LOW BACK PAIN PROGNOSTIC FACTORS IN THE CANADIAN ARMED FORCES

by

Selena A Glover

Submitted in partial fulfilment of the requirements
for the degree of Master of Science

at

Dalhousie University
Halifax, Nova Scotia
April 2014

DEDICATION

To my two “wee” boys, Ewan and Andrew, who have shown patience and understanding beyond their years in allowing me to trade so much of our beloved family time for hours in front of the computer.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Summary:

Low back pain (LBP) is the most common reason for referral to musculoskeletal care in the Canadian military. With healthcare seeking for musculoskeletal care rising over the past five years relative to other health services, and healthcare freely and easily accessible for all military personnel, it is important to investigate factors that may contribute to high usage of the military healthcare system.

Objectives:

1) To explore the association between commonly recognized prognostic factors for LBP outcome in the general population and musculoskeletal healthcare seeking for LBP in Canadian military population 2) To test the independent association between pain-related fear and musculoskeletal healthcare seeking in this population.

Methods:

We used a historical cohort design. We linked data from clinical outcome records for participants of a back rehabilitation class with administrative data from military electronic health records. We conducted an exploratory analysis to identify the associations of *a priori* chosen prognostic factors and musculoskeletal healthcare seeking. Our confirmatory analysis tested the independent association between pain-related fear and musculoskeletal healthcare seeking, as measured by the validated Tampa Scale for Kinesiophobia (TSK).

Results:

51.4% (183) patients had at least one re-referral during the follow up period, with over 20% of the sample re-referred to musculoskeletal services for LBP within six months following discharge. In our exploratory analysis, we identified six statistically significant prognostic factors associated with musculoskeletal healthcare seeking: fear of movement/(re)injury, planning to receive or currently receiving a Veterans Affairs pension, a concurrent diagnosis of post-traumatic stress disorder (PTSD), previous high use of musculoskeletal services, a history of LBP, and military duty status. For our confirmatory analysis, pain-related fear had an independent association with healthcare seeking in this population.

Conclusion:

Psychological and social factors are associated with the rate of musculoskeletal healthcare seeking in this military population.

LIST OF ABBREVIATIONS USED

BMI	Body mass index
CFHIS	Canadian Forces Health Information System
COPD	Chronic obstructive pulmonary disease
CT scan	Computed tomography scan
EPV	Events per variable
FABQ	Fear-avoidance Beliefs Questionnaire
HR	Hazard ratio
IRR	Incidence rate ratio
LBP	Low back pain
MRI	Magnetic resonance imaging
NCM	Non-commissioned member of the Canadian Armed Forces
PCAT	Permanent category duty status
PTSD	Post-traumatic stress disorder
TCAT	Temporary category duty status
TSK	Tampa Scale for Kinesiophobia
VAC	Veterans Affairs compensation
YLD	Years lost due to disability

ACKNOWLEDGEMENTS

I am so very grateful for the many people who have invested their time and energy into supporting me throughout this research project. I must first extend sincerest thanks to Dr. Jill Hayden, my incomparable supervisor, whose boundless energy, knowledge, and self-set high standard of excellence in her own work inspired me to work enthusiastically and tirelessly throughout this process. Next I am deeply thankful for the mentorship of my dear committee member, Dr. Katherine Harman, whose engaging manner and vast theoretical knowledge and insight on a subject for which we share the same passion has been invaluable on this road of learning. I am also very thankful for the expertise of Dr. Gordon Flowerdew, from my committee, and Dr. Pantelis Andreou**,** for their patience with me and with my many statistical queries. I am very grateful for the financial support from both the Federal Public Service of Canada and the Department of National Defence. A special thank you also goes to two very special people: to Major Marsha MacRae, who 'gets' me, and has shown me unwavering support professionally and personally from the moment we met; and also to my 'wife-sister', Adrienne, who is always there whenever my boys need a fill-in mom, and whenever I need a blether. And finally, I am forever grateful for my husband David, whose unparalleled optimism and support carries me through each step on our journey together.

CHAPTER 1: INTRODUCTION

Low back pain (LBP) is a prevalent form of musculoskeletal pain and one of the most costly conditions to manage in occupational health (1,2). An estimated 70-84% of people will experience LBP at some point in their lifetime (3) with a one-year prevalence estimated between 15-55% (4,5). Unlike other modern chronic conditions, LBP rarely leads to death, but its impact on quality of life and work productivity can be substantial. The Global Burden of Disease study from 2010 ranks LBP as the leading cause of *years lost due to disability* (YLD) in the world, which measures the years of what could have been a healthy life that were instead spent in states of less than full health (5).

An increased usage of, and expenditures in, health care for LBP have not resulted in obvious improvements in population outcomes (6-8). Despite international research efforts aimed at improving the management of LBP, the situation has worsened, with some areas of the United States, for example, seeing a five-fold increase in the prevalence of chronic disabling LBP in the last fifteen years (9). In an editorial by Pransky and colleagues, the notion that LBP has become over-medicalized was apparent: at the end of the 2010 International LBP Forum, attendees concluded that the management of LBP is "more of an industry than a system of health improvement" (9). Although there are a wider variety of treatments available than ever before, approximately 60-80% of consulters for LBP still have pain at one-year follow up (10).

In the Canadian Armed Forces the management of LBP and other musculoskeletal conditions is likely an 'underestimated' burden to the Canadian Forces Health Services, due to the resultant decreased ability to exercise, failed annual fitness tests, modified duty status, inability to deploy, and medical releases and pensions (11). Musculoskeletal injuries are the leading cause of morbidity among many military forces, including the Canadian Armed Forces (11). In the most recent Canadian Forces Health and Lifestyle Survey (2008/2009), LBP was the most common of self-reported repetitive strain injuries significant enough to limit activities in the Canadian Armed Forces (12). Of the 41% of chronic health conditions due to musculoskeletal diagnoses in the military population, nearly half are low back conditions, while the remainder is comprised of all other musculoskeletal conditions combined. Approximately 22% of all military medical

releases are due to spinal issues. The Canadian Armed Forces spends $60 million annually on musculoskeletal related medical pensions, and 21% of this is paid out for low back conditions (12). LBP has large financial and operational implications in the Canadian military.

Prognostic research is useful to identify factors associated with clinical outcome of a condition such as LBP (13). The two most commonly measured outcomes in the management of LBP in the Canadian Armed Forces are level of pain and level of disability. These outcomes are important to both clinicians and patients as measures of improvement. However, it is also important to look at the management of LBP in this population, not only at a discrete point in time, where episodes of LBP often have favorable outcomes with regard to pain and disability, but over a longer course for these military members. Recurrences of LBP are common and a proportion of LBP patients develop persistent disabling symptoms. The outcome of healthcare seeking for LBP is important to policy makers because the number of referrals to musculoskeletal services, such as physiotherapy, chiropractic, osteopathy and acupuncture (defined as musculoskeletal healthcare seeking), at Canadian military bases is increasing while healthcare utilization for other health services has remained stable (12).

This thesis explores the association between LBP prognostic factors and musculoskeletal healthcare seeking in the Canadian Armed Forces. It consists of a background literature review, two investigations using the same clinical cohort study, and an overall conclusion. The background literature review discusses the course of LBP, theoretical models used in the study of LBP, a review of LBP prognostic factors seen in the general population, and outlines the need for research in a military population. The first study is an exploratory analysis, to examine whether prognostic factors for LBP found to be consistently associated with poor outcome in the general population are also associated with outcome in a military population. The second study is a confirmatory analysis guided by my clinical observations and evidence from general population studies; this study will test the independent association between a specific prognostic factor, pain-related fear, and healthcare seeking in a military population. The thesis conclusion summarizes the results of both studies, highlights clinical and policy implications, and suggests potential areas for further research.

CHAPTER 2:
BACKGROUND LITERATURE REVIEW

2.1 What is low back pain?

'Non-specific low back pain (LBP)' is pain, tension, or stiffness localized from the ribcage to the top of the thigh, with or without leg pain radiating to the knee(s), but not below the knee(s) (14). Although there are definitive structural diagnoses for LBP including disc prolapse, spinal stenosis (narrowing of the spinal canal), spondylolisthesis (a break in the bony ring of the vertebrae causing instability), tumour, or infection, these account for only 5-15% of all individuals seeking care for LBP (15-17); the majority of individuals experiencing LBP are described as having non-specific LBP, or LBP not attributed to any specific diagnosis or cause.

LBP can be considered on a spectrum from acute to chronic pain, with relapsing or recurrent episodes along that spectrum. Acute LBP is defined as LBP that lasts less than three months (14-18). Chronic LBP is defined as pain over a period of more than three (14,18-20) or six months (3). The definition of 'recurrent' LBP, however, is less uniform. In a recent systematic review, Stanton and colleagues identified 27 different definitions of recurrent LBP used in previous research studies (21). These ranged from at least one episode over the last year (22) to repeated pain episodes in the last year (23). This provides the opportunity for debate on whether a recurrent episode should be managed as an acute occurrence, or as a relapse and part of a chronic cycle of LBP. The potential implications of repeatedly addressing a recurrent or chronic low back condition as an acute episode may promote dependence on a practitioner and may inadvertently reinforce factors that are disabling. For example, previous treatments can have an influence on future healthcare seeking (24,25), and history of LBP can become a risk factor for poor outcome (24).

2.2 Course of low back pain

Non-specific LBP has been widely considered as a self-limiting problem with a favorable prognosis, but this is usually when taking into account the outcome of a

presenting episode at a discrete point in time (24,26). Reviews of the literature have found that, after one year, between 41-66% of LBP patients presenting for care had not recovered full function and between 60-80% still had pain (10,27,28). When looking over the course of an individual's lifetime, with the exception of a significant trauma, it is difficult to determine whether a particular episode of LBP is a new, independent episode, or a recurrence of a prior incident or injury (29). VonKorff defined a flare up as "a phase of pain superimposed on a recurrent or chronic course, usually severe, and lasting approximately one week" (26).

Dunn and colleagues classified LBP using a latent class analysis, in an attempt to understand the course of LBP over a period of twelve months (16). Using a cohort of LBP patients from general medical practices in the United Kingdom, the authors identified four "clusters" or groups representing different pathways of LBP. Cluster 1 identified was *persistent mild*, where patients had a stable and low level of pain, but could continue to function unrestricted. Cluster 2 was *recovering*, in which individuals had an episode of mild pain that quickly progressed to no pain. Cluster 3 was termed *severe chronic*, where patients had consistently high levels of pain, and their lives were detrimentally affected in many respects. Cluster 4 was termed *fluctuating*, where pain varied between mild and high levels. The latter two groups typically had pain for longer than 3 years prior to the study. These classifications are an example of the heterogeneity of LBP, and how different subgroups can follow diverse courses, and may require different management approaches. This literature also suggests that the traditional categories of acute, sub-acute, and chronic LBP may be too simplistic (15,16,27). With 10-20 % of patients developing persistent disabling LBP (3), and this group accounting for the majority of the costs related to the condition (15) it is important to address recurrence of symptoms effectively as part of a longer cycle.

2.3 Biomedical versus biopsychosocial models of low back pain

There are several theories that contribute to the understanding and management of LBP. We will discuss two widely known theoretical models, the biomedical and the biopsychosocial model. We will discuss these models and their relevance to the Canadian military population.

2.3.1 Biomedical Model

The current practice for treating musculoskeletal conditions in the Canadian Armed Forces is a 'sports medicine' approach (11,30), based on the biomedical model. The biomedical model takes the view that nociception (the stimulation of the nervous system from noxious stimuli) equals the subjective pain experience and is proportionally related to the extent of disease/ tissue damage (31). When applying the biomedical model, a practitioner and/or patient expects that upon identifying the damaged or involved structure(s), and treating this appropriately, the symptoms will decrease. Although there is justification for these biomechanical factors in the etiology of LBP (17), the application of this model in isolation has not resulted in the mass reduction of prevalence of LBP in society (6,32,33). Our improved understanding of how the nervous system processes pain and our psychological response to the experience of pain has helped explain limitations of the biomedical model. For example, this model does not adequately address why some individuals have pain in the absence of identifiable pathology, and why some have structural changes in the absence of pain (15). The biomedical model is incomplete when dealing with complex and multifaceted conditions such as recurrent or chronic LBP.

2.3.2 Biopsychosocial model

The biopsychosocial model has become the dominant model in the understanding of the etiology and prognosis of LBP in the general population (34). This model was first conceptualized by Engel in the 1977 (31,35), and further developed into a biopsychosocial model for LBP by Waddell in the 1980's (36). The biopsychosocial model for LBP provides a broader and more comprehensive perspective of the condition, where biomedical, psychological and social factors are simultaneously considered as important to explain etiology and prognosis. The biomedical component of the model addresses the physiological aspects, such as structure, nociception and disease processes. The psychological component addresses the affective (emotional) and cognitive (beliefs and meaning) aspects of the experience of pain. The social component addresses the context, culture, and interaction of the individual with their environment (31).

The biopsychosocial model is relevant when considering LBP in the Canadian Armed Forces. Firstly, in the military environment, there is a high rate of physical injuries, and also a large proportion of chronic conditions (30). Secondly, a proportion of this population experiences psychological stressors such as post-traumatic stress disorder (PTSD), depression, and substance abuse. Pain-related fear, with its subsequent fear-avoidance behavior, may have particular relevance in military populations (1,37,38). Thirdly, there are potential social stressors such as a hierarchical rank system, separation of families during deployments, and a high rate of divorce. Therefore, it would be logical to consider factors associated with LBP outcomes in our military population from a biopsychosocial perspective.

2.4 Prognostic factors of outcome in low back pain

Prognostic studies are useful in identifying characteristics of those who are more likely to have worse or better outcome (10). Research into the prognostic factors for outcome of LBP has received much attention for years in the general population (10,32,39-43). Table 1 describes those factors most consistently associated with poor outcome in a review of systematic reviews (10); these observed prognostic factors reflect the biopsychosocial nature of LBP.

Table 2.1: Prognostic factors of outcome in LBP (from Hayden et al, 2010 (10))

Factor Domain	Prognostic Factor
LBP episode characteristics	Higher level of functional disability
	Sciatica
Individual characteristics	Older age
	Poor general health
Psychological characteristics	Increased psychological or psychosocial stress
	Negative cognitive characteristics
Work environment	Poor relations with colleagues
	Heavy physical work demands
Social environment	Presence of compensation

Prognostic factors are important to study in a military population as well. Spinal pain, of which three quarters of cases are LBP complaints, is the most common musculoskeletal condition seen in military populations (44). In the Canadian Armed Forces, LBP is the most common condition presenting for musculoskeletal healthcare services (45) and is one of the leading reasons for medical release from the Canadian military (11). The Canadian Armed Forces spends $60 million annually on musculoskeletal related medical pensions, and 21% of this is paid out for low back conditions (12). Recent studies in United States and the Netherlands military populations have looked at LBP prognostic factors (37,38), but we are aware of no prognostic studies for LBP in the Canadian military population.

2.4.1 Pain-related fear as a prognostic factor

A particular prognostic factor of interest is pain-related fear, which is the central concept of the fear-avoidance model for LBP (46). The fear-avoidance model proposes that when a pain experience is viewed as non-threatening, a patient will confront it and attempt to gradually resume normal activities in the presence of pain, thus promoting recovery. Conversely, if pain is maladaptively interpreted, it may contribute to the onset of pain-related fear. This can lead to avoidance behavior and hypervigilance, and subsequently to the development of problems such as physical deconditioning, functional disability, persistent LBP, and conditions such as depression (47,48). In general populations, pain-related fear has been shown to be associated with the transition from acute to chronic pain, and also in the maintenance of chronic pain and disability (32). Two recent studies on military populations identified pain-related fear as a significant prognostic factor in clinically relevant improvements (38) and in future military duty status (37). These studies called for more research into the prognostic association of pain-related fear and outcomes in military populations.

2.5 Important low back pain outcomes

Important outcomes for LBP, like the condition itself, are complex and multidimensional (49). The most commonly recommended and used *patient* outcomes in LBP studies are level of disability, level of pain, psychosocial function, general well-

being, satisfaction with care, and work disability measures (return to work, number of sick days)(49-51) However, with the shift in understanding of LBP as having a longer, more recurrent and chronic course (16,27,52), and with the use of healthcare services for LBP increasing dramatically over the last 20 years (53), another useful outcome to *policy makers* is the use of healthcare resources when an individual is experiencing a recurrence, rather than the fact that a recurrence has happened (9). Research shows that the majority of people with LBP in the general population do not seek medical care (3,6,7). As a result, a small proportion of those with LBP who seek care account for a large proportion of the cost (54,55). Few studies on healthcare seeking for LBP have been published (56). Therefore, the outcome of healthcare seeking has become a research priority in recent years (42).

2.6 Healthcare seeking in the Canadian Armed Forces

Healthcare seeking is an important outcome to explore in the Canadian Armed Forces, because of the increase in access of musculoskeletal care in the last five years (12,57), and the high prevalence of LBP in this population (11,30). Andersen (1995) proposed that healthcare seeking was a product of a variety of predisposing factors, including: 1) predisposing characteristics of patients; 2) the availability of resources; and 3) perceived need for care (58). The Canadian Armed Forces population has unique environmental, social, and behavioral characteristics that differ from the general population with regard to healthcare seeking. In the general population, adequate and timely access to health care is often a challenge, where as in the military this is not an issue. In the military, healthcare resources are accessed more quickly than in the general population, are equally accessible by all personnel and are readily available during working hours. According to the most recent Canadian Forces Health and Lifestyle Information Survey (2008/2009), approximately 75% of Canadian regular forces military personnel sought medical attention in the month prior to completing the survey (12). Since the last survey in 2004, there was a significant increase in the proportion of personnel seeking musculoskeletal healthcare services, while care seeking of physician and nursing services remained stable (12). LBP is the most common musculoskeletal

condition treated by musculoskeletal healthcare professionals in the Canadian Armed Forces (45).

Patients presenting to musculoskeletal services for LBP in the Canadian Armed Forces are generally managed as a new episode with each new referral, often seeing a different practitioner each time, and predominantly managed using a biomedical approach (11,30). This possibly results in a repeated access to resources and repetition of interventions. Given the relative ease of access to health care in this population, and the recurrent nature of the condition, it is important to look at other factors that might contribute to a higher or repetitive usage of the healthcare system, such as the predisposing characteristics of the patients themselves and perceived need for care. To date, we are aware of little research on prognostic factors in relation to musculoskeletal healthcare seeking for LBP within a military population.

In this time of fiscal constraint, it is imperative that healthcare providers evaluate their practice to ensure they are appropriately delivering services to meet these present challenges. The Surgeon General of Canada has priorities for making healthcare services in the military more efficient and effective. These are to have a renewed focus on health research, to be 'fiscally responsible', and to 'measure and evaluate our results using a rigorous performance measurement model' (30). This study addresses the Surgeon General's priorities by exploring factors associated with musculoskeletal healthcare seeking in the management of recurrent and chronic LBP at Canadian Forces Base Halifax. The results of this study will provide insight to clinicians and policy makers on the relevant prognostic factors of outcome in Canadian Armed Forces personnel seeking care for LBP. The study will also highlight potential areas of future research, such as which of these factors may be modifiable and how to implement appropriate interventions to address the complex nature of recurrent and chronic LBP.

2.7 Objectives

The objectives of this thesis are:

1) To describe the re-referral patterns for Canadian Armed Forces members with recurrent or chronic LBP, and explore whether prognostic factors observed to be

consistently associated with LBP outcomes in the general population are also associated with musculoskeletal healthcare seeking in a military population.

2) To explore the independent association between pain-related fear and musculoskeletal healthcare seeking for LBP in Canadian Armed Forces personnel with recurrent or chronic LBP.

CHAPTER 3: THE ASSOCIATION OF LOW BACK PAIN PROGNOSTIC FACTORS AND HEALTHCARE SEEKING IN THE CANADIAN ARMED FORCES

ABSTRACT:

Study Design. A historical clinical cohort study of Canadian Armed Forces personnel seeking care for recurrent and chronic low back pain (LBP).

Objective. To explore the association of commonly recognized prognostic factors for LBP outcome in the general population with LBP outcome in Canadian military personnel as measured by re-referral for musculoskeletal healthcare for LBP.

Summary of Background Data. In the Canadian Armed Forces, LBP can have a significant impact on operational readiness. LBP is the most common reason for referral to musculoskeletal care in the Canadian military, but the rate of re-referral (return for more treatment) is unknown. With costs of providing care rising, and healthcare equally and easily accessible to all military personnel, it is important to investigate factors that may contribute to high usage of the military healthcare system. There has been little research conducted about important LBP prognostic factors and healthcare seeking for musculoskeletal conditions in military populations.

Methods. We linked data from clinical outcome records for participants of a back rehabilitation class, with administrative data from military electronic health records. A total of 356 patients with recurrent or chronic non-specific LBP were identified during the study period (May 2007 to December 2012). Univariate and multivariate analyses were performed to examine the associations of *a priori* chosen factors and musculoskeletal healthcare seeking. We defined musculoskeletal healthcare as services from a physiotherapist, chiropractor, osteopath, or acupuncturist, and measured our outcome in two ways: time to first re-referral to musculoskeletal care, expressed as hazard ratios (HR), and total rate of repeated re-referrals, expressed as incidence rate ratios (IRR).

Results. From our dataset, one hundred eighty-three (51.4%) patients had at least one re-referral during the follow up period, with over 20% of the sample re-referred to musculoskeletal services for LBP within six months following discharge from

rehabilitation. In multivariate analysis, fear of movement/(re)injury (HR 1.05; 95% CI 1.02-1.07), planning to receive or currently receiving a Veterans Affairs pension (HR 2.29; 95% CI 1.45-3.61 and HR 1.75; 95% CI 1.06-2.89 respectively), having a concurrent diagnosis of post-traumatic stress disorder (HR 1.72; 95% CI 1.01-2.93), previous high use of musculoskeletal services (HR 1.64; 95% CI 1.14-2.38), showed a statistically significant positive association with time to first re-referral. Pain episode >12 weeks had a protective finding (HR 0.64; 95% CI 0.44-0.92). These prognostic factors, as well as greater than 5-year history of LBP (IRR 2.06; 95% CI 1.03-4.10) and permanent category military duty status (IRR 1.79; 95% CI 1.16-2.76), had statistically significant associations with our second outcome, the rate of re-referrals following discharge from rehabilitation. Other demographic and clinical variables investigated were not found to be associated with time to re-referral or rate of re-referrals for LBP to musculoskeletal services in multivariate analysis.

Conclusion. Psychological and social factors are associated with the rate of musculoskeletal healthcare seeking in a military population.

3.1 INTRODUCTION:

Low back pain (LBP) is often thought of as a self-limiting condition (53). However, recurrences are common, with persistent LBP sufferers most likely to seek care (53). Two widely used patient outcomes in LBP clinical practice and research are pain severity and disability (49-51). However, these may not be the most relevant outcomes to policy makers. Reviews of the literature report that, irrespective of intervention, approximately 41-66% of patients with LBP do not recover full function and 60-80% continue to have pain after one year (24,28). LBP is now understood as more of a chronic and recurrent condition over a life course, rather than a distinct entity with acute, subacute, and chronic LBP (9,27,52). This shift of understanding of the course of LBP, along with the dramatic increase in healthcare resource use for LBP over the past 20 years (15), makes the outcome of healthcare seeking for LBP important to policy makers at this time, as they look for strategies to manage resources of healthcare delivery. There is a call for more studies to look at the prognostic factors associated with LBP from a healthcare seeking perspective (42).

Consensus from experts in the field of LBP research is that the prognosis of LBP is multifactorial (10,59). In a recent systematic review, 221 distinct prognostic factors were investigated and subsequently categorized into 36 different domains, including biological, psychological, and social factors (10). In addition to biomedical factors such as clinical examination findings, researchers and healthcare providers should also consider psychological and social factors in their assessment and management of a LBP patient (15,40,41,43,53).

In the Canadian Armed Forces, there are several important reasons to examine the association between prognostic factors of LBP and musculoskeletal healthcare seeking:
1) Musculoskeletal conditions have a significant impact on operational readiness and on healthcare costs, through healthcare appointments attended during working hours, assignment of modified duty status, the inability to deploy, medical releases, and medical pensions (11);
2) The number of referrals to musculoskeletal services, such as physiotherapy, chiropractic, osteopathy and acupuncture (defined as musculoskeletal healthcare

seeking), at Canadian military bases has increased dramatically over the last five years while healthcare utilization for other services has remained stable (12);
3) LBP is the most commonly seen musculoskeletal condition in the Canadian Armed Forces (30,45);
4) The current management of LBP in the Canadian Armed Forces uses the "traditional militarized sports medicine approach" (11,30), which is biomedically focused, and currently does not screen for biopsychosocial prognostic factors of poor outcome.

Considering these points, an examination of biopsychosocial prognostic factors of LBP and their association with re-referral patterns will provide useful information for program and policy development. Recent research has looked at healthcare seeking of Canadian military personnel for Post-Traumatic Stress Disorder (PTSD) and other mental health conditions (60-63), but little is known about healthcare seeking for recurrent and chronic LBP in this population.

The purpose of this study is to describe musculoskeletal healthcare seeking patterns as measured by rates of re-referral for Canadian Armed Forces members with recurrent and chronic LBP, and to explore whether prognostic factors for LBP consistently observed in general population studies are also found to be associated with healthcare seeking in this population.

3.2 METHODS

3.2.1 Study design and population of interest

This study is a historical cohort, involving secondary use of data. We used outcome measures collected originally for clinical purposes. We linked the clinical data with administrative data from electronic health records by accessing Canadian Forces Health Information System (CFHIS). Our population of interest is Canadian Armed Forces members with recurrent or chronic LBP who sought musculoskeletal care for their condition. Our study population was members of the Canadian Forces Base Halifax, which consists of approximately 11000 personnel from Navy, Air Force and Army elements. There are approximately 600 LBP referrals per year to the Physiotherapy Department at this base. A proportion of these referrals are re-referrals of a same individual for a recurrent or chronic condition.

3.2.2 Study sample

Our sample consisted of military personnel who attended a physiotherapy-led 6-week low back rehabilitation class at Canadian Forces Base Halifax during the period of May 2007 to December 2012 as part of their course of care. For members to be clinically suitable to attend the class, they required a score on a pain scale of less than 8/10, the ability to actively participate in an exercise program, an active straight leg raise of more than 30 degrees, and the commitment to attend at least 10 out of 12 classes. The length of time in previous individual care varied from one or two individual sessions to several months of care. Patients were working in either full or modified duty status at the time of referral. From this group, inclusion criteria for participants of this study were: members between 19-55 years of age with LBP defined as pain between the 12th rib and gluteal fold +/- intermittent pain down one leg to the knee (14). Individuals must have completed the pre-assessment and were subsequently enrolled in the class. We excluded those who had constant pain below the knee into one or both legs with or without neurological deficits, and any other signs of serious pathology (red flags). We also excluded patients with confirmed pregnancy, and patients with a first episode of LBP of less than 3 months duration (acute).

Members attended a six-week class, two afternoons per week. The first afternoon session each week was comprised of education, both in lecture format and then in exercise instruction. The second afternoon weekly session was devoted to exercise and relaxation. Details of the program are found in Appendix 1. Once the program was complete, the members were reassessed and discharged from the rehabilitation class. Those who were still on modified duties because of their LBP were recommended to follow up with their healthcare provider after the class.

3.2.3 Data collection

We collected data in two phases: we collected baseline data from paper records (questionnaires and functional testing), recorded originally for clinical purposes at a pre-assessment interview approximately one week prior to start of the 6-week program. Between July 2 and October 10 2013, administrative data were accessed from CFHIS and

paper records (if an electronic equivalent was not available) for the period of May 2007 to July 2013. We linked clinical and administrative data and stored it to comply with policies and practices regarding privacy/ confidentiality (64) as well as the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (65). Detailed information about the linkage of data can be found in Appendix 2.

3.2.4 Prognostic factors of interest

For this exploratory prognostic study (66), we collected variables that were considered prognostic factors for LBP in the general population and that were representative of the biopsychosocial domains as suggested by a consensus of experts (10). We collected the following information from the Back Class clinical files: Baseline Fear of Movement/ (re)injury as measured by the Tampa Scale for Kinesiophobia (TSK) (67) baseline functional ability score (Roland Morris Questionnaire/ Oswestry Disability Questionnaire) (68), baseline pain severity (numeric rating scale), duration of current episode (defined as a "period of pain in the low back lasting more than 24 hours, preceded and followed by a period of at least one month without LBP"(69)), military rank, military element (Navy, Army, or Air force), duty status, presence of intermittent leg pain, and completion status of class. We collected the following information from electronic health records: age at time of participation in the rehabilitation class, job description, previous history of LBP, the number of radiological investigations for LBP, previous musculoskeletal treatment, Veterans Affairs compensation (VAC) status, and comorbidities at baseline, including concurrent chronic musculoskeletal complaint, BMI >30 kg/m^2, post-traumatic stress disorder (PTSD), depression, anxiety disorder, cardiovascular condition, hypertension, diabetes, and substance abuse. A detailed description of all variables collected and how they were measured is provided in Appendix 3.

We used several categories from a consensus exercise that resulted in a listing of core factors for baseline measurement in LBP cohort studies: clinical, financial, psychological, social, demographic, and work-related (59). Using this subject expert knowledge as our guideline, we selected key variables *a priori* that would represent these multifactorial categories, and chose 25 from our list of 35 that were the most relevant to

this population and most objective to measure (Figure 3.1). For example, under the social domains of work-related and socioeconomic factors, we used *military element* and *military rank* to represent *job description* and *educational status* respectively. A military member is a soldier first, and universal tasks and physical training standards are uniform regardless of trade. Also, when a member has been on modified duties for their LBP for an extended period of time, or has moved from a junior active job to a more senior administrative job in their trade over the years, job description is very difficult to categorize.

3.2.5 Outcome measures

Our outcome variable was musculoskeletal healthcare seeking, as measured by referrals to physiotherapy, chiropractic, osteopathy, and acupuncturist. We collected this information from the electronic health records, where each new re-referral to a healthcare provider and subsequent treatment record had been scanned into the system by the health records department. We measured healthcare seeking in two ways:

1) Time to first re-referral of subjects for LBP to a musculoskeletal healthcare provider eligible for coverage under military scope of care (physiotherapy, chiropractic, osteopathy and acupuncture) following their discharge from the back rehabilitation class.
2) The rate of re-referrals to a musculoskeletal healthcare provider for LBP following discharge from the back rehabilitation class.

3.2.6 Missing data

There was little missing data in our linked dataset (Appendix 4). We imputed missing values using data from a similar subject in the data set (subjects with the most similar characteristics of predictor variables, such as age, gender, disability score, and pain level). If there was more than one subject that fit, we randomly chose one for replacement. That subject was then no longer available for imputation of further missing data (70,71). We used both completed case (dataset with missing data) and imputed dataset in our multivariate analyses.

3.2.7 Statistical Analysis

We described our study sample, including demographic, clinical, psychological, and social factors measured at baseline. We expressed continuous variables using means and standard deviations, or medians and ranges if they did not follow a normal distribution. We tested for normality by observing the skewness in univariate analysis, and by graphing the distribution of each continuous variable using a histogram. We checked for outliers by graphing box plots. Dichotomous and categorical variables were expressed as proportions.

For our first outcome of interest (time to first re-referral following discharge), we described the distribution, including the proportion of subjects that had an event and the proportion that were 'censored' (either released from the military before a re-referral occurred or remained in the military and did not have a re-referral by the end of the study follow up period). We explored the difference between those who were released and those who remained in the military in the proportion of censored observations, using chi-squared tests. We described healthcare usage of this military population by presenting a Kaplan-Meier survival curve of time to first re-referral.

We performed multivariate analyses to identify prognostic factors associated with our outcomes of interest, using statistical significance at $p<0.05$ as our definition of association. For time to first re-referral, we used a Cox proportional hazards model producing hazard ratios (HR). For rate of re-referrals, we used a negative binomial regression model, producing incidence rate ratios (IRR). The period available for follow-up in our second outcome was used as an offset variable, as subjects were followed up for different periods following clinical discharge. For our multivariate analysis, we entered the 22 prognostic factors chosen *a priori* based on previous literature and subject knowledge (Figure 3.1) into our model. Using the rule of thumb of 10 events per variable (EPV) and our number of re-referrals of 183 (or since over 50% of our sample had an event, 1-EPV which was 173), we had slightly over this number, but we also looked at the convergence of the model to check for model fit and ensure that our number of variables was appropriate.

All analyses were conducted using Statistical Analysis System (SAS 9.2) software.

3.3 RESULTS

In our study we included 356 Canadian Armed Forces members with recurrent or chronic non-specific LBP. Figure 3.2 presents the identification of study participants. Median participant follow up time after discharge from the Back Class was 1182 days (range 22-2253 days). Our sample was predominantly male (81.4%) with a mean age of 41 years (range 19-55 years). 25.8% of the participants were high users of musculoskeletal health services using our *a priori* definition of a high user (Appendix 6). Table 3.1 describes complete characteristics of our sample at baseline.

One hundred eighty-three participants (51.4%) in our sample had at least one re-referral following clinical discharge. Approximately 20% of the sample had been re-referred back to musculoskeletal services for LBP within the first six months following discharge from the class and just over 30% of the sample had been re-referred by 12 months (Figure 3.3). Of those re-referred, the median time to first re-referral for LBP was 321days (range 0-2034 days). The rate of referrals was highly skewed with extreme outliers. Approximately 10% of the sample had been repeatedly re-referred to musculoskeletal services up to three to eight times within the available follow up period, which ranged from a two to five year follow up period.

3.3.1 Factors associated with time to first re-referral

The measures of association for potential prognostic factors with our outcomes of interest are presented in Table 3.2. We found the following variables to be statistically significantly associated with time to first re-referral in multivariate analysis: fear of movement/(re)injury (HR 1.05; 95% CI 1.02-1.07), previous high use of musculoskeletal services (HR 1.64; 95% CI 1.14-2.38), having a concurrent diagnosis of PTSD (HR 1.72; 95% CI 1.01-2.93), and planning to or currently receiving a Veterans Affairs pension (HR 2.29; 95% CI 1.45-3.61 and HR 1.75; 95% CI 1.06-2.89 respectively). Duration of current episode also showed a statistically significant association with time to re-referral, with those with pain greater than 12 weeks having a 36% *lower* incidence of re-referral when controlling for covariates (HR 0.64; 95% CI 0.44-0.92). When comparing the results of multivariate proportional hazards regression for the completed case and

imputed datasets, the prognostic factors 'duration of current episode', and 'current pension for LBP' were not statistically significant when analyzed using the imputed dataset for time to first re-referral.

During the follow up period, 70 members (19.7%) either released voluntarily or were medically released from the military (Table 3.3a). Table 3.3b shows the proportion of censored subjects for each of these categories. There was no statistically significant difference in the proportion of censoring between actively serving members and released members (p=0.60).

3.3.2 Factors associated with rate of re-referrals

Fear of movement/(re)injury, previous high use of musculoskeletal services, PTSD, and Veterans Affairs compensation status were also statistically significant prognostic factors for our second outcome, rate of re-referrals. The two additional statistically significant factors for rate of re-referrals were prior history of LBP and duty status; having more than a 5-year history of LBP (IRR 2.06; 95% CI 1.03-4.10) and having a permanent category status at the time of attending the back rehabilitation class (IRR 1.79; 95% CI 1.16-2.76) remained significant after controlling for covariates. Duration of current episode was not statistically significantly associated with rate of re-referrals in the multivariate regression model.

3.4 DISCUSSION

This study looked at prognostic factors and their association with musculoskeletal healthcare seeking for recurrent and chronic LBP in a military population. We found that fear of movement/(re)injury, Veterans Affairs compensation status, concurrent diagnosis of PTSD, and previous high use of musculoskeletal services, were statistically significantly associated with a quicker time to first re-referral following discharge from a back rehabilitation class in multivariate analysis. Duration of current episode of LBP was associated with a longer time to re-referral. Fear of movement/(re)injury, Veterans Affairs compensation status, PTSD diagnosis and previous high use of musculoskeletal services were associated with rate of re-referrals to musculoskeletal services over our

follow-up period. We found that a greater than five year history of LBP and military permanent category duty status were also positively and statistically significantly associated with rate of repeated re-referrals following clinical discharge. No other demographic or clinical variables were found to be statistically significantly associated with time to re-referral or rate of re-referrals for LBP to musculoskeletal services in our sample when controlling for other covariates.

3.4.1 Factors associated with healthcare seeking

Clinical factors

It was notable that neither the severity of pain nor level of disability was found to be a significant prognostic factor of either outcome in our sample when controlling for other factors. These results support the findings of a recent systematic review on the determinants of healthcare seeking with regards to pain severity in the general population with LBP (42). Ferreira and colleagues found that pain severity is not a consistent prognostic factor of healthcare seeking. However, our results contrast the review's findings that disability was a strong prognostic factor of healthcare seeking, with those with high levels of disability up to eight times more likely to access health services. This could be because in our study, military members had to be fairly high functioning to participate in the active rehabilitation class, and therefore did not include those suffering from more disabling symptoms (ie: moderately to severely limiting, as stated in Ferreira's review). Our results are consistent with a recent cohort study on LBP and healthcare seeking, which found that pain and disability were not significantly associated with this outcome in their sample (72). The authors suggested that some individuals may have considerable levels of pain and decreased function, but may have adapted coping strategies to manage symptoms on their own.

In our study, we found duration of current episode to have a *protective* association with healthcare seeking for LBP, where those with LBP greater than 12 weeks took 36% *longer* to be re-referred for physiotherapy or chiropractic care than those with more intermittent and recurrent symptoms (HR 0.64; 95% CI 0.44-0.92). This contrasts other studies that report that those with chronic pain are higher users of the healthcare system (15). One reason for this might be that, when controlling for other factors, those with a

more chronic symptoms were ready to accept the advice and strategies of the self-management program, and the back class intervention itself may be playing a role here. This is only speculation, however, and the intervention itself was not a focus of this study. Another reason could be that those with longer durations of pain were subsequently accessing alternative forms of care, such as a pain management clinic for facet injections, rather than our definition of care-seeking for this study, and were not captured in our outcome of healthcare seeking.

Psychological factors

The role of psychosocial factors such as an individual's beliefs or psychological distress have been studied with respect to outcomes for LBP, but not as comprehensively for care-seeking (42,73). Our study found that fear of movement/(re)injury was a significant prognostic factor of both time to re-referral and how often individuals were being repeatedly referred to physiotherapy or chiropractic care. We will explore this factor further in the next chapter, and discuss how this characteristic may be relevant in a military population. Depression, however, was not a significant prognostic factor in our sample. Our finding could be due to the method in which we recorded this comorbid condition. Other studies assess depression using self-report screening measures of each participant in their study (72,73) while we used a formal diagnosis by mental health professional, documented in administrative health records. The diagnostic criteria may have led to an underestimation of depressive symptoms in our sample. PTSD, however, was shown to be a prognostic factor associated with both outcomes of healthcare seeking in our study. This highlights the importance of recognizing comorbid mental health conditions when managing LBP in a military population, and their prognostic role in outcomes such as healthcare seeking.

Social factors

There is emerging evidence that social factors are independently associated with outcome (74). Our results indicated that Veterans Affairs compensation status is associated with both how quickly members return for treatment and how often they repeatedly are re-referred to musculoskeletal care, with those with pending compensation

claims 126% more likely to be re-referred at any point in time, and have a 64% higher rate of repeated re-referrals than someone who is not intending to apply for compensation for their LBP. We could find no other study that systematically captured this social factor in relation to healthcare seeking for LBP in the general or military population, although many studies have investigated this factor with respect to disability outcomes. This is important, because our study responds to the request for more research on the association of social factors to help better understand the prognosis of LBP (10). Cedraschi and Allaz, describe how "nociception becomes less a determinant of functional status than psychological and social attributes" when pain moves from the acute to chronic stages (75). They suggested that understanding and interpreting pain symptoms can modulate the pain experience, and that social influences such as family and job support, or benefits and compensation can reinforce the expression of symptoms. The implication of this factor is that, regardless of intervention received, members who are seeking compensation for a work related LBP incident may access services more frequently, for a variety of reasons beyond the scope of this paper.

Due to the uniqueness of the military environment, we were unable to objectively and systematically capture heavy workload, which other research has highlighted as an important prognostic factor (10). We did not capture other workplace issues such as job satisfaction or family-related factors such as support at home. Therefore, the contribution of these other social factors in relation to our measured factors is unknown. The potential impact of not capturing these variables is that they could have altered the association of other factors within the model when included in multivariate analysis.

3.4.2 Strengths and limitations of the study

Our study had several strengths. From our search of the literature, we were aware of only a few studies (25,56,72,73,76) and a review (42) that looked at LBP prognostic factors and the outcome healthcare seeking, and none that examined recurrent and chronic LBP within a military population. Our study looked at two measures of healthcare seeking, time to re-referral and rate of re-referrals. This could be considered more useful information than simply whether an individual has had a re-referral or not, as

our measures take the factor of time and repeated referrals into account. Most available studies looked at healthcare seeking from primary care providers in general, and not other musculoskeletal healthcare providers such as physiotherapists and chiropractors. Our study was conducted on a relatively homogeneous sample when compared to the general population, which reduces the potential for confounding from macro-level variables, such as access to musculoskeletal healthcare and sickness and compensation benefits. The participants were referred to the rehabilitation class by all eligible healthcare practitioners in the hospital as part of their routine care, and are representative of patients who seek care for recurrent or chronic LBP in a military community. The factors explored in this study were based on a core set of prognostic factors recommended in the literature (59), and were all objectively measured using either validated questionnaires or from standardized information in the administrative records. There was very little missing data for our prognostic factor variables, and no missing data for our outcomes. We had a clearly defined outcome (record of re-referral to musculoskeletal care) and were able to objectively capture healthcare seeking by accessing administrative health records. Therefore loss to follow up was not a factor in this study. Other studies rely on patient self-report for this information (73).

This study should be considered in light of several limitations. The sample was comprised of Canadian Armed Forces members, all of whom were fit enough to participate in an active back rehabilitation program, and work in some capacity. Pransky and colleagues wrote about the 'healthy worker effect': workers tend to be healthier since ill or disabled individuals are less likely to work and participate in heavy jobs (9). Our results therefore may underestimate healthcare seeking for the more severely affected military members with LBP, and are not generalizable to the general population. Although our sample is representative of those seeking care for recurrent and chronic LBP, we were unable retrospectively to capture those who were referred to but decided not to participate in the class for a specific reason (for example, maybe too busy at work, deployment, or reluctance to exercise). Therefore, participation bias may be an issue here. This would be more of an issue in a two-group cohort, if the participation rate differed between the groups, but it still has a potential impact on the true representativeness of those seeking care for recurrent or chronic LBP in this population. We were able to

mitigate this bias partially, as the classes were run three to five times per year, so those who could not attend due to operational requirements had the opportunity to participate at a later date. A prospective multi-site cohort, including all individuals with recurrent and chronic LBP presenting for musculoskeletal services, would be useful in confirming the results obtained here.

Our study confined musculoskeletal healthcare seeking to physiotherapists, chiropractors, osteopaths, and acupuncturists. Other musculoskeletal services accessed by members with recurrent and chronic LBP in this sample, but not captured, included a multidisciplinary pain management clinic, injections for LBP, orthotic prescription for LBP, and massage therapy. Therefore, our results may be an underrepresentation of the comprehensive array of musculoskeletal services utilized by this population. The majority of participants completed the 6-week rehabilitation class, but a proportion (12.6%) did not. Since the intervention was not the focus of the study and we only used baseline clinical scores, we did not control for those who completed the program and those who did not. There was no statistically significant difference in outcome in bivariate testing between completion status of program and our outcome ($p=0.60$).

Our relatively small sample size of 356 limited the number of variables that we could include in our multivariate models. However, we feel that we were able to obtain a comprehensive selection of variables that fit within the theoretical biopsychosocial framework.

3.4.3 Implications for policy makers and further research

The results of this exploratory study highlight the association of biopsychosocial prognostic factors and healthcare seeking in a military population. This study is important to clinicians and policy makers who are trying to manage healthcare resources in a traditionally biomedical-orientated environment. The results provide insight on the potential need to review the current screening and management of Canadian Armed Forces personnel with LBP to more appropriately acknowledge the multifactorial nature of the condition. For example, our findings call into question whether the level of reported change in pain and disability should be the primary outcome measures when evaluating effectiveness of musculoskeletal interventions. With LBP being increasingly

viewed as a chronic and recurrent condition, more appropriate outcomes may include measures of self-efficacy (the ability to manage their condition without reliance on healthcare seeking), and beliefs about their condition, such as fear of movement/(re)injury, rather than resolution of symptoms. Also, our observed associations between compensation status and healthcare seeking may have implications for policy makers, as this factor is not modifiable at a clinical level. Further exploratory research is required in independent studies on LBP in a military population, using the same core prognostic factors. This would allow for replication and synthesis of results to confirm the prognostic value of psychological and social factors (13). Future research is also needed to test the independent associations of factors such as compensation status and pain-related fear in relation to healthcare seeking for those with recurrent and chronic LBP in military populations.

3.5 CONCLUSION

Our results indicated that fear of movement/(re)injury, compensation status, previous high use of musculoskeletal services, concurrent diagnosis of PTSD, history of LBP, and military duty status are associated with healthcare seeking in those with recurrent and chronic LBP in the Canadian Armed Forces. This is the first prognostic study to examine an association between LBP biopsychosocial factors and healthcare seeking in this population.

Figure 3.1: *A priori* chosen prognostic factors from biological, psychological, and social domains for exploratory analysis, between low back pain prognostic factors and musculoskeletal healthcare seeking in the Canadian Armed Forces

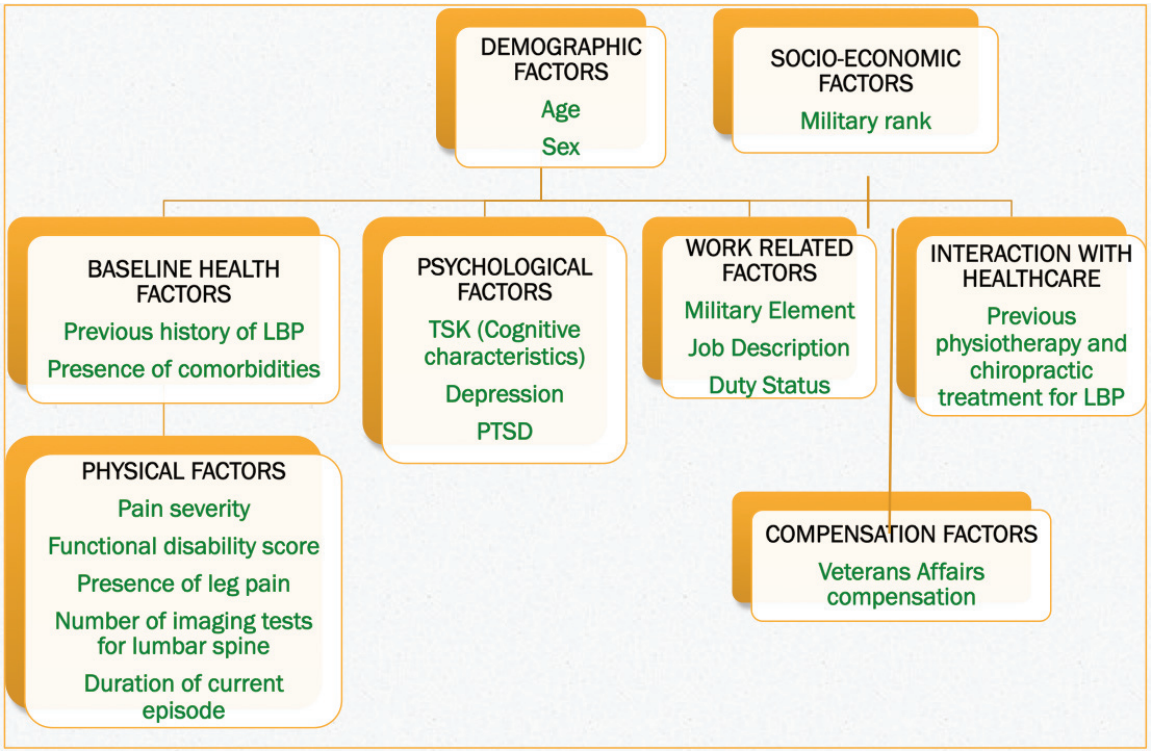


Figure 3.2: Flow diagram of eligible participants in cohort study in Canadian Armed Forces members who sought care for recurrent or chronic low back pain from May 2007 to December 2012

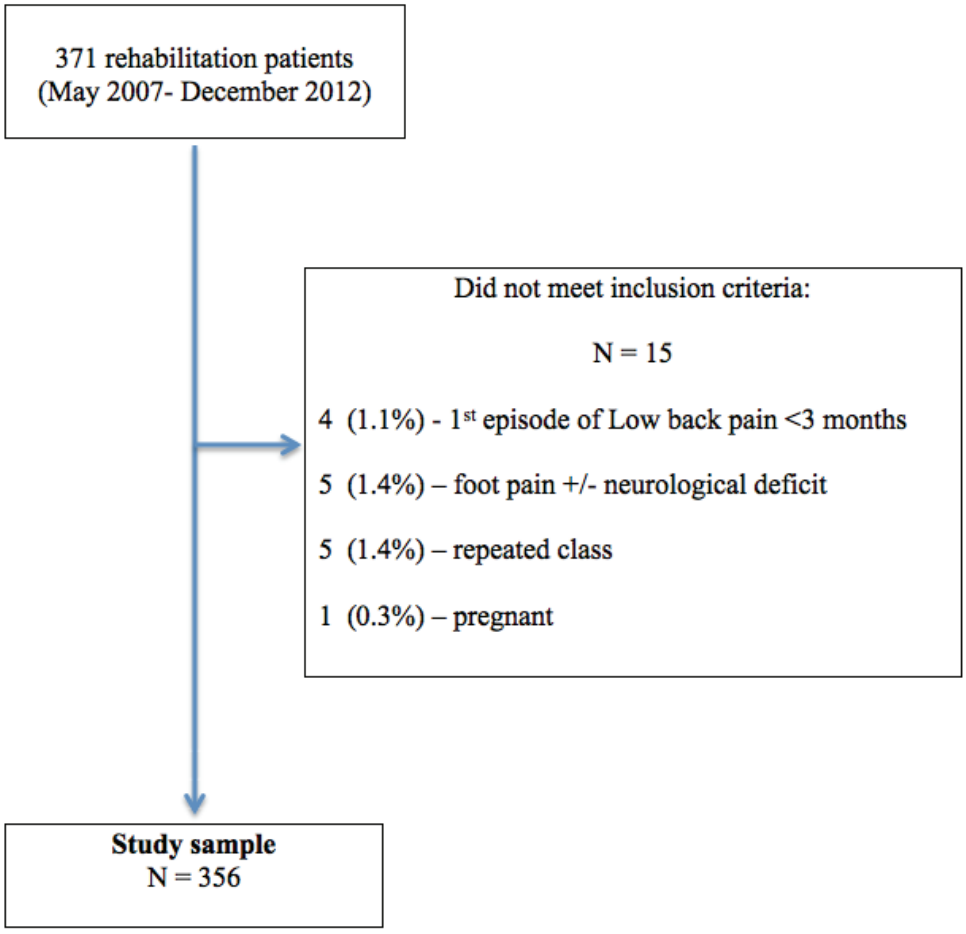


Table 3.1: Baseline characteristics of participants with recurrent and chronic low back pain (LBP) from May 2007-Dec 2012 (n=356)

Variable	Mean (SD)
Age, in years	41 (7.4) 19-55 years
Pain Score (0-10 Numeric Rating Scale)	4 (2.2) 0-9
Disability Score (0-100%)	27.9 (17.7) 0-83%
TSK* Score (17-68)	39.7 (6.6) 19-58.5
	% (n)
Sex (% Male)	81.4 (290)
Rank	
Non-commissioned member	47.2 (168)
Senior Non-commissioned member	38.8 (138)
Officer	14.0 (50)
Element	
Navy	65.5 (233)
Air force	18.5 (66)
Army	16.0 (57)
History of LBP	
< 1 year	8.8 (31)
1-4 years	31.3 (141)
5+ years	59.9 (211)
Duration of current episode	
<= 3months	27.0 (96)
> 3 months	72.9(259)
Presence of leg pain	
No	85.9 (305)
Yes	14.1 (50)
Duty status at end of class	
full	58.1 (207)
TCAT[†](for back)	27.0 (96)
PCAT[Ŧ] (for back)	3.1 (11)
TCAT/PCAT (other)	11.8 (42)
Veterans Affairs compensation status (for LBP)	
No plan to apply	46.8 (162)
Unsure	14.7 (51)
Plan to apply	20.2 (70)
Receiving pension for LBP	18.2 (63)
Comorbidities (% Yes)cateoory	
Chronic musculoskeletal	51.4 (183)
Depression	12.1 (43)
PTSD[§]	7.3 (26)
BMI[ǁ] >30 kg/m^2	27.8 (99)
Diabetes	4.2 (15)
Cardiovascular	4.5 (16)
Anxiety Disorder	5.6 (20)
Substance Abuse	3.4 (12)
Adjustment disorder	3.1 (11)
Hypertension	11.5 (41)
COPD[¶]	1.7 (6)

*TSK = Tampa Scale for Kinesiophobia; [†]TCAT = temporary duty category; [Ŧ]PCAT = permanent duty category; [§]PTSD = post-traumatic stress disorder; [ǁ]BMI = body mass index; [¶]COPD = chronic obstructive pulmonary disease

Table 3.2 Univariate and multivariate associations between low back pain (LBP) prognostic factors and time to first re-referral (hazard ratios) and total number of re-referrals (incident rate ratios) following discharge from care

Variable	Unadjusted HR (95% CI)	Adjusted HR (95% CI)	Unadjusted IRR (95% CI)	Adjusted IRR (95% CI)
Age	0.99 (0.97-1.01)	0.99 (0.97-1.02)	1.00 (0.98-1.02)	1.01 (0.99-1.03)
Sex				
F	Ref	1.00	Ref	1.00
M	1.29 (0.87-1.93)	1.07 (0.66-1.72)	1.23 (0.86-1.75)	1.05 (0.75-1.47)
Rank				
Officer	Ref	1.00	Ref	1.00
NCM	**1.67 (1.02-2.75)**	1.12 (0.65-1.95)	**1.76 (1.13-2.74)**	1.41 (0.92-2.15)
Senior NCM	1.40 (0.84-2.33)	0.95 (0.54-1.66)	1.34 (0.84-2.12)	0.95 (0.61-1.48)
Element				
Navy	Ref	1.00	Ref	1.00
Army	0.92 (0.60-1.40)	1.01 (0.61-1.67)	0.97 (0.66-1.42)	1.08 (0.75-1.54)
Air	0.98 (0.66-1.43)	0.78 (0.50-1.20)	0.94 (0.66-1.34)	0.80 (0.57-1.12)
Previous Hx of LBP				
< 1 year	Ref	1.00	Ref	1.00
1-5 years	1.35 (0.74-2.47)	1.66 (0.81-3.44)	1.64 (0.89-3.00)	1.98 (0.98-3.99)
5+ years	1.31 (0.73-2.32)	1.46 (0.72-2.97)	**1.85 (1.04-3.32)**	**2.06(1.03-4.10)**
Duration of Current Episode				
0-3 months	Ref	1.00	Ref	1.00
>3 months	0.98 (0.71-1.37)	**0.64 (0.44-0.91)**	1.22 (0.90-1.66)	0.87 (0.65-1.15)
Pain Score	**1.09 (1.02-1.17)**	1.04 (0.95-1.14)	**1.10 (1.03-1.17)**	1.03 (0.97-1.10)
Disability Score	**1.01 (1.01-1.02)**	1.00 (0.99-1.01)	**1.01 (1.01-1.02)**	**0**.99 (0.98-1.00)
TSK score	**1.05 (1.03-1.08)**	**1.05 (1.02-1.07)**	**1.05 (1.03-1.07)**	**1.04 (1.01-1.06)**
Leg pain				
No	Ref	1.00	Ref	1.00
Yes	1.29 (0.87-1.92)	0.74 (0.45-1.20)	1.22 (0.83-1.77)	0.80 (0.56-1.16)
Duty Status*				
Full duties	Ref	1.00	Ref	1.00
TCAT†	**1.45 (1.06-1.97)**	1.23 (0.84-1.80)	**1.60 (1.16-2.20)**	1.16 (0.87-1.54)
PCAT††	**1.81 (1.03-3.19)**	1.28 (0.70-2.35)	**2.72 (1.72-4.29)**	**1.79(1.16-2.76)**
Veterans Affairs				
No plan to apply	Ref	1.00	Ref	1.00
Unsure	**1.64 (1.08-2.49)**	1.36 (0.85-2.18)	**1.54 (1.05-2.28)**	1.14 (0.78-1.67)
Plan	**2.35 (1.59-3.48)**	**2.30 (1.46-3.62)**	**2.26 (1.61-3.16)**	**1.65(1.18-2.31)**
Pension for LBP	**1.67 (1.11-2.50)**	**1.76 (1.06-2.89)**	**1.89 (1.32-2.69)**	**1.44 (1.00-2.06)**
BMI‖>30 kg/m^2	1.07 (0.78-1.48)	1.09 (0.75-1.56)	1.07 (0.80-1.45)	0.96 (0.73-1.25)
Depression	**1.67 (1.10-2.54)**	1.07 (0.66-1.75)	**2.10 (1.47-3.01)**	1.29 (0.92-1.80)
PTSD¶	**2.38 (1.52-3.72)**	**1.73 (1.01-2.94)**	**2.70 (1.86-3.93)**	**1.69 (1.21-2.36)**
Previous treatment for LBP (# referrals)				
Low user	Ref	1.00	Ref	1.00
High user	**1.88 (1.36-2.60)**	**1.64 (1.13-2.37)**	**1.82(1.38-2.41)**	**1.58 (1.21-2.06)**

*for the purpose of the regression analysis, the variable Duty Status was condensed from a 5 factor variable to a 3 factor variable for ease of analysis: †TCAT (temporary category) for low back pain and TCAT for other conditions were combined, as were the two ††PCAT (permanent) categories. §other comorbidities not shown, but remainder were non-significant; ‖BMI = body mass index; ¶PTSD = post-traumatic stress disorder

Figure 3.3: Kaplan-Meier survival curve for time to re-referrals following discharge from back rehabilitation class

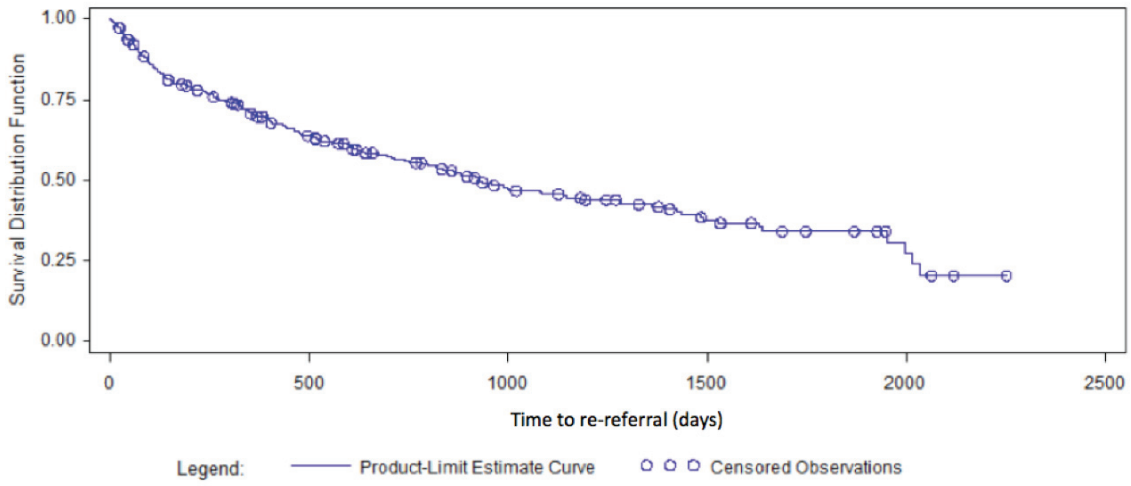


Table 3.3a: Descriptive statistics on participants that released from the military during follow up period, May 2007 to July 2013 (n=356)

Status at end of follow up	**% (n)**	
Released	19.7 (70)	(Deceased = 2; 1 on full duties, 1 on PCAT for back)
Active members	80.3 (286)	
Duty Status on release		**% Re-referred**
Full duties	35.7 (25)	16.0 (4)
PCAT - back	38.5 (27)	76.9 (21)
PCAT - other	25.7 (18)	50.0 (9)

Table 3.3b: The proportion of censored data (those who did not have a re-referral during the follow up period) for those who were still active Canadian Armed Forces members versus those who were released from the military by end of follow up period (July 31, 2013) % (n)

	Total (n=356)	**Active Member (n=286)**	**Released/Deceased (n=70)**	**p-value**
Re-referred	51.4 (183)	52.1 (149)	48.6 (34)	0.60
Censored	48.6 (173)	47.9 (137)	51.4 (36)	

CHAPTER 4: LOW BACK PAIN IN THE CANADIAN ARMED FORCES: THE ASSOCIATION OF PAIN-RELATED FEAR AND HEALTHCARE SEEKING

ABSTRACT

In military populations, low back pain (LBP) can have a significant impact on operational readiness and healthcare seeking. Costs of delivering musculoskeletal healthcare in the Canadian Armed Forces are rising, but the healthcare seeking patterns for LBP are not well understood. Psychosocial factors such as pain-related fear are not commonly recognized with the "sports medicine" approach to musculoskeletal care in this population. Pain-related fear has been identified as a LBP prognostic factor in disability and in future duty status in military populations, but its association with healthcare seeking in this population for recurrent and chronic LBP has yet to be examined.

We studied the characteristics of 356 Canadian Armed Forces members with recurrent or chronic LBP in a historical cohort to explore the independent association of pain-related fear and musculoskeletal healthcare seeking. We defined musculoskeletal healthcare seeking as services provided by a physiotherapist, chiropractor, osteopath, or acupuncturist. We used the validated questionnaire, the Tampa Scale for Kinesiophobia (TSK) to measure pain-related fear. We measured healthcare seeking in two ways: time to first re-referral and rate of re-referral over the period of follow up. We used hazard ratios (HR) to compare time to first re-referral to musculoskeletal care for those with high fear of movement/(re)injury relative to those with low fear of movement/(re)injury. We used incidence rate ratios (IRR) to compare the corresponding rates of re-referral. Univariate and multivariate analyses examined the associations of *a priori* chosen factors, based on a theoretical framework, and musculoskeletal healthcare seeking.

One hundred eighty-three (51.4%) participants had at least one re-referral during the follow up period following discharge. Within six months of discharge from the back rehabilitation class, 12.0% of the low TSK group and 27.5% of the high TSK group had been re-referred to musculoskeletal services with a low back complaint. Within a year of discharge from the back rehabilitation class, 22.7% of the low TSK group and 37.1% of

the high TSK group had been re-referred for LBP (Log rank test $p < 0.0001$). When controlling for confounders, there was a 5% higher probability of being re-referred to musculoskeletal care for every one point increase in TSK score at any point in time during follow up period (HR 1.05; 95% CI 1.02-1.08). For our second outcome, for every one-point increase in TSK score, there was a 4% higher rate of re-referral (IRR 1.04; 95% CI 1.01-1.06) to musculoskeletal services.

The results of this confirmatory prognostic study indicate that pain-related fear is associated with healthcare seeking for recurrent and chronic LBP in a military population, with and without controlling for potential confounders. This adds to the research that recommends considering psychosocial factors in clinical practice in a military population. Further research on military populations using the same factors and outcome would be useful to replicate the results obtained here.

4.1 INTRODUCTION

Low back pain (LBP) is a leading cause of disability internationally (5). In the Canadian Armed Forces, LBP can have a significant impact on operational readiness and healthcare seeking. LBP is the most commonly seen musculoskeletal condition in the Canadian Armed Forces (30,45). There has been an increase in the number of referrals for musculoskeletal care, such as physiotherapy and chiropractic, over the past five years, while healthcare seeking for other services in this population has remained stable (12). Access to health care is easily accessible during military work hours and is the same for all personnel. Therefore factors that may influence the decision to seek care for recurrent and chronic LBP are important to policy makers and clinicians as they try to manage resources.

Patients' pain-related fear may be associated with their decision to seek care for their LBP. Main and colleagues summarized that "those who believed more strongly that pain means they should avoid physical activity and abandon normal roles report higher levels of disability than those with opposite beliefs, and are thus more likely to consult, re-consult, and use further health services" (39). The theoretical framework explaining the construct of pain-related fear is the fear-avoidance model and its influence on LBP outcomes. The fear-avoidance model for LBP was introduced by Vlaeyen and colleagues in 1995 (46), and postulates that for individuals experiencing an episode of LBP, the manner by which they interpret their pain experience (non-threatening perception vs. pain catastrophizing), and how they subsequently behave in relation to this interpretation (confrontation versus avoidance), can lead to two different pathways of recovery (47). Although protective withdrawal from pain may be prudent in the short-term management of LBP, it may actually act as a barrier to recovery in the long term (47). A review article on the fear-avoidance model speculates that fearful LBP patients may be more likely to look for biomedical explanations for their symptoms, and for passive coping strategies for pain relief rather than the restoration of functional activities (32). When considering the recurrent and chronic nature of LBP, where up to 80% of individuals still have pain after one year (24,28), those patients who focus on pain resolution rather than the management of a recurrent condition may be heading for a cycle of disuse and dependence on healthcare practitioners.

Researchers have studied several psychological constructs in relation to the fear-avoidance model, such as pain-related fear, fear avoidance beliefs, fear of movement/(re)injury, and kinesiophobia. Although some of these constructs are often used interchangeably in the literature (32,48,77,78), Lundberg and colleagues have attempted to identify them as separate constructs (79). When looking at the different conceptual definitions, *pain-related fear* can be used as an umbrella construct that incorporates fear of pain, fear of injury, fear of work, and fear of physical activity – all stimuli that can be perceived as a threat (32,79). Therefore, for the remainder of this paper, we will use the terms pain-related fear, and fear of movement/(re)injury as related constructs in reference to the conceptual fear-avoidance model.

LBP is primarily managed in the Canadian Armed Forces using a "sports medicine" approach based on a biomedical model, but the psychosocial factor, pain-related fear, may have relevance in this population. Firstly, military members must pass an annual fitness test and maintain deployable status, and their LBP may interfere with their ability to do so. Secondly, the military follows a hierarchical rank system where subordinates take orders from their superiors, with little autonomy to refuse a task if in pain. Thirdly, there is a higher rate of musculoskeletal injury compared to the general population (11), with the most frequent causes of injury being sports and physical training (12,80). Lastly, this population has a high ease of access to multiple healthcare providers, various investigations and treatment options, which may leave the patient with a variety of biomedically-based messages to interpret regarding their condition (39,81). Considering these factors, and the call for more research on psychosocial prognostic factors in military populations (37,38), pain-related fear is an important factor to study in this population.

Studies have found an association between pain-related fear and various outcomes in the general population: greater perceived disability (33,78,82), increased duration of work restrictions in working populations (83,84), and more frequent recurrence of care-seeking (24,72,73). Pain-related fear has been identified as a LBP prognostic factor associated with disability and future duty status due to LBP in military populations (37,38), but its association as a prognostic factor in healthcare seeking for recurrent and chronic LBP in a military population has yet to be examined. The objective of this study

is to explore the independent association between pain-related fear and musculoskeletal healthcare seeking for LBP in Canadian Armed Forces personnel with recurrent or chronic LBP.

4.2 METHODS

Our sample consisted of 356 Canadian Armed Forces personnel with recurrent or chronic LBP who sought care for their condition and who were enrolled in a 6-week physiotherapy-led back rehabilitation class at Canadian Forces Base Halifax from May 2007 to December 2012 as part of their care. We included personnel between the ages of 19-55 years, who were working in either full or modified duty status at the time of participation in class. LBP was defined as pain between the 12^{th} rib and gluteal fold +/- intermittent pain down one leg to the knee (14). We excluded those who had constant pain below the knee into one or both legs with or without neurological deficits, any signs of serious pathology (red flags), confirmed pregnancies, and anyone referred with a first episode of LBP of less than 12 weeks duration (acute). Individuals must have completed the pre-assessment and been subsequently enrolled in the class. Details of the data collection and linkage, and methods of how we handled missing data are described in detail in Chapter 3. Ethics approval was received from Dalhousie University Ethics Review Board.

4.2.1The measurement of pain-related fear

In this confirmatory analysis (66), our independent prognostic factor of interest was pain-related fear. We used the Tampa Scale of Kinesiophobia (TSK) to measure fear of movement/(re)injury under the umbrella construct of pain-related fear (67). The TSK is said to have close construct redundancy (measurement association) with the Fear Avoidance Beliefs Questionnaire (FABQ) (79,85). The TSK is considered the best measure of kinesiophobia (79) and is used as a tool to quantify fear of movement/(re)injury (48,77,78) and pain-related fear (86). Its subscales represent maladaptive interpretations of pain and cognitions about fear-avoidance behavior. The most recent consensus testing the psychometric properties of the TSK recommends using a 2-factor (17-item) model, with the subscales of *somatic focus* (reflecting the belief that

there is something seriously wrong with the body), and *activity avoidance* (reflecting the belief that avoiding exercise or activity may prevent an increase in pain) (48,78,84). Each item is scored on a 4-point Likert scale. Total scores range from 17 to 68, with higher scores reflecting a higher fear of movement/(re)injury. The TSK-17 has been shown to have good reliability with a α of between .77 and .81 (46,79,85,86).

Most studies that have looked at the psychometric properties of this tool have used the TSK as a continuous variable (77,85,87,88). There are also two commonly used methods for dichotomizing the TSK score. Some studies use Vlaeyen's cut point of 37 to distinguish between high and low TSK score (46,89). Others use their own median TSK from their sample as the cut point (78). There are disadvantages to dichotomizing a continuous variable: 1) a consensus on the optimal cut point score may be difficult to reach (90); 2) an accepted value for a cut point score may change over time, making the results of an earlier study useless (91); and 3) there may be valuable loss of information once the variable is dichotomized rather than leaving it in its continuous form (91). Vlaeyen's original cut point of 37 was proposed nearly 20 years ago and was based on the median of his sample at the time (46). Vlaeyen's rationale for using 37 as a cut point was, as of 2000, "norm data are not yet available and there are no cut off points indicating clinically relevant levels of fear avoidance" (92). In subsequent studies, he and his colleagues used both a different sample median score of 40 (93) and TSK score broken into tertiles (82). There is no consistent consensus on what the ideal cut point score is for the TSK (79). Therefore, we used the TSK score both as a continuous variable and dichotomized. In our descriptive analysis, we used it as a dichotomous variable with the observed mean score from our study population as a cut point for high and low fear of movement/(re)injury. In our multivariate regression analyses, we analyzed TSK continuously with higher scores representing a high fear of movement/(re)injury, and also present results dichotomized for interpretability and comparison with other study results.

4.2.2 Potential confounders

Confounders are extraneous variables that are associated with the prognostic factor of interest, are independent risk factors for the study outcome, and are not along the causal pathway between the main prognostic factor of interest and the outcome. Along

with empirically testing the univariate associations with TSK score and with healthcare seeking, it was also important to include potential confounders that were theoretically based and/or have been seen previously in other research (94). Variables selected for their possible confounding effect from existing baseline characteristics from clinical records of the sample were: Baseline functional ability score (Roland Morris Questionnaire/ Oswestry), pain severity, as measured by the 11 point (0-10) numeric rating scale, sex, military rank, military duty status at baseline, presence of intermittent leg pain, and duration of current episode (period of pain in the low back lasting more than 24 hours, preceded and followed by a period of at least one month without LBP (69)). We collected the following information from electronic health records for their potential confounding effect: Age at time of participation in class, previous physiotherapy /chiropractic/ osteopathy/ acupuncturist treatment, Veterans Affairs Compensation (VAC) status and comorbidities at baseline**.** We were primarily interested in longstanding co-existing conditions such as major depression or post–traumatic stress disorder (PTSD) and other chronic musculoskeletal complaints such as knee or neck pain. We collapsed chiropractic, osteopathy, and acupuncturist treatment into previous chiropractic treatment, as the number of osteopathy and acupuncturist referrals was minimal (< 2%). Fig 4.1 outlines a framework of our association of pain-related fear and healthcare seeking, and the potential confounders chosen for this study.

4.2.3 Outcome measures

Our main outcome variable is musculoskeletal healthcare seeking. We collected this information from electronic administrative health records. The follow up period for healthcare seeking was from time of clinical discharge to either July 31, 2013 or date of release from the military, whichever occurred first. We measured musculoskeletal healthcare seeking in two ways: 1) Time to first re-referral of subjects for LBP to a musculoskeletal healthcare provider eligible for coverage under Canadian Armed Forces scope of care following discharge from the back rehabilitation class. This includes physiotherapy, chiropractic, osteopathy, and acupuncturist; and 2) The rate of re-referrals to a musculoskeletal healthcare provider for LBP following discharge.

4.2.4 Statistical Analysis

We described our study sample, comparing the characteristics of subjects with high and low fear of movement/(re)injury at baseline. Following other studies/recommendations, we used a mean score of 40/68 as a cut point between high and low TSK and conducted a sensitivity analysis using Vlaeyen's originally proposed cut point of 37/68. We expressed continuous variables using means and standard deviations, or medians and ranges if they did not follow a normal distribution. We expressed dichotomous and categorical variables as proportions. We looked at the univariate associations between pain-related fear and other variables, using t-tests for continuous variables and chi-squared tests for categorical variables.

Time to first re-referral

We used Kaplan Meier survival curves to look at the univariate association between high and low fear of movement/(re)injury and the time to first re-referral, accounting for censored data. We looked at the strength of the association using the log rank test. We reported the proportion of subjects that had a re-referral for LBP and the proportion that were 'censored' (either released from the military before a re-referral occurred or remained in the military and did not have a re-referral by the end of the study follow up period). We explored the difference between those who were released and those who remained in the military in the proportion of censored observations, using chi-squared tests. We performed univariate analysis of each variable with time to first re-referral, using a Cox proportional hazards model to produce hazard ratios (HR). In multivariate analyses, we included prognostic factors that were considered potential confounders in the relationship between pain-related fear and healthcare seeking, firstly because of a statistically significant association in univariate analyses with TSK score and with outcome, and added theoretically chosen factors that were considered potential confounders but did not show a statistically significant association in univariate analysis with both TSK score and outcome.

Rate of re-referrals

We used negative binomial regression to explore the association of fear of movement/(re)injury, measured with TSK and rate of re-referrals to physiotherapy and/ or chiropractic care within the follow up period, expressed as incidence rate ratios (IRR) in univariate and multivariate analyses. We used the total follow up time available as the offset variable, which lets the data be expressed as a rate instead of a count. This was important in our study because subjects were followed up for different periods following clinical discharge.

4.2.5 Power calculation

In this study, we had a fixed sample size of 356 participants from the back class. Using our best estimates for our main prognostic factor and outcome of interest, where half of the sample has a re-referral, we had approximately 78-90% power to detect a HR of between 1.4-1.5 in time to first re-referral between subjects with high and low TSK using a mean score of 40 as the cut point. In our multivariate analysis, TSK was entered into the model as a continuous variable, which increased the power. We chose 17 variables to enter into the multivariate model, which fits the rule of thumb of 10 events per variable (EPV) for our 183 re-referrals, or, in this case where we had over 50% of sample with an event, 1-EPV. A second check that we have enough power will be to look at the convergence of the proportional hazards multivariate model (94).

All statistical analyses were conducted using Statistical Analysis System (SAS 9.2) software. Our power calculation was conducted using PS: Power and Sample Size program.

4.3 RESULTS

4.3.1 Descriptive Statistics

Three hundred fifty-six patients were included in our study. Figure 4.2 describes the identification of study participants. The mean age was 41 years, 81% of the sample was male, 66% were Navy personnel, and 73% had chronic LBP (current episode of LBP > 12 weeks). The median time available for follow up was 1182 days (range 22-2253 days).

During the follow up period, 70 members (19.7%) released from the military There was no significant difference in the proportion of censoring between actively serving members and released members ($p = 0.60$).

Approximately 87% of the sample completed the program, with 3.1% of the sample unable to complete due to operational requirements or unrelated medical issue, and 9.5% of the sample dropped out for unexplained reason. Completion status of program was not associated with TSK score ($p = 0.28$), nor did it have a bearing on time to first re-referral ($p = 0.69$) or total number of re-referrals ($p = 0.72$) in univariate analysis.

Table 4.2 compares baseline characteristics for participants with high and low TSK scores. Those with a higher fear of movement/(re)injury were more likely to be male, and to have a higher level of pain, higher level of disability, longer duration of pain (> 12 weeks), intermittent leg pain, and a concurrent diagnosis of PTSD. They were also more likely to have seen more than one type of musculoskeletal healthcare provider, to have a greater number of imaging studies for their low back, be on modified duty status for their low back, and be involved with Veterans Affairs compensation. Our sensitivity analysis using a dichotomous cut point of 37 to distinguish between high and low TSK scores resulted in the same variables showing a statistically significant association for each univariate analysis, at the 0.05 level of significance.

4.3.2 Pain-related fear and "time to first re-referral"

Within six months of discharge from the back rehabilitation class, 12.0% of the low TSK group and 27.5% of the high TSK group had been re-referred to musculoskeletal services with a low back complaint. Within a year of discharge from the back rehabilitation class, 22.7% of the low TSK group and 37.1% of the high TSK group had been re-referred for LBP (Log rank test $p < 0.0001$). Figure 4.3 shows the Kaplan-Meier survival curve of the unadjusted time to first re-referral for high and low TSK subgroups. Conditions for proportional hazards assumption were satisfied by taking the log-negative-log of the survival curve in order to test for proportionality over time.

Table 4.2 reports the unadjusted and adjusted hazard ratios for time to first re-referral in our sample. TSK score remained a statistically significantly associated with time to first re-referral when controlling for identified confounders (HR 1.05; 95% CI

1.02-1.08). For ease of interpretation of results, we conducted a secondary analysis, using TSK as a dichotomous variable, with a cut point of 40. There was a 62% higher probability of being re-referred at any point in time during follow up for those with a high vs. low TSK score (HR 1.62; 95% CI 1.14-2.31). There was convergence of the proportional hazards model, which means the model had enough events with the study's sample size to solve the multivariate equation (94).

4.3.3 Pain-related fear and "rate of re-referrals"

Table 4.4 presents both the unadjusted and adjusted incidence rate ratios for the rate of re-referrals to musculoskeletal services following clinical discharge. TSK score was a statistically significant prognostic factor of rate of re-referrals following clinical discharge when controlling for covariates (IRR 1.04; 95% CI 1.01-1.06). Using TSK as a dichotomous variable, there was a 40% higher rate of re-referrals for those with high TSK scores compared to those with low TSK scores (IRR 1.40; 95% CI 1.07-1.84).

4.3.4 Sensitivity Analysis

When comparing the results of multivariate proportional hazards regression and negative binomial regression models for the completed case and imputed datasets, we observed that TSK score remained statistically significantly independently associated with both outcomes when controlling for potential confounders.

4.4 DISCUSSION

Our study found that pain-related fear, using the construct of fear of movement/(re)injury, was independently associated with musculoskeletal healthcare seeking for Canadian Armed Forces personnel with recurrent or chronic LBP. In univariate analysis, those with a higher fear of movement/(re)injury had a probability of being re-referred more than two times as quickly as those with low fear of movement/(re)injury within a 6 month period following discharge from a back rehabilitation class. Fear of movement/(re)injury remained a statistically significant prognostic factor for time to first re-referral and repeated rate of re-referrals to musculoskeletal services when controlling for other psychological, social and clinical

factors. For every one-point change in TSK score, there was a 5% increase in likelihood of the patient being re-referred for musculoskeletal care at any given time. In clinical interpretations, for example, a patient with a score of 47 on their TSK would have a $1.05^{12} = 1.80$, and therefore an 80% more likelihood of being re-referred back to care at any given time than someone with a TSK score of 35, when controlling for other factors. Using the TSK score as a dichotomous variable, it remained statistically significant in multivariate analysis. To our knowledge, this is the first longitudinal study that looks at pain-related fear and healthcare seeking for recurrent and chronic LBP in a military population. Our findings are consistent with studies from the general population that found an association between pain-related fear and healthcare seeking. (24,72,73).

It is difficult to ascertain whether our sample's recurrent healthcare seeking for physiotherapy or chiropractic services is higher compared to the general population, since the healthcare systems and access to these services vary widely across countries and general and military populations, with most studies reporting on consultations with doctors and other medical professionals as well as physiotherapists or chiropractors. One population based cohort study on members of a large non-profit group insurance plan in the US reported that 24.1% of their sample had a re-referral to a physiotherapist or an occupational therapist for a LBP episode within a two-year period (55). Although chiropractic care was eligible in this group health plan it was not reported. This appears much lower usage than in our sample, but with different restrictions on access to musculoskeletal care, different definitions of consultation, and different populations, it makes it impossible to directly compare.

This study has several strengths. We used validated questionnaires, and systematically recorded objective measurements for our prognostic factor of interest and covariates. Our outcomes were objectively measured from administrative health records. Loss to follow up was accounted for with censoring in our proportional hazards analysis. There was very little missing data. Our sample was comprised of a relatively homogeneous group of predominantly male military personnel, working in full or modified duties, with non-acute LBP, and fit enough to participate in an active rehabilitation program. Our results may be generalizable to other military populations seeking care for recurrent or chronic LBP. For example, the mean TSK score of 40 and

mean age of 41 in our predominantly Navy sample was more comparable to the Netherlands Army cohort with recurrent and chronic LBP (TSK 38.0 ± 7.1; age 39 ± 10 years) (38) than to the US Navy and Marine cohort of younger, more acute presentation of LBP (TSK 21.9 ± 6.4; age 32.3 ± 7.9 years (37). However, it would be useful to conduct a study on various military bases in Canada to confirm a wider applicability of our results. We used a core set of prognostic factors recommended from the literature (59), adapting some measures for the military (ie. military rank to represent socioeconomic status). This will allow the results of our study to be pooled with others in future meta-analyses. Unlike other studies, which capture healthcare seeking from self-report (73), we were able to access administrative records for this information. Therefore, we had objective outcome measurement, and loss to follow up was not a factor in our study.

However, this study should be considered in light of several limitations. Firstly, the participant data was originally collected for clinical purposes. We were unable to retrospectively capture those who were referred to but decided not to participate in the back class for a particular reason, such as too busy at work or reluctant to exercise. Secondly, we did not include those with more severe symptoms and could not participate in an active rehabilitation program. Therefore, our results may be an underestimation of health service use for a subgroup of those seeking care. Thirdly, all of our participants had undergone a cognitive-behavioural program through the Back Class that addresses pain-related fear, but the intervention itself was not a focus of the study. It is unclear if those with a high pain-related fear would seek more or less musculoskeletal care had they not participated in such an intervention. A prospective multisite cohort study, including all individuals presenting for musculoskeletal services and using the same covariates, would be useful to confirm the results obtained here. A fourth limitation could be that, in this historical cohort, TSK was the only psychological questionnaire used clinically to measure pain-related fear. It may have been useful to have other constructs such pain catastrophizing or self-efficacy to explore this population, as another measure of psychological distress, but they were not captured in this sample. However, a recent confirmatory factor analysis concluded that there is a "considerable conceptual overlap" among psychological measures used in LBP research (95). Pain-related distress is the

factor common to all of these measures, including fear-avoidance, pain catastrophizing, self-efficacy, and depression. Finally, we were unable to capture other factors such as heavy physical workload and job satisfaction. Therefore, the potential confounding effect of these social factors in relation to our measured factors is unknown, and may have affected the independent association between pain-related fear and healthcare seeking. Our results are not generalizable to the general population, due to the different access to healthcare and unique social characteristics of the military environment.

Our finding of fear of movement/(re)injury as a prognostic factor in recurrent healthcare seeking is in line with recent military studies that consider pain-related fear as a prognostic factor of other LBP outcomes, using related constructs. One study on US military personnel looked at members presenting for treatment with acute LBP (< 12 weeks) and their subsequent military duty status (37). They found that fear avoidance beliefs were associated with 'not at full duty' at 4 weeks and at 12 weeks follow up in multivariate analysis. A second study on a cohort from the Royal Netherlands army with chronic LBP determined that fear of movement was a significant prognostic factor of self-reported improvements in LBP complaints, both in the immediately post treatment and at 6 months follow up (38).

There are several implications of our findings. A military report recently highlighted the impact of not properly addressing musculoskeletal conditions in the Canadian Armed Forces – suggesting that it could contribute to a potential increase in severity of symptoms, decrease in operational readiness, increase in compensation claims and medical releases, and increase in healthcare costs (11). In a military population, where health resources are easily accessible and free of charge, clinicians should be cognizant of the wider psychosocial factors that affect the rate of healthcare seeking for a recurrent condition such as LBP. This study found an independent association between pain-related fear and healthcare seeking, and provides evidence that this factor should be explored further in larger independent studies on this population. Further prognostic research could explore the pathways by which pain-related fear interacts with other prognostic factors in relation to healthcare seeking in this population. Future experimental research in a military population should also focus on whether pain-related fear is modifiable with cognitive-behavioural interventions such as the program in this study, and if so, whether

this type of program results in more effective management of recurrent and chronic LBP and more efficient use of healthcare resources.

4.5 CONCLUSION

The importance of cognitions and behaviours in LBP is an emerging area of the field of prognostic research. Our findings highlight an independent and positive association between pain-related fear and musculoskeletal healthcare seeking in a military population. Further research is required to replicate these results in similar confirmatory studies in this population.

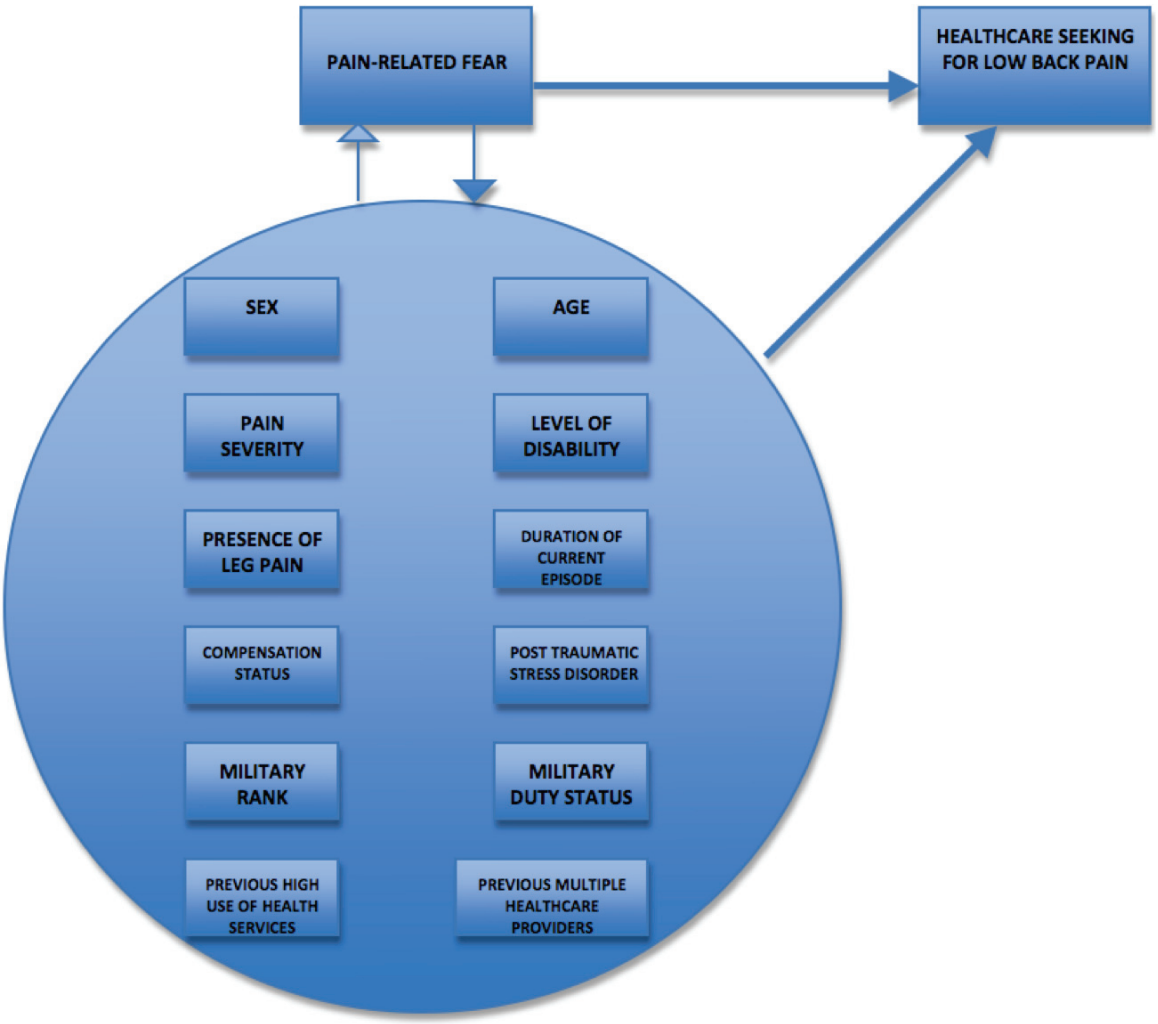


FIGURE 4.1: Confirmatory framework testing the relationship between pain-related fear and musculoskeletal healthcare seeking in the Canadian Armed Forces, controlling for potential confounders

Figure 4.2: Flow diagram of eligible participants in cohort study in Canadian Armed Forces members who sought care for recurrent or chronic low back pain from May 2007 to December 2012

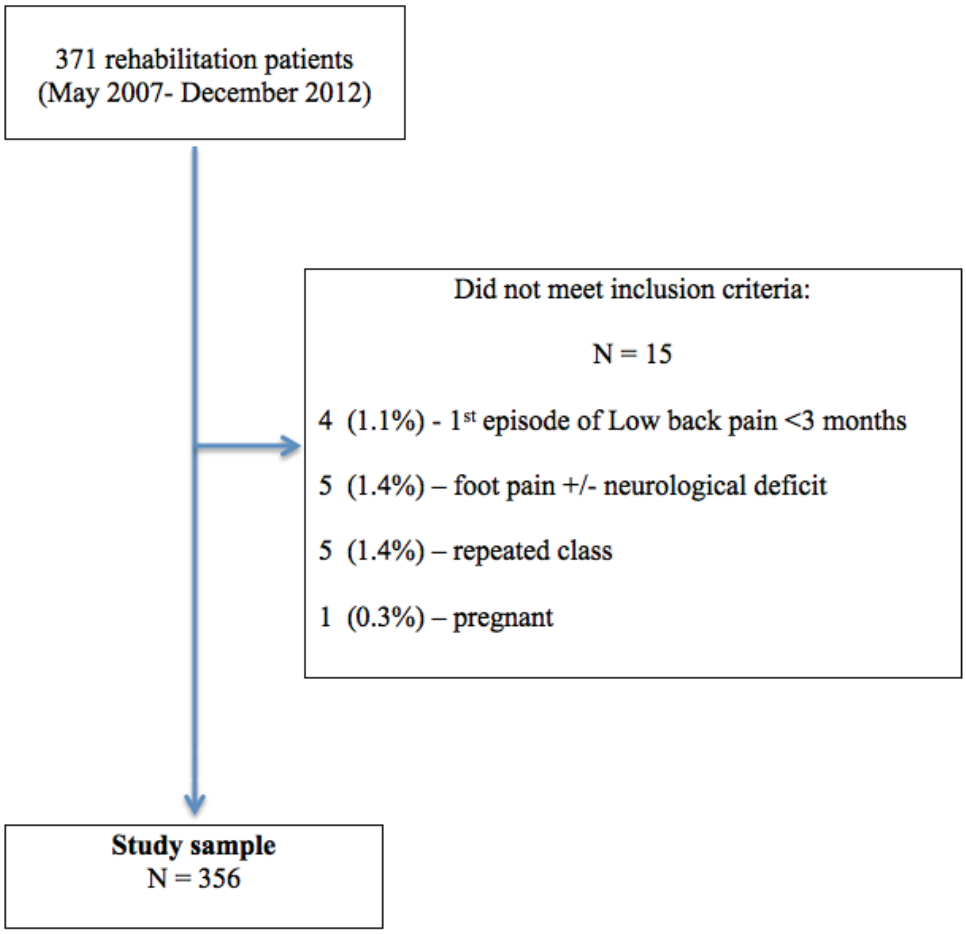
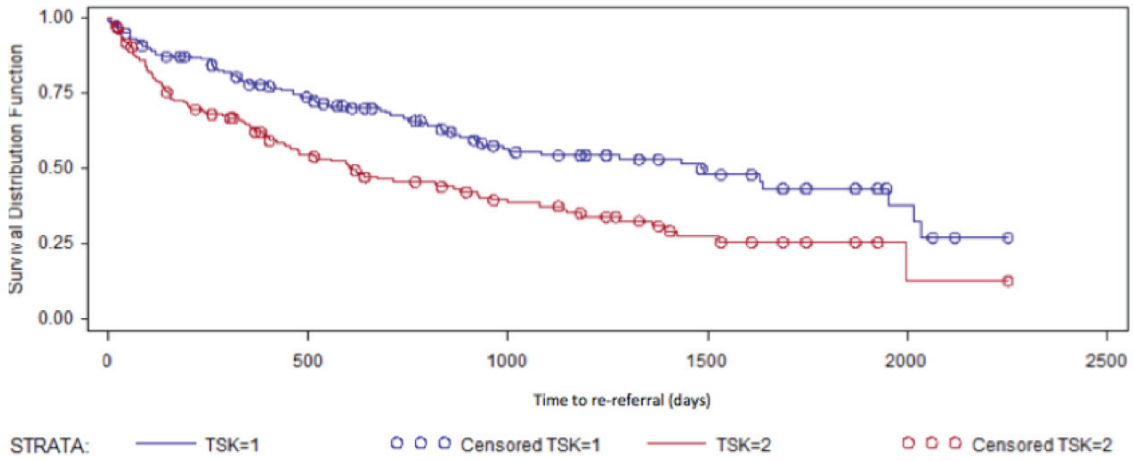


Figure 4.3: Kaplan-Meier survival curve for time to re-referral following discharge from back rehabilitation class, by high and low TSK score (high pain-related fear ≥ 40 TSK)



Log rank test p < 0.0001

TSK=1 Low TSK (<40)
TSK=2 High TSK (≥40)

Table 4.1: Baseline characteristics of study participants for those with high and low fear avoidance beliefs (high defined as >40 points on the TSK score). Participants were attendees at a back rehabilitation class from 2007-2012.

	Total	Low TSK	High TSK
Age, in years	41 (7.4)	41 (40.1-42.5)	41 (39.8-41.8)
Pain Score *** (1-10 Numeric rating scale)	4 (2.2)	3.5 (3.2-3.8)	4.6 (4.3-4.9)
Disability Score (0-100%)***	27.9 (17.7)	20.9 (18.7-23.1)	34.3 (31.8-36.9)
Sex (% Male) **	81.4 (290)	44.5	55.5
Rank (%)*			
NCM†	47.2 (168)	42.9	57.1
Senior NCM	38.8 (138)	48.5	51.5
Officer	14.0 (50)	60.0	40.0
Element (%)			
Navy	65.5 (233)	48.5	51.5
Air force	18.5 (66)	39.4	60.6
Army	16.0 (57)	52.6	47.4
History of LBP (%)			
<1 year	8.8 (31)	41.9	58.1
1-5 years	31.3 (141)	48.2	51.8
>5 years	59.9 (211)	47.4	52.6
Duration of Current Episode (%)**			
0-12 weeks	27.0 (93)	58.1	41.9
> 12 weeks	72.9(251)	42.6	57.4
Presence of leg pain (%)***			
N	85.9 (305)	50.2	49.8
Y	14.1 (50)	30.0	70.0
Duty Status at end of class (%)**			
Full duties	58.2 (207)	55.6	44.4
TCAT	33.4 (119)	37.0	63.0
PCAT	8.4 (30)	33.3	66.7
Number of investigations (%)**			
0	15.9 (55)	63.6	36.4
1	39.1 (135)	49.6	50.4
2	34.5 (119)	39.5	60.5
3	10.4 (36)	36.1	63.9
VAC‡(%)***			
No plan to apply	46.8 (162)	56.2	43.8
Unsure	14.7 (51)	45.1	54.9
Plan to apply	20.2 (70)	41.4	58.6
Receiving pension for LBP	18.2 (63)	34.9	65.1
Comorbidities (% Yes)§			
Chronic musculoskeletal	51.4 (183)	47.5	52.5
Depression	12.1 (43)	37.2	62.8
PTSDII **	7.3 (26)	26.9	62.8
Anxiety	5.6 (20)	35.0	65.0
BMI >30 kg/m²¶	27.8 (99)	50.5	49.5
Previous treatment for LBP (# referrals)			
Low user	74.2 (248)	47.6	52.4
High user	25.8 (86)	41.9	58.1
Previous healthcare providers*			
Physiotherapist only	55.3 (187)	51.3	48.7
Physiotherapist and chiropractor	44.7 (151)	39.7	60.3

†NCM – Non-commissioned member of Canadian Armed Forces

‡VAC – status on application of Veteran's Affairs compensation for a low back condition

§ Comorbidities – other comorbidities, such as hypertension, substance abuse, COPD, and diabetes had numbers less than 5 in their cells, and hence are not reported for the comparison between low and high TSK score.

IIPTSD – Post Traumatic Stress Disorder, ¶ BMI – Body Mass Index

* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

All variables remained at the same level of significance when using Vlaeyen's cut point of 37 for high/low TSK

Table 4.2: Univariate and multivariate associations between TSK score (controlling for potential confounders) and time to 1st re-referral following discharge from the back rehabilitation class (n=356)

Variable	Unadjusted HR† (95% CI)	Adjusted HR (95% CI)
TSK‡ score	1.05 (1.03-1.08)***	1.05 (1.02-1.08)***
Age	0.99 (0.97-1.01)	0.98 (0.96-1.01)
Sex (Referent = Female)	Ref	1.00
Male	1.29 (0.87-1.93)	1.03 (0.65-1.62)
Rank		
Officer	Ref	1.00
Non-commissioned member	1.67 (1.02-2.75)**	1.07 (0.62-1.86)
Senior non-commissioned member	1.40 (0.84-2.33)	0.98 (0.56-1.70)
Duration of Current Episode		
0-3 months	Ref	1.00
>3 months	0.98 (0.71-1.37)	0.66 (0.46-0.94)**
Pain Score (0-10 Numeric rating scale)	1.09 (1.02-1.17)***	1.02 (0.93-1.12)
Disability Score (0-100%)	1.01 (1.01-1.02)***	1.00 (0.99-1.01)
Leg pain		
No	Ref	1.00
Yes	1.29 (0.87-1.92)	0.71 (0.44-1.15)
Duty Status§		
Full duties	Ref	1.00
TCAT	1.45 (1.06-1.97)	1.23 (0.85-1.79)
PCAT	1.81 (1.03-3.19)	1.26 (0.69-2.30)
Veteran's Affairs		
No plan to apply	Ref	1.00
Unsure	1.64 (1.08-2.49)**	1.48 (0.93-2.36)
Plan	2.35 (1.59-3.48)***	2.44 (1.56-381)***
Pension for LBP	1.67 (1.11-2.50)**	1.77 (1.09-2.89)**
Depression	1.67 (1.10-2.54)**	------
PTSDǁ	2.38 (1.52-3.72)***	1.77 (1.09-2.90)**
Previous treatment for LBP (# referrals)		
Low user	Ref	1.00
High user	1.88 (1.36-2.60)***	1.42 (0.99-2.04)
Previous treatment for LBP: Healthcare providers		
Physiotherapist only	Ref	1.00
Physiotherapy and chiropractor	1.62 (1.20-2.18)***	1.82 (1.27-2.60)***

†HR = Hazard ratio; CI = Confidence interval; ‡TSK = Tampa Scale For Kinesiophobia; ǁPTSD = Post-traumatic stress disorder

§for the purpose of the regression analysis, the variable Duty Status was condensed from a 5 factor variable to a 3 factor variable for ease of analysis: TCAT (temporary category) for low back pain and TCAT for other conditions were combined, as were the two PCAT (permanent) categories

* p < 0.10 ** p < 0.05 *** p <0.01

Sensitivity analysis with Depression included in the model – PTSD became non-significant (p=.07) and Depression was not significant (p=.53)

Table 4.3: Univariate and multivariate associations between TSK score (controlling for potential confounders) and rate of repeated re-referrals following discharge from the back rehabilitation class (n=356)

Variable	Unadjusted IRR† (95% CI)	Adjusted IRR: (95% CI)
TSK score‡	1.05 (1.03-1.07)***	1.04 (1.01-1.06)***
Age	1.00 (0.98-1.02)	1.01 (0.99-1.03)
Sex Female	Ref	1.00
Male	1.23 (0.86-1.75)	0.99 (0.72-1.38)
Rank		
Officer	Ref	1.00
Non-commissioned member	1.76 (1.13-2.74)**	1.39 (0.91-2.13)
Senior non-commissioned member	1.34 (0.84-2.12)	0.95 (0.61-1.46)
Duration of Current Episode		
< 12 weeks	Ref	1.00
12+ weeks	1.22 (0.90-1.66)	0.88 (0.67-1.17)
Pain Score	1.10 (1.03-1.17)***	1.02 (0.96-1.09)
Disability Score	1.01 (1.01-1.02)***	0.99 (0.98-1.00)
TSK score‡	1.05 (1.03-1.07)***	1.04 (1.01-1.06)***
Leg pain		
No	Ref	1.00
Yes	1.22 (0.83-1.77)	0.84 (0.58-1.21)
Duty Status§		
Full duties	Ref	1.00
TCAT	1.60 (1.16-2.20)***	1.13 (0.85-1.50)
PCAT	2.72 (1.72-4.29)***	1.70 (1.11-2.61)**
Veteran's Affairs		
No plan to apply	Ref	1.00
Unsure	1.54 (1.05-2.28)**	1.36 (0.93-1.98)
Plan	2.26 (1.61-3.16)***	1.85 (1.31-2.60)***
Pension for LBP	1.89 (1.32-2.69)***	1.54 (1.07-2.21)**
Comorbidities	(No=ref)	
Depression	2.10 (1.47-3.01)***	----
PTSD‖	2.70 (1.86-3.93)***	1.88 (1.37-2.59)***
Previous treatment for LBP (# referrals)		
Low user	Ref	1.00
High user	1.82 (1.38-2.41)***	1.35 (1.03-1.77)**
Previous treatment for LBP: healthcare provider		
Physiotherapist only	Ref	1.00
Multiple providers	1.74 (1.30-2.33)***	1.50 (1.15-1.97)***

†IRR = Incident rate ratio; CI = Confidence interval; ‡TSK = Tampa Scale For Kinesiophobia; ‖PTSD = Post-traumatic stress disorder §for the purpose of the regression analysis, the variable Duty Status was condensed from a 5 factor variable to a 3 factor variable for ease of analysis: TCAT (temporary category) for low back pain and TCAT for other conditions were combined, as were the two PCAT (permanent) categories. Sensitivity analysis with Depression included in the model yielded the same statistically significant predictors, and Depression was not significant at $\alpha = 0.05$

* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

CHAPTER 5: CONCLUSION

5.1 SUMMARY OF FINDINGS

The Surgeon General of Canada has called for a renewed focus on health research in order to make our services more efficient and effective. The demand for healthcare resources in the Canadian Armed Forces has been rising over the last five years (12), and musculoskeletal conditions comprise the majority of healthcare visits (30). LBP is the most common musculoskeletal condition seen in military populations (44,45), but the patterns of musculoskeletal healthcare seeking for recurrent and chronic LBP in this population has not yet been examined. Nearly three quarters of our sample had chronic LBP, and 60% had been dealing with their LBP for over 5 years, either on a recurrent or chronic basis. The focus of this study was on how often these military members were accessing care for their recurrent or chronic condition over time, and to explore the characteristics of those who were accessing musculoskeletal care for their LBP at a high rate.

In our study, we observed a high level of repeated musculoskeletal healthcare seeking for recurrent and chronic LBP, with 51.4% of the cohort re-referred to musculoskeletal care within the follow up period. Approximately 20% of the sample had been re-referred within the first six months following discharge from care, and 30% re-referred within one year. The rate of re-referrals was an interesting finding as well: approximately 10% of the sample had been repeatedly re-referred to musculoskeletal services between three to eight times within the available follow up, which ranged from a two to five year period. Our results are similar to research from the general population that reports approximately 10-20% of those with LBP consume the majority of care for the condition (15).

5.1.1 Exploratory analysis

This study was the first to explore the relationship between biopsychosocial prognostic factors for LBP and musculoskeletal healthcare seeking in those with recurrent and chronic LBP in the Canadian Armed Forces. This is important, as it is the first look at

LBP in this relatively young and active population from more than the traditional biomedical perspective, and highlights that recurrent and chronic LBP may be multifactorial in nature, as in the general population. Our first study identified several factors associated with repeated healthcare use: fear of movement/(re)injury, previous high use of musculoskeletal services, concurrent diagnosis of PTSD, and Veterans Affairs compensation status were factors associated with both a quicker time to first re-referral and a higher rate of re-referrals following discharge from care. History of LBP and military duty status were additional factors associated with a higher rate of re-referrals.

Clinical Factors

Most of the clinical factors explored in this study were not significant prognostic factors in musculoskeletal healthcare seeking. Pain severity, disability level, presence of leg pain, and obesity were not associated with how quickly an individual was re-referred or how often they were repeatedly re-referred. This was an interesting finding in an environment that places such emphasis on a biomedical approach to care. Duration of current episode had a novel protective association with healthcare seeking, where those with symptoms for longer than 12 weeks had a longer time to re-referral when controlling for other factors. This factor was not significantly associated with rate of re-referrals.

Social Factors

We explored several social prognostic factors in this study: military rank (proxy for socioeconomic status), work-related factors (military duty status and military element), previous interaction with health care, and compensation status. Those individuals who reported intent to seek Veterans Affairs compensation for their LBP were over two times as likely to be re-referred to musculoskeletal care at any point in time when controlling for other factors. This finding is consistent with accumulating evidence that suggests the more engagement that patients have with compensation systems, the worse their outcomes (34). This could be due to various reasons, such as those who attribute their onset of LBP to a work-related incident have greater incentives for having the details of the condition documented. Individuals that were considered high users of musculoskeletal care for their LBP in the past were also more likely to seek care

at a higher rate for their condition in the future. This association highlights the relevance of the ease of access to care that is seen in this environment when compared to general population. Military rank, the proxy for socioeconomic status, was not found to be associated with healthcare seeking. This may be due to the fact that the gap between top and bottom salaries in military members is narrower than the range in income that exists in the general population. As with general populations, further prognostic research into social factors is warranted in military populations.

Permanent category duty status (for LBP or other medical issue, such as PTSD or other chronic musculoskeletal condition) was associated with the rate of repeated re-referrals when considering all other factors. Members on a permanent medical category, who are deemed no longer deployable from a military perspective, had a 74% higher rate of repeated re-referrals than those who were on full duties. This is an important finding, as it questions the current perception that musculoskeletal care in the Canadian Armed Forces is focused on returning members to deployable status. It highlights that musculoskeletal health services may be dedicating resources to repetitively managing LBP in patients who, for LBP or other health reason, are not deemed the priority for managing resources in a very busy musculoskeletal care setting in this population.

Psychological factors

Fear of movement/(re)injury and having a concurrent diagnosis of PTSD were associated with both of our outcomes. PTSD is currently a primary focus of care and resources in Canadian Forces health services, so its association with rate of musculoskeletal healthcare seeking is an important finding, as currently there is very little formal collaboration of care between mental health and musculoskeletal healthcare providers. Fear of movement/(re)injury was of particular interest in this cohort, due to its relevance in a military population. For example, if an individual is dealing with recurrent or chronic LBP, there is no autonomy in the hierarchical military rank system to refrain from performing a work related duty or participate in physical training unless you are deemed medically unfit to do so. Therefore the perception of their pain experience (pain-related fear) warranted further independent study.

5.1.2 Confirmatory analysis

Our second study, a confirmatory analysis, tested the independent relationship between pain-related fear and musculoskeletal healthcare seeking. We identified a positive independent association between pain-related fear, as measured by fear of movement/(re)injury, and healthcare seeking. Those with a higher fear of movement/(re)injury were re-referred for musculoskeletal care 62% more quickly at any point in time during the follow up period, suggesting that the way in which these military patients interpret the experience of their LBP is a relevant factor to explore further in this population. Our results add to the growing body of research that suggests pain-related fear is associated with poor outcomes in both the general (59,73,75,82) and military populations (37,38). A patient's beliefs about their pain may be relevant as part of a multifactorial screen for patients presenting for musculoskeletal care in the Canadian Armed Forces. Replication of these results in further large confirmatory studies, such as a multi-site cohort design would provide stronger evidence about the independent association of this factor with healthcare seeking in this population.

5.2 LIMITATIONS

This study was a historical cohort, which has its limitations. We were unable to retrospectively collect potentially important prognostic factors such as heavy physical workload, which may have had a significant association with our outcome and/ or had an effect on the associations of other factors within the model. On the other hand, our sample size of 356 limited the amount of variables we could explore while still maintaining sufficient power to avoid a Type I error (false positive associations).

Secondly, our cohort consisted of patients with recurrent and chronic non-specific LBP. Those who were true acute LBP presentations (first episode of LBP less than 12 weeks) that had been enrolled in the rehabilitation class for clinical purposes were excluded from the study. Therefore, these results are not generalizable to true acute cases of LBP seeking care. The sample also excluded those with a specific diagnosis for their LBP, such as spinal stenosis or disc herniation with nerve root involvement. Although the exclusion of these two subgroups of LBP is favourable in order to minimize

heterogeneity of the sample, it limits the generalizability to all those seeking care for LBP in this population.

Healthcare seeking in this study is confined to those military personnel with recurrent and chronic LBP who sought care from musculoskeletal healthcare providers: physiotherapists, chiropractors, acupuncturists, or osteopath. We did not include medical appointments (drop in or scheduled), and therefore did not capture analgesic use and prescribed sick days for LBP. Other services not included were pain specialist appointments for nerve block injections, orthopedic surgical consultations and procedures, or diagnostic imaging services. Therefore our results are only generalizable to care seeking for the specific musculoskeletal services explored in this study in a military population. The potential wider access to healthcare seeking for LBP in this population remains unknown, so this study may only be providing a small account of the true amount of resources used for recurrent and chronic LBP in the Canadian Armed Forces.

Thirdly, the clinical cohort we used may not be generalizable to all those that seek care for recurrent and chronic LBP in this population. The objective of the back rehabilitation class, which included a cognitive-behavioural and active exercise component, was to promote self-management of LBP and minimize the further requirement of healthcare seeking for the condition. Therefore, it is unknown whether these individuals that have participated in a comprehensive self-management program and are still being re-referred for care are different in recurrent healthcare seeking than those who have not participated in this type of intervention.

5.3 IMPLICATIONS FOR FUTURE RESEARCH

Many guidelines now recommend screening for psychosocial risk factors of outcome at the initial visit in individuals presenting with LBP. This first phase of explanatory prognostic research identified various psychosocial factors that were statistically significantly associated with musculoskeletal healthcare seeking in a military population. These included pain-related fear, PTSD, compensation status, previous history of LBP, previous high use of services, and duty status. Further exploratory prognostic studies in a military setting using these factors would be useful in replicating

the results obtained here, both for the outcome of healthcare seeking, and for other important military outcomes, such as return to full military duty status and reason for military release. Once the key prognostic factors are validated through further prognostic research, an outcome prediction study, another area of prognostic research, would help identify the combination of factors most strongly associated with healthcare seeking and other relevant outcomes in this population (10).

Our second phase of explanatory prognostic research tested the independent association of one of our prognostic factors, pain-related fear, and our outcome while controlling for potential confounders. Further confirmatory studies replicating this independent association, or testing the independent associations of the other prognostic factors with statistically significant associations in our exploratory study, would be the next step.

5.4 IMPLICATIONS FOR POLICY MAKERS

Policy makers in the Canadian Armed Forces are responsible for planning the effective use of the $440 million military health budget, and allocation of resources regarding healthcare delivery. This study found that a proportion of members of the Canadian Armed Forces recurrently seek care for recurrent and chronic LBP. The prognostic factors identified as having an association with the rate of healthcare seeking in this study highlight the association of wider social determinants of health and LBP, such as compensation status and access to care, which are not modifiable at the individual level of care. The findings also identify the association of comorbid mental health conditions, such as PTSD, and healthcare seeking for LBP in this population. Further research on these prognostic factors, and ways to address the delivery of care from a policy level, could lead to more efficient management of LBP and use of resources.

The results of this study are also relevant to the national and regional practice leaders in Canadian Forces Health Services who coordinate the majority of the musculoskeletal health services. The results challenge the comprehensiveness of the traditional military sports medicine approach in providing the services necessary to manage recurrent and chronic LBP, and in facilitating the rapid return to operational fitness that is so desired. The Surgeon General of Canada reports that, in the Canadian

Armed Forces, there is an obligation for Canadian Forces Health Services to provide military personnel "the services necessary to maintain their health and mental wellbeing, to prevent disease, to diagnosis and treat any injury, illness, or disability, and facilitate a rapid return to operational fitness"(30). With 22% of medical releases from the Canadian military due to spinal issues (12), the effective management of LBP in active military personnel is an important area of study.

Dunn and colleagues conducted a latent class analysis on the trajectories of LBP over a longer course (16, 96), and suggested that the standard categorizations of acute and chronic LBP may be insufficient. They determined that LBP 'often assumes a prevailing pattern of recurrent or fluctuating pain' (96). For those repeatedly accessing musculoskeletal services for recurrent and chronic LBP in our study, the factors associated with these quicker re-referral times and higher repeated re-referral rates for LBP were psychological factors such as pain-related fear and PTSD, and social factors such as compensation status, permanent category duty status and previous treatment for LBP. Neither the traditionally measured outcomes representing 'success' of treatment, such as pain severity and level of disability, nor clinical factors such as leg pain, were related to future musculoskeletal healthcare seeking following discharge. Support for the collaboration of clinicians and researchers to review the current management of LBP nationally would be beneficial. There is promising collaboration presently underway among military physiotherapy leaders and other healthcare providers at the national level in the Canadian Armed Forces to develop a spinal pathway for military members with LBP. It would be useful for this group acknowledge the findings of this study and to support further prognostic research in order to aid in clinical decision making.

APPENDIX 1: Description of Back Class Content

Purpose: To promote an active self-management approach for those with LBP

Format: 6 weeks, 2 afternoons per week, 1.5 hours each afternoon (18 hours total)

Pre-assessment: 45 minutes – 1 week prior to start of class

- Patient profile
- Functional goal setting (Patient Specific Functional Scale)
- Numeric Rating Scale, Oswestry/ Roland Morris Disability Questionnaires
- Orebro and Tampa Scale for Kinesiophobia Questionnaires
- Functional Movement Screen (FMS – Gray Cook)
- McGill flexor and extensor endurance tests
- Neurodynamics screening

TUESDAY **Lecture component**	**TUESDAY** **Exercise component**
WEEK 1: INTRODUCTION - Creating awareness – questions to participants - Facts on etiology and course of LBP - Imaging findings : symptoms - Active vs. passive treatment - Outline of program	- basic back mobility exercises (cat camel, hip flexor, knee to chest, extensions, lumbar rotation, quadratus lumborum, hip external rotation) - hip dissociation in forward bending - gluteus maximus facilitation (Sahrmann) - Quadruped (Sahrmann) - Rotating and warming, bending through hips
WEEK 2: MECHANICS OF LBP - Superficial vs. deep muscles, function of muscles - Components of fitness (strength, flexibility, cardiovascular, efficient movement patterns) - Time frame for rehabilitation	- McGill sit up - Gluteus medius facilitation (Sahrmann) - Deep abdominals – Level I and II - Segmental movement – hip dissociation - Birddog - *Issue homework sheet #1 to track progress*
WEEK 3: POSTURE - Efficient static and moving postures, relevance to symptoms - Good vs poor exercise form - Tissue tolerance and adaptation	- Core circuit: bridging, side plank, plank - Prone hip rotation (Sahrmann) - Thoracic extension - *Progression of Week 1 &2 exercises as appropriate* - *Issue homework sheet #2 – Weekly routine*
WEEK 4: STRESS and ACUTE VS PERSISTANT PAIN - Pain physiology made simple - Recognizing triggers of LBP - Review of previous weeks' take home points - Autonomic nervous system – parasympathetic vs sympathetic response - Stresses that are controllable, recognizable - Stresses that are 'not controllable' - Military resources for stress management	- Downward dog, pigeon (yoga) - Review of diaphragmatic breathing - Deep abdominal progression as appropriate - Single leg straight leg dead lift - *Issue homework sheet #3 'Road back from LBP' to reflect on self- management strategies*
WEEK 5: REVIEW OF THREE HOMEWORK SHEETS/ FACILITATION OF DISCUSSION - **Participant led in problem solving, role modeling, etc.**	**FUNCTIONAL ACTIVITY - PROBLEM SOLVING SESSION** - Choice of activities led by participants - ie: golf swing, shoveling, mowing lawn, heavy lifting, storing ship, gardening - interactive, practical group problem solving
WEEK 6: WHAT IS THE MAGIC ANSWER? - Injury vs flare up - Brief summary of literature - Advice from 'The Back Book' - Stages of recovery from an episode Individual's role	**REVIEW OF EXERCISES** - *Homework sheet returned: 'Road back from LBP' : what is working, what isn't, favorite exercises, dealing with flare ups* - *Compare and contrast responses to highlight individuality of self-management strategies*

APPENDIX 1: Back Class Content (cont'd)

<table>
<tr><th colspan="4">THURSDAY - Exercise class</th></tr>
<tr><td colspan="4">10 minute warm up
Circuit training, 4 stations: 2 min for cardio exercise, 1 min each for strengthening exercise</td></tr>
<tr><td>1) Stationary bike
Push ups
Triple extension</td><td>2) Shuttle run
Squats
Medicine ball lifts</td><td>3) Step ups
Lunges
Upper extremity wts</td><td>4) Running on spot
Side lunges
Drawing the sword</td></tr>
<tr><td colspan="4">Group session of back exercises (from Tuesday sessions) – tailored to each participant's level (approximately 20-30 minutes, depending on week)
Relaxation session – autogenic / progressive muscle relaxation – 10 minutes</td></tr>
<tr><td colspan="4">Post-assessment: 45 minutes 1 week after completion of class
• Repeat of measures from pre-assessment</td></tr>
</table>

APPENDIX 2: Data Collection and Management

Personal information was collected and used from DND PPE 810 – Medical Records. The researcher accessed three different records:

Record A - Information from the physiotherapy back class assessments from 2007-2012 was recorded in an Excel file. This file did not contain any directly identifying information and the file was not encrypted. Each observation was labeled using a unique identifier number generated by the physiotherapy department and the file was stored within the physiotherapy department:

Record B - The original back class assessment sheets containing personal information and the unique identifier number generated by the physiotherapy department.

1. Case file number - Unique identifier number as labeled on Record A
2. The patients' military identification number (service number)

Record C – The Canadian Armed Forces electronic health record (CFHIS) using the corresponding military identification number (service number) from the original back class assessments from Record A:

We created **three** new records:

Record 4 – **Protected B**: The researcher created a new Protected B record in the form of an electronic Excel file containing personal information. This new record merged information from Records A, B and C:

1. Study number
2. Case file number - Unique identifier number as labeled on each of the physiotherapy assessment sheets
3. The patient's military identification number (service number)
4. Fear of movement/(re)injury score: The Tampa Scale for Kinesiophobia (TSK)
5. Functional disability score: the Roland Morris Questionnaire or Oswestry Disability Questionnaire
6. Pain Score: the numeric rating scale
7. Sex (M/F)
8. Military Rank

9. Duty status (full duties or medical category)
10. Job description/ Military Element
11. Presence of leg pain
12. Age in years at time of attendance in back rehabilitation class
13. Previous history of LBP
14. Previous physiotherapy treatment for LBP for 5 years prior to back class assessment
15. Previous chiropractic treatment for LBP for 5 years prior to back class assessment
16. Compensation status
17. History of MRI/CT/Xray scan for lumbar spine prior to Back class assessment
18. Comorbidities (other existing medical conditions) at time of back class attendance
19. Time to re-referral to physiotherapy, chiropractic, osteopathic, acupuncturist services or other rehabilitation services for LBP from participants' discharge from back class
20. Total number of visits to physiotherapy, chiropractic, osteopathic, and acupuncturist from discharge from back class to end of follow up period (July 31, 2013)

This record containing personal information was encrypted on a on a DND internal computer. The researcher was the only one with access to the password of this encrypted file. This file was destroyed (triple deleted) once Record 6, listed below, was created.

Record 5 – Code Key – Protected B: Data were coded using a unique study number. The researcher will retain the key that links the participants' code with their service number and, the case file identifier number as labeled on each of the physiotherapy assessment so data can be re-linked if necessary. This code will be encrypted, saved as a separate file and will be maintained on a DND internal computer. Only the principal researcher will have access to this key file. Record 5 was destroyed (triple deleted) on 2013/11/08.

Record 6 – Coded Record - Unclassified: We create a new coded record. Using record 4 (listed above), we de-identified record 4 by removing the unique identifier number as labeled on each of the physiotherapy assessment sheets and the patients' military identification number (service number). Record 6 only contains the unique study number and the remainder of the data elements from record 4. Record 6 was saved to a USB key. This coded information, is not considered personal information. The coded data from the UBS stick was analyzed in the Community Health and Epidemiology Department of Dalhousie University in Halifax, Nova Scotia, and the primary researcher's home in Hatchet Lake, Nova Scotia.

APPENDIX 3: Data Dictionary

CFHIS – electronic health records (if prior to 2007/08, paper charts were accessed for the information)
BCR – Back class physio paper records
CPP – Cumulative patient profile – summary of patient's health profile on opening page of electronic health record
PHA – Periodic Health Assessment
CF T033 – Medical Examination Record
CF T017 - Medical Examination record for Release
CF 2078 or DND 2552 – Medical questionnaire
MO – Medical Officer
BMI- Body Mass Index
VAC – Veteran's Affairs Canada

VARIABLE	TYPE	CONSTRUCT/ DESCRIPTION	SOURCE	SAS NAME	COMMENTS
Demographic					
Age	Continuous	Age at time of class	CFHIS - CPP	Age	Obtained date of birth from CPP, then converted to age on Excel
Sex	Dichotomous	Male or female	CPP	Sex	
Rank	Categorical	**Socioeconomic Status** Rank at time of class	BCR	Rank	0 = Officer 1 = senior NCM 2 = NCM
Element	Categorical	**Proxy for job description** The military environment to which the military member belongs	CFHIS: Patient Registration	Element	Navy Army Air
Administrative					
End of Follow up	Continuous	**Offset variable in our analysis** Total amount of time member was available to access PT or Chiro services from end of back class	CFHIS: Patient Registration	END_FUP	Date recorded as either 31 July 2013 (end of follow up period) if member was still in military, or their release date from military. This date was converted to days using Excel formula END_FUP – Date finished class
Released	Dichotomous	Whether or not member was released from the military by the end of follow up period	Created this variable from release date	Released	Y/N
Duty Status	Categorical	Member's duty status at end of back class	CFHIS: Primary Care	DutyStat	1) Full duties – fully operational status in trade, able to deploy 2) TCAT – on temporary restrictions for 3-6 months because of LBP 3) PCAT – on permanent

					restrictions because of low back condition, and being released from military because their low back condition is preventing member from returning to full duties 4) TCAT or PCAT (other) – member on temporary or permanent restrictions for a condition other than LBP
Duty Status at end of follow up	Categorical	Member's duty status at end of follow up – either still in military or at release date	CFHIS: 1) Primary Care 2) PHA – T2017 or T2033	CurDStat	1) Full duties – fully operational status in trade, able to deploy 2) TCAT – on temporary restrictions for 3-6 months because of LBP 3) PCAT – on permanent restrictions because of low back condition, and was or is being released from military because low back condition is preventing member from returning to full duties 4) TCAT or PCAT (other) – member on temporary or permanent restrictions for a condition other than LBP
Self Reported					
Fear of movement/ re-injury	Continuous (will also be used as a dichotomous variable)	**Pain-related Fear** Tampa Scale for Kinesiophobia (TSK) – 17 item questionnaire - Measure of fear of movement/re-injury at start of class (baseline)	BCR	TSK_base	Likert scale 17-68 Higher scores represent higher fear of mvt/reinjury Median score will be used to represent high/low score in dichotomous use
Pain Intensity	Continuous	**Severity of condition** Numeric Rating Scale (NRS) - at baseline	BCR	NRS_base	Scale from 0-10, with higher score representing perceived higher pain intensity
Disability	Continuous	**Severity of condition** Perceived functional	BCR	Disab	When RMQ was available, this score was recorded.

		status – either Roland Morris Disability questionnaire or Oswestry Low Back Pain Disability questionnaire at baseline			Otherwise, the Oswestry was recorded. The new variable was derived from the questionnaire's score out of 100 points (the RMQ was multiplied by 4.1666)
VAC Status	Categorical	Compensation Member's self report on either intention to claim or currently receiving a pension from VAC	VAC: CFHIS – CF 2078/DND 2552, Questions # 31 and 32	VAC (will separate VAC and MVA into two separate columns)	1) No = member not receiving a VAC pension for back, nor does he intend to apply for one in future 2) UNSURE – member is unsure whether or not he/she will apply to VAC in future (this category does not specify whether it is for a low back condition or otherwise) 3) PLAN = member has either applied for VAC or intends to apply to VAC for low back condition in future 4) Yes = member receiving a VAC pension for low back at start of back class
Clinical					
Previous history of LBP	Categorical	Documented history of LBP in patient records	CFHIS: Primary Care - PHA: 1) T2033 or 2) T2017 3) Paper charts	PrevHx	0 = < 1 year 1 = 1-5 years 2 = > 5 years Many questionnaires use 1 year as the cutoff for the variable. To demonstrate more effectively of the levels of chronicity, there is a third category used in this study. 5 years is used as the cutoff because records > than 5 years are often less consistent (ie: 8 or 12 year history?)
Current episode of LBP	Recorded as continuous Will be used as dichotomous to separate recurrent from chronic	**Chronicity of condition** Length of time subject has been dealing with their current episode of LBP at start of class	1) CFHIS: MO referral in physio/ chiro sections 2) BCR – patient's report of duration o current	CurEp	0 = 0-3 months 1 = >3 months Three months is frequently reported in the literature as the definition for chronic LBP

			episode		
Leg Pain	Dichotomous	Patient report of presence of intermittent leg pain at start of class	BCR	Legpain	0 = No 1 = Yes
Presence of comorbidities:		**General Health Status**	Ensured each condition was present at time of start of class		Comorbidities must have been present at baseline
- musculoskeletal	Dichotomous	Chronic musculoskeletal complaint	CFHIS: 1) CPP 2) T2017 or T2033	MSK	0 = No 1 = Yes Subject has been diagnosed with an ongoing MSK complaint that they may or may not be having concurrent treatment for, such as chronic neck pain, knee osteoarthritis, chronic shoulder complaint, etc
- Depression	Dichotomous	Diagnosed by Mental Health staff as having depression, following the DSN-5	CFHIS: 1) CPP 2) T2017 or T2033	Dep	0 = No 1 = Yes
- PTSD (Post Traumatic Stress Disorder)	Dichotomous	Diagnosed by Mental Health staff as having PTSD, following the DSN-5	CFHIS: 1) CPP 2) T2017 or T2033	PTSD	0 = No 1 = Yes
- Cardiovascular condition	Dichotomous	Diagnosed by MO as having an MI, cardiovascular surgery, or established CHD	CFHIS: 1) CPP 2) T2017 or T2033	CV	0 = No 1 = Yes
- Diabetes	Dichotomous	Diagnosed my MO as having either insulin dependent or non-insulin dependent diabetes	CFHIS: 1) CPP 2) T2017 or T2033	DM	0 = No 1 = Yes
- Obesity	Dichotomous	Diagnosed by MO, with a BMI >30kg/m^2	CFHIS: 1) PHA, Part 1 medical 2) T2017	BMI>30	0 = No 1 = Yes
- Anxiety	Dichotomous	Diagnosed by Mental Health staff as having anxiety, following the DSN-5	CFHIS: 1) CPP 2) T2017 or T2033	Anxiety	0 = No 1 = Yes
- Hypertension	Dichotomous	Diagnosed by MO, with a BP > 140/90	CFHIS: 1) CPP 2) T2017 or T2033	HBP	0 = No 1 = Yes
- Substance Abuse	Dichotomous	Diagnosed my MO or Mental Health staff: AUDIT score (Alcohol Use Disorder Identification Test)	CFHIS: 1) CPP 2) T2017 or T2033	Sub_abus	0 = No 1 = Yes
- COPD	Dichotomous	Diagnosed by MO	CFHIS: 1) CPP 2) T2017 or	COPD	0 = No 1 = Yes

			T2033		
- Cancer	Dichotomous	Diagnosed by lab or investigative testing	CFHIS: 1) CPP 2) T2017 or T2033	Ca	0 = No 1 = Yes for this condition, member may have had treatment for this prior to baseline and had treatment for it, or had diagnosis after baseline
- Adjustment disorder	Dichotomous	Diagnosed by MO or Mental Health staff as having a stressful life event or mental health issue that was concurrent with attendance in Back Class, but was of a more situational or transient nature	CFHIS: 1) CPP 2) T2017 or T2033	Adj_dis	0 = No 1 = Yes
Number of comorbidities	Discrete	Number of comorbidities member had at baseline	Excel formula: addition of columns MSK – Adj_dis	No_Co	Total possible range: 0-12
MRI	Dichotomous	**Use of Diagnostic Imaging** Whether or not member had MRI of their low back prior to baseline	CFHIS: Results – Diagnostic imaging	MRI	0 = No 1 = Yes
CT Scan	Dichotomous	**Use of Diagnostic Imaging** Whether or not member had CT scan of their low back prior to baseline	CFHIS: Results – Diagnostic imaging	CT	0 = No 1 = Yes
XRay	Dichotomous	**Use of Diagnostic Imaging** Whether or not member had Xray of their low back prior to baseline	CFHIS: Results – Diagnostic imaging	XRay	0 = No 1 = Yes
No of imaging	Discrete	The number of different types of imaging tests the member had for their low backprior to baseline	Excel formula: Addition ofcolumns MRI - Xray	No_Ix	Total possible range: 0-3
Previous Physiotherapy Referrals past 5 years	Discrete	**Previous health service use** The number of physiotherapy referrals for LBP in 5 years preceding entrance to back class	1) CFHIS: Physiotherapy –reports 2) paper records	PTr5	Recorded dates of all initial assessments from each new PT record. I then manually tabulated back 5 years and two years from start of class
Previous Physiotherapy Referrals past 2	Discrete	**Previous health service use** The number of	1) CFHIS: Physiotherapy –reports	PTr2	A/A

years		physiotherapy referrals for LBP in 2 years preceding entrance to back class	2) paper records		
Previous Chiropractic Referrals past 5 years	Discrete	**Previous health service use** The number of Chiropractic referrals for LBP in 2 years preceding entrance to back class	1) CFHIS: Specialty – Sports Rehab, Other 2) paper records	Chiror5	Recorded dates of all initial assessments from each new Chiro record. I then manually tabulated back 5 years and two years from start of class * one practitioner would leave the member's chart 'open' and see on an 'as needed' basis. If in the patient record there was a gap between visits of more than 6 months, I counted this as a new separate referral. Osteopaths and Acupuncturists were counted in Chiropractic referrals, as there were so few to have standing on their own.
Previous Chiropractic Referrals past 2 years	Discrete	**Previous health service use** The number of Chiropractic referrals for LBP in 2 years preceding entrance to back class	1) CFHIS: Specialty – Sports Rehab, Other 2) paper records	Chiror2	A/A
Total number of referrals last 5 years	Discrete	**Previous health service use** The number of both physiotherapy and chiropractic referrals for LBP in 5 years preceding entrance into back class	Excel formula: PTr5 + Chiror5	TOTr5	These variables give an indication of how heavy frequently each member accessed a rehabilitative service for their LBP over a 5 year or 2 year period
Total number of referrals last 2 years	Discrete	**Previous health service use** The number of both physiotherapy and chiropractic referrals for LBP in 2 years preceding entrance into back class	Excel formula: PTr2 + Chiror2	TOTr2	A/A
OUTCOMES					
Time to first referral	Continuous	The number in days from end of back class to the member's first re-referral roasted back to PT or Chiro	CFHIS: 1) Physiotherapy – Reports 2) Specialty – Other	T2	T2 is one of 2 things: 1) new referral from MO to another PT or chiro after now

		If member has not been re-referred for duration of available follow up time, then the subject is 'censored'.	Specialty (for some of the earliest subjects, paper charts had to be accessed for outcome)		completed PT class 2) member self referral back to same PT that referred to class if member had a flare up that could not manage on his/her own
Rate of re-referral	Count	Number of times member had been re-referred to PT or chiro following discharge from back class	CFHIS: 1) Physiotherapy – Reports 2) Specialty – Other Specialty (for some of the earliest subjects, paper charts had to be accessed for outcome)	TOTRR	Excel formula: add together T2 – T9 as applicable

APPENDIX 4: Missing Data

Missing data for predictor and outcome variables:			
Predictor			
Age	0	Compensation status	10 (2.8%)
Sex	0	Leg pain	1 (0.3%)
Rank	0	No of investigations	11 (3.1%)
Element	0	Comorbidities	0
End of follow up	0	Previous number of referrals for LBP	24 (6.7%)
Duration of current episode of LBP	12 (3.3%)		
Previous Hx LBP	4 (1.1%)		
TSK	1 (0.3%)	OUTCOME:	
Pain score	4 (1.1%)	Time to first re-referral	0
Disability score	0	Total number of re-referrals	0
Duty status at end of class	0		
Current duty status	0		

The variables TSK score and Pain score would both be considered 'Missing completely at random" (MCAR). MCAR refers to data missing that is not related to the variable itself or any other variable (67). The TSK score had one missing observation which was an incomplete questionnaire that the markers missed at the time. The Pain score had five missing observations because the back class datasheet was missing this information in error and the original sheets could not be located. Data that are MCAR will not bias the results because of their random reason for being missing.

The variables Compensation status, Number of Investigations, Leg pain, Previous history of LBP, Current episode of LBP, and Previous referrals for LBP are all considered "Missing at random" (MAR). MAR refers to data missing in relation to one of the variables, but not to an outcome variable (67). The variable Compensation status was missing 10 observations because these subjects did not complete a standard questionnaire during one of their routine medical visits. This missing data is biased toward those who had LBP for a shorter duration of time or who have been in the military only a few years. These subjects either did not have the opportunity to fill in the questionnaire or did not have a routine medical exam in the one-two year period around their participation in the back class. All the other MAR data were due to the subjects being posted from CFB Halifax to another base. Although their electronic health record were still accessible, we were unable to obtain the paper health records to record the retrospective variables. The benefit of the data being MCAR or MAR is that they are considered 'ignorable', meaning that we could use other variables in the dataset to fill in the blank spaces (67).

REFERENCES

(1) George SZ, Childs JD, Teyhen DS, Wu SS, Wright AC, Dugan JL, et al. Brief psychosocial education, not core stabilization, reduced incidence of low back pain: results from the Prevention of Low Back Pain in the Military (POLM) cluster randomized trial. BMC Med 2011 Nov 29;9:128-7015-9-128.

(2) Bell JA, Burnett A. Exercise for the primary, secondary and tertiary prevention of low back pain in the workplace: a systematic review. J Occup Rehabil 2009 Mar;19(1):8-24.

(3) Hong J, Reed C, Novick D, Happich M. Costs associated with treatment of chronic low back pain: an analysis of the UK General Practice Research Database. Spine (Phila Pa 1976) 2013 Jan 1;38(1):75-82.

(4) Hoy D, March L, Brooks P, Woolf A, Blyth F, Vos T, et al. Measuring the global burden of low back pain. Best Pract Res Clin Rheumatol 2010 Apr;24(2):155-165.

(5) Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012 Dec 15;380(9859):2224-2260.

(6) Burton AK, Balague F, Cardon G, Eriksen HR, Henrotin Y, Lahad A, et al. Chapter 2. European guidelines for prevention in low back pain : November 2004. Eur Spine J 2006 Mar;15 Suppl 2:S136-68.

(7) Maniadakis N, Gray A. The economic burden of back pain in the UK. Pain 2000 Jan;84(1):95-103.

(8) Dagenais S, Caro J, Haldeman S. A systematic review of low back pain cost of illness studies in the United States and internationally. Spine J 2008 Jan-Feb;8(1):8-20.

(9) Pransky G, Buchbinder R, Hayden J. Contemporary low back pain research - and implications for practice. Best Pract Res Clin Rheumatol 2010 Apr;24(2):291-298.

(10) Hayden JA, Dunn KM, van der Windt DA, Shaw WS. What is the prognosis of back pain? Best Pract Res Clin Rheumatol 2010 Apr;24(2):167-179.

(11) Rowe P, Hebert L. The impact of musculoskeletal conditions on the Canadian Armed Forces. Chapter 29. 377-392. 2011; Available at: www.CIMVHR.ca/sites/all/themes/cimvhr/pdf/book.pdf. Accessed February 20, 2013.
(12) Canada. Department of National Defence. Canadian Forces Health and Lifestyle Information Survey. Directorate of Force Health Protection. Available at: Error! Hyperlink reference not valid.. Accessed November 16, 2012.

(13) Riley RD, Hayden JA, Steyerberg EW, Moons KG, Abrams K, Kyzas PA, et al. Prognosis Research Strategy (PROGRESS) 2: prognostic factor research. PLoS Med 2013;10(2):e1001380.

(14) Weiner SS, Nordin M. Prevention and management of chronic back pain. Best Pract Res Clin Rheumatol 2010 Apr;24(2):267-279.

(15) Balague F, Mannion AF, Pellise F, Cedraschi C. Non-specific low back pain. Lancet 2012 Feb 4;379(9814):482-491.

(16) Dunn KM, Jordan K, Croft PR. Characterizing the course of low back pain: a latent class analysis. Am J Epidemiol 2006 Apr 15;163(8):754-761.

(17) Hancock MJ, Maher CG, Laslett M, Hay E, Koes B. Discussion paper: what happened to the 'bio' in the bio-psycho-social model of low back pain? Eur Spine J 2011 Dec;20(12):2105-2110.

(18) New Zealand Acute Low Back Pain Guide - Incorporating the Guide to Assessing Psychosocial Yellow Flags in Acute Low Back Pain. 2004; Available at: www.acc.co.nz. Accessed October20, 2013.

(19) Rozenberg S. Chronic low back pain: definition and treatment. Rev Prat 2008 Feb 15;58(3):265-272.

(20) Gautschi OP, Cadosch D, Bauer S, Land M, Fournier JY, Hildebrandt G. Chronic low Back Pain - A Dreaded Vicious Circle! Praxis (Bern 1994) 2009 Mar 4;98(5):259-269.

(21) Stanton TR, Latimer J, Maher CG, Hancock MJ. How do we define the condition 'recurrent low back pain'? A systematic review. Eur Spine J 2010 Apr;19(4):533-539.

(22) Bruce B, Lorig K, Laurent D, Ritter P. The impact of a moderated e-mail discussion group on use of complementary and alternative therapies in subjects with recurrent back pain. Patient Educ Couns 2005 Sep;58(3):305-311.

(23) Koumantakis GA, Watson PJ, Oldham JA. Trunk muscle stabilization training plus general exercise versus general exercise only: randomized controlled trial of patients with recurrent low back pain. Phys Ther 2005 Mar;85(3):209-225.

(24) Burton AK, McClune TD, Clarke RD, Main CJ. Long-term follow-up of patients with low back pain attending for manipulative care: outcomes and predictors. Man Ther 2004 Feb;9(1):30-35.

(25) Carey TS, Garrett JM, Jackman A, Hadler N. Recurrence and care seeking after acute back pain: results of a long-term follow-up study. North Carolina Back Pain Project. Med Care 1999 Feb;37(2):157-164.

(26) Von Korff M, Saunders K. The course of back pain in primary care. Spine (Phila Pa 1976) 1996 Dec 15;21(24):2833-7; discussion 2838-9.

(27) Donelson R, McIntosh G, Hall H. Is it time to rethink the typical course of low back pain? PM R 2012 Jun;4(6):394-401; quiz 400.

(28) Maetzel A, Li L. The economic burden of low back pain: a review of studies published between 1996 and 2001. Best Pract Res Clin Rheumatol 2002 Jan;16(1):23-30.

(29) Loisel P, Abenhaim L, Durand P, Esdaile JM, Suissa S, Gosselin L, et al. A population-based, randomized clinical trial on back pain management. Spine (Phila Pa 1976) 1997 Dec 15;22(24):2911-2918.

(30) Canada. Department of National Defence. Canadian Armed Forces Health Services. Surgeon General's Report - 2010; Government of Canada. Available at: http://www.forces.gc.ca/health-sante/pub/sgr-rmc-2010/default-eng.asp. Accessed November 16, 2012.

(31) Gatchel RJ, Peng YB, Peters ML, Fuchs PN, Turk DC. The biopsychosocial approach to chronic pain: scientific advances and future directions. Psychol Bull 2007 Jul;133(4):581-624.

(32) Leeuw M, Goossens ME, Linton SJ, Crombez G, Boersma K, Vlaeyen JW. The fear-avoidance model of musculoskeletal pain: current state of scientific evidence. J Behav Med 2007 Feb;30(1):77-94.

(33) Guclu DG, Guclu O, Ozaner A, Senormanci O, Konkan R. The relationship between disability, quality of life and fear-avoidance beliefs in patients with chronic low back pain. Turk Neurosurg 2012;22(6):724-731.

(34) Pincus T, Kent P, Bronfort G, Loisel P, Pransky G, Hartvigsen J. Twenty-five years with the biopsychosocial model of low back pain-is it time to celebrate? A report from the twelfth international forum for primary care research on low back pain. Spine (Phila Pa 1976) 2013 Nov 15;38(24):2118-2123.

(35) Borrell-Carrio F, Suchman AL, Epstein RM. The biopsychosocial model 25 years later: principles, practice, and scientific inquiry. Ann Fam Med 2004 Nov-Dec;2(6):576-582.

(36) Waddell G. 1987 Volvo award in clinical sciences. A new clinical model for the treatment of low-back pain. Spine (Phila Pa 1976) 1987 Sep;12(7):632-644.
(37) Hiebert R, Campello MA, Weiser S, Ziemke GW, Fox BA, Nordin M. Predictors of short-term work-related disability among active duty US Navy personnel: a cohort study in patients with acute and subacute low back pain. Spine J 2012 Sep;12(9):806-816.

(38) Helmhout PH, Staal JB, Heymans MW, Harts CC, Hendriks EJ, de Bie RA. Prognostic factors for perceived recovery or functional improvement in non-specific low back pain: secondary analyses of three randomized clinical trials. Eur Spine J 2010 Apr;19(4):650-659.

(39) Main CJ, Buchbinder R, Porcheret M, Foster N. Addressing patient beliefs and expectations in the consultation. Best Pract Res Clin Rheumatol 2010 Apr;24(2):219-225.

(40) Nicholas MK, Linton SJ, Watson PJ, Main CJ, "Decade of the Flags" Working Group. Early identification and management of psychological risk factors ("yellow flags") in patients with low back pain: a reappraisal. Phys Ther 2011 May;91(5):737-753.

(41) Burton AK, Tillotson KM, Main CJ, Hollis S. Psychosocial predictors of outcome in acute and subchronic low back trouble. Spine (Phila Pa 1976) 1995 Mar 15;20(6):722-728.

(42) Ferreira ML, Machado G, Latimer J, Maher C, Ferreira PH, Smeets RJ. Factors defining care-seeking in low back pain--a meta-analysis of population based surveys. Eur J Pain 2010 Aug;14(7):747.e1-747.e7.

(43) Rasmussen-Barr E, Campello M, Arvidsson I, Nilsson-Wikmar L, Ang BO. Factors predicting clinical outcome 12 and 36 months after an exercise intervention for recurrent low-back pain. Disabil Rehabil 2012;34(2):136-144.

(44) Cohen SP, Gallagher RM, Davis SA, Griffith SR, Carragee EJ. Spine-area pain in military personnel: a review of epidemiology, etiology, diagnosis, and treatment. Spine J 2012 Sep;12(9):833-842.

(45) Hebert L. Canadian Forces Physiotherapy Continuous Quality Improvement Database. 2002-2004.

(46) Vlaeyen JW, Kole-Snijders AM, Boeren RG, van Eek H. Fear of movement/(re)injury in chronic low back pain and its relation to behavioral performance. Pain 1995 Sep;62(3):363-372.

(47) Vlaeyen JW, Linton SJ. Fear-avoidance model of chronic musculoskeletal pain: 12 years on. Pain 2012 Jun;153(6):1144-1147.

(48) Pincus T, Smeets RJ, Simmonds MJ, Sullivan MJ. The fear avoidance model disentangled: improving the clinical utility of the fear avoidance model. Clin J Pain 2010 Nov-Dec;26(9):739-746.

(49) Deyo RA, Battie M, Beurskens AJ, Bombardier C, Croft P, Koes B, et al. Outcome measures for low back pain research. A proposal for standardized use. Spine (Phila Pa 1976) 1998 Sep 15;23(18):2003-2013.

(50) Chapman JR, Norvell DC, Hermsmeyer JT, Bransford RJ, DeVine J, McGirt MJ, et al. Evaluating common outcomes for measuring treatment success for chronic low back pain. Spine (Phila Pa 1976) 2011 Oct 1;36(21 Suppl):S54-68.

(51) Ostelo RW, de Vet HC. Clinically important outcomes in low back pain. Best Pract Res Clin Rheumatol 2005 Aug;19(4):593-607.

(52) Dunn KM, Campbell P, Jordan KP. Long-term trajectories of back pain: cohort study with 7-year follow-up. BMJ Open 2013 Dec 11;3(12):e003838-2013-003838.

(53) Freburger JK, Holmes GM, Agans RP, Jackman AM, Darter JD, Wallace AS, et al. The rising prevalence of chronic low back pain. Arch Intern Med 2009 Feb 9;169(3):251-258.

(54) Luo X, Pietrobon R, Sun SX, Liu GG, Hey L. Estimates and patterns of direct health care expenditures among individuals with back pain in the United States. Spine (Phila Pa 1976) 2004 Jan 1;29(1):79-86.

(55) Ritzwoller DP, Crounse L, Shetterly S, Rublee D. The association of comorbidities, utilization and costs for patients identified with low back pain. BMC Musculoskelet Disord 2006 Sep 18;7:72.

(56) Joud A, Petersson IF, Englund M. Low back pain: epidemiology of consultations. Arthritis Care Res (Hoboken) 2012 Jul;64(7):1084-1088.

(57) Rhynold A 2013, Blue Cross/ Medical Finance, Canadian Forces Health Services Center (Atlantic), oral communication, 27th March.

(58) Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? J Health Soc Behav 1995 Mar;36(1):1-10.

(59) Pincus T, Santos R, Breen A, Burton AK, Underwood M, Multinational Musculoskeletal Inception Cohort Study Collaboration. A review and proposal for a core set of factors for prospective cohorts in low back pain: a consensus statement. Arthritis Rheum 2008 Jan 15;59(1):14-24.

(60) Fikretoglu D, Brunet A, Guay S, Pedlar D. Mental health treatment seeking by military members with posttraumatic stress disorder: findings on rates, characteristics, and predictors from a nationally representative Canadian military sample. Can J Psychiatry 2007 Feb;52(2):103-110.

(61) Fikretoglu D, Brunet A, Schmitz N, Guay S, Pedlar D. Posttraumatic stress disorder and treatment seeking in a nationally representative Canadian military sample. J Trauma Stress 2006 Dec;19(6):847-858.

(62) Fikretoglu D, Elhai JD, Liu A, Richardson JD, Pedlar DJ. Predictors of likelihood and intensity of past-year mental health service use in an active Canadian military sample. Psychiatr Serv 2009 Mar;60(3):358-366.

(63) Fikretoglu D, Guay S, Pedlar D, Brunet A. Twelve month use of mental health services in a nationally representative, active military sample. Med Care 2008 Feb;46(2):217-223.

(64) Minister of Justice. Privacy Act R.S.C., 1985, c. P-21. 2013; Available at: http://laws-lois.justice.gc.ca/eng/acts/P-21/page-2.html#h-4. Accessed June 20, 2013.

(65) Canadian Institute of Health Research, Natural Sciences and Engineering Research Council of Canada, and Social Sciences and Humanities Research Council of Canada. Tri-council Policy Statement: Ethical Conduct for Research Involving Humans. 2010; Available at: http://www.pre.ethics.gc.ca/pdf/eng/tcps2/TCPS_2_FINAL_Web.pdf. Accessed May 5, 2013.

(66) Hayden JA, Cote P, Steenstra IA, Bombardier C, QUIPS-LBP Working Group. Identifying phases of investigation helps planning, appraising, and applying the results of explanatory prognostic studies. J Clin Epidemiol 2008 Jun;61(6):552-560.

(67) Miller RP, Kori SH, Todd DD. Development of the Tampa Scale for Kinesiophobia (TSK) – unpublished report. 1991.

(68) Roland M, Fairbank J. The Roland-Morris Disability Questionnaire and the Oswestry Disability Questionnaire. Spine 2000;25(24):3115-3124.

(69) de Vet HC, Heymans MW, Dunn KM, Pope DP, van der Beek AJ, Macfarlane GJ, et al. Episodes of low back pain: a proposal for uniform definitions to be used in research. Spine (Phila Pa 1976) 2002 Nov 1;27(21):2409-2416.

(70) Streiner DL. The case of the missing data: methods of dealing with dropouts and other research vagaries. Can J Psychiatry 2002 Feb;47(1):68-75.

(71) Andridge RR, Little RJ. A Review of Hot Deck Imputation for Survey Non-response. Int Stat Rev 2010 Apr;78(1):40-64.

(72) Mannion AF, Wieser S, Elfering A. Association Between Beliefs and Care-Seeking Behavior for Low Back Pain. Spine (Phila Pa 1976) 2013 Mar 1;38(12):1016-1025.

(73) Keeley P, Creed F, Tomenson B, Todd C, Borglin G, Dickens C. Psychosocial predictors of health-related quality of life and health service utilisation in people with chronic low back pain. Pain 2008 Mar;135(1-2):142-150.

(74) Pincus T, Kent P, Bronfort G, Loisel P, Pransky G, Hartvigsen J. Twenty-five years with the biopsychosocial model of low back pain-is it time to celebrate? A report from

the twelfth international forum for primary care research on low back pain. Spine (Phila Pa 1976) 2013 Nov 15;38(24):2118-2123.

(75) Cedraschi C, Allaz AF. How to identify patients with a poor prognosis in daily clinical practice. Best Practice & Research Clinical Rheumatology 2005 8;19(4):577-591.

(76) Fritz JM, Childs JD, Wainner RS, Flynn TW. Primary care referral of patients with low back pain to physical therapy: impact on future health care utilization and costs. Spine (Phila Pa 1976) 2012 Dec 1;37(25):2114-2121.

(77) Roelofs J, van Breukelen G, Sluiter J, Frings-Dresen MH, Goossens M, Thibault P, et al. Norming of the Tampa Scale for Kinesiophobia across pain diagnoses and various countries. Pain 2011 May;152(5):1090-1095.

(78) Swinkels-Meewisse IE, Roelofs J, Schouten EG, Verbeek AL, Oostendorp RA, Vlaeyen JW. Fear of movement/(re)injury predicting chronic disabling low back pain: a prospective inception cohort study. Spine (Phila Pa 1976) 2006 Mar 15;31(6):658-664.

(79) Lundberg M, Grimby-Ekman A, Verbunt J, Simmonds MJ. Pain-related fear: a critical review of the related measures. Pain Res Treat 2011;2011:494196.

(80) Hauret KG, Jones BH, Bullock SH, Canham-Chervak M, Canada S. Musculoskeletal injuries description of an under-recognized injury problem among military personnel. Am J Prev Med 2010 Jan;38(1 Suppl):S61-70.

(81) Deyo RA, Mirza SK, Turner JA, Martin BI. Overtreating chronic back pain: time to back off? J Am Board Fam Med 2009 Jan-Feb;22(1):62-68.

(82) Picavet HS, Vlaeyen JW, Schouten JS. Pain catastrophizing and kinesiophobia: predictors of chronic low back pain. Am J Epidemiol 2002 Dec 1;156(11):1028-1034.

(83) Fritz JM, George SZ. Identifying psychosocial variables in patients with acute work-related low back pain: the importance of fear-avoidance beliefs. Phys Ther 2002 Oct;82(10):973-983.

(84) Wertli MM, Rasmussen-Barr E, Weiser S, Bachmann LM, Brunner F. The role of fear avoidance beliefs as a prognostic factor for outcome in patients with nonspecific low back pain: a systematic review. Spine J 2013 Oct 18; (in press).

(85) George SZ, Valencia C, Beneciuk JM. A psychometric investigation of fear-avoidance model measures in patients with chronic low back pain. J Orthop Sports Phys Ther 2010 Apr;40(4):197-205.

(86) Lame IE, Peters ML, Kessels AG, Van Kleef M, Patijn J. Test--retest stability of the Pain Catastrophizing Scale and the Tampa Scale for Kinesiophobia in chronic pain over a longer period of time. J Health Psychol 2008 Sep;13(6):820-826.

(87) French DJ, France CR, Vigneau F, French JA, Evans RT. Fear of movement/(re)injury in chronic pain: a psychometric assessment of the original English version of the Tampa scale for kinesiophobia (TSK). Pain 2007 Jan;127(1-2):42-51.

(88) de Souza FS, Marinho Cda S, Siqueira FB, Maher CG, Costa LO. Psychometric testing confirms that the Brazilian-Portuguese adaptations, the original versions of the Fear-Avoidance Beliefs Questionnaire, and the Tampa Scale of Kinesiophobia have similar measurement properties. Spine (Phila Pa 1976) 2008 Apr 20;33(9):1028-1033.

(89) Branstrom H, Fahlstrom M. Kinesiophobia in patients with chronic musculoskeletal pain: differences between men and women. J Rehabil Med 2008 May;40(5):375-380.

(90) Altman DG, Lausen B, Sauerbrei W, Schumacher M. Dangers of using "optimal" cutpoints in the evaluation of prognostic factors. J Natl Cancer Inst 1994 Jun 1;86(11):829-835.

(91) Streiner DL. Breaking up is hard to do: the heartbreak of dichotomizing continuous data. Can J Psychiatry 2002 Apr;47(3):262-266.

(92) Vlaeyen JW, Linton SJ. Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. Pain 2000 Apr;85(3):317-332.

(93) Vlaeyen JW, Seelen HA, Peters M, de Jong P, Aretz E, Beisiegel E, et al. Fear of movement/(re)injury and muscular reactivity in chronic low back pain patients: an experimental investigation. Pain 1999 Sep;82(3):297-304.

(94) Katz M. Chapter 6: Setting up a multivariable analysis. Multivariable Analysis: A Practical Guide for Clinicians and Public Health Researchers. 3rd ed. New York: Cambridge University Press; 2011. p. 93.

(95) Campbell P, Bishop A, Dunn KM, Main CJ, Thomas E, Foster NE. Conceptual overlap of psychological constructs in low back pain. Pain 2013 Sep;154(9):1783-1791.

(96) Dunn KM, Campbell P, Jordan KP. Long-term trajectories of back pain: cohort study with 7-year follow up. BMJ Open 2013;3:e003838. doi:10.1136/bmjopen-2013-003838.