FACTORS ASSOCIATED WITH PERFORMANCE ON SHORT-FORM FUNCTIONAL CAPACITY EVALUATION IN WORKERS' COMPENSATION CLAIMANTS

By

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Abstract

Background Functional Capacity Evaluations (FCE) are performance-based assessments of work ability that are used to make recommendations for participation in work and other activities of daily living. FCE protocol developers have attempted to decrease the burden and duration of testing through the creation of short-form FCE (SF-FCE) protocols. Physical, psychological, and social factors have been found associated with claimant performance during full FCE. However, it is unknown whether the same factors are associated with performance during SF-FCE. It may be that shortening the duration of the assessment and reducing the number of test items leads to reduced pain exacerbation and a reduced influence of psychological factors, with more of a focus on 'physical' ability. If this were the case, psychological and self-report measures would likely not be significantly associated with SF-FCE performance. However, if the SF-FCE is measuring the same behaviours as those observed during full FCE protocols, the same physical and psychological factors will be found significantly associated with SF-FCE performance.

Objective The purpose of this thesis was to examine factors associated with performance during SF-FCE of workers' compensation claimants with musculoskeletal conditions. Knowing this will allow a comparison of factors associated with SF-FCE performance to those known to be associated with full, lengthier FCE protocols. We hypothesized that factors associated with claimant performance on SF-FCE protocols would be the same as those associated with performance on full FCE protocols.

Methods A cross-sectional study design was used. A secondary analysis was conducted on data obtained in a previous study examining the effectiveness of a SF-FCE. All participants were workers' compensation claimants who were assessed between October 18, 2004 through May 6, 2005, at a workers' compensation rehabilitation center in Edmonton, Alberta, Canada. The University of Alberta Health Research Ethics Board approved this study. Measures included demographic variables (i.e. age, sex), patient reported outcomes (i.e. pain intensity, perceived disability, recovery expectations), and measures of SF-FCE performance (number of 'failed' SF-FCE tasks where performance did not match job demands and weight lifted during floor-to-waist lift). To determine associations between performance on short-from FCE and factors hypothesized to influence performance, Pearson correlation coefficients were calculated for

continuous variables and Point-Biserial correlation coefficients were calculated for dichotomous variables.

Results The data set included 450 injured workers with open workers' compensation claims for a variety of musculoskeletal disorders. The majority of claimants were employed (74%) and male (70%). Male sex and younger age were statistically significantly correlated with higher weight lifted on the floor to waist lift, with correlation coefficients which were small to moderate in magnitude ($r = 0.28$ and -0.33 respectively, $p<0.01$). Better lifting performance was also significantly correlated with lower pain intensity ($r = -0.24$, $p=0.01$), lower self-rated disability ($r = -0.43$, $p<0.01$), and better recovery expectations ($r = -0.19$, $p=0.03$). The only clinical variable not significantly associated with floor-to-waist lifting was the Workplace Support Questionnaire ($p=0.25$). Higher number of failed SF-FCE tasks was significantly correlated with higher pain intensity ($r = 0.15$, $p=0.01$), higher self-rated disability ($r = 0.39$, $p<0.01$), worse recovery expectations ($r = 0.31$, $p<0.01$), and worse perceptions of workplace support ($r = -0.13$, $p=0.02$).

Conclusions Better lifting performance on SF-FCE is significantly associated with younger age, male sex, lower pain intensity, lower pain-related disability, and better recovery expectations. Higher pain intensity, pain-related disability, and lower recovery expectations are also significantly associated with more failed items on the SF-FCE. Results support our hypotheses that factors significantly associated with claimant performance on SF-FCE protocols would be the same as those previously found associated with performance on full FCE protocols. Further research is needed to evaluate the validity of SF-FCE in other contexts and settings.

Preface

This thesis is an original work by Tamseela Chughtai. The research project, of which this thesis is a part, receiver research ethics approval from the University of Alberta Research Ethics Board. The project name is “Factors Influencing Results of Short-Form Functional Capacity Evaluations in Worker’s Compensation Claimants” and project number is Pro00063067

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نَصْرٌ مِّنَ اللّٰهِ وَفَتْحٌ قَرِيبٌ

Help and Victory from Allah is imminent!

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CHAPTER 1

Introduction

1.1 Overview

This thesis evaluates factors associated with performance of workers' compensation claimants undertaking a Short Form Functional Capacity Evaluation (SF-FCE). This study is a secondary analysis of previously collected data from a trial examining the effectiveness of SF-FCE in facilitating return-to-work (RTW). Chapter One provides an introduction to Functional Capacity Evaluation (FCE), as well as the purpose and significance of this study. Chapter Two is a review of literature focusing on the details of FCE procedures, different models of FCE (specifically its relation to the ICF Model), justification for the SF-FCE protocol, and relevant gaps in the associated literature. In the third and fourth chapters, study methodology and results are presented respectively. Lastly, Chapter Five provides an overall summary, discussion, and conclusions of the thesis.

1.2 Background and Context

The Influence of Work on Health

Work is an essential tool to live a life with intention. A healthy person can enjoy the liveliness of work and looks forward to accomplishing more. However, there are some health challenges that can arise from paid employment, and a requirement of sustainable employment is a balance between the needs of the profession and the worker's health.[1] Trauma or injury associated with work can lead a person astray from being filled with hope to a life full of insecurities, psychological misery, financial sufferings, and deteriorating health. These situations also contribute to unemployment. Several studies done in different parts of the world have demonstrated that unhealthy and unemployed individuals have high death rates [2] and high rates of health problems such as cardiovascular diseases,[3] suicide,[4] and emotional troubles.[5]

Rate of Work Disability Worldwide

Referring to the International Labor Office, an estimated 470 million workers experience some form of disability during their work tenure.[6] Disability not only creates a negative mental,

physical, and emotional environment for a worker, but it can also can bring severe financial pressure in terms of workers' compensation costs, disability benefits, insurance premiums, and worker replacement costs. As per a report from the Organization for Economic Co-operation and Development (OECD), in 2008 countries spent twice as much on disability benefits due to work-related injuries as compared to unemployment benefits.[7] This creates a negative impact on society due to the financial burden. Additionally, a sizeable segment of the population on disability benefits never returns to work, which can lead to further health deterioration and create a burden on the labor market.

Work Disability in Canada

In Canada, 1 out of 15 workers are estimated to injure him/herself in the workplace each year.[8] As early as 2001, it was determined that the unemployment rate of disabled individuals (10.7%) was much higher than the non-disabled population (7.1%).[9] Where possible, individuals with mild to moderate disabilities should be encouraged to return to the labour market to improve their long-term health and well-being, as well as reduce the burden of unemployment on the society's economy.

Prevention of Work Disability

Musculoskeletal disorders are one of the leading causes of work disability among adults in industrialized countries. Backache, neck pain, sprains, strains, contusions, nerve damage, fractures, dislocations, and joint pathologies are common reasons for work disability. To overcome this difficulty, clinicians and employers play a critical role in creating an environment that can facilitate an individual in the process of rehabilitation and RTW, rather than creating barriers that lead to long-term work impairment.[10] However, the root cause of work disability often remains unknown. In order to determine the reasons for work loss in individual workers, detailed examination and assessment of the individual is essential. One method for determining individual ability (or lack thereof) for work as well as barriers to work performance is the FCE. FCE has become an integral part of the return-to-work process in several jurisdictions. It forms, a medical basis for RTW decisions by identifying which work-related activities are physically contraindicated or recommended against, and how job tasks can be modified in order to encourage RTW for the injured worker.

1.2.1 Functional Capacity Evaluation (FCE)

FCE has been defined as "*an evaluation of capacity of activities that is used to make recommendations for participation in work while considering the person's body functions and structures, environmental factors, personal factors and health status*".[11] FCE protocols are methodical, comprehensive, performance-based series of tests designed to evaluate an individual's work ability or performance in workplace-related tasks.[12] FCE is a measuring tool that attempts to measure the capacity of an individual to perform activities by keeping in view his or her personal factors, professional commitments, environmental factors and health status.[13] FCE provides information to the worker, employer, physicians, and insurance underwriters. The main goal of an FCE is to provide information regarding the work ability, which forms the basis of RTW goals and plans.[14] FCE also often provides useful background information for the worker to learn more about their work tactics and realize that adhering to work in a safe manner, within the limitations or restrictions outlined during the FCE, may prevent re-injury. Employers can also get information about the functional status of workers through FCE results. They can identify if the employee is ready to RTW, what are the chances of re-injury, and whether the worker is capable of safely returning to their work environment.

1.2.2 Evolution of FCE

FCE has played a major role in RTW practice for several decades. Since 1980, 3 different FCE models or *schools of thought* have been predominantly used. Isernhagen writes that the first FCE protocols were developed to 'catch the malingerer'. This was based on the assumption that injured workers were in fact not affected by bad health, but were trying to create a negative picture of their health to obtain secondary gain. FCEs were designed to determine whether these sorts of patients were legitimately suffering from work related dysfunction or were trying to create a false picture of their health status.[15] The terms 'symptom magnification' and 'exaggerated pain behavior' were coined.[16] Unfortunately, focusing on this goal has the potential to lead to improper judgments and recommendations. Symptoms described by the patients often cannot be seen or measured accurately, and where the behaviours during FCE represent exaggerations also cannot be determined with validity. Because of this questionable validity, what patients describe and how they perform during FCE can lead to false conclusions about the legitimacy of their health status.

In the mid of 1990s, the need arose to discover a better way to cater to the needs of injured workers. In this case, application of the scientific or quantitative method was brought into consideration and formed the second incarnation of FCE. Use of X-ray images, back strength measurement, isometric and isokinetic trunk testing, among other tests were thought to be helpful in detecting functional capacity. This more logical approach to evaluation was studied to evaluate an individual's functional capacity and compare ability to required employment demands. Unfortunately, the theory of using medical investigations as a source of detecting functional capacity also had drawbacks. Medical assessments do not accurately predict future RTW.[17] Additionally, when trust is placed entirely on medical or physical investigations, the patient's reported symptoms can get ignored. For example, a MRI may not show any specific findings, yet the patient may present with excruciating low back pain that limits function. Since the MRI and other advanced medical imaging does not correlate highly with musculoskeletal symptoms,[18] the individual might be considered symptom free as per the investigation reports and a recommendation made for RTW. However, in reality they may be suffering and experiencing difficulty coping with the pain and associated dysfunction. This situation often leads to unsuccessful RTW and ongoing work disability.

Limitations observed in the first 2 approaches gave rise to a more comprehensive and 'functional' approach to doing FCE or RTW testing. Protocols were developed that attempted to assess all required physical job demands of work within a simulated environment (i.e. clinics). Performance on these batteries of functional tests was compared to required job demands. Since an attempt was made to comprehensively assess all required job demands, these protocols were lengthy and often took place over multiple sessions or days. In these FCEs, the worker would complete tasks like lifting, carrying, twisting, turning, bending, kneeling, crawling, hand coordination, grip and pinch strength, walking, standing, and sitting. Activities in the full protocols are typically based on the 20 activities of work outlined in the Dictionary of Occupational Titles.[19, 20] An FCE was deemed to have adequate content validity if it contained items representing all 20 of these activities of work. At times, the protocols are split into 2 testing sessions, with performance on the second session compared to the first session to determine whether exposure to work activities can be sustained.

In these FCE protocols, the whole body is evaluated during functional testing because when an individual is involved in doing work the entire body undergoes a complex strategy of movements. In order to handle these complexities, strength, endurance, balance, co-ordination, involvement of multiple joints at once, normal and compensatory movements all come into play. So it was a step beyond the 'medical' or laboratory examinations of the second stage. This third pathway has continued to be the most common choice as it provides an improved framework for matching of the worker's functional abilities to workplace demands.[15] Various FCE protocols of this type exist (i.e. Isernhagen, Matheson, ErgoScience, etc), but the protocol selected for routine use in Alberta for assessments sponsored by the Workers' Compensation Board (WCB) is the two-day Isernhagen (now named WorkWell) FCE.

Most recently, limitations of these comprehensive FCE protocols have been observed. Typically, FCE protocols can predict future RTW, but predictive accuracy is only modest. There has also been some redundancy observed within the tasks assessed. Most of these protocols were based on the activities of work outlined in the Dictionary of Occupational Titles.[21] This resulted in lengthy protocols that are expensive and burdensome for therapists and workers.[19] In fact, exposure to lengthy testing has often led to pain exacerbation among workers.[20] For these reasons, FCE developers have attempted to maintain the benefits of full FCE protocols, but decrease the burden and duration of testing within short-form FCE protocols.

In Alberta, a short-form FCE protocol was derived from the full WorkWell protocol that has been in common use. Research identified that a few items within the full protocol could predict RTW as successfully as the entire protocols.[22] Based on these findings and results of other researchers, 3 standardized and region-specific SF-FCE protocols were developed and tested in a cluster randomized controlled trial.[22] The SF-FCE was found to lead to comparable RTW and clinical outcomes, predicted RTW as well as the full WorkWell FCE, yet could be completed in substantially reduced time. A comparison of items assessed in the 3 region-specific SF-FCE protocols versus items in the full WorkWell FCE protocol is shown in Table 1.1. However, further research is needed before SF-FCE can be recommended for more widespread use. Further research is needed to confirm that SF-FCE can replace longer FCE protocols and be an efficient tool of fitness for work assessments.

Table 1.1: Comparison of Items in the WorkWell Functional Capacity Evaluation and Short Form Region-Specific Protocols

Full WorkWell FCE Protocol*	SF-FCE Trunk Protocol	SF-FCE Upper Extremity Protocol	SF-FCE Lower Extremity Protocol
Floor-to-waist lift Waist to overhead lift Horizontal lift Front Carry Side Carry Crawling Kneeling Crouching Squatting Elevated Work Static Push Static Pull Trunk flexion in sitting Trunk flexion in stand Rotation in sitting Rotation in standing Stair/Ladder climbing Balance Bending in stand Rotation in stand 30-min standing/sitting Walking Hand Grip Strength Hand Coordination	Standing Floor to Waist Lift Crouching Trunk Flexion Trunk Rotation	Waist to overhead lift Elevated Work Crawling Hand Grip Strength Hand Coordination	Standing Floor to Waist Lift Crouching Kneeling Stepladder or stairs

** Items are typical of protocols based on the Dictionary of Occupational Titles.*

Previous research has identified that performance during FCE is influenced not only by physical ability, but also by psychological and social factors. Results of a systematic review conducted by van Abbema et al found some evidence that biological and psychological factors are associated with FCE results, but also much conflicting evidence.[23] However, very few studies have been done to address the influence of social factors on return to work. In Alberta, a previous study examined factors associated with performance of workers' compensation claimants on the WorkWell FCE protocol. It was found that physical (age, sex, injury duration) and psychological factors (expectations of recovery, perceived disability, and pain intensity) were significantly associated with claimant performance on FCE.[24] However, it is unknown what factors are

associated with performance during SF-FCE and whether these factors are the same as those associated with full FCE protocols.

1.3 Statement of the Problem

Physical, psychological, and social factors have been found to influence claimant performance during full FCE protocols, however, it is unknown whether the same factors influence performance during SF-FCE protocols. It may be that shortening the duration of the assessment and reducing the number of test items leads to reduced pain exacerbation and a reduced influence of psychological factors, with more of a focus on 'physical' ability. If this were the case, psychological and self-report measures would likely not be significantly associated with SF-FCE performance. However, if the SF-FCE is measuring the same behaviours as those observed during full FCE protocols, the same physical and psychological factors will be found significantly associated with SF-FCE performance. Currently there is little research on the SF-FCE protocol, it is unknown what factors are associated with performance of workers' compensation claimants on SF-FCE or whether these factors are the same as those associated with performance on full FCE protocols.

1.4 Purpose and Hypothesis

The purpose of this thesis was to examine factors associated with performance during SF-FCE of workers' compensation claimants with musculoskeletal conditions. Knowing this will allow a comparison factors associated with SF-FCE to those known to influence full, lengthier FCE protocols. We hypothesized that factors associated with claimant performance on SF-FCE protocols would be the same as those associated with performance on full FCE protocols.

1.5 Significance of the Study

Full FCE protocols are considered burdensome or 'weighty' tools in terms of time and money. Short-form FCE on the other hand appear to reduce the time of assessment without affecting the outcomes of recovery. Knowing whether the same factors that influence full FCE protocols also influence SF-FCE will provide additional trust that the same construct is being measured with both forms of assessment. If results are found similar, then clinicians will have further evidence and justification for using a briefer, less burdensome FCE approach. This will save time and money for the stakeholders without compromising quality information gained from full FCE.

Additionally, injured workers will benefit as participating in fewer FCE items will be less likely to aggravate claimant's pain and related symptoms.

1.6 Definition of Terms

1.6.1 *Functional Capacity Evaluation (FCE):* An FCE is an assessment of work ability that is used to make recommendations for participation in work.[25]

1.6.2 *Short Form Functional Capacity Evaluation (SF-FCE):* An abbreviated protocol derived from full FCE protocols to determine future work status, thereby decreasing burden and time of assessment.

1.6.3 *Workers' Compensation Board Alberta (WCB-AB):* WCB-Alberta is a quasi-governmental agency regulated by the provincial government to administer the *Workers' Compensation Act* for the province's workers and employers. Funded by employers, WCB-Alberta attempts to provide cost-effective disability and liability insurance for work-related injury and illness. They compensate workers for lost income and coordinate the health care and other services they need due to a work-related injury.[26]

1.6.4 *Musculoskeletal (MSK) System*: A system that provides shape, support, stability, and movement to the body. The main structures of this system are bones, muscles, cartilage, tendons, ligaments and joints.

1.6.5 *Work-related Musculoskeletal Disorders (WMSDs*): WMSDs are relatively diverse disorders that may affect different structures like bones, muscles, cartilage, tendons, ligaments and joints at work.

1.6.6 *Work Disability*: Getting injured or sick at work, causing hindrance in getting back to work, can be termed as work disability.[27]

1.6.7 *Return to Work (RTW)*: Injured workers getting back to sustainable work after a period of work loss due to injury or sickness.[28]

1.6.8 *Reliability*: The degree of consistency with which an instrument or rater measures a variable.[75] Different forms of reliability include:

1.6.8.1 *Test-Retest Reliability:* The degree to which an instrument is stable, based on repeated administrations of the test to the same individuals over a specified time interval [75]

1.6.8.2 *Inter-rater reliability:* The degree to which one rater can obtain the same rating on multiple occasions of measuring the same variable.[75]

1.6.8.3 *Intrarater reliability:* The degree to which two or more raters can obtain the same ratings for a given variable.[75]

1.6.9 *Validity*: The degree to which an instrument measures what it is intended to measure.[21] Some various forms of validity include:

1.6.9.1 *Face Validity:* The assumption of validity of a measuring instrument based on its appearance as a reasonable measure of a given variable.[75]

1.6.9.2 *Content Validity:* The degree to which the items in an instrument adequately reflect the content domain being measured

1.6.9.3 *Construct Validity*: The degree to which theoretical construct is measured by an instrument.[75]

1.6.9.4 *Criterion-Related Validity*: The degree to which the two different instruments or methods are able to measure the same construct.[75]

1.6.9.5 *Predictive Validity*: A form of measurement validity in which an instrument is used to predict some future performance.[75]

CHAPTER 2

Literature Review

2.1 Return to Work Assessment

Health care professionals are often asked to identify a worker's functional capacity related to work. This typically involves examination and assessment procedures to determine whether the worker is able to resume date of accident duties, whether they need modified work duties or hours, and, if modified work is required, how long this adjustment is required. In the process of assessment and determining work ability, Functional Capacity Evaluation (FCE) is often considered as an important tool. FCEs are designed to help in determining the capacity of the worker for comparison with the functional status of his/her job demands.[29]

2.2 Functional Capacity Evaluation

Functional Capacity Evaluations (FCE) are performance-based assessments of work ability that are used to make recommendations for participation in work and other activities of daily living.[30] They typically are methodical, comprehensive, performance-based series of dynamic tests designed to evaluate an individual's abilities or performance in workplace-related tasks.[12] FCE evaluators usually interpret results within the context of the individual's broader context, taking into consideration personal factors, professional commitments, environmental factors and health status.[31]

FCE provides information to the worker, employer, physician, and insurance underwriters. The end result is that the worker and the employer obtain information regarding the functional capacity of the worker, on the basis of which goals about RTW can be made.[32] This information also provides a background for the worker to know more about their work tactics and recognize that adhering to work in a safe manner, within the limitations or restrictions outlined during the FCE, may prevent re-injury. Employers also gain information about when the employee is ready to RTW, what are the chances of re-injury, and whether the worker will be capable of sustainable work or not.

2.3 Uses of Functional Assessment

FCEs are used in various situations in order to estimate the worker's capability. The most common uses of Functional Assessment are in the following areas: [33]

- Pre/Post-employment screening
- Pre-Rehabilitation assessment
- Return-to-work Assessment
- Vocational Rehabilitation/Re-training (Physical Suitability Analysis)
- Disability/Medical-legal assessment
- Periodic Functional Screen

2.4 Background of FCE

As mentioned earlier, FCE is an evaluation of capacity of activities that is used to make recommendations for participation in work.[30] Clinicians keep different aspects in mind while selecting FCE protocols for use in practice, or the various items that should be included in functional testing to draw results from the FCE. The major things taken into consideration include: safety, reliability, validity, practicality and utility.[34] Legge et al, describe these attributes in the following way:[35]

Table 2.1: Key Attributes of work-related assessments

Attribute	Description
Safety	The test is safe to administer for both the participant and the assessor
Reliability	The test results are reproducible on any occasion between evaluators (inter-rater) and participants (test-retest)
Validity	The test measures what it reports to measure and is predictive of performance
Practicality	The test is easy to administer with reasonable or minimal cost
Utility	The functional test related to job performance and meets the needs of the involved parties

2.5 Models of FCE

FCE protocols have a status of being either standardized or non-standardized (i.e. customized). Standardized FCEs are typically more often commercially available, considered reliable, and conducted based on consistent procedures whereas non-standardized protocols are often adapted or designed as per the specific worker's need.[36] When standardized FCEs are discussed, the main models of FCE in use are the biomechanical, physiological, psychophysical, and kinesiophysical approaches.[37] These models guide how stopping points are determined during FCE and will be discussed below.

Biomechanical Model of FCE addresses occupational issues related to anatomical structures of the human body. Impairments can be in the form of abnormal alignment of anatomical structures, diminished muscular strength, decreased range of motion, and reduced muscular endurance. These disabilities are evaluated during FCE to determine an injured worker's ability to return-to-work.[38] *Physiological model* of FCE is different from the biomechanical model in that it focuses more on assessing physiological parameters rather than assessing mechanics of joints and muscles. Physiological methods of assessing individuals determine work tolerance by measuring heart rate, respiration rate, and other physiological signs throughout the assessment. When both the demonstrated physiological capacity and work requirements match one another, an individual is considered to have full-time work tolerance.[39]

Other approaches include the psychophysical and kinesiophysical methods of FCE. Susan Isernhagen clearly describes and defines these approaches.[40] *Psychophysical* FCE is a method whereby individuals undergoing assessment determine their own maximum functional capacity. This allows the client to determine stopping points during testing, which has been criticized in the past as potentially encouraging less than full effort by allowing the client to control performance level as opposed to the FCE clinician. In contrast, in the *kinesiophysical approach* the FCE evaluator determines maximum functional capacity and different effort levels (low, medium, high). The observer monitors for improper body mechanics, fatigue, lack of movement coordination, excessive heart rates, and/or unsafe methods of carrying out a task. The assumption is that if proper techniques and body mechanics are observed and guided carefully and safely, it ensures the worker's safety during assessment and after RTW.[41] However, little research has been done to compare and contrast these models.

2.6 FCE and ICF

The health/disability model that seems to best describe FCE is the World Health Organization's International Classification of Functioning (ICF) model. The ICF also appears to be the most commonly used model to determine work ability.[42] The ICF highlights that any disease or disorder both influences and is influenced by abnormality in bodily structures and function, the carrying out of activities, or participation in real-world tasks.[43] There might also be other influencing factors coming from the environment or from an individual's personal life. This series of associations can have many consequences. The condition, whether it is physical or mental, can also affect the individual's social life and work participation. Other personal and environmental factors such as age, gender, work environment, social background, education, profession and other environmental and personal factors influence work participation, which can influence an injured worker's life and RTW either positively or negatively.[35]

Further considering the relation of FCE and ICF, the definition of FCE takes the ICF into consideration: "*A FCE is an evaluation of capacity of activities that is used to make recommendations for participation in work while considering the person's body functions and structures, environmental factors, personal factors and health status*".[25] The ICF model is basically a conceptual framework of ability and FCE is an operational framework for assessing function and disability. For this reason, ICF can be used as a potentially useful classification system for FCE and related terminology as the assessment structured around the components of body structure and function (ie. physical examination) and activities (functional tasks tested) in an attempt to predict participation (i.e. return to work). Each of these are influence by personal and environmental factors, which may be influence or be associated with performance during FCE.

Results of a systematic review conducted by van Abbema et al found some evidence for biological and psychological factors that are or are not associated with FCE results, but also much conflicting evidence.[44] Evidence on the influence of social factors was largely absent. A study conducted by Gross et al to determine factors influencing results of full FCE protocols in workers' compensation claimants with low back pain concluded that the performance of FCE is influenced by physical factors (age and sex) and psychological factors (perceptions of disability, pain intensity, recovery expectations).[24] On the other hand, perceptions of workplace organizational policies and procedures were not associated with FCE results.[45] Social factors

have not been as researched as often as physical and psychological factors, and additional research is needed to more fully understand the social factors associated with performance during FCE.

2.7 Process of Conducting FCE

FCE is carried out through a commercially available standardized protocol or it is done in a non-standardized fashion, the overall procedure for conducting FCE remains similar. This typically consists of a detailed interview of the worker, musculoskeletal assessment, functional assessment, and report to stakeholders.[41] Like any other assessment procedure, FCE typically starts with an informed and written consent of the participant after they are made aware of the risks associated with the process. After this, the evaluator collects general information from the participant, followed by a thorough musculoskeletal examination based on the worker's current signs and symptoms, past medical history, pharmacological history, treatment procedures and radiological findings, if any.[46] Vital signs of the patients such as blood pressure and heart rate are often taken before commencing physical testing. After this, functional tests related to specific parts of the body (*upper extremity*-neck, shoulders, arm, elbows, forearm, wrist or hand; *back*-cervical, thoracic or lumbar; and *lower extremity*-hips, thigh, knees, legs, ankles and feet) are performed or the body is tested as a whole.[47] After the assessment is complete a written report is typically completed comparing demonstrated function to required physical job demands, along with the clinician's interpretation of results, chances of returning to work, and whether further recommendations of rehabilitation and/or treatment are needed.[48]

2.8 FCE Methodologies

There are a wide variety of FCE protocols that can be either carried out in a workplace environment or done in various clinical settings. There are different proprietary FCE systems that require formal training through post-graduate clinician training. Some of these systems use specially designed computer programs to generate results. However, for most FCEs the administering clinician interprets results and prepares a report manually. Some examples of these proprietary FCEs are Isernhagen/Workwell FCE (WorkWell), JobFit System PEFA, Matheson FCE, ErgoScience PWPE, Blankenship FCE, Key FCA, and WorkHab FCE.[49] Test items in most of these protocols are based on the activities of work outlined in the Dictionary of Occupational

Titles.[50, 51] An FCE protocol has traditionally been deemed as having adequate content validity if it contains items representing all 20 of these work activities. This can make the full, standardized protocols lengthy and time-consuming. At times, the protocols are split into 2 testing sessions, with performance on the second session compared to the first session to determine whether exposure to work activities can be sustained.[11]

There have been various studies conducted on the reliability and validity of the various proprietary systems. Four of the most popular systems were evaluated in a recent systematic review by Goutterbarge et al,[35] including the Blankenship system (BS), Ergos work simulator (EWS), Ergo-Kit (EK) and WorkWell FCEs. These authors concluded that the WorkWell FCE protocol was considered a good assessment tool because validity to measure actual work-related activity had been tested and found acceptable in various studies. Several test-retest reliability studies have been done on the Isernhagen Work Systems and WorkWell FCE protocols. Reliability of the items in these protocols has varied from Intraclass Correlation Coefficient (ICC) = 0.75 to 0.98, with highest reliability found for the lifting items, indicating acceptable to excellent reliability.[76, 77] An ICC of 0.75 or more is considered as acceptable reliability for clinical measures. All eight manual handing tasks had ICC values above 0.75, which indicated that these tests are reliable. whereas reliability and validity of the Blankenship system (BS), Ergos work simulator (EWS), and Ergo-Kit (EK) are lacking. In comparison to other proprietary protocols, the WorkWell FCE was considered to have moderate to good inter-rater reliability and predictive validity.[49] Due to this evidence base, the WorkWell FCE is still used predominantly by the Alberta Workers' Compensation Board as the protocol of choice. It is also the protocol from which the SF-FCE we are investigating was derived. Therefore, throughout this thesis the WorkWell FCE will be referred to as the 'full protocol'.

In addition to proprietary FCE protocols, clinics have also developed their own customized FCEs to assess an individual's work abilities and limitations. However, reliability and validity of non-standardized assessments are difficult to evaluate.[52]

2.9 FCE Issues

2.9.1 Evaluator qualifications

FCE developers typically provide training to people from different backgrounds to ensure that evaluation and report writing are standardized. Some FCE designers have specially designed training programs with the name of "train-the-trainers" whereas other companies offer certificate courses to individuals who desire to carry out FCE. However, special training does not ensure valid and reliable measurements of FCE. Therefore, more research is required to determine how much training should be given to individuals in order to consider that the evaluators are competent in carrying out the necessary procedures of FCE.[53]

2.9.2 Safety

Another important issue that should be addressed properly during an FCE is safety. In order to protect an individual from aggravating an injury and ensuring whatever they are doing is safe, the evaluator is often recommended to be an active participant by continuously monitoring the participant's way of performing tasks. Safe body mechanics and procedures are generally adhered to in an attempt to ensure that FCE will not cause harm, especially during lifting and carrying tasks. If during the session, the evaluator feels that correction of abnormal behaviours, improper postures and counseling does not help to correct the activity, the activity is stopped and documented.[54] Other test items are less stringent and allow the workers to demonstrate function as they would be conducted in typical work. However, some research has shown that participation in FCE tasks is associated with post-assessment pain exacerbation lasting up to 3 weeks.[36] Minimizing the amount of strenuous physical effort during FCE may be beneficial for reducing these post-assessment flare-ups.

2.9.3 Psychological Component of Assessment

Workers' physical strength and efforts are usually analyzed in an FCE but the motivation level, psychosocial factors, or the environments in which they work are typically not taken into account. Workers at times are seen as lacking in active participation during FCE, and this can limit findings and generate results that will not match the actual physical capability of an individual.[55] However, it is unknown why some workers are unwilling participants, provide less than full effort, or display erratic behaviours during FCE. It may be that factors such as pain, depression, low workplace support, or other psychological factors are influencing performance

during FCE. Currently it is unknown how much performance during FCE is influenced by psychological factors or how to interpret these types of assessment findings.

2.9.4 Assessment Duration

Many researchers have questioned the optimal duration of FCE. A full FCE is typically a lengthy assessment procedure, consuming time and money of both the client and the evaluator. The rationale for lengthy and multiple-session procedures arose from an attempt to simulate a repetitive working schedule of 8 hours a day, 5 days a week. When carried out over multiple session, assessment can simulate the working schedule and be helpful for obtaining results matching the job demands and capacity of the worker. However, a multiple session assessments procedure can be extremely burdensome for all involved stakeholders.[56] There is a possibility of reducing time by eliminating the musculoskeletal examination from FCE and by keeping it as a separate entity of assessment.[57]This would reduce time and expense for carrying out FCE, however some information is lost including the musculoskeletal findings to compare with functional ability. Other researchers have stated that a region specific FCE or a short-form FCE (SF-FCE) could be created depending upon the diagnosis or part of body injured to determine RTW ability in less time and with limited expense.[58] It may be that all of the useful functional or behavioural information obtained in a full FCE protocol could be obtained in a shorter protocol.

2.10 Short-Form Approaches

Lechner et al and Isernhagen have given arguments against using SF-FCE. SF-FCEs have less overall exposure to work activity when testing the individual's capacity, which may impact the validity of testing.[38, 59] According to these authors, SF-FCEs do not provide trustworthy data to support the degree of disability since they are less comprehensive. They suggest that SF-FCE may not be able to determine the stamina of a full work shift. To examine whether full FCEs are comparable to SF-FCE, a series of studies done by Gross and colleagues have demonstrated that SF-FCE can save time in completing an evaluation without negatively affecting RTW outcomes, and predict RTW as well as full FCE protocols.[59, 60] These results suggest there may not be a need to go through lengthy FCE procedures.

Gross and co-investigators initially developed and validated their SF-FCE protocol in patients with low back pain.[22, 45] They observed that 3 items within the WorkWell FCE protocol could

predict RTW as well as the full protocol. The 3 items identified and subsequently included in the SF-FCE were floor-to-waist lifting, 60-second crouch test on a flat surface, and a 30-minute standing tolerance test. Two other items from the University of Michigan's Functional Assessment Screening[61] were added to these 3 items to form a region-specific trunk SF-FCE. This SF-FCE can be tested within an hour and are straightforward to understand and implement. Other 5-item protocols were similarly developed for the upper and lower extremities.

If these SF-FCE protocols capture the relevant functional and behavioural information for determining work ability, barriers to RTW, and predicting RTW, there is no need for conducting full FCE protocols. There is especially little need to test items that are unrelated to the claimant's condition, such as assessing handgrip, hand coordination, balance, or other activities that have no connection with back pain.[59] A similar conclusion was drawn in a study done on patients with early osteoarthritis of hip and/or knee where it was determined that fewer tests can be used to determine the capacity of an individual and there is no need to go through a full FCE protocol.[43] The results of this study showed that patients with osteoarthritis could be tested with only 3 activities (lifting low, lifting overhead and carrying) over 2 consecutive days. Based on their results, they also concluded that the amount of time spent on FCE testing could be reduced, thus encouraging SF-FCE.[43]

In a similar context, a study was done by N. Hollak to develop an efficient or shortened protocol for a hand FCE.[54] The authors concluded that a shorter FCE protocol is a reliable measure in healthy individuals to evaluate hand capacity. According to this study, a reduction in the number of trials of hand function assessment was considered reliable and recommended for use during assessment of workers with hand injuries instead of going through a full FCE.[54]

2.11 Significance of SF-FCE protocols and need for further research

Full FCE protocols are considered 'weighty' tools in terms of time and money. SF-FCE, on the other hand, appear to reduce the time and burden of assessment without affecting the outcomes of recovery.[22] More studies are, however, required to confirm that SF- FCE can replace longer FCE protocols and be a valid and efficient tool of fitness for work assessments. Specifically, factors influencing SF-FCE should be examined to determine whether they are the same as full FCE protocols. As mentioned, physical and psychological factors have been found associated

with claimant performance during full FCE, however, it is unknown whether the same factors influence performance during SF-FCE. It may be that shortening the duration of the assessment and reducing the number of test items leads to reduced pain exacerbation and a reduced influence of psychological factors, with more of a focus on 'physical' ability. If this is the case, psychological and self-report measures would likely not be significantly associated with SF-FCE performance. However, if the SF-FCE is measuring the same behaviours as those observed during full FCE protocols, the same physical and psychological factors will be found significantly associated.

CHAPTER 3

Methodology

3.1 Study Design

A cross-sectional study design was used. A secondary analysis was conducted on the data obtained in a previous cluster randomized controlled trial examining the effectiveness of a SF-FCE in comparison to full FCE.[22] All participants were workers' compensation claimants who were assessed between October 18, 2004 through May 6, 2005, at a workers' compensation rehabilitation center in Edmonton, Alberta, Canada.[22] The University of Alberta Health Research Ethics Board approved this study.

3.2 Subjects

As mentioned, this is a secondary analysis of existing data. The inclusion and exclusion criteria were defined for the original study as follows:

Inclusion Criteria: Claimants were included if they had compensated work-related injuries, were considered eligible and safe by a physician to go through an FCE procedure, had completed their medical examination and investigation procedures, and did not need further diagnostic investigations. Additionally, we only included claimants undergoing SF-FCE since they were the only ones with complete data needed for this analysis.

Exclusion Criteria: Claimants with brain injury, those diagnosed with occupational diseases (i.e. asbestosis) or those with incomplete data were omitted from the original study.[22] The only additional exclusion criterion we added was that claimants with injuries of multiple body parts were excluded.

Claimants referred for FCE testing in the WCB-Alberta system are typically claimants who are considered to have met the necessary time required for healing, have completed their rehabilitation procedures, but are still having difficulty with work duties due to their presenting complaints.[22]

3.3 Data Collection

A cluster randomized trial was conducted, which means that assessing clinicians at WCB-Alberta's Millard Health were randomly placed into two different groups, an intervention and control group. This is different from traditional randomization where patients are randomized into groups. Following clister randomization one group of clinicians was trained in conducting SF-FCE while the other group of clinicians performed the full WorkWell FCE protocol. Clients were assigned to these groups through a cluster randomization process. We only used data from claimants assigned to the SF-FCE group since only these claimants had raw data available on short-form FCE performance. Data for this study are available within Douglas Gross' lab at the University of Alberta where it is stored on password-protected computers.

3.4 Measures

SF-FCE – At the time of the original study, the WCB-Alberta used the WorkWell protocol for FCE procedures. The WorkWell protocol consisted of over 20 different tasks including: lifting, carrying, pushing, pulling, walking, positioning, sitting, standing, grip strength measurement, turning, bending, kneeling, squatting, crouching and crawling. Qualified and trained clinicians at Millard Health carried out the FCE protocols. As discussed previously, tasks from the WorkWell were selected for the short-form FCE protocols, with separate region-specific protocols for the upper extremity, lower extremity and trunk. These protocols have been described in detail elsewhere.[60] The specific items in these protocols are shown in Table 3.1 below. Some claimants underwent testing of these 5 items on one session, while others completed all 5 items on 2 sessions. The number of sessions depended on the referral question at time of the assessment.

The number of 'failed' tasks in the SF-FCE protocol was one of the two main measures in this study. Each SF-FCE protocol, representing Upper Extremity, Lower Extremity and Trunk protocols, was made of 5 core items or tasks. Within these protocols, the number of items in which the claimant's performance did not meet or exceed physical demand requirements of work (determined through interview, questionnaire, or physical demands analysis) was given a rating of 'fail'. If all items were failed, the claimants overall score was 5 indicating that the claimant failed all 5 items in the protocol. And if all 5 tasks were passed, score was a '0' indicating that none of the items was failed by the claimant. This variable 'number of failed tasks' was used as

the variable to determine the association between SF-FCE performance and physical and psychosocial factors such as age, sex, pain and disability perceptions, and recovery expectations, among other factors. This variable was treated as a continuous variable ranging from 0 (failed none, good performance) to 5 (failed all tasks, poor performance) that represented the number of failed items within the protocol. We also examined associations with the amount of weight lifted on the manual handling item within each protocol (continuous variable).

Other variables that were included in the analysis of factors influencing FCE included self-rated health (Pain Disability Index), pain intensity (Visual Analogue Scale of Pain), perceptions of workplace support (Workplace Organizational Policies And Practices Scale), and recovery expectations (Recovery Expectations Questionnaire). Each of these is discussed below.

Table 3.1: Comparison of Items in the Three Region-Specific Short Form Functional Capacity Evaluation Protocols[22]

Trunk	**Upper Extremity**	**Lower Extremity**
15-min stand	Waist to overhead lift	15-min stand
Floor to Waist Lift	Sustained Elevated Work	Floor to Waist Lift
1-min Crouch	Crawling	1-min Crouch
2-min sustained Trunk Flexion	Hand Grip Strength	2-mins kneel
5-min repetitive trunk rotation	Hand Coordination	Stepladder or stairs

3.5 *Pain Disability Index*

The Pain Disability Index (PDI) is a questionnaire designed by Pollard to assist in measuring an individual's level of pain-related disability. This questionnaire has 7 items representing different activities of daily living, which includes family responsibilities, recreation, social activity, occupation, sexual behavior, self-care, and life support activities. Respondents are instructed to report the level to which various activities are hampered because of their pain. Each item is measured with a 0-10 scale and the overall score is summed. The minimal score is thus 0 and maximum is 70 (although a percentage score is also used to accommodate for missing data). The higher the score, the greater is the person's disability due to pain [62, 63] The percentage PDI was used and treated as a continuous variable. As per the study done earlier by Gross et al, it was found that performance on full FCE was moderately associated with pain-related disability as measured by the PDI. Therefore, we hypothesized that performance on the SF-FCE would also be significantly associated with the PDI scores (higher perceived disability associated with worse FCE performance).

3.6 Visual Analog Scale

The pain Visual Analog Scale (VAS) is a single-item scale used to measure the intensity of pain. The VAS used in this study was reported on a horizontal line, having 0 (no pain) at one end and 10 (maximum pain) on the other end.[24] Claimant ratings of increasing pain intensity on the 10-point VAS has been found associated with diminished performance on FCE, and scores have also been found predictive of future RTW among workers' compensation claimants. This variable was treated as a continuous variable (out of 10). In Gross et al's previous study, claimants having lower pain intensity scores on VAS were observed to lift more weight and fail fewer FCE tasks. Therefore, it was hypothesized that the SF-FCE would also be significantly associated with pain intensity reported by the client (higher pain intensity associated with worse FCE performance).

3.7 Recovery Expectations Questionnaire

The Work-Related Recovery Expectation Questionnaire designed by Gross and Battie, includes three items that ask respondents to rate their level of agreement with statements regarding their beliefs about present and future work abilities.[24] This scale has been found to predict future

RTW in claimants with low back pain.[64, 65] The average scale score was used and treated as a continuous variable out of 5. In univariable analysis, the recovery expectations measure was found to moderately correlate with performance on full FCE. Therefore, we hypothesized that it would be significantly associated with performance during the SF-FCE (better expectations associated with better FCE performance).

3.8 Workplace Organizational Policies and Practices Scale (OPP)

The OPP scale was designed by Amick et al to measure workers' perceptions of health and safety policies and procedures at their workplace. Twenty-two different items are rated on this scale from 1 to 5, where 1 is strongly disagree and 5 is strongly agree. The factors assessed through this scale are safety culture, ergonomics and disability management.[24] Only the safety culture scale was used in this study and it was treated as a continuous variable out of 5. We hypothesized that the OPP scale would not be significantly associated with the SF-FCE results, which is consistent with previous results in a study of factors influencing FCE performance.

3.9 Age, Sex, and Injury Duration

It was found in the previous study done by Gross et al that performance on the full WorkWell FCE protocol was associated with claimants' age, sex, and injury duration but these associations were small.[24] These were judged to be physical factors as opposed to psychological factors such as the claimant scores on the self-report questionnaires. Younger males lifted more weight on the FCE floor-to-waist lifting test.[24] Claimants with longer injury durations had more failed FCE items.[24] Therefore, we hypothesized that age, sex and injury duration would be significantly associated with SF-FCE performance (older and female workers will perform to lower levels while claimants with longer durations would fail more SF-FCE items), although the correlation magnitude will be small, consistent with previous research.

3.10 Statistical Analysis

Little data cleaning was required since this data was previously used for research. We calculated descriptive statistics including percentages and means/standard deviations for all the claimant characteristics and clinical variables. We examined differences between those claimants with

missing and no missing data using the chi square test for categorical variables and t tests for continuous variables.

In order to determine the association between performance on short-from FCE and factors hypothesized to influence performance, Pearson correlation was used for continuous variables and Point-Biserial correlation was used for dichotomous variables (i.e. sex). Correlation coefficients between 0 to 0.3 were judged as low, 0.3-0.6 were judged as moderate, and above 0.6 were judged as high.[66]

All analyses were conducted using SPSS v23 and an alpha level was set at 0.05.

CHAPTER 4

Results

4.1 Population Characteristics

The data set included 450 injured workers with open workers' compensation claims for a wide variety of musculoskeletal disorders. The majority of claimants were employed (74%) and male (70%) (See Table 4.1). Average age of the sample is calculated as 43 years. The average annual gross income of these claimants was $40,000 CDN. Some of the clinical variables had missing data, however descriptive statistics for those variables with complete data were similar between those with and without missing clinical data and few statistically significant differences were observed between those with and without missing data. The only variable that was statistically significant between those with and without missing data was SF-FCE protocol used, with claimants undergoing the trunk protocol more likely to have missing data (29.9% missing versus 18.7% not missing).

Table 4.2 shows the descriptive statistics of the various clinical variables. The average amount of weight lifted from floor to waist was 31.6 lbs and 20.6lbs was lifted overhead on average. The number of failed SF-FCE tasks is on average 2.1 out of 5. The average PDI score was 46/100 and pain VAS was 4.3 out of 10. Claimants scored 3.7 out of 5 on average on the recovery expectation questionnaire, while the mean Workplace Support Questionnaire was 3.2 out of 5. Overall, these claimants had moderate levels of pain and disability, and most were neutral regarding their future likelihood of RTW.

Table 4.1 Claimant Characteristics			
Variable	**All Claimants in Dataset (n = 450)**	**Claimants with No Missing Data on Clinical Measures (N=316)**	**Claimants with Missing Data on Clinical Measures (N=134)**
All values represent mean (SD) or number (%)			
Male	313 (69.6%)	216 (68.4%)	97 (72.4%)
Employed	332 (73.8%)	237 (75.0%)	95(70.9%)
Age (years)	43.1 (11.9)	42.8 (11.9)	44.0 (11.7)
Days from injury to FCE	403.8 (836.9)	406.1 (905.4)	398.2 (650.4)
Language of the Claimant (English)	440 (97.8%)	309 (97.8%)	131 (97.8%)
Gross Annual Earnings Amount ($thousands CDN)	$40.2 (22.9)	$39.5 (22.8)	$41.7 (23.3)
Working in 'Blue Collar' Trade	220 (48.9%)	151 (47.8%)	69 (51.5%)
Number of Prior WCB Claims	4.2 (5.3)	3.9 (4.3)	4.9 (7.1)
Number of Healthcare Payments Prior to FCE	54.2 (55.5)	52.3 (55.5)	58.6 (55.6)
Number of PT, Chiro, and Physician visits prior to FCE	34.4 (33.8)	33.2 (33.9)	37.3 (33.7)
Diagnosis			
• Joint disorders	171 (38.0%)	119 (37.7%)	52 (38.8%)
• Sprain/Strain	150 (33.3)	104 (32.9%)	46 (34.3%)
• Fracture	61 (13.6%)	41 (13.0%)	20 (14.9%)
• Dislocation	22 (4.9%)	16 (5.1%)	6 (4.5)
• Contusion	16 (3.6%)	12 (3.8%)	4 (3.0%)
• Laceration	13 (2.9%)	9 (2.8)	4 (3.0%)
• Nerve Damage	12 (2.7%)	12 (3.8%)	0 (0%)
• Other	5 (1.1%)	3 (0.9%)	2 (1.5%)
Type of SF-FCE			
Single Session	299 (66.4%)	209 (66.1%)	90 (67.2%)
Two Sessions	151 (33.6%)	107 (33.9%)	44 (32.8%)
SF-FCE Protocol Used*			
Trunk	99 (22.0%)	59 (18.7%)	40 (29.9%)
Upper Extremity	234 (52.0%)	171 (54.1%)	63 (47.0%)
Lower Extremity	117 (26.0%)	86 (27.2%)	31 (23.1%)

** Statistically significant difference ($p < 0.05$) between claimants with and without missing data.*

Table 4.2 Descriptive Statistics for Clinical Variables in Claimants with no Missing Data	
Variable	**n (%) or Mean (SD) (n = 316 unless stated)**
Number of Failed SF-FCE Tasks (out of 5)	2.1 (1.6)
Percentage Failing SF-FCE Tasks	
Failed none	88 (19.6%)
Failed 1	81 (18.0%)
Failed 2	106 (23.6%)
Failed 3	84 (18.7%)
Failed 4	45 (10.0%)
Failed 5	46 (10.2%)
Floor-to-Waist Lift (lbs, n = 133)	31.6 (22.6)
Waist-to-Overhead Lift (lbs, n = 16)	20.6 (9.0)
% Pain Disability Index	46.2 (21.0)
Pain Visual Analogue Scale (out of 10)	4.3 (2.6)
Recovery Expectation Questionnaire (out of 5)	3.7 (0.9)
Workplace Support Questionnaire (out of 5)	3.3 (1.0)

4.2 Correlations

Table 4.3 shows correlation coefficients between the various descriptive variables and SF-FCE performance variables. SF-FCE performance is measured for all claimants using the number of failed FCE tasks, and for claimants with trunk and lower extremity injuries it is measured with floor-to-waist lifting in pounds. A significant, but medium-sized correlation (r = 0.36) was observed between number of failed items and floor to waist lift indicating these SF-FCE indicators measure a related, but different construct. It is indicative of the fact that as claimants lift more weight, they will have a lower number of 'failed' SF-FCE items that do not match their job demands. Age and sex show significant and small to moderate correlations with floor to waist lifting in pounds (r = 0.28 and -0.33 respectively). No other demographic variable had a significant correlation with either of the SF-FCE measures.

Table 4.3

Correlations Between Descriptive Variables and Short Form Functional Capacity Evaluation Performance

	SF- FCE: Number of Failed Items (n=316)		**Floor to Waist Lifting in Pounds (n=133)**	
	Pearson Correlation	**p Value**	**Pearson Correlation**	**p Value**
SF-FCE Number of Failed Items	1.0	-	- 0.36*	<.01
Floor to Waist Lift	-0.36*	<0.01	1.0	-
Sex	0.06	0.29	0.28*	<0.01
Age	-0.07	0.23	-0.33*	<0.01
English as Primary Language	-0.09	0.13	-0.03	0.70
Job Attachment Status	-0.04	0.52	0.02	0.84
Days between Injury to FCE	0.02	0.71	-0.06	0.52
Gross Annual Pre-Accident Earnings	0.07	0.23	0.03	0.77
Trades vs Other	-0.02	0.79	-0.04	0.67
Number of Prior WCB Claims	0.02	0.73	-0.08	0.36
Number of Health care Payments prior to FCE	0.11	0.06	-0.15	0.09
Number of PT, Chiro and Physician visits Prior to FCE	0.10	0.07	-0.13	0.15

* Correlation is significant at the 0.05 level.

Table 4.4 shows correlation coefficients between clinical variables and SF-FCE performance variables. A significant and small to moderate sized relationship is seen between the number of failed SF-FCE tasks and all patient reported questionnaire scores. Higher number of failed FCE tasks was significantly correlated with higher pain intensity (r = 0.15), higher self-rated disability (r = 0.39), worse recovery expectations (r = 0.31), and worse perceptions of workplace support (r = -0.13). On floor-to-waist lifting, the only clinical variable not significantly associated with FCE performance was the Workplace Support Questionnaire. Better lifting performance was significantly correlated with lower pain intensity (r = -0.24), lower self-rated disability (r = -0.43), and better recovery expectations (r = -0.19).

Table 4.4
Correlations Between Clinical Variables and Short Form Functional Capacity Evaluation Performance

	Short Form FCE: Number of Failed Items (n=316)		**Floor to Waist Lifting in Pounds (n=133)**	
	Pearson Correlation	**p Value**	**Pearson Correlation**	**p Value**
Overall Percentage PDI	0.39*	<0.01	-0.43*	<0.01
Visual Analogue Scale	0.15*	0.01	-0.24*	0.01
Average Recovery Expectations Questionnaire	0.31*	<0.01	-0.19*	0.03
Average Score on Workplace Support Questionnaire	-0.13*	0.02	0.10	0.25

* Correlation is significant at the 0.05 level.

CHAPTER 5

Discussion

The purpose of this study was to determine what factors are associated with SF-FCE performance in workers' compensation claimants. As per a previous study done by Gross et al, certain factors proved to be associated with and possibly affect performance of individuals undergoing a two-day WorkWell FCE protocol.[24] We wanted to see if same factors were associated with performance during SF-FCE.

5.1 Hypotheses Confirmed

The results of our study matched our initial hypotheses for all variables except injury duration. Our results show that there is a significant, small to moderate-sized correlation between claimant performance on the SF-FCE and pain intensity, self-reported disability, and recovery expectation variables. However, the observed correlation coefficients were lower, and typically just below the confidence intervals observed previously for full FCE. This indicates pain, disability, and recovery expectations may not have been as much of an influence on SF-FCE performance as it was during the longer, full WorkWell FCE protocol. The reason might be that the claimants were involved in less testing overall during the SF-FCE, which might not have aggravated and influenced the claimant's pain or disability perception as much as the longer protocol. This may have reduced performance during the full FCE, making performance more closely related to the self-reported scores. The lower correlations could also have been due to a difference in the number of failed FCE tasks variable. In previous studies, the number of failed items was calculated from 25 items tested during the full FCE, whereas in the current study the number of failed items was estimated from the 5 core tasks within the region-specific SF-FCE protocols. This difference may have reduced the magnitude of the correlations we observed since the variable range was limited compared to the full FCE. Alternatively, the lower correlation coefficients could be due to the different samples. The previous study included only claimants with low back pain whereas this study included claimants with a variety of MSK conditions. However, the correlations were still statistically significant and in the same direction.

In the current study, a significant and small to moderate sized relationship was seen between the number of failed SF-FCE tasks and all the self-reported questionnaires. A higher number of

failed FCE tasks (more than 3 failed tasks indicates 60% of tasks were failed from the SF-FCE protocol) were significantly correlated with higher pain intensity (r = 0.15), higher self-rated disability (r = 0.39), worse recovery expectations (r = 0.31), and worse perceptions of workplace support (r = -0.13). On floor-to-waist lifting, the only clinical variable not significantly associated with FCE performance was the Workplace Support Questionnaire. Better lifting performance was significantly correlated with lower pain intensity (r = -0.24), lower self-rated disability (r = -0.43), and better recovery expectations (r = -0.19).

Since this study is a replication of a previous study done by Gross et al to examine various factors associated with performance on full FCE, we can compare the magnitude of the correlation coefficients. In that previous study, univariate analysis showed that moderate sized correlations were seen between the number of failed items and scores on the PDI (r = 0.52), VAS (r = -0.37), and work-related recovery expectations questionnaire (r = 0.30). Moderate correlations were also observed between weight on the floor to waist lift and the PDI (r = -0.55) and VAS scores (r = -0.42).[24] These are consistently lower than the correlations seen in our current study.

Age and sex again showed a significant relationship with floor to waist lifting in pounds, consistent with the results for full FCE. The correlation coefficients were of similar magnitude and within the confidence intervals observed in the previous study. This relation supports that younger males demonstrated better performance during SF-FCE as compared to younger females. However, we did not observe a significant association for duration of injury, which in the previous study was significantly associated with the number of failed FCE tasks. It is unknown why duration of injury was not associated with the number of failed FCE tasks in our study, but it may be due to slightly different claimant characteristics. However, claimants in the current study averaged 406 days between injury and FCE while claimants in the previous study averaged 450 days, which is not a large difference and unlikely to explain differences in results.

There are other studies that have examined factors associated with FCE. A study was done in 2012 by Sandra E. Lakke, which described various factors that affect FCE in patients with musculoskeletal pain. The results were that motivation, chronic pain behavior, and sensation of

pain are the top 3 factors affecting performance on FCE.[67] This is consistent with our findings showing that higher pain intensity, higher perceived disability due to pain, and worse recovery expectations are significantly correlated to poor SF-FCE performance.

Another review was published based on literature from 1966 till 2003, which showed that certain psychosocial factors might influence FCE performance. The major factors that have been found to affect FCE performance as per that review were pain-related fear, self-efficacy, and illness behavior.[68] Self-efficacy beliefs have consistently been found associated with FCE lift performance. This shows that if one believes that he/she is going to succeed in accomplishing a task based on his/her capabilities, he/she would likely experience success during the FCE (i.e. higher demonstrated performance).[69] Similar results were seen in studies done by Lackner et al. [70, 71] Self-efficacy was not available for our analysis, but there appears to be some similarity between the concepts of self-efficacy and recovery expectations, which we found significantly correlated with SF-FCE.

Reneman et al. also studied the relationship between pain intensity, pain-related fear and FCE performance in patients with chronic low back pain.[72] Results showed a weak relationship between pain, pain related fear, and FCE performance. There were 25 different types of analyses done to estimate the correlation between pain intensity and pain related fears in that study. Out of 25, only 7 analyses found significant correlations. When significant, the contribution of pain intensity and fear was interpreted as small and not affecting FCE performance. In contrast to this, our findings showed significant associations with pain and reports of pain-related disability. This may be explained by the different social contexts of testing, with the Reneman study being undertaken in the Netherlands and outside the workers' compensation system.

Another study evaluated whether FCE performance was affected by kinesiophobia (fear of movement).[73] Results showed that participants who had kinesiophobic beliefs lifted a mean of 29.5 kg and were able to perform moderate to heavy work, which was not significantly different from participants who were not kinesiophobic. Strength of correlations between kinesiophobia and FCE performance was very low. Therefore, kinesiophobia did not appear to affect the performance of FCE. Our study, however, did not address kinesiophobia.

A systemic review published in 2011 evaluated 22 different studies related to factors affecting FCE performance. This systemic review commented on low level lifting, high lifting, carrying, and static lifting capacity. Low level lifting was found to be associated with self reported disability and specific self-efficacy, but was not found associated with pain duration. High level lifting was found to be associated with gender and specific self-efficacy, but no significant association was found with pain intensity or age. Carrying was also found to be associated with self-reported disability like low level lifting, but it was not related to specific self-efficacy, sex, or age. Static lifting was, however, associated with fear of movement/re-injury. [23] The findings of our study related to self-reported disability and recovery expectations appear to be consistent with this systematic review, but our findings related to age, sex, and pain intensity are inconsistent. This may be due to different populations included in previous studies, as those studies did not include workers' compensation claimants in their sample while our study sample was based on 100% WCB claimants.

Construct validity of FCE has also been examined in patients with Whiplash-Associated Disorders. Men were found to have more grip strength and lifted more weight than females, which is consistent with our results. FCE was moderately correlated with self-reported functional ability (Spinal Function Sort-SFS) and weakly correlated with self-reported disability (Neck Disability Index (NDI). Results related to the PDI (Pain Disability Index) in our study resemble that of NDI in the Whiplash study. Although the strength of the correlation was higher between FCE and psychological variables in patients with whiplash-associated disorders that in our sample of patients with a variety of MSK disorders.[74]

All the above studies have been done based on performance in full FCE, while the current study was based on the performance of SF-FCE. Besides the floor-to-wait-lift, the number of failed items and self-reported measures, other variables which were included in our study were the claimants' employment status, location of injury, type of injury, primary language, number of healthcare visits prior to the FCE, number of prior WCB claims, and diagnosis. There were no statistically significant correlations observed between these variables and FCE performance. When we compare the results of these factors to previous research,[24] the data on primary measures and descriptive variables such as: diagnosis, Human Resources Development Canada's National Occupational Classification physical demand code (sedentary, light, medium, or heavy

manual work), and employment status, do not seem to be important influences on FCE. However, one novel variable we included was self-reported perceptions of workplace support. This variable was significantly associated with the number of failed SF-FCE tasks, but the correlation coefficient was small (r = 0.13).

The SF-FCE is a relatively new format of FCE that seems to be efficient in terms of saving time and money. Overall, it appears that the SF-FCE is associated with the same clinical variables as the full WorkWell FCE protocol, which may be indicative of construct validity of this performance-based approach to functional testing. Since the results of this study match with that of the study done previously with a full FCE protocol, this study provides more evidence supporting the validity of the SF-FCE.

5.2 Comparing Characteristics of Samples in Previous and Current Study

Descriptive variables that were used in Gross et al's previous study were quite similar to those found in the current study. Prominent descriptive variables were: sex, employment status, age, days from injury to FCE, and diagnosis. Means for all these variables are somewhat similar to Gross et al's previous study based on the factors effecting performance of a full FCE. A moderate level of pain and disability was found in the claimants and most were neutral regarding their perception of returning to work. Additional descriptive variables which are included in this study but were not considered in the previous study are the language of the claimant, gross annual earnings, number of healthcare visits prior to FCE, working in 'Blue Collar' trades, number of prior WCB claims, and the number of healthcare payments and visits. None of these demographic variables had a significant correlation with either of the SF-FCE variables studied.

Self-reported measures used in both studies were identical. Pain Disability Index, Visual Analog Scale, Workplace Support Questionnaire, and the Work-Related Recovery Expectations questionnaire. The two variables measuring FCE performance were also the same, floor to waist lift and the number of failed FCE tasks. However, the number of failed items in the previous study was calculated from 25 items tested during the full FCE, whereas in the current study the number of failed items was estimated from the 5 core tasks within the region-specific SF-FCE protocols. This difference may have influenced the magnitude of the correlations we observed

since the SF-FCE number of failed items has a limited range compared to the full FCE. However, floor-to-waist lift was measured similarly between studies.

5.3 Correlation Between FCE Variables

It is evident from our results that if less weight is lifted by the claimants, there is a higher likelihood of the claimant 'failing' more SF-FCE tasks. In our current study, a significant, but medium sized correlation ($r = 0.36$) was observed between number of failed FCE tasks and floor to waist lift, whereas in the previous study, a strong correlation ($r = 0.60$) was observed between the same clinical variables. This difference might be due to the fact that the number of items tested were more in the full WorkWell FCE (25 items), and number of items tested in SF-FCE were less (5 items), as mentioned above. A strong correlation in the previous study might also be due to the fact that the claimants were suffering from a pain-mediated condition (low back pain), which supports the theory that in pain-mediated conditions, functional performance can decrease due to pain perceptions and pain influence in general. The current study included a wide range of work-related MSK conditions.

5.4 Study Strengths

The first and foremost study strength is related to the data collection itself. All the claimants were from the major rehabilitation facility owned and operated by the Workers' Compensation Board-Alberta, and data were collected for a previous study as part of regular patient care. Data were collected as part of a clinical trial comparing SF-FCE and full FCE, therefore, the data collection procedures were rigorous and generalizable to all claimants assessed at the facility. Another strength was the sample size, which was adequate for our correlational analyses ($n = 316$ and 133 for the number of failed FCE tasks and floor-to-waist lift respectively).

5.5 Study Limitations

A main limitation of the study was the amount of missing data on self reported questionnaires. It is not evident from the data why the claimants did not consistently complete the questionnaires. It is unknown whether claimants refused to complete the questionnaires or if they were not provided with these questionnaires during the assessment. However, descriptive characteristics for those variables with complete data were similar between those with and without missing clinical data. No statistically significant differences were observed between those with and

without missing data, indicating the missing data likely did not introduce an important bias to our results.

Another limitation of this study is that since the data was collected from one facility that is owned and operated by WCB-Alberta, results may not be generalizable outside the facility or province. Also, since this was secondary data collected as part of a clinical trial, manipulation of data was not possible and we were dependent on variables within the dataset. We were not able to add variables that may also have been associated with FCE performance or contact the claimants to ask them to fill out the self-report questionnaires. However, the dataset did have a wealth of information and the same variables used in the previous study examining factors influencing full FCE.

5.6 Implications for practice

Very few researchers have examined SF-FCE to determine whether it is a useful tool for functional assessment of injured workers in comparison to the longer full protocols. Despite this, shorter protocols appear to be gaining wider acceptance among developers of FCE protocols. This study adds to the work done previously related to SF-FCE. The results drawn from this study are similar to those obtained in the study conducted by Gross et al to determine factors influencing the results of full FCE protocols in workers' compensation claimants with low back pain. Performance on both full and SF-FCE appear to be influenced by physical factors (age and sex), and perceptions of disability and pain intensity. Since the results obtained from this study are similar to what was seen in a full FCE protocol, SF-FCE may be a useful tool that can replace more lengthy procedures and be more cost effective. However, more research is needed in other contexts and settings.

5.7 Recommendations for further research

More research needs to be done to evaluate the effectiveness of SF-FCE in various settings and contexts, and possibly with different protocols (i.e. head injury, traumatic psychological injury, amputation, and multiple body part protocols). Methods should also be devised and evaluated to train clinicians and make them familiar with this quick and relatively easy way to determine the functional capacity of an individual to see if SF-FCE implementation can save stakeholder's money and time while not affecting RTW and recovery outcomes. Psychological and social

issues can also be a major concern that needs to be addressed in workers' compensation claimants undergoing FCE. More research is needed to help clinicians understand what psychological and social factors affect claimant performance during FCE.

5.8 Summary and Conclusions

Better lifting performance on SF-FCE is significantly associated with younger age and male sex. Higher pain intensity, pain-related disability, and lower recovery expectations are significantly associated with more failed items on the SF-FCE. Results support our hypotheses that factors significantly associated with claimant performance on SF-FCE protocols would be the same as those previously found associated with performance on full FCE protocols. Further research is needed to evaluate the validity of SF-FCE in other contexts and settings.

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Appendices

1. Acronyms

- FCE: Functional Capacity Evaluation
- ICC: Intraclass Correlation Coefficient
- LBP: Low Back Pain
- MSK: Musculoskeletal
- NDI: Neck Disability Index
- PDI: Pain Disability Index
- PT: Physiotherapist
- RTW: Return to Work
- SF-FCE: Short Form-Functional Capacity Evaluation
- SFS: Spinal Function Sort
- VAS: Visual Analogue Scale
- WHO: World Health Organization
- WMSKDs: Work related musculoskeletal disorders

2. Self Reported Questionnaires

Pain Disability Index and Visual Analogue Scale of Pain Intensity

PAIN DISABILITY INDEX

Millard Health

Service Line _____ **Program** _____

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

VISUAL ANALOGUE SCALE

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

0 ——————————— 10
no pain — unbearable pain

MH-158 Pain Disability Index R-03-02

Millard Health, 131 Airport Road, Edmonton, AB, T5G 0W6, Phone: (780) 498-3200, Toll Free: (888) 498-9902, Fax: (780) 498-3907

Work Related Recovery Expectation Questionnaire

The overall score is obtained by reversing the first item and then taking a summative average.
Please circle a number indicating how strongly you agree or disagree with each statement.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I believe I am physically capable of returning to my usual work activities.	1	2	3	4	5
I believe my symptoms would become worse if I were to return to my usual work activities now.	1	2	3	4	5
I believe that my injury will interfere with my ability to do my usual work activities in the future.	1	2	3	4	5

Organizational Policies and Practices Questionnaire

1. The company involves employees in plans and decisions made.
2. Workers have trust in the company.
3. Communication is open and employees feel free to voice concerns and make suggestions.
4. Working relationships are cooperative.
5. Workers tend to stay with the company for a long time.
6. Top management is actively involved in the safety program.
7. The company spends time and money on improving safety.
8. The company considers safety equally with production and quality in the way work is done.
9. Unsafe working conditions are identified and improved promptly.
10. Equipment is well maintained.
11. Action is taken when safety rules are broken.
12. Employees reprovided training in safe work practices for the job hazards they will encounter.
13. Jobs are designed to reduce heavy lifting.
14. Jobs are designed to reduce repetitive movement.
15. Someone from the company contacts the worker shortly after an injury or illness to express concern and offer assistance.
16. The company keeps track of the injured worker's absence and return to work.
17. The company works with the treating physician to develop a plan for return to work.
18. The company makes accommodations such as special equipment, flexible hours or modified job duties to allow injured worker to return to work
19. After the injured worker returns to work, the company follows up to adjust the work situation as needed.
20. When injured worker can't return to their job, the company provides retraining.
21. Labor and management work as partners in returning injured worker to work.
22. Labor and management work as partners in health and safety.

Ethics Approval

Approval Form

Date:	February 12, 2016
Study ID:	Pro00063067
Principal Investigator:	Douglas Gross
Study Title:	**Factors Influencing Results of Short-Form Functional Capacity Evaluations in Worker's Compensation Claimants**
Approval Expiry Date:	Friday, February 10, 2017

Thank you for submitting the above study to the Health Research Ethics Board - Health Panel . Your application, which constitutes the secondary analysis of anonymized WCB data, has been reviewed and approved on behalf of the committee.

A renewal report must be submitted next year prior to the expiry of this approval if your study still requires ethics approval. If you do not renew on or before the renewal expiry date, you will have to re-submit an ethics application.

Approval by the Health Research Ethics Board does not encompass authorization to access the patients, staff or resources of Alberta Health Services or other local health care institutions for the purposes of the research. Enquiries regarding Alberta Health Services approvals should be directed to (780) 407-6041. Enquiries regarding Covenant Health should be directed to (780) 735-2274.

Sincerely,

Anthony S. Joyce, Ph.D.
Chair, Health Research Ethics Board - Health Panel

Note: This correspondence includes an electronic signature (validation and approval via an online system).