TREATMENT CONSIDERATIONS FOR COMORBID INSOMNIA AND CHRONIC PAIN:

A BIOPSYCHOSOCIAL APPROACH TO CLINICAL CARE

APPROVED BY SUPERVISORY COMMITTEE

Richard Robinson, PhD

Carl Noe, MD

Robert Gatchel, PhD, ABPP

DEDICATION

I would like to thank Dr. Carl Noe and Dr. Robert Gatchel for volunteering their time as my thesis committee members, as well as Dr. Richard Robinson for serving as chairperson and a valuable mentor throughout this process. I would also like to express gratitude for the members of my Graduate Studies Committee for providing this opportunity and my fellow classmates for their ongoing encouragement. In addition, I would like to thank my family and friends who have continuously provided me with support, great understanding, and interest in my chosen field.

TREATMENT CONSIDERATIONS FOR COMORBID INSOMNIA AND CHRONIC PAIN: A BIOPSYCHOSOCIAL APPROACH TO CLINICAL CARE

by

OLIVIA ELIZABETH VAN NESS

THESIS

Presented to the Faculty of the School of Health Professions

The University of Texas Southwestern Medical Center

Dallas, Texas

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF CLINICAL REHABILITATION COUNSELING

Abstract

BACKGROUND: Interdisciplinary pain management programs have proven to be quite effective in alleviating presenting patient symptoms. Sleep is a complex process not well understood and the effects it maintains on subsequent daytime function appear to influence pain and related symptoms.

SUBJECTS: 134 qualifying participants were drawn from an interdisciplinary pain management program. The majority of subjects were females of Caucasian race with sample ages ranging from 20 to 86 years. Participants were compensated a small amount for their time.

METHOD: Patients were administered computerized testing on measures of pain, mood, and function prior to and upon successful completion of the program. Participants were placed into groups based on their performance on sleep measures to be examined for differences.

RESULTS: Time spent in the interdisciplinary program was shown to be effective across all measures administered, including sleep measures. The sleep improvement group showed significantly more change on measures of physical function and social satisfaction.

DISCUSSION: This study further strengthens the argument for the use of interdisciplinary pain management by providing an example of global improvement among the sample. Particular attention should be paid to physical function and social satisfaction when observing differences in sleep disturbance and sleep-related impairment.

Keywords: sleep, pain, interdisciplinary care, insomnia, social satisfaction, mood.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

IASP – International Association for the Study of Pain

CBT – Cognitive Behavioral Therapy

REM – Rapid Eye Movement

NREM – Non-Rapid Eye Movement

DSM-5 – Diagnostic and Statistical Manual for Mental Disorders, 5th Edition

LED – Light Emitting Diodes

DSA – Discretionary Social Activities

EMCPM – Eugene McDermott Center for Pain Management

UTSW – University of Texas Southwestern Medical Center

IRB – Institutional Review Board

NIH – National Institute of Health

PROMIS – Patient Reported Outcomes Measurement Information System

HIPAA – Health Insurance Portability and Accountability Act

PID – Patient Identification Number

CHAPTER ONE

Introduction

A report released in 2011 by the Institute of Medicine concluded that over 100 million adults in the United States suffer from chronic pain, substantially more than any other chronic illness in the country (U.S. Institute of Medicine, 2011). These numbers are only expected to grow as the Baby Boomer generation continues to age in coming years, as 62% of nursing home residents reported pain with nearly a third of those claiming substantial daily pain. The cost of pain in America is estimated to be anywhere between $560 billion and $635 billion annually which encompasses the cost of healthcare and lost productivity due to missed employment wages among adults (Gaskin & Richard, 2012). Many rely on the federal Medicare program, which spent 14% of its budget on pain related costs in 2008 (Institute of Medicine, 2011). These statistics offer valid reason to be concerned over the high and rising costs of pain to the economy, which has an impact on everyone in the United States. Effective treatment options are essential to reducing these costs and addressing pain related economic issues. Future concern over the toll of pain related costs to the nation is warranted and should be investigated to prevent further loss from occurring. Gaskin and Richard (2012) concluded that the goal should be enhancing the lives of those with pain and aiding in function.

The human body evolved to alert us to potential threats of danger, including injury and illness through the sensation of pain. In 1994, the IASP (International Association for the Study of Pain) defined pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage.” Pain encompasses a variety of uncomfortable and often unwanted physical sensations that are informing our brain of what is externally happening outside of our bodies in order to reduce the impact of an imposing stimulus (International Association for the

Study of Pain, 1994). In this way, pain is a protective, biologically adaptive mechanism meant to keep us alive. For reasons not well understood, the body may continue to experience pain long after the danger has passed and can become chronic and detrimental to the individual.

Sleep disturbance occurs when an individual has difficulty initiating or maintaining sleep. Smith and Haythornthwaite (2004) indicate that chronic pain and sleep disturbances constitute a cycle where pain contributes to sleep issues and those issues contribute to pain. Treatment of sleep would consequently improve both insomnia and pain, helping to break the cycle. Asih, Neblett, Mayer, Brede, and Gatchel (2014) concluded that insomnia is not a symptom due to chronic pain, but rather an independent comorbid condition requiring specific treatment. Either way, treatment for sleep is warranted in order to improve both areas and their effect on function. A primary goal of working to improve sleep hygiene practices to address sleep disturbance issues is necessary, as 67-88% of individuals with chronic pain report issues with sleep (Asih et al., 2014; Davin, Wilt, Covington & Scheman, 2014; Finan, Goodin, & Smith, 2013; Smith & Haythornthwaite, 2004). Pain can impact how well an individual sleeps and can lead to feelings of fatigue the next day, therefore contributing to anxiety, depression, and anger commonly present in individuals with chronic pain (Noe and Williams, 2012).

Presently, it is well understood that interdisciplinary treatment can greatly improve functioning in chronic pain populations (Kowal, Wilson, Geck, Henderson, & D'Eon, 2011, Robbins et al., 2003). However, few studies have been done investigating the effects of interdisciplinary treatment on both sleep and pain. The present study seeks to examine the amount of variability in sleep disturbances and sleep related impairment following participation in an interdisciplinary pain management program, as well as how these factors influence pain and other related contributing issues. Sleep plays an important role in overall health and is

valuable to understand in the context of chronic pain populations in order to better benefit patients and improve the quality of treatment in interdisciplinary care settings.

CHAPTER TWO

Review of the Literature

Definitions and Descriptions of Pain

Types of pain vary depending on the stimuli and the body's reaction to it. According to Woolf (2010), there are three main types of pain: nociceptive, inflammatory, and dysfunctional. Nociceptive pain produces the physical warning sent to the brain after encountering instances involving an unsafe temperature or a sharp object. The physical sensation is unpleasant and therefore the body responds by reflexively distancing itself from it. Pain in this instance is protective in nature and meant to prevent damage from occurring. Inflammatory pain occurs when tissue has actually become damaged and the body needs to keep itself limited in terms of movement, giving it an opportunity to heal. Inflammation keeps the affected area sensitive to ensure that it is guarded from further damage. On certain occasions, inflammatory pain needs to be limited and treated because it is not indicative of danger. Other types of pain are a result of the nervous system malfunctioning because of damage or the perceived presence of damage where none exists. This is referred to as dysfunctional pain because it is impacting the person without a physical cause to do so (Costigan, Scholz, & Woolf, 2009; Woolf, 2010).

Time Factor in Pain

The length of time at which an individual experiences pain can also have an impact on the way pain is perceived. Acute pain is short term, while chronic pain is more lasting. Pain is often considered to be chronic after a period of three to six months, although the length of time is less reliable for diagnosis than other associated features (International Association for the Study of Pain, 1994; Katz, Rosenbloom, & Fashler, 2015). The time that pain lasts can vary greatly depending on the extent of the injury or illness. Acute pain and chronic pain are more accurately

distinguished by the body's response to analgesic treatment and the overall experience of pain (Loeser and Melzack, 1999). Grichnik and Ferrante (1991) argue that acute pain serves a biological purpose, while chronic pain does the opposite and is not beneficial to the individual. Acute pain is often described as the "normal" pain response to an adverse event that only lasts until shortly after the body is healed. Acute pain can also be considered a trigger to an alarm to motivate action that will prevent tissue damage and it can be treated from a traditional biomedical perspective (Lumley et al., 2011). Chronic pain develops when the physical damage is long lasting or is still lingering despite having healed, requiring more complex approaches to treatment.

Medical Treatment for Chronic Pain

Medical treatment for chronic pain follows a traditional model of viewing the body and related issues as biological and physiological. Patients with chronic pain will seek medical attention likely from their primary care provider as the initial first option. Ashburn and Staats (1999) list several treatment options for chronic pain management. Among these options is pharmacological treatment requiring a series of steps that are recommended for use between the patient and their physician. Prior to beginning a pharmacological regimen for pain, the physician should gather a full medical history from the patient and perform a physical evaluation to ensure the best method of treatment (Ashburn and Staats, 1999). Once a decision is made to pursue treatment, a written plan should be made that includes goals for the patient in order to measure effectiveness. The physician should then have a discussion with the patient about the possible risks and benefits of the medication in order to ensure they both agree it is appropriate and allows for informed consent on behalf of the patient (Ashburn and Staats, 1999). Once the medication regimen has initiated, it is critical that the physician check in periodically with the

patient to assess whether or not the medication is helpful in obtaining the goals made prior to treatment. Maintenance of open communication and a positive relationship between provider and patient is important in the context of medical treatment for chronic pain (Esquibel and Borkan, 2014).

Opioid medications are often prescribed to manage chronic pain, although there are issues such as hyperalgesia and tolerance (Angst and Clark, 2006). Hyperalgesia occurs when there is an increase in sensitivity to pain sensations. This phenomenon is separate from tolerance, which is a decrease in effectiveness of the medication that requires an increased dose in order to be successful (Angst and Clark, 2006). Medication compliance is an essential component to pharmacological treatment and should be frequently monitored by the physician. Monti and Caporali (2015) suggest that innovative pharmacological treatments are becoming increasingly important due to negative effects of opioid medication and issues with patient compliance due to tolerance, particularly in those who have used this as treatment for pain for a long period of time. Oral administration of opioids relies on the patient to take the medication appropriately, as doing so is critical in reducing negative side effects and risk of abuse and misuse. Recently, it has been shown that using an implant to deliver set doses of drugs to a patient can greatly reduce side effects seen with traditional opioid use, as well as reduce the probability of noncompliance and addiction. (Caraway, Walker, Becker, and Hinnenthal, 2015). Moore and McQuay (2005) found that common significant adverse events including dry mouth, nausea, and constipation were present in a sample of patients taking opioids for moderate chronic pain. A significant amount of patients taking opioids (22%) withdrew due to adverse events (Moore and McQuay, 2005). Not all individuals experience negative side effects as a result of taking opioids; however the issue of tolerance still remains (Jungquist, Flannery, Perlis, and Grace, 2012). Due to the difficulties and

risks presented in prescribing opioids, it would appear that non-pharmacological treatment options for chronic pain should be adequately developed and maintained.

Another form of medical treatment that is considered interventional is the use of steroid injections. Injections can be made directly into a joint or a muscular trigger point area (Patel, Wasserman, and Imani, 2015). This modality will not cure pain, but rather it will make it easier for the individual to feel enough temporary relief to complete physical therapy exercises and stretching that will also be of benefit. Depending on the type of injection, more movement and flexibility is seen in the affected area so the patient can be reconditioned into better physical shape, thus likely improving pain and making it more probable that other therapeutic options necessary will be sought out (Patel, Wasserman, and Imani, 2015). Interventional medical treatment also encompasses the use of surgery to correct anatomical issues. Fusion of the spine is intended to decrease movement and stabilize a weak area in order to decrease pain. Ibrahim, Tleyjeh, and Gabbar (2008) investigated the effectiveness of a surgical fusion for back pain and concluded that spinal fusion did not significantly improve pain and disability compared to a non-surgical intervention after a period of two years. Surgery is not always cost effective in terms of finance, time, or risk therefore alternative treatments are often necessary to address populations that will not receive much long term benefit from a major procedure. Patel, Wasserman, and Imani (2015) suggest that combining interventional modalities with other forms of treatment makes them highly effective in chronic pain management. Success using interventional methods also requires that the physicians be knowledgeable and precise in their methods (Patel, Wasserman, and Imani, 2015).

The Subjective Experience of Pain

The development of chronic pain is also controlled by the individual's initial reaction to the precipitating event and their emotions towards the pain (Carr and Goudas, 1999; Lumley et al., 2011). Turk and Okifuji (2002) discuss fear, avoidance, and anxiety as contributing factors that perpetuate pain and increase disability. Negative reactions and emotions to pain can lead to maladaptive pain behaviors that do not help to improve the condition of the individual. Different reactions to pain are seen between individuals with similar conditions. Fear avoidance is a term used to describe a particular set of emotions experienced by individuals whose pain has influenced their decision to participate in certain activities (Wong et al., 2015). The key components of fear avoidance are kinesiophobia and catastrophizing. An individual exhibiting these will maintain an irrational fear that moving and being active will lead to more pain, causing them to avoid the activity completely (Denison, Åsenlöf, & Lindberg, 2004, Inoue et al., 2014). This not only leads to deconditioning of the body over time, but also can impede progress in rehabilitation. Denison, Åsenlöf, and Lindberg (2004) found that emotional attitudes towards pain, such as self-efficacy and fear avoidance, were better determinants of disability than pain intensity and duration.

Due to the variability in sensation and how pain is perceived, the concept of pain is subjective in nature and the experience of it can vary greatly from one person to another. Gatchel (2004) points out that pain is separate from nociception in that it is the subjective experience of the individual when nerves are stimulated to deliver the sensory message of pain to the brain. The experience of pain is altered through the emotional reaction to nociception and the meaning attached to it based on prior encounters with physical distress (Gatchel, McGeary, McGeary, & Lippe, 2014). Varying responses to pain based on the meaning that people attach to it is much more commonly understood that it has been previously. Approaches to both pain and nociception

have evolved over time to account for their impact on the psychological state of an individual (Campbell, Clauw, and Keefe, 2003).

Theoretical Background and Evolution of the Biopsychosocial Model

The human body was once regarded as a machine despite the presence of an individual mind. This machine functioned by activated nociceptors at the site of injury or damage that traveled up the spine to alert the portion of the brain responsible for pain, which would then send a response back down for the body to react. This mechanistic notion is that pain as a process involves specific biological processes and is known today as specificity theory (Melzack, 1993). Specificity theory originated with Rene Descartes, who believed the mind and body were separate entities that functioned independent of one another (Descartes, 1641). With this notion, the brain and mind were separate, with the brain responsible for controlling physical processes of the body. The mind was independent of the body and was responsible for thoughts and emotions (Descartes, 1641). These notions would make psychological responses to nociception near impossible since the mind and body do not have to interact. Traditional medical models of treatment are based on this concept; therefore the belief is that repairing physical damage inflicted on the body should relieve pain and aid in solving all other related psychological issues to the injury.

Treatment for pain continued in this way until 1965 when Melzack and Wall proposed the gate control theory, which involved more activity on the part of the brain than specificity theory where it merely sent and received messages from the site of pain. Here, the pain messages encounter “gates” comprised of an interneuron in the substantia gelatinosa in the dorsal horn of the spinal cord that either block the signals or send them along (Melzack and Wall, 1965). The opening and closing of the gates was thought to be controlled by messages being sent down by

the brain, therefore it suggested that the brain played a more operational role in nociception than previously understood and can have an impact on the severity of pain for the individual. The brain's instructions to the gates were considered to be influenced by emotional and environmental factors (Campbell, Clauw, & Keefe, 2003). This is illustrated quite well in people who continue to function after being injured because they did not feel the pain that alerted them to stop what they were doing. Moayedi and Davis (2013) examined the limitations of specificity and gate control theories and concluded that both have limited application due to issues of oversimplification and misleading details, however both helped to make way for further investigation of the subject.

From what is understood of pain, there is no doubt that a biological component exists within the body that determines pain sensations. Following the gate control theory, it was known that the brain is also a key player in determining those sensations (Melzack and Wall, 1965). This leads to the implication of a psychological component involving the mind. The idea that the condition of an individual can have an impact on relatives and friends comprises a social, or environmental, component. Together, these factors contribute to the notion that all should be considered, leading to the biopsychosocial model that is becoming widespread and accepted. All factors contribute to the condition of the individual and therefore need to be considering in deciding a course of treatment (Engel, 1977). The biological component is responsible for the process of nociception to produce the sensations that can be treated with chemical drugs or physical surgery. The psychological component involves the brain and helps take into account the emotional state of the person and how they react to pain. When exposed to pain for a long period of time, the individual may develop low self-efficacy, helplessness, and cognitive distortions (Campbell, Clauw, & Keefe, 2003) which are also common among psychiatric

populations. The social aspect considers impact on family members and friends who also influence the emotions and psychological state of the person with pain based on how they respond to each other through social interaction. All factors impact each other and can change throughout the course of time. The biopsychosocial model also helps explain why people react differently to pain, as no two people perceive the world in precisely the same way. Clinicians treating individuals with pain are now encouraged to explore the emotions of their patient and significant events throughout their lifespan, as these can shape the psychosocial element and help to understand the best course of treatment (Lumley et al., 2011).

George L. Engel first proposed the biopsychosocial model be put to use in 1977 when he called for the field of psychiatry to reject the traditional medical model of disease as the sole method of care (Engel, 1977). He sought a more integrated approach that would not force providers into conflicting with each other. Engel argued that many people bring complaints involving social, psychological, and biological factors to their doctor along with medical issues; therefore physicians need to be equipped to address problems from various perspectives as well as make referrals to other providers when necessary (Engel, 1977). This would require collaboration and communication among different professions, which is a critical component in the biopsychosocial model. His desire was to point out the relevance in the biomedical model, but also to shed light on the limitations it presents. It is useful in conceptualizing the issues of a patient from one perspective, however it cannot account for all influences of the condition of a person. Engel (1977) argues that psychosocial factors alter how a patient experiences their condition and therefore accounts for variation among similar conditions. Boundaries between health and illness are also discussed as being indistinct which illustrates how the biomedical model tries to clearly define disease and in many instances is not able to do so (Engel, 1977).

Buchanan, Cohen, Katz, Quintner, and Williamson (2007) propose that the biopsychosocial model is not as useful as specificity theory because it names pain as a subjective concept. In doing so, it separates pain from the body and creates a cycle that argues it can be reinforced rather than medically treated (Buchanan et al., 2007). By accepting pain as subjective, we are admitting that it is elusive and incurable rather than seeking a biological way to get rid of it since the human body is anatomical (Buchanan et al., 2007). The notion that pain cannot be measured or felt for another person proposes that alternative and inclusive treatment is the best option, rather than seeking techniques to allow the clinician to precisely be able to treat pain and nociception efficiently (Buchanan et al., 2007). Nonetheless, medical advances have not yet achieved that goal therefore the multifactorial approach of the biopsychosocial model is still significantly suitable and effective for chronic pain treatment (Engel, 1977).

Interdisciplinary Care and Chronic Pain

The biopsychosocial model is the basis for the formation and development of interest in interdisciplinary care for pain management. Centralizing locations of services for patients with chronic pain can tremendously increase the likelihood of receiving adequate treatment in all areas previously discussed in the biopsychosocial model. Gatchel and colleagues (2014) make the clear distinction between interdisciplinary and multidisciplinary pain clinics. Multidisciplinary refers to the notion that various providers needed for the treatment of pain maintain their own treatment goals in different locations. In an interdisciplinary setting, treatment goals are set and upheld by all providers who comprise a team that communicates on the progress of the patient (Gatchel et al., 2014). Services are available at one location, giving the patient easier access to all areas they may need. This allows for the team members to enhance the care they are individually providing by collaborating to address specific issues that arise with the

patient via staffing meetings. The goal of an interdisciplinary program is not to cure pain, but rather rehabilitate the person and improve their life with it (Turk et al., 2000). Traditional medical treatment of pain is considered to be passive, or rather the patient is expecting a result through some form of drug or procedure external of themselves. Interdisciplinary care calls for the patient to take a more active role in pain management by learning ways they can cope and function with their condition (Turk and Burwinkle, 2005). The interdisciplinary team is comprised of a number of different specialists that contribute to the biopsychosocial model. Typically, providers include but are not limited to physicians, nurses, psychiatrists, psychologists and counselors, physical therapists, occupational therapists, and case managers (Oslund et al., 2009). An interdisciplinary team functions much like the components of the biopsychosocial model, constantly interacting with and influencing one another. Turk and Burwinkle (2005) refer to interdisciplinary treatment models as treating the whole person rather than simply addressing the pain and related physical symptoms. In this type of care setting, there is much overlap between the roles of the providers to enhance the treatment goals of the individual patient and provide coordination of services (Ashburn & Staats, 1999).

Cost and Effectiveness of Interdisciplinary Care and Chronic Pain

Interdisciplinary treatment is frequently seen as costly and time consuming due to the nature of involving a large number of specialized providers and length of typical programs. A study performed by Oslund and colleagues (2009) found that patients participating in an interdisciplinary pain management program saw a 17% decrease in pain severity after 6 months compared to pretreatment and a 21% decrease after one year. Similar significant improvement results were seen with hours spent resting, pain interference, control of pain, and perceived helpfulness (Oslund et al., 2009). A different study performed by Kowal, Wilson, Geck,

Henderson, and D'Eon (2011) examined rates of reported change, both in pain alone and overall variation. It was found that only 54.3% of patients reported improvement in pain severity, but 93.2% reported overall global improvement. In this case, the treatment was a week shorter than most traditional programs and still involved reconditioning and exercise. Patients may not have begun to use strategies learned consistently following a physically involved program, which led to some reporting an increase or no change in pain severity (Kowal et al., 2011). Those reporting increases in pain were found to have higher levels of catastrophizing, functional limitations, and lower self-efficacy than those reporting improvement. Overall global improvement was still significantly high, showing the program was effective in other areas that contribute to improved function (Kowal et al., 2011).

Robbins et al. (2003) concluded that completers of an interdisciplinary program demonstrated significant improvements in measures of depression, perceived pain and disability, mental health, physical function, perceived functional disability, coping, and treatment satisfaction compared to those who did not complete the program. These gains were maintained at a one-year follow up, showing that the patients were still receiving benefit from their treatment (Robbins et al., 2003). It was also observed that the dropout group used a larger amount of opioids upon entering the program, while treatment completers were able to decrease their medication usage including opioids and antidepressants (Robbins et al., 2003). This leads to the assumption that those who complete this type of pain management program are less likely to be seeking medical care, particularly for medication, which effectively reduces the expense of healthcare and decreases the need for further costly treatment.

Interdisciplinary programs have shown to be very effective in the management of chronic pain, despite the cost of aligning specialists for that purpose. Cost effectiveness can be defined as

less reliance on healthcare, as well as contributing to society in a way that is opposite of creating a burden through maintaining disability and low function (Robbins et al., 2003). Using an estimation of 176,000 patients utilizing an interdisciplinary pain program, Turk (2002) estimated an annual savings of $1.87 billion in medical costs. Many insurance companies see a high upfront cost as unnecessary, but when compared with the cost over time of inadequate pain treatment it appears to be quite minute. An interdisciplinary program utilizing a team of specialists should be viewed as an investment rather than skipping it in lieu of a cheaper, less beneficial treatment method.

The financial cost of chronic pain to the economy presents a serious issue, however the impact that chronic pain can have on the individual is multifactorial and often leads to debilitation in more areas than just pain. Truchon (2001) calls these concerns “human costs” and includes the notion of pain, as well as quality of life and feelings of helplessness. This is particularly the case for individuals suffering from chronic pain due to a work related injury that is preventing them from returning to receiving wages and contributing to both their family and society. Campbell, Clauw, and Keefe (2003) found that anywhere from 30% to 54% of patients with persistent pain meet criteria for depression, which can enhance certain maladaptive pain behaviors such as withdrawal and unnecessary inactivity. Turk and Okifuji (2002) discuss the implications of pain on self-efficacy and confidence due to a decrease in function and perceived ability levels, maintaining that pain can have more than a physical and biological impact. Many patients with chronic pain fear reinjury and become overprotective of their body, which leads to immobilizing the injured area. This can unbalance the body and cause other physiological issues that would not have been present if it were not for the original injury, further exacerbating the impact of pain (Turk and Okifuji, 2002).

Role of Treatment Providers

The role of the physicians, nurses, and other medical staff is to provide the patient with services that would be considered the biological portion of the model. This includes a variety of things on the part of the physician such as prescribing and monitoring chemical medications, including opioids and narcotics for pain (Ashburn and Staats, 1999). The medical staff would also provide any physical interventions to the individual to relieve pain including surgery, injections, and implants. The physician should be focused on a detailed examination of neurological and musculoskeletal issues (Ashburn & Staats, 1999). The nurse or physician's assistant will see patients following procedures in order to gain follow up information and assess effectiveness. An important role of the physician is to act as medical director of the treatment team and attend staffing meetings to provide information on progress or a lack of to advise on how physically capable an individual is following medical treatment (Gatchel et al., 2014).

Many injuries are a result of an accident at work or have an effect on the ability of the individual to maintain employment (Robbins et al., 2003). Chronic pain can also impact the day-to-day functions and routine of an individual, or activities of daily living (ADLs) such as self-care, household chores, and meal preparation (Wæhrens and Fisher, 2010). The providers that assist with the motor functions and physicality of life are occupational therapists and physical therapists (Ashburn and Staats, 1999). Physical therapists assume responsibility for teaching the patient proper movements and mechanics of the body including in regards to exercise (Gatchel et al., 2014). Their goal is often to challenge the patient to improve their mobility and flexibility in a safe manner (Ashburn and Staats, 1999). Occupational therapists deal with motor function also, but as it relates to daily activities. Occupational therapists can measure if a person is capable of returning to their original position at work or if modifications are possible to improve ability and

function (Hesselstrand, Samuelsson, & Liedberg, 2015). Occupational therapists can also aid the individual in safely returning to performing leisure activities that have ceased due to pain (Ashby, Fitzgerald, & Raine, 2012). Both physical and occupational therapists will also attend staffing meetings to discuss patient progress and barriers to treatment (Gatchel et al., 2014).

The role of the psychologist and other mental health care providers such as professional counselors is to address barriers to rehabilitation in terms of psychological issues including anxiety and depression (Ashburn and Staats, 1999). A key role of psychologists is to administer and interpret assessments and clinical interviews to gain a clear understanding of the motivation of the patient and their concerns entering an interdisciplinary program (Turk and Burwinkle, 2005). This information is useful to all members of the treatment team; therefore attendance to staffing meetings is necessary (Gatchel et al., 2014). Psychologists will also provide treatment in the form of therapy with the patient to improve negative thinking patterns and coping mechanisms. Many mental health providers utilize cognitive behavioral therapy (CBT) to treat various painful conditions. CBT is useful because it is very structured and helps to address specific goals that the patient has. Often, this will involve overcoming fears of reinjury and catastrophizing, improving communication skills through assertiveness training, coping with anger or stressors, and sleep hygiene (Noe and Williams, 2012). Turk and Burwinkle (2005) stated that the length of time a program lasts could vary, although many are 8 hours a day, five days a week for three to four weeks. In this time frame, patients will typically receive eight to ten sessions of CBT, each designed to address a specific topic relevant to treatment of pain (Noe and Williams, 2012). Ashburn and Staats (1999) stated that there are four components to CBT for chronic pain including education, skills acquisition, cognitive and behavioral rehearsal, and generalization and maintenance. Some may also benefit from specialized relaxation techniques

such as biofeedback and hypnosis provided by a mental health professional (Robbins et al., 2003).

Sleep and Chronic Pain

Definitions and Description of Sleep

Rasch and Born (2013) define sleep as "a natural and reversible state of reduced responsiveness to external stimuli and relative inactivity, accompanied by a loss of consciousness." There is much to still be learned about the entire process and function of sleep, however, humans spend a significant portion of their life sleeping and it has been well documented that sleep is necessary for survival (Luyster, Strollo, Zee, and Walsh, 2012). Humans have a homeostatic drive that will eventually force them to sleep, even if only for a short period of time, despite their efforts to remain awake (Luyster, Strollo, Zee, and Walsh, 2012). Sleep has both cycles and stages that occur in order to produce the maximum amount of benefit for the individual. The entire process should repeat itself several times throughout the night. The cycles are based on whether or not rapid eye movement (REM) is occurring (Izac, 2006). There are 4 stages to sleep that all occur during the non-rapid eye movement (NREM) cycle (Silber et al., 2007). Stage 1 is brief and sleep is shallow and easily disturbed. Stage 2 lasts slightly longer and will require more intense interruption in order to be disturbed than would be the case in stage 1. Stages 3 and 4 are often grouped and referred to as slow wave sleep due to increased slow wave brain activity (Silber et al., 2007). Stage 3 is shorter than stage 4 and stage 4 has the most amount of slow wave activity. Following stage 4, the NREM cycle is over and REM can begin (Izac, 2006). The REM cycle is characterized by mixed frequency waves and periods of rapid eye movement (Izac, 2006: Silber et al., 2007). REM cycle sleep is closely associated with dreams and will progressively last longer as the cycles continue to alternate.

Many changes occur from when the body is awake to when it is asleep. Several major systems are affected and undergo changes without needing conscious effort from the brain (Izac, 2006). Initially, the heart rate will slow and blood pressure will drop due to the sympathetic nervous system signaling the body to do so. The sympathetic nervous system is part of the autonomic nervous system, which is primarily responsible for regulating the body systems during periods of sleep (Izac, 2006). Decreased muscle tone is seen in slow wave sleep as well as REM sleep and it keeps the body as restricted as possible during periods when reflexes are not necessary (Izac, 2006). Body temperature begins to decrease prior to the onset of sleep and will continue to drop until closer to waking when the body will begin to warm itself back up (Izac, 2006). During sleep, the muscles of the body are also supplied with more blood than when awake. This helps to promote regeneration as well as healing in affected tissues (Oswald, 1980). Deficits in sleep can be considered good indications that an individual's overall health is suffering. When an individual is healthy, they will sleep a healthy amount. When a sleep disorder exists, it is important to treat it prior to it having an effect on health to avoid creation of a reciprocal cycle (Buysse, 2014).

The International Classification of Sleep Disorders names poor sleep and consequent impaired function as two core criteria for insomnia (American Academy of Sleep Medicine, 2005). Insomnia and nonrestorative sleep are often interchanged when describing sleep disturbances, however they have separate definitions (Liedberg, Bjork, & Borsbo, 2015). Nonrestorative sleep can occur regardless of sleep duration and refers to light rest that still negatively impacts function the next day. Insomnia is difficulty maintaining consistent sleep such as waking often, waking too early, or not falling asleep. Chronic insomnia can develop after one month of experiencing these symptoms consistently (Harsora and Kessman, 2009). Dickens,

McGowan, and Dale (2003) noted that the presence of depression indicates a higher sensitivity to pain. The presence of insomnia is also a risk factor for major depression (Paunio et al., 2015), therefore issues with sleep can inadvertently lead to more pain sensitivity. This clearly illustrates the need for use of the biopsychosocial model in treating chronic pain, as several other factors interact with each other and can contribute to pain.

Psychosocial Issues with Sleep and Chronic Pain

Common psychological issues seen in chronic pain populations are anxiety, depression, anger, and sleep disturbances (Noe & Williams, 2012). Blake et al. (2015) screened chronic pain patients participating in a multidisciplinary program and found that all of them were classified as having some form of sleep disturbance. Many interventions exist for adjusting sleep, particularly in chronic pain populations. Pain is a form of stress on the body that can physically keep you awake, however it also can alter affect through rumination, worry, and other mood related issues that contribute to stress and poor sleep (Lautenbacher, 2012). A study performed by Hamilton, Catley, and Karlson (2007) showed that restorative sleep impacts responses to stress. Stress plays a vital role in maintaining healthy sleep, and those with pain are often facing stress in multiple areas of their life.

Other factors such as stress and psychosocial issues may also contribute to poor sleep, possibly more so than pain alone. It is true that pain can interfere with sleep, but it has been suggested that associated issues are more to blame for this interference. Emotional distress can disrupt sleep as well as exacerbate pain. Lautenbacher (2012) points out how depression has an impact on the way an individual processes pain. Rumination and worry can cause fragmented sleep; therefore treatment of a comorbid mood issue may improve sleep as well as focusing simply on pain (Lautenbacher, 2012). For this reason, some believe pain does not impact sleep

and vice versa in that cycle (Asih et al., 2014). These other present issues are thought to have more of an impact on sleep than pain itself and the lack of quality sleep will exacerbate the same issues that need to be treated separately from pain. A study performed by Asih and colleagues (2014) concluded that insomnia was not an indication of higher pain or mood symptoms, but rather was independent and warranted its own treatment strategies. The biopsychosocial model calls for treating the whole person, no matter the reasons for issues occurring. The nature of the relationship between sleep and pain is often debated, but treating both issues to benefit the individual overall should be the primary goal.

Many patients presenting with chronic pain also present with sleep issues (Blake et al., 2015). Numerous psychiatric disorders also feature various forms of sleep disturbance, including sleeping too much or too little. Eslami, Zimmerman, Grewal, Katz, and Lipton (2015) examined stress, depression, and medical comorbidities as they relate to sleep in individuals with chronic pain. It was concluded that in order to treat sleep related symptoms, it is necessary to concurrently treat all factors contributing to the sleep disturbance. Significant amounts of individuals with chronic pain report comorbid depression symptoms (Campbell, Clauw, and Keefe, 2003). The DSM-5 lists insomnia or hypersomnia as potential core symptoms of depression (American Psychiatric Association, 2013), showing some overlap between depression, pain, and sleep. Campbell et al. (2013) reported that sleep disturbance in adults with persistent pain can aid in predicting onset of depressive symptoms.

Liedberg et al. (2015) studied nonrestorative sleep in fibromyalgia patients and found that the group reporting bad sleep also reported a lower rate of employment and study than those reporting good sleep. This implies that sleep not only impacts an individual personally, but also their ability to contribute to society and participate in meaningful activities including

employment (Liedberg et al., 2015). Poor sleep can lead to poor function the following day, which presents a serious issue when function is already limited due to the presence of pain. Many people tend to not get enough sleep due to both work and social demands (Luyster et al., 2012), but pain can also limit the amount of sleep acquired as well as the quality of sleep. A study performed by del Angel and colleagues (2015) found that restricting time spent sleeping to four hours for five consecutive days resulted in decreased visuospatial and phonological storage in the process of working memory. This implies that those who frequently get little sleep may have issues with problem solving as it relates to verbal information and analyzing spatial cues (del Angel et al., 2015), both of which are often central components of employment. One study found that combining exercise with sleep deprivation may help to reduce the effect of sleep related impairment on long term memory and synaptic plasticity in the hippocampus area of the brain (Zagaar, Dao, Levine, Alhaider, and Alkadhi, 2013). Memory is essential to human survival because it allows for continued adaptation to an inconsistent environment. Chronic sleep loss can impact function in many ways, but memory is especially important to daily productive activities (Rasch and Born, 2013).

Health Risks and Sleep

Because poor sleep is a good indicator of underlying health problems, it is important to take insomnia symptoms seriously. Risk factors for cardiovascular disease including hypertension, obesity, diabetes, and dyslipidemia have been linked to deficits in sleep quality and quantity (Kohansieh and Makaryus, 2015). Problems with sleep are genetic, indicating a biological component exists with insomnia (Luyster et al., 2012). It is considered unethical to do sleep deprivation studies on human subjects, but short sleep durations over a long period of time are linked with an increased risk of death (Luyster et al., 2012). Society as a whole sleeps

increasingly less as time goes on, so sleep is clearly a topic of concern for future health. For this reason, a statement released by the American Academy of Sleep Medicine and Sleep Research Society in 2012 called for increased attention to sleep in healthcare fields (Luyster et al., 2012).

Sleep disturbances often indicate a higher risk for the development of various types of cancer including nasal, breast, oral, and prostate cancers. The presence of sleep disturbances particularly after reaching middle age indicates high risk for cancer development (Fang, Miao, Chen, Sithole, and Chang, 2015). Long sleep duration in women has been considered to decrease the risk of developing breast cancer due to higher levels of melatonin (Verkasalo et al., 2005). One study indicated that insomnia is also highly prevalent in chronic kidney disease populations, with many at risk for sleep apnea (Ahmad, Gupta, Gupta, and Dhyani, 2013). The same study found that the presence of diabetes and depression increased the risk for sleep problems among patients with chronic kidney disease (Ahmad, Gupta, Gupta, and Dhyani, 2013). Research indicates that issues with sleep are related to many chronic and debilitating health conditions (Ahmad, Gupta, Gupta, and Dhyani, 2013, Fang et al., 2015, Verkasalo et al., 2005), warranting further research into treatment options for insomnia.

Chronic sleep loss is comparable with jetlag exhaustion and a recent phenomenon that factors in social determinations of time spent in leisure activity and working versus time spent sleeping, known as social jetlag (Wittman, Dinich, Merrow, and Roenneberg, 2006). Here, there is a discrepancy between the biological clock and the social clock. This form of fatigue is seen less in individuals who sleep and wake at similar times daily, no matter their work and leisure schedule. Social jetlag has been correlated with cigarette use, which possibly ties into the consumption of caffeinated beverages since both are stimulants (Wittman, Dinich, Merrow, and Roenneberg, 2006). Many caffeinated drinks contain large amounts of sugar and a study by

Cappuccio et al. (2008) noted that there is a relationship between short sleep duration and obesity, although causality could not be determined. Overall, it would appear that fatigue and decreased sleep can lead to unhealthy lifestyles, making the case that sleep lost through the presence of chronic pain also presents a serious issue.

Treatment of Insomnia

Medication Usage and Sleep Disruption

Davin et al., (2014) suggested that medications used to treat chronic pain such as opioids and tricyclic antidepressants may be at fault for interrupting sleep rather than pain alone. Interdisciplinary programs often offer medication management and pharmacological interventions (Turk and Burwinkle, 2005), thus if medication is interfering with sleep it can be readily addressed and other options can be explored. Sleep can frequently be treated without using medication by educating the patient about the process and emphasizing the importance of regular, healthy sleep (Berry et al., 2015). Although treatment of sleep related symptoms is present in interdisciplinary care (Davin et al., 2014), often the treatment involves pharmacologic interventions through the physician using medication (Chapman, Lehman, Elliot, & Clark, 2006). This carries particular risks, as sleep medications are effective in the short term, but the long-term effects have yet to be established and a tolerance can build up resulting in additional sleep difficulties if used for longer than the acute period of insomnia (Roth, Krystal, and Lieberman, 2007).

Opioids prescribed for pain have sedative effects on the body, including on the respiratory system (Jungquist, Flannery, Perlis, and Grace, 2012). This is particularly dangerous in patients presenting with sleep apnea or breathing problems prior to being diagnosed with chronic pain due to the respiratory depression associated with opioids. Respiratory depression

during sleep, as well as sleep disruption, are both symptoms associated with opioid use that have not received much research attention (Jungquist, Flannery, Perlis, and Grace, 2012; Von Korff, 2013). Given that opioids are often prescribed to individuals with pain problems, this creates additional sleep issues in a population where it is already prevalent (Webster, Choi, Desai, Webster, and Grant, 2008). It should be noted that a negative side effect of opioids is hyperalgesia, a lowered pain threshold and increased sensitivity to pain (Angst and Clark, 2006). Pain and sleep already interact and can create a vicious cycle, but it appears that opioids can create a similar cycle of increased pain and increased opioid doses further impairing the process of sleep (Finan, Goodin, and Smith, 2013). Prescribing opioids at a higher dose may certainly increase the physiological effects of the drugs, such as the decrease in respiratory function previously discussed.

A study performed by Morin et al. (2009) found that using medication in addition to CBT was helpful for improving acute insomnia, but long-term success was best when medication was discontinued for maintenance CBT. There has been a recent shift towards using antidepressants to treat sleep related issues, rather than typical sleep medication due to the positive effects for both mood and sleep (Chapman, Lehman, Elliot, & Clark, 2006). Antidepressants can act as analgesics to block pain, as well as enhancing sleep. Certain types, such as tricyclic antidepressants, should be used with caution due to a risk of negative side effects (Ashburn & Staats, 1999). Liedberg et al. (2015) found that those reporting bad sleep were using more medication than the group reporting good sleep, which indicates that alternative treatments are necessary to better address sleep issues not improved with prescription medication.

Non-pharmacological Treatment of Insomnia

Few well-established treatment options exist for comorbid pain and sleep issues despite the evidence that they are parallel in a large percentage of patients **(**Davin, Wilt, Covington, and Scheman, 2014). Cognitive behavioral therapy (CBT) has shown to be effective for treating insomnia, although therapy can take anywhere from four to eight sessions. Each session lasts approximately 60 to 90 minutes and will address a variety of topics (Harsora and Kessmann, 2009). Many patients will bring sleep complaints to their medical provider, so it is essential to be aware of basic CBT techniques for insomnia or to make appropriate referrals to other professionals (Harsora and Kessman, 2009). Typically, mental health professionals such as psychiatrists, psychologists, and counselors perform CBT. CBT is effective for treating pain, but can also be useful in addressing sleep issues (Harsora and Kessman, 2009, Morin et al., 2009). The goal of CBT for insomnia is to identify both physical and mental patterns that contribute to poor sleep and work to correct them (Harsora and Kessman, 2009). Depending on the level of insomnia, more extensive interventions and treatment may be necessary. Davin and colleagues (2014) suggest that some individuals are more at risk for sleep problems and consequently require treatment tailored appropriately in order to maximize benefit. There are several CBT techniques and interventions that can be used by nearly any type of clinician to help address insomnia.

Brief psychoeducation interventions that involve simple modifications to lifestyle habits have shown to improve particular aspects of sleep and can be very cost effective (Berry et al., 2015; Harsora and Kessman, 2009). Patient education about sleep hygiene is often helpful for those who may not realize how they can improve sleep by omitting or including certain daily activities. These modifications can be explained briefly by a medical professional and does not require additional visits to a mental health care provider (Berry et al., 2015). Universal healthy

habits include sleeping and waking at consistent times every day of the week, as well as avoiding napping for extended periods of time throughout the day (Berry et al., 2015). In terms of consumption, it is best to avoid large meals and limit caffeine intake beginning several hours before bedtime (Berry et al., 2015). Fluid intake should also become less towards the end of the day to prevent frequent waking due to urination. Healthy individuals will sleep better; therefore it is beneficial to exercise as long as it is several hours in advance of bedtime due to the elevated heart rate associate with activity (Berry et al., 2015). Several modifications can be made to the bedroom to improve sleep. Using the bed only for sleeping and sexual activity has been shown to increase the association between the bed and sleep. In order to maintain the association between the bed and sleep, it is not recommended to remain in bed if you are having difficulty falling asleep (Harsora and Kessman, 2009). Keeping lights dim towards the end of the day and establishing a routine prior to bed will also help teach the body when it is time for sleep (Berry et al., 2015). This is based on the learning principle of stimulus control where environmental cues can become strongly associated with a natural habit such as sleep (Harsora and Kessman, 2009).

Cajochen and colleagues (2011) investigated the effects of light emitting diodes (LED) containing a short wavelength on melatonin, alertness, and cognitive performance. Melatonin is a hormone that aids the body in keeping on a sleep wake schedule by prompting sleepiness as the day goes on and gets darker (Cajochen et al., 2011). There was a significant suppression of melatonin in the group using the LED devices for five hours prior to sleeping in the evening (Cajochen et. al., 2011). Today, many devices are backlit by this form of light including televisions, smartphones, tablets, and computer screens. Light plays an important role in the human ability to maintain a circadian rhythm, and the sun emits light on a wavelength that stimulates vitamin D synthesis in the body (Smolensky, Sackett-Lundeen, and Portaluppi, 2015).

Artificial light allows humans to spend more time awake when they should naturally be sleeping and it is important for patients struggling with insomnia to be informed of this basic evolutionary principle and how circadian rhythms operate.

Tracking sleep through the use of a sleep diary can provide both the patient and clinician with valuable information to discover what works best to improve insomnia. Patterns and trends can be more readily recognized and adjusted when necessary (Berry et al., 2015). Sleep diaries need to be maintained for extended periods of time in order to create a more accurate clinical picture of present sleep issues (Smith and Haythornthwaite, 2004). Many patients can become distressed over a lack of sleep, so it is important to address that fear and any unrealistic expectations about the process of improving sleep. Relaxation strategies are very helpful in calming an individual and with practice, can be done at home as part of a routine prior to bedtime (Harsora and Kessman, 2009, Morin et al., 1999). One study using progressive relaxation found that the technique improved nocturnal sleep, but may take longer to improve subsequent function in the daytime (Means, Lichstein, Epperson, and Johnson, 2000). It is important to note that non-pharmacological interventions for insomnia may take significantly longer in order to be effective than pharmacological treatment (Morin et al., 2009). It is critical to address sleep issues as quickly as possible due to the complex relationship that exists with overall function.

Scope of the Current Study

Following a review of the literature on chronic pain, interdisciplinary care, and sleep it would appear that a study examining sleep among chronic pain populations in an interdisciplinary care setting would contribute to and expand existing knowledge. The interdisciplinary care model is based on the biopsychosocial model, which calls for treatment of

all factors contributing to the condition of a patient. Most literature on these subjects focuses on the interaction among symptoms instead of how well they are being addressed in clinical care. Sleep disturbance and sleep-related impairment are both present in chronic pain conditions regardless of the question of causality. Treatment of all symptoms would be necessary in an interdisciplinary program to better benefit patients and their overall health. Sleep alone plays a key role in health and daily functioning, so it essential to attempt to understand in the context of pain management. This study seeks to examine how well sleep and insomnia are addressed following participation in an interdisciplinary care program that focuses primarily on chronic pain management. Investigating differences in comorbid symptoms in the participants that started the program with lower sleep scores and improved and those who saw little to no improvement would provide insight into what other factors require more attention in interdisciplinary care in order to see more global improvement among patients. Interdisciplinary care has proven to be one of the most effective treatment options for chronic pain, but the condition brings other comorbid symptoms that need attention also in order to increase success rates and improve treatment quality.

H_1: Scores on the sleep measures will significantly improve through participation in the interdisciplinary pain management program.

H_2: Participants showing no sleep improvement following conclusion of the program will exhibit both higher levels of comorbid mood symptoms and higher levels of pain compared to those with higher sleep scores.

CHAPTER THREE

Method

Setting

This study was conducted at the Eugene McDermott Center for Pain Management (EMCPM) located at the University of Texas Southwestern Medical Center (UTSW) in Dallas, Texas. The clinic offers both individual pain management treatments, as well as a comprehensive four-week interdisciplinary program with involvement from multiple providers. UTSW's Institutional Review Board (IRB) consistently monitors ongoing collection, storage, and use of participant data. Participants included outpatient individuals pursuing treatment for chronic pain and were recruited for the program after meeting with clinical staff members for treatment or potential admission into the interdisciplinary program. During an evaluation prior to enrolling in the program, patients completed the study measures in the form of initial testing in order to gain an objective baseline. If they continued into the program, they would repeat study measures at their midpoint and again upon discharge.

Patients entering the program will expect to participate two days per week for about two and a half hours. Appointments are set up either Monday and Wednesday or Tuesday and Thursday for four consecutive weeks. Treatment included physical therapy sessions, behavioral health and counseling sessions, and a group psychoeducation class. Patients could choose from two time slots, either 8 a.m. until 10:30 a.m. or 9:30 a.m. until 12 p.m. and their providers would be scheduled accordingly. All patients in the program received one group psychoeducation session that focuses on sleep in addition to their individual CBT sessions with a psychologist where sleep may be addressed depending on patient preference and need. Although the program is structured, each patient maintains an individual treatment plan set through collaboration of all

providers and patient input. For this reason, the program is a unique, individualized experience for each patient designed to meet his or her needs.

Inclusion and Exclusion Criteria for Participants

Patients presenting with chronic non-cancer pain issues were permitted to engage in the study as long as they were adults over the age of 18, had a primary language of English, and were able to provide consent. Patients also have to grant permission for electronic medical record access by the study team. Study consent was obtained prior to any enrollment in the program in order to gather objective initial data. A number of measures in the study do not have an alternate language other than English to provide or have not been tested for validity; therefore patients who are not proficient in English were excluded from study participation. Prior to testing, patients were informed that the study is optional and they have the option to decline participation without any clinical repercussions that would have an effect on their treatment in the program. Children and adolescents were excluded from the study as the program does not generally serve this population. The program serves chronic pain populations not caused by cancer, therefore only non-cancer participants are included in the study. Participants with incomplete data and missing testing time points were excluded from analysis in this study. 151 patients completed program testing, but only 134 provided complete responses on all measures and were included.

Compensation for Patient Participation

Patients participating in the ongoing study at EMCPM were compensated for their time based on how many time points they completed testing. All individuals were given a choice between receiving either a Wal-Mart or Starbucks gift card to be administered after conclusion of individual testing. Participants were paid an amount of $5 for each time point they tested, not including midpoint testing. Payments were made to those who completed any combination of

baseline testing, post-program testing, and follow up testing for a maximum compensation amount of $15. All gift cards were sent via postal mail to study participants.

Measures

EMCPM has been collecting data to track clinical outcomes, but the data set for this study comprises only a small part of the overall ongoing study. Data is collected from patients at three separate points in the program (initial, midpoint, and discharge) and uses a pre/post treatment data collection method. At the initial testing, demographic data is collected, as well as any relevant medical and psychiatric history, including the onset and origin of pain. The larger ongoing study includes a number of measures on pain, impact on daily function, perceived disability, medication use, healthcare utilization, and pain behaviors. The current study included measures on pain, anger, anxiety, depression, fatigue, pain behavior, pain interference, and physical function as each relates to measures of sleep disturbance and sleep related impairment. Midpoint testing was omitted from analysis in order to include more participants with completed data at all time points.

Composite Pain Rating

This study utilized a rating scale from zero (“No Pain”) to ten (“Worst Pain Possible”) to determine both current pain and pain from the previous week. Patients provided this information at three separate points in the program to determine any improvement or deterioration.

PROMIS Measures Overview

The National Institutes of Health (NIH) created the Patient Reported Outcomes Measurement System (PROMIS) in 2004 to enhance precision and universality of patient reported outcome questionnaires. The overall goal is to use scientific knowledge to provide an efficient way to gather useful and accurate information from patients that can also be used for

their benefit in treatment (Cella et al., 2007). PROMIS measures are based on item-response theory (IRT), which reduces redundant questions and provides for higher statistical power in clinical trials. The three PROMIS domains are physical health, mental health, and social health therefore all items and measures are divided into those overarching categories (Fries, Bruce, and Cella, 2005).

PROMIS Sleep Disturbance Scale

The PROMIS bank for Sleep Disturbance (PROMIS Sleep Disturbance v1.0) contains 27 items that inquire about the patient's sleep in the past seven days including sleep disturbances, sleep quality, and satisfaction with sleep (Buysse et al., 2010). This measure uses a likert scale ranging from five ("not at all") to one ("very much"), five ("very poor") to one ("very good"), or five ("never") to one ("always"). The scale is also designed for use among numerous health conditions and is readily used to compare to other PROMIS measures.

PROMIS Sleep-Related Impairment Scale

The PROMIS bank for Sleep-Related Impairment (PROMIS Sleep-Related Impairment v1.0) contains 16 items that address subsequent daytime impairment following sleep and sleep issues in the past seven days (Buysse et al., 2010). The responses use a likert scale ranging from one ("never") to five ("always") or one ("not at all") to five ("very much"). This scale is often used in conjunction with the PROMIS Sleep Disturbance Scale, as they are currently the only two PROMIS measures for sleep.

Additional Comparison PROMIS Measures

The current study used other PROMIS measures for comparison to the sleep measures including PROMIS Bank v1.0- Anger, PROMIS Bank v1.0-Anxiety, PROMIS Bank v1.0-Depression, PROMIS Bank v1.0-Fatigue, PROMIS Bank v1.0-Pain Behaviors, PROMIS Bank

v1.0-Pain Interference, PROMIS Bank v1.0-Social Satisfaction in Discretionary Social Activities (DSA), PROMIS Bank v1.0-Satisfaction with Social Roles and Activities (Social Sat. Role), and PROMIS Bank v1.0-Physical Function. The PROMIS bank measures for anger and anxiety are both comprised of 29 questions initially, using a likert scale ranging from “never” to “always.” The PROMIS bank measure for depression includes 28 items using a likert scale ranging from “never” to “always.” The bank for fatigue is comprised of 94 items using a likert scale ranging from “not at all” to “very much.” The pain behaviors measure initially has 39 items ranging from “had no pain” to “never” to “always.” The measure for satisfaction in discretionary social activities (DSA) is comprised of 12 items using a likert scale ranging from “not at all” to “very much”. The other social satisfaction scale measures satisfaction with social roles and activities, with a 14-item measure using a likert scale ranging from “not at all” to “very much.” The pain interference item bank is comprised of 41 questions with two likert scales ranging from “not at all” to “very much” and “never” to “always.” The item bank for physical function initially has 124 items with two likert scales ranging from “not at all” to “cannot do” and “without any difficulty” to “unable to do.”

Procedure

Data collection for this study occurred at three separate points for each patient: prior to participation in the interdisciplinary program, mid-way through the program, and upon discharge from the program. The program lasted four weeks, so the midpoint testing was administered after 2 weeks of treatment. Research assistants and clinical staff assisted the patients in testing, as well as filling out necessary documentation. All testing is voluntary and patients were informed that declining participation will not negatively affect their entry or continuation of the program. Prior to testing, all patients were asked to sign a written consent form provided by the UTSW’s IRB as

well as a Health Insurance Portability and Accountability Act (HIPAA) form that details no patient identifiers or protected health information will be released as part of the study without permission from the patient. Both forms were explained to the patient and they were given a copy to keep for their own record. All patients were informed of the purpose of the study, as well as the clinical usefulness of provided answers prior to signing any forms. The measures were administered on a laptop computer using an online resource called Assessment Center. Research assistants set up the computers and explain to patients how to access the site using a login and password assigned to each individual. The site recorded patient responses under their unique Patient Identification (PID) number, also provided prior to each point of testing. Patients were then allowed to start testing and reminded that they may decline to participate at any time. Patients could take breaks as needed and were monitored by research assistants to ensure no technical difficulties occur and the patient could ask questions regarding testing when necessary. If a patient required any physical accommodations for testing such as an increased font size or alternate administration of a paper copy of testing, research assistants would ensure patients are comfortable with the set up and were able to complete the measures.

Assessment Center allows for multiple measures to be combined into one administration therefore patient responses to a multitude of measures can be collected. The larger ongoing study includes 22 overall measures, each with a number of questions for the patient regarding their pain, how it impacts their life, and the history of their condition. Testing generally took patients anywhere from twenty minutes to an hour to complete, depending on the speed of their responses. Baseline testing took participants slightly longer because more questions are asked and more detailed information is necessary. Midpoint and discharge testing included all the same measures, but was shorter than the initial testing and used the same PID the patient used for their

baseline testing. The current study only utilized the baseline and post-program testing. Patients were not billed for the time they spend in a testing session, but required an appointment normally made on a day the patient will already be in for treatment with another provider. The appointments were set up through the EMCPM clinic staff.

Hypotheses

The present study contains two overall hypotheses. The first maintains that scores on the sleep measures will significantly improve through participation in the interdisciplinary pain management program. Improvement will be measured by assessing any differences from baseline to post-program on the two PROMIS sleep measures (PROMIS Bank v1.0-Sleep Disturbance and PROMIS Bank v1.0-Sleep Related Impairment). Statistical analysis was performed using one-way ANOVAs to determine percent improvement upon program completion. The second hypothesis states that participants with non-improved sleep scores following conclusion of the program will exhibit both higher levels of comorbid mood symptoms and higher levels of pain. This process utilized mixed ANOVAs with all other PROMIS measures to compare to groups based on the PROMIS sleep measures to determine any statistically significant interactions among variables.

Statistical Analysis Plan

All data analysis was conducted by means of IBM SPSS software. This study employed a pre/post design structure in order to examine differences throughout the time spent in the program. Paired samples t-tests were performed on the sleep disturbance and sleep-related impairment measures in order to determine statistically significant mean change from baseline to post-program. Participants were then be coded as “sleep improvement” or “non-sleep improvement” in order to individually look at comorbid symptoms between the two groups. The

final T-scores for all PROMIS measures have a mean of 50 and a standard deviation of 10. Participants with scores that improved by 5 points (half standard deviation) on both of the PROMIS sleep measures were examined for individual differences in regards to other PROMIS measures.

In order to observe any interactions between groups, a mixed design ANOVA was conducted using all PROMIS measures with the “sleep improvement” groups representing the between-subjects factor and program testing points (time) representing the within-subjects factor. Main effects of group and time were reported for insignificant measure results. Simple main effects were reported for significant measures by performing an individual one-way ANOVA to assess effect of group, and performing a repeated measures ANOVA with cases split by “sleep improvement” groups to assess effect of time. Because statistics were based on all cases with valid data for modeled variables, separate two-way mixed design ANOVAs was performed on the pain rating measures due to a lower response rate in comparison to all other included measures.

CHAPTER FOUR

Results

Descriptive Statistics and Group Differences

Demographic Information

Of the 151 participants who participated in both initial and post-program testing, 17 were excluded for incomplete measures. Statistics were based on all cases with valid data for modeled variables; therefore the use of last observation carried forward was not used in the sample. One-hundred thirty-four individuals completed all testing measures and were included in analysis. Participants were coded into groups based on whether or not they improved by 5 points on both of the PROMIS sleep measures. Twenty-two individuals comprised the “sleep improvement” group for comparison to the 112 that were placed into the “non-sleep improvement” group. The mean age of the participant sample was 54.52 with a standard deviation of 15.14, and participants ranged from 20 to 86 years of age. The majority of participants were female (77.5%), with 22.5% being male. In terms of race, 62.3% of participants identified as White, 12.6% identified as Black or African-American, 1.3% identified as Asian, 2% identified as American Indian or Alaskan Native, and 21.9% identified as Other. Regarding ethnicity, 23.2% of participants reported their ethnicity as Hispanic or Latino, with 71.5% reporting Not Hispanic or Latino, and 5.3% reported their ethnicity as Not Provided.

Pain Ratings

Participants provided pain ratings (current pain and average pain for the previous week) at both initial and post-program testing. The average rating for current pain at baseline was 5.37, with a standard deviation of 2.47. An average rating of 6.53 for the previous week with a standard deviation of 2.11 was reported at baseline. Post-program the average pain rating was

4.22 with a standard deviation of 2.56. The participants' post-program average pain ratings for the previous week had a mean of 4.89 with a standard deviation of 2.31.

In terms of comparison of pain ratings between study groups, there were outliers, as assessed by boxplot present in the analysis. There was an interaction observed between the sleep improvement groups and time on current pain ratings from baseline to discharge that was not shown to be statistically significant, $F(1, 83) = 1.413$, $p > .05$, partial $\eta^2 = .017$. The main effect of time showed a statistically significant difference in current pain ratings at the different time points, $F(1,83) = 23.023$, $p < .001$, partial $\eta^2 = .217$. The main effect of group showed no statistically significant difference in current pain ratings between the two sleep improvement groups, $F(1,83) = .123$, $p > .05$, partial $\eta^2 = .001$. An interaction was also observed between sleep improvement groups on the measure of average pain from the previous week that was not shown to be statistically significant, $F(1, 83) = 1.223$, $p > .05$, partial $\eta^2 = .015$. The main effect of time presented a statistically significant difference in average pain ratings from the previous week between the sleep improvement groups, $F(1,83) = 29.033$, $p < .001$, partial $\eta^2 = .259$. The main effect of group showed no statistically significant difference in average pain ratings from the previous week between the sleep improvement groups, $F(1, 83) = .066$, $p > .05$, partial $\eta^2 = .001$.

Program Sleep Improvement Results

A paired-samples t-test was used to determine whether there was a statistically significant mean change from baseline to post-program on measures of sleep disturbance and sleep-related impairment. Outliers were detected via boxplot, but upon inspection were not determined to be extreme and therefore were kept in the analysis. Participants improved significantly on sleep disturbance from baseline (M=57.320, SD=9.938) to post-program (M=50.505, SD=18.951), a statistically significant mean decrease of 6.815, SE=1.637, t(135)=-4.162, p<.001, d=-.357.

Significant improvement was also seen on sleep-related impairment from baseline (M=57.819, SD=9.426) to post-program (M=51.872, SD=17.807), a statistically significant mean decrease of 5.947, SE= 1.553, t(134)=-3.828, p<.001, d=-0.329.

Additional PROMIS Measures Comparison Results

Anger

There were outliers, as assessed by boxplot in the groups included in analysis. There was homogeneity of variances (p > .05) as assessed by Levene's test of homogeneity of variances. There was no statistically significant interaction between the sleep improvement group and time on anger, $F(1, 132) = .017$, p > .05, partial $\eta^2 = .000$. The main effect of time showed a statistically significant difference in anger at the different time points, $F(1, 132) = 5.871$, p < .05, partial $\eta^2 = .043$. The main effect of group showed that there was no statistically significant difference in anger between the sleep improvement groups $F(1, 132) = .525$, p>.05, partial $\eta^2=.004$.

Anxiety

There were outliers, as assessed by boxplot in the groups included in analysis. There was homogeneity of variances (p > .05) as assessed by Levene's test of homogeneity of variances. There was no statistically significant interaction between the sleep improvement group and time on anxiety, $F(1, 132) = .154$, p > .05, partial $\eta^2 = .001$. The main effect of time showed a statistically significant difference in anxiety at the different time points, $F(1, 132) = 10.759$, p=.001, partial $\eta^2 = .075$. The main effect of group showed that there was no statistically significant difference in anxiety between the sleep improvement groups $F(1, 132) = 2.432$, p>.05, partial $\eta^2 = .018$.

Depression

There were outliers, as assessed by boxplot in the groups included in analysis. There was homogeneity of variances (p > .05) as assessed by Levene's test of homogeneity of variances. There was no statistically significant interaction between the sleep improvement group and time on depression, $F(1, 132) = .025$, p > .05, partial $\eta^2 = .000$. The main effect of time showed a statistically significant difference in depression at the different time points, $F(1, 132)= 8.979$, p<.05, partial $\eta^2 = .064$. The main effect of group showed that there was no statistically significant difference in depression between the sleep improvement groups $F(1, 132) = 1.498$, p>.05, partial $\eta^2 = .011$.

Fatigue

There were outliers, as assessed by boxplot in the groups included in analysis. There was homogeneity of variances (p > .05) as assessed by Levene's test of homogeneity of variances. There was no statistically significant interaction between the sleep improvement group and time on fatigue, $F(1, 132) = .174$, p > .05, partial $\eta^2 = .001$. The main effect of time showed a statistically significant difference in fatigue at the different time points, $F(1, 132)= 16.347$, p<.001, partial $\eta^2 = .110$. The main effect of group showed that there was no statistically significant difference in fatigue between the sleep improvement groups $F(1, 132) = .526$, p>.05, partial $\eta^2 = .004$.

Pain Behavior

There were outliers, as assessed by boxplot in the groups included in analysis. There was homogeneity of variances (p > .05) as assessed by Levene's test of homogeneity of variances. There was no statistically significant interaction between the sleep improvement group and time on pain behavior, $F(1, 132) = .117$, p > .05, partial $\eta^2 = .001$. The main effect of time showed a statistically significant difference in pain behavior at the different time points, $F(1, 132)= 7.911$

p<.05, partial η^2 = .057. The main effect of group showed that there was no statistically significant difference in pain behavior between the sleep improvement groups, $F(1, 132)$ = 1.166, p>.05, partial η^2 = .009.

Physical Function

There were outliers, as assessed by boxplot, present in the analysis groups. There was a statistically significant interaction between the sleep improvement groups and time on physical function, $F(1, 132) = 6.263$, $p < .05$, partial η^2 = .045. Physical function was statistically significantly greater in the sleep improvement group (M = 37.198, SE = 1.669, p<.05) compared to the non-sleep improvement group (M=34.731, SE=.740, p>.05). Simple main effects were calculated using a separate one-way ANOVA. No statistically significant difference in physical function between groups was present at baseline, however there was a statistically significant difference in physical function between groups post-program, $F(1, 149) = 3.899$, $p = .050$, partial η^2 = .026. There was a statistically significant effect of time on physical function for the sleep improvement group, $F(1, 21) = 17.490$, $p < .001$.

Social Satisfaction (Discretionary Social Activities)

There were outliers, as assessed by boxplot, present in the analysis groups. There was a statistically significant interaction between the sleep improvement groups and time on social satisfaction DSA, $F(1, 132) = 6.516$, $p < .05$, partial η^2 = .047. Social satisfaction DSA was statistically significantly greater in the sleep improvement group (M = 40.795, SE = 1.797, p<.05) compared to the non-sleep improvement group (M=38.904, SE=.797, p>.05). Simple main effects were calculated using a separate one-way ANOVA. No statistically significant difference in social satisfaction DSA between groups was present at baseline, $F(1,133)=1.822$, p>.05, partial η^2 = .014. There was also no statistically significant difference in social

satisfaction DSA between groups post-program, $F(1, 149) = 3.375$, $p > .05$, partial $\eta^2 = .022$. There was a statistically significant effect of time on social satisfaction DSA for the sleep improvement group, $F(1, 21) = 20.853$, $p < .001$.

Social Satisfaction (Roles and Activities)

There were outliers, as assessed by boxplot, present in the analysis groups. There was a statistically significant interaction between the sleep improvement groups and time on satisfaction with social roles, $F(1, 132) = 8.364$, $p < .05$, partial $\eta^2 = .060$. Satisfaction with social roles was statistically significantly greater in the sleep improvement group (M = 37.555, SE = 1.911, p<.05) compared to the non-sleep improvement group (M=36.920, SE=.847, p>.05). Simple main effects were calculated using a separate one-way ANOVA. No statistically significant difference in satisfaction with social roles between groups was present at baseline, $F(1,134)=3.210$, p>.05, partial $\eta^2 = .023$. There was also no statistically significant difference in satisfaction with social roles between groups post-program, $F(1, 149) = 2.208$, $p > .05$, partial $\eta^2 = .015$. There was a statistically significant effect of time on satisfaction with social roles for the sleep improvement group, $F(1, 21) = 4.529$, $p < .05$. There was also a statistically significant effect of time on satisfaction with social roles for the non-sleep improvement group, $F(1,112)=7.19$, p<.05.

Pain Interference

There were outliers, as assessed by boxplot in the groups included in analysis. There was homogeneity of variances (p > .05) as assessed by Levene's test of homogeneity of variances. There was no statistically significant interaction between the sleep improvement group and time on pain interference, $F(1, 132) = .005$, p > .05, partial $\eta^2 = .000$. The main effect of time showed a statistically significant difference in pain interference at the different time points, $F(1, 132)=$

14.137, p<.001, partial η^2 = .097. The main effect of group showed that there was no statistically significant difference in pain interference between the sleep improvement groups $F(1, 132)$ = .285, p>.05, partial η^2 = .002.

CHAPTER FIVE

Discussion

Principle Findings

The current study investigated the effectiveness of interdisciplinary care on measures of sleep disturbance and sleep-related impairment, as well as differences among participants who improved on sleep measures and those who did not. Overall, patients in the interdisciplinary pain management program improved significantly on both sleep measures, as illustrated by an average decrease of approximately 6 points from baseline to program discharge. Once categorized into sleep-improvement and non-sleep improvement groups, participants were compared on all other 9 remaining PROMIS measures, as well as measures of pain ratings. Significant interaction was observed on 3 measures between improvement groups including physical function, social satisfaction with discretionary social activities, and satisfaction with social roles. This illustrated how the sleep-improvement group displayed more positive change on those measures than the non-sleep improvement group.

One hypothesis of the study anticipated higher mood scores for those participants who did not exhibit sleep improvement. This was not a finding of the study, presumably because of the sample setting. EMCPM patients often do not present with high levels of mood disturbance, and therefore little variation in scores is expected. This did not necessarily reflect findings within the literature arguing for poor sleep being related to higher mood disturbance, such as described by Chapman, Lehman, Elliot, and Clark (2006). As Campbell and colleagues (2003) pointed out, sleep disturbance is associated with both depression and chronic pain. Overlap in symptoms occurs and as a result, many test interpretations should be followed up with clarifying inquiries to assess the origin of the symptoms present (Turk and Burwinkle, 2005). It has also been

inferred that mood disturbance likely is a contributing factor to sleep disturbance (Smith and Haythornthwaite, 2004), although similar levels of mood problems and sleep disturbance were not observed in the current study at baseline. Berry et al. (2015) speculated that although mood and sleep may not directly be related, a possible indirect relationship could exist due to the impact that each has on pain. This study did not account for variations in reported pain levels among participants within the groups, and therefore could have contributed to the lack of significance observed between sleep and mood.

Certain PROMIS measures not directly describing mood were included for analysis because they are administered within program testing. Significant interaction was observed on a measure of physical function and two measures of social satisfaction between the sleep improvement groups. Although unanticipated, these findings provide valuable information in the context of pain management. One recent study examined the effect of social satisfaction and physical function on measures of anger and depression, and also utilized PROMIS items for testing. It was argued that chronic pain and emotional distress were negatively influenced by physical and social factors in a complex manner (Sturgeon, Dixon, Darnall, & Mackey, 2015). Although that study did not investigate sleep, it well illustrated the impact chronic pain can have on similar measures of physical function and social satisfaction, as well as how the development of particular issues can lead to other problems within pain populations (Sturgeon, Dixon, Darnall, & Mackey, 2015).

Patients with higher levels of physical functioning presumably would have higher levels of social satisfaction since they are able to better engage with the community. This notion would lead to less global distress and therefore may contribute to better sleep. Fitzgerald and Vietri (2015) noted that particular residual effects of sleeping medication resulted in difficulty with

close personal relationships, ability to work, and home management. The current study did not investigate the effect of sleep medications on results, but those that were able to decrease medication levels by post-program by utilizing non-chemical strategies would likely see less of the residual symptoms reported in the literature which impact social satisfaction.

It was also hypothesized that the interdisciplinary program would significantly decrease sleep disturbance and sleep-related impairment, which was confirmed via statistical analysis. Previous studies have shown similar levels of improvement using comparable treatment methods as those utilized at EMCPM. Interventions focus primarily on cognitive-behavioral strategies in the literature for chronic pain (Berry et al., 2015; Smith and Haythornthwaite, 2004; Gatchel et al., 2014), but also for insomnia and other related issues (Harsora and Kessman, 2009; Morin et al., 2009; Means, Lichstein, Epperson, and Johnson, 2000). Interdisciplinary care has proven to exhibit significant global improvement among patients (Kowal et al., 2011), which would encompass improvement in insomnia as well.

The findings of the current study have clinical application for interdisciplinary pain management. First, the effect of time in the program was shown to be statistically significant on all measures including current pain, average pain from the previous week, anger, anxiety, depression, fatigue, pain behavior, physical function, pain interference, and social satisfaction with discretionary social activities and roles. Although difference between sleep improvement groups was only shown on measures of physical function and social satisfaction, overall the program was successful in all other areas for all patients as well. This strengthens the argument that interdisciplinary care for pain management is quite effective in improving several aspects of patients' lives that influence and contribute to their condition. The results appear to closely embrace the biopsychosocial model in that improvement in one area is reflected in several others

as well. Second, combined sleep disturbance and sleep-related impairment improvement was observed by an average decrease of approximately 6 points. This also echoes the ability of the program to produce relief of insomnia and the effects it has on subsequent daytime function.

Study Limitations

The current study examined participants in an outpatient pain management program. Although encompassing several different types of providers, patients attend only two days per week for a few hours. Other pain management programs require more involvement and higher attendance frequency in order to produce effective results. EMCPM primarily serves private insurance patients over the age of 40, and therefore many are no longer working or as immersed in their community. The majority of the sample was female (77.5%) and many were of higher socioeconomic status or retired. Due to these majorities present in the sample, findings may not be as generalizable or comprehensive in terms of providing information, although still applicable within those demographics. Also, as previously mentioned, many of the patients did not present to the EMCPM program with significant mood disturbance, therefore possibly limiting relevant findings in terms of the related hypothesis involving mood measures. The effects of various medications including opioids, sedatives, and antidepressants were not investigated in the current study and may have influenced particular results such as pain ratings, sleep disturbance, and mood depending on individual patient dosage.

Directions for Future Research

Future studies could control for medication dosage among participants in the sample to verify whether or not substances altering mood, pain, and sleep have similar outcomes. Further research into social satisfaction and the effects it has on pain management is warranted, as the literature appears to lack focused studies on this topic. Because of the interaction observed

between sleep improvement and social satisfaction, prospective research could attempt to explain that relationship more in depth to provide a better understanding of the occurrences presented in the current study.

Conclusions

In summary, the interdisciplinary program at EMCPM was effective in producing relief on a spectrum of symptoms for participants. It was not shown as predicted that those who displayed improvement on sleep measures also displayed better mood (e.g. anger, anxiety, and depression) than those who did not improve as much on sleep by the conclusion of their treatment. The program was effective in lowering sleep disturbance and sleep-related impairment, as expected prior to analysis. The sleep improvement group displayed significantly more improvement on measures of social satisfaction and physical function. The results of this study also reinforce the notion presented by Turk and Burwinkle (2005) that interdisciplinary care should be a model of treating the whole person rather than focusing on individual symptoms independent of one another.

References

Ahmad, S., Gupta, R., Gupta, M., & Dhyani, M. (2013). Prevalence and correlates of insomnia and obstructive sleep apnea in chronic kidney disease. *North American Journal of Medical Sciences North Am J Med Sci, 5*(11), 641-646.

American Academy of Sleep Medicine. International classification of sleep disorders. 2nd ed. Diagnostic and coding manual. IL, Westchester: American Academy of Sleep Medicine; 2005.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Angst, M., & Clark, J. (2006). Opioid-induced hyperalgesia: A qualitative systematic review. *Acute Pain, 104*(3), 570-587.

Ashburn, M. A., & Staats, P. S. (1999). Management of chronic pain. *The Lancet, 353*(9167), 1865-1869.

Ashby, S., Fitzgerald, M., & Raine, S. (2012). The impact of chronic low back pain on leisure participation: Implications for occupational therapy. *The British Journal Of Occupational Therapy, 75*(11), 503-508.

Asih, S., Neblett, R., Mayer, T., Brede, E., & Gatchel, R. (2014). Insomnia in a chronic musculoskeletal pain with disability population is independent of pain and depression. *The Spine Journal*, 2000-2007.

Berry, R., Verrier, M., Rashiq, S., Simmonds, M., Baloukov, A., Thottungal, J., . . . Dick, B. (2015). A brief cognitive–behavioral intervention for sleep in individuals with chronic noncancer pain: A randomized controlled trial. *Rehabilitation Psychology, 60*(2), 193-200.

Blake, C., Cunningham, J., Power, C., Horan, S., Spencer, O., & Fullen, B. (2015). The Impact of a Cognitive Behavioral Pain Management Program on Sleep in Patients with Chronic Pain: Results of a Pilot Study. *Pain Medicine,* Epub ahead of print.

Buchanan, D., Cohen, M., Katz, J., Quintner, J., & Williamson, O. (2007). Beyond Biopsychosocial: A New Framework for Pain Medicine. *Pain Medicine*, *8*(7), 614-615.

Buysse, D. J. (2014). Sleep Health: Can We Define It? Does It Matter? Sleep, 37(1), 9–17.

Cajochen, C., Frey, S., Anders, D., Spati, J., Bues, M., Pross, A., . . . Stefani, O. (2011). Evening exposure to a light-emitting diodes (LED)-backlit computer screen affects circadian physiology and cognitive performance. *Journal of Applied Physiology*, *110*(5), 1432-1438.

Campbell, L., Clauw, D., & Keefe, F. (2003). Persistent pain and depression: A biopsychosocial perspective. *Biological Psychiatry*, 399-409.

Campbell P, Tang N, McBeth J, et al. (2013). The role of sleep problems in the development of depression in those with persistent pain: a prospective cohort study. Sleep 36: 1693–1698.

Cappuccio, F. P., Taggart, F. M., Kandala, N.-B., Currie, A., Peile, E., Stranges, S., & Miller, M.A. (2008). Meta-Analysis of Short Sleep Duration and Obesity in Children and Adults. *Sleep*, *31*(5), 619–626.

Caraway, D., Walker, V., Becker, L., & Hinnenthal, J. (2015). Successful Discontinuation of Systemic Opioids After Implantation of an Intrathecal Drug Delivery System. *Neuromodulation: Technology at the Neural Interface,* 508-516.

Carr, D., & Goudas, L. (1999). Acute pain. *The Lancet*, 2051-2058.

Chapman, J. B., Lehman, C. L., Elliott, J. and Clark, J. D. (2006), Sleep Quality and the Role of Sleep Medications for Veterans with Chronic Pain. *Pain Medicine,* 7: 105–114.

Costigan, M., Scholz, J., & Woolf, C. J. (2009). Neuropathic Pain: A Maladaptive Response of the Nervous System to Damage. *Annual Review of Neuroscience, 32*, 1–32.

Davin, S., Wilt, J., Covington, E., & Scheman, J. (2014). Variability in the Relationship Between Sleep and Pain in Patients Undergoing Interdisciplinary Rehabilitation for Chronic Pain. *Pain Med Pain Medicine,* 1043-1051.

Del Angel, J., Cortez, J., Juárez, D., Guerrero, M., García, A., Ramírez, C., & Valdez, P. (2015). Effects of sleep reduction on the phonological and visuospatial components of working memory. *Sleep Science, 8*(2), 68-74.

Denison, E., Åsenlöf, P., & Lindberg, P. (2004). Self-efficacy, fear avoidance, and pain intensity as predictors of disability in subacute and chronic musculoskeletal pain patients in primary health care. *Pain*, *111*(3), 245-252.

Descartes, R. (1641) *Meditations on First Philosophy, in The Philosophical Writings of René Descartes*, trans. by J. Cottingham, R. Stoothoff and D. Murdoch, Cambridge: Cambridge University Press, 1984, vol. 2, 1-62.

Dickens, C., McGowan, L., & Dale, S. (2003). Impact of depression on experimental pain perception: A systematic review of the literature with meta-analysis. *Psychosomatic Medicine*, *65*(3), 369-375.

Engel, G. L. (1977). The need for a new medical model: a challenge for biomedicine. *Science*, *196*(4286), 129-136.

Eslami, V., Zimmerman, M., Grewal, T., Katz, M., & Lipton, R. (2015). Pain grade and sleep disturbance in older adults: Evaluation the role of pain, and stress for depressed and non-

depressed individuals. *Int J Geriatr Psychiatry International Journal of Geriatric Psychiatry,* Epub ahead of print.

Esquibel, A. Y., & Borkan, J. (2014). Doctors and patients in pain: Conflict and collaboration in opioid prescription in primary care. *Pain*, *155*(12), 2575-2582.

Fang, H., Miao, N., Chen, C., Sithole, T., & Chung, M. (2015). Risk of Cancer in Patients with Insomnia, Parasomnia, and Obstructive Sleep Apnea: A Nationwide Nested Case-Control Study. *J. Cancer Journal of Cancer, 6*(11), 1140-1147.

Finan, P., Goodin, B., & Smith, M. (2013). The Association of Sleep and Pain: An Update and a Path Forward. *The Journal of Pain,* 1539-1552.

Gaskin, D. J., & Richard, P. (2012). The economic costs of pain in the United States. *The Journal of Pain, 13*(8), 715-724.

Gatchel, R., McGeary, D., McGeary, C., & Lippe, B. (2014). Interdisciplinary chronic pain management: Past, present, and future. *American Psychologist,* 119-130.

Grichnik, K. P., and F. M. Ferrante. "The Difference between Acute and Chronic Pain." *The Mount Sinai Journal of Medicine* 58.3 (1991): 217-20.

Hamilton, N., Catley, D., & Karlson, C. (2007). Sleep and the affective response to stress and pain. *Health Psychology,26*(3), 288-295.

Harsora, P., & Kessmann, J. (2009). Nonpharmacologic management of chronic insomnia. *Am Fam Physician, 79*(2), 125-130.

Hesselstrand, M., Samuelsson, K., & Liedberg, G. (2015). Occupational therapy interventions in chronic pain – a systematic review. *Occupational Therapy International, 22*(4), 183-194.

IASP (International Association for the Study of Pain) Part III: Pain terms, a current list with definitions and notes on usage. In: Merskey H, Bogduk N, editors. Classification of chronic pain. 2nd ed. Seattle, WA: IASP Press; 1994. pp. 209–214.

Ibrahim, T., Tleyjeh, I., & Gabbar, O. (2008). Surgical versus non-surgical treatment of chronic low back pain: A meta-analysis of randomised trials. *International Orthopaedics*,589-590.

Inoue, M., Inoue, S., Ikemoto, T., Arai, Y. P., Nakata, M., Miyazaki, A., & ... Ushida, T. (2014). The efficacy of a multidisciplinary group program for patients with refractory chronic pain. *Pain Research & Management*, *19*(6), 302-308.

Institute of Medicine (U.S.). (2011). *Relieving pain in America: A blueprint for transforming prevention, care, education, and research*. Washington, D.C: National Academies Press.

Jungquist, C.R., Flannery M., Perlis, M.L., Grace, J.T. (2012) Relationship of chronic pain and opioid use with respiratory disturbance during sleep. *Pain Manag. Nurs., 13*(2), 70-79

Katz, J. S., Rosenbloom, B., & Fashler, S. (2015). Chronic Pain, Psychopathology, and DSM-5 Somatic Symptom Disorder. *Canadian Journal Of Psychiatry*, *60*(4), 160-167.

Kohansieh, M., & Makaryus, A. (2015). Sleep Deficiency and Deprivation Leading to Cardiovascular Disease. *International Journal of Hypertension*, Epub ahead of print.

Kowal, J., Wilson, K. G., Geck, C. M., Henderson, P. R., & D'Eon, J. L. (2011). Changes in perceived pain severity during interdisciplinary treatment for chronic pain. *Pain Research & Management : The Journal of the Canadian Pain Society*, *16*(6), 451–456.

Lautenbacher, S. (2012). Experimental approaches in the study of pain in the elderly. *Pain Medicine*,*13*(Suppl 2), S44-S50.

Liedberg, G. M., Björk, M., & Börsbo, B. (2015). Self-reported nonrestorative sleep in fibromyalgia – relationship to impairments of body functions, personal function factors, and quality of life. *Journal of Pain Research, 8*, 499–505.

Loeser, J., & Melzack, R. (1999). Pain: An overview. *The Lancet,*1607-1609.

Lumley, M. A., Cohen, J. L., Borszcz, G. S., Cano, A., Radcliffe, A. M., Porter, L. S., & ... Keefe, F. J. (2011). Pain and emotion: a biopsychosocial review of recent research. *Journal Of Clinical Psychology, 67*(9), 942-968.

Luyster, F. S., Strollo, P. J., Zee, P. C., & on behalf of the Boards of Directors of the American Academy of Sleep Medicine and the Sleep Research Society, J. K. (2012). Sleep: A Health Imperative. *Sleep, 35*(6), 727–734.

Means, M. K., Lichstein, K. L., Epperson, M. T., & Johnson, C. T. (2000). Relaxation therapy for insomnia: Nighttime and day time effects. *Behaviour Research And Therapy*, *38*(7), 665-678.

Melzack, R., & Wall, P. (1965). Pain Mechanisms: A New Theory. *Science,* 971-978.

Melzack, R. (1993). Pain: Past, present and future. *Canadian Journal Of Experimental Psychology/Revue Canadienne De Psychologie Expérimentale*, *47*(4), 615-629.

Moayedi, M., & Davis, K. (2013). Theories of pain: From specificity to gate control. *Journal of Neurophysiology, 109*(1), 5-12.

Monti, S., & Caporali, R. (2015). Chronic pain: The burden of disease and treatment innovations. *Reumatismo., 67*(2), 35-44.

Moore, R.A., & McQuay, H.J. (2005). Prevalence of opioid adverse events in chronic non-malignant pain: a systematic review of randomized trials of oral opioids. *Arthritis Res Ther. 7*(5), R1046-R1051

Morin, C. M., Vallières, A., Guay, B., Ivers, H., Savard, J., Mérette, C., … Baillargeon, L. (2009). Cognitive-Behavior Therapy, Singly and Combined with Medication, for Persistent Insomnia: Acute and Maintenance Therapeutic Effects. *JAMA : The Journal of the American Medical Association*, *301*(19), 2005–2015.

Noe, C., & Williams, C. (2012). The benefits of interdisciplinary pain management. *J Fam Pract*, *61*(4 Suppl), S12-6.

Oslund, S., Robinson, R. C., Clark, T. C., Garofalo, J. P., Behnk, P., Walker, B., … Noe, C. E. (2009). Long-term effectiveness of a comprehensive pain management program: strengthening the case for interdisciplinary care. *Proceedings (Baylor University. Medical Center)*, *22*(3), 211–214.

Oswald, I. (1980). Sleep studies in clinical pharmacology. *British Journal of Clinical Pharmacology*, *10*(4), 317–326.

Patel, V., Wasserman, R., & Imani, F. (2015). Interventional Therapies for Chronic Low Back Pain: A Focused Review (Efficacy and Outcomes). *Anesthesiology and Pain Medicine Anesth Pain Med*.

Paunio, T., Korhonen, T., Hublin, C., Partinen, M., Koskenvuo, K., Koskenvuo, M., & Kaprio, J. (2015). Poor sleep predicts symptoms of depression and disability retirement due to depression. *Journal Of Affective Disorders*, *172*381-389.

Rasch, B., & Born, J. (2013). About Sleep's Role in Memory. *Physiological Reviews*, *93*(2), 681–766.

Robbins, H., Gatchel, R., Noe, C., Gajraj, N., Polatin, P., Deschner, M., . . . Adams, L. (2003). A Prospective One-Year Outcome Study of Interdisciplinary Chronic Pain Management:

Compromising Its Efficacy by Managed Care Policies. *Anesthesia & Analgesia, 97*(1), 156-162.

Roth, T., Krystal, A. D., & Lieberman, J. A., III. (2007). Long-term issues in the treatment of sleep disorders. *CNS Spectrums, 12*(7, Suppl. 10), 1–14.

Silber MH, Ancoli-Israel S, Bonnet MH, Chokroverty S, Grigg-Damberger MM, Hirshkowitz M, Kapen S, Keenan SA, Kryger MH, Penzel T, Pressman MR, Iber C (2007). The visual scoring of sleep in adults. *Journal of Clinical Sleep Medicine 3*(2): 121–31

Smith, M., & Haythornthwaite, J. (2004). How do sleep disturbance and chronic pain inter-relate? Insights from the longitudinal and cognitive-behavioral clinical trials literature. *Sleep Medicine Reviews,* 119-132.

Smolensky, Michael H., Linda L. Sackett-Lundeen, and Francesco Portaluppi. (2015) Nocturnal Light Pollution and Underexposure to Daytime Sunlight: Complementary Mechanisms of Circadian Disruption and Related Diseases. *Chronobiology International 32*(8): 1029-1048.

Sturgeon, John A., Dixon, Eric A., Darnall, Beth D., and Mackey, Sean C. (2015) Contributions of physical function and satisfaction with social roles to emotional distress in chronic pain: a Collaborative Health Outcomes Information Registry (CHOIR) study. *Pain 156*(12): 2627-2633.

Robbins, H., Gatchel, R., Noe, C., Gajraj, N., Polatin, P., Deschner, M., . . . Adams, L. (2003). A Prospective One-Year Outcome Study of Interdisciplinary Chronic Pain Management: Compromising Its Efficacy by Managed Care Policies. *Anesthesia & Analgesia, 97*(1), 156-162.

Truchon, M. (2001). Determinants of chronic disability related to low back pain: Towards an integrative biopsychosocial model. *Disability & Rehabilitation, 23*(17), 758-767.

Turk, D., & Burwinkle, T. (2005). Clinical Outcomes, Cost-Effectiveness, and the Role of Psychology in Treatments for Chronic Pain Sufferers. *Professional Psychology: Research and Practice, 36*(6), 602-610.

Turk, D. C. (2002). Clinical effectiveness and cost-effectiveness of treatments for patients with chronic pain. *The Clinical journal of pain, 18*(6), 355-365.

Turk, D. C., & Okifuji, A. (2002). Psychological factors in chronic pain: evolution and revolution. *Journal of consulting and clinical psychology, 70*(3), 678.

Verkasalo, P. (2005). Sleep Duration and Breast Cancer: A Prospective Cohort Study. *Cancer Research, 65*(20), 9595-9600.

Von Korff, M. R. (2013). Long-term Use of Opioids for Complex Chronic Pain. Best Practice & Research. Clinical Rheumatology, 27(5), 663–672.

Wæhrens, E. E., Amris, K., & Fisher, A. G. (2010). Performance-based assessment of activities of daily living (ADL) ability among women with chronic widespread pain. *Pain, 150*(3), 535-541.

Webster, L.R., Choi, Y., Desai, H., Webster, L., Grant, B.J. (2008). Sleep disordered breathing and chronic opioid therapy. *Pain Med. 9*(4), 425-432

Wittmann, M., Dinich, J., Merrow, M., & Roenneberg, T. (2006). Social Jetlag: Misalignment of Biological and Social Time. Chronobiology International: The Journal Of Biological & Medical Rhythm Research, 23(1/2), 497-509.

Wong, W. S., Lam, H. J., Chen, P. P., Chow, Y. F., Wong, S., Lim, H. S., & ... Fielding, R. (2015). The fear-avoidance model of chronic pain: Assessing the role of neuroticism and

negative affect in pain catastrophizing using structural equation modeling. *International Journal Of Behavioral Medicine, 22*(1), 118-131.

Woolf, C. J. (2010). What is this thing called pain? *The Journal of Clinical Investigation*, *120*(11), 3742–3744.

Zagaar, M., Dao, A., Levine, A., Alhaider, I., & Alkadhi, K. (2013). Regular Exercise Prevents Sleep Deprivation Associated Impairment of Long-Term Memory and Synaptic Plasticity in The CA1 Area of the Hippocampus. *Sleep,36*(5), 751–761.

Table 1

Overall Descriptive Program Pain Ratings

	Baseline		Discharge	
Type of Rating	n	M (*SD*)	n	M (*SD)*
Previous Week Average Pain	135	6.53 *(2.11)*	101	4.89 *(2.31)*
Current Average Pain	134	5.37 *(2.47)*	101	4.22 *(2.56)*

Table 2

Overall Program Changes in Sleep (Paired Differences)

Measure	n	M (*SD*)	95% CI	p
Sleep Disturbance	136	-6.81 *(19.09)*	[-10.05, -3.58]	.000
Sleep-Related Impairment	135	-5.95 *(18.05)*	[-9.02, -2.87]	.000

Note. CI = confidence interval.

Table 3

Measure Estimates in Non-Sleep Improvement Group at Baseline

	Non-Sleep Improvement Group		
PROMIS Measure	n	M (*SE*)	95% CI
Anger	134	52.17 (.85)	[50.49, 53.84]
Anxiety	134	56.37 (.76)	[54.87, 57.87]
Depression	134	53.93 (.79)	[52.36, 55.49]
Fatigue	134	61.06 (.77)	[59.55, 62.58]
Pain Behavior	134	59.43 (.37)	[58.70, 60.16]
Physical Function	134	35.69 (.58)	[34.54, 36.84]
Social Sat. (DSA)	134	39.77 (.72)	[38.35, 41.19]
Social Sat. (Role)	134	37.58 (.74)	[36.11, 39.05]
Pain Interference	134	64.49 (.62)	[63.27, 65.72]

Note. CI = confidence interval.

Table 4

Measure Estimates in Sleep Improvement Group at Baseline

	Sleep Improvement Group		
PROMIS Measure	n	M (*SE*)	95% CI
Anger	134	53.73 (1.91)	[49.95, 57.51]
Anxiety	134	60.78 (1.71)	[57.41, 64.16]
Depression	134	57.20 (1.79)	[53.67, 60.73]
Fatigue	134	63.72 (1.73)	[60.31, 67.14]
Pain Behavior	134	60.86 (.83)	[59.21, 62.49]
Physical Function	134	34.99 (1.31)	[32.39, 37.58]
Social Sat. (DSA)	134	37.37 (1.62)	[34.17, 40.57]
Social Sat (Role)	134	33.75 (1.68)	[30.44, 37.08]
Pain Interference	134	65.91 (1.39)	[63.15, 68.67]

Note. CI = confidence interval.

Table 5

Measure Estimates by Non-Sleep Improvement Group at Discharge

		Non-Sleep Improvement Group	
PROMIS Measure	n	M (*SE*)	95% CI
Anger	134	47.76 (1.51)	[44.78, 50.74]
Anxiety	134	50.81 (1.57)	[47.71, 53.91]
Depression	134	48.95 (1.53)	[45.92, 51.98]
Fatigue	134	53.75 (1.68)	[50.43, 57.07]
Pain Behavior	134	53.59 (1.48)	[50.68, 56.52]
Physical Function	134	33.78 (1.13)	[31.53, 36.01]
Social Sat. (DSA)	134	38.04 (1.29)	[35.47, 40.61]
Social Sat. (Role)	134	36.26 (1.29)	[33.71, 38.81]
Pain Interference	134	56.91 (1.69)	[53.55, 60.26]

Note. CI = confidence interval.

Table 6

Measure Estimates in Sleep Improvement Group at Discharge

	Sleep Improvement Group		
PROMIS Measure	n	M (*SE*)	95% CI
Anger	134	49.78 (3.40)	[43.06, 56.51]
Anxiety	134	53.71 (3.53)	[46.73, 60.70]
Depression	134	51.67 (3.46)	[44.83, 58.52]
Fatigue	134	54.72 (3.79)	[47.23, 62.21]
Pain Behavior	134	56.27 (3.33)	[49.69, 62.88]
Physical Function	134	39.41 (2.56)	[34.35, 44.47]
Social Sat. (DSA)	134	44.22 (2.93)	[38.43, 50.01]
Social Sat (Role)	134	41.35 (2.91)	[35.59, 47.10]
Pain Interference	134	58.04 (3.83)	[50.48, 65.61]

Note. CI = confidence interval.

BIOGRAPHICAL SKETCH

Olivia Van Ness
oliviavanness@gmail.com

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	YEAR	FIELD OF STUDY
Texas State University - San Marcos	B.A.	2014	Psychology (minor in Sociology)
The University of Texas Southwestern Medical Center at Dallas-Southwestern School of Health Professions	M.C.R.C.	2016	Clinical Rehabilitation Counseling Psychology

Positions and Employment

2014-Present Nexus Recovery Center, Chemical Dependency Technician/Resident Assistant

Clinical Experience

2013-2014 RestoreFX Functional Restoration Program, Psychology Research Intern
2015-2016 Productive Rehabilitation Institute of Dallas for Ergnomics (PRIDE), Disability Management Intern
2015-Present UT Southwestern University Rehabilitation Services (URS), Individual Counseling and Psychological Assessment Intern
2016-Present Productive Rehabilitation Institute of Dallas for Ergonomics (PRIDE), Psychology and Counseling Intern

Presentations and Publications

2016 Coauthor: Huber, E., Robinson, R. C., Noe, C. E., & Van Ness, O. (2016). Who Benefits from Chronic Opioid Therapy? Rethinking the Question of Opioid Misuse Risk. *Healthcare*, *4*(2), 29. http://doi.org/10.3390/healthcare4020029

Professional Memberships

2013-Present Psi Chi International Honor Society in Psychology, Lifetime Member
2015-Present International Association of Rehabilitation Professionals (IARP)