALE

On a scale of 0-10 (where 0 is no pain and 10 is unbearable pain, the worst pain you can imagine), mark where your pain is most of the time.

0 — 10
no pain — unbearable pain

Millard Health, 131 Airport Road, Edmonton, AB, T5G 0W8, Phone: (780) 498-3200, Toll Free: (888) 498-9902, Fax: (780) 498-3907

Chapter 4

Do Prognostic Factors for Receiving Wage Replacement Benefits Differ Between Older and Younger Workers?

Abstract

Objectives: To identify the prognostic factors for wage replacement and determine whether they are similar between younger and older workers.

Methods: Secondary analysis was conducted on an administrative database. Our main test of whether prognostic factors were the same across age groups was testing the interaction between each factor and a categorized age variable (25-54, 55-64, and ≥65 years).

Results: Differences in prognostic factors were observed across the three age groups based on the unadjusted odds ratios. Interactions between health care factors and the categorized age variable were statistically significant, with more physician and physical therapy visits predictive of delayed recovery only in younger workers.

Conclusions: There appear to be differences in prognostic factors for wage replacement across different age groups, especially physician and physical therapy visits, suggesting older workers may need to be considered separately when predicting return to work.

Keywords: Older workers, aging, work-related injuries, prognostic factors, return to work, musculoskeletal injuries.

4.1. Introduction

The proportion of older individuals (≥65) among the general population has increased substantially, and is a trend that is expected to continue. [1] In 2008, the proportion of individuals aged 65 years and older constituted 7% of the world's total population; this figure is expected to double to 14% by 2041. This increase in the proportion of older adults is carrying over into the workforce. In fact, increasingly higher numbers of workers are continuing to work beyond the typical retirement age of 65 years. [2] With respect to older workers in general, employment rates for Canadian men and women aged 55 and above in 2010 were 39% and 29% respectively, while these rates were 30% and 16% in 1997. [3]

Several reviews have highlighted the benefits of work participation and the importance of 'safe and productive work' to the health and wellbeing of older individuals. [4-6] However, the aging workforce faces important challenges from work-related injuries, which can entail particularly severe consequences for older workers. [7,8] According to Statistics Canada, the rate of disability increases with age. [9]

The high social and financial burdens of work disability and delayed return to work (RTW) from work-related musculoskeletal (MSK) injuries have motivated researchers to identify prognostic factors for RTW. Although several studies have identified some aspects that are associated with a worse prognosis for MSK disorders, numerous inconsistencies and limitations exist among these studies. [10] In particular, research considering prognostic factors for RTW or the receipt of compensation payment have often ignored older injured workers (≥55) despite the fact that several studies have reported the increasing age of the workforce [11] and longer recovery time after work-related injuries among older injured workers. [12]

Most injured workers recover within a short period of time without intervention; however, some injured workers experience prolonged work disability. [13] Knowledge of factors contributing to prolonged disability is critical, particularly for older workers, who represent a growing segment of the population. Dasinger et al. reported that when the age of injured workers increased by 10 years, the RTW rate decreased by 15%. [14] Moreover, work disability represents the most common reason for early retirement before the age of 60. [15] Accordingly, we aimed to

identify prognostic factors for continuing to receive Wage Replacement Benefits (WRB) three months after assessment among injured workers and determine whether these factors differ between young and middle-aged working adults (25-54), adults nearing retirement (55-64), and adults past typical retirement age (≥65).

4.2. Methods

4.2.1. Research Design

A historical cohort design (retrospective) was used to identify prognostic factors for receiving WRB three months after comprehensive RTW assessment and test whether they are similar across three age groups. Secondary analysis was conducted on a population-based database previously created from clinical and administrative claims data from the Workers' Compensation Board of Alberta (WCB-Alberta) for the purpose of creating a clinical decision support tool (the MSK Injury Triage Database). [16] This dataset includes information on workers (workers' compensation claimants) experiencing work-related MSK injuries in the province of Alberta, Canada who underwent a comprehensive RTW assessment and/or received rehabilitation. The University of Alberta's Health Research Ethics Board approved this research.

4.2.2. Study Population

Data were available on 8,003 workers' compensation claimants receiving rehabilitation for predominately sub-acute MSK injuries between December 1, 2009 and January 1, 2011. Workers' compensation is mandatory for the vast majority of workers in the jurisdiction and is administered on a provincial basis. Since the database contains information on all workers across the province undergoing rehabilitation, it represents virtually the entire population. The workers were stratified into three age groups: young and middle- aged adults (25-54 years), adults nearing retirement age (55-64 years), and adults over typical retirement age (≥65 years). This allowed us to compare across the age groups to determine whether prognostic factors are different in older and younger workers. In the case of a claimant with more than one claim, only the first claim was included. Claimants with missing data were omitted. The final sample was 5,362 claimants with complete data and continuing employment or a job to which to return.

As mentioned in a previous paper, [17] within the jurisdiction, claimants are sent for a comprehensive RTW assessment after undergoing required primary care treatment in the community (i.e. physician, physical therapy, or chiropractic care), but fail to return-to-work after a course of acute treatment. Claimants are systematically referred for work/clinical assessment based on a care pathway when they have not recovered within the anticipated healing time of their injury (typically between 4 to 8 weeks). [18] These claimants are assessed to determine their ability to return-to-work. Our research group has previously studied the comprehensive RTW assessment and the tools used to assess ability to return-to-work in this jurisdiction. [19] The measures and information available have proved trustworthy and acceptable for research purposes.

4.2.3. Measures

4.2.3.1. Dependent variable

Outcome information from the administrative workers' compensation claims data included whether the claimants were receiving total or partial temporary disability wage replacement benefits 3 months after the comprehensive RTW assessment. The timeline of 3 months is a key point in recovery for injured workers as it has been found that injured workers who cannot return to work within three months are likely to continue to experience work disability until 15 months. [13] Reception of benefits is a surrogate indicator of work disability and return-to-work, and is commonly used as an outcome within studies of compensation claimants.[20] The outcome was defined as whether or not the claimant was receiving compensation payment 3 months (90 days) after discharge from the comprehensive RTW assessment. The outcome was either "*no wage replacement"* or *"wage replacement",* which are described below*:*

> *No wage replacement* signified that the claimant at 90 days after discharge from the comprehensive RTW assessment was not receiving any type of compensation due to total or partial temporary disability. The claimant had returned to work and was working in a full time job.

Wage replacement, signified that the claimant was continuing to receive compensation payments due to total or partial temporary disability. The claimant was either working in a modified part time capacity (due to partial temporary disability) or not working at all due to the work injury.

4.2.3.2. Independent variables:

As mentioned in a previous paper,[17] this database contains information on a variety of potential prognostic factors, which were included in the present study based on a biopsychosocial framework and earlier reports of potential effects on return to work and work disability. [21-23] They ranged from individual demographic and social factors (e.g. age, gender, marital status, educational level, urban/rural status) and occupational factors (e.g. occupational category, employment and working status, modified work availability) to health/injury factors (e.g. previous injuries, self-rated health status, pain intensity and perceived disability) and health care utilization (e.g. number of visits to primary care providers occurring between the date of the injury until the date of the comprehensive RTW assessment). The database also contains three regularly collected clinical measures: the Short Form Health Survey (SF-36), the pain Visual Analogue Scale VAS, and the Pain Disability Index (PDI).

The SF-36 has been used in many studies to assess patients' health-related quality of life.[24] The SF-36 has previously been validated for examining the patient's perspective on his/her health-related functioning and well being [25] and has also been validated in an injury population.[26] It has been used, in particular, in patients with MSK disorders and occupational disability.[27-30] The measure includes eight health domain scales including: physical functioning, physical role functioning, mental health, emotional role functioning, social role functioning, general health perception, vitality and bodily pain. [31]

The VAS was used to measure pain severity on a scale ranging from 0 to 10, where 0 means no pain and 10 means the most severe pain. In this measure, the claimant is asked to mark his/her pain severity level on a line. There is evidence to support the validity and reliability of the scale and it has been found associated with return to work.[32]

The PDI is a self-report questionnaire that is commonly used to measure the level of disability associated with pain.[33,34] It includes seven areas: recreation, family and home, social, occupation, sexual relations, self-care and life support activities. Respondents are asked to rate their disability level due to pain in each of the seven areas where 0 = no disability and 10= the worst disability. Since the sexual relations item is commonly missing, overall PDI in percentage (%) was calculated with higher scores indicative of worse disability. The PDI has been examined previously in several different populations and the concurrent reliability and test-retest validity was found to be acceptable.[35-37]

4.2.4. Data Analysis

Means, frequencies and proportions were computed for each age group and compared across the three age groups of interest using ANOVA and chi-square tests or the respective non-parametric equivalent (Kruskal-Wallis test or Fisher's exact test). To identify the significant predictive/prognostic factors for long-term work disability (WRB) among the three age groups, multiple logistic regression analysis was used since the main dependent variable was dichotomous. Our primary test of effect was the interaction between age and the various predictor variables within a final logistic regression model, with statistically significant interactions indicating important differences between the age groups.

A purposeful modeling strategy was used.[38] First, univariate regression was used for each variable separately. The independent variables which were significant at *p-value* =0.20 were entered into a multiple logistic regression model. Next, variables that were not statistically significant at *p-value*<0.05 were removed and tested for their potential confounding effect.[38] The continuous variables in the interim model were tested for potential violation of the linearity assumption. The continuous variables, which violated the linearity assumption, were categorized. The final (main effects) model included statistically significant independent variables, confounding variables, clinically important variables and the categorized age variable. All interactions with age were tested one at a time (between each variable and the categorized age variable). The final model included the significant prognostic factors and interactions, and confounding variables. If the interactions between the categorized age variable and the other variables were found to be significant, the prognostic factors for WRB in each age category

would be determined individually. The STATA procedure (lincom) was used to determine the Odds Ratio (OR) and 95% confidence interval for each factor or level of a prognostic factor that was significant and was part of a significant interaction effect in the final model after fixing the other factors that had an interaction with the same prognostic factor. A sensitivity analysis was also conducted using only two age groups (25-54 years and ≥ 55 years) in order to avoid any potential effects due to the small sample size for the claimants aged ≥ 65 years. The fitness of the final model was assessed using the Hosmer-Lemeshow Test. All statistical analyses were done using STATA software (StataCorp. 2011. *Stata Statistical Software: Release 12*. College Station, TX: StataCorp LP).

4.3. Results:

The descriptive characteristics of the three age groups appear in Table 4.1. Several of these characteristics differed significantly across the age groups. Claimants nearing retirement age were more likely to be married, widowed, or living in common-law relationships; work in white-collar jobs; have ≥ 6 prior claims; and have ≥ 91 days between accident and comprehensive assessment in comparison to claimants aged 25-54 and ≥ 65 years. The claimants past typical retirement age were more likely to have not finished high school; be absent from work at the time of RTW assessment; lack access to modified work; have incurred their work injuries in the torso area; have had 61-90 days between accident and comprehensive RTW assessment; and have had ≥ 6 physician visits and ≥ 21 physical therapy visits in comparison to the two younger age groups. Both older groups were more likely to have had ≥ 91 days between accident and comprehensive assessment; ≥ 6 physician visits; and ≥ 21 physical therapy visits in comparison to the claimants aged 25-54 years. Appendix 4.1 shows descriptive statistics for those who received wage replacement 3 months after comprehensive assessment and those who did not as well as the unadjusted ORs for the whole sample. Both groups of older workers were slightly more likely to be receiving WRB at 3 months after comprehensive RTW assessment.

Missing data were most common for the self-report questionnaires, including the SF-36 domains, the PDI and pain VAS. Importantly, there did not appear to be meaningful differences between the three age groups with respect to the frequency of missing data. The numbers of claimants with complete data and included in subsequent analyses for young and middle-aged

working adults (25-54), adults nearing retirement (55-64), and adults past typical retirement age (≥65) were 4,367, 875, and 120 claimants respectively.

4.3.1. Unadjusted odds ratios for each age group

The unadjusted ORs of receipt of any wage replacement for each age group are shown in Table 4.2. In both younger groups those working in blue-collar and health jobs were more likely to receive WRB three months after comprehensive assessment than those in white collar jobs. Conversely, claimants in these jobs past typical retirement age were less likely to receive this benefit. Furthermore, the youngest claimants with sprains or strains and joint disorders were less likely to receive WRB than if fracture or dislocation had been experienced, but this was not the case for either of the older age groups. Young and middle-aged claimants with comorbidities were more likely to receive WRB, but a similar trend was not evident in older claimants. Young and middle-aged claimants who had waited ≥ 91 days following their accident before a comprehensive assessment also were more likely to receive WRB than those assessed within 30 days of injury. Yet, a similar finding was not present in claimants 65 and older. Claimants aged 25-54 years with ≥ 6 physician visits at the time of assessment had 10.1 times the odds (95% CI: 5.4-19.0) of receiving WRB than those with two or fewer visits, while the odds were only 3.0 and 1.2 times greater in claimants 55-64 and ≥ 65 years. All age groups who had ≥ 21 physical therapy visits prior to assessment were more likely to receive WRB. Virtually all scores indicating worse health, disability and pain at assessment were associated with a greater likelihood of receiving WRB three months later.

4.3.2. Results from multiple logistic regression analysis

The results from the final multiple logistic regression analyses of receiving WRB are shown in Table 4.3. In the multiple logistic regression analysis, the variables that were significantly associated with the WRB outcome included: SF-36 Physical Function, SF-36 Role Physical, SF-36 Social Function, pain intensity (VAS), perceived disability (PDI), injuries in upper extremities, high school/partial technical diploma/partial university, technical diploma/university degree, living in urban areas, working at the time of comprehensive

assessment, and the availability of modified work. In addition, there was a significant interaction between age group and visits to physicians and physical therapists, respectively.

In the final model, claimants who had work-related injuries in the upper extremities and higher levels of education were more likely to receive wage replacement. Conversely, claimants who were living in urban areas, working at the time of comprehensive assessment, and possessed modified work availability were less likely to receive wage replacement.

After allowing for the interaction effects, among claimants aged 25-54 years old, workers with ≥ 6 physician visits and workers with 11-20 or ≥ 21 physical therapy visits were more likely to receive WRB in comparison to those with ≤ 2 physician visits and those with ≤ 10 physical therapy visits respectively. Moreover, claimants aged 55-64 years and with ≥ 21 physical therapy visits were more likely to receive WRB in comparisons to those with ≤ 10 visits.

Since the sample size was small in the oldest age group (n=120), a multiple logistic regression was conducted with two older age groups combined and the results are shown in Appendix 4.2. The ORs for most prognostic factors from the multiple logistic regression with three age groups (Table 4.3) and the two older age groups combined (Appendix 4.2) were very similar.

4.4. Discussion

The objective of this article involved the identification of prognostic factors for receiving WRB among workers' compensation claimants and aimed to compare these prognostic factors across younger and middle-aged working adults (25-54 years), adults nearing retirement (55-64 years), and adults past typical retirement (≥65 years). Specifically, prognostic factors were sought for receiving WRB 3 months following a comprehensive RTW assessment in claimants whose conditions had not followed early expected recovery. In particular, the prognostic value of number of physician and physical therapy visits differed across the three age groups, as demonstrated by statistically significant interaction effects with age groups in the final model. This indicates that the usefulness of these prognostic factors is not identical across age groups, and that younger and older workers likely need to be considered separately when predicting return to work.

Results from the unadjusted odds ratios for each age group demonstrate interesting findings that may be clinically important. Among claimants with blue-collar jobs, workers aged 65 years or older were less likely to receive WRB while younger workers were more likely to obtain this benefit. This unexpected finding contradicts the results of previous studies, which found that older workers in jobs with heavy physical demands have a higher risk of continuing to experience work disability after work-related MSK injuries.[39] Moreover, a 2012 study found that blue-collar workers experienced a greater likelihood of failing to return to work three months following their injury.[40] According to Smith et al. [41] older age and higher physical demands are associated with more detrimental work injury outcomes. Our findings are inconsistent with these previous results and may reflect a greater need among older workers to maintain their jobs and livelihood. We have previously demonstrated that workers past typically retirement age are less educated, less likely to be offered modified duties, and more likely to work in blue-collar employment.[17] These workers may not have the ability or means to retire and thus have financial motivations to return to work. However, additional research is needed to confirm this finding.

Descriptive characteristics highlighted the longer time both older groups waited between filing their injury claim and receiving a comprehensive RTW assessment. The longer waiting periods between accident and comprehensive RTW assessment may result from older workers' need for additional acute health care services (physician visits and physical therapy). However, a higher number of health care visits was not a significant prognostic factor among older workers past typical retirement age as it was for younger workers. This indicates that the additional health care received by older workers likely did not detrimentally affect their outcome related to subsequent WRB, and is likely appropriate given the longer time it takes older workers to recover from injuries. Conversely, younger workers with ≥ 6 physician visits were 10.1 times the odds more likely to be receiving wage replacement 3 months later, and 4.5 times the odds more likely to receive WRB if they had received ≥ 21 physical therapy visits.

Also, according to the final multivariate logistic model, the prognostic effect of physician or physical therapy visits on receiving WRB differed across the age groups. Claimants aged 25-54 years with ≥6 physician visits were 5 times the odds more likely to receive wage replacement. Furthermore, younger workers with more physical therapy visits (11-20 and ≥21 visits) were also more likely to continue receiving wage replacements. Higher health utilization represented an

important indicator of longer work disability among younger workers aged 25-54 years, consistent with previous evidence indicating that more healthcare visits is a robust predictor of delayed recovery. [42] Thus, there may be value in early referral of younger workers with a high number of health care visits to comprehensive RTW evaluation and appropriate rehabilitation programs, as such younger workers may be at higher risk of long-term work disability. However, the older groups, especially the claimants past typical retirement age, exhibited negative or lower odds ratios for receiving wage replacement indicating a higher number of health visits is not detrimental to their recovery, and should be of less concern.

Claimants in both older groups with a high number of prior claims (≥6 claims) were less likely to receive WRB while younger workers were more likely to obtain such benefits. Kucera et al. reported a significant association between delayed RTW and workers who had previous claims;[43] however, they did not differentiate between younger and older workers. A previous study in the USA[44] failed to find differences among outcomes, including RTW, between older and younger injured workers with differing rates of prior work-related injuries. Nevertheless, the lower likelihood of receiving wage replacement benefits in older workers may also be explained by a specific bias, which is known as the 'healthy worker effect'. Healthier workers may stay at the workplace longer while sicker workers may retire or leave the workplace earlier.

Claimants who were at work at the time of the comprehensive RTW assessment were less likely to receive wage replacement. The availability of modified jobs and early light mobilization represent two significant predictors for a quick RTW,[10] and the availability of work modifications has been found significantly associated with shorter periods of work disability.[45] We also found that claimants with modified work available were less likely to receive wage replacement, indicating more positive outcomes if employers co-operate in facilitating the RTW process for injured workers.

Despite the possible existence of a healthy worker effect in this study, the present investigation was likely free from selection bias. Specifically, this study included all injured workers except for those with missing data or without a job at time of comprehensive RTW assessment. Although few differences were seen between those with and without missing data, there did not appear to be meaningful differences between the three age groups with respect to

the frequency of missing data. However, this study is subject to the same limitations as any other studies that used a secondary analysis of previously collected workers' compensation data, such as lack of control of the variables available or the quality of the data. Finally, any disagreement or discrepancies between the present investigation and previous studies that examined older workers may result from the fact that most previous studies omit workers aged 65 and older. Rather, these studies used the term "older worker" to indicate workers aged 50 or 55 years and older rather than the 65-plus age group included in this study.

In conclusion, there appear to be differences in prognostic factors for wage replacement across different age groups, especially related to number of physician and physical therapy visits, suggesting prognostic factors differ across age groups. Thus, younger and older workers likely need to be considered separately when predicting return to work. A higher utilization of primary health care services by younger workers may indicate a risk for prolonged work disability, and alternate management strategies should be considered, such as early referral for multidisciplinary rehabilitation. However, this finding did not apply to older injured workers and a higher number of healthcare services among older workers may not adversely affect this group's likelihood of return to work.

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4.6. Tables

Table 4.1: Descriptive statistics for the three age groups.

Variables	25-54	55-64	≥ 65	Total	
		Mean±SD/ Count (%)			P-value
Gender					
Male	2669 (61.1%)	540 (61.7%)	83 (69.2%)	3292 (61.4%)	0.198
Female	1698 (38.9%)	335 (38.3%)	37 (30.8%)	2070 (38.6%)	
Marital status					
Single	679 (15.5%)	65 (7.4%)	9 (7.5%)	753 (14%)	0.000
Separated or Divorced	278 (6.4%)	70 (8.0%)	12 (10.0%)	360 (6.7%)	
Married, Common-Law, or Widowed	1734 (39.7%)	443 (50.6%)	50 (41.7%)	2227 (41.5%)	
Not Specified	1676 (38.4%)	297 (33.9%)	49 (40.8%)	2022 (37.7%)	
Educational level					
Grade 8 or less/Partial high school	472 (10.8%)	131 (15.0%)	26 (21.7%)	629 (11.7%)	0.000
High school/Partial Technical diploma/Partial university	1085 (24.8%)	212 (24.2%)	18 (15.0%)	1315 (24.5%)	
Technical diploma/University degree	860 (19.7%)	178 (20.3%)	18 (15.0%)	1056 (19.7%)	
Not specified	1950 (44.7%)	354 (40.5%)	58 (48.3%)	2362 (44.1%)	
Annual salary	42218.31±28491.35	42026.83±27185.13	38579.81±49484.7	42105.6±28917.5	0.395
Geographic region					
Rural	1337 (30.6%)	267 (30.5%)	33 (27.5%)	1637 (30.5%)	0.765
Urban	3030 (69.4%)	608 (69.5%)	87 (72.5%)	3725 (69.5%)	
Occupation					
white-collar jobs	1582 (36.2%)	376 (43.0%)	46 (38.3%)	2004 (37.4%)	0.006
Blue-collar jobs	2343 (53.7%)	422 (48.2%)	64 (53.3%)	2829 (52.8%)	
Health jobs	442 (10.1%)	77 (8.8%)	10 (8.3%)	529 (9.9%)	
Current Working status					
No	1992 (45.6%)	405 (46.3%)	70 (58.3%)	2467 (46.0%)	0.022
Yes	2375 (54.4%)	470 (53.7%)	50 (41.7%)	2895 (54.0%)	
Modified Work Availability					
No	1585 (36.3%)	320 (36.6%)	62 (51.7%)	1967 (36.7%)	0.003
Yes	2782 (63.7%)	555 (63.4%)	58 (48.3%)	3395 (63.3%)	

Diagnoses					
Fractures/dislocations	501 (11.5%)	155 (17.7%)	21 (17.5%)	677 (12.6%)	0.000
Sprains/strains	2022 (46.3%)	380 (43.4%)	50 (41.7%)	2452 (45.7%)	
Joint disorders	1266 (29.0%)	235 (26.9%)	35 (29.2%)	1536 (28.6%)	
Others (Lacerations/Contusions/Nerve damage/Others)	578 (13.2%)	105 (12.0%)	14 (11.7%)	697 (13.0%)	
Anatomical Sites					
Torso (Neck/ upper &lower back/other torso)	1254 (28.7%)	182 (20.8%)	39 (32.5%)	1475 (27.5%)	0.000
Upper Extremity	1690 (38.7%)	378 (43.2%)	40 (33.3%)	2108 (39.3%)	
Lower Extremity	838 (19.2%)	193 (22.1%)	28 (23.3%)	1059 (19.8%)	
Others (Multiple sites/Not specified/Head)	585 (13.4%)	122 (13.9%)	13 (10.8%)	720 (13.4%)	
Comorbidity					
No	3082 (70.6%)	608 (69.5%)	88 (73.3%)	3778 (70.5%)	0.637
Yes	1285 (29.4%)	267 (30.5%)	32 (26.7%)	1584 (29.5%)	
Prior Claims					
0 claims	971 (22.2%)	137 (15.7%)	24 (20.0%)	1132 (21.1%)	0.000
1-5 claims	2295 (52.6%)	388 (44.3%)	57 (47.5%)	2740 (51.1%)	
≥ 6 claims	1101 (25.2%)	350 (40.0%)	39 (32.5%)	1490 (27.8%)	
Accident to comprehensive assessment					
≤ 30 days	656 (15.0%)	102 (11.7%)	11 (9.2%)	769 (14.3%)	0.000
31-60 days	1370 (31.4%)	208 (23.8%)	30 (25.0%)	1608 (30.0%)	
61-90 days	719 (16.5%)	141 (16.1%)	26 (21.7%)	886 (16.5%)	
≥ 91 days	1622 (37.1%)	424 (48.5%)	53 (44.2%)	2099 (39.1%)	
Doctor visit					
≤ 2 visits	528 (12.1%))	98 (11.2%)	7 (5.8%)	633 (11.8%)	0.001
3-5 visits	907 (20.8%)	139 (15.9%)	20 (16.7%)	1066 (19.9%)	
≥ 6 visits	2932 (67.1%)	638 (72.9%)	93 (77.5%)	3663 (68.3%)	
Physical therapy visit					
≤ 10 visits	1819 (41.7%)	293 (33.5%)	42 (35.0%)	2154 (40.2%)	0.000
11-20 visits	1374 (31.5%)	250 (28.6%)	30 (25.0%)	1654 (30.8%)	
≥ 21 visits	1174 (26.9%)	332 (37.9%)	48 (40.0%)	1554 (29.0%)	
SF-36 Physical Functioning	55.3±24.8	53.1±24.7	48.1±24.5	54.8±24.8	0.001
SF-36 Role-Physical	30.0±26.0	33.2±26.7	35.4±26.1	30.7±26.1	0.001
SF-36 Bodily-Pain	25.8±20.3	28.2±21.0	27.7±20.9	26.2±20.4	0.006
SF-36 General Health	67.9±19.1	67.0±20.1	68.1±20.7	67.7±19.3	0.637

SF-36 Vitality	49.0±21.0	51.1±21.1	54.0±23.1	49.4±21.1	0.001
SF-36 Social-Functioning	52.8±27.1	56.6±28.3	54.5±25.9	53.4±27.3	0.001
SF-36 Role-Emotional	58.8±33.2	59.0±32.5	52.0±34.5	58.7±33.1	0.080
SF-36 Mental-Health	63.0±21.1	65.0±21.2	67.5±19.1	63.5±21.1	0.004
Visual Analog Scale	5.1±2.5	4.9±2.5	4.9±2.8	5.0±2.5	0.075
Overall PDI	47.0±22.1	45.8±21.9	43.8±21.3	46.8±22.0	0.118

Table 4.2: Univariate analyses for each age group for receipt of any wage replacement benefits at three months post assessment.

	25-54			55-64			≥ 65		
Prognostic Factors	**OR**	**(95% CI)**	**P-value**	**OR**	**(95% CI)**	**P-value**	**OR**	**(95% CI)**	**P-value**
Gender									
Male	**1.00**			**1.00**			**1.00**		
Female	**0.97**	(0.80 - 1.17)	0.72	**1.17**	(0.81 - 1.70)	0.41	**2.01**	(0.72 - 5.61)	0.18
Marital status									
Single	**1.00**			**1.00**			**1.00**		
Separated or Divorced	**1.00**	(0.67 - 1.52)	0.98	**1.20**	(0.52 - 2.81)	0.67	**0.73**	(0.04 - 13.45)	0.83
Married, Common-Law, or Widowed	**1.01**	(0.78 - 1.31)	0.94	**0.76**	(0.38 - 1.50)	0.43	**1.30**	(0.14 - 12.08)	0.82
Not Specified	**0.65**	(0.49 - 0.86)	0.003	**0.75**	(0.37 - 1.51)	0.42	**1.80**	(0.20 - 16.26)	0.60
Educational level									
Grade 8 or less/Partial high school	**1.00**			**1.00**			**1.00**		
High school/Partial Technical diploma/Partial university	**1.19**	(0.86 - 1.65)	0.29	**1.25**	(0.69 - 2.26)	0.46	**1.53**	(0.27 - 8.63)	0.63
Technical diploma/University degree	**1.11**	(0.79 - 1.57)	0.54	**0.95**	(0.50 - 1.79)	0.87	**2.95**	(0.60 - 14.38)	0.18
Not specified	**0.82**	(0.59 - 1.12)	0.21	**0.91**	(0.52 - 1.60)	0.75	**1.05**	(0.25 - 4.44)	0.95
Annual Salary	**1.00**	(1.00 - 1.00)	0.000	**1.00**	(1.00 - 1.00)	0.000	**1.00**	(1.00 - 1.00)	0.20
Geographic region									
Rural	**1.00**			**1.00**			**1.00**		
Urban	**0.77**	(0.64 - 0.94)	0.01	**1.01**	(0.68 - 1.50)	0.97	**0.72**	(0.25 - 2.11)	0.55
Occupation									
white-collar jobs	**1.00**			**1.00**			**1.00**		
Blue-collar jobs	**1.32**	(1.07 - 1.62)	0.01	**1.07**	(0.72 - 1.58)	0.75	**0.37**	(0.12 - 1.11)	0.08
Health jobs	**1.53**	(1.12 - 2.09)	0.01	**1.69**	(0.92 - 3.11)	0.09	**0.90**	(0.16 - 4.93)	0.90
Current Working status									
No	**1.00**			**1.00**			**1.00**		
Yes	**0.32**	(0.26 - 0.39)	0.000	**0.39**	(0.26 - 0.57)	0.000	**0.35**	(0.11 - 1.13)	0.08
Modified Work Available									
No	**1.00**			**1.00**			**1.00**		
Yes	**0.57**	(0.47 - 0.68)	0.000	**0.55**	(0.38 - 0.79)	0.001	**0.64**	(0.23 - 1.77)	0.39
Diagnosis Group									
Fractures/dislocations	**1.00**			**1.00**			**1.00**		
Sprains/strains	**0.66**	(0.50 - 0.87)	0.003	**1.18**	(0.71 - 1.99)	0.52	**1.30**	(0.24 - 7.01)	0.76
Joint disorders	**0.63**	(0.47 - 0.85)	0.003	**1.18**	(0.67 - 2.06)	0.57	**1.58**	(0.28 - 9.00)	0.60

Others (Lacerations/Contusions/Nerve damage/Others)	**0.90**	(0.64 - 1.25)	0.52	**0.41**	(0.17 - 0.99)	0.05	**5.28**	(0.85 - 32.62)	0.07
Anatomical Site									
Torso (Neck/ upper &lower back/other torso)	**1.00**			**1.00**			**1.00**		
Upper Extremity	**1.28**	(1.01 - 1.62)	0.04	**1.08**	(0.66 - 1.77)	0.75	**1.86**	(0.50 - 6.93)	0.36
Lower Extremity	**1.43**	(1.09 - 1.88)	0.01	**1.18**	(0.68 - 2.06)	0.55	**1.46**	(0.33 - 6.41)	0.62
Others (Multiple sites/Not specified/Head)	**1.14**	(0.83 - 1.56)	0.42	**0.80**	(0.41 - 1.58)	0.53	**2.63**	(0.50 - 13.72)	0.25
Comorbidity									
No	**1.00**			**1.00**			**1.00**		
Yes	**1.60**	(1.32 - 1.93)	0.000	**1.12**	(0.76 - 1.66)	0.57	**0.76**	(0.23 - 2.49)	0.65
Prior Claims									
0 claims	**1.00**			**1.00**			**1.00**		
1-5 claims	**1.27**	(1.00 - 1.62)	0.05	**0.89**	(0.52 - 1.51)	0.66	**0.42**	(0.12 - 1.42)	0.16
≥ 6 claims	**1.26**	(0.96 - 1.67)	0.10	**0.88**	(0.52 - 1.51)	0.65	**0.44**	(0.12 - 1.65)	0.22
Accident to comprehensive assessment									
≤ 30 days	**1.00**			**1.00**			**1.00**		
31-60 days	**0.91**	(0.67 - 1.23)	0.53	**1.24**	(0.62 - 2.49)	0.54	**0.90**	(0.15 - 5.49)	0.91
61-90 days	**0.72**	(0.50 - 1.04)	0.08	**1.20**	(0.57 - 2.52)	0.63	**0.59**	(0.08 - 4.12)	0.59
≥ 91 days	**1.47**	(1.11 - 1.95)	0.01	**1.33**	(0.70 - 2.51)	0.38	**0.80**	(0.15 - 4.41)	0.80
Physician Visits									
≤ 2 visits	**1.00**			**1.00**			**1.00**		
3-5 visits	**1.35**	(0.64 - 2.85)	0.44	**0.69**	(0.23 - 2.03)	0.50	**0.67**	(0.05 - 8.73)	0.76
≥ 6 visits	**10.09**	(5.36 - 19.01)	0.000	**3.04**	(1.38 - 6.73)	0.01	**1.15**	(0.13 - 10.29)	0.90
Physical therapy Visits									
≤ 10 visits	**1.00**			**1.00**			**1.00**		
11-20 visits	**1.33**	(1.02 - 1.74)	0.04	**0.59**	(0.32 - 1.07)	0.09	**1.06**	(0.22 - 5.10)	0.95
≥ 21 visits	**4.45**	(3.54 - 5.60)	0.000	**2.54**	(1.64 - 3.92)	0.000	**2.82**	(0.82 - 9.67)	0.10
SF-36 Physical Functioning (10 units)	0.82	(0.79- 0.85)	0.000	0.85	(0.79- 0.92)	0.000	0.75	(0.60- 0.94)	0.01
SF-36 Role-Physical (10 units)	0.77	(0.74- 0.81)	0.000	0.75	(0.69 - 0.82)	0.000	0.61	(0.45 - 0.83)	0.001
SF-36 Bodily-Pain (10 units)	0.81	(0.77 - 0.85)	0.000	0.78	(0.70 - 0.86)	0.000	0.63	(0.44 - 0.89)	0.01
SF-36 General Health (10 units)	0.88	(0.84 - 0.93)	0.000	1.01	(0.92 - 1.10)	0.86	0.76	(0.59 - 0.97)	0.03
SF-36 Vitality (10 units)	0.87	(0.84 - 0.91)	0.000	0.90	(0.82 - 0.98)	0.01	0.79	(0.63 - 0.99)	0.04
SF-36 Social-Functioning (10 units)	0.81	(0.78 - 0.84)	0.000	0.82	(0.77 - 0.88)	0.000	0.76	(0.60 - 0.96)	0.02
SF-36 Role-Emotion (10 units)	0.89	(0.86 - 0.91)	0.000	0.87	(0.82 - 0.92)	0.000	0.85	(0.72 - 1.00)	0.04
SF-36 Mental-Health (10 units)	0.84	(0.81 - 0.88)	0.000	0.84	(0.78 - 0.92)	0.000	0.76	(0.58 - 1.00)	0.05
Visual Analog Scale	1.18	(1.14 - 1.23)	0.000	1.17	(1.08 - 1.26)	0.000	1.35	(1.09 - 1.66)	0.01
Overall PDI (10 units)	1.35	(1.29 - 1.41)	0.000	1.29	(1.18 - 1.41)	0.000	1.49	(1.12 - 1.97)	0.01

Table 4.3: The final model of prognostic factors for receipt of any wage replacement benefits at three months post assessment.

Prognostic factors	OR	(95% Conf. Interval)	P-value
SF-36 Physical Functioning (10 units)	**0.94**	(0.89, 0.99)	0.01
SF-36 Role-Physical (10 units)	**0.91**	(0.86, 0.96)	0.000
SF-36 Social-Functioning (10 units)	**0.94**	(0.90, 0.98)	0.01
Visual Analogue Scale	**1.05**	(1.01, 1.11)	0.03
Overall PDI (10 units)	**1.09**	(1.02, 1.17)	0.01
Annual Salary			
$0.00	**1.00**		
$0.01 to $40,000.00	**1.21**	(0.90, 1.63)	0.21
$40,000.01 to $80,000.00	**1.23**	(0.92, 1.64)	0.16
≥ $80,000.01	**1.46**	(1.00, 2.12)	0.05
Anatomical Site			
Torso (Neck/ upper &lower back/other torso)	**1.00**		
Upper Extremity	**1.77**	(1.37, 2.28)	0.000
Lower Extremity	**1.22**	(0.93, 1.61)	0.15
Others (Multiple sites/Not specified/Head)	**1.32**	(0.96, 1.80)	0.08
Educational level			
Grade 8 or less/Partial high school	**1.00**		
High school/Partial Technical diploma/Partial university	**1.61**	(1.18, 2.20)	0.003
Technical diploma/University degree	**1.47**	(1.06, 2.04)	0.02
Not specified	**1.25**	(0.93, 1.68)	0.15
Geographic region			
Rural	**1.00**		
Urban	**0.81**	(0.67, 0.98)	0.03
Current Working status			
No	**1.00**		
Yes	**0.47**	(0.38, 0.58)	0.000
Modified Work Available			
No	**1.00**		
Yes	**0.75**	(0.62, 0.91)	0.004

Physician visits			
25-54 Years			
≤ 2 visits	**1.00**		
3-5 visits	**1.19**	(0.56, 2.55**)**	0.65
≥ 6 visits	**5.28**	(2.75, 10.12**)**	0.000
55-64 Years			
≤ 2 visits	**1.00**		
3-5 visits	**0.83**	(0.27, 2.56**)**	0.75
≥ 6 visits	**2.03**	(0.87, 4.75**)**	0.10
≥ 65 Years			
≤ 2 visits	**1.00**		
3-5 visits	**0.57**	(0.04, 9.07**)**	0.69
≥ 6 visits	**0.59**	(0.05, 6.34**)**	0.66
Physical therapy visits			
25-54 Years			
≤ 10 visits	**1.00**		
11-20 visits	**1.39**	(1.05, 1.85**)**	0.02
≥ 21 visits	**3.74**	(2.90, 4.83**)**	0.000
55-64 Years			
≤ 10 visits	**1.00**		
11-20 visits	**0.55**	(0.29, 1.04**)**	0.07
≥21 visits	**2.22**	(1.37, 3.61**)**	0.001
≥ 65 Years			
≤ 10 visits	**1.00**		
11-20 visits	**1.32**	(0.25, 6.89**)**	0.74
≥ 21 visits	**2.66**	(0.70, 10.09**)**	0.15
Occupation			
white-collar jobs	**1.00**		
Blue-collar jobs	**1.19**	(0.95, 1.50**)**	0.14
Health jobs	**1.34**	(0.97, 1.84**)**	0.08
Gender			
Male	**1.00**		
Female	**1.09**	(0.86, 1.38**)**	0.47

- **The logistic regression model demonstrated a better goodness of fit when assessed by the Hosmer-Lemeshow test (Chi^2 (8)=5.75, p-value is 0.68).**

4.7. Appendices

Appendix 4.1: Descriptive statistics of receiving Wage Replacement Benefits (WRB) outcome and univariate analyses for the whole sample.

Variables	Receiving Wage replacement N (Mean±SD/%)	No Wage replacement N (Mean±SD/%)	OR	95% CI		P-value
Age**						
25-54	511 (11.7%)	3856 (88.3%)	1.00			
55-64	135 (15.4%)	740 (84.6%)	1.38	1.12	1.69	0.002
≥ 65	18 (15.0%)	102 (85.0%)	1.33	0.80	2.22	0.27
Gender						
Male	405 (12.3%)	2887(87.7%)	1.00			
Female	259 (12.5%)	1811 (87.5%)	1.02	0.86	1.20	0.82
Marital status**						
Single	103 (13.7%)	650 (86.3%)	1.00			
Separated or Divorced	53 (14.7%)	307 (85.3%)	1.09	0.76	1.56	0.64
Married, Common-Law, or Widowed	304 (13.7%)	1923 (86.3%)	1.00	0.78	1.27	0.99
Not Specified	204 (10.1%)	1818 (89.9%)	0.71	0.55	0.91	0.01
Educational level**						
Grade 8 or less/Partial high school	79 (12.6%)	550 (87.4%)	1.00			
High school/Partial Technical diploma/Partial university	192 (14.6%)	1123 (85.4%)	1.19	0.90	1.58	0.23
Technical diploma/University degree	143 (13.5%)	913 (86.5%)	1.09	0.81	1.46	0.56
Not specified	250 (10.6%)	2112 (89.4%)	0.82	0.63	1.08	0.16
Annual Salary***	664 (52978.7±26895.5)	4698 (40568.9±28866.2)	1.00	1.00	1.00	0.000
Geographic region*						
Rural	229 (14.0%)	1408 (86.0%)	1.00			
Urban	435 (11.7%)	3290 (88.3%)	0.81	0.68	0.97	0.02
Occupation*						
white-collar jobs	219 (10.9%)	1785 (89.1%)	1.00			
Blue-collar jobs	363 (12.8%)	2466 (87.2%)	1.20	1.00	1.43	0.05
Health jobs	82 (15.5%)	447 (84.5%)	1.50	1.14	1.97	0.004

Current Working status * **						
No	460 (18.6%)	2007 (81.4%)	1.00			
Yes	204 (7.0%)	2691 (93.0%)	0.33	0.28	0.39	0.000
Modified Work Available* **						
No	324 (16.5%)	1643 (83.5%)	1.00			
Yes	340 (10.0%)	3055 (90.0%)	0.56	0.48	0.66	0.000
Diagnosis						
Fractures/dislocations	103 (15.2%)	574 (84.8%)	1.00			
Sprains/strains	290 (11.8%)	2162 (88.2%)	0.75	0.59	0.95	0.02
Joint disorders	177 (11.5%)	1359 (88.5%)	0.73	0.56	0.94	0.02
Others (Lacerations/Contusions/Nerve damage/Others)	94 (13.5%)	603 (86.5%)	0.87	0.64	1.18	0.36
Anatomical Site*						
Torso (Neck/ upper &lower back/other torso)	155 (10.5%)	1320 (89.5%)	1.00			
Upper Extremity	275 (13.0%)	1833 (87.0%)	1.28	1.04	1.57	0.02
Lower Extremity	151 (14.3%)	908 (85.7%)	1.42	1.11	1.80	0.004
Others (Multiple sites/Not specified/Head)	83 (11.5%)	637 (88.5%)	1.11	0.84	1.47	0.47
Comorbidity* **						
No	419 (11.1%)	3359 (88.9%)	1.00			
Yes	245 (15.5%)	1339 (84.5%)	1.47	1.24	1.74	0.000
Prior Claims						
0 claims	125 (11.0%)	1007 (89.0%)	1.00			
1-5 claims	347 (12.7%)	2393 (87.3%)	1.17	0.94	1.45	0.16
≥ 6 claims	192 (12.9%)	1298 (87.1%)	1.19	0.94	1.51	0.15
Accident to comprehensive assessment * **						
≤ 30 days	86 (11.2%)	683 (88.8%)	1.00			
31-60 days	173 (10.8%)	1435 (89.2%)	0.96	0.73	1.26	0.76
61-90 days	82 (9.3%)	804 (90.7%)	0.81	0.59	1.11	0.20
≥ 91 days	323 (15.4%)	1776 (84.6%)	1.44	1.12	1.86	0.004
Physician Visits* **						

≤ 2 visits	18 (2.8%)	615 (97.2%)	1.00			
3-5 visits	32 (3.0%)	1034 (97.0%)	1.06	0.59	1.90	0.85
≥ 6 visits	614 (16.8%)	3049 (83.2%)	6.88	4.27	11.08	0.000
Physical therapy Visits* **						
≤ 10 visits	156 (7.2%)	1998 (92.8%)	1.00			
11-20 visits	137 (8.3%)	1517 (91.7%)	1.16	0.91	1.47	0.23
≥ 21 visits	371 (23.9%)	1183 (76.1%)	4.02	3.29	4.91	0.000
SF-36 Physical Functioning (10 units) * **	664 (44.2±24.2)	4698 (56.3±24.5)	0.82	0.80	0.85	0.000
SF-36 Role-Physical (10 units) * **	664 (18.2±19.5)	4698 (32.4±26.5)	0.77	0.74	0.80	0.000
SF-36 Bodily-Pain (10 units) * **	664 (19.3±17.7)	4698 (27.2±20.6)	0.80	0.77	0.84	0.000
SF-36 General Health (10 units) * **	664 (64.3±19.9)	4698 (68.2±19.2)	0.90	0.87	0.94	0.000
SF-36 Vitality (10 units) * **	664 (44.4±20.9)	4698 (50.1±21.0)	0.88	0.85	0.91	0.000
SF-36 Social-Functioning (10 units) * **	664 (40.8±24.8)	4698 (55.2±27.2)	0.81	0.79	0.84	0.000
SF-36 Role-Emotional (10 units) * **	664 (46.7±33.3)	4698 (60.4±32.7)	0.88	0.86	0.90	0.000
SF-36 Mental-Health (10 units) * **	664 (56.7±21.9)	4698 (64.4±20.8)	0.85	0.81	0.88	0.000
Visual Analog Scale* **	664 (5.9±2.3)	4698 (4.9±2.5)	1.18	1.14	1.22	0.000
Overall PDI (10 units) * **	664 (58.3±19.8)	4698 (45.1±21.9)	1.34	1.28	1.39	0.000

The differences between claimants who received WRB and claimants who do not were significant at:*P-value <0.05, <0.01,*** <0.001.**

Appendix 4.2: The final model of prognostic factors for receipt of any wage replacement benefits at three months post assessment for two age groups.

		2 Age groups		
Prognostic factors	**OR**	**[95% Confidence Interval]**		**P-value**
SF-36 Physical Functioning (10 units)	**0.94**	0.89	0.99	0.01
SF-36 Role-Physical (10 units)	**0.91**	0.86	0.96	0.000
SF-36 Social-Functioning (10 units)	**0.94**	0.90	0.98	0.01
Visual Analog Scale	**1.05**	1.01	1.11	0.03
Overall PDI (10 units)	**1.09**	1.02	1.17	0.01
Annual Salary				
$0.00	**1.00**			
$0.01 to $40,000.00	**1.20**	0.90	1.62	0.22
$40,000.01 to $80,000.00	**1.22**	0.92	1.63	0.17
≥ $80,000.01	**1.45**	1.00	2.11	0.05
Anatomical Site				
Torso (Neck/ upper &lower back/other torso)	**1.00**			
Upper Extremity	**1.77**	1.38	2.29	0.000
Lower Extremity	**1.23**	0.93	1.61	0.14
Others (Multiple sites/Not specified/Head)	**1.32**	0.96	1.80	0.09
Educational level				
Grade 8 or less/Partial high school	**1.00**			
High school/Partial Technical diploma/Partial university	**1.61**	1.18	2.19	0.003
Technical diploma/University degree	**1.46**	1.05	2.03	0.02
Not specified	**1.24**	0.92	1.68	0.15
Geographic region				
Rural	**1.00**			
Urban	**0.81**	0.67	0.98	0.03
Current Working status				
No	**1.00**			
Yes	**0.47**	0.38	0.58	0.000
Modified Work Available				
No	**1.00**			
Yes	**0.75**	0.62	0.91	0.004

Physician visits				
25-54 Years				
≤ 2 visits	**1.00**			
3-5 visits	**1.19**	0.56	2.55	0.65
≥ 6 visits	**5.28**	2.75	10.11	0.000
≥ 55 Years				
≤ 2 visits	**1.00**			
3-5 visits	**0.84**	0.30	2.34	0.74
≥ 6 visits	**1.79**	0.81	3.97	0.15
Physical therapy visits				
25-54 Years				
≤ 10 visits	**1.00**			
11-20 visits	**1.39**	1.05	1.85	0.02
≥ 21 visits	**3.74**	2.89	4.82	0.000
≥ 55 Years				
≤ 10 visits	**1.00**			
11-20 visits	**0.61**	0.34	1.11	0.11
≥ 21 visits	**2.28**	1.44	3.59	0.000
Occupation				
white-collar jobs	**1.00**			
Blue-collar jobs	**1.19**	0.94	1.49	0.14
Health jobs	**1.34**	0.97	1.84	0.08
Gender				
Male	**1.00**			
Female	**1.09**	0.86	1.38	0.47

- **The logistic regression model demonstrated a better goodness of fit when assessed by the Hosmer-Lemeshow test (Chi^2 (8)=5.91, p-value is 0.66).**

Appendix 4.3: The final model of prognostic factors for receipt of any wage replacement benefits at three months post assessment [after adding the interaction effects between physical therapy visits and the number of days between injury and RTW assessment].

Prognostic factors	OR	[95% Conf. Interval]		P-value
SF-36 Physical Functioning	0.99	0.99	1.0	0.01
SF-36 Role-Physical	0.99	0.99	1.0	0.001
SF-36 Social-Functioning	0.99	0.99	1.0	0.006
Visual Analogue Scale	1.05	1	1.1	0.048
Overall PDI	1.01	1	1.02	0.014
Annual Salary				
$0.00	1			
$0.01 to $40,000.00	1.19	0.88	1.6	0.26
$40,000.01 to $80,000.00	1.21	0.9	1.62	0.2
≥ $80,000.01	1.45	0.99	2.11	0.054
Anatomical Site				
Torso (Neck/ upper &lower back/other torso)	1			
Upper Extremity	1.77	1.37	2.28	0.000
Lower Extremity	1.27	0.96	1.68	0.09
Others (Multiple sites/Not specified/Head)	1.35	0.98	1.85	0.06
Educational level				
Grade 8 or less/Partial high school	l			
High school/Partial Technical diploma/Partial university	1.63	1.19	2.23	0.002
Technical diploma/University degree	1.47	1.05	2.05	0.02
Not specified	1.25	0.92	1.68	0.15
Geographic region				
Rural	1			
Urban	0.82	0.68	1.0	0.048
Currently Working				
No	1			
Yes	0.46	0.37	0.57	0.000
Modified Work Available				
No	1			
Yes	0.76	0.63	0.93	0.01
Occupation				
white-collar jobs	1			
Blue-collar jobs	1.19	0.95	1.5	0.13
Health jobs	1.33	0.96	1.84	0.08
Gender				
Male	1			
Female	1.1	0.86	1.39	0.46

Physician visits				
25-54 Years				
Up to 2 visits	1			
3-5 visits	1.16	0.54	2.5	0.71
≥6 visits	5.33	2.76	10.28	0.000
55-64 Years				
Up to 2 visits	1			
3-5 visits	0.9	0.29	2.8	0.85
≥6 visits	2.19	0.93	5.15	0.07
≥ 65 Years				
Up to 2 visits	1			
3-5 visits	0.67	0.04	11.6	0.79
≥6 visits	0.73	0.06	8.61	0.8
Physiotherapy visits				
25-54 Years				
Up to 10 visits	1			
11-20 visits	2.08	1.07	4.03	0.03
≥21 visits	10.76	5.8	19.95	00.000
55-64 Years				
Up to 10 visits	1			
11-20 visits	0.84	0.35	2.03	0.7
≥21 visits	6.92	3.24	14.75	0.000
65 and older Years				
Up to 10 visits	1			
11-20 visits	1.93	0.33	11.31	0.47
≥21 visits	7.33	1.69	31.83	0.01
Physiotherapy visits				
Up to 10 visits				
≤30 days	1			
31-60 days	1.20	0.74	1.97	0.46
61-90 days	1.23	0.66	2.30	0.52
≥ 91 days	2.17	1.33	3.54	0.002
11-20 visits				
≤30 days	1			
31-60 days	0.90	0.49	1.64	0.72
61-90 days	0.77	0.39	1.52	0.45
≥ 91 days	1.04	0.55	1.93	0.91
≥21 visits				
≤30 days	1			
31-60 days	0.82	0.46	1.44	0.49
61-90 days	0.50	0.27	0.93	0.03

≥ 91 days	0.38	0.23	0.62	0.000

- **The logistic regression model demonstrated a better goodness of fit when assessed by the Hosmer-Lemeshow test (Chi2 (8)=12.05, p-value is 0.1490)**

- **The number of days between injury and receiving the RTW assessment had a significant interaction with the number of physical therapy visits and it was added to the model.**

Chapter 5

Age Differences in Prediction of Occupational Disability Three Months After Functional Restoration

Abstract

Purpose: This study aimed to identify prognostic factors for occupational disability and determine whether they are similar among younger and older injured workers undergoing occupational rehabilitation.

Methods: A historical cohort design was used. Secondary analysis was conducted on a database including demographic and social, occupational, health/injury, health care utilization, and other factors from 2,602 injured workers undergoing functional restoration programs. Regression analysis was used to determine whether prognostic factors were the same in the younger (25-54 years) and older (≥ 55 years) age groups by considering the interaction between each predictor variable and a dichotomous variable indicating age group.

Results: Older workers were more likely to be male; live with their partner; work in white-collar jobs; have ≥ 91 days between the accident and comprehensive assessment; and have undergone ≥ 25 physical therapy visits (26% vs. 19%). No significant interactions were observed between age group and any of the prognostic factors. The older age group, lesser SF-36 physical role functioning, more comorbidity, more physician visits, unavailability of modified duties, and working in a health-related job were associated with greater occupational disability after three months in the final prognostic model.

Conclusion: Despite important differences between younger and older workers on descriptive characteristics, there were no significant differences in prognostic factors for occupational disability, as indicated by wage replacement, between younger and older age groups undergoing occupational rehabilitation. Given that older workers are more likely to experience work disability after work-related injuries, these findings suggest that other factors may need to be investigated.

Key words: Injured workers, Aging, Work-related musculoskeletal injuries, Functional Restoration, Work disability, Return to work.

5.1. Introduction

One of the most important challenges in the workforce involves work-related musculoskeletal (MSK) injuries leading to prolonged work disability. Although the majority of injured workers recover and return to work (RTW), some injured workers are at risk for developing chronic work disability. Such workers account for the majority of health care costs.[1] In the USA, about 70 million physician visits per year are due to MSK injuries with health care costs of $130 million USD to cover outpatient, hospital, and emergency room visits. [2] The assessment and rehabilitation of workers with MSK injuries may be complicated by physiological, psychological, social, and workplace aspects that influence recovery and return to work.

According to Elliott (2004),[3] workers with chronic injuries require different treatment approaches than workers with acute injuries due to the complexity of chronic injuries. One common treatment method for workers with chronic injuries involves occupational rehabilitation focused on functional restoration (FR). Many researchers consider FR programs among the most successful approaches developed for treating injured workers with work-related MSK injuries.[4,5] In fact, studies have reported that 82-87% of patients that complete FR programs successfully RTW.[4-6]

Similar to other populations, the average age of the Canadian workforce has been increasingly. In 2013, the Canadian labour force of 18.7 million included 8 million Canadians aged 45 or older, of which 3.6 million were 55 years or older.[7] Previous research has indicated that older workers experience significant challenges from a vocational rehabilitation perspective, with more severe injuries and work in at-risk occupations (trades and transport), and a lower likelihood of being offered modified duties or rehabilitation.[8] In fact, older age has been reported to be a risk factor for failure to RTW following FR, as well as a prognostic factor for slower recovery. [9,10] According to Bendix et al., [11] older age is associated with disability while younger age is associated with RTW after injury. This finding prompts the question as to why older workers, in comparison with younger workers, experience worse outcomes after FR programs.

The present study aimed to identify prognostic factors for receipt of wage replacement benefits (WRB), an indicator of work disability, among injured workers three months after discharge from FR programs, and determine whether these factors differ between young and middle-aged working adults (25-54 years) and older workers (≥ 55 years).

5.2. Methods

5.2.1. Design

This research used a historical retrospective cohort design. We conducted secondary analysis on a database previously created from clinical and administrative claims data from the Workers' Compensation Board of Alberta for the purpose of creating a clinical decision support tool. [12] This database included information on workers' compensation claimants experiencing work-related MSK injuries in the province of Alberta, Canada. Specifically, the workers selected from this database underwent a comprehensive RTW assessment and then underwent a FR program. The University of Alberta's Health Research Ethics Board approved the study.

5.2.2. Study Population

The database contained information on 4,103 workers' compensation claimants with predominately sub-acute MSK injuries who were admitted for FR between December 1, 2009 and January 1, 2011. We excluded claimants with missing data and those who were not employed or did not have jobs to return to. The final sample included 2,602 claimants undergoing FR programs. In the case of a worker with multiple claims, the study only included the first claim.

FR programs are often used to enhance injured workers' functional ability for work and facilitate RTW in order to avoid chronic disability after work-related MSK injuries. [4,5,13] The FR programs used in this study have been described previously. [12] These programs involved interdisciplinary FR performed at designated rehabilitation centres across the province. Specifically, the rehabilitation focused on specific exercise routines, graded activity, and work simulation. These programs also often incorporate a biopsychosocial approach to care and include communication and negotiation with relevant stakeholders, such as employers and case

managers, to facilitate RTW. In the current study, the prognostic factors involved a set of characteristics derived from workers' compensation claims data collected at the time of a comprehensive RTW assessment done at program baseline.

To compare across age groups and to determine whether prognostic factors were similar in all workers, the claimants were stratified into two age groups: young or middle-aged adults (25-54 years) and adults nearing retirement or past typical retirement age (≥ 55 years).

As mentioned in a previous paper, [8] injured workers within the Alberta jurisdiction are considered for FR after undergoing required primary care treatment in the community (i.e. physical therapy, chiropractic care, or medical care) and failing to return to work. The referral for FR occurs when workers have failed to recover within the recommended healing time, which typically involves 4 to 8 weeks of acute care. [14] These claimants are then assessed to determine their ability to RTW and/or need for appropriate rehabilitation. The comprehensive RTW assessment and the tools for assessing the ability to RTW in this jurisdiction prior to FR have previously undergone study by our research group. [15] The measures used in this study have proven trustworthy and acceptable for research purposes.

5.2.3. Measures

5.2.3.1. Dependent variable

Information from the administrative workers' compensation claims data specified whether the claimants were receiving total or partial temporary disability WRB three months after discharge from the FR program. Thus, the study outcome was defined as the claimants' receipt of total or partial disability compensation payments at three months after discharge from the FR program. The receipt of benefits after work-related injuries commonly represents an important outcome within studies of compensation claimants, as it serves as an indicator of occupational disability and RTW. [16] Injured workers who lack the ability to resume work within three months after work-related injuries are likely to continue experiencing work disability [17].

5.2.3.2. Independent variables

As mentioned in a previous paper, [8] the database we used contained information on a variety of potential prognostic factors. The factors considered in this study underwent selection on the basis of a biopsychosocial framework and have been found to have potential effects on RTW and work disability. [18-20] Included were individual demographic and social factors, occupational factors, health or injury factors, and health care utilization. Demographic and social factors included age, gender, marital status, educational level, and urban/rural status, while occupational factors included occupation, working status, and modified work availability. The health or injury factors consisted of previous injuries, self-rated health status, pain intensity, and perceived disability. Finally, health care utilization entailed the number of visits to primary care providers (physician and physical therapist visits paid for by WCB-Alberta that occurred between the date of injury until the date of the RTW assessment). The data from three clinical measures, Short Form Health Survey (SF-36), pain Visual Analogue Scale (VAS), and Pain Disability Index (PDI), were also available.

The SF-36 has been used frequently with patients with MSK injuries, disorders and work-related disabilities, [21-24] and has been validated in this population. [25] This assessment tool contains measurements in eight health-related domains: physical functioning, physical role functioning, mental health, emotional role functioning, social role functioning, general health perception, vitality, and bodily pain. [26] Another measurement tool, the pain VAS, assesses pain severity on a scale ranging from 0 to 10. There is evidence for the validity and reliability of this scale and it has been associated with future RTW. [27] The final clinical assessment tool in this study, the PDI, comprises a self-report questionnaire that measures the level of disability associated with pain. [28,29] Studies examining the concurrent validity and test-retest reliability of the PDI have determined these measures are acceptable. [30-32] The PDI includes seven domains: recreation, family and home, social, occupation, sexual relations, self-care, and life support activities. In each of these seven areas, respondents rate their disability level resulting from pain and the scores are summed. A score of 0 indicates a lack of disability while a rating of 70 implies the most severe level of disability. A percentage score is often calculated to accommodate for missing data. Since the sexual relations item is commonly missing from research, this study calculated the overall PDI percentage with higher scores indicative of greater levels of disability.

5.2.4. Statistical Analysis

In the statistical analysis, means (SD), frequencies and proportions were computed and compared across the two age groups of interest using t-tests and chi-square tests, respectively. Multiple logistic regression analysis was used to identify significant prognostic factors for receiving WRB for each age group. In the final logistic regression model with significant predictors, significance of interaction effects between age and predictor variables were tested one at a time. Statistically significant interactions indicated important differences in the association of predictor variables with receiving WRB between the age groups. In addition interaction effects between the predictor variables in the final logistic regression were also tested.

A purposeful modeling strategy was used for model building. [33] The initial step involved the use of univariate regression for each individual variable. Subsequently, independent variables with a *p-value* of 0.20 were entered into a multiple logistic regression model. Variables that lacked statistical significance at *p-value*<0.05 were eliminated and tested for a potential confounding effect. [33] The final model (main-effect model) included statistically significant independent variables, confounding variables, clinically important variables, and the categorized age variable. All plausible and important interactions were tested one at a time (especially the interaction between each variable and the categorized age variable). Consequently, the final model contained the significant prognostic factors and interactions, as well as the confounding variables. If the interactions between age and the other variables were significant, independent regression analysis was carried out to determine the prognostic factors for WRB within each age group. The same determination was done for prognostic factors that had any significant interaction with other variables. Lastly, the good-ness of fit of the final model was assessed using the Hosmer-Lemeshow Test. All statistical analyses were performed using STATA software (StataCorp. 2011. *Stata Statistical Software: Release 12*. College Station, TX: StataCorp LP).

5.3. Results

The characteristics of the two age groups are shown in Table 5.1, with some differing significantly. In comparison to younger workers aged 25-54 years, older workers nearing or past retirement age (≥ 55 years) were more likely to be male; live with their partner; work in white-

collar jobs; experience fractures or dislocations (18% vs. 11%); have incurred injuries in the lower extremities (24% vs. 18%); have ≥ 6 prior claims; have ≥ 91 days between the accident and comprehensive RTW assessment; and ≥ 25 physical therapy visits (26% vs. 19%). Furthermore, in comparison to the younger workers, older workers were less likely to experience sprain or strain injuries or work injuries in the torso area. There was no significant difference between older and younger age groups with respect to physician visits. Appendix 5.1 shows the descriptive statistics for workers who received wage replacement three months after discharge from the FR program, as well as the unadjusted odds ratios (ORs) for the entire sample. These figures reveal that older workers had a slightly greater likelihood of receiving WRB three months after their discharge from the FR program (OR=1.69).

Claimants with missing data, primarily on the three self-report questionnaires (SF-36, VAS, PDI), were less likely to have high school, partial technical or partial university education, and had a greater likelihood of neglecting to specify their marital status or educational levels. In addition, these workers were less likely to live in a rural area and to have comorbidities. At the start of the rehabilitation program, claimants with missing data had a greater likelihood of having modified work available and a job to return to. Although statistically significant differences were observed between claimants with and without missing data, the differences appear small. The numbers of younger claimants (25-54 years) and older claimants (≥ 55 years) with complete data and included in subsequent analyses were 2,145, and 457 claimants respectively.

5.3.1. Unadjusted odds ratios for each age group

The unadjusted ORs for the receipt of wage replacement in each age group appear in Table 5.2. The univariate analyses demonstrated similarities in the direction and magnitude of the association with WRB outcome for most of the variables except two: working status at time of comprehensive RTW assessment and physician visits. Younger claimants who were working at the time of comprehensive RTW assessment were less likely to receive WRB after three months than claimants who were not working; however, this variable was not significant in older workers. For physician visits, the difference between the two groups occurred only in the magnitude of the association with the direction of the association being the same for both groups. While younger claimants with 6-15 and ≥ 16 physician visits were 4.8 and 28.7 times more likely

to receive WRB than those with ≤ 5 visits, older claimants with 6-15 and ≥ 16 physician visits were only 1.6 and 6.8 times more likely to receive this benefit than those with ≤ 5 visits. The rest of the variables that were significantly associated with the WRB outcome in one or both groups had similar direction and magnitude across age groups. These variables were: neglecting to specify marital status and educational levels, having comorbidities, waiting ≥ 91 days between the accident and comprehensive assessment, having ≥ 25 physical therapy visits, SF-36 domains, the pain VAS, and PDI.

5.3.2. Results from the multiple logistic regression analysis

The results from the final multiple logistic regression analysis of workers receiving WRB appear in Table 5.3. These findings demonstrate that the variables significantly associated with future receipt of WRBs included: SF-36 physical role functioning, presence of comorbidity, 6-15 and ≥ 16 physician visits, older age, lack of availability of modified work, and working in a health-related job. No significant interactions were observed between the age group and any of the prognostic factors. However, significant interactions were observed between days between accident to comprehensive assessment and physical therapy visits, and physical therapy visits and gender. In the final model, claimants who had comorbidities, higher numbers (6-15 and ≥ 16 visits) of physician visits, older age (≥ 55 years), and were working in a health-related job had a greater likelihood of receiving WRB. Conversely, claimants with modified work availability were less likely to receive wage replacement benefits.

After allowing for the interaction effects, we found that among claimants who had their comprehensive RTW assessment within one, two or three months following injury and had ≥ 25 physical therapy visits were at 13.5, 22.2, and 9.7 times greater odds to receive WRB than workers without any visits. In addition, claimants who had their comprehensive RTW assessment after three months and had between 1 to 12 physical therapy visits were at 3.7 times greater odds to receive WRB than workers without any visits. After allowing for the interaction effects between gender and physical therapy visits, female claimants who had 13-24 physical therapy visits had 2.2 times greater odds to receive WRB than male claimants.

5.4. Discussion

This article aimed to identify prognostic factors for receiving WRB among claimants undergoing FR and compared these prognostic factors between two age groups: younger claimants (25-54 years) and older claimants (≥ 55 years). The final model identified six prognostic factors (SF-36 physical role functioning, comorbidity, 6-15 and ≥ 16 physician visits, older age, the availability of modified work, and health jobs) as being significantly associated with the WRB outcome. In addition, two significant interactions were observed between days from accident to comprehensive assessment and the number of physical therapy visits, and between the number of physical therapy visits and gender. However, we did not find any statistically significant interaction effects based on age in the final model, indicating that the prognostic values related to these factors appear to be similar across age groups. Age was a predictor of work disability, with older workers more likely to receive WRB. It is possible that other prognostic factors, not included in our database, made older workers more likely to receive WRB. It is also possible that these findings were influenced by aspects of the triage process; older workers with worse cases might have been screened out of FR and not offered rehabilitation.[8]

As expected, we found that older workers were more likely to receive WRB three months after participating in FR programs. This finding is consistent with previous studies that have shown the same trend. [11,34] Aging-related changes may affect older injured workers' recovery and delay their progress with rehabilitation and return to work. With respect to the availability of work modification, the current study found that injured workers with such modification were less likely to receive WRB. This result agrees with previous evidence showing that the availability of work modification is a significant predictor for faster RTW [35] and shorter periods of work disability. [36] These results emphasize the importance of employer cooperation in facilitating the RTW process for both age groups, which had similar association estimates with future receipt of WRB, an indication of work disability. Regarding occupation, our results demonstrated that working in health-related jobs increased the likelihood of receiving WRB. Previous research has indicated that injured workers with blue-collar or manual occupations may experience lower RTW rates than white-collar workers. [37,38] It has been reported that healthcare work is a physically demanding job. [39] Among health-care workers, Andersen et al. (2012) [40] reported that

moderate to severe pain from body parts such as low back, neck/shoulder and knees was a significant risk factor for long-term sick absence.

As expected, claimants with co-morbidities were more likely to continue receiving WRB three months after discharge from the FR program, as demonstrated by the crude associations for each group and the association in the final model of multivariate analyses. In agreement with our findings, other studies have found an association between co-morbidity and both lower rates of RTW and longer periods of sickness absence. [41,42] Workers with co-morbidity complaints may have more complicated cases that need more time for diagnosis, recovery, and rehabilitation. However, the interaction with age was not significant. This may be an indication of healthy worker effect bias. Older workers with co-morbidities or bad general health may already have left the workforce while the healthiest older workers remain.

According to the final multivariate logistic model, the prognostic effect of physician visits for receiving WRB appeared similar across the age groups and no significant interaction was observed. Claimants with 6-15 and ≥ 16 physician visits were 2.8 and 12.9 times more likely to receive WRB. These results demonstrate consistency with previous evidence, indicating that healthcare visits represent a predictive factor for delayed recovery. [43] Claimants with higher healthcare service utilization are at a higher risk of longer work disability. This suggests that workers with many healthcare visits before RTW assessment and rehabilitation enrolment may need different or enhanced rehabilitation approaches to improve RTW. This was particularly evident in the group of young and middle-aged claimants with ≥ 16 physician visits with increased odds of receiving WRB after three months of 28.7, as compared to claimants with ≤5 visits.

The literature has revealed consistent associations between a high number of preadmission health visits and three outcomes: days to suspension of time loss benefits, days to claim closure, and sustained recovery. [43] The present study agrees with these findings. Higher numbers of physician and physical therapy visits prior to the FR programs increased the likelihood of receiving WRB according to both ORs in univariate and multivariate logistic regression analyses. According to the final multivariate logistic model, the prognostic effect of physical therapy visits for receiving WRB appeared different based on the time in which the

comprehensive RTW assessment was done and the gender of claimants. Claimants with ≥ 25 physical therapy visits prior to the assessment, and who had their comprehensive assessment within one, two, or three months, had 13.5, 22.2, and 9.7 times greater likelihood to receive WRB. Claimants with ≥ 25 physical therapy visits were at a higher risk of continuing to receive WRB among all injured workers, according to both univariate and multivariate analyses. As found in previous studies, [35,44,45] female claimants with 13-24 visits were more likely to receive WRB. The potential explanation for these gender differences leading to females experiencing delayed recovery time could be due to social or cultural differences.

As in the case of any study using secondary data, this research has some limitations, including the inability to control the variables or the quality of the data. However, the large population-based database used contains information about a range of personal, social, occupational, and clinical/health care variables, which were previously used for research.

In conclusion, despite important differences between younger and older workers on descriptive characteristics, there were no significant differences in prognostic factors for wage replacement between younger and older age groups undergoing occupational rehabilitation. Age was identified as a prognostic factor, with older workers somewhat more likely to experience prolonged work disability. The explanation for this association requires further investigation.

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5.6. Tables

Table 5.1: Distribution of predictor variables for the two age groups and the whole group.

Variables	25-54 (N=2,145)	≥ 55 (N=457)	Total	P-value
		Mean ±S D/ Count (%)		
Gender*				
Male	1279(59.6%)	299 (65.4%)	1578 (60.6%)	0.021
Female	866(40.4%)	158 (34.6%)	1024 (39.4%)	
Marital status**				
Living without partner	480(22.4%)	88 (19.3%)	568 (21.8%)	0.002
Living with partner	785(36.6%)	207 (45.3%)	992 (38.1%)	
Not Specified	880(41.0%)	162 (35.4%)	1042 (40.0%)	
Educational level				
Grade 8 or less/Partial high school	241(11.2%)	60 (13.1%)	301 (11.6%)	0.12
High school/Partial Technical diploma/Partial university	516(24.1%)	108 (23.6%	624 (24.0%)	
Technical diploma/University degree	393(18.3%)	100 (21.9%)	493 (18.9%)	
Not specified	995(46.4%)	189 (41.4%)	1184 (45.5%)	
Annual salary	$45576.97± $25419.19	$45,866.2±$25,331.5	$45627.77± $25399.18	0.83
Geographic region				
Rural	584(27.2%)	119 (26.0%)	703 (27.0%)	0.60
Urban	1561(72.8%)	338 (74.0%)	1899 (73.0%)	
Occupation*				
white-collar jobs	738(34.4%)	185 (40.5%)	923 (35.5%)	0.04
Blue-collar jobs	1163(54.2%)	230 (50.3%)	1393 (53.5%)	
Health jobs	244(11.4%)	42 (9.2%)	286 (11.0%)	
Current Working status				
No	1156(53.9%)	256 (56.0%)	1412 (54.3%)	0.41
Yes	989(46.1%)	201 (44.0%)	1190 (45.7%)	
Modified Work Availability				
No	692(32.3%)	168 (36.8%)	860 (33.1%)	0.06
Yes	1453(67.7%)	289 (63.2%)	1742 (66.9%	
Diagnoses**				
Fractures/dislocations	242(11.3%)	83 (18.2%)	325 (12.5%)	0.001
Sprains/strains	1030(48.0%)	197 (43.1%)	1227 (47.2%)	
Joint disorders	634(29.6%)	128 (28.0%)	762 (29.3%)	
Others (Lacerations/Contusions/Nerve damage/Others)	239(11.1%)	49 (10.7%)	288 (11.1%)	

Anatomical Sites**				
Torso (Neck/ upper &lower back/other torso)	724(33.8%)	117 (25.6%)	841 (32.3%)	0.001
Upper Extremity	758(35.3%)	171 (37.4%)	929 (35.7%)	
Lower Extremity	383(17.9%)	110 (24.1%)	493 (18.9%)	
Others (Multiple sites/Not specified/Head)	280(13.1%)	59 (12.9%)	339 (13.0%)	
Comorbidity				
No	1531(71.4%)	332 (72.6%)	1863 (71.6%)	0.58
Yes	614(28.6%)	125 (27.4%)	739 (28.4%)	
Prior Claims***				
0 claims	465(21.7%)	73 (16.0%)	538 (20.7%)	0.000
1-5 claims	1155(53.8%)	205 (44.9%)	1360 (52.3%)	
≥ 6 claims	525(24.5%)	179 (39.2%)	704 (27.1%)	
Accident to comprehensive assessment**				
≤ 30 days	323(15.1%)	55 (12.0%)	378 (14.5%)	0.001
31-60 days	732(34.1%)	123 (26.9%)	855 (32.9%)	
61-90 days	355(16.6%)	81 (17.7%)	436 (16.8%)	
≥ 91 days	735(34.3%)	198 (43.3%)	933 (35.9%)	
Physician visit				
≤ 5 visits	616 (28.7%)	120 (26.3%)	736 (28.3%)	0.12
6-15 visits	1038(48.4%)	212 (46.4%)	1250 (48.0%)	
≥ 16 visits	491(22.9%)	125 (27.4%)	616 (23.7%)	
Physical therapy visit***				
0 visit	514(24.0%)	87 (19.0%)	601 (23.1%)	0.000
1-12 visit	602(28.1%)	101 (22.1%)	703 (27.0%)	
13-24 visit	622(29.0%)	150 (32.8%)	772 (29.7%)	
≥ 25 visit	407(19.0%)	119 (26.0%)	526 (20.2%)	
SF-36 Physical Functioning**	52.28±23.70	48.8±23.3	51.67±23.67	0.004
SF-36 Role-Physical**	25.15±22.54	28.8±24.8	25.78±22.99	0.004
SF-36 Bodily-Pain*	23.35±19.33	25.4±19.8	23.71±19.44	0.04
SF-36 General Health	67.54±18.71	67.6±19.9	67.54±18.91	0.97
SF-36 Vitality**	47.40±20.51	50.2±20.7	47.90±20.56	0.008
SF-36 Social-Functioning**	49.90±25.68	53.9±27.0	50.60±26.00	0.004
SF-36 Role-Emotional	55.35±33.12	54.7±31.9	55.24±32.90	0.69
SF-36 Mental-Health*	61.98±20.59	64.3±19.9	62.38±20.48	0.03
Visual Analog Scale*	5.43±2.42	5.1±2.5	5.38±2.43	0.019
Overall PDI	50.50±20.21	48.8±20.4	50.20±20.26	0.11

P-value: *<0.05, **<0.01, ***<0.001.

Table 5.2: Univariate analyses for each age group for receipt of any wage replacement benefits at three months after discharge from the functional restoration program.

Variables	25-54 years (N=2,145) OR	[95% C I]		P-value	≥ 55 years (N=457) OR	[95% C I]		P-value
Gender								
Male	**1.00**				**1.00**			
Female	**0.95**	0.68	1.31	0.74	**1.30**	0.73	2.32	0.37
Marital status								
Living without partner	**1.00**				**1.00**			
Living with partner	**0.95**	0.64	1.42	0.82	**0.79**	0.38	1.63	0.53
Not specified	**0.57**	0.37	0.87	0.01	**0.68**	0.31	1.47	0.32
Educational levels								
Grade 8 or less/Partial high school	**1.00**				**1.00**			
High school/Partial Technical diploma/Partial university	**1.11**	0.64	1.91	0.72	**1.01**	0.45	2.29	0.98
Technical diploma/University degree	**1.08**	0.61	1.92	0.79	**0.44**	0.17	1.14	0.09
Not specified	**0.70**	0.41	1.18	0.18	**0.38**	0.17	0.89	0.03
Annual Salary	**1.00**	1.00	1.00	0.001	**1.00**	1.00	1.00	0.06
Geographic region								
Rural	**1.00**				**1.00**			
Urban	**0.77**	0.54	1.08	0.13	**0.63**	0.34	1.14	0.13
Occupation								
White-collar Jobs	**1.00**				**1.00**			
Blue-collar Jobs	**1.26**	0.88	1.82	0.21	**1.04**	0.57	1.90	0.90
Health Jobs	**1.46**	0.86	2.47	0.16	**1.56**	0.62	3.96	0.35
Currently Working								
No	**1.00**				**1.00**			
Yes	**0.57**	0.40	0.79	0.001	**1.07**	0.61	1.88	0.82
Modified work available at start of program								
No	**1.00**				**1.00**			
Yes	**0.66**	0.48	0.92	0.014	**0.61**	0.35	1.07	0.09
Diagnoses								
Fractures and dislocations	**1.00**				**1.00**			
Sprains/strains	**0.93**	0.56	1.56	0.80	**0.64**	0.30	1.35	0.25
Joint disorders	**0.91**	0.53	1.57	0.73	**0.94**	0.44	2.02	0.87

Others [lacerations, contusions, nerve damage, and others]	**0.64**	0.31	1.31	0.22	**0.23**	0.05	1.06	0.06
Anatomical sites								
Torso [Neck, upper back, lower back, and other torso]	**1.00**				**1.00**			
Upper Extremity	**1.30**	0.89	1.90	0.17	**1.92**	0.89	4.15	0.10
Lower Extremity	**0.96**	0.59	1.57	0.87	**1.43**	0.60	3.42	0.42
Others [Multiple sites, Not specified, and Head]	**0.80**	0.45	1.43	0.45	**1.21**	0.42	3.51	0.72
Comorbidity								
No	**1.00**				**1.00**			
Yes	**1.82**	1.31	2.53	0.000	**1.10**	0.59	2.05	0.76
Prior Claims								
0 claims	**1.00**				**1.00**			
1-5 claims	**1.37**	0.88	2.14	0.16	**0.88**	0.40	1.92	0.74
≥ 6 claims	**1.48**	0.90	2.44	0.12	**0.79**	0.35	1.79	0.58
Accident to Admission								
≤ 30 days	**1.00**				**1.00**			
31-60 days	**1.17**	0.68	2.02	0.57	**1.53**	0.41	5.81	0.53
61-90 days	**0.76**	0.38	1.49	0.42	**2.17**	0.56	8.40	0.26
≥ 91 days	**1.85**	1.10	3.11	0.02	**3.47**	1.02	11.77	0.05
Physician visits								
≤ 5 visits	**1.00**				**1.00**			
6-15 visits	**4.82**	2.05	11.35	0.000	**1.55**	0.59	4.08	0.37
≥ 16 visits	**28.67**	12.48	65.87	0.000	**6.82**	2.74	16.97	0.000
Physical Therapy visits								
0 visits	**1.00**				**1.00**			
1-12 visits	**1.14**	0.61	2.13	0.67	**1.01**	0.32	3.11	0.99
13-24 visits	**1.69**	0.95	3.02	0.07	**0.86**	0.30	2.51	0.79
≥ 25 visits	**7.06**	4.16	11.97	0.000	**5.18**	2.06	13.02	0.000
SF-36 Physical Functioning	**0.99**	0.98	1.00	0.003	**1.01**	0.99	1.02	0.38
SF-36 Role-Physical	**0.98**	0.97	0.99	0.000	**0.97**	0.96	0.99	0.000
SF-36 Bodily-Pain	**0.99**	0.98	1.00	0.003	**0.98**	0.96	0.99	0.007
SF-36 General Health	**0.99**	0.98	1.00	0.007	**1.01**	0.99	1.02	0.40
SF-36 Vitality	**1.00**	0.99	1.00	0.44	**1.00**	0.99	1.02	0.85
SF-36 Social-Functioning	**0.99**	0.98	0.99	0.000	**1.00**	0.99	1.01	0.46
SF-36 Role-Emotional	**1.00**	0.99	1.00	0.08	**1.00**	0.99	1.00	0.33
SF-36 Mental-Health	**0.99**	0.98	1.00	0.03	**1.00**	0.98	1.01	0.68
Visual Analog Scale	**1.08**	1.01	1.16	0.03	**1.07**	0.95	1.20	0.26
Overall PDI	**1.02**	1.01	1.03	0.000	**1.01**	0.99	1.02	0.34

Table 5.3: The final model of prognostic factors for receipt of any wage replacement benefits at three months after discharge from the functional restoration program.

Prognostic Factors	OR	[95% Conf. Interval]		P-value
SF-36 Role-Physical	0.98	0.97	0.99	0.000
Comorbidity				
No				
Yes	1.47	1.06	2.05	0.02
Accident to comprehensive assessment				
≤ 30 days				
0 Physical therapy visits	1			
1-12 Physical therapy visits	1.04	0.26	4.14	0.96
13-24 Physical therapy visits	3.06	0.73	12.83	0.126
≥ 25 Physical therapy visits	13.54	2.55	71.90	0.002
31-60 days				
0 Physical therapy visits	1			
1-12 Physical therapy visits	1.48	0.47	4.66	0.51
13-24 Physical therapy visits	1.19	0.38	3.76	0.77
≥ 25 Physical therapy visits	22.20	7.17	68.72	0.000
61-90 days				
0 Physical therapy visits	1			
1-12 Physical therapy visits	1.49	0.19	11.81	0.71
13-24 Physical therapy visits	1.18	0.22	6.38	0.85
≥ 25 Physical therapy visits	9.73	1.84	51.48	0.01
≥ 91 days				

0 Physical therapy visits	1			
1-12 Physical therapy visits	3.66	1.35	9.92	0.01
13-24 Physical therapy visits	0.59	0.23	1.56	0.29
≥ 25 Physical therapy visits	1.59	0.71	3.57	0.26
Physician visits				
≤ 5 visits				
6-15 visits	2.75	1.43	5.27	0.002
≥ 16 visits	12.90	6.59	25.25	0.000
Geographic region				
Rural				
Urban	0.72	0.51	1.01	0.06
Age				
Younger Workers				
Older Workers	1.72	1.19	2.50	0.004
Modified work available at start of program				
No				
Yes	0.68	0.49	0.94	0.02
Occupation				
White-collar Jobs				
Blue-collar Jobs	1.23	0.82	1.87	0.32
Health Jobs	1.78	1.03	3.07	0.04
Gender				
0 Physical therapy visits				
Male	1			
Female	1.49	0.59	3.75	0.40

1-12 Physical therapy visits				
Male	1			
Female	0.46	0.18	1.13	0.090
13-24 Physical therapy visits				
Male	1			
Female	2.15	1.04	4.45	0.04
≥ 25 Physical therapy visits				
Male	1			
Female	1.06	0.60	1.89	0.84

- **The logistic regression model demonstrated a better goodness of fit when assessed by the Hosmer-Lemeshow test (Chi^2 (8)= 6.8, p-value is 0. 56).**

5.7. Appendices

Appendix 5.1: Descriptive statistics of Wage Replacement Benefit outcome and univariate analyses for the whole sample

Prognostic Factors	Receiving Wage Replacement N (Mean±SD/%)	No Wage Replacement N (Mean±SD/%)	Univariate analyses OR (95% CI)	P-value
Age**				
25-54	161 (7.5%)	1984 (92.5%)	1.00	
≥55	55 (12.0%)	402 (88.0%)	1.69 (1.22- 2.33)	0.002
Gender				
Male	131 (8.3%)	1447 (91.7%)	1.00	-
Female	85 (8.3%)	939 (91.7%)	1.00 (0.75- 1.33)	1.00
Marital status**				
Living without partner	57 (10.0%)	511 (90.0%)	1.00	-
Living with partner	94 (9.5%)	898 (90.5%)	0.94 (0.66- 1.33)	0.72
Not specified	65 (6.2%)	977 (93.8%)	0.60 (0.41- 0.86)	0.01
Educational levels**				
Grade 8 or less/Partial high school	31 (10.3%)	270 (89.7%)	1.00	-
High school/Partial Technical diploma/Partial university	67 (10.7%)	557 (89.3%)	1.05 (0.67- 1.64)	0.84
Technical diploma/University degree	44 (8.9%)	449 (91.1%)	0.85 (0.53- 1.38)	0.52
Not specified	74 (6.3%)	1110 (93.8%)	0.58 (0.37- 0.90)	0.02
Annual Salary***	216 (51860.0±21432.4)	2386 (45063.6±25657.3)	1.00 (1.00- 1.00)	0.000
Geographic region*				
Rural	71 (10.1%)	632 (89.9%)	1.00	-
Urban	145 (7.6%)	1754 (92.4%)	0.74 (0.55- 0.99)	0.04
Occupation				
White-collar Jobs	68 (7.4%)	855 (92.6%)	1.00	-
Blue-collar Jobs	119 (8.5%)	1274 (91.5%)	1.17 (0.86- 1.60)	0.31
Health Jobs	29 (10.1%)	257 (89.9%)	1.42 (0.90- 2.24)	0.13
Currently Working**				
No	137 (9.7%)	1275 (90.3%)	1.00	-
Yes	79 (6.6%)	1111 (93.4%)	0.66 (0.50- 0.88)	0.01
Modified work available at start of program**				
No	92 (10.7%)	768 (89.3%)	1.00	-
Yes	124 (7.1%)	1618 (92.9%)	0.64 (0.48- 0.85)	0.002
Diagnoses				
Fractures and dislocations	33 (10.2%)	292 (89.8%)	1.00	-

Sprains/strains	101 (8.2%)	1126 (91.8%)	0.79 (0.52- 1.20)	0.27
Joint disorders	67 (8.8%)	695 (91.2%)	0.85 (0.55- 1.32)	0.48
Others [lacerations, contusions, nerve damage, and others]	15 (5.2%)	273 (94.8%)	0.49 (0.26- 0.91)	0.03
Anatomical sites				
Torso [Neck, upper back, lower back, and other torso]	61 (7.3%)	780 (92.7%)	1.00	-
Upper Extremity	94 (10.1%)	835 (89.9%)	1.44 (1.03- 2.02)	0.03
Lower Extremity	39 (7.9%)	454 (92.1%)	1.10 (0.72- 1.67)	0.66
Others [Multiple sites, Not specified, and Head]	22 (6.5%)	317 (93.5%)	0.89 (0.54- 1.47)	0.64
Comorbidity**				
No	134 (7.2%)	1729 (92.8%)	1.00	-
Yes	82 (11.1%)	657 (88.9%)	1.61 (1.21- 2.15)	0.001
Prior Claims				
0 claims	37 (6.9%)	501 (93.1%)	1.00	-
1-5 claims	115 (8.5%)	1245 (91.5%)	1.25 (0.85- 1.84)	0.25
≥ 6 claims	64 (9.1%)	640 (90.9%)	1.35 (0.89- 2.06)	0.16
ACCIDENT TO ADMISSION***				
≤ 30 days	22 (5.8%)	356 (94.2%)	1.00	-
31-60 days	60 (7.0%)	795 (93.0%)	1.22 (0.74- 2.02)	0.44
61-90 days	25 (5.7%)	411 (94.3%)	0.98 (0.55- 1.78)	0.96
≥ 91 days	109 (11.7%)	824 (88.3%)	2.14 (1.33- 3.44)	0.002
Physician visits***				
≤ 5 visits	12 (1.6%)	724 (98.4%)	1.00	-
6-15 visits	63 (5.0%)	1187 (95.0%)	3.20 (1.72- 5.98)	0.000
≥ 16	141 (22.9%)	475 (77.1%)	17.91 (9.82-32.65)	0.000
Physical Therapy visits***				
0 visits	24 (4.0%)	577 (96.0%)	1.00	-
1-12 visits	31 (4.4%)	672 (95.6%)	1.11 (0.64- 1.91)	0.71
13-24 visits	45 (5.8%)	727 (94.2%)	1.49 (0.90- 2.47)	0.13
≥ 25	116 (22.1%)	410 (77.9%)	6.80 (4.31- 10.75)	0.000
SF-36 Physical Functioning*	216 (48.0±21.9)	2386 (52.0±23.8)	0.99 (0.99- 1.00)	0.02
SF-36 Role-Physical***	216 (17.8±18.0)	2386 (26.5±23.3)	0.98 (0.97- 0.99)	0.000
SF-36 Bodily-Pain***	216 (18.9±16.3)	2386 (24.1±19.6)	0.98 (0.98- 0.99)	0.000
SF-36 General Health*	216 (65.2±16.7)	2386 (67.8±19.1)	0.99 (0.99- 1.00)	0.06
SF-36 Vitality	216 (47.3±19.7)	2386 (47.9±20.6)	1.00 (0.99- 1.01)	0.68
SF-36 Social-Functioning***	216 (44.6±24.0)	2386 (51.1±26.1)	0.99 (0.98- 1.00)	0.000
SF-36 Role-Emotional*	216 (50.9±32.6)	2386 (55.6±32.9)	1.00 (0.99- 1.00)	0.05
SF-36 Mental-Health*	216 (59.8±19.7)	2386 (62.6±20.5)	0.99 (0.99- 1.00)	0.05
Visual Analog Scale *	216 (5.8±2.2)	2386 (5.3±2.4)	1.07 (1.01- 1.14)	0.02
Overall PDI***	216 (56.1±17.8)	2386 (49.7±20.4)	1.02 (1.01- 1.02)	0.000

P-value: *<0.05, **<0.01, ***<0.001.

Chapter 6

General Discussion and Conclusion

6.1. Overview

The proportion of older people among the general population has increased substantially in recent decades.[1] This increase has also affected the workforce, in which rising numbers of senior citizens are participating. One of the greatest challenges facing the aging workforce involves work-related injuries. In particular, musculoskeletal (MSK) injuries constitute one of the most common types of workplace injuries. For example, MSK claims comprise about 70% of all claims made in Ontario.[2] Such injuries regularly cause temporary or even permanent work disability.[3] Disabilities or delays in return to work (RTW) in turn lead to significant costs for compensation and health rehabilitation systems.[4] This is particularly true of older workers, who experience a higher prevalence of MSK injuries and often require a longer time for recovery after injuries.[5,6] Unavoidable problems of aging, such as reduced functional capacity,[7] cardiovascular capacity [8] and MSK capacity, [9] may partially explain this delay in recovery.

A previous study, in fact, has reported that the RTW rate decreased when the age of injured workers increased.[10] If older workers are likely to possess different characteristics than younger workers, the current approaches for the assessment and treatment of injured employees may require modification. However, the literature contains limited information about the most important age-related changes and characteristics influencing work disability in older workers, which might inform the optimal strategies for intervening to prevent or mitigate long-term work loss in the older population. The interventions utilized with senior employees should target workers at the greatest risk for chronic disability. Based on this notion, studies should pursue early identification strategies that aim to detect injured employees who are most susceptible to developing prolonged work disability.[11] In order to achieve this objective, research should strive to isolate the reasons that some injured workers recover and RTW while other workers experience chronic work disability.[12] The existing body of literature has mainly focused on workers younger than 55 years old while neglecting to examine the prognostic factors related to employees aged 55 or older.

Accordingly, this thesis had two primary objectives; first, it sought to determine characteristics and prognostic factors for prolonged work disability among injured workers. The second goal involved establishing whether these characteristics and prognostic factors differ significantly between younger and older injured workers.

6.2. Characteristics of Older and Younger Injured Workers

In comparison to younger workers, older workers usually experience more missed workdays after an injury.[5,6] This finding may result in part from the aging-related changes experienced by older workers. In addition, older employees' prolonged work absence may indicate a deficiency in the current approaches for the assessment and rehabilitation of older injured workers. Currently, the interventions provided to injured workers fail to differentiate between younger and older employees; however, the rehabilitative and treatment approaches for each age group of employees should correspond to the characteristics of the particular group.[13] Moreover, a previous review has identified a deficiency in the secondary and tertiary interventions used in treating older injured employees.[13] These findings underscore the need to examine the characteristics of older injured workers as well as differentiate such traits from those of younger injured workers. The first study in this thesis (in Chapter Three) aimed to describe and compare the characteristics of injured workers across three age groups: younger and middle-aged working adults (25-54 years), adults nearing retirement age (55-64 years), and adults past typical retirement age (≥65 years).

This research showed that in comparison to younger workers, older workers aged 65 years and older encountered several challenges. Specifically, such workers had a greater likelihood of experiencing severe injuries, having lower levels of education, and working in labor positions such as in the trades and transport industries. In addition, these employees had a lower likelihood of working in some capacity at the time of assessment and to have been offered modified work duties. In addition, such workers were less likely to be offered rehabilitation, even though they experienced more serious injuries. Thus, in comparison to younger injured workers, older injured workers appear to have significant disadvantages and challenges from the viewpoint of vocational rehabilitation.

The findings of this thesis were consistent with those of previous research.[14,15] As compared to younger individuals, older people have a greater likelihood of experiencing a higher prevalence of osteoporosis, which may explain the greater likelihood that older workers will experience fractures. Consequently, if may be beneficial for older employees to receive osteoporosis awareness or management strategies at the workplace. In addition, due to the impacts of age-related reductions in physical and functional capacity, older injured workers may require extra cooperation and support from employers in order to facilitate their RTW process. Previous research[9,16] agrees with these results, finding that the majority of employers may lack the ability to accommodate injured workers past typical retirement age because the nature of their jobs prevents such accommodation attempts. For example, the older employees in both this project and a previous study[17] were more likely to work in trades and transport occupations, where employers may experience difficulties in modifying such jobs. Despite this finding, other research has reported occurrences of workplace ageism and discrimination against individuals or groups on the basis of age.[18] This result, in conjunction with the inability to modify job duties, may account for the reduced rate of modified work available to older employees. Consequently, health care professionals should strive to identify suitable modified jobs for older workers as a means of workplace intervention. Previous evidence has revealed the effectiveness of facilitating suitable modified work in workers aged 44 years and older.[19]

Surprisingly, our results indicated that older workers past typical retirement age were more likely to be assigned no further rehabilitation than the younger groups. Despite the apparent lack of substantial clinical differences between the two groups of older employees, injured workers aged 55-64 years were more likely to be given some form of rehabilitation than older injured workers past typical retirement age. Research has yet to determine the reasons that injured workers over 65 were less likely to receive referrals for rehabilitation. In addition, older workers over 65 years of age experienced the greatest average period of time between their injury and the clinical RTW assessment. This finding raises questions about the reasons for delaying the RTW assessment. However, a higher risk of delayed RTW correlated with a longer duration of time between injury and rehabilitation.[20]

Although older injured employees may respond more slowly than younger workers to rehabilitation, the interventions for senior workers still have potential for improvement. A previous study has emphasized the fact that physicians might provide inadequate medical information to

older patients and implement different therapies based on the doctors' beliefs and assumptions about age and its healthcare implications.[21] Yet, research has neglected to reveal the reasons behind the finding that employers are less likely to offer modified duties to older workers. Specifically, investigations have failed to clarify whether these results arise from preconceived notions of aging or whether age-related changes in older workers actually decrease their likelihood of benefiting from medical and rehabilitative care.

These assumptions about age, known as "medical ageism," may relate to any healthcare provider that unfairly assesses or treats older workers.[22] This lack of equitable treatment may reflect false stereotypes about aging; for example, physicians may refrain from offering older injured workers rehabilitation opportunities if they believe that individuals over 65 are unworthy of treatment. Previous evidence[23] has suggested that ageism negatively impacts the physical and psychological health of older adults. Some examples of negative perceptions by healthcare professionals include the following beliefs: 1) older people have medical problems with complex comorbidities that prevent these individuals from benefiting from effective treatment; 2) senior citizens experience impaired cognitive functions, which may affect their ability to follow medical instructions; and 3) older individuals have worked for long enough and should retire.[23] In addition to healthcare professionals, some employers and supervisors may hold such perceptions of older workers. Thus, medical educators should strive to prevent medical ageism and expose ageist myths. Accordingly, the next two sections of this chapter will discuss the most important findings from the second and the third studies, Chapters 4 and 5 respectively, and investigate whether these differences in the characteristics of age groups may affect work disability.

6.3. Prognostic Factors for Receiving Wage Replacement Benefits

6.3.1. Prognostic Factors for Receiving Wage Replacement Benefits after Discharge from Comprehensive Clinical Assessment

Studies have reported that although the majority of injured workers recover and RTW within a short period of time, some injured workers continue experiencing work disability.[24] These findings illustrate the need to identify the injured workers at risk for prolonged work disability, especially older workers, who represent a growing segment of the population.[1] In this thesis, the second study, detailed in Chapter Four, aimed to identify the prognostic factors for

work disability among injured workers three months after a clinical RTW assessment. This investigation also aimed to determine whether these factors differ between young and middle-aged working adults (25-54), adults nearing retirement (55-64), and adults past typical retirement age (≥65).

The final multiple logistic regression model in this study included ten significant prognostic factors and two significant interactions. These ten factors included SF-36 Physical Function, SF-36 Role Physical, SF-36 Social Function, pain intensity (VAS), perceived disability (PDI), injuries in upper extremities, high school/partial technical diploma/partial university, technical diploma/university degree, living in urban areas, working at the time of comprehensive assessment, and the availability of modified work. Moreover, the two interactions involved those between age groups and visits to physicians or physical therapists. These interactions and their effects constituted the unique contribution of this study to the existing body of literature. Specifically, the study found that the prognostic value of the number of physician and physical therapy visits varied among the three age groups, as demonstrated by statistically significant interaction effects among age groups in the final model. This finding implies that the prediction of RTW or work disability for younger and older workers should receive separate consideration. Additionally, this study found that claimants with access to modified work had a lower likelihood of receiving wage replacement; suggesting that employers' cooperation in facilitating the RTW process for injured workers may enhance positive outcomes. Although this result demonstrated consistency with previous evidence,[25] the study did not find significant interactions between work modification and age group.

Consistent with the first study in chapter 3, the second study in chapter 4 highlighted that, in comparison to younger workers, older employees experienced a longer wait time between the period of filing their injury claim and receiving a comprehensive RTW assessment. This longer waiting period may result from older workers' need for additional acute health care services, such as visits to physicians and physical therapists. However, the crude ORs revealed that the larger number of health care visits for older workers past retirement age, in comparison to those for younger workers, failed to constitute a significant prognostic factor. This finding indicates that the additional health care that older employees obtained likely lacked negative impacts on their outcome of receiving subsequent work-related benefits (WRB). Furthermore, the increased

medical care provided to older workers may result from the longer duration that older workers require to recover from injuries. Conversely, younger workers (25-54) with ≥ 6 physician visits had 10.1 times the odds of obtaining wage replacement after three months as compared to those with ≤ 2 physician visits, and 4.5 times the odds of receiving WRB when attending ≥ 21 physical therapy visits as compared to ≤10 visits.

Similar to the results from crude ORs, the final multivariate logistic model demonstrated that the prognostic effect of physician or physical therapy visits on receiving WRB differed across the age groups. Younger claimants with ≥ 6 physician visits and ≥ 21 physical therapy visits were more likely to be receiving wage replacement after three months. Consistent with previous evidence indicating that a high number of healthcare visits constitute a strong predictor of longer recovery time,[26] this higher health utilization among younger claimants aged 25-54 years appears to be an indicator of prolonged work disability. Younger workers with a high number of health care visits prior to RTW assessment may require early referral to comprehensive RTW evaluation and appropriate rehabilitation programs; as such, younger workers may have a higher risk of long-term work disability. However, this implication does not appear to apply to older workers, especially those claimants past typical retirement age, as they exhibited negative or lower ORs for receiving wage replacement. Also, a greater number of health care visits does not necessarily signify a slow recovery in older workers, suggesting that healthcare visits should not constitute an indicator of delayed RTW in this population.

6.3.2. Prognostic Factors for Receiving Wage Replacement Benefits after Discharge from Functional Restoration Programs

Whereas the second study in Chapter 4 examined prognostic factors among a large group of claimants without considering the type of rehabilitation they underwent after assessment, the third study in Chapter 5 focused on the subgroup of claimants who were triaged into Functional Restoration (FR) programs. This was important, given that some studies consider FR programs to be the most successful approach for treating injured employees with work-related MSK injuries.[27,28] In fact, previous studies have reported that over 82% of workers who complete FR programs successfully RTW.[27-29] The first study in this thesis found, however, that older workers over 65 years of age face significant challenges from the perspective of vocational rehabilitation. Specifically, senior employees had a greater likelihood of incurring severe injuries, working in

occupations such as trades and transport, being considered at high risk for injuries, and being less likely to have work modifications or rehabilitation opportunities.[30] These characteristics may partially explain the poorer RTW outcome of older injured workers. Research has reported that older age comprises a prognostic factor for slower recovery and constitutes a risk factor for failure to RTW following FR.[31,32] These findings prompt the question as to why older workers, in comparison with younger workers, experience worse outcomes after FR programs. The third study, contained in Chapter Five, aimed to answer this question by identifying the prognostic factors for receipt of WRB among injured workers three months after discharge from FR programs. In addition, this study sought to determine whether these factors differ between younger (25-54) and older workers (≥ 55).

The final multiple logistic regression model identified six significant prognostic factors associated with the WRB outcome: higher score of SF-36 physical role functioning, presence of co-morbidity, higher number of physician visits, older age, availability of modified work, and working in jobs related to health care. Furthermore, the study also revealed two significant interactions: (a) an interaction between days from accident to comprehensive assessment and the number of physical therapy visits, and (b) an interaction between the number of physical therapy visits and sex. As expected, older workers were more likely to receive WRB, and age constituted a predictor of work disability. However, an unexpected finding in the final model involved the absence of any statistically significant interaction effects based on age, indicating that the prognostic values related to these factors appear to show similarity across age groups. A possible explanation for this result lies in the attenuating influence of the FR program on some negative prognostic factors or the fact that workers with negative prognostic factors were not referred for FR programs. As found in the first study, older workers over the age of 65 had a greater likelihood of being denied further rehabilitation despite their higher likelihood of experiencing severe injuries, such as fractures. Thus, the findings of the third study may have been influenced by the triage process, in which health care workers screen older employees with severe cases and avoid or deny rehabilitation.[30]

Congruent with previous evidence,[33,34] this study found that older workers were more likely to receive WRB three months after participating in FR programs. As previously mentioned in this chapter, aging-related changes may impact the recovery process of older injured workers,

leading to a delay in their RTW. The second and third studies display consistency regarding the availability of work modification, finding that injured employees with such modifications had a lower likelihood of receiving WRB. These results agree with previous research findings indicating that the availability of work modification functions as a significant predictor for a fast RTW [25] and for shorter periods of work disability. [35] These results underline the importance of employer cooperation in expediting the RTW process for both age groups and for any type of rehabilitation program.

While the interaction between co-morbidities and age lacked significance, employees possessing co-morbidities were more likely to continue receiving WRB three months after their discharge from the FR program, as demonstrated by the crude association for each age group individually and the association in the final model of multivariate analyses. Although this result agrees with previous evidence,[36,37] such findings may indicate the presence of the healthy worker effect bias. Specifically, senior employees with co-morbidities may have already exited the workforce while the healthiest older workers remain employed.

Although the third study in chapter 5 (in contrast to the second study in chapter 4) seems to indicate a lack of age difference with respect to the prognostic value of physician visits, the claimants with a higher number of physician visits were more likely to receive WRB. The claimants in the third study comprised employees enrolled in FR programs, while the second study included all claimants prior to their participation in any rehabilitation programs. However, a high number of healthcare visits represents a predictive factor for delayed recovery [26] and work disability. Accordingly, claimants with greater healthcare service utilization possess a higher risk of prolonged work disability. Thus, employees with numerous medical visits prior to their RTW assessment and rehabilitation admission may require different assessment strategies and rehabilitation methods than those with less prior medical care. However, the crude ORs measuring the relationship between having ≥ 16 physician visits and receiving WRB revealed similarities in the direction but differences in the magnitude of the relationship across age groups. In particular, younger employees seem to be more likely to obtain WRB than older workers. This disparity may suggest that younger employees are at greater risk of incurring work disability; however, the interaction between the age groups and physician visits lacked significance among employees participating in FR. While these findings indicate the possible

presence of other confounders that may impact this relationship, such confounders were not contained in the study's database.

The prognostic effect of number of physical therapy visits for receiving WRB appeared to differ across different time periods between the accident and the comprehensive RTW assessment, and varied according to the sex of the claimants. Claimants with a higher number of physical therapy visits prior to the clinical RTW assessment were more or less likely to receive WRB depending on the time in which the comprehensive assessment was conducted: within one, two, or three months. In concurrence with the second study and prior research evidence,[26] the third study found that greater numbers of physician and physical therapy visits before the FR programs enhanced the likelihood of receiving WRB according to both ORs in univariate and multivariate logistic regression analyses. As found in previous studies,[25,38,39] female claimants with 13-24 physical therapy visits, in comparison to their male counterparts, had a greater likelihood of obtaining WRB. Despite this finding, existing research has failed to provide a possible explanation for the trend of females experiencing delayed recovery time.

6.4. Study Limitations

The studies contained in this thesis have several limitations. These include the restrictions that typically characterize secondary data analyses, such as lack of control over the variables or the quality of the data. However, these investigations utilized a large, population-based database that involved a rich combination of personal, social, occupational and clinical/health care variables. In addition, the research in this thesis used only work-related injury claims accepted by a workers' compensation board, thus discounting rejected claims and does not represent all older employees with musculoskeletal conditions. We also acknowledge that the cessation of compensation benefits (Wage Replacement Benefits) may result from reasons other than returning to work such as changing benefit systems, returning to school, choosing to refrain from claiming benefits or requesting voluntary cessation of benefits. It may be that the bias introduced due to these factors may differentially affect older workers, since they may be more motivated to stop receiving benefits and retire rather than continue with the claim process.

Although this study may contain a healthy worker effect bias, the investigation likely precluded a selection bias. Specifically, this research included all injured workers with the exception of those containing missing data or unemployed at time of the comprehensive RTW

assessment and at time of discharge from FR programs. Although a few differences were observed between injured workers with and without missing data, there did not appear to be large differences. Finally, discrepancies between the present research and previous literature studying older injured employees may relate to the fact that the majority of investigations overlook the group of workers aged 65 and older.

6.5. Future Research

Future research should focus on prospective longitudinal cohort studies. These investigations represent the most appropriate research method for prediction models. Specifically, researchers conducting prospective studies recruit injured workers and collect baseline information before the injured workers develop work disability. This approach allows researchers to select the best measurements of both predictors and outcomes as well as to overcome several limitations and biases. Future research should also investigate new prognostic factors omitted from this research project and consider testing the most clinically important variables, as well as possible confounding and interaction effects. More studies involving injured workers over the age of 65 are required to confirm the findings from this research.

6.6. Conclusion

The three studies in this thesis reveal that the characteristics of injured workers differ significantly across the age groups. Among older injured workers past typical retirement age, those with work-related musculoskeletal injuries appear to constitute a disadvantaged group from the viewpoint of vocational rehabilitation. In particular, these workers have a greater likelihood of possessing lower educational attainment, working in trades and labour occupations, and lacking access to modified work options. These employees also were less likely to have had rehabilitation despite having more severe injuries. In addition, six factors – SF-36 Role Physical, modified work availability, number of health care visits, time period between accident and comprehensive RTW assessment, sex, and age – appear to be of value in predicting work disability. Furthermore, the research revealed significant differences in prognostic factors for wage replacement across different age groups; these are especially related to the number of physician and physical therapy visits. This finding indicates that researchers, healthcare workers, and employers need to consider younger and older workers as separate groups when predicting

employees' RTW. Higher usage of primary health care services in younger workers may indicate a greater risk for prolonged work disability, thus indicating the need to consider alternate management strategies, such as an early referral to multidisciplinary rehabilitation. In comparison to younger workers, older employees who utilized a larger number of healthcare services did not experience a lower likelihood of RTW at the three-month follow-up. Finally, despite significant disparities between the traits of younger and older workers, these two groups of employees failed to display major differences in prognostic factors for wage replacement after undergoing occupational rehabilitation. One negative prognostic factor, age, predicted that older workers possessed a greater likelihood of experiencing prolonged work disability, thus indicating the need to investigate other prognostic factors.

6.7. References

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