PREDICTORS OF ATTRITION IN AN INTERDISCIPLINARY
PAIN MANAGEMENT PROGRAM

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DEDICATION

I would like to thank the members of my Graduate Committee, my Mom and Dad, my boys—Don and Milo, and all professors, colleagues, and friends who have inspired, nurtured, and supported me along the way.

PREDICTORS OF ATTRITION IN AN INTERDISCIPLINARY PAIN MANAGEMENT PROGRAM

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PREDICTORS OF ATTRITION IN AN INTERDISCIPLINARY PAIN MANAGEMENT PROGRAM

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Background: Chronic pain is a debilitating condition that affects millions of adults in the United States. In recent years, particularly with the growing concerns about opioid use, there has been a steady increase in the use of interdisciplinary pain programs (IPP) to treat chronic pain. The effectiveness of such programs has been well-documented; however, attrition has also been identified as a neglected topic in outcome studies. *Objective*: This study aimed to investigate the extent to which demographic/clinical characteristics predict attrition in an IPP. Study aims also included examining longitudinal changes in score for the completion group

for a variety of clinical measures, and an exploratory analysis comparing changes between non/completion groups. *Method*: Participants included one hundred and seventy-eight patients receiving treatment for chronic pain conditions in an IPP at the McDermott Center for Pain Management. Participants completed measures related to pain and psychosocial functioning at baseline, mid-intervention (2 weeks post-enrollment), and post-intervention (4 weeks post-enrollment). *Analysis*: This study used logistic regression analyses to identify variables most predictive of attrition in five domains: 1) selected demographic variables, 2) number of medical diagnoses [psychiatric and non-psychiatric], 3) opioid use/risk of misuse, 4) pain-related cognition and behavior, and 5) physical, social, and mental well-being. Mixed models analyses were also conducted to examine longitudinal changes in score on a variety of clinical measures for the completion group. *Results*: Participants who were of younger age, unemployed, and not on opioids pre-intervention had higher odds of dropping out. The completion group demonstrated improvement pre- to post-intervention on each of the measures assessed in the 1) pain-related cognition and behavior domain and 2) physical, social, and mental well-being domain, except for one measure. *Discussion*: Mean age of non-completers was 48.72 years (SD = 13.44); these patients may have had difficulty with program compliance due to more outside stressors (e.g., younger children, demanding jobs). Participants may have been unemployed due to a number of potential contributing factors (e.g., lack of transportation, lower motivation, physical mobility), which would create barriers to program completion. Previous findings suggest opioid dependency contributes to higher odds of dropout; however, results from the current study suggest pre-intervention opioid use—not dependency—does not contribute to higher odds of attrition.

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LIST OF DEFINITIONS

IOM – Institute of Medicine

AAPM – American Academy of Pain Management

CDC – Center for Disease Control and Prevention

IASP – International Association of the Study of Pain

HHS – Department of Health and Human Services

APS – American Pain Society

AAPM – American Academy of Pain Medicine

APA – American Psychiatric Association

Biopsychosocial – Biological, psychological, and social

DSM – Diagnostic and Statistical Manual of Mental Disorders

SSD – Somatic Symptom Disorder

IDDS – Implantable drug delivery system

NMDA – N-Methyl-D-Aspartate

CBT – Cognitive-Behavioral Theory

PDI – Pain Disability Index

DASS – Depression, Anxiety, and Stress Scale

MCMI – Millon Clinical Multiaxial Inventory

MMPI – Minnesota Multiphasic Personality Inventory

POMS – Profile of Mood States

SCI – Spinal cord injury

MS – Multiple sclerosis

CP – Cerebral palsy

EMCPM – Eugene McDermott Center for Pain Management

UTSW – University of Texas Southwestern

PMQ – Pain Medication Questionnaire

LOT-R – Life Orientation Test-Revised

SF-36 – Medical Outcomes Study 36-Item Short Form Survey

PCS – Pain Catastrophizing Scale

FABQ – Fear-Avoidance Beliefs Questionnaire

PROMIS – Patient Reported Outcome Measurement Information System

NIH – National Institute of Health

HIPAA – Health Insurance Portability and Accountability Act

IRB – Institutional review board

CAT – Computerized adaptive testing

PID – Patient identification number

CHAPTER ONE

Introduction

Overview of Chronic Pain

An estimated 116 million United States (U.S.) adults suffer from chronic pain conditions—making it "one of the most frequent reasons for physician visits, among the most common reasons for taking medications, and a major cause of work disability" (Institute of Medicine [IOM], 2011, p. 19-20). The IOM (2011) report, Relieving Pain in America, highlighted the significant impact of pain both economically and in people's lives. Analyses for the report found that the annual cost of chronic pain is at least $560-635 billion, which includes cost of healthcare ($261-300 billion) and of lost productivity ($297-336 billion) attributable to pain (IOM, 2011). The American Academy of Pain Management (AAPM, 2003) found that approximately 57 percent of adults described experiencing chronic or recurrent pain in the past year. Of those individuals, 62 percent reported being in pain for more than one year and 40 percent noted that they were constantly in pain. In fact, an estimated 20 million U.S. adults report experiencing high-impact chronic pain that is severe enough to interfere with life or work activities on a daily basis (Center for Disease Control and Prevention [CDC], 2016). These findings suggest that the problem of chronic pain places a large burden on patients, the medical system, and on society. It is evident that effective and affordable interventions are needed for the treatment and management of chronic pain.

Conceptualizations of chronic pain have become increasingly complex over the years as more research emerges on the importance of a comprehensive view of an individual and

an integration of biological, psychological, and sociocultural factors on human functioning (Meyer, 2008). The biopsychosocial model has become widely accepted as the most integrative approach to the understanding and treatment of chronic pain conditions, expanding the biomedical model (Gatchel, McGeary, McGeary & Lippe, 2014). Biopsychosocial conceptualizations of pain incorporate physical/biological variables as well as psychological, social, and cultural factors, and explain how each of these factors interact to impact the experience of pain. An example of a treatment approach that has been developed to address this complex process is interdisciplinary pain management programs.

Interdisciplinary pain management programs typically include services such as medication management, physical therapy, meditation/relaxation training, and cognitive-behavioral treatment to address psychosocial issues (Gatchel et al., 2014). Research shows strong evidence for the efficacy of interdisciplinary treatment, with numerous studies consistently demonstrating significant outcomes associated with improvements in pain, mood, and functionality, as well as higher rates of return to work and lower use of the health care system (Gatchel & Okifuji, 2006; Turk & Swanson, 2007; Chou et al., 2009). Although the efficacy of this treatment modality has been well-documented, there are limited studies that have focused on the issue of attrition in pain management programs, particularly interdisciplinary programs (Turk & Rudy, 1990). A search of PubMed, EBSCO, Ovid, and Google Scholar databases found only one study—a doctoral dissertation—examining attrition and failure specifically in an interdisciplinary pain rehabilitation program at the Cleveland Clinic (Mintz, 2013). A further search of the databases above was conducted for additional studies addressing attrition in multidisciplinary pain management settings, which

produced less than one dozen studies. Although there have been recent efforts to clearly define “interdisciplinary” and “multidisciplinary” programs, one of the difficulties in examining these modalities is that the terms are often used interchangeably, which may conflate results. However, even after accounting for this issue, there remains a significant gap in literature examining the issue of attrition in pain management programs overall.

In a meta-analysis on the efficacy of multidisciplinary treatment programs, Curtis (1992) found that close to half of the studies included in the analysis were rated as having potential bias due to attrition rates. In fact, Turk and Rudy (1990) identified attrition as one of the three “neglected topics” that have not received sufficient attention in chronic pain treatment outcome studies. Rates of attrition may not necessarily be reported and participants who drop out are typically excluded from studies altogether, thus the reasons for failure-to-complete are often not well-understood (Turk & Rudy, 1990). More importantly, there exists a gap in research specifically examining attrition in interdisciplinary settings. Therefore, an exploratory study will aid in identifying and understanding some of the factors that may influence participant dropout. Based on findings from previous research on pain management programs, some possible factors that may impact pain management outcomes in interdisciplinary settings include factors related to socioeconomic status (Bonathan, Hearn, & Williams, 2013; Poleshuck & Green, 2008), history of opioid use (Turner et al., 2016; Chelminski et al., 2005), medical comorbidities (Chwastiak et al., 2002; Turner & Cardenas, 1999; Archibald et al., 1994; Schwartz, Engel, & Jensen, 1999), and history of past or present mental health (Gatchel, 2004; McWilliams, Cox, & Enns, 2003; Benjamin et al., 2000). A review of the relevant literature will provide a clearer context for the proposed study.

CHAPTER TWO

Review of the Literature

Defining Chronic Pain

The International Association for the Study of Pain (IASP) defines pain as "an unpleasant sensory or emotional experience associated with actual or potential tissue damage, or described in terms of such damage…Pain is always subjective…It is unquestionably a sensation in a part or parts of the body, but it is also always unpleasant and therefore also an emotional experience" (pg. 249-250). Published in 1994, this definition was influential in shifting from earlier views that pain was strictly a biological problem. Historically, chronic pain has been conceptualized from the biomedical model and viewed primarily as a biological disease, while other factors such as psychological or social influences are viewed as consequences of the medical issue (Turk, 1996). Today, however, a more inclusive conceptualization integrates both biological disease and illness, the latter of which factors in the psychosocial impact of pain.

One of the early proponents for this integration was an American physician named Dr. George L. Engel. He argued that the biomedical model oversimplified how "illness" was viewed and treated, and further critiqued that standard medical education failed to train doctors to assess patients holistically (Engel, 1977). Engel believed that the boundaries between disease and illness are inherently subtle and further diffused by psychological, social, and cultural factors. He proposed that it was a providers' responsibility to consider the

contributions of these critical factors. To provide the most effective treatment for patients with chronic pain conditions, providers must acknowledge the complex interaction of biological, psychological, and social influences, and consider how each of these factors interact to cause and/or maintain chronic pain (Gatchel et al., 2014). Known as the biopsychosocial model, this approach is now widely accepted and has received more empirical support than the biomedical model of pain (Gatchel, Peng, Peters, Fuchs & Turk, 2007).

The American Psychiatric Association (APA) has also made significant changes to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) with regard to pain, in hopes of eliminating the mind-body separation implicit in the DSM-IV so that clinicians could provide more holistic care (APA, 2013). The DSM-5 (2013) does not include a pain-specific disorder as in past editions of the DSM, but has instead replaced related diagnoses with Somatic Symptom Disorder (SSD). The diagnostic criteria for SSD, includes one or more somatic symptoms lasting six months, or longer, that are associated with excessive thoughts, feelings, or behaviors around the pain condition. There are three specifiers that can be included to describe the nature (i.e., with predominant pain), duration (i.e., persistent, if longer than 6 months), and severity (i.e., mild, moderate, or severe) of the symptoms.

Although there are concerns as to whether the criteria may be overly inclusive and lead to excessive pathologizing of somatic symptoms (Katz, Rosenbloom, & Fashler, 2015), the change in criteria is important in several ways. The classification categorizes pain as acute—with duration of less than six months—or chronic—with duration of six months or

longer. It also acknowledges that psychological factors play a prominent role in the exacerbation, and/or maintenance of pain; and may play a role in development of pain (Turk & Okifuji, 2002). From a biopsychosocial perspective, psychosocial factors seem to play a more significant role the longer pain persists, and may require different approaches to treatment than acute pain (Turk & Okifuji, 2002).

The new DSM-5 criteria reduces the need to determine whether symptoms are medical versus psychological in nature, and instead, recognizes that mind and body are inextricably linked (Stein et al, 2010). Chronic pain conditions are often comorbid with psychiatric disorders, such as depressive disorders (Tsang et al., 2008; Arnow et al., 2006; Fishbain, Cutler, Rosomoff, & Rosomoff, 1997; Romano & Turner, 1985), anxiety disorders (Tsang et al., 2008; Norton & Asmundson, 2003; Greenberg & Burns, 2003; McCracken, Gross, Sorg, & Edmands, 1993), and substance use disorders (Chou et al., 2009; Manchikanti et al., 2007; Compton, Darakjian, & Miotto, 1998). Psychological symptoms and disorders may develop as individuals adjust to the knowledge they have a chronic pain condition that may significantly impact their life. Negative affect may become more frequent and/or intense the longer an individual experiences chronic pain as related problems increase and become more integrated in their lives (Turk & Monarch, 2002). There is also significant evidence that chronic pain and depression have a reciprocal causative relationship; that is, a change in severity of either symptom predicts severity of the other symptom (Kroenke et al., 2011).

Grichnik and Ferrante (1991) identify several differences between acute and chronic pain. Acute pain is triggered by a specific disease or injury, serves a useful biologic purpose, and is associated with sympathetic nervous system activation. In contrast, chronic pain lasts

longer than the normal time of healing (if associated with a disease or injury), has no recognizable end-point, and serves no discernable biological purpose (Grichnik & Ferrante, 1991). As previously discussed—although a specific disease or injury starts the process—the longer pain persists, the more psychosocial factors seem to play a significant role. The classification of pain as acute or chronic has important implications for treatment as care for acute pain typically involves time and rest; however, management of chronic pain may require a combination of medical, physical therapy, and psychosocial treatments (McCracken & Turk, 2002).

Medical Interventions for Chronic Pain

There are many treatment methods available to address a wide variety of chronic pain conditions. Common treatments may include any combination of the following (Ashburn & Staats, 1999): medication (including opioids and over-the-counter drugs), implantable drug delivery systems (IDDSs), surgery, nerve blocks, spinal cord stimulation, cognitive-behavioral interventions, physical therapy and/or complementary and alternative medicine modalities (e.g., acupuncture, homeopathy). The goal of chronic pain management is generally not to "cure" the pain; rather, the aim is to decrease pain and suffering while improving physical, mental, and social functioning (Ashburn & Staats, 1999).

In recent years, opioid use in particular has received much national attention. In 2016, 11.5 million people misused prescription opioids and close to 43,000 people died from overdosing on opioids. Over 100 Americans die daily from an opioid-related overdose (U.S. Department of Health and Human Services [HHS], 2018). Due to these alarming statistics, it

has become known as the “Opioid Epidemic.” Opioid analgesics are still widely used for the treatment of severe acute pain, cancer-related chronic pain, or at the end of life. However, the use of chronic opioid therapy to treat other types of chronic pain remains a point of contention within the medical community.

Prior to the opioid epidemic, studies found some evidence of marginal benefits associated with long-term opioid use (e.g., consistent pain relief, improved functioning, and better quality of life) for a select patient population (Chou, Fanciullo, et al., 2009). Findings from a study by Portenoy, Messina, Xie, and Peppin (2007) suggest that patients with specific types of pain, such as osteoarthritis and diabetic neuropathy, may benefit from long-term opioid use in a controlled setting. For this patient population, several factors have been identified as contributing to the success of long-term opioid use, including: a) appropriate informed consent; b) individualized opioid management plan, including proper initiation, dose escalations, and titration; and c) careful monitoring throughout treatment (Chou, Fanciullo, et al., 2009). This includes—as suggested by the American Pain Society/American Academy of Pain Medicine (APS/AAPM) guideline on opioid therapy for chronic pain—assessing abuse-related risks and potential adverse effects, such as increased risk of respiratory depression in individuals with obstructive sleep apnea or increased risk of falls and fractures in older patients (Chou et al., 2015).

In addition to the risk of abuse, other common side effects of opioid use include: sedation, dizziness, nausea, vomiting, constipation, physical dependence, and tolerance (Benyamin et al., 2008). Patients with prolonged opioid use can develop opioid tolerance, a phenomenon resulting in the need for an increased dose in order to maintain adequate

analgesic effects. Increasing dosage also carries the possibility of additional side effects which may likely outweigh the goal of pain reduction (Ballantyne & Mao, 2003). Opioid-induced hyperalgesia can also develop causing patients who receive opioid treatment to become more sensitive to certain painful stimuli (Lee et al., 2011).

Systematic reviews of placebo-controlled randomized trials of opioids for chronic low back pain revealed two trials demonstrating moderate benefits of opioids—1.5 to 2 points on a 10-point pain scale—compared with placebo over a 12-week trial (Hale, Ahdieh, Ma, & Rauck, 2007; Katz et al., 2007) and some trials demonstrating no analgesic benefit of opioids over placebo and no clear evidence of improved function (Deshpande et al., 2007; Martell et al., 2007). In a meta-analytic review of older adults suffering from musculoskeletal pain, opioid analgesics had only a small effect on pain and function, and a higher probability of adverse events and treatment discontinuation (Megale et al., 2017). In a recent randomized clinical trial comparing opioid versus nonopioid medication over a 12-month period, results showed that treatment with opioid medication was not superior to nonopioid medication for improving pain-related function over 12 months (Krebs et al., 2018). Although earlier studies have shown marginal benefits for opioid use, more recent research has found growing evidence regarding adverse effects and concern for long-term opioid use.

Under the umbrella of medical interventions, other forms of treatment also include operative procedures, regional anesthesia, injections, and non-opioid pharmacotherapy (e.g., non-steroidal anti-inflammatories, NMDA antagonists, and topical medications; Turk, 2002). The most widely used procedures to treat chronic back pain have been surgeries, such as: lumbar spinal fusion (i.e., surgery to fuse vertebras); discectomy (i.e., surgical removal of an

intervertebral disc); laminectomy (i.e., surgical removal of a vertebrae); and corticosteroid injections (i.e., cortisone injections into joints) (Andersson, 1999). Despite limited evidence for long-term benefits and concerns about high disability rates after these medical procedures (Tarnanen et al., 2012), some studies have shown an increase in surgical interventions for chronic pain. Rajaee et al. (2012) found that, between 1998 and 2008, there was a 137 percent increase in spinal fusion surgery for low back pain and an 11.8 percent increase in laminectomy procedures.

Several studies have looked at the efficacy of surgery to treat low back pain. In a systematic review, Chou, Loeser, et al. (2009) found that for non-radicular low back pain with common degenerative changes, patients who underwent spinal fusion did not significantly improve in pain or function compared to patients who received intensive rehabilitation with a cognitive-behavioral emphasis (Chou, Baisden, et al., 2009). Furthermore, less than half of patients in the study who underwent spinal fusion experienced optimal outcomes (i.e., no more than occasional pain, minor restriction of functioning, and infrequent use of analgesics). Similar results were published for a randomized controlled trial which assessed the clinical effectiveness of spinal fusion surgery compared to intensive rehabilitation for patients with chronic low back pain (Fairbank et al., 2005). The study showed that there was no clear evidence that spinal fusion surgery was any more beneficial than intensive rehabilitation, and surgery was associated with potential risk and increased cost.

Studies evaluating the efficacy of corticosteroid injections to treat chronic low back pain have comparable findings. One study revealed that after 1- and 3-month follow-ups,

none of the outcome measures evaluating pain severity, back mobility, and functional status differed clinically or statistically between a group of patients who received steroid injections versus placebo saline injection (Carette et al., 1991). In a systematic review of randomized trials to determine the efficacy of corticosteroid injections for knee osteoarthritis, consistent findings demonstrated that injections reduced pain in the short-term compared with other interventions. However, the efficacy of injections is seen consistently only at one week and not beyond (Hepper et al., 2009).

In summary, studies suggest that medical interventions can provide some benefits. Regarding use of chronic opioid therapy, there is mixed evidence as earlier studies have shown some improvements in a select population with shorter trials (i.e., less than 16 weeks; Chou, Fanciullo, et al., 2009; Portenoy et al., 2007; Hale et al., 2007; Katz et al., 2007). However, in recent studies with longer trials, findings suggest that opioid versus nonopioid treatment does not result in significantly better pain-related function (Megale et al., 2017; Krebs et al., 2018). In studies evaluating the efficacy of corticosteroid injections, findings demonstrated only short-term benefits (Carette et al., 1991; Hepper et al., 2009). Lastly, although there has been a significant increase in surgical procedures for chronic pain, results show that surgeries were no more beneficial than intensive rehabilitation, which is associated with less risk and lower costs (Chou, Loeser, et al., 2009; Chou, Baisden, et al., 2009; Fairbank et al., 2005). With medical interventions only providing some benefits, it appears that a biopsychosocial approach—utilizing a combination of treatments—may be necessary to help better manage chronic pain conditions.

The Biopsychosocial Model

The biopsychosocial approach has led to the development of treatment options that address various factors which are thought to play a role in the onset and course of chronic pain. These interventions may include: a) medication management; b) self-management training; c) diet and nutrition counseling; d) behavioral health, including counseling for addiction when necessary; e) access to interventional therapies through organized healthcare delivery networks; f) chiropractic care; and g) other complementary and alternative therapies (IOM, 2011). These examples highlight the complex phenomenon of pain, influenced by different biological factors and psychosocial components. In particular, social and environmental context seem to play a particularly significant role in the experience of pain (Turk & Okifuji, 2002). Of these social factors, culture may be one of the most important (Lasch, 2000).

Pain is a context-dependent experience (Gatchel, 2004), and cultural background plays an important part in determining the meaning of pain for an individual, how pain is perceived and communicated, and how an individual responds to the pain experience (Ramer et al., 1999). Helman (2001) explained that pain is internal, and to know whether a person is experiencing pain, it must be expressed through verbal or nonverbal signals or behaviors. Although pain is a private experience, pain behavior is influenced by sociocultural factors. For example, in a study examining cultural variations in pain experience among different ethnic groups, Liao, Henceroth, Lu, and LeRoy (2016) found that, in Asian cultures, stoicism and restraint is held in high regard in the context of pain. Conversely, in Hispanic culture, unrestrained expressions of pain are an acceptable way to communicate physical and

emotional distress. In some African cultures, pain can also represent a test of faith or be viewed as a punishment. Pain expression also influences how an individual copes with pain, and how they use and seek support (Liao et al., 2016). For example, African-Americans report greater use of praying/hoping and Hispanics reported greater use of spirituality as well as non-traditional (e.g. traditional healers) means of managing illness. In contrast, non-Hispanic Caucasians, who endorse the mind-body dualism view, tend to believe that their pain can only be effectively treated by physicians in a medical setting (Liao et al., 2016).

Ramer and colleagues (1999) studied the relationship among pain perception, ethnic identity, and socioeconomic status and found that pain management can be affected by factors, such as language, religion, beliefs and moral values, and social stigma. For example, ethnic minority groups and economically disadvantaged individuals may have difficulty feeling in control within a setting of well-educated medical professionals. By attempting to be a "good" patient, they may fail to express their needs and preferences for treatment. Patients from cultures that have been historically disenfranchised or exploited are also more prone towards lower expectations and distrust of Western models of care (Pillay, Van Zyl, & Blackbeard, 2014).

Interestingly, not only do patients bring their cultural perspectives, but healthcare providers also bring their own cultural beliefs to the interpretation of a patient's pain experience (Flaskerud, 2015). A common assumption is that training within the Western biomedical model will override personal/cultural beliefs about pain (Dalton, 1989). However, research suggests that providers' beliefs also impact pain management. In his research on the patient-provider relationship, Dalton (1989) reported that providers were influenced by their

own cultural beliefs about pain and at times altered their responses to the patients' assessment of pain. For example, a provider familiar with traditional Chinese medicine may suggest acupuncture—in addition to standard treatment—to a patient of Chinese descent or familiar with Chinese philosophy. This supports the view that personal/cultural views exist alongside medical explanations, which can affect the patient-provider relationship and communication between providers (O'Daniel & Rosenstein, 2005).

As discussed, culture shapes not only beliefs, but also influences the ways in which individuals from different cultures communicate. Within a medical setting, providers from different disciplines have a "culture"—behavioral norms and ways of communicating—that are distinct from one another (Vaidyanathan, 2015). On an interdisciplinary pain management team, for example, an initial physical therapy screening may include an examination of a patient's musculoskeletal, neuromuscular, cardiovascular/pulmonary, and integumentary systems. Although this examination may be routine and easily understood between physical therapists, other interdisciplinary providers may not be as familiar with the purpose of such an evaluation or with the language used. Without clear communication between providers, the team may have difficulty understanding one another. In addition to a discipline's own culture, one of the biggest barriers to effective treatment is the tendency for each discipline to focus on their own roles, responsibilities, and treatment goals—rather than viewing patient care holistically (O'Daniel et al., 2005). Patient care can become compromised when providers are not communicating effectively within the team and the team's goals are not aligned; thus, collaboration between the medical team and with the patient is essential.

Interdisciplinary Pain Management

Given the many facets of pain, as well as the widespread impact pain can have on an individual's life, interdisciplinary treatment—a modality that addresses a range of biopsychosocial factors—has become the standard of care. Combined treatments for chronic pain have demonstrated greater efficacy than unimodal treatments, such as physical therapy/exercise (Nelson, Miller, Hogan, Wegner, & Kelly, 1995), medication management (Cardenas, Turner, Warms, & Marshall, 2002), as well as individual cognitive-behavioral therapy (Morley, Eccleston, & Williams, 1999), and group cognitive-behavioral therapy (Keefe et al., 2002).

Interdisciplinary treatment of chronic pain typically consists of medical interventions (e.g., medications, surgery), psychological interventions (e.g., cognitive-behavioral therapy, biofeedback), and physical therapy (e.g., physical rehabilitation, active physical coping strategies; Stanos, 2012). Within the treatment team, the physician serves as medical director of the interdisciplinary team, assumes direct role of medical management for the patient, and coordinates medical treatment provided by other healthcare professionals. The psychologist's role is to provide a full psychosocial evaluation, assess patient's psychological strengths and weaknesses, and address psychosocial issues using a cognitive-behavioral treatment approach. The physical therapist manages the patient's physical rehabilitation, educates the patient on the physiological bases of pain, and teaches appropriate body mechanics and pacing (Gatchel et al., 2014). Other treatment modalities, including nursing and occupational therapy, are also frequently employed. The nurse's role consists of assisting the physician, providing follow-up for all procedures (e.g., injections, nerve blocks, etc.), and may function

as the case manager. Occupational therapy addresses vocational issues and physical determinants of disability, contacts employers to obtain job description/offer job retraining, and may teach pain techniques for managing pain on the job (Gatchel et al., 2014).

Lastly, with an interdisciplinary approach, the plan of care takes into account the multiple assessments and treatment regimens, and integrates these services to create an individualized care program that best addresses the needs of the patient (O'Daniel & Rosenstein, 2015). In addition, review of the literature shows that team collaboration and effective communication can lead to the following positive outcomes: a) more effective interventions; b) improved safety; c) increased patient and family satisfaction; d) decreased lengths of stay; e) enhanced employee morale; and f) improved information sharing (Joint Commission Resources, 2005).

Turk and colleagues (2010) discuss the subtle, but important, differences in the terms interdisciplinary and multidisciplinary, which are often used interchangeably. Although multidisciplinary care involves the care of several disciplines, treatment may not be coordinated and may occur with different goals in parallel, rather than as an integrated approach. On interdisciplinary teams, providers have complementary roles, where each discipline involved has unique knowledge and distinct skills that enhance patient care. Interdisciplinary teams not only encourage collaborative problem solving and shared accountability, but decisions about recommended treatments, therapeutic interventions, and other activities are consensus-based and reflect the team's view (Stanos, 2012). Although successful interdisciplinary programs depend on these key features, the most important features of interdisciplinary care are a shared philosophy, mission, and set of objectives. To

provide the best patient care, there must be constant communication among treatment providers and all providers must attempt to instill the treatment philosophy of rehabilitation in their patients to ensure effective comprehensive treatment (Turk et al., 2010).

The effectiveness of interdisciplinary pain management programs has been well established. A review of the relevant literature reflects that interdisciplinary programs are an evidence-based treatment modality that has been systematically evaluated and shown to be therapeutically efficacious and cost-effective (Gatchel et al., 2014; Okifuji, Turk, & Kalauokalani, 1999; Gatchel & Turk, 1999). Studies evaluating pain management programs found that—in comparison to no treatment, wait-list groups, and single-modality methods—patients participating in interdisciplinary programs demonstrated significant, long-term improvement (Gatchel & Okifuji, 2006; McCracken & Turk, 2002). Findings from a study by Oslund et al. (2009) also showed that patients in interdisciplinary programs reported improved outcomes across a range of domains (e.g. pain severity, interference, and functionality) and that these gains were maintained at one-year follow-up. Flor and colleagues (1992) found that patients receiving interdisciplinary treatment were functioning better than 75 percent of control patients and reported improved outcomes regarding activity level, pain intensity, pain behaviors, and use of medication and health services compared with untreated patients. Furthermore, 68 percent of patients returned to work versus 36 percent of the no-treatment group (Flor, Fydrich, & Turk, 1992). When compared to other pain treatments (e.g. pharmacological treatments, surgery, stimulators/implants, etc.), interdisciplinary programs provide significantly better outcomes for healthcare utilization, lower medication use, improved functional activity, and with fewer consequences and

adverse events (Turk, 2002). Furthermore, interdisciplinary programs performed better than less coordinated multidisciplinary programs and resulted in greater overall effectiveness than other common pain management interventions, including medication and cognitive-behavioral therapy (Weiner & Nordin, 2010; Scascighini, Toma, Dober-Speilmann, & Sprott, 2008). In addition to the medical interventions previously examined, two important components of interdisciplinary treatment also include cognitive/psychosocial and physical therapy interventions, which will be reviewed in the following sections.

Cognitive Interventions for Chronic Pain

As discussed, sociocultural context, cognitive, behavioral, and affective components are all important considerations in one's experience of chronic pain (Gatchel et al., 2014). Empirical evidence indicates that fear of pain and pain-related experiences and activities, combined with avoidance behavior, may actually be more disabling than pain itself (Pfingsten et al., 2001). Avoidance refers to a pattern of behavior that delays an unwanted situation or experience. Avoidance behavior can be a typical adaptive response to acute injury (Morley, 2011; Vlaeyen & Linton, 2000). For example, an individual may reduce (or avoid) physical activity in the days after an injury to avert pain and allow for healing. However, if the avoidance behavior persists after the injury has healed, then avoidance may be viewed as a maladaptive response that can contribute to disability, physical deconditioning, dysphoric affect, and preoccupation with somatic symptoms (Pfingsten et al., 2001). In order to help an individual adjust and develop a sense of control over their pain,

treatment approaches that acknowledge the importance of cognitive, behavioral, and affective factors in the onset and maintenance of pain are necessary.

Although there are a variety of psychological treatments available, the most commonly used are evidence-based, cognitive-behavioral theory (CBT) approaches. These approaches have evolved over the years and now incorporate aspects of operant conditioning, biofeedback, stress management, cognitive therapy, mindfulness, fear-avoidance, and acceptance commitment therapy (Morley, 2011). Current CBT approaches emphasize the importance of fear-avoidance and guide treatment to focus on challenging patients' fears of engaging in specific movements will result in catastrophic consequences. Cognitive-behavioral interventions for pain management are comprised of three basic components: teaching, application, and problem-solving (Carlson, 2014). The first component is helping the patient understand that cognitions and behavior can affect the experience of pain and that they can play an active role in controlling their own pain. The second component is teaching specific coping skills that involve relaxation (e.g., progressive relaxation, cue-controlled brief relaxation exercises), distraction (e.g., guided imagery, pleasant activity scheduling), and cognitive restructuring (i.e., replacing automatic negative thoughts with adaptive, coping thoughts). The last component is an application and maintenance phase where the patient is encouraged to practice learned coping skills, address problem-solving issues, and develop a plan for dealing with pain flares (Carlson, 2014).

CBT has become the treatment of choice for chronic pain as current evidence-based clinical research overwhelmingly supports the modality, particularly in interdisciplinary pain management programs. In a meta-analysis by Morley, Eccleston, and Williams (1999), CBT

interventions demonstrated significant improvements in multiple psychosocial dimensions related to chronic pain, such as pain behavior, coping, and social functioning. Numerous controlled trials have also shown that CBT interventions in interdisciplinary contexts are successful at helping patients manage their chronic pain conditions (Gatchel, Robinson, Pulliam, & Maddrey, 2003; McCracken & Turk, 2002). A review by Gatchel and Rollings (2008) further supported the evidence regarding the efficacy of CBT interventions in pain management programs. Furthermore, group CBT has also been widely recommended as an important treatment for chronic pain conditions (Keefe et al., 2004).

In summary, there is strong evidence for the efficacy of CBT as an effective intervention for chronic pain management (Keefe et al., 2004; Gatchel et al., 2003; McCracken & Turk, 2002; Morley et al., 1999). As previously discussed, psychosocial factors seem to play an increasingly significant role the longer pain persists. Therefore, cognitive interventions—and specifically CBT—are an important part of interdisciplinary treatment as patients learn to replace maladaptive cognitions, emotions, and behaviors with more adaptive ones to maximize the benefits of other components (e.g., medication adherence, physical therapy) within interdisciplinary care (Gatchel et al., 2014). Furthermore, CBT helps the patient gain independence and effectiveness in managing chronic pain on their own through learned coping and enhanced problem-solving skills (Gatchel et al., 2014).

Physical/Manual Therapy Interventions for Chronic Pain

Interdisciplinary pain management also involves a physical therapy component, typically based on a functional restoration approach which emphasizes goal-oriented graded

exercise progression using strength-training and aerobic conditioning (Stanos, 2012). Graded exercise therapy involves slowly initiating a physical activity then gradually increasing the intensity and/or duration of the activity over time. This method helps patients re-engage in physical movement in a manner that feels physically and psychologically safe (Butler & Moseley, 2013). Another important element of physical therapy is helping the patient gain a basic understanding of pain physiology, not only to understand the nature of their pain, but to begin helping the patient shift the way their brain interprets pain signals (Moseley, Nicholas, & Hodges, 2004). For example, the patient can begin to recognize that recurrent pain may often be protective and does not necessarily indicate that they are sustaining new damage or re-injury. This is important as it helps set an expectation for the patient that the physical therapy component of treatment may include some pain, but that does not necessarily indicate that the patient is injured (Butler & Moseley, 2013). Evidence suggests that combining patient education of pain physiology along with physical therapy exercises can decrease pain and increase level of physical capacity (Moseley, 2003). When a patient understands how pain works, they can bring awareness to their pain triggers, and in doing so, learn to decrease their pain and implement more adaptive thoughts and behaviors through CBT interventions.

In studies examining exercise therapy specifically, a comprehensive systematic review by Hayden, van Tulder, Malmivaara, and Koes (2005) found exercise slightly to moderately superior to no treatment for relief of chronic low back pain. Results also demonstrated that exercise was superior to usual care or no treatment in 2 of 9 trials for relief of acute low back pain. In a review focusing on work outcomes, findings demonstrated a

significant decrease in patients who took sick leave as well as higher return-to-work rates at one-year follow-up (Kool et al., 2004). A meta-regression analysis was conducted and results suggested that exercise therapy using individualized treatment plans, supervision, stretching, and strengthening were associated with optimal outcomes (Hayden, van Tulder & Tomlinson, 2005).

Within physical therapy, manual therapy is often combined with exercises that are used to treat specific musculoskeletal conditions (Bookhout, 1996). Manual therapy involves the use of passive (hands-on) and active (hands-off) techniques that are intended to modulate pain; mobilize or manipulate soft tissue and joints; reduce soft tissue swelling, inflammation, or restriction; improve tissue extensibility; increase range of motion; and induce relaxation. Techniques may include manual lymphatic drainage, manual traction, massage, and mobilization/manipulation (American Physical Therapy Association [APTA], 2019). In a study by Aure, Nilsen, and Vasseljen (2003) comparing the impact of manual and exercise therapy in individuals with chronic low back pain, the authors found significant improvements in both groups on measures of pain and disability, with manual therapy showing considerably greater gains. Furthermore, 27% in the exercise therapy group versus 67% in the manual therapy group had returned to work. In a randomized, controlled trial comparing the effectiveness of physical therapy, manual therapy, and continued care by a general practitioner in patients with non-specific neck pain, the manual therapy group consistently showed better improvements than the other two groups on most outcome measures, particularly perceived recovery which combines factors such as pain, disability, and patient satisfaction (Hoving et al., 2002). In a more recent systematic review of

randomized control trials, the study found that for patients with different stages of non-specific neck pain, combining different forms of manual therapy with exercise is better than either intervention alone, and that mobilization techniques do not need to be applied at the symptomatic level for improvements (Hidalgo, Hall, Bossert, Dugeny, Cagnie & Pitance, 2017).

Gatchel and Mayer (2008) also found that functional restoration has consistently demonstrated significant improvements in diagnosis, intervention, and pain management compared with other approaches. In a systematic review of randomized controlled trials, there was strong evidence that intensive biopsychosocial rehabilitation along with a functional restoration approach significantly improved function and reduced pain, when compared with inpatient or outpatient non-multidisciplinary treatments (Guzman et al., 2001). Not only did controlled studies show significantly better outcomes for patients undergoing functional restoration programs as compared to control groups, but studies demonstrated return-to-work rates of 80 to 90 percent at one- and two-year follow up (Poiraudeau, Rannou & Revel, 2007; Mayer et al., 1987; Mayer et al., 1985). In addition to increased reemployment and work retention, functional restoration also resulted in lower rates of recurrent or new injury among a sample of "high risk" workers' compensation patients (Garcy, Mayer & Gatchel, 1996).

In summary, physical therapy interventions—such as therapy focusing on exercise and/or functional restoration—demonstrate promising findings, especially when treatment plans include an individualized regimen using a graded exercise approach (Hayden et al., 2005; Kool et al., 2004; Gatchel & Mayer, 2008; Poiraudeau et al., 2007)). However, due to a

fear of sustaining new damage or re-injury, patients may be particularly reluctant to participate in physical activities. Therefore, the success of physical therapy requires constant communication among providers in order to address physical, psychological, and vocational challenges during the treatment process (Moseley et al., 2004). As can be seen, pain is a complex condition that requires interdisciplinary care providers to work as a team and help restore the physical, psychological, and social situations of patients through their active participation in treatment.

The Issue of Attrition

A meta-analysis of multidisciplinary pain management programs revealed that close to half of the studies included in the analysis were rated as having potential bias due to attrition rates, but found that it was difficult to understand the nature of bias as the reasons for incompletion are often unclear (Curtis, 1992). Turk and Rudy (1990) found that rates of attrition were often not reported and participants who dropped out were typically excluded from the study altogether. They found that reported attrition rates ranged from 4 to 70 percent, which may undermine the validity and generalizability of results if authors neglect to consider the impact of attrition on their findings.

Although the efficacy of interdisciplinary pain management programs has been well-documented (Gatchel & Okifuji, 2006; Turk & Swanson, 2007; Chou et al., 2009), there have been limited studies that have focused on the issue of attrition in interdisciplinary pain management programs. A search of PubMed, Ovid, and Google Scholar databases found one systematic review and one doctoral dissertation examining dropout in interdisciplinary

programs. The systematic review by Oosterhaven, Wittink, Mollema, Kruitwagen, and Deville (2019) included eight studies conducted between 1994 and 2009; five of which took place in the U.S. and three of which took place in Europe. Out of the 63 potential predictors of dropout, significant results were found for 18 predictors in four domains: 1) two predictors in the sociodemographic domain; 2) eight predictors in the patient domain; 3) six predictors in the disease domain; and 4) two predictors in the treatment domain. In the socio-demographic domain, ethnicity (Sloots et al., 2009) and number of sick days (Bendix, Bendix, & Haestrup, 1998) were significant predictors of drop out. However, age (Biller et al., 2000; Carosella, Lackner, & Feuerstein, 1994) and pre-treatment work status (i.e., not working pre-treatment) (Howard, Mayer, Theodore, & Gatchel, 2009) were found to have conflicting results. In the patient domain, pre-contemplation, action (Biller et al., 2000), opioid dependency, cluster B personality traits (Howard et al., 2009), return-to-work expectation, somatization (Carosella et al., 1994), self-efficacy, and walk distance (Coughlan, Ridout, Williams, & Richardson, 1995) were significant predictors. Two studies found a significant association of depression with dropout; one study indicated an association with low depression scores (Biller et al., 2000) and another study indicated an association with higher scores (Howard et al., 2009). In the disease domain, ability to work (Bendix et al., 1998), variability in pain (Kvaal, Lofland, & Nigro, 1999), pain behavior, length of medication use (Richmond & Carmody, 1999), length of disability (Howard et al., 2009), and duration of work disability (Carosella et al., 1994) were significant predictors. However, pain intensity (Biller et al., 2000; Carosella et al., 1994) and severity of disability (Howard et al., 2009; Richmond et al., 1999) were found to have conflicting results. In the treatment domain,

type of institution and phase of treatment (Sloots et al., 2009) were significant predictors. The authors discussed that since all the studies in the review investigated different combinations of potential predictors, the conflicting results in their findings were somewhat anticipated. The differences in types of treatment as well as study design may have also contributed to the differences in the study population (Oosterhaven et al., 2019). For example, the types of interventions in the review differed in program goal (e.g., return to work versus pain management), duration of the program (i.e., four to 20 weeks), and the inclusion criteria for the study population. Furthermore, depending on the country where treatment took place (i.e., U.S. or Europe), there were differences in the healthcare system, such as referral and funding, that may have resulted in differences in the study population (Oosterhaven et al., 2019).

A search of the databases also found one doctoral dissertation examining attrition and failure in an interdisciplinary pain rehabilitation program at the Cleveland Clinic (Mintz, 2013). The study was conducted with an epidemiological and biostatistical focus with aims to build a statistical model and a nomogram to predict program failure. In the 3-week outpatient program, patients received a) individual and group therapy; b) relaxation and meditation training; c) group medication management; d) physical/occupational therapy; e) family and/or couples counseling; and f) participate in various exercise activities (e.g., walking, swimming, basketball, etc.). In the sample of 1542 patients, 19 percent (292 patients) did not complete the program. The study found four factors predictive of program attrition: marital status, intelligence quotient (IQ), chemical dependence, and clinician-assessed depression. In the final model, only chemical dependence positively predicted attrition, while the other three

factors were negatively correlated (i.e., being married or partnered, having a higher IQ, and clinician-assessed [as opposed to patient self-assessed] depression). There were no significant differences between attrition and completion groups in the following factors: a) gender; b) age; c) smoking status; d) work status; e) disability status; f) pain type, duration, and intensity; g) hours of rest per day; h) Pain Disability Index (PDI) score; i) University of Alabama at Birmingham (UAB) Pain Behavior Scale score; j) serious mental illness; and k) Depression, Anxiety, and Stress Scale (DASS) scores. Given that chemical dependence was the only factor positively predicting attrition, programmatic support particularly for patients with substance use histories may be useful in interdisciplinary programs (Mintz, 2013). The study also points out that, since eliminating or tapering use of benzodiazepines and opiate medication are often an important part of interdisciplinary care, attrition in this subset of patients may relate to the general difficulty of maintaining recovery for these patients.

A further search of the databases above was conducted for additional studies addressing attrition in multidisciplinary pain management settings. In a meta-analysis evaluating the efficacy of multidisciplinary pain management programs, Flor and colleagues (1992) documented that, in some studies, as many as 87 percent of participants did not complete the entire study. However, in more a recent meta-analysis by Jeffery, Butler, Stark, & Kane, (2011), attrition rates ranged from 0 to 48 percent. Turk and Rudy (1990) found that the most common reasons for attrition from multidisciplinary programs were due to a) family problems—29%; b) disruptive or uncooperative behavior—23%; c) financial difficulties—10%; d) taking a job—6%; other—13%; and unspecified—19% (Turk et al., 1990).

Kearns and Haythornthwaite (1998) examined early attrition from a 10-week cognitive-behavioral-based multidisciplinary program. The program incorporated behavioral contracts for accomplishing goals, coping skills training, and focused on developing an active problem-solving approach to manage chronic pain. The study found that among patients who participated in the rehabilitation program, there was a tendency for a larger proportion of depressed patients to fail to complete the program. This finding suggests that depression may be a hindrance to full participation and that greater attention should be paid to the experience of depression in order to successfully engage many of these patients. Interestingly, depressed patients were just as likely as mildly-depressed and non-depressed patients to experience diminished symptoms of pain and interference upon completion of the program. That is, all groups showed similar progress toward their behavioral rehabilitation goals.

Carosella, Lackner, and Feuerstein (1994) studied measures related to pain functioning, psychological distress, perceived work environment, and patient expectation to determine whether such factors were associated with failure to complete rehabilitation. The 4-week program consisted of treatment five days per week in a work rehabilitation-based multidisciplinary setting. Findings showed that younger patients with longer duration of work disability—who report lower return-to-work expectations and higher levels of perceived disability, pain severity, and focus on bodily sensations—had problems adhering to treatment during active rehabilitation. The study also found that higher scores on the somatic preoccupation and dysthymia subscales of the Millon Clinical Multiaxial Inventory-II (MCMI-II) distinguished patients who dropped out early from the program. The authors hypothesized that this may be due to higher transient increases in pain and related distress

when exposed to physical and work conditioning in a highly structured program designed to increase functioning.

King and Snow (1989) examined attrition rates in an inpatient, multidisciplinary setting. Patients were admitted to a 21-day program which included psychotherapy, stress management, physical therapy, and occupational therapy. Patients who were taking opiate medication or abusing benzodiazepines were detoxed during the hospitalization. The study found that patients who dropped out of treatment early reported significantly less psychopathology as measured by a) Hypochondriasis, Depression, and Hysteria scales on the Minnesota Multiphasic Personality Inventory (MMPI) and b) Anxiety and Fatigue scales on the Profile of Mood States (POMS). The non-completers also had a higher number of pain-related surgeries, were more likely to be college graduates, and had limited social support from their families. Interestingly, the clinic staff reported that these patients were less cooperative and had more psychological problems than patients who completed the program. The authors suggested the non-completers may have been more defensive and less willing to report psychological symptoms.

Clark (1996) studied attrition from a 19-day cognitive-behavioral-based inpatient, multidisciplinary program in a Veterans Administration setting. Treatment consisted of psychoeducational lectures, group therapy, relaxation training, physical therapy, occupational therapy, vocational readjustment evaluation, leisure time training, and goal-directed walking/ exercises. Additionally, narcotic withdrawal took place during the first 10 days of the program. The study attempted to use the Negative Treatment Indicators (TRT) scale of the MMPI-2—which measure negative attitudes and beliefs about physicians and psychological

treatment—as a predictor of attrition. Results indicated that the TRT scale was more closely related to psychosocial dysfunction and emotional distress than to attitudes about treatment, and did not serve as a reliable indicator of attrition.

Among less formal studies, Gottlieb et al. (1977) found that attrition was related to general dissatisfaction with treatment and a lack of motivation to be rehabilitated. In particular, patients appeared to attribute increased pain following physical therapy to further injury rather than rehabilitation. Similarly, Basler & Rehfisch (1990) observed that patients dropped out of the program when they realized they were expected to have an active approach to treatment. During interviews with the patients, they also reported feeling less accepted within the therapy group and less supported by their families.

In summary, previous studies have identified factors such as limited social support (Flor et al., 1992; King & Snow, 1989), uncooperative behavior to treatment (Gottlieb et al., 1977; Basler & Rehfisch, 1990), and employment/financial barriers (Flor et al., 1992) as potential contributors to attrition from pain management programs. Although one study by King and Snow (1989) found that less psychopathology predicted early dropout, the results may have also been due to an underreporting of symptoms by non-completers. Indeed, findings from several studies indicate that psychopathology and psychosocial function contributed to early dropout (Kearns & Haythornthwaite, 1998; Clark, 1996; Carosella et al., 1994).

Overall the results demonstrate a gap in literature examining the reasons for incompletion from pain management programs. In particular, there has been limited research examining attrition in interdisciplinary settings. This issue is further complicated by the fact

that the terms “multidisciplinary” and “interdisciplinary” are often used interchangeably and may conflate results. Therefore, an exploratory study—specifically looking at an interdisciplinary pain management program—would aid in identifying and understanding some of the factors that may influence participant dropout.

Predictors of Interest in Attrition

Based on findings from previous research on pain management programs, some possible factors that may impact pain management outcomes in interdisciplinary settings include factors related to socioeconomic status, history of opioid use, medical comorbidities, and history of past or present mental health.

In a thorough review of studies examining the relationship between chronic pain and socioeconomic status (SES), Bonathan and colleagues (2013) found a strong association between lower SES and higher rates of chronic pain. In addition to an increased likelihood of developing chronic pain, individuals with lower SES report greater disability and levels of distress, even when controlling for confounding variables. Bonathan and colleagues (2013) proposed that living in a less socially cohesive neighborhood, combined with poorer education and job opportunities, are likely to interact with psychological factors that increase the consequences associated with chronic pain. With additional barriers such as limited autonomy (e.g., economic and transportation barriers), physically demanding jobs, and poor health insurance, there may be a scope of factors that directly or indirectly impact whether an individual enters and/or remains in treatment (Poleshuck & Green, 2008). In a population-based study examining the general public’s knowledge, attitudes, and beliefs about chronic

pain, Turner et al. (2017) found that low SES groups also have poorer knowledge about multiple aspects of chronic pain and treatment. This lack of understanding may also contribute to discrepant expectations about treatment, particularly regarding medications for symptom relief. Factors that might discourage individuals from seeking, or continuing to seek, treatment include not only the "typical" obstacles (e.g., lack of a routine source of care), but also language barriers, communication difficulties, distrust in clinicians, and poorer expectations of treatment outcomes (IOM, 2011).

Regarding opioid use, multiple epidemiological studies have demonstrated that patients receiving opioids report higher levels of pain and lower activity levels compared to patients not using opioids (Turner et al., 2016; Freheim et al., 2014; Erikson et al., 2006). Long-term opioid use for chronic pain remains controversial due to concerns about efficacy, adverse side effects, and especially their potential for misuse and abuse (Turk, Swanson, & Gatchel, 2008). In a study examining the effects of multidisciplinary pain management on the outcomes of pain, disability, mood, and substance use in an academic primary care practice, results showed not only was there a high prevalence of substance misuse (32 percent), but over 20 percent of patients who were identified as having misused opioids dropped out of the program when they were no longer prescribed opioids (Chelminski et al., 2005). In a study completed at the Mayo Clinic, which has a 3-week outpatient rehabilitation center that requires opioid discontinuation during the course of treatment, Rome and colleagues (2004) compared patients with daily opioid use to patients without daily use. They found that higher morphine equivalent analgesic doses at pre-treatment were associated with a greater probability of treatment dropout. In a more recent study at the Mayo Clinic, Townsend and

colleagues (2008) found evidence that higher doses of opioids was associated with a higher treatment dropout rate, and at 6-month follow-up, over 20 percent had restarted their opioid use.

Another factor that can interfere with effective treatment is the presence of specific medical diagnoses, where chronic pain may be a secondary problem to certain conditions, such as a spinal cord injury (SCI), multiple sclerosis (MS), or cerebral palsy (CP). With these disorders, there is the potential for pain to increase the negative impact of these already disabling conditions to the point where they cannot engage in activities of daily living (Chwastiak et al., 2002). In a survey of individuals with SCI, Turner and Cardenas (1999) reported that the majority (74 percent) of respondents reported that SCI-related pain prevented them from participating in various activities, including self-care, housework, and outdoor activities. Chronic pain can also result from a variety of factors associated with multiple sclerosis, such as lesions in the brain stem and tonic spasms in the spinal tracts (Chwastiak et al., 2002). Although it is well recognized that individuals with MS can experience chronic pain conditions, little is known about the impact of MS-related pain on psychosocial functioning. In one of the few studies to examine the effects of MS-related pain on daily living, Archibald et al. (1994) found that individuals with chronic pain reported poorer mental health and more limitations in social role functioning than those without pain. In a study of adults with CP, 67 percent of the sample reported one or more areas of chronic, bothersome pain. The findings suggested that the pain experienced by individuals with CP interfered less with daily functioning than that experienced by individuals with other primary

conditions such as SCI (Schwartz et al., 1999). However, the authors hypothesized that it may also be due to a floor effect of the already low functional level of their sample.

Lastly, extensive research has demonstrated that chronic pain is commonly associated with depression, anxiety, and problems in quality of life and psychosocial problems (Gatchel, 2004; McWilliams et al., 2003; Benjamin et al., 2000). Psychiatric problems may be secondary to chronic pain in some individuals, but in others, the psychopathology may predate the onset of pain or may reflect different expressions of the same underlying issue (IOM, 1987). Regardless of the etiology, psychiatric problems can exacerbate pain conditions and impede treatment. In particular, untreated psychopathology is not only associated with poorer treatment outcomes which may interfere with successful rehabilitation, but can also increase pain intensity and disability which may exacerbate pain-related dysfunction (Henrikson et al., 2014; Hozberg, Robinson, Geisser, & Germillion, 1996). For example, anxiety and depression have been associated with decreased pain threshold and tolerance, amplification of somatic pain, and intensification of medical symptoms (Katon et al., 1996; Sullivan & Katon, 1993). In a study by Olfson and colleagues (2009), findings suggested that approximately 20 percent of individuals in mental health treatment dropped out before completing the recommended course of treatment, and dropout was found to be even higher (over 30 percent) when individuals were receiving mental health services during the course of general medical treatment.

Although there are limited studies looking at attrition from pain management programs, there is considerably more research examining premature dropout from psychotherapy. A comprehensive review by Wierzbicki and Pekarik (1993) found an average

dropout rate of 47% across 125 studies. Attrition rates appear lower than what was estimated a couple decades ago; however, it remains a significant problem. In a meta-analysis of 669 studies on dropout, Swift and Greenberg (2012) found that about 1 in every 5 clients drop out of therapy. In three decades of research on premature termination of psychotherapy, Reis and Brown (1999) found that only SES and ethnicity emerged as consistent predictors of dropout. Overall, it appears that attrition remains a significant concern when examining particular mental health issues as well as behavioral health treatments.

Scope of the Current Study

This study aims to investigate potential contributors to attrition in an interdisciplinary pain management program. Although some studies have looked at attrition in multidisciplinary settings and individual pain treatments, there is still a dearth of research on early dropout from pain management programs, particularly in "multidisciplinary" and "interdisciplinary" settings as these two modalities are often conflated. The efficacy of interdisciplinary pain management programs has been well documented (Gatchel & Okifuji, 2006; Turk & Swanson, 2007; Chou, Loeser, et al., 2009); however, not fully understanding the reasons for failure-to-complete likely results in ineffective pain management interventions. This study will fill a gap in literature by identifying specific factors that may be related to attrition from interdisciplinary programs. By identifying attrition factors, patients at risk for early dropout can be targeted for specific interventions that keep them in treatment longer and provide more effective pain management. Following are the aims and hypotheses for this study:

Aim I: Evaluate the extent to which the following five domains will predict non/completion for adults consenting to an interdisciplinary pain management program: 1) selected demographic variables, 2) number of medical diagnoses [psychiatric and non-psychiatric], 3) opioid use/risk of misuse, 4) pain-related cognition and behavior, and 5) physical, social, and mental well-being.

Hypothesis 1.a) Selected demographic variables (i.e., age, sex, education, marital status, and employment status) will predict attrition.

Hypothesis 1.b) The number of medical diagnoses [psychiatric and non-psychiatric] will predict attrition.

Hypothesis 1.c) Risk of opioid misuse and opioid use at the start of treatment will predict attrition.

Hypothesis 1.d) Pain-related cognition and behavior will predict attrition.

Hypothesis 1.e) Physical, social, and mental well-being will predict attrition.

Aim II: Examine changes in score for the completion group for a variety of clinical measures (detailed within the "Procedure" section) across at least two time points for each participant (i.e., baseline with either midpoint and/or endpoint test scores).

Hypothesis 2.a) Participants in the completion group are expected to improve in the pain-related cognition and behavior domain over time.

Hypothesis 2.b) Participants in the completion group are expected to improve in the physical, social, and mental well-being domain over time.

CHAPTER THREE

Methodology

STUDY DESIGN

Setting

This study population consists of patients who sought outpatient treatment for chronic pain at the Eugene McDermott Center for Pain Management (EMCPM). The EMCPM—a part of The University of Texas Southwestern Medical Center in Dallas, TX—offers a four-week interdisciplinary chronic pain management program. Participants consist of adult outpatients who initiated care or received ongoing care at EMCPM. Treatment consists of medication management, physical therapy, cognitive-behavioral therapy (CBT), and group psychotherapy. Throughout the four-week program, patients participate in two programs days per week—for a total of eight program days. Each program day consists of one session of physical therapy, individual psychotherapy, and group therapy. Additionally, individuals who enter the program with a history of opioid use are monitored and provided psychoeducation regarding the limited evidence supporting long-term opioid use for chronic pain management. Participants in the study completed study measures at intake and at two separate intervals over the course of their treatment, including midpoint and endpoint testing. Data collection and use is monitored by the Institutional Review Board (IRB) of The University of Texas Southwestern (UTSW) Medical Center.

PARTICIPANTS

The EMCPM offers an interdisciplinary pain management program as well as various general pain management interventions. During an initial appointment at the EMCPM, a physician evaluates whether a patient would benefit from the interdisciplinary program. If the physician recommends a referral to the program, the patient is set up with a psychological evaluation and a physical therapy evaluation. After the evaluation process, all interdisciplinary providers decide as a team whether the patient is appropriate for admittance to the program.

Treatment team meetings are an integral part of interdisciplinary care. In addition to discussing patient eligibility, the weekly case conferences are also an opportunity to review the progress of current patients and make appropriate recommendations for individuals not admitted to the program. This includes individuals with acute or severe psychopathology (e.g. psychosis, suicidality), intellectual disabilities, or significant difficulty with hearing or speech. Once a patient is referred to the interdisciplinary program, the patient decides whether to enter or not enter the program. Some common reasons for declining to participate in the program include transportation barriers, financial constraints, and scheduling difficulties. For patients who initiate the program and attend at least one session of the four-week program, they become a part of the sample set in this study. It is beyond the scope of this study to examine individuals who completed the evaluation process and declined to participate in the program, as the aim of this study is to investigate the characteristics of completers versus non-completers in the program.

Inclusion Criteria

Patients were invited to participate in the study if they initiated the program (i.e., attended at least one session), were of consenting adult age (i.e., 18 years of age and older), were capable of providing informed consent, were able to read and speak English, were experiencing non-cancer pain-related problems, and were willing to allow access to their electronic medical records.

Exclusion Criteria

Persons under 18 years of age were excluded from the study as EMCPM does not provide care to children/adolescent populations. Non-English-speaking patients were excluded from the study as empirically-validated language versions and norms were not available for certain measures used in the study. Patients who were unwilling or unable to complete the requisite study questionnaires were excluded from the study. Patients experiencing cancer pain-related problems were also excluded.

MEASURES

Data collected at the baseline time point included: a) demographic information; b) medical history [psychiatric and non-psychiatric]; c) history of opioid mediation use; d) pain-related history; and e) psychosocial history. Baseline testing took place prior to patients entering the four-week program at EMCPM. Midpoint testing occurred two weeks into treatment and endpoint testing occurred at the end of treatment. Multiple measures of pain-related data were collected at all time points, including evaluation of pain duration/intensity,

associated opioid medication use, functional impairment, level of disability, and pain behaviors. In this proposed study, the measure used to examine *Risk of Opioid Misuse* includes: a) Pain Medication Questionnaire. The measures used to examine *Pain-Related Cognition and Behavior* include: a) Pain Catastrophizing Scale, b) Fear-Avoidance Beliefs Questionnaire, c) PROMIS Bank v1.0 - Pain Behavior, d) PROMIS Bank v1.0 - Pain Interference. The measures used to examine *Physical, Social, and Mental Well-being* include: a) Life Orientation Test-Revised, b) Medical Outcomes Study 36-Item Short Form Survey, c) PROMIS Bank v1.0 - Physical Function, d) PROMIS Bank v1.0 – Anxiety, e) PROMIS Bank v1.0 – Depression, f) PROMIS Bank v1.0 – Applied Cognition General Concerns, and g) PROMIS Bank v1.0 - Sleep-Related Impairment.

Pain Medication Questionnaire (PMQ)

The PMQ is a 26-item self-report screening instrument for opioid medication misuse in chronic pain patients. The questionnaire helps to determine whether patients require more in-depth assessment for risk of opioid misuse and to assist physicians in decisions regarding whether patients might be appropriate for opioid treatment (Holmes et al., 2006). The items were constructed, based on relevant literature and input from pain management specialists, to reflect suspected behavioral and attitudinal correlates of opioid misuse (Holmes et al., 2006). Using a 5-point Likert scale, patients respond to a series of statements, such as: “At times, I run out of pain medication early and have to call my doctor for refills;” “Family members seem to think that I may be too dependent on my pain medication;” and “At times, I need to borrow pain medication from friends or family to get relief.” In a study of 184 chronic pain

patients, Adams et al. (2004) found the PMQ to be a reliable instrument, with a test-retest reliability of 0.84, an internal consistency yielding a Cronbach's alpha of 0.73, and adequate construct and content validity.

Pain Catastrophizing Scale (PCS)

The PCS is a 13-item self-report measure developed to help quantify an individual's pain experience and catastrophic thinking related to pain, asking about feelings and thoughts they experience when they are in pain (Sullivan, 2009). People who catastrophize tend to do three things—ruminate about the pain, magnify the pain, and feel helpless to manage the pain—all of which are measured by the test (Sullivan, 2009). Using a 5-point Likert scale, patients respond to a series of statements, such as: Rumination—"I can't stop thinking about how much it hurts;" Magnification—"I'm afraid that something serious might happen;" and Helplessness—"There is nothing I can do to reduce the intensity of my pain." The PCS has been shown to have adequate to excellent internal consistency (0.87 - 0.93). In a study of 80 patients with neuropathic pain conditions, the PCS subscales correlated significantly with the Inventory of Negative Thoughts in Response to Pain (INTRP), ($p < .01$) providing evidence of concurrent validity (Sullivan, Bishop & Pivik, 1995; Osman et al., 1997).

Fear-Avoidance Beliefs Questionnaire (FABQ)

The FABQ is a 16-item self-report measure developed to assess patient beliefs about the effect of work and physical activity on their low back pain. Specifically, it measures patients' fear of pain and consequent avoidance of work and physical activity because of

their fear. There are two subscales within the FABQ—the work subscale and the physical activity subscale (Williamson, 2006). Using a 7-point Likert scale, patients respond to a series of statements, such as: "I cannot do physical activities which (might) make my pain worse;" "My work aggravated my pain;" and "I should not do my normal work with my present pain." In a study of 176 patients with acute low back pain, the FABQ subscales were found to have good internal consistency with Cronbach's alpha ranging from 0.84 to 0.92 on the work subscale and 0.52 to 0.77 on the physical activity subscale. Results looking at concurrent validity between the FABQ and Tampa Scale for Kinesiophobia (TSK) showed a moderately strong correlation ($r = 0.59$) with the physical activity scale (Swinkels-Meewise et al., 2003).

Life Orientation Test-Revised (LOT-R)

The LOT-R is a 10-item self-report measure of optimism and pessimism, which are broad constructs generally used to convey an individual's attitude and expectations about the future (Hirsch, Britton, & Conner, 2010). Dispositional optimism is a stable, general positive attitude about the future and a tendency to anticipate favorable outcomes, whereas pessimism is a negative view of the future (Hirsch et al., 2010). Orientations toward the future may influence psychological and physical health through their effect on coping responses. For example, optimistic individuals may use active and adaptive coping strategies such as approaching problems directly and attempting to overcome adversity (Puskar et al., 1999). Using a 5-point Likert scale, patients respond to a series of statements, such as: "In uncertain times, I usually expect the best;" "I hardly ever expect things to go my way;" and "Overall, I

expect more good things to happen to me than bad." The LOT-R has shown strong internal consistency with a Cronbach's alpha of 0.78, good test-retest reliability (r = 0.79), and shown a Cronbach's alpha of 0.77 in previous studies with chronic pain populations (Carver, Scheier, & Segerstrom, 2010; Smith & Zautra, 2008).

Medical Outcomes Study 36-Item Short Form Survey (SF-36)

The SF-36 is a 36-item patient-reported outcome measure that quantifies health status and measures health-related quality of life. The SF-36 assesses eight health concepts, using one multi-item scale: 1) general health perceptions; 2) physical functioning; 3) bodily pain; 4) physical role functioning; 5) emotional role functioning; 6) social role functioning; 7) general mental health; and 8) vitality (i.e., energy and fatigue) (Ware & Sherbourne, 1992). In the measure patients respond to a series of questions and statements, such as: "Compared to one year ago, how would you rate your health in general now?;" "During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities? (like visiting with friends, relatives, etc.);" and "During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems? (such as feeling depressed or anxious)." In a review of the use of the SF-36 Survey with a chronically disabled back pain population, McHorney, Ware, Lu, and Sherbourne (1994) found consistently high reliability coefficients of r = .80 or more for all eight scales, using both test-retest and internal consistency methods, across diverse patient groups. In a population-based survey of 8,242 respondents in the general population, the study found the SF-36 to have high internal consistency and good criterion

validity as each dimension of the measure was strongly associated with participants' reports of overall general health (Jenkinson, Wright, & Coulter, 1994).

PROMIS Overview

The Patient Reported Outcome Measurement Information System (PROMIS) is a system of reliable, evidence-based measures of patient-reported health status for physical, social, and mental well-being (National Institute of Health [NIH], 2007). The measures were created using item-response theory (IRT) and developed by the NIH for the purpose of efficiently obtaining valid patient-reported outcomes (Fries, Krishnan, Rose, Lingala, & Bruce, 2011). PROMIS measures are frequently used in clinical studies to determine the effect of treatment on a wide range of patient factors and provide both researchers and clinicians with relevant information that is typically not found in traditional measures (NIH, 2007). The information can be used by treatment providers not only to inform treatment, but to also improve communication with patients to better manage their chronic illnesses. Regarding scoring of PROMIS measures, "a higher PROMIS T-score represents more of the concept being measured. For negatively-worded concepts like Anxiety, a T-score of 60 is one SD worse than average. By comparison, an Anxiety T-score of 40 is one SD better than average" (NIH, 2007).

PROMIS Bank v1.0 – Pain Behavior

The PROMIS Pain Behavior Scale is comprised of 39 items that assess self-reported external manifestations of pain (NIH, 2007). This includes behaviors that typically indicate to

others that an individual is experiencing pain, categorized as: actions or reactions; verbal or nonverbal; and involuntary or deliberate. These include observable displays (e.g., sighing, crying), pain severity behaviors (e.g., resting, facial expressions, asking for help), and verbal reports of pain (NIH, 2007). In a sample of 15,528 respondents in the general population and 967 individuals with different types of chronic pain, this measure was found to have good evidence supporting unidimensionality and model fit as well as good construct validity (Cook et al., 2013).

PROMIS Bank v1.0 – Pain Interference

The PROMIS Pain Interference Scale consists of 41 items that assess self-reported consequences of pain on relevant aspects of one's life (NIH, 2007). This includes the extent to which pain interferes with physical, mental, and social activities. The scale assesses pain interference over the past seven days and also incorporates items probing sleep and enjoyment in life (NIH, 2007). In a sample of 14,848 participants from large community and clinical populations, the measure provided substantial information across levels of pain. Correlations with other health outcomes supported the construct validity of the measure and, for scores in the T-score range of 50-80, the reliability was equivalent to 0.96 to 0.99. (Amtmann et al., 2010).

PROMIS Bank v1.0 – Physical Function

The PROMIS Physical Function Scale contains 124 items that assess self-reported capability—rather than actual performance—of physical activities (NIH, 2007). This

includes the functioning of upper extremities (e.g., dexterity), lower extremities (e.g., mobility), and central regions (e.g., neck, back), as well as instrumental activities of daily living, such as running errands. In a study of 1,607 patients with back or leg pain, the scale demonstrated excellent item reliability (r = 0.99) and good construct validity when correlating physical function scores with other clinical and patient-reported outcome measures (Brodke et al, 2017).

PROMIS Bank v1.0 – Anxiety

The PROMIS Anxiety Scale consists of 29 items that assess self-reported fear (e.g., fearfulness, panic), anxious misery (e.g., worry, dread), hyperarousal (e.g., tension, nervousness, restlessness), and somatic symptoms related to arousal (e.g., racing heart, dizziness) (NIH, 2007). The scale was designed to capture the symptoms that best differentiate anxiety, such as symptoms that reflect autonomic arousal and the experience of threat (NIH, 2007). In a sample of 14,836 participants with a variety of health-related conditions, Cronbach's alpha internal consistency reliability estimate was 0.97 and adjusted item-total correlations ranged from 0.61 to 0.88 (Choi, Schalet, Cooke, & Cella, 2014). To look at convergent and discriminant validity, the general distress scale from the Mood and Anxiety Symptom Questionnaire (MASQ) was used as the convergent measure (r = 0.80) and the Center for Epidemiologic Studies Depression Scale (CES-D) was used as the divergent measure (r = 0.75) (Pilkonis et al., 2011).

PROMIS Bank v1.0 – Depression

The PROMIS Depression Scale is a 28-item measure designed to assess self-reported negative mood (e.g., sadness, guilt), views of self (e.g., self- criticism, worthlessness), and social cognition (e.g., loneliness, interpersonal alienation), as well as decreased positive affect and engagement (e.g., loss of interest, meaning, and purpose) (NIH, 2007). The scale does not account for the full range of symptoms commonly associated with Major Depressive Disorder, as somatic symptoms were excluded based on psychometric properties and poor fit of these items compared to other items in the scale (NIH, 2007). In a sample of 14,839 participants with a variety of health-related conditions, the internal consistency of the scale was excellent with a Cronbach's alpha of 0.95. To look at convergent and discriminant validity, the CES-D was used as the convergent measure ($r = 0.83$) and the general distress scale from the MASQ was used as the divergent measure ($r = 0.72$) (Pilkonis et al., 2011).

PROMIS Bank v1.0 – Applied Cognition General Concerns

The PROMIS Applied Cognition General Concerns Scale consists of 34 items that assess perceived cognitive functioning. The measure covers multiple aspects of cognition, such as attention and concentration, memory, fluency, and general mental clarity (NIH, 2007). Conceptually, the scale seeks to determine the degree to which compromised cognitive function disrupts an individual's ability to complete activities of daily living. In a sample of 148 adult medical outpatients, the scale demonstrated high internal consistency (Cronbach alpha = 0.98) and was moderately correlated with self-reported depressive

symptoms, self-efficacy, barriers to health promotion, health, and functional status (all correlation coefficients > 0.35) (Saffer et al., 2015).

PROMIS Bank v1.0 – Sleep-Related Impairment

The PROMIS Sleep-Related Impairment Scale is a 16-item measure designed to assess self-reported perceptions of alertness, sleepiness, and tiredness during usual waking hours as well as perceived functional impairments associated with sleep problems or impaired alertness (NIH, 2007). The scale does not directly assess cognitive, affective, or performance impairment; however, it assesses alertness and function within the context of overall sleep-wake function (NIH, 2007). In a sample of 21,133 participants in the general population, the Cronbach's alpha internal consistency reliability estimate was 0.95 and the adjusted item-total correlations ranged from 0.56 to 0.85. Construct validity was supported by moderate to strong correlations with widely accepted measures. (Cella et al., 2010).

PROCEDURE

Participants include adult outpatients who initiated (i.e., attended at least one session of) the interdisciplinary pain management program at EMCPM. During a participant's initial visit, study personnel informed the participant regarding the purpose and terms of the research study—including that participation was voluntary—and answered any participant questions. Study personnel obtained written consent from the participant, with each participant completing a Health Insurance Portability and Accountability Act (HIPAA) release form and a UTSW IRB Informed Consent form.

Study personnel provided the participant with an explanation of the nature of Computerized Adaptive Testing (CAT), as well as with a description of the NIH resource "Assessment Center" through which the study measures were administered. Using EMPCM laptop computers, study personnel assigned each participant a unique log-in and patient identification (PID) number, which the participant used to access the Assessment Center database. After reviewing instructions regarding how to complete the measures, study personnel informed participants that they could request help at the nurse station located down the hallway from the testing site and take breaks as needed. Study personnel were accessible to answer any additional questions or troubleshoot any computer-related problems.

Study participants were asked to complete a series of measures that included questions regarding the participant's treatment history for pain (including medication), participant's perception of pain, impact on daily functioning, and ability to complete basic activities, as well as any impact on the participant's cognitive, psychological, and social functioning. The measures included in this study are as follows: Pain Medication Questionnaire, Life Orientation Test-Revised, Medical Outcomes Study 36-Item Short Form Survey, Pain Catastrophizing Scale, Fear-Avoidance Beliefs Questionnaire, PROMIS Bank v1.0 - Pain Behavior, PROMIS Bank v1.0 - Pain Interference, PROMIS Bank v1.0 - Physical Function, PROMIS Bank v1.0 – Anxiety, PROMIS Bank v1.0 – Depression, PROMIS Bank v1.0 – Applied Cognition General Concerns, PROMIS Bank v1.0 – Sleep-related Impairment. Participants accessed and completed the assessment measures online via Assessment Center. Hard copies of the measures were also available for participants who were unable to complete them on the computer.

At mid- and post-treatment—approximately two and four weeks, respectively, after initiating the program—study personnel met with participants either prior to, or immediately following, their appointment with an EMPCM provider. Each participant was assigned a new log-in and password for the testing sessions (which corresponded to the patient's original PID) on Assessment Center. After offering to answer any additional questions, participants completed the same set of measures administered during their initial testing appointment.

HYPOTHESES

This study contained two primary aims. The first aim was to evaluate the extent to which the following five domains would predict non/completion for adults consenting to an interdisciplinary pain management program: 1) selected demographic variables, 2) number of medical diagnoses [psychiatric and non-psychiatric], 3) opioid use/risk of misuse, 4) pain-related cognition and behavior, and 5) physical, social, and mental well-being. Using baseline data, logistic regression analyses were conducted for the five domains separately, then predictors with $p < 0.15$ from each of the five domains were integrated into a final multivariable logistic regression model to test the primary hypotheses.

An intention to treat sample (including non/completers) included all participants who attended the first program day of the interdisciplinary pain program between 2012 – 2015. Non-completers were defined as participants who did not attend at least 6 of 8 program days of the interdisciplinary program and/or discontinued any component of treatment—physical therapy, individual therapy, or group therapy—prior to program completion (i.e., patients were theoretically no longer receiving interdisciplinary treatment at that point).

Hypothesis 1.a) Selected demographic variables will predict attrition. Specifically, age, sex, education, marital status, and employment status would serve as predictor variables. Age and education were defined in years. Sex was classified as "male" or "female" according to their electronic medical record. Employment status was defined as "employed" if working full-time or part-time, "unemployed", "retired," or "student." Marital status was defined as "partnered" if married or cohabiting, while all other participants were classified as "unpartnered."

It was hypothesized that participants identified as young, male, low education, unpartnered status, and employed status would have higher odds of dropping out of the program. A logistic regression was conducted using all of the selected demographic variables in order to assess whether any of the factors predicted attrition.

Hypothesis 1.b) An increasing number of medical diagnoses [psychiatric and non-psychiatric] will predict attrition. At baseline, the medical diagnoses were obtained from the participant's electronic medical records and tallied for a numerical total. It was hypothesized that the odds of dropping out of the program would be increased if an increasing number of medical diagnoses were present.

Hypothesis 1.c) Risk of opioid misuse and opioid use at the start of treatment will predict attrition. The sample included both opioid-using and opioid-naïve patients. Opioid use was classified as "yes" if a patient started the program with opioid medication use or

"no" if a patient did not start the program with opioid medication use. This variable captured present use only, and not a history of previous opioid use. It was hypothesized that patients at a higher risk for opioid medication misuse as measured by the PMQ and/or who started the program with opioid use would have higher odds of dropping out of the program. A logistic regression was conducted to assess whether scores on the PMQ and opioid use at the start of treatment predicted attrition.

Hypothesis 1.d) Pain-related cognition and behavior will predict attrition. It was hypothesized that patients with higher levels of 1) pain-related catastrophic thinking as measured by the PCS, 2) fear-avoidance beliefs as measured by the FABQ, 3) external manifestations of pain as measured by the PROMIS Pain Behavior Scale, and 4) perceived pain interference with physical, mental, and social activities as measured by the PROMIS Pain Interference Scale, would have higher odds of dropping out of the program. A logistic regression was conducted to assess whether patient scores on the PCS, FABQ, PROMIS Pain Behavior, and PROMIS Pain Interference Scales predicted attrition.

Hypothesis 1.e) Physical, social, and mental well-being will predict attrition. It was hypothesized that patients with 1) lower perceived quality of life as measured by the SF-36, 2) lower levels of dispositional optimism as measured by the LOT-R, and 3) lower perceived physical capability as measured by the PROMIS Physical Function Scale would be would have higher odds of dropping out of the program. It was also hypothesized that patients with 1) higher levels of anxiety as measured by the PROMIS Anxiety Scale, 2) higher levels of

depression as measured by the PROMIS Depression Scale, 3) higher levels of cognitive concerns as measured by the PROMIS Applied Cognition General Concerns, and 4) higher levels of sleep-related concerns as measured by the PROMIS Sleep-Related Impairment Scale would have higher odds of dropping out of the program. A logistic regression was conducted to assess whether patient scores on the SF-36, LOT-R, PROMIS Physical Function, PROMIS Anxiety, PROMIS Depression, PROMIS Applied Cognition General Concerns, and PROMIS Sleep-Related Impairment Scales predicted attrition.

As mentioned above, logistic regression analyses were conducted for each of the five domains separately, then all predictors with $p<0.15$ from the domains were integrated in a final multivariable logistic regression model to test the primary hypotheses.

The second aim of this study was to examine the change in scores for the completion group using mixed models analyses across at least two time points (i.e., baseline with either midpoint and/or endpoint test scores). The data set included scores from the pain-related cognition and behavior domain (i.e., PROMIS Pain Behavior and PROMIS Pain Interference Scales) as well as scores from the physical, social, and mental well-being domain (i.e., LOT-R, PROMIS Physical Function, PROMIS Anxiety, PROMIS Depression, and PROMIS Sleep-Related Impairment Scales).

Hypothesis 2.a) Participants in the completion group are expected to improve in the pain-related cognition and behavior domain over time. This was measured by examining the longitudinal changes in score on the PROMIS Pain Behavior and Pain Interference Scales. Mixed models analyses with at least two time points for each patient (i.e., baseline with

either midpoint and/or endpoint test scores) was used to examine change for each measure listed above, with additional post hoc analysis, if appropriate.

Hypothesis 2.b) Participants in the completion group are expected to improve in the physical, social, and mental well-being domain over time. This was measured by examining the longitudinal change in score on the LOT-R, PROMIS Physical Function, PROMIS Anxiety, PROMIS Depression, and PROMIS Sleep-Related Impairment Scales. Mixed models analyses with at least two time points for each patient (i.e., baseline with either midpoint and/or endpoint test scores) was used to examine change for each measure listed above, with additional post hoc analysis, if appropriate.

STATISTICAL ANALYSIS PLAN

Analyses pertaining to this study were conducted using IBM SPSS v26 and PROC MIXED in SAS v9.4. This study used 1) logistic regression analyses to identify the variables most predictive of attrition and 2) mixed models analyses to examine changes in score on a variety of clinical measures over time for the completion group.

For the first aim, the assumptions of logistic regression were evaluated prior to analyses. To test for linearity in the logit, the Box-Tidwell procedure, which adds an interaction term between continuous independent variables and their natural logs to the regression equation, was used. If the interaction term was statistically significant, the independent variable did not meet the assumption of linearity. Tabachnick and Fidell (2014) recommend an alternative approach of applying a Bonferroni correction to the alpha level based on all terms in the model when assessing the linearity assumption. To calculate the new p-value, the alpha level $\alpha = .05$ was divided by the number of terms in the model. If the assumption was not met after a Bonferroni correction, variables were transformed to the ordinal level and included in the model.

To detect for multicollinearity (i.e., whether two or more of the predictors in a model are highly correlated), correlation coefficients and Tolerance/VIF values were examined. Cases with VIF values above 10 and tolerance statistics below 0.2 were examined for collinearity within the data. To detect significant outliers, casewise diagnostics were checked. Cases with studentized residual values greater than 2.5 were examined to determine the reasons cases were outliers and to remove them from the analysis, if necessary.

After checking the assumptions, logistic regression analyses were conducted separately for each of the five domains in Hypothesis 1.a) selected demographic variables; Hypothesis 1.b) number of medical diagnoses [psychiatric and non-psychiatric]; Hypothesis 1.c) opioid use/risk of misuse; Hypothesis 1.d) pain-related cognition and behavior; and Hypothesis 1.e) physical, social, and mental well-being. All significant predictors ($p < .15$) from the five domains were then integrated in a final multivariable logistic regression model to test the primary hypotheses. Effect sizes were reported in terms of odds ratios.

For the second aim, mixed models analyses were used to examine longitudinal changes in score for the completion group. Since the attrition rate in this study was relatively high (34%), this approach is considered to be flexible and robust with respect to handling missing data. Using observed scores in the full, incomplete dataset, maximum likelihood estimation (MLE) can estimate the curve that best fits the data. Although an assumption of MLE is that values are missing-at-random (MAR)—which is not the case with non-completers as midpoint/endpoint measures are not MAR—Mallinckrodt, Kaiser, Watkin, Molenberghs, and Carroll (2004) suggest that a minor violation of this assumption can still provide a good estimate of values.

With the mixed model analyses, three covariance structures—compound symmetry, autoregressive, and unstructured—were compared. The selection of results for interpretation was based on the smallest Akaike Information Criterion (AIC). In a compound symmetry structure, variances across conditions are assumed to be equal and covariances between pairs of conditions are also assumed to be equal. In an autoregressive structure, the relationship between variances change in a systematic way and correlations between repeated

measurements are assumed to be the strongest at adjacent time points. With an unstructured covariance structure, covariances do not conform to a systematic pattern and correlations are assumed to be random (Fields, 2009).

In total, two mixed models analyses were conducted for each measure. The first analysis examined main effects of time for the completion group. The second analysis was conducted to examine main and interaction effects of time x group for the completion (n = 118) and non-completion (n = 7) groups. Since the sample size for the non-completion group was small and would likely lead to biased findings, a conservative approach was used for the second analysis, and only for exploratory purposes. If the interaction was not significant, the analysis was conducted again without the interaction. Post-hoc power analyses were conducted using the software package, NCSS (Hintz, 2013). Effect sizes were reported using Cohen's d and 95% confidence intervals (CI).

CHAPTER FOUR

RESULTS

Sample Disposition

The sample for the current study consisted of 178 participants. The participants included patients who attended at least the first program day of the interdisciplinary pain program. Non-completers were defined as participants who did not attend at least 6 of 8 program days and/or discontinued any component of treatment—physical therapy, individual therapy, or group therapy—prior to program completion. Demographic information for the sample was obtained as part of participants' completion of baseline testing. Baseline characteristics were compared between the two groups (completers versus non-completers) using independent samples t-tests or Mann-Whitney U test and chi-square or Fishers Exact tests, as appropriate. There were no significant differences for age, sex, education, marital status, race, and ethnicity between completers and non-completers. Table 1 provides a more detailed breakdown of sample demographics.

Across the sample, there were significant differences in proportions between completers and non-completers for the measure, employment status. Results from chi-square tests revealed that group x employment status was not independent, $\chi^2(3) = 12.94$, $p = .01$. Post hoc analyses compared the proportions using a Tukey-type multiple comparison test (Dunn method). There were significant differences between the Employed vs Unemployed groups, $Q = 4.45$, $p < .05$, and the Retired vs Unemployed groups $Q = 3.75$, $p < .05$.

Observed frequencies and percentages of employment groups for completers and non-completers are presented in Table 1.

Statistical Analyses

Research Question 1.a) Do selected demographic variables serve as predictors of attrition in an interdisciplinary pain program?

Hypothesis 1.a) Selected demographic variables will predict attrition.

Specifically, age, sex, education, marital status, and employment status will serve as predictor variables. It was hypothesized that participants identified as young, male, having low education, unpartnered status, and employed status would have higher odds of dropping out of the program.

A logistic regression was performed to predict program completion using baselines demographic variables (i.e., age, sex, education, marital status, and employment). Linearity of the logit for the continuous variables (i.e., age and education) was assessed via the Box-Tidwell procedure, and age did not meet the assumption. Using the Bonferroni correction method (Tabachnick & Fidell, 2014), all continuous independent variables were found to be linearly related to the logit. No cases were found to have VIF values above 10, tolerance statistics below 0.2, or studentized residual values greater than 2.5.

The preliminary logistic regression model was statistically significant, $\chi^2(7) = 26.61$, $p = .001$. The variance accounted for was small, with Cox and Snell R^2 equal to .13 and Nagelkerke R^2 equal to .18. Preliminary analysis resulted in two significant predictors, age and employment.

The final model conducted with the predictors from the domain with $p < .05$ (i.e., age and employment) was statistically significant, $\chi^2(4) = 20.23$, $p < .001$. The variance accounted for was small, with Cox and Snell R^2 equal to .11 and Nagelkerke R^2 equal to .15. The Hosmer-Lemeshow Test was not significant, $\chi^2(8) = 6.91$, $p > .40$, indicating that the model was a good fit. Both variables, age and employment status, were statistically significant. For age, the odds of dropping out of the program was .96 times greater for every one-year decrease in age. For employment status, the odds of dropping out of the program was 3.13 times greater for unemployed participants. See Table 2 for the regression coefficients, Wald statistics, statistical significances, odds ratios, and 95% CI for each of the five predictors.

Research Question 1.b) Does the number of medical diagnoses [psychiatric and non-psychiatric] serve as a predictor of attrition in an interdisciplinary pain program?

Hypothesis 1.b) An increasing number of medical diagnoses [psychiatric and non-psychiatric] will predict attrition.

At baseline, the medical diagnoses were obtained from the participant's electronic medical records and tallied for a numerical total. It was hypothesized that the odds of dropping out of the program would be increased if an increasing number of medical diagnoses were present.

Since the number of medical diagnoses has not been widely used as a variable in other studies and because there was uncertainty about the significance of a diagnosis count as a variable, a Spearman correlation was used to determine the strength and direction of the

linear relationship between the number of medical diagnoses and the Physical Component Summary (PCS) score of the SF-36. Preliminary analyses showed the relationship to be linear with both variables approximately normally distributed, as assessed by visual inspection of the histograms and Q-Q Plots. There was a statistically significant, small negative correlation between the number of medical diagnoses and the PCS score of the SF-36, $r_s(176) = -.23$, $p < .01$. As PCS scores decreased, the number of medical diagnoses increased.

Next, a logistic regression was performed to predict program completion using the number of medical diagnoses. Linearity of the continuous variable was assessed via the Box-Tidwell procedure and found to be linearly related to the logit of the dependent variable. No cases were found to have VIF values above 10, tolerance statistics below 0.2, or studentized residual values greater than 2.5. The logistic regression model was not statistically significant, $\chi^2(1) = .05$, $p > .05$. There was no variance accounted for in this model, with Cox and Snell R^2 equal to 0 and Nagelkerke R^2 equal to 0. Preliminary analysis did not demonstrate the number of medical diagnoses as a significant predictor. Table 3 provides the results.

Research Question 1.c) Does the risk of opioid misuse and opioid use at the start of treatment serve as predictors of attrition in an interdisciplinary pain program?

Hypothesis 1.c) Risk of opioid misuse, as measured by the PMQ, and opioid use at the start of treatment will predict attrition.

Opioid use was classified as “yes” if a patient was on opioid medication pre-intervention or “no” if a patient was not on opioid medication pre-intervention. It was hypothesized that patients with higher scores on the PMQ and who started the program with opioid use would have higher odds of dropping out of the program.

A logistic regression was performed to predict program completion using PMQ scores and opioid use at the start of treatment. Linearity of the logit for the continuous variable (i.e., PMQ score) was assessed via the Box-Tidwell procedure and found to be linearly related to the logit. No cases were found to have VIF values above 10, tolerance statistics below 0.2, or studentized residual values greater than 2.5.

The preliminary logistic regression model using PMQ scores and opioid use at the start of treatment was statistically significant, $\chi^2(2) = 14.94$, $p = .001$. The variance accounted for is very small, with Cox and Snell R^2 equal to .08 and Nagelkerke R^2 equal to .11. Preliminary analysis resulted in one significant predictor, opioid use at the start of treatment.

The final model conducted with the predictor from the domain with $p < .05$ (i.e., opioid use at the start of treatment) was statistically significant, $\chi^2(1) = 12.70$, $p < .001$. The variance accounted for was small, with Cox and Snell R^2 equal to .07 and Nagelkerke R^2 equal to .10. Since there was only one categorical predictor in the model, the Hosmer-Lemeshow Test is not applicable. The odds ratio indicated that there was a .18 greater chance of dropping out of the program for participants who did not start the program on opioids. See Table 4 for the regression coefficient, Wald statistic, statistical significance, and odds ratio for the predictors.

Research Question 1.d) Does pain-related cognition and behavior serve as predictors of attrition in an interdisciplinary pain program?

Hypothesis 1.d) Pain-related cognition and behavior will predict attrition.

It was hypothesized that patients with higher levels of 1) pain-related catastrophic thinking as measured by the PCS, 2) fear-avoidance beliefs as measured by the FABQ, 3) external manifestations of pain as measured by the PROMIS Pain Behavior Scale, and 4) perceived pain interference with physical, mental, and social activities as measured by the PROMIS Pain Interference Scale, would have higher odds of dropping out of the program.

A logistic regression was performed to predict program completion using pain-related cognition and behavior. Linearity of the logit for the continuous variables (i.e., PCS, FABQ, PROMIS Pain Behavior, Pain Interference) was assessed via the Box-Tidwell procedure and found to be linearly related to the logit. No cases were found to have VIF values above 10, tolerance statistics below 0.2, or studentized residual values greater than 2.5. The logistic regression model was not statistically significant, $\chi^2(4) = 5.97$, $p > .05$. The variance accounted for was very small, with Cox and Snell R^2 equal to .03 and Nagelkerke R^2 equal to .05. Preliminary analysis did not result in any significant predictors in the model. Table 5 provides the results.

Research Question 1.e) Does physical, social, and mental well-being serve as predictors of attrition in an interdisciplinary pain program?

Hypothesis 1.e) Physical, social, and mental well-being will predict attrition.

It was hypothesized that patients with 1) lower perceived quality of life as measured by the SF-36, 2) lower levels of dispositional optimism as measured by the LOT-R, and 3) lower perceived physical capability as measured by the PROMIS Physical Function Scale would have higher odds of dropping out of the program. It was also hypothesized that patients with 1) higher levels of anxiety as measured by the PROMIS Anxiety Scale, 2) higher levels of depression as measured by the PROMIS Depression Scale, 3) higher levels of cognitive concerns as measured by the PROMIS Applied Cognition General Concerns, and 4) higher levels of sleep-related concerns as measured by the PROMIS Sleep-Related Impairment Scale would have higher odds of dropping out of the program.

A logistic regression was performed to predict program completion using physical, social, and mental well-being. Linearity of the logit for the continuous variables (i.e., SF-36 PCS/MCS, LOT-R, PROMIS Physical Function, Anxiety, Depression, Cognitive Concerns, Sleep Impairment) was assessed via the Box-Tidwell procedure, and SF-36 PCS did not meet the assumption. Using the Bonferroni correction method (Tabachnick & Fidell, 2014), all continuous independent variables were found to be linearly related to the logit. No cases were found to have VIF values above 10, tolerance statistics below 0.2, or studentized residual values greater than 2.5. The logistic regression model was not statistically significant, $\chi^2(8) = 6.49$, $p > .05$. The variance accounted for was very small, with Cox and Snell R^2 equal to .04 and Nagelkerke R^2 equal to .06. None of the predictors in this model were significant. Table 6 provides the results.

Research Question 1)

Finally, all significant predictors ($p < .15$) from the five domains (i.e., age, sex, marital status, employment status, and opioid use at start of treatment) were then integrated in a multivariable logistic regression model to test the primary hypotheses. The preliminary model was statistically significant, $\chi^2(7) = 33.85$, $p < .001$. Preliminary analysis resulted in three significant predictors—age, employment, and opioid use at start of treatment.

The final model conducted with the three predictors from the domain with $p < .05$ was statistically significant, $\chi^2(5) = 30.75$, $p < .001$. The variance accounted for was small to moderate, with Cox and Snell R^2 equal to .16 and Nagelkerke R^2 equal to .22. The Hosmer-Lemeshow Test was not significant, $\chi^2(8) = 5.47$, $p > .40$, indicating that the model was a good fit. For age, the odds of dropping out of the program was .96 times greater for every one-year decrease in age. For employment status, the odds of dropping out of the program was 2.78 times greater for unemployed participants. Lastly, there was a .20 greater chance of dropping out of the program for participants who did not start the program on opioids. See Table 7 for the regression coefficients, Wald statistics, statistical significances, odds ratios, and 95% CI for all three predictors.

Prior to conducting analyses for Hypothesis 2, baseline scores were compared between the two groups (completers versus non-completers) using independent samples t-tests or Mann-Whitney U test, as appropriate. There were no significant differences for any of the measures in the opioid use domain; pain-related cognition and behavior domain; and the physical, social, and mental well-being domain. Table 8 provides a more detailed breakdown of the comparison of the baseline scores for non/completers.

Research Question 2.a) Do participants in the completion group collectively demonstrate improvement in the pain-related cognition and behavior domain over time?

Hypothesis 2.a) Participants in the completion group are expected to improve in the pain-related cognition and behavior domain over time. This was measured by examining the longitudinal changes in score on the PROMIS Pain Behavior and Pain Interference Scales when comparing participants' baseline test scores.

Analyses for the PROMIS Pain Behavior Scale

In the mixed model analysis examining the completion group only, an unstructured covariance structure fit the data best. Results showed that PROMIS Pain Behavior scores for the completion group decreased from a T-score of 59.52 ± 4.19 (95% CI, 58.76 to 60.29) pre-intervention to 59.33 ± 5.00 (95% CI, 58.42 to 60.24) two weeks into the intervention to 58.29 ± 5.62 (95% CI, 57.27 to 59.32) post-intervention. The scores were significantly different across time points during the program, $F(2, 117) = 3.72$, $p = .03$. Post hoc analysis with a Bonferroni adjustment revealed that the difference in group means was significantly different from pre-intervention to post-intervention (T-score of 1.23 (95% CI, .08 to 2.38), $p = .03$). A sample size of 86 was sufficient to detect a medium effect size ($d = .40$). Table 8 provides the results.

In the preliminary mixed model analysis examining completers versus non-completers, an unstructured covariance structure fit the data best. There was no significant difference for the group x time interaction, group, and time (all p-values > .05). Effect sizes were very small with Cohen's $d = .07$, .09, and .03, respectively. With the interaction

removed, an unstructured covariance structure still fit the data best. There was no significant difference in the final model between completers and non-completers (see Figure 1). However, there was a significant change in scores over time, $F(2, 123) = 3.13$, $p = .047$ (as shown in Table 9).

Analyses for the PROMIS Pain Interference Scale

In the mixed model analysis examining the completion group only, an unstructured covariance structure was used. Results showed that PROMIS Pain Interference scores for the completion group decreased from a T-score of 64.94 ± 6.03 (95% CI, 63.84 to 66.04) pre-intervention to 63.22 ± 7.42 (95% CI, 61.86 to 64.57) two weeks into the intervention to 61.61 ± 7.95 (95% CI, 60.16 to 63.06) post-intervention. The scores were significantly different across time points during the program, $F(2, 117) = 11.61$, $p < .0001$. Post hoc analysis with a Bonferroni adjustment revealed that the difference in group means was significantly different from pre-intervention to two weeks (T-score of 1.72 (95% CI, .04 to 3.40), $p = .04$) and from pre-intervention to post-intervention (T-score of 3.32 (95% CI, 1.65 to 5.00), $p < .0001$). A sample size of 86 was sufficient to detect a medium effect size ($d = .64$). Table 8 provides the results.

In the preliminary mixed model analysis examining completers versus non-completers, an unstructured covariance structure fit the data best. There was no significant difference for group x time interaction, group, and time (all p-values > .05). Effect sizes were small with Cohen's $d = .14$, .06, and .11, respectively. With the interaction removed, an unstructured covariance structure still fit the data best. There was no significant difference in

the final model between completers and non-completers (see Figure 2). However, there was a significant change in scores over time, $F(2, 123) = 11.30$, $p < .0001$. Post hoc analyses demonstrated a mean difference of 3.12 ($p < .0001$) between pre-intervention to post-intervention mean T-scores on the PROMIS Pain Interference Scale (as shown in Table 9).

Research Question 2.b) Do participants in the completion group collectively demonstrate improvement in the physical, social, and mental well-being domain over time?

Hypothesis 2.b) Participants in the completion group are expected to improve in the physical, social, and mental well-being domain over time. This was measured by examining the longitudinal change in score on the LOT-R, PROMIS Physical Function, PROMIS Anxiety, PROMIS Depression, and PROMIS Sleep-Related Impairment Scales when comparing participants' baseline scores.

Analyses for the Life Orientation Test—Revised

In the mixed model analysis examining the completion group only, a compound symmetry covariance structure was used. Results showed that LOT-R scores for the completion group increased from a score of 14.53 ± 5.20 (95% CI, 13.61 to 15.45) pre-intervention to 14.94 ± 6.27 (95% CI, 13.83 to 16.05) two weeks into the intervention to 15.27 ± 5.63 (95% CI, 60.16 to 63.06) post-intervention. The scores were not significantly different across time points during the program, $F(2, 124) = 1.52$, $p > .05$. With a sample size of 86, a small effect size ($d = .17$) was detected. Table 10 provides the results.

In the preliminary mixed model analysis examining completers versus non-completers, a compound symmetry covariance structure fit the data best. There was no significant difference for group x time interaction, group, and time (all p-values > .05). Effect sizes were very small with Cohen's d = .02, .04, and .06, respectively. With the interaction removed, a compound symmetry covariance structure still fit the data best. There was also no significant difference in the final model for group and time (all p-values > .05). Refer to Table 11 for additional details.

Analyses for the PROMIS Physical Function Scale

In the mixed model analysis examining the completion group only, an autoregressive covariance structure was used. Results showed that PROMIS Physical Function scores for the completion group increased from a T-score of 35.98 ± 6.58 (95% CI, 34.86 to 37.10) pre-intervention to 36.59 ± 7.71 (95% CI, 35.28 to 37.90) two weeks into the intervention to 37.60 ± 7.26 (95% CI, 36.37 to 38.83) post-intervention. The scores were significantly different across time points during the program, $F(2, 135) = 4.38$, $p = .01$. Post hoc analysis with a Bonferroni adjustment revealed that the difference in group means was significant difference from pre-intervention to post-intervention (T-score of -1.62 (95% CI, -2.95 to -.28), $p = .01$). A sample size of 86 was sufficient to detect a small effect size ($d = .35$). Table 10 provides the results.

In the preliminary mixed model analysis examining completers versus non-completers, an autoregressive covariance structure fit the data best. Although the group x time interaction was not significant, there was a small effect ($p = .08$) with a Cohen's $d = .15$.

Group and time were not significant (all p-values > .05). Effect sizes were small with Cohen's d = .12 and .08, respectively. With the interaction removed, an autoregressive covariance structure still fit the data best. There was no significant difference in the final model between completers and non-completers (see Figure 3). However, there was a significant change in scores over time, $F(2, 143) = 93.10$, $p = .048$. Post hoc analyses demonstrated a mean difference of -1.35 ($p = .04$) between pre-intervention to post-intervention mean T-scores on the PROMIS Pain Function Scale (as shown in Table 11).

Analyses for the PROMIS Anxiety Scale

In the mixed model analysis examining the completion group only, an unstructured covariance structure was used. Results showed that PROMIS Anxiety scores for the completion group initially increased from a T-score of 56.47 ± 7.33 (95% CI, 55.03 to 57.92) pre-intervention to 58.34 ± 8.33 (95% CI, 56.82 to 59.86) two weeks into the intervention, but decreased to 54.87 ± 8.45 (95% CI, 53.33 to 56.41) post-intervention. The scores were significantly different across time points during the program, $F(2, 117) = 12.47$, $p < .0001$. Post hoc analysis with a Bonferroni adjustment revealed that the difference in group means was statistically significantly different from two weeks to post-intervention (T-score of 3.47 (95% CI, 1.78 to 5.16), $p < .0001$). A sample size of 86 was sufficient to detect a medium effect size (d = .39). Table 10 provides the results.

In the preliminary mixed model analysis examining completers versus non-completers, an unstructured covariance structure fit the data best. The group x time interaction, group, and time were not significant (all p-values > .05). Effect sizes were very

small with Cohen's d = .05, .08, and .15, respectively. With the interaction removed, an autoregressive covariance structure fit the data best. There was no significant difference in the final model between completers and non-completers (see Figure 4). However, there was a significant change in scores over time, $F(2, 144) = 9.59$, $p = .0001$. Post hoc analyses demonstrated a mean difference of -1.91 ($p = .03$) between pre-intervention to mid-intervention and a mean difference of 3.26 ($p < .0001$) between mid-intervention to post-intervention mean T-scores on the PROMIS Anxiety Scale (as shown in Table 11).

Analyses for the PROMIS Depression Scale

In the mixed model analysis examining the completion group only, a compound symmetry covariance structure was used. Results showed that PROMIS Depression scores for the completion group decreased from a T-score of 54.73 ± 9.36 (95% CI, 53.15 to 56.31) pre-intervention to 53.68 ± 11.65 (95% CI, 51.71 to 55.65) two weeks into the intervention to 52.70 ± 10.44 (95% CI, 50.93 to 54.46) post-intervention. The scores were significantly different across time points during the program, $F(2, 136) = 3.25$, $p = .04$. Post hoc analysis with a Bonferroni adjustment revealed that the difference in group means was statistically significantly different from pre-intervention to post-intervention (T-score of 2.04 (95% CI, .10 to 3.98), $p = .04$). A sample size of 86 was sufficient to detect a small effect size ($d = .34$). Table 10 provides the results.

In the preliminary mixed model analysis examining completers versus non-completers, a compound symmetry covariance structure fit the data best. The group x time interaction, group, and time were not significant (all p-values > .05). Effect sizes were very

small with Cohen's d = .07, .11, and .05, respectively. With the interaction removed, a compound symmetry covariance structure still fit the data best. There was no significant difference in the final model between completers and non-completers (see Figure 5). However, there was a significant change in scores over time, $F(2, 144) = 3.19$, $p = .04$. Post hoc analyses demonstrated a mean difference of 1.91 ($p = .04$) between pre-intervention to post-intervention mean T-scores on the PROMIS Depression Scale (as shown in Table 11).

Analyses for the PROMIS Sleep-Related Impairment Scale

In the mixed model analysis examining the completion group only, an autoregressive covariance structure was used. Results showed that PROMIS Sleep-Related Impairment scores for the completion group initially increased from a T-score of 58.26 ± 9.42 (95% CI, 56.64 to 59.87) pre-intervention to 58.89 ± 10.98 (95% CI, 57.01 to 60.77) two weeks into the intervention, but decreased to 55.77 ± 10.36 (95% CI, 53.99 to 57.54) post-intervention. The scores were significantly different across time points during the program, $F(2, 132) = 8.71$, $p < .0005$. Post hoc analysis with a Bonferroni adjustment revealed that the difference in group means was statistically significantly different from pre-intervention to post-intervention (T-score of 2.49 (95% CI, .53 to 4.45), $p < .01$) and from two weeks to post-intervention (T-score of 3.12 (95% CI, 1.25 to 4.99), $p < .0005$). A sample size of 86 was sufficient to detect a medium effect size ($d = .41$). Table 10 provides the results.

In the preliminary mixed model analysis examining completers versus non-completers, an autoregressive covariance structure fit the data best. The group x time interaction, group, and time were not significant (all p-values > .05). Effect sizes were very

small with Cohen's d = .16, .01, and .03, respectively. With the interaction removed, an autoregressive covariance structure still fit the data best. There was no significant difference in the final model between completers and non-completers (see Figure 6). However, there was a significant change in scores over time, $F(2, 140) = 7.12$, $p = .001$. Post hoc analyses demonstrated a mean difference of 2.25 ($p = .02$) between pre-intervention to post-intervention and a mean difference of 2.80 ($p = .001$) between mid-intervention to post-intervention mean T-scores on the PROMIS Sleep-Related Impairment Scale (as shown in Table 11).

Summary of Statistical Analyses

Research Question 1.a) Did selected demographic variables serve as predictors of attrition in an interdisciplinary pain program?

Participants who were of younger age (OR: .96 ; 95%CI: .93, .99) and participants who were unemployed (OR: 3.13; 95%CI: 1.45, 6.67) had higher odds of dropping out. Sex, education, and marital status were non-significant predictors in the model ($p > .05$).

Research Question 1.b) Did the number of medical diagnoses [psychiatric and non-psychiatric] serve as a predictor of attrition in an interdisciplinary pain program?

The number of medical diagnoses was a non-significant predictor ($p > .05$).

Research Question 1.c) Did the risk of opioid misuse and opioid use at the start of treatment serve as predictors of attrition in an interdisciplinary pain program?

Participants who were not on opioids pre-intervention (OR: .18; 95%CI: .06, .55) had higher odds of dropping out, whereas higher scores on the PMQ was a non-significant predictor ($p > .05$).

Research Question 1.d) Did pain-related cognition and behavior serve as predictors of attrition in an interdisciplinary pain program?

Higher scores on the PCS, FABQ, PROMIS Pain Behavior Scale, and PROMIS Pain Interference Scale were non-significant predictors ($p > .05$).

Research Question 1.e) Did physical, social, and mental well-being serve as predictors of attrition in an interdisciplinary pain program?

Lower scores on the SF-36, LOT-R, and PROMIS Physical Function Scale were non-significant predictors ($p > .05$). Higher scores on the PROMIS Anxiety Scale, PROMIS Depression Scale, PROMIS Applied Cognition General Concerns, and PROMIS Sleep-Related Impairment Scale were also non-significant predictors ($p > .05$).

Research Question 1)

In the final multivariable logistic regression analysis model, age, employment status, and opioid use at start of treatment were significant predictors. Participants who were of younger age (OR: .96 ; 95% CI: .93, .99) and participants who were unemployed (OR: 2.78; 95% CI: 1.28, 5.88) had higher odds of dropping out. Participants who were not on opioids pre-intervention (OR: .20; 95% CI: .06, .61) had higher odds of dropping out.

Research Question 2.a) Did participants in the completion group collectively demonstrate improvement in the pain-related cognition and behavior domain over time?

PROMIS Pain Behavior scores were significantly different across time points during the program [$F(2, 117) = 3.72$, $p = .03$], specifically from pre- to post-intervention ($d = .40$). PROMIS Pain Interference scores were significantly different across time points during the program [$F(2, 117) = 11.61$, $p < .0001$], specifically from pre- to mid-intervention and from pre- to post-intervention ($d = .64$).

Research Question 2.b) Did participants in the completion group collectively demonstrate improvement in the physical, social, and mental well-being domain over time?

PROMIS Physical Function scores were significantly different across time points during the program [$F(2, 135) = 4.38$, $p = .01$], specifically from pre- to post-intervention ($d = .35$). PROMIS Anxiety scores were significantly different across time points during the program [$F(2, 117) = 12.47$, $p < .0001$], specifically from mid- to post-intervention ($d = .39$). PROMIS Depression scores were significantly different across time points during the program [$F(2, 136) = 3.25$, $p = .04$], specifically from pre- to post-intervention ($d = .34$). PROMIS Sleep-Related Impairment scores were significantly different across time points during the program [$F(2, 132) = 8.71$, $p < .0005$], specifically from pre- to post-intervention ($d = .41$). Only scores from one measure, the LOT-R, were not significantly different across time points during the program [$F(2, 124) = 1.52$, $p > .05$, $d = .17$].

CHAPTER FIVE

DISCUSSION

This retrospective study examined attrition rates in the Interdisciplinary Pain Management Program at The University of Texas Southwestern Medical Center. There were a total of 178 patients included in this intention-to-treat sample (i.e., all participants who attended the first program day of the interdisciplinary program between 2012 – 2015). Within this sample, 60 (34%) patients were identified as non-completers (i.e., participants who did not attend at least 6 of 8 program days of the interdisciplinary program and/or discontinued any component of treatment—physical therapy, individual therapy, or group therapy—prior to program completion). Previous studies have found reported attrition rates in pain management programs ranging from 4 to 70 percent (Turk & Rudy, 1990). Since therapy for pain management is similar to that of therapy for mental disorders, examining attrition rates in psychotherapy may also be useful. Recent literature on dropout in psychotherapy/cognitive therapy demonstrated dropout rates ranging from 19 to 22 percent (Fernandez et al., 2015), indicating attrition was somewhat higher in this study.

The main purpose of this study was to identify factors that may predict attrition in an interdisciplinary pain program. Previous studies suggest that factors such as ethnic minority status, opioid dependency, unpartnered status, and unemployment contribute to higher rates of attrition (Sloots et al., 2009; Howard et al., 2009; Bendix et al., 1998; Richmond et al., 1999). However, conflicting results were found for factors such as age, pre-treatment work status, pain intensity, and severity of disability (Bendix et al., 1998; Carosella et al., 1994; Coughlan et al., 1995; Kvaal et al., 1990; Sloots et al., 2009; Richmond et al., 1999).

In this study, some of the patterns above were confirmed. Specifically, in the demographic domain, age, sex, education, marital status, and employment status were evaluated; age and employment status were found to be significant predictors of attrition. According to the analyses, *younger age* and *unemployment* were factors that contributed to increased odds of dropping out of the program. The findings related to age are consistent with previous studies; six of the seven studies in the systematic review by Oosterhaven et al. (2019) investigating attrition in interdisciplinary pain programs also found younger age to be a significant predictor. Among non-completers, the mean age was 48.72 years (SD = 13.44) whereas among completers, the mean age was 55.60 (SD = 15.36). Refer to Figure 7 for additional details. Participants in the earlier stages in life may have more outside stressors (e.g., younger children, demanding jobs) compared to older participants, who may be close to retirement and have less obligations. This may help explain difficulties with program compliance since treatment consists of two program days per week (for four weeks).

Conflicting results were found for previous studies examining employment status as a predictor of attrition; unemployment was retained as a significant predictor by Howard and colleagues (2009) but results were not significant in a study by Richmond and colleagues (1999). This study found similar results to Howard et al.'s (2009) findings demonstrating that patients working at time of admission—specifically working full-time—were more likely to complete the program. In their study, the investigators also found that patients who temporarily stopped working to pursue treatment—but still had their jobs available to them post-treatment—were more likely to complete the program (Howard et al., 2009). Although the cited study consisted mostly of patients with a work-related injury, these findings suggest

that if employers are able to keep the participant at work or consider allowing the participant to return to work post-treatment, the odds of completing a treatment program may increase. Participants in this study may have been unemployed due to a number of potential contributing factors (e.g., lack of transportation, lower motivation, physical mobility), which would create barriers to successfully completing the program.

Concerning other demographic variables, race and ethnicity were not included in the logistic regression models due to homogeneity of the sample which consisted mostly of participants who identified as White (78%) and Non-Hispanic (94%). This suggests that racial and ethnic minority groups are underrepresented in this sample; however, results are typical of the literature. In general, pain research has not explored the experiences of diverse populations, and even less, within specific racial/ethnic groups (NIH, 2011). In studies on pain disparities, very few have included Native American, Alaskan Native, Asian American, Native Hawaiian, Pacific Islander, Arab American, or other racial/ethnic groups. Most studies have primarily focused on Non-Hispanic White, Hispanic/Latino, and Black/African American populations (Mossey, 2011). These findings suggest racial/ethnic groups have often not been the focus of research and a critical area to address.

Opioid use at the start of treatment (i.e., pre-intervention) was also found to be a significant predictor of attrition. In this study, opioid users made up 21% of the treatment sample. Results showed 33 out of 37 patients (89%), who started the program with opioid use, completed the program. Although previous findings suggest patients with opioid dependency are more likely to drop out of chronic pain treatment, results from the current study demonstrate that patients with opioid use—not dependency—were more likely to

complete treatment compared to patients without opioid use pre-intervention. There is an important distinction between patients with opioid dependency and patients with opioid use. Opioid dependence may result in loss of control, strong cravings, compulsive drug use, and failure to meet work, social, or family obligations (DSM-5, 2013). On the other hand, opioid use may result in physical dependence, but can be managed and resolved by slowly lowering the dose. Both groups have been merged in the "Opioid Epidemic" which has conflated findings about appropriate opioid usage (Moride et al., 2019). This finding sheds some light on the importance of separating these two distinct groups in pain research. In this particular sample, due to the changes in criteria from DSM-IV to DSM-5 and the retrospective nature of this study, it is difficult to ascertain which participants met criteria for opioid dependency versus opioid abuse. However, results from this study demonstrate that patients with opioid use pre-intervention benefited from an interdisciplinary pain program. In fact, follow-up analyses revealed that 24 out of 37 completers (65%) on opioids pre-intervention reduced or eliminated use over the course of the program.

The pain cognition and behavior domain in this study specifically looked at pain catastrophizing, fear-avoidance beliefs, pain behavior, and pain interference. Previous studies have found pain behavior to be a significant predictor (Richmond et al., 1999), and catastrophizing and fear-avoidance to be non-significant predictors (Carosella et al., 1994; Coughlan et al., 1995). For pain interference, the ability to engage with work-related activities has been demonstrated to be a significant predictor, but not the ability to engage with social activities (Bendix et al., 1998). Results demonstrated that all four predictors were not significant in this study. Furthermore, the variables investigated in the physical, social,

and mental well-being domain were also not significant. In previous studies, psychosocial factors have been found to be associated with poor treatment outcomes, including higher levels of depression, anxiety, and perceived disability (Gatchel et al, 2006; Biller et al., 2000; McGeary et al., 2003; Rush, Polatin, & Gatchel, 2000; Sullivan et al., 2005). In this study, none of these findings were confirmed. As previously mentioned, since attrition studies investigate a number of different combinations of potential predictors, the conflicting results among all the findings were somewhat anticipated.

A secondary aim in this study was to examine the extent to which the interdisciplinary pain program was effective for the completion group as demonstrated by improvements on a variety of clinical measures. Over the course of the program, the completion group demonstrated significant improvement pre- to post-intervention on each of the measures assessed in the 2.a) pain-related cognition and behavior domain (i.e., pain behavior and pain interference) and 2.b) physical, social, and mental well-being domain (i.e., physical function, anxiety, depression, and sleep-related impairment), with the exception of the LOT-R. For the significant models, there was a significant improvement specifically pre- to post-intervention on all measures except anxiety. For anxiety, the group means actually initially increased from pre- to mid-intervention, but decreased considerably from mid- to post-intervention. This initial increase is common in CBT when patients are initially taught to slowly expose themselves to feared situations which may increase their anxiety levels. However, the anxiety lessens once patients become more accustomed to the feared situations and begin to use specific coping skills learned in treatment (Carlson, 2014). This is not only a

common outcome, but also provides some evidence for the use of cognitive-behavioral interventions for pain management, albeit limited by lack of a control group.

In the exploratory analysis examining whether the interdisciplinary pain program was effective for both the completion and non-completion groups, there were no interactions for any of the measures assessed. This is may be due to the low power in the non-completion group as both groups likely did not experience similar changes over the course of the study. The results were almost identical to that of results for the completion group. Both groups demonstrated significant improvement pre- to post-intervention on each of the measures assessed in the 2.a) pain-related cognition and behavior domain and 2.b) physical, social, and mental well-being domain, with the exception of the LOT-R. For the significant models, there was a significant improvement specifically pre- to post-intervention on all measures except anxiety and pain behavior. For anxiety, there was the same initial increase from pre- to mid-intervention, but a significant decrease from mid- to post-intervention. For pain behavior, pre- to post-intervention almost reached significance ($p = .06$), but ultimately none of the time points were significant. Due to the sample size for the non-completion group, the analysis was conducted for exploratory purposes only.

Limitations

The limitations of this study include a small sample size, study site/context, retrospective analysis, and lack of a control group. The number of participants was small ($n = 118$ completers and $n = 60$ non-completers) and from a single study site, which limits the generalizability of the findings. This study was also completed in the context of a larger, on-

going study that was part of a working clinic. Many of the individuals who completed baseline measures did not participate in the current study due to various constraints (e.g., transportation, schedule conflicts, etc.). The intention-to-treat sample included only participants who attended the first program day of the interdisciplinary program, and not those who were referred but did not attend the first program day, which may be of interest in attrition studies. In order to maximize power for the longitudinal analyses, only participants who completed at least two points of testing (i.e., baseline with midpoint and/or endpoint) were included. This resulted in only seven participants from the non-completion group being included as part of the analyses, which made it difficult to determine whether there were any meaningful results. Another important factor was that due to the retrospective nature of the study, variables that were initially of interest—such as socioeconomic status indicators, distance from clinic, and reliability of transportation—were not available and therefore could not be investigated. Lastly, although positive results were found in this study, the lack of a control group does not allow for any significant conclusions to be made about whether these results were due to the interdisciplinary pain program, rather than to other factors.

Directions for Future Research

In future studies, an amended data collection process, including detailed documentation related opioid use, and conducting exit interviews would be beneficial. It would be useful to maintain improved records of participant enrollment and participation. This may include tracking historical, demographic, and treatment factors specific to each patient which may provide clearer answers as to why certain patients present with more

difficulty and drop out of treatment early. In particular, detailed tracking of opioid users' decisions to enter or decline the interdisciplinary pain program, specific goals about opioid reduction or elimination over the course of the program, and/or other factors related to motivation for treatment. If possible, conducting exit interviews with participants to investigate their reasons for dropping out would also be beneficial. An amended data collection and interview process could provide rich information for future studies investigating attrition from interdisciplinary pain management programs.

Follow up studies should include a larger sample size, multi-site design, and control group to further examine the effectiveness of an interdisciplinary pain program and to increase the generalizability of results across a larger population. As previously discussed, racial/ethnic diversity has often not been the focus of pain research. Results from studies primarily focused on majority racial/ethnic populations may be inflated and impact the quality of healthcare provided to underserved populations. Therefore, future studies should also investigate the reasons for patients of minority racial/ethnic status' decision not to enter and/or complete an interdisciplinary pain program.

Clinical Relevance and Practical Recommendations

This study identified baseline demographic and opioid use-related variables that may be potential contributors to non/completion in an interdisciplinary pain management program. Treatment providers may be able to reduce attrition by screening for some of these risk factors and using motivational enhancement techniques to target patients at risk of early dropout from the program. In their systematic review, Oosterhaven and colleagues (2019)

also suggest making a distinction as to whether potential predictors are modifiable or non-modifiable in order to determine whether specific interventions, modifications to program structure, or other changes may be helpful. For example, younger age is a non-modifiable predictor and may require further assessment of specific age-related factors that are contributing to dropout. Alternatively, unemployment is a modifiable predictor and perhaps providing resources on job opportunities and helping patients secure employment post-treatment may result in higher odds of completing the program.

Another important finding in this study was that patients who started the program on opioids did not having higher odds of dropping out of the program as hypothesized. Although the findings of this study did not replicate those in the literature, this may be due to specific factors in this program, which places an emphasis on psychoeducation of the adverse effects of long-term opioid use and closely monitoring patients' opioid use with the goal of reducing or eliminating opioids throughout the program. This finding suggests that it may be beneficial for each interdisciplinary pain management program to evaluate their own program goals and patient population, investigating demographic and background factors for the distinct group of opioid users in their program. By identifying these factors and evaluating them along with attrition/completion rates, programs may be able to establish improved guidelines regarding opioid use in their specific programs (e.g., requiring complete detoxification versus partial stabilization of opioid use prior to program start).

Overall, the current study demonstrates that patients who completed the interdisciplinary pain management program showed significant improvements across a variety of pain-related symptoms, compared to the pre-treatment baseline. By gaining a better

understanding of potential contributors to non/completion, interdisciplinary pain management programs can increase retention rates, improve treatment completion, and aim to reduce the national rates of chronic pain in the future.

Table 1 – Demographic Information

	Total (n=178)	Completers (n=118)	Non-Completers (n=60)	p
Age (M±SD)	53.28±15.06	55.60±15.36	48.72±13.44	.17
Sex				.34
Female	124 (69.7%)	85 (72.0%)	39 (65.0%)	
Male	54 (30.3%)	33 (28.0%)	21 (35.0%)	
Education (M±SD)	14.78±2.33	14.96±2.20	14.42±2.54	.22
Marital Status				.18
Partnered	113 (63.5%)	79 (66.9%)	34 (56.7%)	
Unpartnered	65 (36.5%)	39 (33.1%)	26 (43.3%)	
Employment Status				.01
Employed	65 (36.5%)	50 (42.4%)	15 (25.0%)	
Unemployed	74 (41.6%)	38 (32.2%)	36 (60.0%)	
Retired	29 (16.3%)	23 (19.5%)	6 (10.0%)	
Student	10 (5.6%)	7 (5.9%)	3 (5.0%)	
Race				.85
White	139 (78.1%)	94 (79.7%)	45 (75.0%)	
Black	32 (18.0%)	19 (16.1%)	13 (21.7%)	
Asian	3 (1.7%)	2 (1.7%)	1 (1.7%)	
Other/NR	4 (2.3%)	3 (2.5%)	1 (1.7%)	
Ethnicity				.60
Non-Hispanic	167 (93.8%)	112 (94.9%)	55 (91.7%)	
Hispanic	10 (5.6%)	5 (4.2%)	5 (8.3%)	
Other/NR	1 (0.6%)	1 (0.8%)	0 (0.0%)	

Note: NR = Not Reported

Table 2 – Do selected demographic variables serve as predictors of attrition in an interdisciplinary pain program?

Preliminary logistic regression model predicting program completion using baselines variables (i.e., age, sex, education, marital status, and employment)

	B	SE	Wald	df	p	Odds Ratio	95% CI for O.R. Lower	95% CI for O.R. Upper
Age	.04	.02	5.66	1	.02	1.04	1.01	1.07
Sex	.62	.39	2.52	1	.11	1.85	.87	3.95
Education	.05	.08	.39	1	.53	1.05	.90	1.22
Marital	-.59	.36	2.61	1	.11	.56	.27	1.13
Employment (Reference Group: Employed)			12.61	3	.01			
Unemployed	-1.23	.41	9.08	1	<.01	.29	.13	.65
Retired	-.53	.62	.74	1	.39	.59	.17	1.97
Student	.84	.89	.89	1	.35	2.32	.41	13.31

Final logistic regression model predicting program completion based on predictors from the demographic domain with p < .05 (i.e., age and employment status)

	B	SE	Wald	df	p	Odds Ratio	95% CI for O.R. Lower	95% CI for O.R. Upper
Age	.04	.01	6.81	1	.01	1.04	1.01	1.07
Employment (Reference Group: Employed)			11.22	3	.01			
Unemployed	-1.13	.38	8.66	1	<.01	.32	.15	.69
Retired	-.52	.61	.72	1	.40	.60	.18	1.97
Student	.56	.84	.45	1	.50	1.76	.34	9.09

Note: Hosmer Lemeshow p > .40

Table 3 – Does the number of medical diagnoses [psychiatric and non-psychiatric] serve as a predictor of attrition in an interdisciplinary pain program?

Logistic regression model predicting program completion using number of medical diagnoses

	B	SE	Wald	df	p	Odds Ratio	95% CI for O.R. Lower	95% CI for O.R. Upper
Diagnoses	.00	.02	.05	1	.83	1.00	.97	1.03

Table 4 – Does the risk of opioid misuse and opioid use at the start of treatment serve as predictors of attrition in an interdisciplinary pain program?

Preliminary logistic regression model predicting program completion using scores on the PMQ and opioid use at start of treatment

	B	SE	Wald	df	p	Odds Ratio	95% CI for O.R. Lower	95% CI for O.R. Upper
Opioid Risk	-.03	.02	2.17	1	.14	.98	.94	1.01
Opioid Use Start	1.69	.56	9.14	1	<.01	5.41	1.81	16.16

Note: Hosmer Lemeshow p > .40

Final logistic regression model predicting program completion based on predictors from the opioid use domain with p < .05 (i.e., opioid use at start of treatment)

	B	SE	Wald	df	p	Odds Ratio	95% CI for O.R. Lower	95% CI for O.R. Upper
Opioid Use Start	1.69	.56	9.25	1	<.01	5.44	1.83	16.18

Note: Hosmer Lemeshow not applicable.

Table 5 – Does pain-related cognition and behavior serve as predictors of attrition in an interdisciplinary pain program?

Logistic regression model predicting program completion using scores on the PCS, FABQ, PROMIS Pain Behavior, and PROMIS Pain Interference Scales

	B	SE	Wald	df	p	Odds Ratio	95% CI for O.R. Lower	95% CI for O.R. Upper
PCS	-.01	.01	.64	1	.43	.99	.96	1.02
FABQ	-.01	.01	1.47	1	.23	.99	.97	1.01
PROMIS Pain Behavior	-.06	.05	1.31	1	.25	.95	.86	1.04
PROMIS Pain Interference	.02	.03	.29	1	.59	1.02	.95	1.09

Table 6 – Does physical, social, and mental well-being serve as predictors of attrition in an interdisciplinary pain program?

Logistic regression model predicting program completion using scores on the SF-36, LOT-R, PROMIS Physical Function, PROMIS Anxiety, PROMIS Depression, PROMIS Applied Cognition General Concerns, and PROMIS Sleep-Related Impairment Scales

	B	SE	Wald	df	p	Odds Ratio	95% CI for O.R.	
							Lower	Upper
SF-36 Physical Comp	.01	.02	.51	1	.48	1.01	.98	1.05
SF-36 Mental Comp	.02	.02	.93	1	.33	1.02	.99	1.05
LOT-R	.03	.04	.59	1	.44	1.03	.95	1.13
PROMIS Physical Function	.00	.03	.00	1	.96	1.00	.94	1.07
PROMIS Anxiety	.00	.03	.00	1	.95	1.00	.95	1.06
PROMIS Depression	-.01	.02	.24	1	.63	.99	.95	1.03
PROMIS ACGC	.02	.02	.64	1	.43	1.02	.98	1.05
PROMIS SRIS	.01	.03	.05	1	.82	1.01	.96	1.06

Table 7 – Preliminary multivariable logistic regression analysis predicting program completion based on predictors from each domain with p < 0.15 (i.e., age, sex, marital status, employment status, and opioid use at start of treatment)

	B	SE	Wald	df	p	Odds Ratio	95% CI for O.R. Lower	95% CI for O.R. Upper
Age	.03	.02	5.26	1	.02	1.04	1.01	1.07
Sex	.53	.40	1.79	1	.18	1.70	.78	3.67
Marital	.47	.37	1.58	1	.21	1.60	.77	3.32
Employment (Reference Group: Employed)			11.49	3	<.01			
Unemployed	-1.15	.41	7.80	1	<.01	.32	.14	.71
Retired	-.36	.63	.34	1	.56	.70	.20	2.37
Student	.86	.88	.95	1	.33	2.37	.42	13.40
Opioid Use Start	1.53	.57	7.07	1	<.01	4.60	1.49	14.17

Final multivariable logistic regression analysis predicting program completion based on predictors from multivariable logistic regression model with p < .05 (i.e., age, employment status, and opioid use at start of treatment)

	B	SE	Wald	df	p	Odds Ratio	95% CI for O.R. Lower	95% CI for O.R. Upper
Age	.04	.02	6.19	1	.01	1.04	1.01	1.07
Employment (Reference Group: Employed)			9.87	3	.02			
Unemployed	-1.02	.40	6.65	1	.01	.36	.17	.78
Retired	-.33	.62	.28	1	.60	.72	.22	2.43
Student	.74	.85	.75	1	.39	2.10	.40	11.12
Opioid Use Start	1.62	.57	8.04	1	<.01	5.05	1.65	15.48

Note: Hosmer Lemeshow p > .40

Table 8 – Independent samples t-test comparing baseline scores between non/completers

	Completers (M±SD)	Non-Completers (M±SD)	t	p
		Opioid Use Domain		
PMQ	20.40±9.28	22.78±10.40	1.56	.12
		Pain-Related Cognition & Behavior Domain		
PCS	17.05±13.92	20.75±13.32	1.70	.09
FABQ	41.05±18.24	46.25±21.21	1.70	.09
PROMIS Pain Behavior	59.51±4.17	60.78±4.36	1.89	.06
PROMIS Pain Interference	64.94±5.95	65.83±6.01	.94	.35
		Physical, Social & Mental Well-being Domain		
SF-36 Physical Comp	32.26±15.10	27.63±13.12	-1.93	.06
SF-36 Mental Comp	48.83±17.99	42.43±17.85	-2.13	.05
LOT-R	14.64±4.95	13.51±4.96	-1.39	.17
PROMIS Physical Function	35.88±6.22	35.25±7.36	-.60	.55
PROMIS Anxiety	56.55±7.91	58.52±9.65	1.46	.15
PROMIS Depression	53.71±11.10	56.57±9.04	1.73	.09
PROMIS ACSC	41.38±13.41	42.96±12.44	.73	.47
PROMIS SRIS	58.18±8.43	59.54±8.32	1.02	.31

Table 9 – Means and standard deviations for outcome measures in the pain-related cognition and behavior domain for non/completers over time

	n	Pre-intervention (M±SD)	n	Mid-intervention (M±SD)	n	Post-intervention (M±SD)
				PROMIS Pain Behavior		
Completers	118	59.51±4.17	61	59.16±5.43	82	58.38±5.07
Non-completers	60	60.78±4.36	4	57.68±2.38	4	60.70±6.60
				PROMIS Pain Interference		
Completers	118	64.94±5.95	60	61.65±11.35	82	61.55±7.33
Non-completers	60	65.83±6.01	4	59.18±2.77	4	65.10±2.81

Table 10 – Do participants in the completion group collectively demonstrate improvement in the pain-related cognition and behavior domain over time?

Linear mixed-effects model examining the longitudinal changes in score on the PROMIS Pain Behavior and PROMIS Pain Interference Scales

Outcome Measure	Time			Pairwise Comparisons (Time)		
	F	df	p	T_1 vs. T_2 (p value)	T_1 vs. T_3 (p value)	T_2 vs. T_3 (p value)
PROMIS Pain Behavior	3.74	2, 117	.03	>.999	.03	.12
PROMIS Pain Interference	11.61	2, 117	<.0001	.04	<.0001	.06

Table 11 – Do participants in the completion group versus non-completion group collectively demonstrate improvement in the physical, social, and mental well-being domain over time?

Preliminary linear mixed-effects model examining Group x Time interaction on the PROMIS Pain Behavior and PROMIS Pain Interference Scales

Outcome Measure	Group*Time			Group			Time		
	F	df	p	F	df	p	F	df	p
PROMIS Pain Behavior	.32	2, 123	.73	.72	1, 123	.40	.14	2, 123	.87
PROMIS Pain Interference	1.72	2, 123	.18	.42	1, 123	.52	1.50	2, 123	.23

Final linear mixed-effects model examining changes in Group and Time on the PROMIS Pain Behavior and PROMIS Pain Interference Scales

	Group			Time			Pairwise Comparisons (Time)		
Outcome Measure	F	df	p	F	df	p	T_1 vs. T_2 (p value)	T_1 vs. T_3 (p value)	T_2 vs. T_3 (p value)
PROMIS Pain Behavior	.55	1, 123	.46	3.13	2, 123	.047	>.999	.06	.17
PROMIS Pain Interference	.88	1, 123	.35	11.30	2, 123	<.0001	.03	<.0001	.12

Table 12 – Means and standard deviations for outcome measures in the physical, social, and mental well-being domain for non/completers over time

	n	Pre-intervention (M±SD)	n	Mid-intervention (M±SD)	n	Post-intervention (M±SD)
				LOT-R		
Completers	107	14.64±4.95	56	14.45±5.28	79	15.06±4.57
Non-completers	57	13.51±4.96	4	14.75±2.87	3	16.67±2.08
				PROMIS Physical Function		
Completers	117	35.88±6.22	60	35.91±7.45	82	37.76±6.04
Non-completers	60	35.25±7.36	4	43.20±4.62	4	34.08±6.03
				PROMIS Anxiety		
Completers	118	56.55±7.91	61	57.43±10.39	82	55.01±7.77
Non-completers	60	58.52±9.65	4	57.33±3.01	4	53.98±3.86
				PROMIS Depression		
Completers	118	53.71±11.10	61	54.63±8.28	82	52.89±8.48
Non-completers	60	56.57±9.04	4	48.73±2.48	4	54.33±3.48
				PROMIS Sleep-Related Impairment		
Completers	114	58.18±8.43	60	58.48±9.05	81	55.72±9.54
Non-completers	60	59.54±8.32	4	56.58±4.63	4	59.88±4.00

Table 13 – Do participants in the completion group collectively demonstrate improvement in the physical, social, and mental well-being domain over time?

Linear mixed-effects model examining the changes in score on the LOT-R, PROMIS Physical Function, PROMIS Anxiety, PROMIS Depression, and PROMIS Sleep-Related Impairment Scales

Outcome Measure	Time			Pairwise Comparisons (Time)		
	F	df	p	T_1 vs. T_2 (p value)	T_1 vs. T_3 (p value)	T_2 vs. T_3 (p value)
LOT-R	1.52	2, 124	.22	--	--	--
PROMIS Physical Func	4.38	2, 135	.01	.70	.01	.18
PROMIS Anxiety	12.47	2, 117	<.0001	.05	.12	<.0001
PROMIS Depression	3.25	2, 136	.04	.75	.04	.92
PROMIS SRIS	8.71	2, 132	<.0005	>.999	<.01	<.0005

Table 14 – Do participants in the completion group versus non-completion group collectively demonstrate improvement in the physical, social, and mental well-being domain over time?

Preliminary linear mixed-effects model examining Group x Time interaction on the LOT-R, PROMIS Physical Function, PROMIS Anxiety, PROMIS Depression, and PROMIS Sleep-Related Impairment Scales

Outcome Measure	Group*Time			Group			Time		
	F	df	p	F	df	p	F	df	p
LOT-R	.05	2, 128	.95	.13	1, 117	.71	.18	2, 128	.83
PROMIS Physical Func	2.51	2, 141	.08	.92	1, 123	.34	.63	2, 141	.54
PROMIS Anxiety	.29	2, 123	.75	.69	1, 123	.41	2.16	2, 123	.12
PROMIS Depression	.41	2, 142	.66	1.00	1, 123	.32	.30	2, 142	.74
PROMIS SRIS	2.05	2, 138	.13	.01	1, 122	.94	.11	2, 128	.89

Final linear mixed-effects model examining changes in Group and Time on the LOT-R, PROMIS Physical Function, PROMIS Anxiety, PROMIS Depression, and PROMIS Sleep-Related Impairment Scales

Outcome Measure	Group			Time			Pairwise Comparisons (Time)		
	F	df	p	F	df	p	T_1 vs. T_2 (p value)	T_1 vs. T_3 (p value)	T_2 vs. T_3 (p value)
LOT-R	.15	1, 117	.70	1.48	2, 130	.23	--	--	--
PROMIS Physical Func	1.14	1, 123	.29	3.10	2, 143	.048	.84	.04	.39
PROMIS Anxiety	.76	1, 123	.39	9.59	2, 144	.0001	.03	.22	<.0001
PROMIS Depression	1.13	1, 123	.29	3.19	2, 144	.04	.65	.04	>.999
PROMIS SRIS	.01	1, 122	.93	7.12	2, 140	.001	>.999	.02	.001

Figure 1 – Mean T-scores for PROMIS Pain Behavior Scale

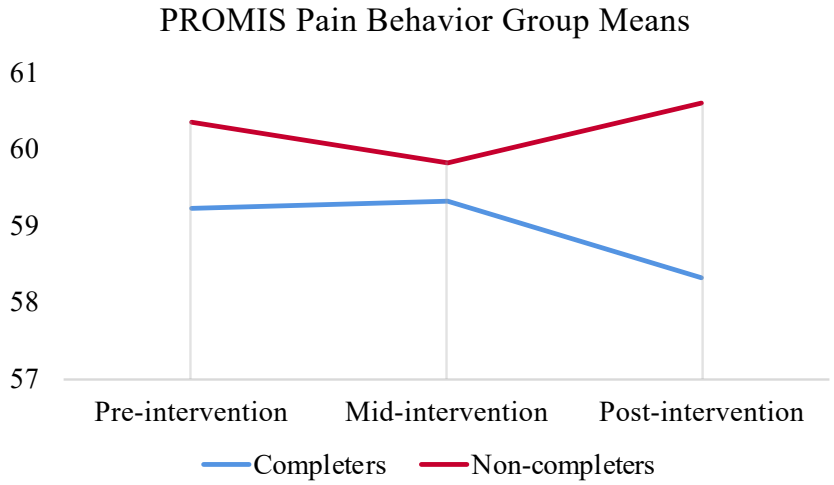


Figure 2 – Mean T-scores for PROMIS Pain Inference Scale

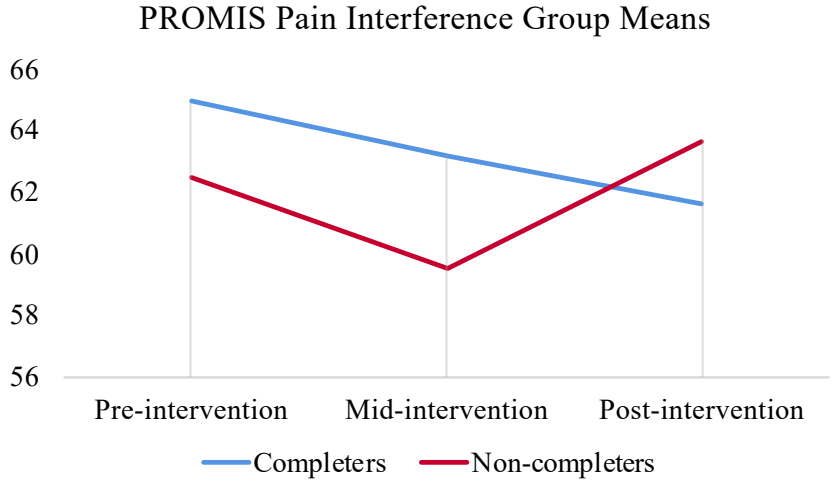


Figure 3 – Mean T-scores for PROMIS Physical Function Scale

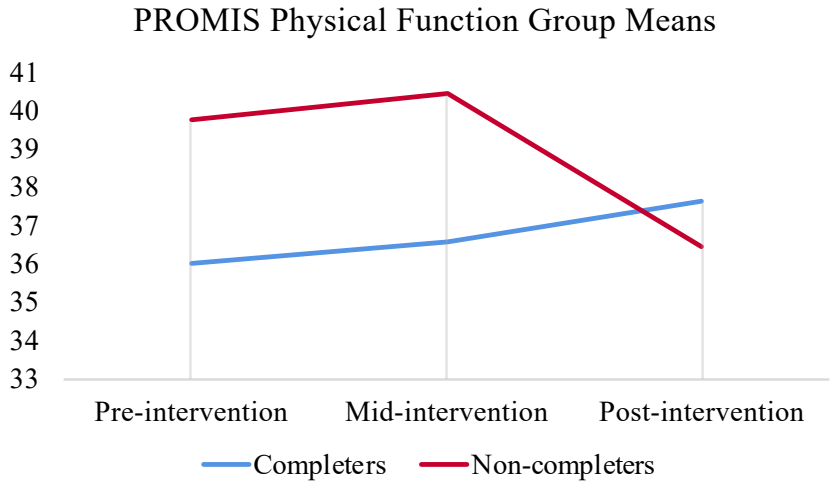


Figure 4 – Mean T-scores for PROMIS Anxiety Scale

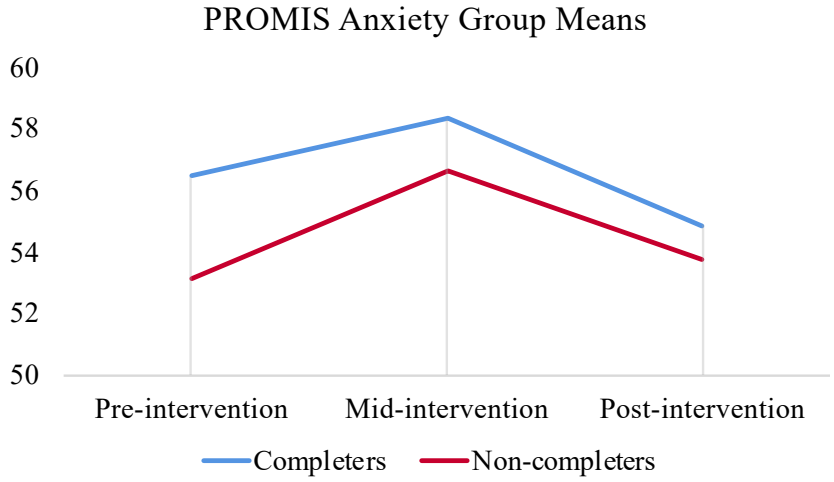


Figure 5 – Mean T-scores for PROMIS Depression Scale

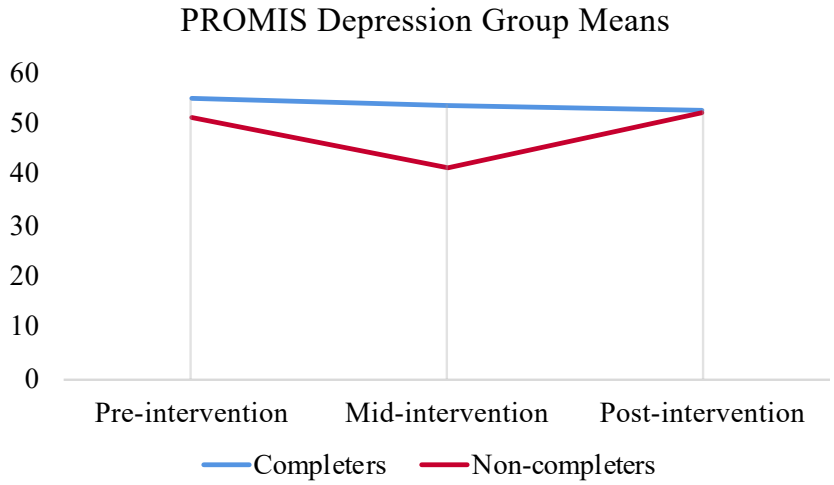


Figure 6 – Mean T-scores for PROMIS Sleep-Related Impairment Scale

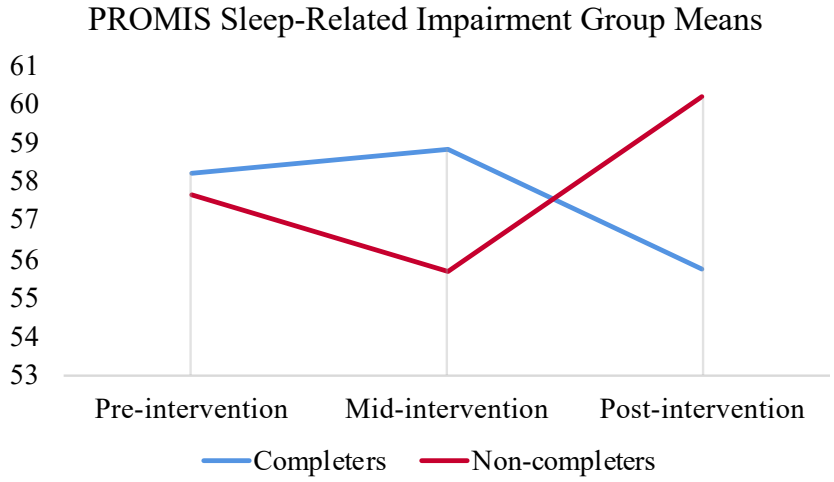
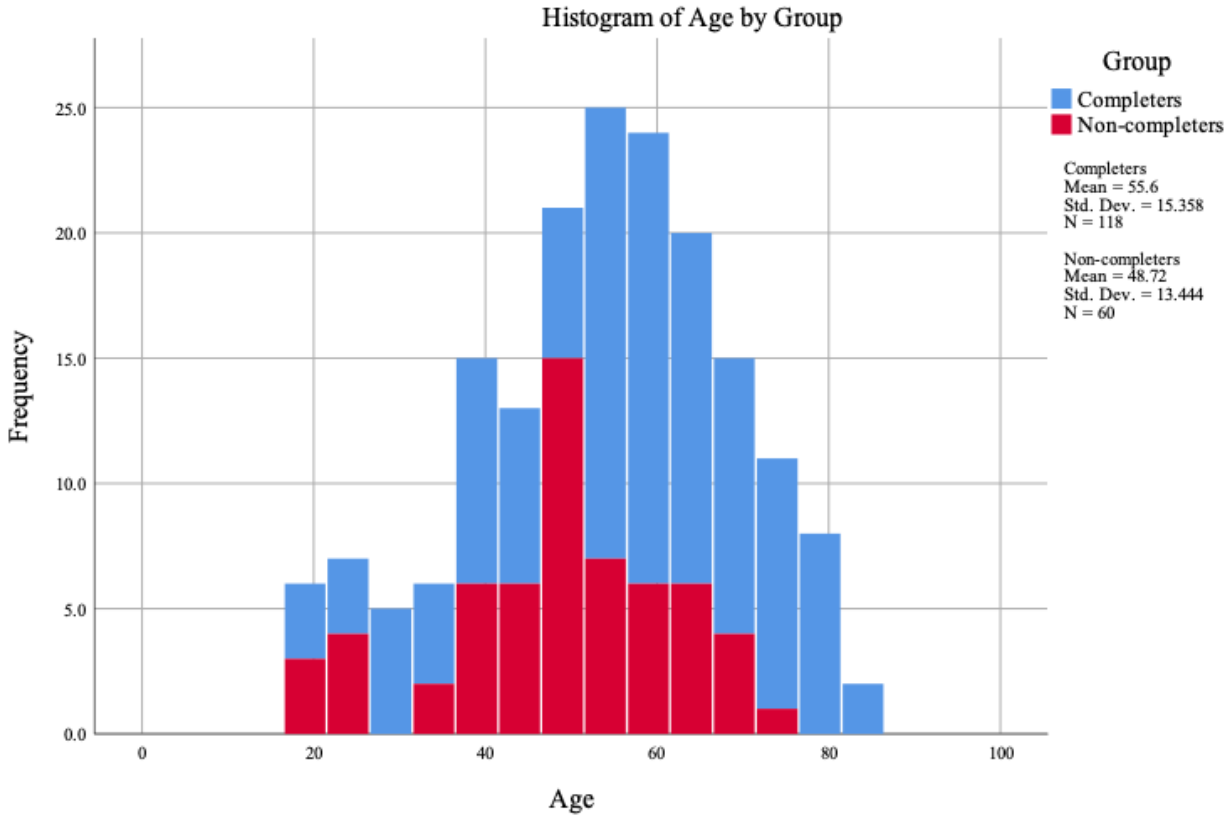


Figure 7 – Stacked histogram of age by completion status



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