THE PREVALENCE AND RESPONSIVENESS OF HEAD INJURIES IN A CHRONIC DISABLING OCCUPATIONAL MUSCULOSKELETAL DISORDER POPULATION

by

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Abstract

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Injuries to the head cause problems in multiple domains, including cognitive functioning, emotion regulation, memory recall, and reaction time. Head injuries are often highly debilitating and cause patients to have a difficult and lengthy recovery process, frequently resulting in lifelong depression and much lower quality of life. Although research has been conducted to assess separate psychosocial or medical interventions, no research exists examining the effectiveness of an interdisciplinary functional restoration rehabilitation program following head trauma. The aim of the present study was to examine the effect of functional restoration on head injury patients (n = 122) in comparison to matched patients (n = 122) out of a subset of Chronic Disabling Occupational Musculoskeletal Disorders patients. Head-injury patients were matched to non-head injury patients on other extraneous injuries that they share. Patients participated in functional restoration and were administered measures of psychosocial distress upon admission and discharge from the program. Additionally, demographic variables were collected at admission. Overall, patients with a head injury performed comparably to the matched patients such that their psychosocial outcomes significantly improved through treatment and their one-year outcomes reflected those of typical patients. These results indicate that functional restoration is a useful tool to aid in recovery following trauma to the head.

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Chapter 1

Introduction

1.1 Chronic Pain

Chronic pain is a complicated, expensive, and debilitating state that ultimately affects both productivity and quality of life for any who experience it. This type of pain, which is defined as pain lasting for three or more months, often evolves into a multidimensional problem that involves not only the physiological injury itself, but also social and psychological factors.

Treatment for chronic pain most often follows the biopsychosocial model, which targets a person's treatment by including biological, psychological, and social factors that each contribute to their illness (Engel, 1977; Gatchel, 2005). With this model, practitioners are able to take into account not only their patient's physiological makeup and genetic history, but also the perception of these physiological changes and their resulting emotional response, as well as the social factors that the culture views as an appropriate response to their specific type of illness. This united approach helps to assess the severity of the illness and to find the best route to recovery for that person (Engel, 1980). As one could assess from this description, the biopsychosocial model presents a mutlidisciplinary type of treatment, which is most often recommended to optimally manage pain.Treatment can only be provided if the injury, and resulting pain, are properly assessed, however.

Each year, $85 billion is spent simply on accurately diagnosing pain (Wallace, 2005), while the total annual cost of chronic pain due to both direct and indirect costs may be as high as $294.5 billion in America alone (National Academics of Sciences and Institute of Medicine, 2001). However, chronic pain has become a concerning problem the world over, not just in America. According to the World Health Organization, about

20% of individuals have a form of chronic pain (Turk & Swanson, 2007). Pain may account for up to 80% of all physician visits (Gatchel, Peng, Peters, Fuchs, & Turk, 2007), yet typical treatments for chronic pain, such as surgery or medications, are often found to be unsuccessful (Glenn, 2002; Mayer & Polatin, 2000; Mayer et al., 1985). Understandably, this chronic musculoskeletal pain accounts for 29% of lost workdays, leading to incredible financial loss not only from treatment costs, but also the setback of lost income from missing work that is (International Association for the Study of Pain, 2009b) estimated to cost $41.7 billion annually (International Association for the Study of Pain, 2009a).

In a circular type of pattern, many Americans that suffer from chronic musculoskeletal pain were actually injured at work. The Department of Labor reported 38.5 cases of musculoskeletal disorders per 10,000 full-time workers in 2011, which increased 12% from 2010. These musculoskeletal disorders accounted for 33% of all workplace injuries and illnesses requiring time off of work in 2011 (Bureau of Labor Statistics, 2012). According to one study, the estimated costs associated with lost work days and compensation for occupational musculoskeletal disorders can range from $13 billion to $20 billion per year (Gatchel & Mayer, 2000). Forty-eight percent of these workplace injuries came from instances such as falling boxes, malfunctioning forklifts, or falls and trips (Bureau of Labor Statistics, 2012). Oftentimes, these types of occurences also result in head injuries in addition to the musculoskeletal injury, which can impact the victim's recovery, cognition, and day-to-day functioning and quality of life.

1.2 Head Injuries

1.2.1 Diagnosis

According to the National Institute of Health, a traumatic brain injury (TBI) is the result of "any trauma that injures the scalp, skull, or brain" (National Library of Medicine,

2013). The severity of such an injury may range from “mild” – a brief change in mental status or consciousness – to “severe” – an extended period of unconsciousness or amnesia after the injury. A concussion, one of the most common types of TBI, and a minor bump on the skull are both considered a mild TBI (mTBI).

1.2.2 Prevalence Rate and Estimated Costs

In 2010, the Centers for Disease Control and Prevention determined that about 2.5 million emergency room visits, hospitalizations, or deaths were associated with TBI (Centers for Disease Control and Prevention, 2014). Over the past decade, the rate of TBI-related emergency room visits has increased by 70%. In 2012, it was estimated that approximately 1.3 to 3.8 million of the traumatic brain injuries each year were due to sports injuries alone, thus not accounting for daily or on-the-job accidents (Valerio & Illes, 2012). In 2011, 11% of all of the musculoskeletal disorders were comprised of multiple traumatic injuries, and 20% were head related (Bureau of Labor Statistics, 2012). The CDC estimated that TBIs cost an average of $1,940 a year in medical costs, and an average of $3,355 due to work loss, leading to a total average of over $5,000 a year per person for Americans between the ages of 30-65 (Centers for Disease Control and Prevention, 2014). With so many people sustaining these injuries, it is very important that the consequences are researched and understood.

1.2.3 Symptoms and Comorbidites

Symptoms of a head injury can occur right away, or could be delayed, not presenting until up to several days later. Injuries to the head often cause problems in multiple domains, including cognitive functioning, emotion regulation, memory recall, and reaction time. Less severe symptoms can include drowsiness, headaches, loss of consciousness, memory loss, nausea and vomiting, seeing flashing lights, feeling confused, spacey or foggy, while severe symptoms requiring immediate attention are

changes in alertness and consciousness, lasting confusion, convulsions or seizures, muscle weakness, unequal pupil size, remaining unconscious (coma), repeated vomiting, unusual eye movements, and equilibrium problems (National Library of Medicine, 2013).

Head injuries can be highly debilitating and cause people to have a difficult and lengthy recovery process. Studies have shown that past experience of a mild traumatic brain injury (mTBI) may be a risk factor for increased symptom difficulty for several months post-injury (K. J. Miller, Ivins, & Schwab, 2013), meaning that someone who has experienced at least one mild head injury in their life may have worse symptoms, prolonged experience of symptoms, or both. Such symptoms could include depression, irritability, anxiety, insomnia, and other negative mood states, that could lead to increased pain intensity. Due to this increased risk of negative affect it is important to keep track of individuals with a history of head injuries. Figure 1.1 shows a complete picture of the symptoms and consequences that can come from a head injury (Concussion Clinic at Burwood Hospital, 2013).

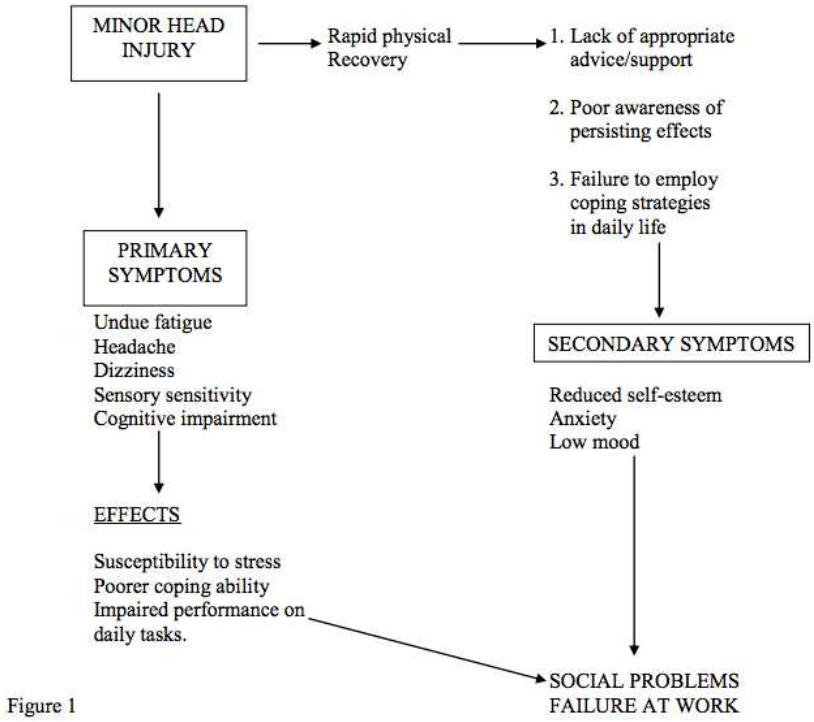

Figure 1.1 Primary and Secondary Symptoms of a Minor Head Injury

1.2.4 Disability

Acute brain injury due to trauma is the leading cause of disability in the under-40s age group, and studies show that even a minor head injury can result in a prolonged disability (Seeley et al., 2009). Over time, individuals with a head injury may become physically independent, no longer requiring assitance with self-care or mobility, but still maintain major cognitive deficits, having difficulty with communication, social adjustment, and cognition (Andelic et al., 2010). Impaired awareness is a consequence of such a general cognitive impairment, which results in maladaptive behavior, greater distractibility, post-traumatic amnesia, and general memory impairment (Trudel, Tryon, & Purdum, 1998). Not only do patients often maintain a disability that requires assistance, but many patients also have issues reintegrating socially. In turn, this keeps patients from

being able to work, which keeps them from being a functioning member of society (Andelic et al., 2010).

1.2.5 Treatment

Although there is no cure for head injuries, there have been studies exploring different types of treatments, both medically- and psychosocially-based. Some of these potential treatments include cognitive-behavioral therapy (CBT), supporting lifestyle modifications, pharmacologic treatments, and light therapy (Ponsford et al., 2012). Cognitive-behavioral therapy is a widely used form of therapy that offers a wide range of techniques for patients to utilize in order to cope with their illness. Some CBT techniques specific to pain include "self-instructions (e.g. distraction, imagery, motivational self-talk), relaxation and/or biofeedback, development of adaptive coping strategies (e.g. minimizing negative or self-defeating thoughts), changing maladaptive beliefs about pain, and goal setting" (Gatchel & Rollings, 2008). Cognitive-behavioral therapy can also help address comorbid conditions such as depression and anxiety, which are common in patients with head injuries.

Although there are several pharamacological and complementary and alternative medical (CAM) treatments available, they are used to treat the symptoms and comorbidities as opposed to the actual head injury. Such pharmacological interventions can include modafinil and melatonin, which aid in sleep regulation and depression (Ponsford et al., 2012). Persistent pain, such as headaches and migraines, resulting from the injury to the head can be treated with non-opioids, such as acetaminophen or non-steroidal anit-inflammatory drugs (NSAIDs). One CAM therapy seen in head injury treatment is light therapy. Light therapy involves exposure to light or wavelengths in order to regulate depression, Seasonal Affective Disorder, and sleep (Ponsford et al., 2012).

In addition to these, one program makes use of an individualized therapy plan that emphasizes physical fitness as a mean of improving stamina. Their individualized approach gives the counselor an advantage in keeping the patient's attention through direct, one-on-one interaction. Focusing and paying attention are essential since many of these individuals have difficulties with cognitive functioning, especially in a group setting (Zubko, 2011). However, after individual progress has been made, these patients transition to group therapy due to its ability to show individuals that other people have brain injuries, allowing them to realize they are not alone, leading to improved rehabilitation (Zubko, 2011). This program also makes use of CBT, motivational interviewing, which is a counseling style that elicits behavior change by aiding clients in exploration and resolution of indecision (Rollnick & Miller, 1995), and a technique know as "mindfulness." Mindfulness-based meditation helps patients focus on their minds and bodies, and brings them into the present moment. This also aids in coping with stress and emotions in a novel and productive way. Mindfulness-based meditation is delivered in the forms of meditation, yoga, body awareness, and even certain aspects of Tai Chi (Zubko, 2011).

Some experimental therapies have also been tested on individuals with a head injury. For instance, electrical stimulation of the interstitial thalamic nuclei has been used on a few individuals with severe TBI with minimal consciousness. This intervention improved their ability to participate and respond to both cognitive and motor therapy (Ruff & Riechers, 2012). Amantadine has also recently been tested as a pharmacological response to severe TBI (Ruff & Riechers, 2012). Amantadine hydrochloride has been commonly prescribed for patients with disorders of consciousness (Giacino et al., 2012; Whyte et al., 2005). The mechanism of action is unclear, although amantadine appears to act as an N-methyl-D-aspartate antagonist and indirect dopamine agonist (Giacino et al.,

2012; Peeters, Page, Maloteaux, & Hermans, 2002). Unfortunately, neither of the electric stimulation nor the amantadine have been found to reduce the effects of mild or moderate TBI. Although research has been conducted on both the pharmacologic and the behavioral interventions, no research has been done with interdisciplinary interventions, such as functional restoration (Mayer & Gatchel, 1988).

1.3 Functional Restoration Treatment

Functional Restoration (FR) is an interdisciplinary approach to chronic pain that utilizes the biopsychosocial model. One of the most effective tertiary rehabilitation programs, FR is based on a sports medicine approach that focuses the importance of returning a patient's function and productivity. This is novel in that pain reduction is not the primary goal. FR consists of a medically-supervised, quantitatively-directed exercise progression combined with a multi-modal disability management program (MDMP). The MDMP consists of cognitive-behavioral therapy (CBT), stress management and biofeedback training, education, and vocational reintegration (Mayer & Gatchel, 1988).

Functional restoration treatment is highly effective. According to a study conducted in 2004, since opening in 1983, the Productive Rehabilitation Institute in Dallas for Ergonomics (PRIDE) clinic has successfully used FR treatment to return almost half of all of their patients to work, with more than half of these patients returning to their original employer (Kolata, 2004). A few years ago, another study determined that this same establishment had a work return rate of 93% for the years 2004-2008, and work retention rates of 84% (Productive Rehabilitation Institute of Dallas for Ergonomics, 2009).

Functional restoration has not been evaluated as a treatment for head injuries. However, due to the functional focus of FR, and the loss of function experienced by head

trauma victims, it is important to examine how FR can impact the recovery of these individuals.

1.4 Purpose of the Current Study

Overall, this study aimed to determine the effectiveness of FR for treating patients with a head injury, despite not having been referred specifically for their head injury. This was examined by using both subjective psychosocial measures, such as self-reported pain intensity, disability, and depressive symptoms, and objective one-year socioeconomic measures, such as work return and work retention. This was achieved by comparing the outcomes of the head injury patients to those of a matched population. By examining patients' WAIS scores, psychosocial, and one-year socioeconomic outcomes, this study has allowed researchers to better understand the uniqueness of patients recovering from a head injury, as well as how effective FR treatment is for this specific population.

1.5 Hypotheses

There were several hypotheses associated with this project. The first hypothesis was two-fold in nature. First, it was expected that patients with a head injury would significantly improve their psychosocial outcomes from admission to discharge of the FRP such that their pain intensity, perceived disability, depressive symptoms, insomnia, and fear-avoidance would be lowered and their quality of life would increase. Although improvement was expected with treatment, it was anticipated that FRP would have a stronger effect for patients without a head injury. Specifically, it was expected that patients with a head injury would have: higher pain intensity post-treatment, higher depressive symptoms post-treatment, higher levels of insomnia, higher kinesiopohobia scores, and lower quality of life. However, based on prior research, no difference was expected between the two groups with perceived disability. The second hypothesis

proposed that as compared to matched patients, patients with a head injury would have lower scores on the Wechsler test, or a lower ability to reason. Finally, the third hypothesis posited that when compared to matched patients, those with a head injury would have worse one-year outcomes such that they would have lower return-to-work rates, lower work retention rates, and higher health-care utilization.

Chapter 2

Methods

2.1 Participants

Participants were gathered from a pool of patients that underwent a functional restoration program (FRP) at a regional interdisciplinary rehabilitation facility. IRB consent was not required as the patient information was collected as part of the standard medical record.

Patients were admitted to the FRP if they met the following qualifications: (1) a minimum of 3 months lapsed between the date of injury and treatment; (2) primary and/or secondary care were unsuccessful or unnecessary; (3) surgery was either not an option or did not produce relief from the injury; (4) severe pain and functional limitations remained; and (5) patients must communicate in English or Spanish. Patients signed a Health Insurance Portability and Accountability Act (HIPAA) authorization before beginning the program. Patients did not receive payment or reward for participation in this study.

Patients were eligible for this study if they had a head injury, or had injuries that matched the supplemental injuries of the patients with a head injury. The overall sample consisted of 33,362 CDOMD patients from the years 1992-2014 who were referred to FR treatment. Of those, 126 (0.4%) had completed the FRP and sustained a head injury. Based on any supplemental injuries, these patients were then matched to 122 patients without a head injury. For example, if a patient had sustained a head injury, a shoulder injury, and a low-back injury, then they were “matched” with another patient who had also sustained a shoulder injury and a low-back injury. Patients who had only sustained a head injury, but no other extraneous injuries, were excluded due to their inability to be

matched by supplemental injuries. This created a sample size of 244 (head injury group, *n* = 122, matched group, *n* = 122). Table 2.1 provides a detailed breakdown of the types of head injuries each of these completers had.

Table 2.1 Type of Head Injury, Completers Only

Head Injury	***N* (%)**
• Concussion (mTBI)	85 (69.7%)
• Traumatic Brain Injury	31 (25.4%)
• Fracture	3 (2.5%)
• Aneurysm/Stroke/CVA	2 (1.6%)
• Prior Surgery	1 (0.8%)
Total	122 (100%)

Comparisons between the head injury group and the matched group showed no differences in demographic data in regards to gender, age, ethnicity, length of disability, marital status, years of education, total temporary disability, or pre-treatment surgery as shown in Table 2.2. However, patients with a head injury were more likely to have multiple injuries.

Table 2.2 Demographic Information by Injury Type at Admission, Completers Only (*N* = 244)

Variable	Valid Total N	Head Injury (Total N=122)	Valid Group N*	Matched (Total N=122)	Valid Group N*	*F* / χ^2	*p*	Effect Size
Area of Injury, n (%)	200		101		99	45.91	.00	.48
• Lumbar only		0 (0%)		13 (13%)				
• Cervical only		0 (0%)		12 (12%)				
• Extremity only		2 (2%)		4 (4%)				
• Multiple spinal		13 (13%)		17 (17%)				
• Spinal plus additional musculoskeletal areas		50 (50%)		46 (47%)				
• Other		36 (36%)		7 (7%)				
Gender, n (% male)	244	81 (66%)	122	75 (62%)	122	.64	.42	
Age, mean (SD)	244	44.9 (11.5)	122	44.4 (9.5)	122	.14	.71	
Ethnicity, n (%)	173		88		85	1.27	.74	
• Caucasian		45 (51%)		48 (57%)				
• African American		18 (21%)		13 (15%)				
• Hispanic		24 (27%)		22 (26%)				
• Other		1 (1%)		2 (2%)				
Length of Disability in Months, mean (SD)	242	21.6 (31.2)	122	24.1 (40.6)	120	.28	.60	
Marital Status, n (%)	214		110		104	1.99	.85	
• Single		15 (14%)		11 (11%)				
• Married		63 (57%)		65 (63%)				
• Separated		10 (9%)		11 (11%)				
• Divorced		17 (16%)		15 (14%)				
• Widowed		2 (2%)		1 (1%)				
• Cohabitating		3 (3%)		1 (1%)				
Years Education, mean (SD)	174	12.0 (3.2)	89	12.2 (2.6)	85	.23	.63	
Total Temporary Disability, mean (SD)	121	14.9 (17.8)	72	16.7 (25.0)	49	.21	.65	
Compensable Injuries, n (%)	202		102		100	12.97	.00	.25
• 1 injury		10 (10%)		30 (30%)				
• More than 1 injury		92 (90%)		70 (70%)				
Pre-treatment Surgery, n (% yes)	180	34 (39%)	87	28 (30%)	93	1.60	.21	

*Valid Group N is lower than total group N due to missing data

2.2 Materials and Measures

2.2.1 Psychosocial Intake Evaluation

Once a patient was accepted to the FRP, they participated in an initial Mental Health Evaluation (MHE). This evaluation included a packet of self-report questionnaires to assess the psychological aspects of pain, perceived disability, depressive symptoms, health-related quality of life, fear-avoidance, coping mechanisms, and ability to reason. All of these psychosocial questionnaires are administered at admission as well as upon discharge from the program.

2.2.1.1 Perceived Pain Intensity

Pain intensity was measured via a 10 mm visual analog scale (VAS). This scale used the anchors of “no pain” to “worst possible pain.” The level of pain intensity was assessed by measuring the distance from the “no pain” endpoint to the patient’s indicated marking. The VAS is an easily understood tool and is useful in measuring a patient’s subjective pain perception (Jensen, Karoly, & Braver, 1986).

2.2.1.2 Million Visual Analog Scale (MVAS)

The MVAS measured the impact that pain and disability have on the activities of daily living with a 15-item questionnaire. These 15 items were scored on a six-point VAS, with a total score ranging from 0 (no functional disability), to 150 (total functional disability; Million, Hall, Nilsen, Baker, & Jayson, 1982). A patient’s score fell into one of three categories: mild disability (0-39), moderate disability (40-84), or severe disability (85-150). The MVAS was originally validated by Million et al (1982), and remains easy to use. It has also demonstrated good relation to non-completion status and one year socioeconomic outcomes, and was thus useful in identifying at-risk patients (Anagnostis, Mayer, Gatchel, & Proctor, 2003). The Cronbach’s Alpha for this sample was $\alpha = .724$.

2.2.1.3 Patient Disability Questionnaire (PDQ)

The PDQ measured functional status, and was designed to not only understand the biopsychosocial aspects of disability, but also to be used in a CDOMD population (Anagnostis, Gatchel, & Mayer, 2004). This differed from both the MVAS and the Oswestry Disability Index which were both designed for low back pain populations. Like the MVAS, this was a 15-item questionnaire where items were scored on a 10cm VAS scale, with total scores ranging from 0 (optimal functioning), to 150 (total disability). The PDQ could be broken down into two components: functional status and psychosocial status. The PDQ has been shown to correspond with meaningful clinical change, psychosocial and socioeconomic outcomes, and demonstrated high construct validity (Anagnostis et al., 2004; Gatchel, Mayer, & Theodore, 2006). The Cronbach's Alpha for this sample was α = .643.

2.2.1.4 Oswestry Disability Index (ODI)

As a widely used measure of disability, the Oswestry Disability Index (ODI) has been a psychometrically sound measure for many years (Fairbank & Pynsent, 2000). However, as with any questionnaire, limitations have been found, such as the inability to distinguish low-scoring patients and its narrow focus on only low back pain (Gatchel et al., 2006). Despite these limitations, the ODI was used in this study in order to learn as much as possible about the study population. The ODI was comprised of ten sections referring to functional limitations due to pain. Each section contained a series of six possible responses ranging from no difficulty to high functional difficulty. The total score was doubled and expressed as a percentage, so with a maximum possible raw score of 50, patients could have presented with a maximum of 100%. Ranges for the ODI have been established as follows: minimal disability (0-20%), moderate disability (20-40%), severe disability (40-60%), crippled (60-80%), and bed-bound or exaggerating (80-100%)

(Fairbank, Couper, Davies, & O'Brien, 1980). The Cronbach's Alpha for this sample was α = .344.

2.2.1.5 Beck Depression Inventory (BDI)

The Beck Depression Inventory (BDI) was created as a measure of depressive symptoms (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). The BDI has been frequently used as a screening tool in pain centers, but has been shown to be subject to overestimation due to the similarity between somatic symptoms of depression and the physical symptoms of chronic pain (Wesley, Gatchel, Gorofalo, & Polatin, 1999). Despite this imperfection, the BDI was used for this study as it is still considered the "gold standard" for depressive measures. The measure consisted of 21 items scaled on a 0-3 point scale, where zero indicated the depressive symptom was not present and three indicated a severe symptom. Total scores for the BDI ranged from 0-63, where 0-9 represented no depression, 10-18 represented mild to moderate depression, 19-29 was moderate to severe depression, and 30-63 represented severe depression. The BDI has been found to have high internal consistency, moderate stability, and high criterion, concurrent, construct, and discriminate validity (Beck, Steer, & Garbin, 1988). The Cronbach's Alpha for this sample was α = .740.

2.2.1.6 Hamilton Rating Scale for Depression (HRSD)

The HRSD, a structured clinical interview, was created to measure depressive symptoms over a short period of time. It assessed 21 depressive symptoms with ratings on a five-point scale as follows: absent (0), doubtful or trivial (1), mild (2), moderate (3), and severe (4); or on a three-point scale as follows: absent (0), doubtful or mild (2), and obvious, distinct, or severe (2)(Hamilton, 1967). The HRSD has been commonly used and has also demonstrated high validity, internal consistency, and inter-rater reliability (Trajkovic et al., 2011). The Cronbach's Alpha for this sample was α = .806.

2.2.1.7 Insomnia Severity Index (ISI)

The ISI, a brief patient-report measure, was created to assess the severity of daytime and nighttime components of insomnia (Asih, Neblett, Mayer, Brede, & Gatchel, 2014; Bastien, Vallières, & Morin, 2001). It used a five-point Likert ranging from "not at all" (0) to "extremely" (4). The ISI has been shown to have good sensitivity and specificity, and a cut-off score of 15 has been determined to be useful in identifying insomnia in clinical settings (Smith & Trinder, 2001). The Cronbach's Alpha for this sample was α = .435.

2.2.1.8 Tampa Scale for Kinesiophobia (TSK)

The Tampa Scale for Kinesiophobia (TSK) was first introduced in an unpublished report in 1991 (R. P. Miller, Kori, & Todd, 1991). Vlaeyen et al (1995) later published a Dutch translation of the TSK, and outlined a cognitive behavioral model of fear avoidance. The original version of the TSK consisted of 17 items, each rated on a 4-point scale ranging from 1 (strongly disagree) to 4 (strongly agree). Higher scores indicated a higher degree of fear of movement and injury/re-injury (kinesiophobia). Four of those items were reverse-scored. Several authors have found that removing those 4 items (resulting in a 13 item scale) improved the psychometrics (Clark, Kori, & Brockel, 1996; Geisser, Haig, & Theisen, 2000; Goubert et al., 2004; Roelofs, Goubert, Peters, Vlaeyen, & Crombez, 2004; Swinkels-Meewisse, Swinkels, Verbeek, Vlaeyen, & Oostendorp, 2003). This 13-item scale was the measure used for collection in this study. Factor analysis by several research groups has identified two subscales, which have been termed activity avoidance and somatic focus.(Clark et al., 1996; Geisser et al., 2000; Goubert et al., 2004; Roelofs et al., 2004; Woby, Roach, Urmston, & Watson, 2005). The activity avoidance factor has been defined as a belief that activity may result in pain and/or (re)injury, and the somatic focus factor has been defined as a belief that one's

pain is caused by an underlying and/or serious medical problem (Roelofs et al., 2004). The TSK has demonstrated adequate psychometric properties across languages, including Dutch and English (Roelofs et al., 2004; Vlaeyen et al., 1995). The Cronbach's Alpha for this sample was α = .906.

2.2.1.9 Medical Outcome Study 36-item Short-form Health Survey (SF-36)

The SF-36 measured health-related quality of life that represents multidimensional health concepts (McHorney, Ware, & Raczek, 1993). The SF-36 included eight subscales – physical functioning, role limitations, social functioning, mental health, general health perceptions, bodily pain, and vitality – which were condensed into two summary scales: the Mental Component Scale and the Physical Component Scale. With high reliability and content, criterion, and construct validity (McHorney et al., 1993) the SF-36 has also shown good relation to socioeconomic outcomes (Gatchel, Mayer, Dersh, Robinson, & Polatin, 1999), although it has been found that it is less useful for showing individual responsiveness (Gatchel, Polatin, Mayer, Robinson, & Dersh, 1998). A higher score was reflective of better self-reported health. The Cronbach's Alpha for this sample was α = .840.

2.2.1.10 The Wechsler Abbreviated Scale of Intelligence (WASI)

The Wechsler Adult Intelligence Scale (WAIS) was created as an intelligence test used to inspect the overall capacity of an individual to control his or her actions, think rationally, and deal with their surroundings effectively (Wechsler, 1939; Wechsler, 1955). It consisted of 11 subtests divided into six verbal and five performance subtests. The verbal subtests were as follows: Information, Comprehension, Arithmetics, Digit Span, Similarities, and Vocabulary. The performance subtests included: Picture Arrangement, Picture Completion, Block Design, Object Assembly, and Digit Symbol. The scores for these tests were based on Verbal IQ (VIQ), Performance IQ (PIQ) and Full-Scale IQ

(FSIQ). FSIQ was considered to be the standard score with a mean of 100 and a standard deviation of approximately 15. In general, the subtests' reliability average coefficients exceeded .80. The Wechsler Abbreviated Scale of Intelligence (WASI) was created as a faster test that uses vocabulary, similarities, block design, and matrix reasoning subtests similar to those of the WAIS. These provided an estimate of FSIQ in a much shorter amount of time (Wechsler, 2011). This test was only administered upon admisison to the FRP. The Cronbach's Alpha for this sample was α = .914.

2.2.2 Structured One-year Follow-up Interview

Socioeconomically-relevant outcomes were assessed one-year after discharge in a structured interview. These outcomes included: work return, work retention, excessive health care utilization, and the number of new injuries and new surgeries acquired within one year after discharge. Work return assessed if the patient has regained employment at any point during the year following discharge from the FRP. Work retention assessed whether the patient was still working at the time of the one-year follow-up. Excessive health care utilization was measured by the number of visits made to healthcare providers in excess of the standard follow-up visits made after discharge. Although the interview itself was subjective, these outcomes were independently verified through employers, the worker's compensation system, and insurance carriers, thus making these outcomes objective and able to measure responsiveness to the FRP (Mayer & Polatin, 2000).

2.3 Procedure

The Functional Restoration program (FRP) was a medically-supervised, quantitatively-directed rehabilitation program that has adopted a sports medicine approach and was based on the biopsychosocial model, which views dysfunction and occupational illness as a complex interaction of biological, psychological, and social

variables (Gatchel et al., 2007; Turk, 1996). The primary goal of a FRP is to restore function and reduce perceived disability in a CDOMD population. Although decreased pain is often a by-product of FRP, eliminating pain is not the focus. This treatment addressed the psychological, physical, financial, legal, and work-related – or occupational – complications that can act as barriers to recovery in a chronic pain patient. Treatment was guided by a physician, who served as the medical director, whereas nurses served as an extension of the physician. Patients also participated in physical therapy, occupational therapy, group stretching/yoga, and a multi-modal disability management program in which patients underwent individual and group counseling using a cognitive-behavioral therapy (CBT) approach, stress management, biofeedback, educational sessions on the nature of pain, stress, disability, and recovery, and vocational integration handled by a case manager. FRP has been considered interdisciplinary rather than multidisciplinary because each clinician is housed in the same structure and has direct communication with one another (Deschner & Polatin, 2000).

FRP consisted of three major phases. The first phase addressed barriers to recovery and disability education, led by a psychology staff member. The psychology staff, which included both psychologists and psychiatrists, also began to treat underlying pathologies through counseling and/or pharmacotherapy during this phase. In addition, goals to increase stretching/yoga and range of motion (ROM) were emphasized by both the physical therapy (PT) and occupational therapy (OT) staff. During this initial phase, baseline physical function assessments and an initial occupational assessment and interview took place. Frequent assessments of physical and psychosocial functioning helped to maintain objectivity and to provide patients with feedback with their treatment progression.

The second phase of FRP was considered the intensive rehabilitation phase. It focused on the enhancement of physical strength, endurance, and aerobic capacity through the use of an individualized graded exercise plan. Physical therapy and OT were the key staffs during the second phase, with the psychology staff assisting with barriers to recovery and medication reliance. The PT staff focused specifically on treating the injured body area, whereas, the OT staff coordinated whole body movement in order to hone job skills and activities involved in daily living. Functional Capacity Evaluations (FCEs) were performed regularly in order to objectively measure improvement.

The third and final phase of the FRP was follow-up. During this phase, the patient was gradually weaned off of the FRP. Emphasis was placed on continuing the exercise regimen at home and focusing on the upcoming return to work. A recurrence of symptom magnification, non-compliance, and regression often took place during this phase due to the patient's anxiety in regards to the future, making the counseling and case manager teams very crucial during this final phase (Deschner & Polatin, 2000; Mayer & Gatchel, 1988; Mayer & Polatin, 2000).

2.4 Statistical Analyses

One-way or mixed-model Analyses of Variance (ANOVAs) were used to compare the head injury and matched groups for continuous variables. Although it had been proposed that mixed-model Analyses of Covariance (ANCOVAs) would be used in the case of any demographic differences, the only significant differences, area of injury and number of compensable injuries, did not significantly correlate with any of the psychosocial variables used in this investigation. Effect size for all continuous variables was reported using partial eta-squared (η^2). Due to the large number of two-level factorial designs, the Holm Step-down procedure was initially used to determine the need for adjusted *p*-values (Holm, Mark, & Adolfsson, 2005). However, no significant differences

were found between the Holm *p*-values and the unadjusted *p*-values, therefore, the unadjusted *p*-values were reported throughout the analysis. Independent Chi-Square tests (χ^2) were used for categorical variables when comparing the head injury and matched groups. Effect size for categorical variables was reported using the phi coefficient.

A power analysis conducted with G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007; Faul, Erdfelder, Buchner, & Lang, 2009). This was determined by running a Fixed Effects ANOVA F-test with a power value of .80 and an alpha error probability of .05, yielding a minimum of 64 patients per group in order to detect a medium effect size f of .25. These requirements were fulfilled.

Chapter 3

Results

There were three main hypotheses that were examined in this study. The first was two-fold in nature, while the second and third examined one question each.

3.1 Assessment of Psychosocial Differences and Treatment Responsiveness

The first hypothesis was two-fold in nature and posited that patients with a head injury would signifcantly decrease their psychosocial outcomes from pre- to post-treatment, but that they would still have more negative outcomes than the comparison group upon discharge from the program. Means and standard deviations for all psychosocial variables are shown in Table 3.1.

3.1.1 Pain Intensity

The first hypothesis proposed that patients with a head injury would have lower their pain intensity from pre- to post-treatment, but would have higher pain intensity than the comparison group upon discharge from the program. To test this, a mixed-model between-participant Analysis of Variance (ANOVA) was conducted to examine the differences in self-reported pain intensity between patients with a head injury and those without. Overall, there was a significant main effect of time, $F(1, 178) = 70.93$, $p < .001$, partial $\eta^2 = .29$, such that both the head injury ($M = 5.39$, $SD = 2.52$) and matched groups ($M = 5.16$, $SD = 2.32$) showed significant improvement from pre- to post-treatment. However, there was no significant main effect of group, $F(1, 178) = .15$, $p = .701$, partial $\eta^2 = .001$, nor significant interaction effect of time x group, $F(1, 178) = .34$, $p = .559$, partial $\eta^2 = .002$, suggesting that both the head injury and matched groups improved comparatively over the course of the FRP. This supported the first part of the hypothesis, but not the second.

Table 3.1 Psychosocial Variable Means and Standard Deviations

Variable, mean (SD)		Head Injury		Matched	
		Admission	**Discharge**	**Admission**	**Discharge**
Pain Intensity					
	PVAS	6.88 (.21)	5.37 (.25)	6.89 (.21)	5.16 (.26)
Perceived Disability					
	MVAS	97.69 (2.96)	72.93 (3.70)	95.77 (3.77)	72.42 (4.71)
	PDQ	100.56 (3.61)	73.77 (4.78)	97.07 (5.36)	72.48 (7.10)
	ODI	46.14 (3.72)	29.51 (2.21)	43.18 (5.33)	30.21 (3.16)
Depressive Symptoms					
	BDI	21.40 (1.15)	15.72 (1.06)	17.58 (1.15)	9.99 (1.06)
	HRSD	16.92 (1.00)	10.25 (.94)	16.05 (.88)	9.04 (.82)
Insomnia					
	ISI	15.58 (2.00)	15.09 (1.12)	14.71 (2.79)	13.65 (1.56)
Fear-Avoidance					
	TSK	27.00 (6.14)	22.00 (4.09)	36.50 (11.48)	34.50 (7.66)
Quality of Life					
	SF-36 MHS	35.22 (1.74)	33.80 (2.39)	37.86 (2.43)	44.61 (3.33)
	SF-36 PHS	28.09 (1.32)	28.41 (1.95)	27.11 (1.84)	32.79 (2.72)

3.1.2 Perceived Disability

It was expected that patients with a head injury would significantly decrease their percevied disability by participating in the FRP, but based on previous literature, it was expected that there would be no difference in perceived disability between the two injuries groups upon discharge.

3.1.2.1 MVAS

A mixed-model between-participant Analysis of Variance (ANOVA) was conducted to examine the differences in self-reported perceived disability, as reported on the MVAS, between patients with a head injury and those without. Overall, there was a significant main effect of time, $F(1, 111) = 91.00$, $p < .001$, partial $\eta^2 = .45$, but no significant main effect of group found between the head injury ($M = 72.93$, $SD = 33.37$) or matched group ($M = 72.42$, $SD = 26.39$), $F(1, 111) = .06$, $p = .801$, partial $\eta 2 = .001$, nor significant interaction effect of time x group, $F(1, 111) = .08$, $p = .781$, partial $\eta^2 = .001$. This suggested that both groups significantly improved from pre- to post-treatment, but that the groups improved comparatively to one another, supporting both parts of the hypothesis.

3.1.2.2 PDQ

A mixed-model between-participant Analysis of Variance (ANOVA) was conducted to examine the differences in self-reported perceived disability, as reported on the PDQ, between patients with a head injury and those without. Overall, there was a significant main effect of time, $F(1, 91) = 43.66$, $p < .001$, partial $\eta^2 = .32$, such that both the head injury group ($M = 73.39$, $SD = 39.68$) and matched group ($M = 71.42$, $SD = 32.03$) significantly decreased their perceived disability from pre- to post-treatment. However, no significant main effect of group, $F(1, 91) = .14$, $p = .715$, partial $\eta 2 = .001$, nor significant interaction effect of time x group was found, $F(1, 91) = .08$, $p = .777$, partial

η^2 = .001. This suggested that both groups significantly decreased their scores from pre- to post-treatment, but that both groups had comparable scores upon discharge, which supported the hypothesis as a whole.

3.1.2.3 ODI

A mixed-model between-participant Analysis of Variance (ANOVA) was conducted to examine the differences in self-reported perceived disability, as reported on the ODI, between patients with a head injury and those without. There was a significant main effect of time, $F(1, 117) = 19.40$, $p < .001$, partial $\eta^2 = .14$, but no significant main effect of group found between the head injury ($M = 29.67$, $SD = 20.70$) or matched group ($M = 30.10$, $SD = 16.11$), $F(1, 117) = .07$, $p = .715$, partial $\eta 2 = .001$, nor significant interaction effect of time x group, $F(1, 117) = .30$, $p = .588$, partial $\eta^2 = .003$. This suggested that both groups significantly improved from pre- to post-treatment, but that the groups improved comparatively to one another, supporting both parts of the hypothesis.

3.1.3 Depressive Symptoms

This hypothesis proposed that patients with a head injury would significantly decrease their depressive symptoms, but would have higher depressive symptoms than the comparison group upon discharge from the FRP.

3.1.3.1 BDI

This hypothesis was tested by a mixed-model between-participant ANOVA to examine the differences in self-reported depressive symptoms, as reported on the BDI, between patients with a head injury and those without. Overall, there was a significant main effect of time, $F(1, 178) = 83.29$, $p < .001$, partial $\eta^2 = .32$, and significant main effect of group found between the head injury ($M = 15.72$, $SD = 11.05$) and matched group ($M = 9.99$, $SD = 9,02$), $F(1, 178) = 11.88$, $p = .001$, partial $\eta^2 = .06$. However, there

was no significant interaction effect of time x group, $F(1, 178) = 1.73$, $p = .190$, partial $\eta^2 = .01$. This suggested that both groups significantly improved from pre- to post-treatment, but that the head injury group still had significantly worse depressive symptoms upon discharge from the program, supporting both parts of the hypothesis.

3.1.3.2 HRSD

A mixed-model between-participant Analysis of Variance (ANOVA) was conducted to examine the differences in self-reported depressive symptoms, as reported on the HRSD, between patients with a head injury and those without. There was a significant main effect of time, $F(1, 143) = 171.79$, $p < .001$, partial $\eta^2 = .55$, but no significant main effect of group found between the head injury ($M = 10.25$, $SD = 9.33$) or matched group ($M = 8.82$, $SD = 5.91$), $F(1, 143) = .78$, $p = .378$, partial $\eta 2 = .005$, nor significant interaction effect of time x group, $F(1, 143) = .11$, $p = .741$, partial $\eta^2 = .001$. This suggested that both groups significantly improved from pre- to post-treatment, but that the groups improved comparatively to one another, supporting only the first part of the hypothesis.

3.1.4 Insomnia

It was expected that patients with a head injury would significantly decrease their insomnia from pre- to post-treatment, but would report more insomnia symptoms than the comparison group upon discharge from the FRP. In order to examine this relationship, a mixed-model between-participant ANOVA was conducted to examine the differences in self-reported insomnia between patients with head injury and those without. Overall, there was no main effect of time, $F(1, 48) = .21$, $p = .647$, partial $\eta^2 = .004$, no main effect of group, $F(1, 48) = .27$, $p = .605$, partial $\eta^2 = .006$, nor an interaction effect of time x group, $F(1, 48) = .03$, $p = .865$, partial $\eta^2 = .001$. This suggested that neither the head injury group ($M = 14.97$, $SD = 5.56$) nor the matched group ($M = 13.44$, $SD = 7.66$)

significantly decreased their insomnia symptoms from pre- to post-treatment, and the two groups had comparable scores upon discharge from the FRP, which did not support either part of the hypothesis.

3.1.5 Fear-Avoidance

This first hypothesis expected that patients with a head injury would significantly decrease their fear-avoidance scores from pre- to post-treatment, but would have higher kinesiophobia scores than those in the matched group upon discharge. This was examined via a mixed-model between-participant ANOVA. Overall, there was no significant main effect of time, $F(1, 7) = 1.05$, $p = .340$, partial $\eta^2 = .130$, no significant main effect of group, $F(1, 7) = 1.09$, $p = .330$, partial $\eta^2 = .135$, and no significant interaction effect between time x group, $F(1, 7) = .19$, $p = .674$, partial $\eta^2 = .027$, which suggested that neither the head injury group ($M = 22.00$, $SD = 10.86$) nor the matched group ($M = 34.50$, $SD = 10.61$) significantly decreased their fear-avoidance from pre- to post-treatment and that both groups had comprable scores upon discharge from the FRP, which did not support either part of the hypothesis.

3.1.6 Quality of Life

This first hypothesis proposed that patients with a head injury would significantly improve their quality of life by participating in FRP, but would have lower quality of life than their matched counterparts at discharge from the FRP.

3.1.6.1 SF-36 Mental Health Summary (MHS)

A mixed-model between-participant ANOVA was conducted to examine the differences in self-reported mental quality of life between patients with a head injury and those without. Overall, there was no significant main effect of time, $F(1, 104) = 2.37$, $p = .127$, partial $\eta^2 = .022$, but there was a significant main effect of group, $F(1, 104) = 4.58$, $p = .035$, partial $\eta^2 = .042$, and a significant interaction effect of time x group, $F(1, 104) =$

5.55, p = .020, partial η^2 = .051, such that those with a head injury (M = 34.28, SD = 21.06) reported significantly lower mental quality of life than their matched counterparts (M = 45.73, SD = 16.82) upond discharge from the FRP. This supported the second part of the hypothesis, but not the first.

3.1.6.2 SF-36 Physical Health Summary (PHS)

A mixed-model between-participant ANOVA was conducted to examine the differences in self-reported physical quality of life between patients with a head injury and those without. Overall, there was a significant main effect of time, F(1, 104) = 4.37, p = .039, partial η^2 = .04. However, there was no significant main effect of group, F(1, 104) = .47, p = .494, partial η^2 = .005, nor significant interaction effect of time x group, F(1, 104) = 3.49, p = .064, partial η^2 = .032. This revealed that both groups significantly improved their physical quality of life from pre- to post-treatment, but that the head injury group (M = 28.55, SD = 17.68) and matched group (M = 32.49, SD = 11.97) had comparable scores upon discharge. This supported the first part of the hypothesis, but not the second.

3.2 Assessment of Ability to Reason

The third hypothesis proposed that as compared to matched patients, patients with a head injury would have lower scores on the Wechsler test, or a lower ability to reason. In order to test this, a one-way between-participant ANOVA was conducted. There was no significant difference in full scale IQ (FSIQ) found between the head injury (M = 87.73, SD = 13.99) or matched groups (M = 88.19, SD = 9.88), F(1, 85) = .03, p = .859, partial η^2 = .00. Despite this lack of significant difference between the groups, the reseracher was curious if there were differences between the two subscales, Verbal (VIQ) and Performance IQ (PIQ). There was no significant difference in VIQ found between the head injury (M = 86.20, SD = 13.49) and matched groups (M = 89.11, SD =

11.11), $F(1, 85) = 1.16$, $p = .285$, partial $\eta^2 = .01$. Similarly, there was no significant difference in PIQ found between the head injury ($M = 91.30$, $SD = 14.47$) and matched groups ($M = 89.30$, $SD = 10.25$), $F(1, 85) = .56$, $p = .456$, partial $\eta^2 = .01$. None of these results supported the hypothesis.

3.3 Assessment of One-Year Outcome Differences

The third and final hypothesis posited that when compared to matched patients, those with a head injury would have worse one-year outcomes such that they would have lower return-to-work rates, lower work retention rates, and higher health-care utilization. These results are presented in Table 3.2. Outcomes were not significantly associated with group membership for any of the measures one year after discharge from the FRP, which did not support the hypothesis.

Table 3.2 Comparison of One-year Outcome Measures Between Head Injury and Matched Groups

Variable	Valid Total N	Head Injury (N=94)	Valid Group N*	Matched (N=79)	Valid Group N*	F / χ^2	p	Effect Size
Return to Work, n (% yes)	125	56 (86%)	65	55 (92%)	60	.95	.329	.09
Work Retention, n (% yes)	118	45 (74%)	61	43 (75%)	57	.04	.835	.02
Health Care Utilization, n (% yes)	127	15 (22%)	67	12 (20%)	60	.11	.743	.03
Doctor Visits, M (SD)	126	1.9 (5.6)	67	1.9 (5.9)	59	.001	.979	.00
Surgery on Original Injury, n (% yes)	123	4 (6%)	65	4 (7%)	58	.03	.868	.02
New Injury, n (% yes)	119	0 (0%)	62	1 (2%)	57	1.10	.295	.10

* Valid Group N is lower than total group N due to missing data

Chapter 4

Discussion

The overarching goal of the present study was to examine head injuries in the context of a functional restoration program developed for chronic disabling occupational musculoskeletal disorder population. Specifically, this study aimed to determine the effectiveness of FR for treating patients with a head injury by examining the prevalence of head injuries, the responsiveness of these special patients as they underwent treatment at the FRP, the effectiveness of this treatment one-year after discharge, and the characteristics of this special population as compared to a sample without head injuries. This involved comparing these two groups on psychosocial variables as well as IQ scores.

4.1 Evaluation of Psychosocial Differences

The first hypothesis examined the differences how patients with a head injury responded to the FRP in regards to the psychosocial variables. It was expected that they would significantly improve from pre- to post-treatment, but that patients with a head injury would have worse symptoms than their matched counterparts upon discharge from the FRP. Specifically, it had been expected that patients with a head injury would significantly improve their pain intensity, and this proved to be true. This suggests that FRP is a successful tool to help patients overcome the typical issues associated with pain after an injury to the head. However, it was also expected that they would have higher pain intensity than their matched counterparts upon discharge, but that did not end up being the case. Although unexpected, this is not a negative result. Previous studies have found that for every unit of increase in pain, the odds of a patient going back to work reduce by 96% (Dawson, Deirdre R.Schwartz, Michael L.Winocur, GordonStuss,Donald T., 2007), and that pain and fatigue are highly and significantly correlated even up to two

years post-injury (Bushnik, Englander, & Wright, 2008). One study even found that 58% of patients had pain from headaches five years after their initial head injury (Hillier, Susan L.Sharpe,Margie H.Metzer, Jacques, 1997). Due to these studies, it is unlikely that the comparable level of pain intensity in this study was due to length of time since injury (Dobscha et al., 2009), but instead, due to the FRP itself.

It was also expected that patients would successfully reduce their perceived disability by discharge, and this, too, was found to be true. As expected, those with a head injury had comparable levels of perceived disability to the matched group upon discharge. Similarly, it was expected that patients with a head injury would significantly decrease their depressive symptoms from pre- to post-treatment, and this was found to be true. However, only one measure of depressive symptoms showed that patients with a head injury still maintained significantly worse depressive symptoms as compared to their matched counterparts, as expected. This reflects previous literature that has found that head injuries are highly comorbid with depressive symptoms (Kreutzer, Jeffrey S.Seel,Ronald T.Gourley, Eugene, 2001; K. J. Miller et al., 2013; Rapoport, 2012), but also how variable and subjective the domains of depression can be following a head injury. Mood, somatic, and cognitive domains each present significant problems, but can vary across patient samples (Kreutzer, Jeffrey S.Seel,Ronald T.Gourley, Eugene, 2001). It should also be noted that depressive symptoms and other disorders such as PTSD and anxiety are highly comorbid, and that victims of head injuries are at a high risk of obtaining any or all of these (McCauley, Stephen R.Boake, CorwinLevin, Harvey S.Contant, Charles F.Song,James X., 2001). These slight variances may be why one scale found differences where the other did not. It could also be due to the oversensitivity of the BDI.

It was hypothesized that head injury patients would also significantly improve their insomnia and fear avoidance by discharge from the FRP. Contrary to the hypothesis, head injury patients did not significantly decrease their insomnia symptoms, nor did they significantly decrease their kinesiophobia. This could again be due to the low number of test scores available. However, previous literature suggests that these results shouldn't be unexpected. Fatigue and poor sleep patterns are quite common in patients with a head injury (Kreutzer, Jeffrey S.Seel,Ronald T.Gourley, Eugene, 2001; K. J. Miller et al., 2013; Rapoport, 2012). Despite fatigue and poor sleep patterns being key depressive symptoms in victims of head injuries, those with a head injury did not report worse insomnia than their matched counterparts upon discharge. Similarly, no difference was found on fear avoidance scores, contrary to expectations. Both of these findings could be due to the low number of patients scores available for these tests. Due to the large time span of the sample, 1992-2014, many patients were not participating in the FRP when these questionnaires were introduced.

Finally, it was hypothesized that patients with a head injury would significantly improve their quality of life upon discharge from the program. These patients did not significantly increase their mental quality of life, but they were able to significantly improve their physical quality of life. As their unique injury involves the head, the lack of mental improvement is not surprising. Head injury patients were comparable to the matched patients on every psychosocial outcome with the exception of mental quality of life. These findings at discharge, showcasing decreased pain intensity, disability, depressive symptoms, and increased physical quality of life are comparable to a typical patient undergoing a functional restoration treatment program (Anagnostis et al., 2003; Anagnostis et al., 2004; Gatchel et al., 2006). When examining the results for the second part of they hypothesis, it was found that patients reported good quality of life as

expected, such that matched patients reported higher quality of life, both mentally and physically, than did patients with a head injury. This coincides with previous literature that found that head injuries have a large influence on health-related quality of life (Jacobsson, 2010; Lippert-Grüner, MarcelaMaegele, MarcHaverkamp, HeinzKlug, NorfridWedekind, Christoph, 2007).

4.2 Evaluation of Ability to Reason

With the second hypothesis, it was expected that patients with a head injury would have lower IQ scores on the WASI. This was based on the knowledge that chronic cognitive difficulties are common after head injuries, and that cognitive deficits can be observed even 1 year post-injury (Andelic et al., 2010; Dean & Sterr, 2013). According to one study, 58.8% of participants still had problems with poor memory, 67% still had problems with poor concentration, and 43.5% still had problems taking longer to think more than a year after their initial head injury (Stålnacke, 2012). This study did not have any other groups such as “6 months”, “18 months”, or “24 months” in order to compare the effects of longer time on these postconcussive symptoms. Thus, this hypothesis was more exploratory in nature and did not end up being supported.

In the current study, those in the head injury group performed comparably to their matched counterparts. Not only was their FSIQ up to par, but both their VIQ and PIQ were analagous as well. Previous literature does suggest that although certain postconcussive symptoms may effect a person’s vocabulary, they will not worsen an individual’s ability to perform neurocognitive functions (Ruttan, 2003). However, this could also be due to the length of time that had passed before admission to the program, as suggested previously. Because the patients only completed a WASI upon admission, the information is not available to see how patients may have improved their cognitive ability after time in the FRP. In the future, it would be interesting to test patients again upon

discharge in order to see if the 6 week program does in fact make an improvement cognitively. It is entirely possible that the FRP would make a difference in patients' cognitive functioning as many patients, with or without a head injury, have been on disability leave for a significant amount of time prior to starting the program.

4.3 Evaluation of One-Year Outcome Differences

There were no significant differences between the head injury and matched groups on one-year outcomes. These findings were unexpected due to the long-term effects of head injuries (Biros & Heegard, 2009; Concussion Clinic at Burwood Hospital, 2013; Gronwall, Wrightson, & Waddell, 1990; Hampton & Hulgus, 1993), and their liklihood to delay a victim from returning to work (Daneshvar et al., 2011), but they are far from disheartening. The average length of disability for patients with a head injury was about 21 months, which is roughly 2 years. In general, mild TBI symptoms should be mostly or completely resolved in about 6 months. However, these effects typically last longer in people over the age of 40 such that even a mild injury can easily take up to a year to resolve (Biros & Heegard, 2009; Concussion Clinic at Burwood Hospital, 2013; Gronwall et al., 1990; Hampton & Hulgus, 1993; McMillan, 1997). Despite the lengthened recovery time expected for this sample, the one-year outcomes were measured about 3 years after the time of injury, providing plenty of time for even the natural decline of symptoms.

4.4 Conclusions

Functional Restoration, which has been shown to be effective in a CDOMD population (Kolata, 2004; Productive Rehabilitation Institute of Dallas for Ergonomics, 2009), has not been previously evaluated for use as a specialized treatment for victims of head injuries. Results show that by undergoing treatment at an FRP, these patients can significantly decrease their negative psychosocial outcomes and regain their pre-injury

life. Not only did patients respond to FR treatment in a similar manner to typical CDOMD patients, but they were also able to return to work, retain work, and decrease their visits to health care providers. Overall, these results indicate that patients with a head injury benefit from FR treatment, and therefore, this treatment should be recommended as another tool for rehabilitation following trauma to the head.

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