MODELING WORK RETENTION IN CHRONIC DISABLING OCCUPATIONAL MUSCULOSKELETAL DISORDERS: THE ROLE OF PRE-TREATMENT AND POST-TREATMENT RISK FACTORS

by

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Presented to the Faculty of the Graduate School of

The University of Texas at Arlington in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF SCIENCE IN PSYCHOLOGY

THE UNIVERSITY OF TEXAS AT ARLINGTON

May 2011

ACKNOWLEDGEMENTS

I would like to thank the members of my committee, Dr. Angela Dougall, Dr. Pablo Mora, and Dr. Robert Gatchel, for their guidance and advice in the writing of this paper. I would also like to thank Dr. Tom Mayer and the staff of the Productive Rehabilitation Institute of Dallas for Ergonomics for allowing me to participate in their research program.

February 11, 2011

ABSTRACT

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Chronic pain has become an increasing problem, with serious social and economic consequences. One important socioeconomic outcome in the treatment of chronic disabling occupational musculoskeletal disorders (CDOMD) is work retention (WR), which reflects the patient's ability to both obtain and maintain employment following treatment.

A consecutive CDOMD patient sample received complete physical and psychosocial evaluations at admission to and discharge from a functional restoration program, and WR was evaluated one year later. It was hypothesized that the effect of economic and psychosocial factors at admission on WR would be mediated by those same factors at discharge .

A structural equation model was developed which included age; work status, government disability benefits, opiate dependence, perceived disability, and depressive symptoms at admission; and work status and perceived disability at discharge. Physical, psychosocial, and economic factors at admission and discharge interact to determine the maintenance of functional gains during the year following discharge.

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CHAPTER 1

INTRODUCTION

Chronic pain (pain present for more than 3-6 months) has become a pervasive medical problem in industrialized societies. Prevalence rates of chronic pain have been reported to average near 20% in the United States (Gatchel, Peng, Peters, Fuchs, & Turk, 2007), Europe, Israel (Breivik, Collett, Ventafridda, Cohen, & Gallacher, 2006), and Australia (Blyth, et al., 2001). Chronic pain is the most common complaint causing patients to seek medical care, as well as one of the leading causes of disability (Hardt, Jacobsen, Goldberg, Nickel, & Buchwald, 2008); and musculoskeletal pain is the primary reason for pain-related disability (Walsh, et al., 2008). More than half of all adults will experience musculoskeletal pain at some point in their life (McBeth & Jones, 2007), with 11% reporting non-minor pain within the preceding month (Hardt, et al., 2008). Costs of chronic musculoskeletal pain in the United States were reported to have reached $254 billion in 2008 (Walsh, et al., 2008).

Chronic pain conditions have a dramatic impact on the economy. According to the Americans Living with Pain Survey, 51% of chronic pain patients report that their productivity is affected by their pain (Roper, 2004). The American Productivity Audit estimates that pain conditions result in an annual loss of productivity amounting to $61.2 billion (Stewart, Ricci, Chee, Morganstein, & Lipton 2003). This includes losses from both absent workers and “presentees,” workers who remain at work but reduce their level of work activity due to pain (Howard, Mayer, & Gatchel, 2009). Loeppke et al. (2007) found that back and neck pain had higher total costs than any other condition when medical, pharmacy, and productivity costs were all considered.

Musculoskeletal pain disorders frequently result from occupational injuries. According to the United Stated Bureau of Labor Statistics (2009), musculoskeletal injuries including sprains or strains accounted for 39% of workplace injuries that required time away from work in 2008. Sprains and strains required a median of 9 days away from work, and back injuries accounted for

40% of these injuries. Repetitive motion injuries caused the longest work absences, with a median of 18 days away from work, and 38.4% of these injuries persisted longer than 31 days (Bureau of Labor Statistics, 2009). It is estimated that total costs for job-related injuries and illnesses exceeded $110 billion in 2005 (Leigh, 2008).

Disability due to chronic pain may begin as an acute injury. Pain triggered by an initial injury to tissue may exceed the body's capacity for healing, resulting in pain that is perpetuated by factors other than actual tissue damage (Loeser & Melzack, 1999). Although the majority of people who miss work due to low back pain (the most common musculoskeletal pain condition) recover within 3-4 months, those whose symptoms persist past that point are likely to remain disabled up to two years later (Mayer & Gatchel, 1988). When pain persists beyond 2-4 months, patients often develop persistent pain behaviors such as guarding, splinting, and protection of the injured area to reduce immediate pain. However, this reduction of mobility in the injured area results in a loss of strength, flexibility, and coordination. As the muscles of the injured area atrophy, they become irritable and are likely to spasm, causing the patient to experience increased pain. This leads to further disuse of the area and becomes a vicious cycle known as the deconditioning syndrome (Mayer & Gatchel, 1988).

Most people with occupational injuries can be treated through primary care, which is the patient's initial point of contact with the healthcare system. Primary care is usually administered by a single provider during the acute phase of injury, and involves basic symptom control using passive modalities such as non-steroidal anti-inflammatory drugs (NSAIDs), application of hot or cold, or massage. Patients who do not improve during the normal healing period are candidates for secondary care. During the post-acute phase of injury, the goal of treatment becomes reactivation of the injured area through physical or occupational therapy. Treatment involves exercise and education so that patients can safely increase their activity level without causing re-injury. A minority of patients will fail to respond to secondary care and develop chronic pain and serious disability. These patients require intensive tertiary care to regain normal function and reverse the effects of disability (Mayer & Polatin, 2000, Gatchel, 2005).

Tertiary care rehabilitation of patients with chronic disabling occupational musculoskeletal disorders (CDOMDs) requires an interdisciplinary approach to manage the physical, psychological, and social consequences of these conditions. Perhaps the best known interdisciplinary chronic pain management program is functional restoration. Functional restoration is a type of tertiary care that can be utilized when other interventions have failed. The program is guided by a supervising physician who coordinates the treatment team while emphasizing the setting of specific goals, leading to return to function. Other members of the treatment team include nurses, physical and occupational therapists, psychologists, and case managers (Mayer & Gatchel, 1988).

One of the hallmarks of functional restoration is an emphasis on compilation of objective data. Only by collecting physical and psychosocial measurements throughout the rehabilitation process can a patient's true progress be assessed. Prior to beginning treatment, patients complete a physical assessment designed to measure range of motion, muscle strength, aerobic fitness, and lifting capacity. Patients also undergo a complete psychosocial evaluation to assess pain, depressive symptoms, perceived disability, and psychiatric disorders. Socioeconomic information is collected, including measures of work status, relationship with employer, pending litigation, intent to return to work after treatment, and enrollment in government benefit programs such as Social Security Disability Insurance (SSDI) or Supplemental Security Income (SSI). All of these measurements are repeated at the end of treatment to document the extent of the patient's recovery. Most importantly, the patients are tracked after discharge to identify their post-treatment socioeconomic outcomes (Flores, Gatchel, & Polatin, 1997).

At one year post-treatment, patients are contacted either in person or by telephone, and a structured interview is conducted to assess socioeconomic outcomes. Although these measures are reported by the patient, and so in one sense are subjective, measures of work status have the advantage of being independently verifiable (Flores, et al., 1997). Two main measures of work status are work return and work retention. Work return can be defined as whether the patient was working at any point during the post-treatment year. It is the most widely studied socioeconomic outcome and has excellent face validity in assessing economic recovery. However, initial return to work does not always indicate long-term successful employment. Initial returns to work are followed by subsequent periods of disability in as many as 61% of workers (Baldwin, Johnson, & Butler, 1996). A less studied, yet equally important, outcome is work retention. Work retention can be defined as whether the patient is still working at one year post-treatment, regardless of the duration of post-rehabilitation employment. The ability to maintain work over time implies a level of recovery adequate to manage the physical and psychosocial demands of the workplace. Thus work retention may have greater significance than return to work as a measure of treatment success.

CHAPTER 2

THEORIES OF PAIN

2.1 Biological Basis of Pain Perception

Pain has traditionally been defined as "an unpleasant sensory or emotional experience associated with actual or potential tissue damage" (Merksey and Bogduk, 1994). The subjective experience of pain can be separated into the response of nociceptors in the peripheral nervous system, the perception and modulation activities of the central nervous system, and the emotional and cognitive responses resulting from the experience of pain.

There are three main types of nociceptors that all detect different types of tissue damage. Thermal nociceptors, which respond to extremes of temperature, and mechanical nociceptors, which respond to intense pressure, both feature small diameter nerve fibers with thin myelin sheaths and fast conduction. These fibers are referred to as Aδ fibers. In contrast, polymodal nociceptors respond to several types of stimulation including high intensity mechanical, thermal, and chemical inputs. Polymodal nociceptors are small diameter, non-myelinated nerve fibers with slower rates of signal conduction, called C fibers. In general, sharp, intense painful sensations are transmitted by the Aδ fibers, while slow, dull pain sensations are carried by the C fibers. Also contributing to pain perception are the large diameter, myelinated Aβ fibers, which do not directly respond to pain sensations, but rather modulate the responses of the nociceptors (Basbaum and Jessel, 2000).

The dorsal horn of the spinal cord contains several areas that are highly involved in pain perception and processing. Lamina I and lamina II receive direct input from both Aδ and C fibers. Many lamina I neurons respond exclusively to noxious stimuli, while lamina II neurons respond to both noxious and neutral stimuli. Neurons in lamina V receive inputs from a variety of nerve fibers, including Aδ, C, and Aβ fibers. These neurons respond in a graded fashion to noxious and neutral mechanical stimulation. The neurons of laminae I and V project to the thalamus via the spinothalamic tract, which is the most prominent ascending pathway for nociceptive input (Basbaum and Jessel, 2000).

Advances in neurological imaging procedures have contributed to the identification of brain regions involved in the perception and processing of pain. One of the most reliable findings is that the insular cortex, which processes information on the internal state of the body, is activated bilaterally in response to pain (Peyron, Laurent, and García-Larrea, 2000). The insula is believed to contribute to the autonomic response to pain and the integration of sensory, affective, and cognitive components of pain (Bausbaum and Jessel, 2000). The second somatosensory cortex and the associative parietal cortex are also activated during pain processing, and along with the insula, are involved in the discrimination of stimulus intensity (Peyron, et al., 2000). Another brain region associated with pain perception and processing is the anterior cingulate cortex (ACC). The ACC has been implicated in emotional, affective, and cognitive responses to pain. The dorsal-lateral pre-frontal cortex and the posterior parietal cortex are believed to be involved in attention to pain and localization of stimuli (Peyron, et al., 2000).

The thalamus receives projections from peripheral nociceptors via the spinothalamic tract and functions as a relay site for the processing of pain signals (Tracey and Mantyh, 2007). It is also believed that the thalamus is activated as part of a general arousal reaction to pain and functions as a part of the discrimination and attentional networks involved in pain processing (Peyron, et al., 2000). Other brain areas are involved in the descending modulation of pain signals. These include the periaqueductal gray area, which inhibits pain signals, producing endogenous analgesia effects, as well as the frontal lobe, insula, ACC, amygdala, and hypothalamus (Tracey and Mantyh, 2007).

2.2 Theories of Pain Perception

2.2.1 Gate Control Theory

In 1965, Melzack and Wall proposed what is known as the Gate Control Theory of pain. According to this theory, the transmission of nerve impulses from nociceptors to the spinal cord transmission cells is modulated by a gating mechanism. This mechanism in influenced by the relative amount of activity in the large and small diameter nerve fibers, such that signals from the large fibers tend to “close” the gate, while signals from the small fibers tend to “open” the gate. When the output of the spinal cord transmission cells exceeds the cortical threshold, the neural areas responsible for pain experience and pain behaviors are activated. In addition, the gate is influenced by descending impulses from the brain and spinal cord. When certain cognitive processing centers are active, the modulating properties of the gate are altered (Melzack and Wall, 1965).

In physiological terms, this means that the experience of pain results from the balance of activity in nociceptive and non-nociceptive nerve cells. Neurons in laminae I and V receive excitatory input from Aβ fibers, which are non-nociceptive, and Aδ and C fibers, which are nociceptive. Input from Aβ fibers inhibits the firing of neurons in lamina V by activating lamina II inter-neurons, which closes the gate. Input from Aδ and C fibers excites the lamina V neurons and inhibits the firing of inhibitory inter-neurons in lamina II, which opens the gate. Stimulation of the periaqueductal gray region has an analgesic effect, inhibiting the firing of nociceptive neurons in laminae I and V (Basbaum and Jessel, 2000).

Psychological mechanisms also play a role in Gate Control Theory. The gate determines a person’s perception of pain. Coping strategies that increase perception of control over pain, such as biofeedback or cognitive-behavioral therapy, have the same effect as descending inhibition, and tend to close the gate, decreasing pain. An open gate can be caused by cognitive and biological factors, which predisposes a person to pain and increase vulnerability to pain. An open gate may be caused by focus on pain, negative thinking, catastrophizing, stress, hopelessness, anger, and depression. Other factors that lead to an open gate are poor nutrition, inactivity, insomnia, and smoking (Gatchel, 2005).

2.2.2 Neuromatrix Theory

Although the Gate Control Theory explained many aspects of the experience of pain, some questions remained unanswered. While studying patients with phantom limb pain, Melzack (1999) developed the Neuromatrix Theory of pain. The theory proposes a widespread neural network that connects the thalamus, the limbic system, and the sensory cortex. The overall neural network includes smaller networks that function in parallel and contribute to the dimensions of the pain experience, including sensation, discrimination, emotional experience, motivation, and cognitive processes. The networks receive sensory input from the somatic receptor cells, visual/sensory input resulting from cognitive interpretation of sensation, cognitive input from the frontal and pre-frontal cortex, emotional input from the limbic systems, and intrinsic inhibitory input from the parasympathetic nervous system. Although the components of the pain experience are processed in parallel, the output of the synaptic connections of the entire network converges to produce a "neurosignature," which is the characteristic pattern produced by the processing of nerve impulses. The neurosignature is impressed on all nerve impulse patterns that pass through the Neuromatrix, and the pattern is transmitted to a neural hub that converts the neurosignature into conscious experience (Melzack, 1999).

2.2.3 The Biopsychosocial Model

The Biopsychosocial (BPS) model was proposed as an alternative to purely biological theories in recognition of the fact that psychosocial factors mediate the experience of pain. In many cases, organic and structural impairments do not predict either the intensity or duration of pain symptoms. Waddell (1992) identified five components to the BPS model that interact to produce pain and disability. First, the sensory system is responsible for the perception of painful stimuli through nociceptor responses and the modulation of perception by the descending activity of neural tracts. The modulation may result in either decreased perception of pain, through endogenous analgesia, or sensitization to pain. Next, the cognitive system includes attitudes and beliefs about pain that influence behavior in response to pain. Processes such as catastrophizing, assigning an excessively negative meaning to pain sensations, or kinesiophobia, an excessive fear that physical activity will lead to pain, serve to amplify the effects of pain. The affective system is also involved, producing psychological distress, increased bodily awareness, depressive symptoms, anxiety, and panic. The next component of the BPS model is illness behavior. This is the set of actions which communicate the fact that a person is experiencing pain, such as guarding, bracing, rubbing, or grimacing. The final component is the social environment, which determines the acceptable expression of pain behavior. This can vary considerably between cultures. For example, in industrialized societies, over 80% of people experience at least one episode of back pain, while in developing countries; the incidence of disability due to back pain is very low. The social environment includes compensation for injury, family structure, and opportunities for secondary gain, all of which increase the incidence of illness behavior (Waddell, 1992).

An alternative description of the BPS model proposed four primary components: a biological component, which includes physiological and neural functioning; a physical function component, involving the ability to perform activities of daily living; a psychological component, which involves both cognitive and emotional processes; and a social function component, which consists of the ability to carry out one's appropriate roles within a socio-cultural environment (Schultz, Joy, Crook, and Fraser, 2001). Pain is most complex when it persists over time, and psychological, social, and economic factors interact with physical pathology to modulate the experience of pain and the development of subsequent disability (Gatchel, 2005).

The BPS model focuses on illness, which is the result of the interaction between biological, psychological, and social factors, including genetic factors, prior learning, physiological processes, psychological status, emotional regulation, and socio-cultural context. All of these factors combine to shape one's perceptions of and responses to pain. Biological factors may initiate, maintain, or modulate physical changes, while psychological factors influence the appraisal and perception of internal physiological experience, including the personal meaning given to the pain experience. Social factors, such as the acceptable expression of pain and degree of stoicism or emotionality expected by the culture, shape the behavioral responses to pain. Some people have certain risk factors that predispose them to developing chronic pain. These may include the experience of trauma, previous episodes of pain, or a genetically determined low threshold for nociceptive activation. If a person at risk for the development of chronic pain encounters a persistent aversive internal or external stimulus that is associated with negative meaning, the sympathetic nervous system can be activated, motivating avoidance responses. These avoidance behaviors can develop into a set of maladaptive behavioral responses and inadequate coping mechanisms, leaving the person unable to reduce the physical and psychological impact of aversive stimuli. Operant conditioning mechanisms reinforce the avoidance responses and maintain the maladaptive behaviors, prolonging the experience of pain and producing disability. Cognitive processes, such as catastrophizing and rumination in response to stress or pain, can lead to an increased sensitivity to pain, a decrease in the pain threshold, and preoccupation with physical symptoms. Maladaptive physical responses, such as activation of the sympathetic nervous system, increased muscular reactivity, and central and peripheral pain sensitization can increase or exacerbate episodes of pain. In the end, the nature of the coping response determines the course of the illness. Strategies such as active avoidance, passive tolerance, and depressive withdrawal, tend to produce negative outcomes, while a strategy of confrontation or adaptation can lead to more positive outcomes (Turk and Flor, 1999).

2.3 Development of Chronic Pain and the Deconditioning Syndrome

2.3.1 The Stress-Pain Connection

Physical and psychological stressors can affect the body's response to pain. Following an injury, cytokines are released into the peripheral bloodstream. The cytokines travel to the brain to activate the hypothalamus prompting the restoration of homeostasis. If the injury is severe, the sympathetic nervous system is also activated, and adrenaline is released into the bloodstream. The perception of injury activates the hypothalamic-pituitary-adrenal axis, causing the release of corticotropin-releasing hormone from the hypothalamus and adrenocorticotropin hormone from the pituitary gland. This causes the activation of the adrenal cortex, which releases cortisol, readying to body to respond to a life-threatening situation. Although this reaction is beneficial in response to short-term threats, prolonged exposure to cortisol results in the breakdown of muscle protein, inhibits the replacement of calcium into the bone, suppresses the immune system, and causes degeneration of neural tissue. This results in destruction of muscle, bone, and neural tissues (Melzack, 1999). In addition, prolonged stress activates the limbic system, which influences emotion, motivation, and cognition. The established pain becomes a stressor in its own right and creates further demands on the body. Fear, anxiety, and beliefs about pain contribute to increased levels of stress, which increases the deviation from homeostasis, and begins the entire process over again (Turk and Monarch, 2002).

2.3.2 The Development of Chronic Pain

When pain is first encountered, it is referred to as acute pain. In this stage of pain, emotional reactions, such as fear, anxiety, and worry, develop due to the perception of pain. In acute pain, these reactions are adaptive as they prompt the search for ways to alleviate pain and motivate the seeking of medical attention. Other adaptive strategies for acute pain involve reduction of movement of the injured areas and resting to recover from injury. However, if the pain perception persists beyond two months, becoming subacute pain, these strategies become harmful, rather than adaptive. Psychological problems, such as learned helplessness and anger, and maladaptive behaviors, such as activity avoidance, begin to develop. Personality, psychosocial background, prior learning, and socioeconomic/environmental conditions influence the development of such problems. When pain persists past four months, it is referred to as chronic pain. Chronic pain causes considerable stress to the patient, and the patient’s life may begin to revolve around pain and the behaviors that maintain it. Secondary gain from the sick role, such as being excused from social and occupational responsibilities, also maintains pain and pain behaviors. This combination of factors contributes to reduced physical activity and can lead to what is referred to as the deconditioning syndrome. The decrease in strength, mobility, and endurance, resulting from disuse of the affected area leads to atrophy. The patient’s deteriorated physical state makes him or her more prone to muscle spasm and pain “flare-ups”, which can lead to even further reduced activity levels. The decline in physical condition interacts with the patient’s emotional state to cause negative emotions, such as depression and hopelessness, which can lead to still further reductions in activity (Gatchel, 2005).

There are also differences in the experience of anxiety between patients with acute vs. chronic pain. In acute pain, anxiety increases in proportion to the increase in pain intensity.

Once treatment begins, anxiety levels are sharply reduced, leading to decreases in pain perception. Anxiety is usually resolved before pain is completely relieved. In chronic pain, however, the initial anxiety related to pain does not decrease, but leads to increased pain sensitivity and perception. When the patient is unable to successfully reduce pain, anxiety is increased and contributes to despair and helplessness (Gatchel, 2005).

2.3.3 The Deconditioning Syndrome

In patients with chronic pain; range of motion, muscle strength, cardiovascular fitness, and lifting capacity are all decreased as a result of inactivity. Disuse of the musculoskeletal system leads to muscle atrophy, loss of joint mobility, and decreases in the ability to resist fatigue. In particular, splinting, bracing, and guarding to protect the injured area leads to localized muscle and ligament atrophy in addition to the decreased total body fitness. The resulting decrease in muscle endurance and tone and the decrease in aerobic capacity leads to deficits in proprioception, agility, and coordination. Additionally, the decrease in physical capacity predisposes the chronic pain patient to recurrence of injury. As inactivity persists, the state of lowered physical demands leads to further physical decline. The atrophied muscles become more irritable and subject to overload, increasing the incidence of muscle spasm, which is often interpreted by the patient as a new injury, leading the patient to reduce activity even further (Mayer and Gatchel,1988).

CHAPTER 3

LITERATURE REVIEW

3.1 Risk Factors for Work Retention

Very few studies have addressed work retention directly. Campello et al. (2006), operationalized work retention as a continuous variable: the number of days subjects remained on the job after being released back to work at the end of treatment. Any work loss exceeding three consecutive days or five days in a 12-month period was defined as failure to retain work. The study found that 75% of patients completing a multi-disciplinary work-reconditioning program retained work at two years after discharge. Using a multivariate regression analysis, the researchers identified three variables that significantly predicted work retention. Patients with high levels of Somatization 1 (bodily expression of psychological distress), as measured by the Symptom Checklist 90, revised (SCL-90R), or impaired trunk flexion at the beginning of the program were significantly less likely to retain work at 2 years after discharge. Patients with high levels of obsessive-compulsive symptoms on the SCL-90R were more likely to retain work at two years after discharge. The study failed to find any significant relationship between work retention and depression, anxiety, perceived disability, pain intensity, lifting capacity, or trunk extension.

There are several important limitations to this study. First of all, only patients with non-specific low back pain were included. Thus, results cannot be generalized to injuries involving any other body part, to painful spinal disorders that involve radiation to the leg, or to disorders involving a herniated disc or fractured vertebra. Second, patients who had received any type of surgery were excluded from the study, as were patients with severe levels of depression. These conditions are extremely common among patients suffering from chronic pain conditions. Third,

any patient who did not return to work immediately after treatment was excluded from the study. This has the effect of eliminating the most severely disabled patients and considering only the mildly impaired subjects. One other consideration is the relatively short length of disability of the patients in the study, an average of nine months. According to a meta-analysis by Feuerstein, Menz, Zastowny, & Barron (1994), the average length of disability for patients entering multi-disciplinary rehabilitation was 16 months, and ranged from 11 to 36 months. Thus the patient sample in this study may not be representative of the CDOMD population.

Many other studies have examined work retention as a secondary outcome of functional restoration treatment, considered along with work return, recurrence of injury, excessive utilization of the healthcare system, and recurrent injury or new surgery to the site of the original injury. Risk factors for failure to retain work include demographic factors, such as older age (Gatchel, Mayer, Kidner, & McGeary, 2005; Mayer, et al., 1998). Some demographic variables were shown to be unrelated to work retention; these included marital status (Gatchel, et al., 2005) and female gender (Gatchel et al., 2005; McGeary, Mayer, Gatchel, Anagnostis, & Proctor, 2003). Lifestyle factors that predicted failure to retain work were identified, such as smoking cigarettes (McGeary, Mayer, Gatchel, & Anagnostis, 2004), however other lifestyle factors, such as obesity, were not related to work retention (Mayer, Aceska, & Gatchel, 2006).

Additional risk factors for work retention following functional restoration involved specifics of the individual's injury. Pre-treatment surgery was found to be a risk factor for failure to retain work in some studies (Gatchel, et al., 2005). However, other similar studies found that spinal discectomy surgery, but not spinal fusion surgery, was related to failure to retain work (Mayer, et al., 1998), and cervical spine surgery was not a risk factor for lack of work retention (Mayer, Anagnostis, Gatchel, & Evans, 2002). Other injury-specific risk factors for failure to retain work included recurrence of injury to the same anatomical area (Garcy, Mayer, & Gatchel, 1996) and longer length of disability, the time between injury and treatment (Jordan, Mayer, & Gatchel, 1998). Chronic widespread pain, pain occurring above and below the spine and on both the left and right sides of the body, was not predictive of work retention (Mayer, Towns, Neblett, Theodore, & Gatchel, 2008). Socioeconomic factors, such as presenteeism, remaining at work after injury (Howard, Mayer, & Gatchel, 2009), and treatment-related factors such as successful completion of the treatment program (Proctor, Mayer, Theodore, & Gatchel, 2005) were found to be predictive of work retention.

Psychosocial risk factors for failure to retain work after functional restoration included higher scores on pain and disability self-report measures (Gatchel, Mayer, Dersh, Robinson, & Polatin, 1999; Anagnostis, Mayer, Gatchel, & Proctor, 2003; Gatchel, Mayer, & Eddington, 2006; McGeary, Mayer, & Gatchel, 2006) as well as certain psychiatric conditions (Dersh, et al., 2007) and a history of early childhood abuse (McMahon, Gatchel, Polatin, & Mayer, 1997). One of the most significant risk factors for failure to retain work was the use, abuse, or high dosage of opiate pain medications (Dersh, et al., 2007; Dersh, et al., 2008; Kidner, Mayer, & Gatchel, 2009).

What is noticeable about these findings is that risk factors for work retention are rarely considered in combination with each other. In addition, occupational factors such as income, government disability benefits, job demand, and availability of the patient's original job are not considered. Only a few studies examined risk factors that were assessed at the completion of treatment; these were limited to a few self-report measures of pain and disability (Gatchel, et al., 1999; Anagnostis, et al, 2003; Gatchel, et al., 2006; McGeary et al., 2006). An explicit model of the factors that predict work retention after functional restoration has not yet been identified.

3.2 Models of Risk Factors for Return to Work after Treatment for Chronic Pain

Although no comprehensive models of work retention have been reported in the literature, several models of return to work in chronic pain patients have been created. Regression analysis is a commonly used method for modeling return to work that aims to predict one dependent variable from a set of independent variable or to explain the relationships between dependent and independent variables. A variation on this type of modeling is the Cox regression procedure, which examines how the likelihood of a given event changes with the passage of time. Another approach to modeling is discriminant analysis, in which membership in a group (in this case, return to work or not) is predicted using a set of independent variables. The ultimate goal of return to work modeling is to be able to identify patients who are unlikely to return to work, in order to target intervention strategies to improve outcomes, or to exclude such patients from the treatment program when success is unlikely.

Several of the return to work models were conducted on patients who had undergone functional restoration treatment. Poulain, et al. (2010), found that practice of sports at admission to the functional restoration program, low-back pain with first onset before the age of 35, and duration of sick leave less than 6 months all independently predicted successful return to work. The study found that factors such as pain intensity, anxiety, depression, perceived disability were unrelated to prediction of return to work. Bendix, Bendix, & Hæstrup (1998) determined that younger age, female gender, shorter length of disability, and low pain intensity at pre-treatment predicted successful return to work. Physical function variables such as aerobic capacity, mobility, and isometric endurance were unrelated to return to work. Hildebrandt, Pfingsten, Saur, & Jansen (1997) identified longer length of disability, a patient's beliefs that he or she would not return to work, application for disability pension, and work as a truck driver as significantly predictive of failure to return to work. The study also considered parameters of change resulting from treatment. It was found that treatment by individual physiotherapists, reductions in disability, improved daily functioning, and decrease in depressive symptoms significantly predicted successful return to work.

Reiso, et al. (2003) evaluated graduates of an outpatient back disorder clinic two years after treatment. Older age, higher pain intensity, greater self-reported work disability, and patient expectation of continued work absence predicted a longer time to successfully return to work. Back pain with radiation to the leg predicted shorter time to return to work. Although the study did not contain a detailed description of the treatment procedure at the outpatient clinic, it is likely that treatment was not interdisciplinary, including only minimal physical or occupational therapy and no psychosocial treatment. Velozo, Lustman, Cole, Montag, & Eubanks (1991) examined a combination of demographic factors, therapist predictions, and self-report measures in patients from a work-hardening program. The program focused on work simulation, but also included general strengthening, aerobic conditioning, and patient education. The researchers found that therapist prediction of treatment success, lower pain intensity, and injury to areas other than the low back were significantly associated with successful return to work. A final study by Lysgaard, Fonager, and Nielsen (2005) examined return to work outcomes following a vocational rehabilitation program in Denmark. The program consisted mainly of education, provided by social workers, although physical therapy and psychological treatment were sometimes included. The researchers found that involvement of financial compensation for an injury strongly predicted failure to return to work. In addition, younger age, longer school attendance, longer experience in the labor market, and owning one's residence were associated with successful return to work.

These models identify conflicting risk factors for return to work. Age and gender were sometimes significant risk factors for return to work, but just as often were found to be unrelated. Likewise, pain intensity, psychosocial measurements, and length of disability were associated with return to work in some models, but not in others. It is notable that only one of these studies considered post-treatment as well as pre-treatment variables. The inconsistency of the risk factors identified by these models suggests that the relationship between demographic, psychosocial, occupational, and injury-related factors and treatment outcomes is very complex and cannot be explained by basic regression analysis.

3.3 Epidemiological Models of Return to Work

Some models of return to work utilize an epidemiological method in which patients reporting chronic pain are tracked and repeatedly receive surveys or examinations, but are not treated for their pain in any systematic fashion. These models vary considerably in the time between the initial evaluation and follow-up, from a minimum of three months, to a maximum of 21 months. The goal of epidemiological modeling is to identify patients at high-risk of treatment failure prior to entry into the rehabilitation system.

Schultz, et al. (2002), evaluated workers compensation claimants with sub-acute or chronic low back pain. Follow-up evaluation was obtained three months later, along with measures of return to work status. It was found that shorter duration of pain symptoms, better scores on measures of quality of life scales (vitality and change in health status), feelings of job security, expectation of recovery, perception of less severe disability, and absence of sciatica (pain radiating down the back of the leg) or pain behaviors (guarding and slower movements) were all significant predictors of successful return to work. A similar study (Schultz, et al., 2004), considered only psychosocial factors in developing a predictive model for return to work at a three month follow-up. The study identified four significant predictors of return to work: duration of pain symptoms, perception of change in health status, the patient's expectations of recovery, and support from co-workers. The authors in both studies noted that measures of psychosocial distress, psychopathology, and pain intensity were not significant risk factors for return to work.

Researchers in the Netherlands conducted interviews with low back pain patients at the time of initial injury and one year later (van der Geizen, Bouter, & Nijhuis, 2000). The factors identified as predictive of successful return to work were general health, job satisfaction, status as the main source of income for a family, younger age, and lower pain intensity. A final study by Crook, Moldfosky, and Shannon (1998) conducted a longitudinal study of workers with chronic low back pain. Participants were assessed at three, nine, 15, and 21 months post-injury. It was found that men and younger workers were more likely to return to work, while patients with lower levels of physical independence and higher levels of functional disability were less likely to return to work. In addition, the availability of a modified work environment increased the likelihood of return to work.

3.4 Risk Factors for Return to Work

3.4.1 Demographic Risk Factors

Many researchers have considered demographic factors related to return to work. However, with most demographic variables, equally reasonable arguments can be made for either outcome, and results are accordingly inconsistent. For example, one might suppose that men would be more likely to return to work than women because men are more often the major source of income for a household. However, it could also be the case that women are more likely than men to return to work because women are less likely to have physically demanding jobs. Likewise, it could be predicted that older workers would return to work more often because their longer job experience would result in more job security. Conversely, older workers might be more likely to opt for early retirement and thus be less likely to return to work.

Many studies have examined the relationship between age or gender with return to work. Although many studies have found younger age to be predictive of successful return to work (Fey, Williamson-Kirkland, & Frangione, 1987; Lee, Chow, Lieh-Mak, Chan, & Wong, 1989; Milhaus, et al., 1989; Guck, Meilman, Skultety, & Dowd, 1986; Crook & Moldofsky, 1994; Haldorsen, Indahl, & Ursin, 1998; Dionne, et al., 2007; Infante-Rivard & Lortie, 1996; Selander, Marnetoft, Bergroth, & Ekholm, 2002; Cairns, Mooney, & Crane, 1984; Gallagher, et al., 1989; Fredrickson, Trief, VanBeveren, Yuan, & Baum, 1988; Straaton, Maisiak, Wrigley, & Fine, 1995), many other studies have found no relationship between age and return to work (Buchner, Neubauer, Zahlten-Hinguranage, & Schiltenwolf, 2007; Soucy, Truchon, & Côté, 2006; Gervias, et al., 1991; Shaw, et al., 2007; Deyo & Diehl, 1988; Brennan, Barrett, & Garretson, 1986; Barnes, Smith, Gatchel, & Mayer, 1989; Polatin, et al., 1989). Likewise, many studies have found a significant relationship between gender and return to work (Fey, et al., 1987; Sandström, 1986; Cairns, et al., 1984; Crook & Moldofsky, 1994; Soucy, et al., 2006; Dionne, et al., 2007; Gatchel, et al., 2005; MeGeary, et al., 2003; Polatin, et al., 1989; Straaton, et al., 1995) while others have failed to find such a relationship (Guck, et al., 1986; Haldorsen, et al., 1998; Infante-Rivard & Lortie, 1996; Brennan, et al., 1987; Fredrickson, et al., 1988). Similarly mixed results have been found for marital status (Selander, et al., 2002; Guck, et al., 1986; Sandström, 1986; Gatchel, et al., 2005; Haldorsen, et al., 1998; Soucy, et al., 2006; Barnes, et al., 1989), having children at home (Haldorsen, et al., 1998; Crook & Moldofsky, 1994; Gatchel, et al., 2005), and ethnicity (Selander, et al., 2002; Gatchel, et al., 2005; Polatin, et al., 1989). One demographic risk factor that has consistently failed to relate to return to work is education level (Gatchel, et al., 2005; Haldorsen, et al., 1998; Soucy, et al., 2006; Dionne, et al., 2007; Gervais, et al., 1991; Infante-Rivard & Lortie, 1996; Deyo & Diehl, 1988; Fredrickson, et al., 1988; Polatin, et al., 1989).

3.4.2 Injury-Related and Physical Risk Factors

In many cases, treatment success or failure is affected by physical factors. These factors may be specific to the type of injury, for example, whether the injured area is the low back or an extremity or whether the injury is a result of cumulative trauma or a specific incident. Alternatively, injury-specific factors may involve the severity of the injury, such as whether the injury is localized to a single body part or if multiple body parts are involved. Other physical factors that may contribute to outcomes include co-morbid disorders such as obesity or heart disease and prior treatments such surgical procedures.

The type of injury experienced by an injured worker, for example, low back injury as compared to injury of an extremity, has been inconsistently related to return to work (Selander, et al., 2002; Gervais, et al., 1991; Infante-Rivard & Lortie, 1996; Crook & Moldofsky, 1994; Straaton, et al., 1995). Low back pain with sciatica or pain extending into the leg is usually predictive of failure to return to work (Milhaus, et al., 1989; Dionne, et al., 2007; Dionne, et al., 2005; Infante-Rivard & Lortie, 1996; DuBois & Donceel, 2008), although not in all studies (Deyo & Diehl, 1988); and back pain classification has been found to predict successful return to work (McNeill Sinkora, & Leavitt, 1986). Contradictory relationships have also been found between return to work and pre-treatment surgery (Dionne, et al., 2005; Dionne, et al., 2007; Gatchel, et al., 2005; Barnes, et al., 1989; Polatin, et al., 1989; Mayer, Anagnostis, Gatchel, & Evans, 2002; Mayer, et al., 1998; Deyo & Diehl, 1988), as well as recurrent injuries (Selander, et al., 2002; Dionne, et al., 2007; Evans, Mayer, & Gatchel, 2001) and multiple areas of pain (Lee, et al., 1989; Sandström, 1986; Mayer, et al., 2008). Obesity has been shown to be unrelated to return to work (Mayer, et al., 2006; Deyo & Diehl, 1988).

Most types of physical capacity testing have not been linked to return to work. For example, lifting ability (Milhaus, et al., 1989; Gallagher, et al., 1989; Polatin, et al., 1989; Fishbain, et al., 1993) and other biomechanical tests (Milhaus, et al., 1989, McArthur, Cohen, Gottlieb, Naliboff, & Schandler, 1987) do not predict return to work. Similarly, range of motion and forward flexion are usually not related to return to work (Haldorsen, et al., 1998; Milhaus, et al., 1989;

Gallagher, et al., 1989; Deyo & Diehl, 1988), although better overall flexibility has been shown to predict successful return to work (McArthur, et al., 1987; Crook & Moldofsky, 1994; Fredrickson, et al., 1988). However, the ability to perform activities of daily living has been reliably shown to predict successful return to work (Milhuas, et al., 1989; Sandström, 1986; Lee, et al., 1989; Selander, et al., 2002; Crook & Moldofsky, 1994; DuBois & Donceel, 2008; Gallagher, et al., 1989).

3.4.3 Occupational and Socioeconomic Risk Factors

Many studies have examined the relationship between job-related occupational factors or socioeconomic factors and return to work. The majority of studies have found that patients with a shorter length of disability – the time between injury and rehabilitation – are more likely to return to work (Milhaus, et al., 1989; Sandström, 1986; Selander, et al., 2002; Jordan, Mayer, & Gatchel, 1998; Crook & Moldofsky, 1994; Brennan, et al., 1987; Haldorsen, et al., 1998; Gervias, et al., 1991; Infante-Rivard & Lortie, 1996; Gallagher, et al., 1989) although not all studies have replicated this effect (Deyo & Diehl, 1988; DuBois & Donceel, 2008; Polatin, et al., 1989; Guck, et al., 1986). Mixed results have also been found for the amount of physical activity required by the job (Selander, et al., 2002; Marhold, Linton, Melin, 2002; Haldorsen, et al., 1998; Dionne, et al., 2007; Deyo & Diehl, 1988; Infante-Rivard & Lortie, 1996; Gervais, et al., 1991; Gallagher, et al., 1989; Fredrickson, et al., 1988). This likely reflects the fact that type of injury is closely related to job demand. Although accidents in jobs with high physical demand may result in more severe injuries, people with sedentary jobs are more susceptible to repetitive strain injuries, which are much more difficult to treat. In addition, workers with physically active jobs are likely to be in better overall physical condition and may recover more easily from an injury than more those with more sedentary jobs. A similarly inconsistent effect was found for pre-injury income level (Lee, et al., 1989; Selander, et al., 2002; Shaw, et al., 2007; Barnes, et al., 1989, Sandström, 1986; Haldorsen, et al., 1998; Soucy, et al., 2006; Gervias, et al., 1991). Although people with higher incomes may have greater financial resources to withstand a period of prolonged disability, making them less likely to return to work, they may also have a greater discrepancy between their pre-injury income and their disability compensation, making return to work a financial necessity.

Other occupational risk factors are less conflicted. Patients who were employed at admission to a rehabilitation program were more likely to return to work (Fey, et al., 1987; Anderson, Schwaegler, Cizek, & Leverson, 2006; Dionne, et al., 2007; Deyo & Diehl, 1988; Brennan, et al., 1987; Straaton, et al., 1995) as were people who had a longer job tenure (Infante-Rivard & Lortie, 1996; Dionne, et al., 2007; Haldorsen, et al., 1998; Selander, et al., 2002; Polatin, et al., 1989), people with their original job still available (Selander, et al., 2002; Polatin, et al., 1989), and people with a positive work environment (Selander, et al., 2002; Crook & Moldofsky, 1994; Infante-Rivard & Lortie, 1996). Patients receiving government disability benefits were less likely to return to work (Jamison, Matt, & Parris, 1988; Straaton, et al., 1995; Crook & Moldfosky, 1994). Economic conditions, both local and national, have been shown to have a negative effect on return to work (Fey, et al., 1987; Dionne, et al., 2007). Occupational factors shown to be unrelated to return to work include job satisfaction (Marhold, et al., 2002; Soucy, et al., 2006, Gervais, et al., 1991; Infante-Rivard & Lortie, 1996; Shaw, et al., 2007; Gallagher et al.,, 1989) and co-worker support (Crook & Moldfosky, 1994; Soucy, et al., 2006).

3.4.4 Treatment Related Risk Factors

Several treatment-related factors have been shown to be important influences on return to work. Patients receiving rehabilitation earlier in the course of their injury returned to work more successfully than those with delayed treatment (Selander, et al., 2002; Garcy, et al., 1996). This relates to the fact that patients with longer periods of disability and inactivity develop more severe physical deconditioning. Patient who fail to complete a treatment program are less likely to return to work (Selander, et al., 2002; Proctor, Mayer, Theodore, & Gatchel, 2005), possibly due to poor motivation to return to work. Treatment programs that focus on reintegration into the workplace are more successful in returning their graduates to work (Selander, et al., 2002). In addition, patients who are satisfied with their treatment are more likely to return to work (Dionne, et al., 2007; Selander, et al., 2002; Hazard, Haugh, Green, & Jones, 1994).

3.4.5 Psychosocial Risk Factors

Many studies have focused on the role of psychosocial factors in predicting successful return to work. Although some of these factors are clearly related to return to work, examinations of other factors have produced inconsistent results. This may reflect the differential ability of treatment programs to intervene with psychosocially distressed patients. Thus, it might be expected that patient undergoing multidisciplinary rehabilitation would receive a great deal of treatment for psychosocial distress, while patients being treated in work-hardening, physical therapy, or educational treatments might receive little or no assistance with psychosocial issues.

Psychosocial risk factors that have had mixed results include high levels of depression (Lee, et al., 1989; Sullivan, Adams, Thibault, Corbiére, & Stanish, 2006; Marhold, et al., 2002; Dionne, et al., 2007; Dersh, et al., 2007; Gervais, et al., 1991; Shaw, et al., 2007; Brennan, et al., 1987; Barnes, et al., 1989; Polatin, et al., 1989, Dolce, Crocker, & Doleys, 1986) and results of the Minnesota Multiphasic Personality Inventory (Dolce, et al., 1986; Gallagher, et al., 1989; Milhaus, et al., 1989; Cairns, et al., 1984; Trief & Yuan, 1983; Brennen, et al., 1987; Guck, et al., 1988; Gentry, Newman, Goldner, & von Baeyer, 1977; Fredrickson, et al., 1988; Gatchel, et al., 2006; Barnes, Gatchel, Mayer, & Barnett, 1990). In addition, health locus of control, or the degree to which a person believes their actions directly relate to their health status (Haldorsen, et al., 1998; Crook & Moldfosky, 1994; Gallagher, et al., 1989; Dionne, et al., 2007; Gervais, et al., 1991), significant life events or life satisfaction (Selander, et al., 2002; Dionne, et al., 2007; Sandström, 1986, Gervais, et al., 1991; Shaw, et al., 2007; Lee, et al., 1989), and high levels of self-efficacy (Dionne, et al., 2007; Gervais, et al., 1991; Dolce, et al., 1986) have been inconsistently related to return to work.

Other psychosocial risk factors are more clearly related to return to work. One of the most important predictors of return to work is a lower level of perceived disability, or the degree to which a person feels unable to function in their pre-injury lifestyle (Gallon, 1989; Dionne, et al., 2007; Shaw, et al., 2007; Dozios, Dobson, Wong, Hughes, & Long, 1995; Hazard, et al., 1994; Anagnostis, et al., 2003; Gatchel, et al., 2006; Barnes, et al., 1989; Polatin, et al., 1989; Straaton, et al., 1995). In addition, patient with high levels of pain are significantly less likely to return to work (Lee, et al., 1989; McGeary, et al., 2006; Marhold, et al., 2002; Dionne, et al., 2007; Gervais, et al., 1991; Dionne, et al., 2005; Shaw, et al., 2007; Brennan, et al., 1987; Barnes, et al., 1989; Hazard, et al., 1994; Polatin, et al., 1989). Another important influence on return to work is the person's own beliefs and attitudes about work and his or her ability to successfully return to work (Selander, et al., 2002; Marhold, et al., 2002; Dionne, et al., 2005; Dolce, et al., 1986). Patients with disturbed sleep (Lee, 1989; Dionne, 2005), low self-esteem (Dionne, et al., 2007; Soucy, et al., 2002), use of narcotic pain medications (Dersh, et al., 2007; Dersh, et al., 2008; Kidner, et al., 2009), and high levels of pain-related fear (Dionne, et al., 2007; Soucy, et al., 2002) are also less likely to return to work.

Some psychosocial factors have been consistently unrelated to return to work. These include smoking status (Sandström, 1986; Evans, et al., 2001; Haldorsen, et al., 1998; Infante-Rivard & Lortie, 1996; Gallagher, et al., 1989) and high levels of anxiety (Dersh, et al., 2007; Haldorsen, et al., 1998; DuBois & Donceel, 2008; Gervais, et al., 1991; Shaw, et al., 2007). Likewise, perceived health status (Shaw, et al., 2007; Deyo & Diehl, 1988), more adaptive coping mechanisms (Gallagher, et al., 1989; Marhold, et al., 2002; Shaw, et al., 2007), and social support (Shaw, et al., 2007; Haldorsen, et al., 1998; Gallagher, et al., 1989) have little to no effect on successful return to work.

3.5 Purpose and Scope of the Current Study

The purpose of the current study is to develop a descriptive and predictive model of work retention and its related factors in the context of a functional restoration treatment program. Although return to work is an important socioeconomic outcome, it is concerned with only the ability to attain initial employment. Work retention, the ability to both obtain employment and to maintain that employment over time, may be a better indicator of vocational recovery. In modeling work retention, demographic, physical, occupational, and psychosocial factors must all be considered. In addition, the analysis will specifically focus on understanding and modeling the relationship between admission risk factors and discharge risk factors. Because all patients entering a functional restoration program have sustained an occupational injury followed by an extended period of disability, the patient would be expected to have high levels of physical problems and psychosocial distress upon admission to the treatment program. Thus, in considering only admission risk factors, the range of responses will be likely to be restricted to only high values. There is also range restriction in considering only discharge factors. Functional restoration programs typically have between 70-85% recovery rates (Feuerstein, et al., 1994), so the majority of patients would be expected to have significantly lower levels of risk factors at discharge. By considering admission risk factors, discharge risk factors, and the interaction between the admission and discharge factors, a more complete model can be developed.

3.6 Hypotheses

There were several hypotheses associated with this project. First, it was expected that a structural model describing and explaining work retention would be identified. Second, it was expected that discharge risk factors would mediate, either fully or partially, the relationship between admission risk factors and work retention. It was also expected that some variables would have significant impact on work retention both at admission and discharge. These included work status, government disability benefits, perceived disability, pain intensity and depressive symptoms. Furthermore, it was expected that a number of variables collected at admission only would significantly influence work retention. These included demographic factors (age, gender, length of disability), occupational factors (income, job availablility), and psychosocial factors (the MMPI disability profile, opiate dependence).

CHAPTER 4

PROCEDURE

4.1 Participants

The present study utilized a consecutive cohort of 1850 patients who were referred to a regional rehabilitation center and consented to treatment. Patients were accepted into the treatment program based on 5 criteria: (1) at least three months had elapsed since the initial injury, (2) primary and secondary care had been attempted and had failed to restore acceptable levels of function and/or relieve the patient's pain, (3) surgery had either been unsuccessful or was not recommended, (4) the patient continued to experience severe functional limitations, and (5) the patient was able to communicate in English or Spanish. Only patients who completed the full course of functional restoration treatment were included in the current study. Demographic characteristics of the sample are shown in Table 4.1. Patients were compared in two groups:

Work retention (WR): Patients who both returned to work during the year following treatment discharge and who remained employed at the time of the one-year follow-up interview.

Non-work retention (NWR): Patients who were not working at the one-year follow-up interview, regardless of whether they had returned to work at some point in the year following program discharge.

Table 4.1 Demographic characteristics of sample

	All patients (N = 1850)
Age (mean, SD)	46.23 (9.4)
Gender (n, %male)	972 (52.7%)

Table 4.1 - *Continued*

Race (n, %)	
White	895 (52.2%)
Black	421 (24.6%)
Hispanic	359 (21%)
Asian	27 (1.6%)
Other	11 (0.6%)
Type of injury (n, %)	
Cervical spine only	68 (3.8%)
Thoracic/lumbar spine only	628 (35.4%)
Extremity only	484 (27.3%)
Multiple spinal	220 (12.4%)
Multiple musculoskeletal	375 (21.1%)
Length of disability, months (mean, SD)	19.59 (23.5)
Pre-treatment surgery (n, %)	792 (43.5%)
Pre-injury income (mean, SD)	$545.25 (400)
Education, years (mean, SD)	11.63 (3.0)
Work limitations (n, %)	
not working	1534 (84.2%)
light/partial duty	219 (12%)
full duty	68 (3.7%)

4.2 Materials and Measures

4.2.1 Quantified Physical Evaluation

All patients admitted to functional restoration underwent a complete quantified evaluation of physical functioning. This evaluation was conducted by the physical and occupational therapists and included measurements of range of motion, muscle strength and endurance in the injured area, whole body aerobic capacity, and functional performance tasks such as lifting, bending, or gripping (Mayer & Mayer, 1988). In addition, the patient was evaluated by the physician to identify barriers to recovery, such as dependence on narcotic medications that need to be addressed. Individualized treatment plans were developed by collaboration with the interdisciplinary team of providers (Cox, Garcy, Leeman, Santana, & Mayer, 1995). The quantified physical evaluation was repeated upon discharge from the treatment program to track patient outcomes and to establish impairment ratings.

4.2.2 Medical Case Management Evaluation

Demographic and socioeconomic data were collected by the case management and nursing departments. The information collected included basic information such as age, type of injury, surgical procedures performed, how long the patient had been disabled, and if the patient had previously sustained another work-related injury. Socioeconomic data included information about the patient's job where the injury occurred, such as name of employer, job type, and job demand. Income was also assessed, including pre-injury income levels, the amount of compensation received from disability sources such as worker's compensation programs, and what type of income the patient was receiving. Of particular importance was whether the patient was receiving federal disability benefits such as Supplemental Security Income (SSI) or Social Security Disability Income (SSDI). Legal matters such as case settlement and attorney retention are evaluated as well.

4.2.2.1 Work Status

Work status was assessed by determining if the patient was currently working, if they were working at a modified level of duty, and if they were working part-time or full-time (Mayer, Prescott, & Gatchel, 2000). Work status was assessed both at admission to and at discharge from the treatment program. If the patient was working at least part-time and at least at light-duty on the day of the admission and discharge assessment, they were classified as working. A secondary measure of work status, whether the original pre-injury job was still available to the patient, was assessed at pre-treatment only. In addition, patients were assessed for *presenteeism*, continuing to work after injury, or *absenteeism*, a complete absence from the workplace. Presenteeism has been defined as working more than 20% of the time during the post-injury period and working more than three months after being injured (Howard, et al., 2009). Presenteeism was assessed at pre-treatment only.

4.2.3 Psychosocial Intake Evaluation

All patients were evaluated by a member of the psychology staff during the initial treatment phase. Patients completed various self report measures of pain, disability, and psychological symptoms. In addition, patients were assessed for the presence of psychological disorders.

4.2.3.1 Pain Visual Analog Scale

Patients completed the pain visual analog scale (VAS), which consists of a 10 cm line, with the endpoints labeled as “no pain” and “worst possible pain.” The patient placed a mark on the line to indicate their current levels of pain. The pain VAS has been shown to be reliable and valid, as well as responsive to treatment effects. In addition, data from the pain VAS has been shown to have the properties of ratio data, meaning that the results of the scale represent actual magnitudes of pain intensity (Jensen & Karoly, 2001). Patients usually understand the pain VAS easily, and it has been considered a useful measure of subjective pain (Jensen, Karoly, & Braver, 1986).

4.2.3.2 Million Visual Analog Scale

The Million Visual Analog Scale (MVAS), an instrument with 15 questions that assesses the effects of pain and disability on physical functioning and activities of daily living (Million, et al., 1982), was also administered. Each response was marked on a line with the endpoints identified from least to most, in terms specific to each question. Scores can range from 0-150, and cut-off scores have been identified as follows: no disability (0), mild disability (1-40), moderate disability (41-70), severe disability (71-100), very severe disability (101-130), and extreme disability (131-150). One of the advantages of the MVAS is that the visual analog format decreases the degree to which the scores depend on verbal ability, and the scale has been found to be sensitive to changes in clinical condition (Anagnostis, et al., 2003).

4.2.3.3 Oswestry Disability Index

The Oswestry Disability Index (ODI) was designed to measure disability related to pain. It was used to measure various aspects of physical functioning, and resulted in a percentage score representing the patient's level of function compared to a person without pain (Fairbank, Couper, Davies, & O'Brien, 1980). Although the scale was originally developed to measure limitations in function due to back pain, the ODI has been widely used to measure many different types of pain (Fairbank, 2007). Categories representing different levels of disability have been established: minimal disability (0-20%), moderate disability (21%-40%), severe disability (41%-60%), crippled (61%-80%), and bed-bound or exaggeration of symptoms (>81%). Reliability and validity have been well established, and the ODI has been one of the most commonly used instruments to evaluate pain-related disability (Fairbank & Pynsent, 2000).

4.2.3.4 Pain Disability Questionnaire

The Pain Disability Questionnaire (PDQ) was administered as a comprehensive measure of disability for chronic disabling musculoskeletal disorders. Unlike the MVAS or the ODI, which were developed primarily to evaluate back pain, the PDQ was designed to be used with chronic pain in the upper and lower extremities as well as spinal pain in both the back and neck (Anagnostis, et al., 2004). The scale has been shown to have excellent psychometric properties, and the following categories have been determined: mild-moderate disability (0-70), severe disability (71-100), and extreme disability (100-150). In addition, the PDQ has been found to be responsive to changes in clinical condition (Gatchel, Mayer, & Theodore, 2006).

4.2.3.5 Minnesota Multiphasic Personality Inventory

The Minnesota Multiphasic Personality Inventory, 2nd edition (MMPI-2) has been one of the most widely used tests of personality and psychopathology. The test, which contains multiple scales developed to differentiate between clinical and normal populations on a variety of psychological characteristics (Butcher, Atlis, & Hahn, 2004), was administered as a part of psychosocial screening. Although attempts to use individual MMPI scales or combinations of scales (such as the neurotic triad or conversion V) have not yielded consistent results in chronic pain populations, one profile that is relevant to chronic pain patients has been identified. The "disability profile" was defined as elevation of four or more scales on the MMPI, and it has been shown to be highly related to psychopathology in chronic pain patients (Gatchel, Mayer, & Eddington, 2006).

4.2.3.6 Beck Depression Inventory-II

The Beck depression inventory-II (BDI) has been used to measure depressive symptoms in both psychiatric and chronic pain settings. Scores on the BDI can range from 0-63, and the following cut-off points have been recommended: no depression or minimal depression (0-10), mild to moderate depression (10-18), moderate to severe depression (19-29), and severe depression (30-63). Although the BDI did not provide an official diagnosis of major depressive disorder, it was easy to administer and has been shown to be both reliable and valid (Beck, Steer, & Garbin, 1988). The BDI can be useful as a screening tool in a chronic pain setting, but scores on the BDI may be inflated in chronic pain patients due to the similarity between the somatic symptoms of depression and the physical symptoms of chronic pain (Wesley, Gatchel, Garofalo, & Polatin, 1999). However, reliability and validity have been found for the BDI even among chronic pain patients (Harris & D'Eon, 2008).

4.2.3.7 Short-Form 36 Health Survey

The Medical Outcome Study 36-item short form health survey (SF-36), a self-report measure of health-related quality of life, was included among the screening questionnaires. It was developed to measure general health concepts such as physical functioning, social function, mental health, role performance, bodily pain, perceived health status, and vitality (McHorney, Ware, & Raczek, 1993). Although the SF-36 containes eight subscales, usually only two components are reported: the physical health component and the mental health component. The SF-36 has been shown to be useful for documenting changes in health status over time at the group level, but the instrument may be less useful for identifying change in individual patients (Gatchel, Polatin, Mayer, Robinson, & Dersh, 1998). However, the number of associations between socioeconomic outcomes and SF-36 scores suggest that the instrument may be useful as a part of a complete psychosocial assessment in chronic pain patients (Gatchel, et al., 1999).

4.2.3.8 Structured Clinical Interview for DSM-IV Diagnosis

The Structured Clinical Interview for DSM-IV diagnosis (SCID) was used as a standardized interview format that resulted in psychiatric diagnoses for both Axis I and Axis II disorders according to the criteria set by the American Psychological Association in the DSM-IV. The SCID allowed for the evaluation of both lifetime prevalence of psychiatric diagnoses and current psychiatric disorders. The SCID must be administered by a trained interviewer, and it is often more time and personnel intensive than self-report measures. However, the SCID has been shown to have better inter-rater reliability and validity than semi-structured and unstructured interview formats (Schneider, et al., 2004).

4.2.3.9 Psychosocial Clinical Interview

The clinical interview was conducted by a qualified clinician and integrated the findings of the self-report measures with an personal assessment of the patient. The clinician assessed the patient for signs and symptoms of depression, anxiety, stress, and psychiatric disorders. The patient was also assessed for disturbances in the family situation and available social supports. In addition, the psychologist determinde the patient’s motivation for recovery, including financial disincentives for returning to work, secondary gain issues, and symptoms of malingering (Gatchel, 1991).

4.2.4 Structured One-year Follow-up Interview

Post-discharge socioeconomic outcomes were assessed at one year following discharge using a structured interview administered either by phone or in person. Information about work status was obtained, including both work return and work retention. Health-care utilization was assessed by determining the number of visits to surgical, medical, and/or chiropractic providers that exceeded routine follow-up care. Resolution of legal and compensation matters was evaluated, including long-term disability, enrollment in federal disability programs, permanent partial disability, and case closure. In addition, new or recurrent injuries and additional surgical procedures were noted. If needed, these measures were substantiated by consultation with employers, the worker's compensation system, or insurance carriers (Mayer & Polatin, 2000).

4.2.4.1 Work Retention

Work retention was measured at one-year following discharge from the treatment program. Patients who were working at least part-time and at least at light-duty at the time of the one-year follow-up interview were classified as having work retention. All patients who were not working at the time of the one-year interview were classified as non-work retention. The non-work retention group included both patients who did not return to work at any point in the year following discharge and patients who returned to work during the year after discharge but were no longer working at the time of the follow-up interview.

4.3 Procedure

All patients received treatment with functional restoration, a biopsychosocial multidisciplinary treatment program for individuals with chronic disabling musculoskeletal disorders. Although the majority of patients in such a program were being treated for a work-related injury, the treatment program was not exclusive to occupational injuries. Functional restoration simultaneously addressed the many problems that accompany a CDOMD, using a sports-medicine approach. The goals of functional restoration treatment includde returning the patient to productivity, maximizing physical function which in turn minimizes pain, encouraging the patient to take responsibility for the management of his or her condition and progress through the program, eliminating or reducing future medical utilization, preventing the recurrence of injury, maintaining therapeutic gains, and avoiding medication abuse or dependence (Gatchel & Turk, 1999).

The functional restoration program was guided by a supervising physician who coordinated patient care with an emphasis on return to function and guided the formulation of treatment plans that set specific goals to achieve that return to function (Mayer & Gatchel, 1988). The nursing staff functioned as physician extenders, and they provided counseling on medical matters and education about medication as well as rationales for treatment procedures. Nurses also served as follow-up contacts that bridge the gap between the intensive therapeutic environment and home care.

The physical therapists were responsible for mobilizing and strengthening the injured body part. Treatment consisted of a qualitatively-directed exercise program to restore muscle strength, flexibility, and endurance. Physical therapists promoted increasing mobility to increase flexibility and joint motion. They also taught patients how to increase strength using a progressive resistive exercise program, utilizing both maximum resistance and repetitive low-load exercises. In addition, the physical therapists supervised cardiovascular reconditioning through aerobic exercise training.

Occupational therapists were the team members who manage re-training of daily activity performance. Treatment included the simulation of physical tasks such as lifting, bending, twisting, grasping, and climbing stairs. The goal of occupational therapy was to increase tolerance for daily activities, including static postures such as sitting and standing. Occupational therapy tasks simulated real-life activity as well as work activity, and improve coordination and agility.

The psychology staff members assisted the patient, using a crisis-intervention treatment model, to cope with the end of disability, the return to workplace, changes in family roles, and barriers to recovery. The psychologist supervised the process of opiate de-escalation and withdrawal, and recommended appropriate medications, if needed, for depression and anxiety. Counseling for psychological problems was provided, however, the goal was not complete recovery, but rather a return to the level of functioning that had previously been associated with gainful employment. The psychologist utilized a multimodal disability management program that included individual and group counseling to overcome barriers to recovery and to manage the influence of stress as well as family counseling to deal with the dysfunction in the family situation resulting from prolonged disability. Family counseling also dealt with changes in the family as the patient recovers and managed secondary gain issues. Behavioral stress management included modalities such as biofeedback and relaxation training to teach patients how to reduce the reciprocal effects between mental stress and muscle tension. In addition, cognitive-behavioral skills training was used to educate the patient on the relationship between thoughts, feelings, and actions and to teach the patient how to modify his or her thoughts, how to challenge anxiety-producing irrational beliefs, and how to act assertively to meet psychological needs.

Finally, case managers assisted the patient in resolving work-related issues. Case managers served as advocates for the patient in dealing with insurance carriers, employers, attorneys, and the worker's compensation system. They also located and arranged vocational retraining programs. Case managers were responsible for determining post-program outcomes; they tracked activity levels and socioeconomic indicators following discharge from the treatment program (Gatchel & Turk, 1999).

4.4 Statistical Analysis

4.4.1 Mediation Analysis

Barron and Kenny (1986) identified four steps as part of the process of evaluating mediation effects. The first step was to show that the initial variable is related to the outcome. Next, it was determined if the initial variable was related to the mediator. Then, the relationship of the mediator and the outcome variable was evaluated. Finally, through the estimation of direct and indirect effects, the extent to which the mediator affects the relationship between the initial variable and the outcome was determined. For the purposes of this study, these step were followed, but in a different order. While large amounts of information were collected at program admission, many fewer assessments were repeated at program discharge. It was decided to analyze the post-treatment (mediating) risk factors first, then to determine which initial (pre-treatment) variables related to the mediators. Then the effect of the initial (pre-treatment) variables on the outcome (work retention at one year) was analyzed. Finally, using structural equation modeling, the extent of the mediating effects (full or partial mediation) was determined.

4.4.2 Model Development

4.4.2.1 Identification of Mediators (Post-treatment Risk Factors)

Preliminary analyses were used to determine which discharge factors contributed to work retention at one year after discharge. The WR and NWR groups were compared using univariate analyses to determine statistical differences in discharge variables. Pearson chi-square (χ^2) tests were used for categorical variables, and independent t-tests were used for continuous variables. Variable found to be significant in the univariate analysis were entered into a logistic regression analysis to determine which variables significantly predicted WR.

4.4.2.2 Identification of Initial Variables (Pre-Treatment Risk Factors)

Once significant discharge risk factors were identified, each risk factor was examined individually to determine the admission variables that influenced the discharge risk factors. Demographic, occupational, injury-related, and psychosocial variables were evaluated at the univariate level and then entered into regression analyses to establish significant relationships between admission factors and the discharge risk factors for work retention. Categorical discharge risk factors were examined using logistic regression analyses, and continuous discharge risk factors were examined using linear regression procedures. Admission variables found to be significant predictors of discharge risk factors were used to develop a structural model along with the significant discharge risk factors.

4.4.2.3 Effects of Initial Variables (Pre-treatment Risk Factors) on Outcome (Work Retention at One Year)

In this step of the analysis, the effects of pre-treatment risk factors identified as related to the mediating variables (post-treatment) risk factors were evaluated to determine their relationship to the outcome variable (work retention at one year) using a logistic regression analysis. In addition, a hierarchical regression analysis was used to examine the combined effects of pre-treatment and post-treatment risk factors on work retention.

4.4.2.4 Development of Structural Model

Using the results of the previous analyses, a structural model was developed to examine the risk factors for work retention. The model was constructed to show that admission risk factors predict discharge risk factors which in turn predict work retention, i.e., that the relationship between the admission factors and work retention is mediated by the discharge risk factors. Correlations between all variables included in the model were examined, and any correlations with a small or larger effect size ($r \geq 0.15$) were included in the structural model.

4.4.2 Model Testing

Parameter estimates were calculated for all variables included in the model; standardized estimates were included in the model diagrams. Using a bootstrap maximum likelihood procedure, standard errors, significance tests, and 95% confidence intervals were obtained for all parameter estimates. The variance of each endogenous variable explained by the model was evaluated using the squared multiple correlation. Model fit was assessed using several goodness-of-fit indices, including the chi-square goodness-of-fit, the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the Akaike Information Criterion. The chi-square goodness-of-fit index evaluates the difference between the observed and estimated covariance matrices. Ideally, the chi-square value for a model with good fit would be non-significant, indicating that there was no difference between the estimated and observed covariance (Hair, Black, Babin, Anderson, and Tatham, 2006). Marsh, Hau, and Wen (2004) propose that the chi-square goodness of fit test is the most stable index of model misspecification. The RMSEA test attempts to correct for sample size and number of parameters, and represents how well a model fits the population. A good fitting model should have an RMSEA < 0.06 (Ullman, 2007), although some researchers support the use of a stricter criterion of RMSEA < 0.03 in samples greater than 800 (Chen, Curran, Bollen, Kirby, and Paxton, 2008).. The comparative fit index is a measure of incremental fit that compares the difference between the hypothesized model and the null model (Hair, et al., 2006). Models with good fit should have a CFI > 0.95 (Ullman, 2007). Marsh, et al. (2004) found that the CFI had better performance in comparing nested models than in evaluating the overall goodness-of-fit.

Post-hoc modification indices, based on the Lagrange Multiplier test, were calculated after the evaluation of the original model. Parameters that improved model fit, did not create feedback loops, and that made theoretical sense in the context of the data were added to the model. Changes to the model were evaluated based on the chi-square test of the difference and using the Akaike Information Criterion (AIC) to compare models. The AIC is a measure of model fit and parsimony, and it is only interpretable in relation to another model, with the lower AIC indicates the better fitting, more parsimonious model (Garson, 2010). Finally, estimates of direct, indirect, and total effects were obtained using a maximum likelihood bootstrap procedure.

CHAPTER 5

RESULTS

5.1 Identification of Mediators: Discharge Risk Factor Analysis

The first step in the analysis was to identify possible mediating variables from among the post-treatment risk factors. Table 5.1 shows the results of the univariate analysis of the discharge risk factors. Variables considered included occupational risk factors (work status, case settlement, and government disability benefits) and psychosocial test results. It was found that several tests had significant amounts of missing data, and further examination revealed that these tests were not collected in all the years contained in the sample. These tests included the PDQ (missing 72.5% of cases), the SF-36 (missing 43.5% of cases), and the ODI (missing 45.3% of cases); these variables were excluded from the regression analysis. Also excluded were the non-significant variables attorney retention and case settlement.

Table 5.1 Comparison of work retention to non-work retention groups on post-treatment factors

Variable	Non-work retention group	Work retention group	Statistic	Sig.	Effect size
Working at discharge (*n*, %) *n* = 1744	49 (14.6%)	401 (28.5%)	$\chi^2 = 27.6$ *df* = 1	.000	*OR* = 2.33 *CI* = 1.7, 3.2
Case settled at discharge (*n*, %) *n* = 1714	138 (41.9%)	529 (38.2%)	$\chi^2 = 1.57$ *df* = 1	.210	

Table 5.1 - *Continued*

SSI/SSDI at discharge (*n*, %) *n* = 1711	15 (4.6%)	18 (1.3%)	χ^2 = 15.1 *df* = 1	.000	*OR* = 3.64 *CI* = 1.8, 7.3
Pain VAS at discharge (*M, SD*) *n* = 1673	4.82 (2.06)	4.20 (2.18)	*t* = 4.60 *df* = 1671	.000	*d* = 0.29
BDI at discharge (*M, SD*) *n* = 1676	10.75 (8.23)	8.71 (8.05)	*t* = 4.07 *df* = 1674	.000	*d* = 0.25
MVAS at discharge (*M, SD*) *n* = 1656	68.65 (29.3)	57.42 (29.4)	*t* = 6.13 *df* = 1654	.000	*d* = 0.38
PDQ at discharge (*M, SD*) *n* = 508	64.29 (29.1)	57.78 (27.6)	*t* = 2.01 *df* = 506	.045	*d* =0.30
SF-36 mental health at discharge (*M, SD*) *n* = 1045	44.91 (10.3)	51.74 (113.8)	*t* = -0.89 *df* = 1043	.373	
SF-36 physical health at discharge (*M, SD*) *n* = 1045	34.83 (7.56)	36.88 (7.83)	*t* = -3.49 *df* = 1042	.001	*d* = -0.27
ODI at discharge (*M, SD*) *n* = 1012	28.67 (14.5)	23.74 (13.7)	*t* = 4.64 *df* = 1010	.000	*d* = 0.35

The regression analysis to predict work retention from discharge risk factors is shown in Table 5.2. The variables work status at discharge, MVAS at discharge, and disability benefits were found to be significant predictors of work retention and the next phase of the analysis examined admission risk factors for these variables.

Table 5.2 Regression analysis to predict work retention from post-treatment factors

Variable	*B*	*S.E.*	Wald	*df*	*p*	Odds Ratio	95% *CI* for odds ratio	
							lower	upper
Work status at post-treatment	0.85	0.19	21.19	1.00	0.00	2.34	1.63	3.36
MVAS at post-treatment	-0.01	0.00	8.77	1.00	0.00	0.99	0.98	1.00
SSI/SSDI at post-treatment	0.90	0.39	5.23	1.00	0.02	2.45	1.14	5.27
BDI at post-treatment	-0.01	0.01	0.43	1.00	0.51	0.99	0.98	1.01
Pain VAS at post-treatment	-0.02	0.05	0.13	1.00	0.72	0.98	0.90	1.07
Constant	1.18	0.43	7.59	1.00	0.01	3.24		

Note: χ^2 (df = 5) = 66.7, p = .000, Cox and Snell R^2 = 4.1%

5.2 Identification of Initial Variables: Admission Risk Factor Analysis

After identifying potential mediators in the previous step of the analysis, the next step was to determine the relationship of the pre-treatment risk factors (initial variables) to the post-treatment risk factors (mediating variables). The post-treatment mediators examined in this step were: work status at discharge, SSI/SSDI status at discharge, and MVAS score at discharge.

5.2.1 Identification of Initial Variables: Admission Risk Factors for Work Status at Discharge

The first mediating variable that was analyzed was work status at post-treatment. Patients who were working at least part-time and light-duty on the day of the discharge assessment (within four weeks of the last day of treatment) were considered "working at discharge." Patients who were not working on the day of the discharge evaluation were considered “not working at discharge.” The results of the risk factor analysis for predicting work return at discharge are displayed in Table 5.3. Demographic and occupational variables were considered, along with the results of psychosocial testing and psychiatric diagnosis.

Table 5.3 Comparison of working at discharge to not working at discharge groups

Variable	Not working at discharge *N* = 690 (76.9%)	Working at discharge *N* = 207 (23.1%)	Statistic	Sig.	Effect Size
Age (*M, SD*)	46.47 (9.3)	45.9 (9.7)	*t* = .763 *df* = 895	.446	
Gender (*n*, %)	367 (53.3%)	113 (54.9%)	χ^2 = .161 *df* = 1	.688	
Type of injury (*n*, %)			χ^2 = 1.03	.905	
	30 (4.5%)	10 (5.1%)	*df* = 4		
Cervical spine only	238 (35.7%)	69 (34.8%)			
Thoracic/lumbar					
spine only	178 (26.7%)	58 (29.3%)			
Extremity only	78 (11.7%)	24 (12.1%)			
Multiple spinal	142 (21.3%)	37 (18.7%)			
Multiple musculoskeletal					

Table 5.3 - *Continued*

Length of disability, months (*M, SD*)	18.24 (20.3)	21.19 (25.7)	*t* = -1.72 *df* = 895	.086	
Working at admission (*n*, %)	42 (6.2%)	88 (42.7%)	χ^2 = 168.3 *df* = 1	.000	*OR* = 11.3 *CI* = 7.5, 17.2
Pre-treatment surgery (*n*, %)	321 (47.6%)	72 (35%)	χ^2 = 10.26 *df* = 1	.001	*OR* = 1.69 *CI* = 1.2, 2.3
Pre-injury wage (*M, SD*)	$533.5 (311)	$554.83 (329)	*t* = -0.84 *df* = 863	.403	
Attorney retained pre-treatment (*n*, %)	146 (21.7%)	34 (16.7%)	χ^2 = 2.31 *df* = 1	.129	
Case settled pre-treatment (*n*, %)	171 (25.2%)	59 (28.6%)	χ^2 = .960 *df* = 1	.327	
SSI/SSDI at pre-treatment (*n*, %)	14 (2.1%)	2 (1%)	χ^2 = 1.06 *df* = 1	.303	
Original job available at pre-treatment (*n*, %)	318 (57.3%)	148 (77.9%)	χ^2 = 25.6 df = 1	.000	*OR* = 2.63 *CI* = 1.8, 3.8
Presentees (*n*, %)	182 (35.3%)	118 (66.7%)	χ^2 = 52.6 *df* = 1	.000	*OR* = 3.66 *CI* = 2.6, 5.3
Pain VAS at pre-treatment (*M, SD*)	6.67 (1.77)	6.30 (1.82)	*t* = 2.58 df = 886	.010	*d* = .206
MVAS at pre-treatment (*M, SD*)	96.75 (22.9)	90.09 (23.7)	*t* = 3.62 *df* = 877	.000	*d* = .285

Table 5.3 - *Continued*

BDI at pre-treatment (*M, SD*)	18.14 (10.2)	14.86 (10.8)	t = 4.01 df = 887	.000	d = .312
ODI at pre-treatment (*M, SD*)	40.6 (15.7)	34.55 (14.4)	t = 4.74 df = 839	.000	d = .402
Opiate dependence (*n*, %)	138 (20.2%)	25 (12.4%)	χ^2 = 6.27 df = 1	.012	*OR* = 1.79 *CI* = 1.1, 2.8
Major depressive disorder (*n*, %)	389 (57%)	93 (46.3%)	χ^2 = 7.26 df = 1	.007	*OR* = 1.54 *CI* = 1.1, 2.1
Any anxiety disorder (*n*, %)	112 (16.4%)	28 (13.9%)	χ^2 = .723 df = 1	.395	
Antisocial personality disorder (*n*, %)	28 (4.2%)	3 (1.5%)	χ^2 = 3.01 df = 1	.083	
Borderline personality disorder (*n*, %)	118 (17.6%)	33 (17.0%)	χ^2 = .038 df = 1	.846	
Histrionic personality disorder (*n*, %)	62 (9.3%)	21 (10.8%)	χ^2 = .428 df = 1	.513	
Dependent personality disorder (*n*, %)	18 (2.7%)	3 (1.5%)	χ^2 = .825 df = 1	.364	
MMPI disability profile (*n*, %)	309 (53%)	73 (42.4%)	χ^2 = 5.92 df = 1	.015	*OR* = 1.53 *CI* = 1.1, 2.2

Variables significant at the univariate level were entered into a logistic regression analysis to predict work return at discharge, the results of which are contained in Table 5.4. It was determined that work status at admission and availability of the original job significantly predicted work status at discharge.

Table 5.4 Regression to predict work status at post-treatment from pre-treatment factors

Variable	*B*	*S.E.*	Wald	*df*	*p*	Odds Ratio	95% *CI* for odds ratio	
							lower	upper
Working at admission	2.11	0.26	65.51	1	0.00	8.23	4.94	13.71
original job available	0.43	0.24	3.18	1	0.07	1.54	0.96	2.49
ODI at pre-treatment	-0.01	0.01	2.12	1	0.15	0.99	0.97	1.00
pre-treatment surgery	0.23	0.22	1.02	1	0.31	1.25	0.81	1.94
MMPI disability profile	0.15	0.25	0.34	1	0.56	1.16	0.71	1.90
opiate dependence	0.03	0.29	0.01	1	0.92	1.03	0.58	1.83
major depressive disorder	-0.03	0.25	0.01	1	0.91	0.97	0.60	1.58
BDI at pre-treatment	0.00	0.01	0.00	1	0.95	1.00	0.97	1.03
constant	-1.64	0.53	9.56	1	0.00	0.19		

Note: χ^2 (df = 11) = 109, p < .001, Cox and Snell R^2 = 17%

5.2.2 Identification of Initial Variables: Admission Risk Factors for Government Disability Benefits at Discharge

The second mediating variable that was evaluated was government disability benefits at post-treatment. Table 5.5 shows the results of the univariate analysis of admission risk factors for government disability benefits (SSI/SSDI) at discharge. A large number of admission variables were found to be significantly different between patients with and without SSI/SSDI at discharge.

Table 5.5 Comparison of SSI/SSDI at discharge to no SSI/SSDI at discharge groups

Variable	no SSI/SSDI at discharge *N* = 1914	SSI/SSDI at discharge *N* = 40	Statistic	Sig.	Effect Size
Age (*M, SD*)	45.78 (9.42)	54.08 (8.47)	*t* = -5.53 *df* = 1952	.000	*d* = -0.93
Gender (*n, %)*	1014 (53.1%)	15 (38.5%)	χ^2 = 3.27 *df* = 1	.071	
Type of injury (*n*, %)			χ^2 = 3.21 *df* = 4	.523	
Cervical spine only	69 (3.7%)	1 (2.5%)			
Thoracic/lumbar spine only	660 (35.8%)	10 (25%)			
Extremity only	504 (27.3%)	11 (27.5%)			
Multiple spinal	217 (11.8%)	7 (17.5%)			
Multiple musculoskeletal	394 (21.4%)	11 (27.5%)			
Length of disability, months (*M, SD*)	18.23 (21.5)	60.58 (38.9)	*t* = -6.87 *df* = 39.5	.000	*d* = -1.35
Working at admission (*n*, %)	283 (15%)	0 (0%)	χ^2 = 7.01 *df* = 1	.008	

Table 5.5 - *Continued*

Pre-treatment surgery (*n*, %)	794 (42.2%)	28 (70%)	χ^2 = 12.4 *df* = 1	.000	*OR* = 3.2 [1.6, 6.3]
Pre-injury wage (*M, SD*)	$540 (395)	$515 (281)	*t* = .404 *df* = 1889	.686	
Attorney retained pre-treatment (*n*, %)	384 (20.5%)	18 (45%)	χ^2 = 14.1 *df* = 1	.000	*OR* = 3.17 [1.7, 6.0]
Case settled pre-treatment (*n*, %)	502 (26.5%)	31 (77.5%)	χ^2 = 50.9 *df* = 1	.000	*OR* = 9.54 [4.5, 20.2]
SSI/SSDI at pre-treatment (*n*, %)	11 (0.6%)	34 (85%)	χ^2 = 1225 *df* = 1	.000	*OR* = 967 [338, 2767]
Original job available at pre-treatment (*n*, %)	993 (63.9%)	2 (5.3%)	χ^2 =54.5 *df* = 1	.000	*OR* = .031 [.008, .131]
Pain VAS at pre-treatment (*M, SD*)	6.62 (1.83)	6.97 (1.84)	*t* = -1.19 *df* = 1921	.234	
MVAS at pre-treatment (*M, SD*)	93.28 (24.5)	103.0 (21.8)	*t* = -2.47 *df* = 1905	.014	*d* = -0.419
BDI at pre-treatment (*M, SD*)	17.54 (10.7)	23.28 (11.6)	*t* = -3.31 df = 1921	.001	*d* = -0.514
ODI at pre-treatment (*M, SD*)	38.96 (15.4)	43.44 (14.2)	t = -1.22 *df* = 1112	.222	
Opiate dependence (*n*, %)	320 (17.5%)	12 (35.3%)	χ^2 = 7.18 *df* = 1	.007	*OR* = 2.57 [1.3, 5.2]

Table 5.5 - *Continued*

Major depressive disorder (*n*, %)	1005 (55.1%)	25 (73.5%)	χ^2 = 4.60 *df* = 1	.032	*OR* = 2.26 [1.1, 4.9]
Any anxiety disorder (*n*, %)	310 (17%)	11 (32.4%)	χ^2 = 5.52 *df* = 1	.019	*OR* = 2.34 [1.1, 4.8]
Antisocial personality disorder (*n*, %)	63 (3.6%)	0 (0%)	χ^2 = 1.31 *df* = 1	.252	
Borderline personality disorder (*n*, %)	338 (19.4%)	5 (14.3%)	χ^2 = .575 *df* = 1	.448	
Histrionic personality disorder (*n*, %)	158 (9.1%)	4 (11.4%)	χ^2 = .231 *df* = 1	.630	
MMPI disability profile (*n*, %)	606 (49.6%)	12 (52.2%)	χ^2 = .060 *df* = 1	.806	

When these variables were all entered into a logistic regression analysis, the results were not interpretable. It was determined that SSI/SSDI at admission had excessively high multicollinearity with SSI/SSDI at discharge, and so SSI/SSDI at admission was removed from the analysis. The results of the logistic regression are shown in Table 5.6. Age, length of disability, and the availability of the original job were found to significantly predict the presence of SSI/SSDI benefits at discharge.

Table 5.6 Regression to predict SSI/SSDI status at post-treatment from pre-treatment factors

Variable	*B*	*S.E.*	Wald	*df*	*p*	Odds Ratio	95% *CI* for *OR*	
							lower	upper
Length of disability	0.02	0.01	18.29	1.00	0.00	1.02	1.01	1.03
Age	0.10	0.03	16.72	1.00	0.00	1.11	1.05	1.16
job available pre-treatment	3.34	1.08	9.65	1.00	0.00	28.23	3.43	232.35
BDI at pre-treatment	0.02	0.02	1.30	1.00	0.25	1.02	0.98	1.06
case settled pre-treatment	-0.50	0.49	1.08	1.00	0.30	0.61	0.23	1.56
Opiate dependence	-0.42	0.45	0.88	1.00	0.35	0.66	0.28	1.58
MVAS at pre-treatment	0.01	0.01	0.70	1.00	0.40	1.01	0.99	1.03
attorney at pre-treatment	-0.34	0.43	0.64	1.00	0.42	0.71	0.31	1.64
Major depressive disorder	-0.33	0.50	0.45	1.00	0.50	0.72	0.27	1.90
Pre-treatment surgery	-0.21	0.45	0.21	1.00	0.65	0.81	0.34	1.97
Anxiety disorder	-0.02	0.49	0.00	1.00	0.97	0.98	0.38	2.56
constant	-12.61	2.21	32.47	1.00	0.00	0.00		

Note: χ^2 (df = 11) = 109, $p < .001$, Cox and Snell R^2 = 17%

5.2.3 Identification of Initial Variables: Admission Risk Factors for Million Visual Analog Scale Score at Discharge

The final mediating variable that was examined was MVAS score at post-treatment. Because the MVAS score at discharge was a continuous, correlations were calculated to find the significant effects of admission risk factors on the discharge scores. Pearson's r coefficient was used for correlations between two continuous variables, and Spearman's rho coefficient was used for correlations between one continuous and one categorical variable. Table 5.7 shows the results of the correlation analysis.

Table 5.7 Correlations between Million Visual Analog Scale (MVAS) score at discharge to pre-treatment risk factors

	MVAS at discharge	Significance
Age	*r* = .083	.000
Gender	ρ = -.019	.408
Type of injury	ρ = .027	.255
Length of disability, months	*r* = .016	.498
Working at admission	ρ = -.081	.000
Pre-treatment surgery	ρ = .029	.206
Pre-injury wage	*r* = -.046	.051
Attorney retained pre-treatment	ρ = .053	.022
Case settled pre-treatment	ρ = -.030	.194
SSI/SSDI at pre-treatment	ρ = .084	.000
Original job available at pre-treatment	ρ = -.060	.019
Pain VAS at pre-treatment	*r* = .237	.000
MVAS at pre-treatment	*r* = .363	.000
BDI at pre-treatment	*r* = .197	.000
ODI at pre-treatment	*r* = .269	.000
Opiate dependence	ρ = .084	.000
Major depressive disorder	ρ = .090	.000
Any anxiety disorder	ρ = .047	.049
Antisocial personality disorder	ρ = .050	.037
Borderline personality disorder	ρ = .018	.445
Histrionic personality disorder	ρ = .000	.986
MMPI disability profile	ρ = .151	.000

Variables with a small effect size or larger ($r \geq 0.15$) were entered into a regression analysis, shown in Table 5.8. It was found that MVAS score at admission, age, BDI score at admission, pain VAS score at admission, and SSI/SSDI at admission significantly predicted MVAS score at discharge.

Table 5.8 Regression to predict MVAS score at discharge from pre-treatment factors

Variable	*B*	*S.E.*	Beta	*t*	*p*	tolerance
MVAS at pre-treatment	0.4	0.04	0.32	10.29	.000	0.66
Age	0.31	0.08	0.1	3.96	.000	0.96
BDI at pre-treatment	0.18	0.09	0.07	2.17	0.03	0.72
Pain VAS at pre-treatment	0.95	0.51	0.06	1.87	0.06	0.72
SSI/SSDI at pre-treatment	10.45	5.04	0.05	2.07	0.04	0.95
Job available at pre-treatment	1.57	1.7	0.03	0.93	0.36	0.85
Antisocial personality disorder	1.49	4.41	0.01	0.34	0.74	0.98
Opiate dependence	0.19	1.98	0.00	0.10	0.92	0.93
Working at pre-treatment	-0.82	2.1	-0.01	-0.39	0.7	0.93
Attorney retained at pre-treatment	-0.84	1.94	-0.01	-0.44	0.66	0.93
Major depressive disorder	-0.61	1.7	-0.01	-0.36	0.72	0.8
Anxiety disorder	-1.63	2.08	-0.02	-0.78	0.43	0.89
Constant	-3.16	5.35		-0.59	0.56	

Note: $R^2 = .157$, adjusted $R^2 = .149$, $F(12, 1302) = 20.2$, $p < .001$

5.2.4 Effects of Initial Variables on Outcome: Predicting Work Retention from Admission Factors

In order to determine if the admission variables identified in the previous analyses were significant predictors of work retention, all the admission factors were entered into a simultaneous logistic regression analysis to predict work retention. It was found that the variable job availability had significant multicollinearity with SSI/SSDI status at admission. Because SSI/SSDI status was believed to be a more important factor and because job availability had a larger amount of missing data, it was decided to remove job availability from the analysis. The results of the analysis are shown in Table 5.9. The variables length of disability and pain VAS at admission were found to be non-significant, identifying age, work status at admission, MVAS score at admission, SSI/SSDI status at admission, and BDI score at admission to be significant predictors of work retention.

Table 5.9 Regression to predict work retention from pre-treatment factors

Variable	*B*	*S.E.*	Wald	*df*	*p*	Odds Ratio	95% *CI* for *OR*	
							lower	upper
Age	-0.04	0.01	37.87	1	0.00	0.96	0.94	0.97
Working at admission	-0.83	0.22	14.74	1	0.00	0.44	0.29	0.67
MVAS at pre-treatment	-0.01	0.00	14.29	1	0.00	0.99	0.98	0.99
SSI/SSDI at admission	0.78	0.34	5.35	1	0.02	2.19	1.13	4.24
BDI at pre-treatment	-0.01	0.01	4.72	1	0.03	0.99	0.98	1.00
Length of disability	0.00	0.00	0.46	1	0.50	1.00	0.99	1.00
Pain VAS at pre-treatment	0.01	0.04	0.05	1	0.82	1.01	0.93	1.09
Constant	4.85	0.64	57.23	1	0.00	127.83		

Note: χ^2 (df = 7) = 90.3, p < .001, Cox and Snell R^2 = 6%

Next, a hierarchical regression analysis was conducted to examine the prediction of work retention from both admission and discharge risk factors. The variables SSI/SSDI status at admission and SSI/SSDI status at discharge had previously been identified as having high multicollinearity, so SSI/SSDI at admission was omitted from the analysis. The significant admission variables identified above were entered in the first block, and the discharge variables (work status at discharge, SSI/SSDI status at discharge, and MVAS at discharge) were entered in the second block. However, it was found that in combination with the other variables, SSI/SSDI status at discharge was no longer a significant predictor of work retention. Thus, SSI/SSDI at discharge was omitted from the analysis and was replaced with SSI/SSDI status at admission. The results are shown in Table 5.10. SSI/SSDI status at admission was a significant predictor of work retention in combination with the other admission variables. When the discharge variables (work status at discharge and MVAS at discharge) were entered in the second step, the variables work status at admission and SSI/SSDI status at admission became non-significant, suggesting that these variables were mediated by the discharge variables.

Table 5.10 Regression to predict work retention from pre-treatment and post-treatment factors

	Variable	*B*	*S.E.*	Wald	*df*	*p*	Odds Ratio	95% *CI* for *OR* lower	95% *CI* for *OR* upper
Block 1	Age	-0.05	0.01	39.29	1	0.00	0.95	0.94	0.97
	MVAS at pre-treatment	-0.01	0.00	15.22	1	0.00	0.99	0.98	0.99
	Work status at admission	-0.73	0.23	10.08	1	0.00	0.48	0.31	0.76
	BDI at pre-treatment	-0.02	0.01	5.70	1	0.02	0.99	0.97	1.00
	SSI/SSDI status at admission	0.67	0.35	3.65	1	0.06	1.96	0.98	3.90
	Constant	5.10	0.67	57.33	1	0.00	163.54		
Block 2	Age	-0.04	0.01	34.62	1	0.00	0.96	0.94	0.97
	Work status at discharge	-0.61	0.20	9.54	1	0.00	0.55	0.37	0.80
	MVAS at post-treatment	-0.01	0.00	7.97	1	0.01	0.99	0.99	1.00
	MVAS at pre-treatment	-0.01	0.00	7.59	1	0.01	0.99	0.98	1.00
	BDI at pre-treatment	-0.01	0.01	3.85	1	0.05	0.99	0.98	1.00

Table 5.10 - *Continued*

	SSI/SSDI at admission	0.63	0.36	3.12	1	0.08	1.88	0.93	3.77
	Work status at admission	-0.43	0.25	3.07	1	0.08	0.65	0.40	1.05
	Constant	5.33	0.68	61.17	1	0.00	206.55		

Note: χ^2 (df = 7) = 119, $p < .001$, Cox and Snell R^2 = 7.3%

5.2.6 Addition of Psychological Disorder Diagnoses

The study conducted by Howard, Mayer, Theodore, and Gatchel (2009) found that diagnoses of opiate dependence or cluster B personality disorders (antisocial, borderline, histrionic, or narcissistic) had a significant impact on completion rates in a functional restoration program. Although these disorders were not identified as significant in any of the previous analyses, it was decided to examine these factors to determine if they added anything above and beyond the factors already identified. Table 5.11 shows the univariate comparisons of the psychological diagnoses. Only opiate dependence and antisocial personality disorder were found to differ significantly between the work retention and non-work retention groups.

Table 5.11 Comparison of work retention and non-work retention groups on psychological diagnoses

	Non-work retention group	Work retention group	Statistic	P	Effect size 95% *CI*
Opiate dependence (*n*, %)	86 (25%)	228 (16.1%)	χ^2 = 14.76 *df* = 1	.000	*OR* = 1.73 [1.31, 2.3]
Antisocial personality disorder (*n*, %)	20 (6%)	39 (2.9%)	χ^2 = 7.56 *df* = 1	.000	*OR* = 2.14 [1.23, 3.71]
Borderline personality disorder (*n*, %)	71 (21.3%)	259 (19.2%)	χ^2 = .699 *df* = 1	.403	

Table 5.11 - *Continued*

Histrionic personality disorder (*n*, %)	40 (12%)	115 (8.5%)	χ^2 = 3.78 *df* = 1	.052	
Narcissistic personality disorder (*n*, %)	25 (7.5%)	132 (9.8%)	χ^2 = 1.69 *df* = 1	.193	

When these two variables were added to the previous regression model, only opiate dependence contributed significantly over and above the variables already in the model. Table 5.12 shows the final regression model, with opiate dependence added into the admission variables. Although the significance of SSI/SSDI at admission is marginal (*p* = 0.08) when opiate dependence is included in the model, it was believed to be theoretically important, and was retained in the structural model. In addition, BDI at admission is not significant in the presence of the discharge variables, suggesting possible mediation by discharge factors.

Table 5.12 Final regression model to predict work retention from pre-treatment and post-treatment factors

	Variable	*B*	*S.E.*	Wald	*df*	*p*	Odds Ratio	95% *CI* for *OR*	
								lower	upper
Block 1	Age	-0.05	0.01	41.41	1	0.00	0.95	0.94	0.97
	MVAS at pre-treatment	-0.01	0.00	12.76	1	0.00	0.99	0.98	1.00
	Work status at admission	-0.69	0.24	8.53	1	0.00	0.50	0.32	0.80
	Opiate dependence	0.39	0.16	5.69	1	0.02	1.48	1.07	2.03
	BDI at pre-treatment	-0.01	0.01	3.85	1	0.05	0.99	0.97	1.00
	SSI/SSDI status at admission	0.65	0.37	3.02	1	0.08	1.91	0.92	3.98

Table 5.12 - *Continued*

	Constant	4.77	0.71	45.08	1	0.00	118.16		
Block 2	Age	-0.05	0.01	37.06	1	0.00	0.95	0.94	0.97
	MVAS at post-treatment	-0.01	0.00	7.91	1	0.01	0.99	0.99	1.00
	Work status at discharge	-0.52	0.20	6.75	1	0.01	0.60	0.40	0.88
	MVAS at pre-treatment	-0.01	0.00	5.99	1	0.01	0.99	0.99	1.00
	Opiate dependence	0.39	0.16	5.73	1	0.02	1.48	1.07	2.04
	Work status at admission	-0.44	0.25	3.00	1	0.08	0.65	0.40	1.06
	SSI/SSDI at admission	0.58	0.38	2.38	1	0.12	1.79	0.85	3.75
	BDI at pre-treatment	-0.01	0.01	2.28	1	0.13	0.99	0.98	1.00
	Constant	5.00	0.72	48.32	1	0.00	148.59		

Note: χ^2 (*df* = 8) = 117, $p < .001$, Cox and Snell R^2 = 7.5%

5.3 Structural Model Development and Testing

5.3.1 Identification of Structural Model

To develop the structural model, the variables identified as significant were combined according to theoretical considerations (see Figure 5.1). The variables work status at admission and SSI/SSDI status at admission were combined into a latent variable labeled “economic factors at admission,” and a latent variable labeled “economic factors at discharge” was created using work status at discharge. The variables opiate dependence, BDI at admission, and MVAS at admission were combined into a latent variable labeled “psychosocial factors at admission,” and the variable MVAS at discharge made up the latent variable “psychosocial factors at discharge.” The variable age did not seem to be theoretically part of any of the factors, so it was left as an individual variable, with a direct relationship to work retention. The model was constructed so that economic factors at admission predicted economic factors at discharge, which predicted work retention. In addition, psychosocial factors at admission predicted psychosocial factors at discharge, which predicted work retention. The variables work status at admission and work status at discharge were hypothesized to have correlated error terms due to the longitudinal nature of the variables, and the same was hypothesized for MVAS score at admission and discharge.

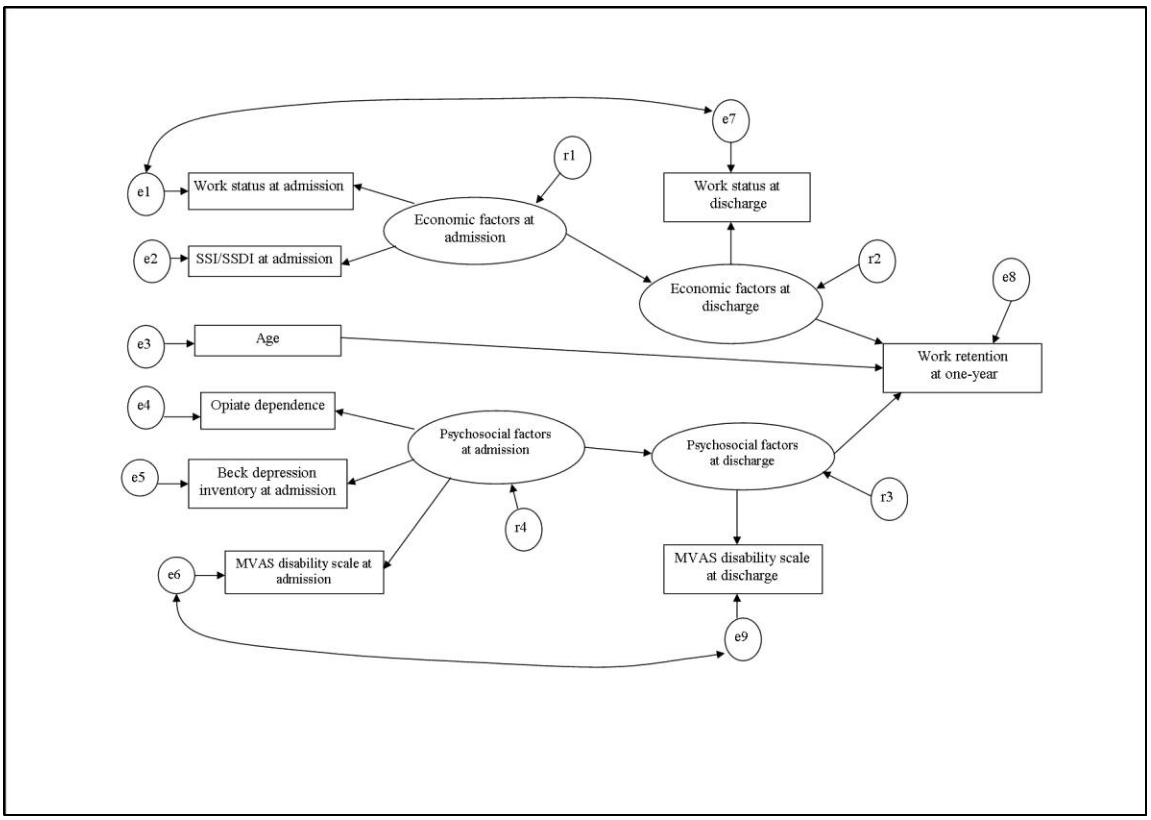

Figure 5.1. Model 1: Original structural model

5.3.2 Model Testing and Revision

The original structural model (Model 1) was evaluated and was not an adequate fit for the data (χ^2 (*df* = 22) = 166.2, $p < .001$). A model with good fit should have a non-significant chi-square test, with smaller chi-square values indicating a better fitting model. The comparative fit index (CFI) was 0.856; a good-fitting model should have a CFI value of > 0.95. The root mean square of approximation (RMSEA) was 0.066, with a 90% confidence interval of [0.057, 0.076]; a model with excellent fit should have a RMSEA value < 0.03. Post-hoc modification indices were performed and the addition of several paths was recommended: from psychosocial factors at admission to economic factors at admission, from psychosocial factors at discharge to economic factors at discharge, and from age to SSI/SSDI status at admission, resulting in Model 2. The addition of these paths improved the fit of the model (χ^2 (*df* = 19) = 42.7, *p* = .001), as can be seen from the chi-square difference test (χ^2 (*df* = 3) = 123.5, *p* < .001). However, the chi-square goodness of fit was still statistically significant, indicating lack of overall model fit. Some of the fit indices were improved including the CFI = 0.976, indicating good fit, and RMSEA = 0.029, with a 90% confidence interval [0.017, 0.041], indicating marginal fit. Improvement in model fit can also be seen in the comparison of the Akaike Information Criterion (AIC) value, an index of model parsimony where smaller values indicate a better-fitting, more parsimonious model. The AIC value for Model 1 was 230.2; this improved to AIC = 112.7 with the additional paths in Model 2. Model 2 with standardized estimates can be seen in Figure 5.2.

The parameter results are shown in Table 5.13. According to the bootstrap significance test, all the parameters are statistically significant except for the relationship between psychosocial factors at discharge and work retention. Model 2 accounted for 38% of the variance in psychosocial factors at discharge, 79% of the variance in economic factors at discharge, and 15% of the variance in work retention. Although the variance in work retention explained by the model seems small, it accounts for twice as much variance as does the final logistic regression model (Cox and Snell R^2 = 7.5).

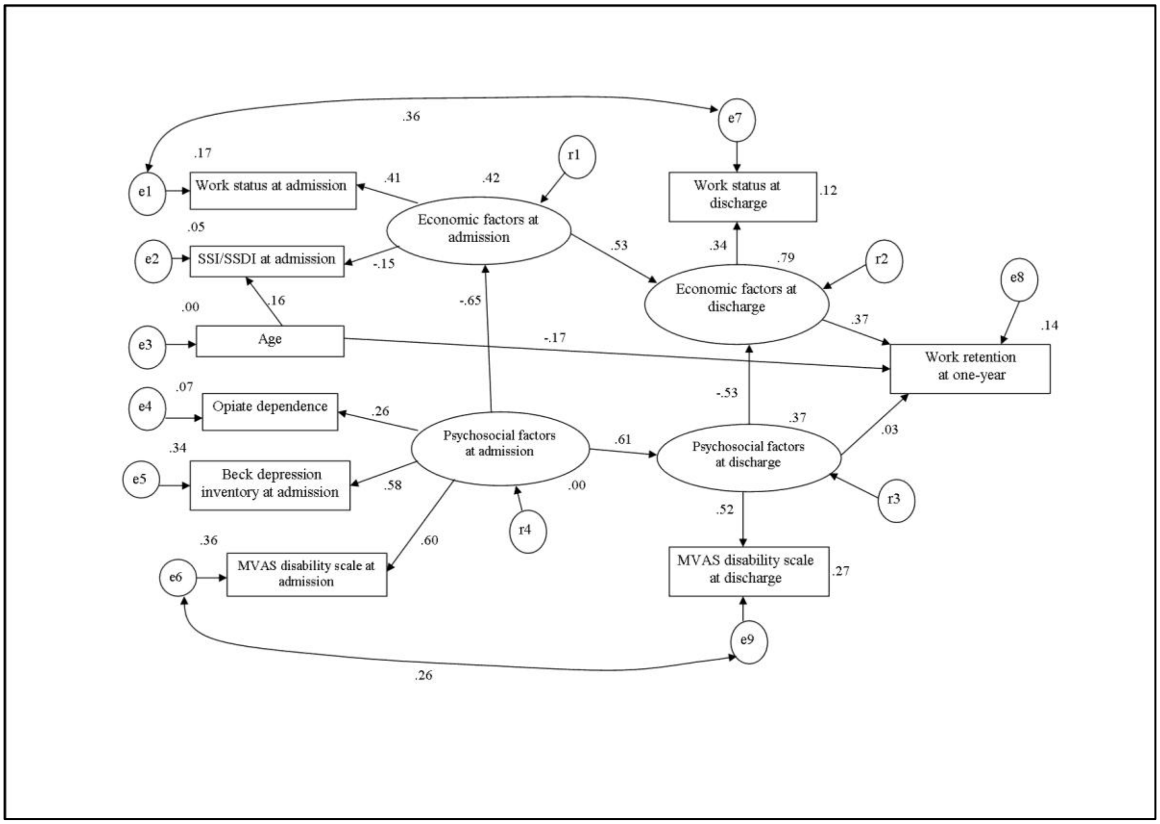

Figure 5.2. Model 2: Final structural model with standardized estimates

Table 5.13 Results from structural equation model 2

Parameter		β	*B*	Bootstrap *S.E.*	Bootstrap sig.	Bias-corrected bootstrap 95% *C.I.* lower bound	upper bound
Economic factors at discharge	Work retention	.37	.98	1.4	.002	.20	6.1
Psychosocial factors at discharge	Work retention	.034	.001	.014	.701	-.007	.057
Age	Work retention	-.17	-.01	.001	.001	-.009	-.005
Psychosocial factors at admission	Psychosocial factors at discharge	.61	93.9	19.1	.001	64	142
Psychosocial factors at admission	Economic factors at admission	-.65	-.96	.19	.001	-1.4	-.65
Economic factors at admission	Economic factors at discharge	.53	.53	.29	.008	.074	1.08
Psychosocial factors at discharge	Economic factors at discharge	-.53	-.01	.03	.007	-.012	-.001

Table 5.13 - *Continued*

Economic factors at discharge	Work status at discharge	.34	1.00	n/a	n/a	n/a	n/a
Psychosocial factors at admission	Opiate dependence	.26	1.00	n/a	n/a	n/a	n/a
Psychosocial factors at admission	MVAS at admission	.60	140	21.2	.001	109	193
Psychosocial factors at admission	BDI at admission	.58	61	9.3	.001	46	81
Psychosocial factors at discharge	MVAS at discharge	.52	1.00	n/a	n/a	n/a	n/a
Economic factors at admission	Work status at admission	.41	1.00	n/a	n/a	n/a	n/a
Economic factors at admission	SSI/SSDI status at admission	-.15	-.15	.06	.001	-.32	-.06
Age	SSI/SSDI status at admission	.158	.002	.001	.001	.002	.004

5.3.3 Direct, Indirect and Total Effects

In order to evaluate the hypothesis that the relationship between the admission variables and work retention was mediated by the discharge variables, an analysis of total, direct, and indirect effects was performed using a maximum likelihood bootstrap procedure. The results of this analysis are shown in Table 5.14.

Economic factors at admission had only indirect effects on work retention. Psychosocial factors at admission had only indirect effects on work retention, but had significant direct effects on economic factors at admission and psychosocial factors at discharge. In addition, psychosocial factors at admission had significant indirect effects on economic factors at discharge. Economic factors at discharge were found to have significant direct effects on work retention. Psychosocial factors at discharge had non-significant direct effects and significant indirect effects on work retention; however, psychosocial factors at discharge also had significant direct effects on economic factors at discharge. This suggests that psychosocial factors at discharge acts as a mediating variable between psychosocial factors at admission and economic factors at discharge, and that economic factors at discharge mediates the relationship between psychosocial factors at discharge and work retention. This is a very different structure than was originally hypothesized, and it was decided to test this model (Model 3) as an alternative to Model 2 identified above. A diagram of Model 3 is shown in Figure 5.3. Although Model 3 adequately fits the data (χ^2 (df = 24) = 91.1, p < .001, CFI = .933, RMSEA = 0.043, 90% CI = [0.034, 0.053]), the chi-square difference test indicates that Model 2 has significantly better fit (χ^2 (df = 5) = 48.4, p < 0.001). In addition, a comparison of parsimony adjusted goodness-of-fit measures indicates that Model 2 (AIC = 112.7), is a better-fitting, more parsimonious model than the Model 3 (AIC = 151.1). Furthermore, Model 3 makes less sense theoretically than Model 2. Thus, it was decided to retain Model 2 and discard Model 3.

Table 5.14 Direct, indirect, and total effects on work retention

		Economic factors at admission			Psychosocial factors at discharge			Economic factors at discharge			Work retention		
		unstd.	*SE*	*sig*	*unstd.*	*SE*	*sig*	*unstd.*	*SE*	*sig*	*unstd.*	*SE*	*sig*
Psychosocial factors at admission	direct effects	-.958	.189	.001	93.9	19.2	.001						
	total indirect effects							-.981	.198	.001	-.877	.17	.001
	total effects	-.958	.189	.001	93.9	19.2	.001	-.981	.198	.001	-.877	.17	.001
Economic factors at admission	direct effects							.527	.288	.008			
	total indirect effects										.515	.365	.007
	total effects							.527	.288	.008	.515	.365	.007

Table 5.14 - *Continued*

Psychosocial factors at discharge	direct effects							-.005	.003	.007	.001	.014	.701
	total indirect effects										-.005	.014	.003
	total effects							-.005	.003	.007	-.004	.003	.023
Economic factors at discharge	direct effects										.978	1.40	.002
	total indirect effects												
	total effects										.978	1.40	.002

Note: *Ustd.* = unstandardized estimate, *SE* = standard error, i = significance

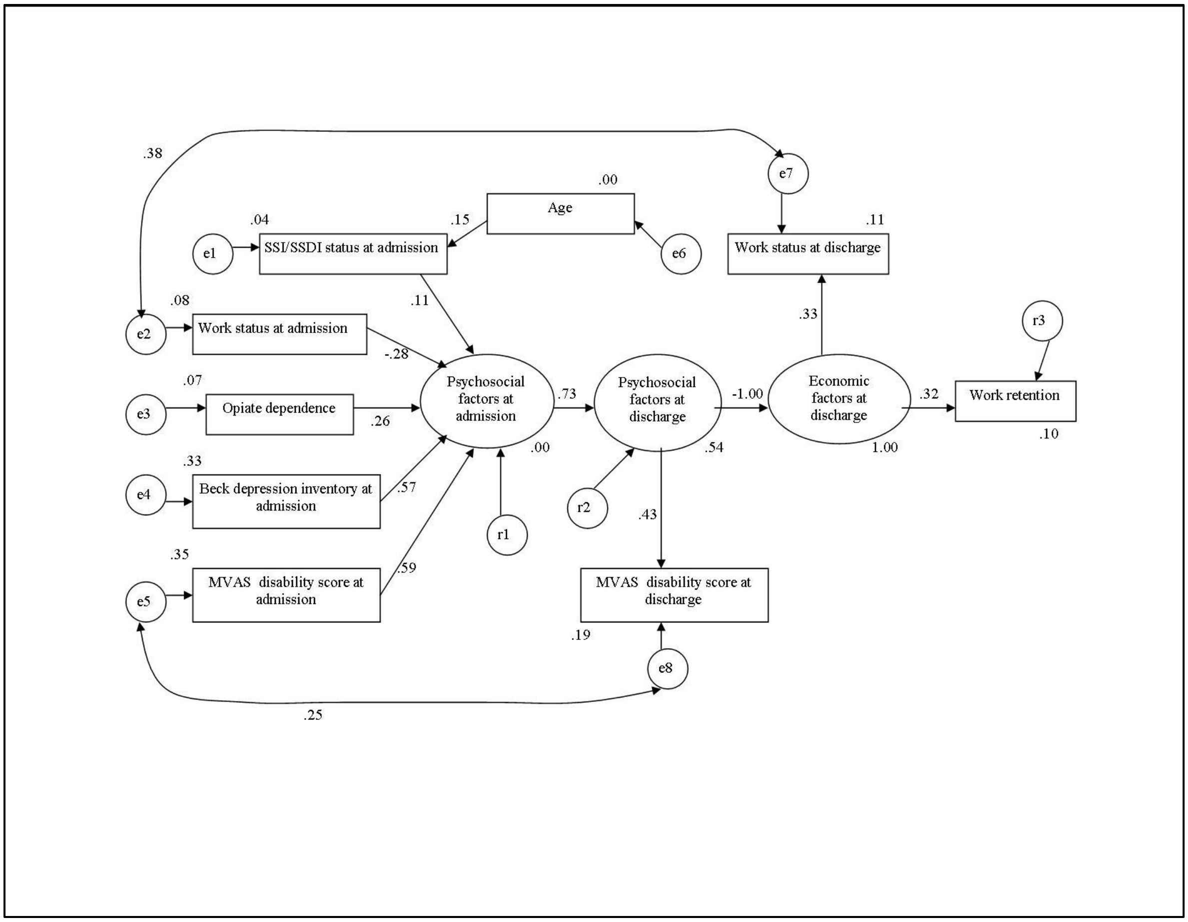

Figure 5.3 Model 3: Alternative model with standardized estimates

CHAPTER 6

DISCUSSION

The purpose of the current study was to develop a descriptive and predictive model of work retention and its related factors in the context of a functional restoration treatment program. Using the steps described by Barron and Kenny (1986), initial (pre-treatment) and mediating (post-treatment) variables that were highly related to the outcome (work retention at one year) were identified. A structural equation model was then developed to establish the relationships between the variables identified as highly related to both post-treatment mediating risk factors and work retention at one year.

6.1 Evaluation of Hypotheses

The first hypothesis, that a structural model describing work retention could be identified, was partially supported. The final model described the relationships between the admission variables, the discharge variables, and work retention, but had inconsistent goodness of fit. The chi-square goodness of fit test indicated poor model fit, the RMSEA indicated marginal model fit, and the CFI and AIC indicated good model fit. The variables included in the final model corresponded to variables identified in the literature as predictive of return to work, which suggests that the factors influencing return to work and work retention are similar. The second hypothesis, that the relationship between admission factors and work retention would be mediated by discharge factors, was also supported. The analysis of the direct and indirect effects supported the mediation of admission psychosocial factors by discharge psychosocial factors and the mediation of admission economic factors by discharge economic factors. The next hypothesis dealt with the contributions of admission and discharge risk factors. It was originally hypothesized that work status, government disability benefits, perceived disability, pain intensity and depressive symptoms would affect work retention both at admission and discharge. However, it was found that only work status and perceived disability had significant effects on work retention at both admission and discharge. Government disability benefits and depressive symptoms had significant effects on work retention at pre-treatment only. The final hypothesis that variables obtained at admission only (age, gender, length of disability, income, job availability, MMPI disability profile, and opiate dependence) would significantly influence work retention, was mostly disconfirmed. Only age and opiate dependence were found to have significant effects on work retention.

6.2 Risk Factors Identified

6.2.1 Demographic Risk Factors

The only demographic risk factor found to relate to work retention was age. Patients who were older were less likely to retain work. This is similar to the findings of Mayer, Gatchel, and Evans (2001), who found that workers over the age of 55 were less likely to retain work at one year after discharge. This may be due to several factors. Older workers (over the age of 55) who have lost a job through disability or unemployment are much less likely to return to work than younger workers, and are less likely to be employed at all than workers over the age of 55 who have not lost their jobs (Chan and Stevens, 2001). In addition, older workers who need to change jobs or reduce hours, due to work restrictions or other factors, are more likely to stop working entirely than to find a new job with the desired characteristics (Abraham and Houseman, 2005). In this sample, as was found by Mayer, Gatchel, and Evans (2001), workers older than 55 were much less likely to find both new jobs and new employers than workers under the age of 55.

Patients who were older were more likely to be receiving disability benefits through SSI or SSDI. This suggests several possible explanations. First of all, SSDI benefits are scaled based on average lifetime earnings (Social Security Administration, 2010). Patients who are older have longer work histories and are more likely to have higher incomes, making disability benefits more attractive to older workers. Second, one of the most desirable benefits of government disability insurance is that receipt of benefits for two years qualifies a person to receive health insurance through Medicare, a benefit that is usually more important to older workers than to younger workers. Boyle and Lahey (2010) found that older workers who obtained access to free health insurance outside of employment were less likely to continue working full-time than workers without access to health insurance. Third, recent changes to the retirement age for full social security benefits (from 65 to 67) and the increase in penalties for early retirement at age 62, have resulted in increased enrollment in SSDI for workers between the ages of 45 and 64, possibly as an alternative to early retirement (Duggan, Singleton, and Song, 2007).

6.2.2 Psychosocial Risk Factors

Perceived disability, as measured by the MVAS was found to be highly related to work retention, both at pre-treatment and at post-treatment. This corresponds to the risk factors identified in the literature review; perceived disability was one of the most robust psychosocial risk factors found across a large number of studies. The fact that perceived disability at post-treatment was highly related to work retention is also important. In a functional restoration program, patients must have been injured for at least four months and have significant physical limitations to qualify for admission to the program. It is expected that they would have high levels of perceived disability upon admission, as it is an accurate reflection of their circumstances. However, the treatment program includes many types of therapy to increase physical function and to decrease psychosocial distress. Patients who fail to improve and continue to demonstrate high levels of perceived disability at program completion are at risk for poorer outcomes.

Higher levels of depressive symptoms, as measured by the Beck Depression Inventory-II, at admission were also found to be predictive of failure to retain work. Depressive symptoms can increase focus on somatic symptoms and disturb sleep, worsening both the perception of pain and the depressive symptoms (Wesley et al., 1999). However, depressive symptoms at discharge from treatment were not found to be related to work retention. This may be due to an interaction of depression with symptoms of disability as found by Alschuler, Theisen-Goodvich, Haig, and Geisser (2008). An alternative explanation is that pharmacological treatments with anti-depressants, initiated at the beginning of treatment, may have successfully reduced depressive symptoms by the discharge evaluation to the point where the difference between patients with and without work retention is no longer appreciable.

The final psychosocial risk factor for failure to retain work identified in this study was dependence on opiate pain medications. Patients who were found to be dependent on opiates at admission were less likely to retain work at one-year after discharge. Previous literature has likewise found dependence on opiates to be related to poor treatment outcomes, including return to work, work retention, excessive healthcare utilization, and program completion (Dersh, et al., 2007; Dersh, et al., 2008; Kidner, et al., 2009; Howard, et al., 2009). It may be that patients with more severe injuries are more likely to be dependent on opiates, as Dersh et al. (2008) found that opiate dependent patients had disabled for significantly longer than non-opiate dependent patients. However, another possibility is that use of opiate pain medications may prolong the recovery process. One of the goals of the treatment program is to reduce or eliminate opiate dependence, but information on the dosage of such medications at admission or discharge was not available for this sample. A possible topic for future research might be the effect of success or failure of opiate detoxification or the post-treatment use or dosage of opiates on treatment outcomes.

Contrary to the original hypotheses, pain intensity at both admission and discharge was found to be unrelated to work retention. Although prior studies identified pain intensity as predictive of treatment outcomes (McGeary, et al., 2006), when considered in combination with perceived disability, depressive symptoms, and opiate dependence, pain intensity did not significantly contribute to the prediction or work retention. This may be a result of construct overlap; pain intensity may share significant amounts of variation with perceived disability. Similarly, depressive symptoms may interact with pain intensity, causing increases in both types of symptoms, and patients with higher levels of pain may be more likely to use and/or abuse opiate pain medications.

The hypothesis that psychosocial factors at program discharge mediate the effects of psychosocial factors at admission on work retention was supported. The psychosocial factors at admission had only indirect effects on work retention and only direct effects on psychosocial factors at discharge. The effects of psychosocial factors at admission cannot be adequately explained without considering psychosocial factors at discharge. Patients who fail to show improvement in psychosocial factors despite intensive treatment are at high risk for failure to retain work. An unexpected finding was that the effects of psychosocial factors at discharge on work retention were mediated by the economic factors at discharge, as demonstrated by significant indirect effects and non-significant direct effects. This is evidence that both psychosocial and economic factors must be considered in evaluating treatment success.

6.2.3 Economic Risk Factors

Work status, both at admission and discharge, was identified as highly related to work retention. Patients who were working at both admission and discharge were 3.8 times more likely to retain work than patients who were not working at admission or discharge. In addition, patients who were not working at admission, but who had resumed work by discharge, were twice as likely to retain work as patients who had not resumed work by discharge. Access to transitional employment, i.e., work that can be resumed with reduced hours and/or at light duty status during the course of the treatment program, is associated with improved work retention rates. This finding supports the stay-at-work model (Howard, et al., 2009) in which injured workers are encouraged to remain at work even if they require modifications to their job duties. This model attempts to avoid or minimize time away from work to prevent the development of secondary psychological factors and to maintain as much physical function as possible.

Government disability benefits, including SSI and SSDI, were also significantly related to work retention. This is not surprising, because according to the Social Security Administration (2009), only 5.1% of workers receiving benefits due to injury returned to any type of full- or part-time work successfully in 2008. Although recipients of SSI or SSDI rarely return to full-time employment, part-time work with earnings under $1050 per month is allowed without loss of benefits or decrease in payments. However, all of the patients in this program who were receiving SSI or SSDI at the admission assessment expressed a desire to return to work at least part-time. The fact that patients receiving SSI or SSDI at admission failed to retain work at a significantly higher rate than patients without government disability benefits indicates that these patients either overestimated or misrepresented their return to work intentions. Contrary to the original hypothesis, SSI/SSDI benefits were only influential at pre-treatment. This appears to be due to the fact that only 11 patients who were receiving SSI or SSDI at admission were no longer receiving benefits at discharge. Thus, SSI and SSDI at admission and discharge is essentially the same variable, also indicated by the excessive multicollinearity between the variables.

An unexpected finding was that economic factors were significantly influenced by psychosocial factors. The original conception of the model expected that the effects of economic and psychosocial factors would be somewhat independent. However, at both admission and discharge, psychosocial factors had significant direct effects on economic factors. This indicates that economic and psychosocial factors cannot be considered in isolation. Rather, the entire spectrum of biopsychosocial factors needs to be considered in order to accurately predict work retention.

Finally, the hypothesis that the effects of economic factors at admission on work retention would be mediated by economic factors at discharge was supported. Economic factors at admission had significant direct effects on economic factors at discharge and significant indirect effects on work retention; while economic factors at discharge had significant direct effects on work retention. This pattern suggests that the effect of economic factors at admission occurs only through economic factors at discharge.

6.3 Conclusions

The goal of the present study was to identify a model for explaining work retention that accounted for the effects of risk factors at both admission and discharge. Age, work status at admission, SSI/SSDI status at admission, opiate dependence, perceived disability at admission, depressive symptoms at admission, work status at discharge, and perceived disability at discharge were all found to be significant risk factors for determining work retention at one year following discharge. A model was constructed that explained 15% of the variance in work retention, however the fit of the model was not consistently supported by the statistical fit indices. It is difficult to explain large amounts of variance in a one-year outcome due to the multitude of intervening variables than are not able to be accounted for or controlled. However, it is notable that the structural equation model, which takes into account the mediating effect of the discharge risk factors, explained twice as much variance as a logistic regression model consisting of the same risk factors. Furthermore, the hypothesis that admission factors would be mediated by discharge factors was supported; and it was found that psychosocial factors have significant influence on economic factors. As is predicted by the biopsychosocial model, physical, psychosocial, and economic factors interact to determine the patient's response to treatment and the ability to maintain treatment gains in physical and psychosocial function during the year following discharge.

These findings suggest that it is not enough to simply examine admission and discharge risk factors, one must also account for the relationships between the variables. The present study also emphasizes the fact that the presence of risk factors for poor outcomes at admission should not be used as selection criteria for admittance to a treatment program. Patients who enter treatment with significant risk factors can reduce the risk of negative outcomes through responsiveness to the treatment program. Only when the full set of admission and discharge factors have been identified can the risk of failure to retain work be accurately assessed. A practical application of these findings might be to identify patients at higher risk of failure to retain work during their progress through the treatment program, so that additional treatment or support can be offered in order to improve work retention rates. However, the major new finding of this research was that discharge risk factors play an important role in determining work retention one year after treatment with functional restoration.

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BIOGRAPHICAL INFORMATION

Emily Brede received her B.A. in Psychology from the University of Oklahoma in 2001, and received her B.S. in Nursing from Texas Woman's University in 2005. She has worked as a critical care nurse for five years, and she is certified as a Critical Care Registered Nurse. Ms. Brede's research has focused on two areas: clinical outcomes following multidisciplinary rehabilitation for chronic disabling occupational musculoskeletal disorders and the use of surface electromyography biofeedback for the treatment of chronic disabling occupational spinal disorders. Ms. Brede is an author on five journal articles and two book chapters. Her work has been presented to the local chapter of the American Association of Neuroscience Nurses and at the national convention of the National Association of Spinal Surgeons.