Fall 12-2021

Sleeping with the Enemy: Examining the Relationship Between Sleep and Pain in Post-9/11 Veterans

John L. Schwartz Jr.
Old Dominion University, jschw004@odu.edu

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by

John L. Schwartz, Jr.
B.S. May 2013, Michigan State University
M.S. December 2015, Francis Marion University

A Dissertation Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

PSYCHOLOGY

VIRGINIA CONSORTIUM PROGRAM IN CLINICAL PSYCHOLOGY
December 2021

Approved by:

Michelle L. Kelley (Director)

Karen Y. Holmes (Member)

Robin J. Lewis (Member)

Skye O. Margolies (Member)

ABSTRACT

SLEEPING WITH THE ENEMY: EXAMINING THE RELATIONSHIP BETWEEN SLEEP AND PAIN IN POST-9/11 VETERANS

John L. Schwartz
Old Dominion University, 2021
Director: Dr. Michelle L. Kelley

United States veterans are a diverse group of individuals, yet as a result of their service, they share a unique set of customs, traditions, and values. Post-9/11 veterans are more likely to experience elevated levels of pain and poor sleep quality compared to their civilian counterparts; however, little is known about how beliefs related to veterans' pain impact their sleep and how levels of pain acceptance influence the sleep-pain association. This study examined relationships between sleep and pain in a sample of 102 post-9/11 veterans. Results support associations between pain and sleep identified in other populations. Positive correlations were found between levels of pain and poor sleep quality, pain-related beliefs about sleep and poor sleep quality, and pain and pain-related beliefs about sleep. A negative correlation was found between levels of pain acceptance and pain-related beliefs about sleep – that is, higher levels of acceptance of one's pain was associated with lower pain-related thoughts regarding one's sleep. Additionally, pain-related beliefs about sleep were found to mediate the relationship between pain and sleep quality. This finding reinforces the importance of addressing pain-related thoughts about sleep among post-9/11 veterans. Although it was hypothesized that greater acceptance of chronic pain would moderate the relationship between pain and sleep, this hypothesis was not supported. Findings from this study provide vital information to help inform treatment in efforts to assist co-occurring conditions related to sleep and chronic pain commonly found in veterans. The relationship between pain and sleep among recent-era veterans is complex; thus, additional

research is needed to further elucidate this relationship and continue to examine specific treatments to more effectively assist post-9/11 veterans with comorbid pain and sleep difficulties.

This dissertation is dedicated to my wife, parents, and sister. You all have provided unconditional encouragement and love throughout this exhilarating journey.

ACKNOWLEDGEMENTS

Throughout my time in the Virginia Consortium Program in Clinical Psychology, I have been blessed with incredible mentorship and support from faculty members across all three institutions. Dr. Kelley, you are the hardest working individual I have had the pleasure of working with, and I am grateful to have been under your mentorship. I appreciate your dedication to help guide and support me throughout this dissertation process. I would also like to thank the rest of my committee; every one of you have had a profound impact on my academic journey. Dr. Holmes, I have valued your professional guidance and commitment to facilitate my growth as an academic and lecturer. It was a joy to work with you throughout the years. Dr. Lewis, your devotion to the program and its students is unwavering. You have truly gone above and beyond to provide counsel and support on multiple occasions, and I am grateful for your willingness to join this committee. Dr. Margolies, more than anyone you have enriched my growth as a clinician. Under your mentorship, I discovered my passion for working with those with chronic pain and insomnia, and you helped me fuse this passion into my research endeavors as well. In addition, I owe a great deal of gratitude to all of the supervisors, instructors, mentors, and colleagues who have helped me throughout my academic career. I would also like to thank my parents and sister for their steadfast encouragement and love. To my dog, Tie, and tortoise Rupert, thank you for being patient and being two of the best listeners I could ask for. Lastly, to my wife; you have always been there to support me and my dream to become a clinical psychologist. From moving away from family to completing the vast majority of the household duties; out of everyone, you have sacrificed the most. Your love and encouragement have made it possible for me to complete this dissertation with my sanity still intact.

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CHAPTER I

INTRODUCTION

It is estimated that there will be over five million post-9/11 veterans by the end of 2021 (National Center for Veterans Analysis and Statistics [NCVAS], 2018). More than any other era, these veterans are diagnosed with a variety of conditions directly related to their activity while in the service. Some of the most common disorders are related to chronic pain and poor sleep (Cifu et al., 2013; Polley, Frank, & Smith, 2013). Although many researchers have examined a bidirectional association between these two variables in civilian populations, little is known about the relationship between pain and sleep among post-9/11 veterans. The present study investigated this association by examining the impact that veterans' thoughts have regarding their pain and sleep on their levels of pain intensity and sleep quality. Other studies have demonstrated the impact that one's acceptance regarding their pain has on their levels of pain sensitivity and co-occurring factors, such as mood (Cook et al., 2015; Kratz, Davis, & Zautra, 2007; McKracken, 1998; Veehof, Oskam, Schreurs, & Bohlmeijer, 2011). This relationship has not yet been demonstrated within post-911 veterans; therefore, the present study examined the impact of acceptance of pain on sleep quality in recent-era veterans. It is the hope that findings will provide information that may assist this population with both chronic pain and sleep.

Recent-Era United States Veterans

Veterans are individuals who served in the active military and received any type of discharge from their service other than dishonorable (Szymendera, 2016). They are a unique group of men and women, and as a result of their military service, they share distinct cultural values, customs, traditions, patterns of communication, codes of conduct, and ethos (Olenick,

Flowers, & Diaz, 2015). It is estimated that there are more than 18 million veterans currently living in the United States (NCVAS, 2019a).

Although close to one-half of all living veterans served in the Army (44%), the current veteran population is also comprised of prior Navy (21%), Air Force (17%), Marine Corps (11%), Reserves (5%), and non-defense members (1%), which includes the Coast Guard, the Public Health Service, and the National Oceanic and Atmospheric Administration (NCVAS, n.d.). Veterans are also diverse in terms of ethnicity and socioeconomic backgrounds. Most veterans identify as Caucasian (77%), 11.5% of veterans are African American, 7.3% are Hispanic, 1.7% identify as more than one race, and 1.6% are Asian (NCVAS, 2019a). Although the average number of veterans who are at or below the poverty level is slightly lower than the civilian average, veterans are overrepresented in the homeless population (Fargo et al., 2012; NCVAS, 2019a). Among those in poverty, veterans are two-to-three times more likely to be homeless than civilians. Veterans are also at an increased risk of chronic diseases (Fargo et al., 2012). According to the NCVAS (2019a), the average veteran is also likely to be male (91%); the median age for male veterans is 65 years, whereas the median age for female veterans is 51 years.

As veterans are diverse in age, it is important to differentiate between the eras in which veterans served. Veterans can be placed into two broad categories: pre- and post-9/11 servicemembers. Those who served before the Iraq and Afghanistan conflicts include, WWII, Korean, Vietnam, and Persian Gulf War veterans; veterans serving after 9/11 include those involved in Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF), Operation New Dawn (OND), and Operation Inherent Resolve (OIR; Torreon, 2015). As of 2016, there were 4.2 million post-9/11 veterans, and this number is constantly growing as recent-era military members

continue to leave the service (NCVAS, 2018). Based on the era in which they served, veterans have faced varying circumstances and are comprised of different demographics. At a median age of 35, recent-era veterans are younger, more ethnically diverse, and are at greater need of physical and mental health services. Although many veterans experience similar health concerns, given that recent-era veterans have experienced unique combat situations, the present study focused on post-9/11 veterans.

Veteran health. Not only do veterans experience the same health conditions as non-veterans, but they are at an increased risk of being diagnosed with physical and mental health problems due to the nature of many service positions and deployment demands. As a result, veterans acquire service-connected disabilities, which are disabilities that are a direct result of an injury or event experienced during active military service. Currently there are about 4.7 million veterans who have a service-connected disability (NCVAS, 2019b). Although the veteran population has been steadily declining since 1990, there has been a 117% increase in the total number of veterans who have a service-connected disability due to increased injuries among recent-era veterans. Specifically, 35.9% of post-9/11 veterans have a service-connected disability, compared to 18.6% of all other veterans (NCVAS, 2018). In a 2017 report of 92,853 combat-wounded veterans, Fales and colleagues found that 88.1% of post-9/11 veterans with service-connected disabilities had three or more injuries or health problems. Two of the most common problems were related to sleep and pain.

Since 2002, 61% of OEF, OIF, and OND veterans have obtained Veterans Affairs (VA) health care; musculoskeletal alignments (i.e., back and joint conditions) are the most commonly diagnosed disorders (Department of Veterans Affairs, 2015). Other common physical disorders that veterans experience are traumatic brain injuries (TBIs), amputations, chronic pain, and

various ailments due to exposure to hazardous chemicals, such as radiation and other pollutants (Olenick et al., 2015). Olenick et al. (2015) state that healthcare professionals need to be mindful of veterans' increased risk of mental health disorders; in fact, about one-third of veterans have at least one mental health diagnosis, such as post-traumatic stress disorder (PTSD), depression, or a substance use disorder. More than one-half of recent-era combat-wounded veterans reported visiting a professional to assist with mental health related issues in the past three months (Fales et al., 2017). As a result of veteran-specific struggles that accompany members of this population, it is projected that anywhere between 18 and 22 veterans commit suicide each day, with veterans under the age of 44 being at a greater risk (Olenick et al., 2015). There is a close link between both physical and mental health problems experienced by this population. For example, with veterans it is common for mental health symptoms, such as PTSD and depression, to exacerbate co-occurring physical disorders, such as chronic pain and sleep issues (Karlin, Trockel, Taylor, Gimeno, & Manber, 2013; Outcalt et al., 2015).

Veteran Sleep Quality

As issues related to sleep quality are some of the most common health problems among veterans, there is a clear need to assist this population with managing these symptoms (Alexander et al., 2016). Sleep quality encompasses more than just the time an individual is asleep throughout the night. In fact, sleep quality is comprised of multiple components. Specifically, when considering one's overall sleep quality, it is also important to measure the amount of time it takes one to fall asleep (onset/latency), daytime dysfunction, self-rated sleep quality levels, sleep efficiency (the ratio of amount of time one spends asleep to the total amount of time they are in bed), use of sleep medication, and both the number and duration of one's night-time awakenings (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Insomnia develops

when components of poor sleep quality persist over time, such as trouble initiating and maintaining sleep despite given an adequate amount of time (Thorpy, 2012). According to Spielman's 3-p model of insomnia, predisposing, precipitating, and perpetuating factors are integral to the onset and maintenance of poor sleep and insomnia. Everyone starts with certain predisposing factors that make them more or less susceptible to poor sleep; however, it is in the presence of a precipitating event – such as shift work schedules, pregnancy, or combat exposure, to name a few – that triggers reaching this threshold (Perlis, Shaw, Cano, & Espie, 2011). Over time individuals try to compensate for poor sleep by engaging in behaviors that do not promote better sleep and inadvertently interfere with their sleep quality, such as staying in bed when they are not ready to fall asleep. Thus, even when a precipitating event has passed or is no longer relevant, the compensatory behaviors (i.e., perpetuating factors) lead to the chronic pervasiveness of poor sleep that can cause a variety of other health conditions.

Those who have poor sleep quality and quantity are prone to experience increased emotional distress, severe impairments in daytime functioning, and general mortality (Gallicchio & Kalesan, 2009; Rosekind & Gregory, 2010). Rosekind and Gregory (2010) also found that insomnia can initiate and exacerbate symptoms of mental health disorders, including anxiety, depression, and substance abuse. Insomnia can also affect physical conditions, such as obesity, hypertension, breathing problems, diabetes, and chronic pain. Thus, it is imperative to examine populations that are more prone to having sleep disorders.

The veteran population is one that is at particularly high risk of experiencing poor sleep quality and coinciding sleep disorders (Faestel, Littell, Vitiello, Forsberg, & Littman, 2013). Faestel and colleagues (2013) examined a group of 411,313 adults (55,361 of whom were veterans) to investigate possible differences between veteran and non-veteran sleep quality. They

determined that veterans were more likely to experience insufficient sleep and reported getting less sleep compared to non-veterans (Faestel et al., 2013). Another study conducted by Polley et al. (2013) examined sleep in 2,866 veterans and determined that veterans obtain an average of 5.6 hours of sleep per night compared to 6.7 hours in the general population. In addition, they found that 76% of the veterans experienced insufficient sleep, 91% reported excessive daytime sleepiness, and 74% met clinical criteria for insomnia. They identified factors that influence the sleep quality of veterans, to include difficulty slowing or stopping thoughts at night and experiencing pain and muscle tension. Veterans with combat experience reported hypervigilance, nightmares, and distressing memories as factors affecting their sleep (Polley et al. 2013).

Troxel et al. (2015) argued that most of the poor sleep demonstrated in recent-era veterans is due to sleep disturbances as a reaction to stress. Service members endure nontraditional work hours, and the demands of deployment have an impact on their sleep schedules that can persist once they complete deployment (Plumb, Peachey, & Zelman, 2014). One study examined the impact of work stressors on 101 U.S. Navy members before, during, and six months after an 8-month post-9/11 deployment (Bravo, Kelley, Swinkels, & Ulmer, 2018). Not only was a direct, positive correlation between work-related stress and poor sleep quality demonstrated, but it was poor sleep quality that mediated the relationship between increased work stress and increased depressive symptoms. Bravo and colleagues also found that sleep problems remained problematic six months after their deployment. Thus, the difficult demands that servicemembers endure have lasting impacts on both their physical and mental well-being.

It is well documented that deployment-related stressors, such as combat exposure, are associated with TBIs and PTSD, both of which contribute to poor sleep (Bramoweth & Germain, 2013). Among 1,388 recent-era veterans, 17% meet criteria for TBI (Lindquist, Love, &

Elbogen, 2017). Individuals with a history of a TBI are about four times more likely to experience excessive daytime sleepiness, nightmares, early awakenings, and overall poor sleep maintenance compared to those who do not (Mathias & Alvaro, 2012). In a meta-analysis designed to estimate the prevalence of PTSD, Fulton et al. (2015) estimated that 23% of recent-era veterans serving in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) have PTSD. Among 80 veterans with PTSD, 74% met criteria for insomnia and 61% endorsed frequent nightmares (Pigeon, Campbell, Possemato, & Ouimette, 2013). Not only is insomnia highly correlated with PTSD, obstructive sleep apnea is as well. In a sample of 195 OEF, OIF, and OND veterans, Colvonen and colleagues (2015) found that 69.2% either met criteria or were at risk of obstructive sleep apnea. There was a positive correlation between sleep apnea and PTSD-symptom severity. Not only do these factors negatively affect sleep, but poor sleep has additional adverse impacts on veteran's health.

Poor sleep in veterans can lead to cardiometabolic disorders and daytime-cognitive impairment, which can increase the risk of accidents, injury, and ultimately lead to mortality amongst veterans (Troxel et al., 2015). Poor sleep quality in veterans is also associated with an increased risk and exacerbation of panic disorders, major depressive disorders, PTSD, TBI symptoms, suicidality, and risky drinking behaviors (Bramoweth & Germain, 2013; Swinkels et al., 2013; Troxel et al., 2015). In fact, the combination between poor sleep quality and heavy drinking can increase risks of suicide ideation and attempts among veterans. In a study of 161 veterans, Chakravorty and colleagues (2014) found that among those who reported heavy drinking, 39% endorsed suicidal ideation. Further, those with poor sleep quality were more likely to have attempted suicide in the past year. In fact, due to shorter sleep time and the coinciding health effects associated with poor sleep, Faestel et al. (2013) concluded that veterans are a high-

risk group that should receive additional education and interventions to improve their sleep quality.

Sleep quality treatment. The recommended treatment to improve sleep quality depends on the intensity of the symptoms and the nature of the sleep disorder itself. For example, if the veteran is diagnosed with obstructive sleep apnea, they are most likely be prescribed a continuous positive airway pressure (CPAP) machine or similar device (Polley et al., 2013). Nearly 40% of veterans have been prescribed a CPAP machine or similar device as an effective tool to combat obstructive sleep apnea. Although many veterans use sleeping pills for assistance, they are not the most effective sleeping aid. Sleeping pills can lead to physical and psychological dependency, can lose their effectiveness over time, have been found to reduce the overall quality of one's sleep, and lead to daytime dysfunction and cognitive impairment (Smith, Robinson, & Segal, 2019). Sleep hygiene recommendations – such as discontinuing the use of electronic devices prior to falling asleep, waking up at the same time every morning, keeping the room cool and dark, and monitoring caffeine usage – can benefit those with mild sleep dysfunction; however, if a veteran meets criteria for insomnia, more effective treatments are recommended.

The frontline treatment recommended to assist with severely poor sleep quality in this population is cognitive behavioral therapy for insomnia (CBT-I; Trockel, Karlin, Taylor, & Manber, 2014). CBT-I includes therapies such as stimulus control, sleep restriction, and cognitive strategies. Although stimulus control strengthens bed-sleep associations by limiting time in the bedroom to sleeping, sleep restriction works to realign one's sleep drive with their natural circadian rhythm, and cognitive strategies assist with pervasive thoughts that prevent them from sleeping. These factors work together in an effort to improve the overall sleep quality.

Trauma-related nightmares also contribute to insomnia as they keep veterans up throughout the night. Techniques such as imagery rehearsal therapy are used to assist with nightmares. The procedure of imagery rehearsal therapy starts by having the veteran select a nightmare, then changing the nightmare, and rehearsing the new dream (Krakow & Zadra, 2006). Moreover, multiple studies have emphasized that imagery rehearsal therapy is more effective along with CBT-I (Casement & Swanson, 2012). In a randomized control trial, Margolies and colleagues (2013) demonstrated the effectiveness of combining CBT-I and imagery rehearsal therapy in a veteran sample. When compared to the wait-listed control group, the treatment sample exhibited significant reductions in overall PTSD symptoms, PTSD-related nighttime issues, distressed mood, and improvements in sleep quality.

Although there are effective treatments to assist with sleep quality, many veterans do not use them. Instead, many use ineffective sleep aids, such as alcohol or sleeping pills (Polley et al., 2013). There are many barriers that influence veterans' choices to engage in treatment to improve their sleep quality. Polley et al. found that 28% of veterans surveyed who had sleep difficulties are reluctant to talk to healthcare professionals about their sleep. Veterans in this survey reported that a lack of confidence in treatment efficacy, stigma of having a sleep disorder, aversion to sleep medications, and not wanting to go to the doctor were the most common reasons why they do not seek sleep assistance. It is also difficult to assist veterans with their sleep without addressing common, co-occurring physical disorders that influence their sleep, such as chronic pain.

Veterans and Chronic Pain

According to the International Association for the Study of Pain, chronic pain is "an unpleasant sensory and emotional experience associated with actual or potential tissue damage,

or described in terms of such damage" (Treede, 2018). Additionally, chronic pain is defined as pain that continues past the normal healing period and is classified as such when it persists for more than three months (Treede et al. 2015). Approximately 20% of individuals are affected by chronic pain worldwide (Treede et al. 2015). Chronic pain is the result of a number of factors that can be due to serious illnesses, such as cancer, as well as neuropathic, headache/orofacial, visceral, or musculoskeletal pain. The veteran population is at a greater risk of injury and subsequent opioid misuse; thus, they require additional attention and may greatly benefit from alternative treatments for pain management (Kartalias & Mauntel, 2019; Volkow & Collins, 2017).

Service members across all branches experience physically demanding conditions related to their military duties. Although injuries can result from combat situations, such as implemented explosive device blasts or firefights, most injuries sustained by veterans are a result of training and environmental conditions (Army Public Health Center [APHC], 2018b). Musculoskeletal injuries (e.g., neck, back, and leg pain) are often referred to the biggest health problem in the military (APHC, 2018a). These injuries can arise as a result of either acute or chronic incidents to the body due to repeated stress over time. Nearly 50% of military members experience at least one injury annually, with the most common related to stress fractures, sprains, and strains found in the lower extremities, back, and shoulders. Over half of the injuries are a result of physical training exercises, specifically running-related activities. Additional injuries in the military can result from obstacle courses, combative training, and road marching, where service members march long distances while carrying between 75 and 125 pounds of equipment (APHC, 2018b).

As a result of these conditions and demands, it is not surprising that many veterans experience chronic pain. Using a sample of 970 OIF and OEF veteran electronic medical records,

Gironda and colleagues (2006) determined that pain was the most common complaint that veterans reported at VA hospitals. These records showed 47% of veterans self-reported at least mild levels of pain, whereas 28% endorsed moderate or severe levels of pain. More recently, Cifu and colleagues (2013) examined 613,391 Veteran Health Administration records and found that 40.2% of OIF, OEF, and OND veterans were diagnosed with pain disorders. Musculoskeletal and connective tissue disorders are the most prevalent in returning service members, causing up to 82% of chronic pain complaints (Gironda, Clark, Massengale, & Walker, 2006). Goulet and colleagues (2016) examined 5,237,763 Veterans Health Administration patient records of individuals who visited at least twice within an 18-month period or were identified to have a muscular disorder between 2000 and 2011. Of these veterans, 18% endorsed clinically severe pain. The most common types of musculoskeletal pain were non-traumatic joint pain (27%), back pain (25%), and osteoarthritic pain (21%). Among veterans with other physical problems, chronic pain appears especially high. Specifically, Lew and colleagues (2009) examined the prevalence chronic pain in 340 OIF and OEF veterans using Veterans Affairs Polytrauma Network Site medical records. Among those who endorsed polytrauma complaints, such as light sensitivity, headaches, and cognitive difficulties, 81.5% endorsed chronic pain with the most common pain locations in the back (58%) and head (55%). As there is such a variety of injuries within this population, treatment for pain varies between individuals as well.

Chronic pain treatment. Similar to treatment recommendations for sleep, chronic pain treatment is informed by the nature and intensity of the pain. Turk, Wilson, and Cahana (2011) report that traditional forms of treatment for chronic pain include steroid or nerve-blocking injections, implantable devices, surgery, physical therapy, or transcutaneous electric nerve

stimulation (TENS) units, yet the most common treatment for most chronic pain disorders is the use of pharmaceuticals. These medications include non-steroidal anti-inflammatory drugs (NSAIDs), skeletal muscle relaxants, topical agents, as well as the most common class of prescription pain drugs: opioids. Although indicated for some patients (malignant pain, etc.), opioids are highly addictive and can cause multiple side effects, including constipation, nausea, somnolence, and misuse that can lead to death. Between 2010 and 2016, opioid overdose deaths among veterans increased by 65% (Lin, et al., 2019). As of 2011, 720,287 Veterans Health Administration patients were prescribed opioids to assist with non-cancer-related chronic pain (Edlund et al., 2014), and approximately 12.5% of veterans prescribed opioids were diagnosed with an opioid use disorder (Bennett, Elliott, & Golub, 2015). As a result of this misuse, the U.S. Department of Veterans Affairs and the Department of Defense recently revised the guidelines for opioid therapy in efforts to reduce the frequency of opioid prescriptions for chronic pain (Rosenberg, Bilka, Wilson, & Spevak, 2017). In this interest, adjunctive interventions beyond pharmaceutical approaches are recommended to minimize pain intensity and interference. Where pain intensity refers to the level of pain one may experience, pain interference is the level to which one's pain limits their social, physical, or mental activities (Amtmann et al., 2010).

Chronic pain is often interpreted from a biopsychosocial vantage, yet there is a combination of social and psychological factors that accompany this disorder (Gatchel, Peng, Peters, Fuchs, & Turk, 2007). While traditional forms of treatment aim to eliminate or decrease levels of pain, it is recommended that treatment should focus on increasing functioning within this population (Center for Substance Abuse Treatment, 2012; Govenden & Serpell, 2014). Thus, more comprehensive care is needed to extend beyond the focus of eliminating or blocking the biological causes of the pain. This includes chronic pain management that considers the

psychological and social aspects of pain. To achieve this more holistic approach, integrative or complementary forms of treatment are used to better address chronic pain needs. These treatments include massage therapy, yoga, exercise, and mindfulness-based stress reduction practices (Teets, Dahmer, & Scott, 2010). Multiple meta-analyses support the effectiveness of these treatments in reducing musculoskeletal-based pain while also aiming to increasing levels of functioning (Anheyer, et al., 2017; Furlan, Imamura, Dryden, & Irvin, 2009; Hayden, Van Tulder, Malmivaara, & Koes, 2005; Holtzman & Beggs, 2013). Specifically, within the veteran population, yoga has been demonstrated to reduce chronic low-back pain while subsequently increasing energy and decreasing symptoms of depression (Groessl, Weingart, Aschbacher, Pada, & Baxi, 2008).

Acceptance and Commitment Therapy (ACT) is another treatment that has strong support as an intervention for individuals experiencing chronic pain, as it has been demonstrated to lower levels of depression, anxiety, and disability while increasing pain acceptance (McCracken & Vowles, 2014). ACT uses mindfulness meditation, cognitive defusion, and committed action exercises to enhance psychological flexibility to assist chronic pain veterans to live a life according to their values. ACT for chronic pain has been associated with improved levels of pain interreference, decreased levels of depression, and less pain-related anxiety (Wetherell, et al., 2011). According to Wetherell and colleagues, when compared to cognitive behavioral therapy for pain, those who participated in ACT report higher levels of satisfaction regarding their treatment.

Pain acceptance. One of the hallmarks of ACT is related to one's level of acceptance regarding their pain. A natural reaction for those who experience chronic pain is to either avoid or attempt to control the pain (McKracken, 1998). Although a counterintuitive approach,

acceptance of chronic pain aims to decrease attempts to avoid or control one's pain while increasing participation in valued activities (McCracken, Vowles, & Eccleston, 2004). McCracken (1998) sought to demonstrate the benefits of pain acceptance in regards to chronic pain symptoms and overall life quality. He examined 160 chronic pain patients and found that, regardless of the intensity of their pain, their level of pain acceptance was negatively correlated with pain-related anxiety and avoidance, symptoms of depression, and both physical and psychosocial disability. Additionally, pain acceptance was also correlated with increased daily uptime, improved work status, and overall positive adjustment (McKracken, 1998). In order to guide and inform treatment for chronic pain, it is important to examine specific factors within a population that influence one's level of acceptance.

The relationship between one's level of pain acceptance and the perception of the intensity of their chronic pain is inversely related. Veehof and colleagues (2011) conducted a meta-analysis examining the effects of ACT on chronic pain symptoms. Their review demonstrated relationships between increased levels of pain acceptance and decreased levels of perceived intensity across studies (Veehof et al., 2011). Additionally, Kratz and colleagues (2007) examined chronic pain acceptance in a sample of 110 female chronic pain patients diagnosed with either osteoarthritis or fibromyalgia. Their findings demonstrated that greater levels of pain acceptance act as an effective moderator in weakening the relationship between negative emotions and intensified pain (Kratz, Davis, & Zautra, 2007). Additionally, one study examined levels of pain acceptance in trauma-exposed veterans found that pain acceptance was negatively associated with disability even after accounting for symptoms of PTSD, depression, alcohol use issues, and mild TBI (Cook, et al., 2015). Little else is known about the relationship

between pain acceptance and chronic pain as compared to other factors that influence pain acceptance in veterans.

Relationship Between Sleep Quality and Chronic Pain

The relationship between poor sleep and chronic pain can be described using the two-process model of sleep regulation. This model states that there are two processes – circadian rhythm and the homeostatic sleep drive – that interact to affect patterns in sleep (Toporikova, Hagenauer, Ferguson, & Booth, 2017). While the circadian rhythm is our natural 24-hour-based alerting system, the homeostatic sleep drive is best described as our hunger for sleep; the longer we are awake the more this hunger builds. When these two systems are properly aligned, the need for sleep builds up throughout the day, and we fall asleep when our internal alerting signals wind down in the evenings. Pain can influence this process, affecting the quality and quantity of sleep one is able to attain. Pain sensitivity is also modulated by the time of day and influenced by prior sleep. Toporikova and colleagues suggest that daily rhythms of pain sensitivity reflect an interaction of the circadian rhythm and homeostatic sleep drive processes. In other words, pain both impacts and is impacted by circadian rhythm and homeostatic processes. An overwhelming amount of evidence suggests a bidirectional effect between pain and sleep; as one worsens, it can cause the other to do as well (Koffel et al., 2016).

Although considerable literature has demonstrated poor sleep as a direct predictor for subsequent increases in pain, additional studies have demonstrated that pain-related worry, as it is associated to sleep, is what predicts sleep disturbances, despite one's levels of pain intensity (Buenaver et al., 2012; Tang, Goodchild, Sanborn, Howard, & Salkovskis, 2012). Tang and colleagues (2012) investigated a number of factors related to pain, sleep, pre-sleep arousal, and mood in a sample of 119 patients living with chronic pain and insomnia. They found that sleep

quality was a consistent predictor for reported pain levels experienced the next day. Although pre-sleep levels of pain were not a predictor of sleep in their study, Tang et al. found that sleep was more accurately predicted by levels of pre-sleep cognitive arousal. In other words, it is the thoughts regarding the pain and poor sleep, also referred to as pain-related beliefs about sleep, that might be interrupting sleep more than the physical aspects of the pain. Related to the Tang et al. study, Buenaver and colleagues (2012) were interested in examining the indirect effects that catastrophizing about one's pain may have on the individual. They found that sleep disturbances explained much of the variance between the pain severity/pain-related interreference relationship. Additionally, they found that sleep disturbances were associated with greater levels of pain catastrophizing. More specifically, the rumination component of pain catastrophizing thoughts yielded the strongest associations to sleep disturbances. These relationships have not been investigated within the veteran population.

Not only are veterans affected by poor sleep quality and chronic pain independently, but these two conditions are highly co-morbid. Koffel and colleagues (2016) examined this bidirectional relationship between pain and sleep in a sample of 250 veterans. They determined that changes in pain significantly predicted changes in sleep and, to a greater extent, changes in sleep predicted changes in pain. It is not surprising that the effects of these reciprocating factors are common across this population. According to Polley and colleagues (2013), combat veterans reported difficulty slowing their thoughts down as the primary factor impacting their sleep and pain as the second most impactful factor. Surprisingly, those who did not engage in combat rated pain as the primary factor that disrupted sleep. Many veterans attempt to compensate for both pain and poor sleep by taking opioids and sedatives. Kelley and colleagues (2019) examined a group of 212 combat-wounded veterans and found that 46.2% met criteria for opioid misuse and

21.7% for sedative misuse. Those who misused both opioids and sedatives displayed more distress as they reported higher levels of depression, suicidality, PTSD symptoms, anger, alcohol use, and both sleep disturbances as well as pain interference.

As pain and sleep are intertwined, it is imperative to examine the impact of the thoughts related to these aspects in efforts to inform treatment. Pain-related beliefs about sleep are dysfunctional beliefs or attitudes that many who experience chronic pain may have about how their pain may interfere with sleep (Afolalu, Moore, Ramlee, Goodchild, & Tang, 2016). Examples of these beliefs include, "Unless I get rid of the pain, I won't sleep well," and, "With the pain, I can never get myself comfortable in bed." Afolalu and colleagues demonstrated that pain-related beliefs about sleep are positively correlated with insomnia severity scores in non-veteran samples. Little is known about how these thoughts may play a role on the intensity and frequency of the symptoms related to both pain and sleep quality among veterans. Thus, more research is needed to understand veterans' pain-related beliefs associated to sleep and the impact they have on sleep quality.

Study Purpose

The purpose of this study was to examine the relationships between pain and sleep quality within the veteran population. Additionally, the investigator was interested in exploring pain-related beliefs about sleep and levels of acceptance veterans have regarding their pain. The potential for pain-related beliefs about sleep to mediate the relationship between the pain intensity and sleep quality relationship was also investigated. Furthermore, the investigator examined levels of veterans' chronic pain acceptance as a moderator of the pain intensity and sleep quality association. The following hypotheses were proposed based on the literature described above.

Hypothesis 1 (Pain and poor sleep quality). The investigator hypothesized a positive correlation between veterans' levels of pain and their poor sleep quality, such that higher reports of pain would be correlated with poorer sleep quality.

Hypothesis 2 (Pain-related beliefs about sleep and poor sleep quality). Similar to the relationship between pain-related beliefs about sleep and poor sleep quality in non-veteran samples (Afolalu et al., 2016), it was hypothesized that pain-related beliefs about sleep would be significantly and positively correlated with poor sleep quality, such that more pain-related beliefs about sleep would be correlated with poorer sleep quality.

Hypothesis 3 (Pain and pain-related beliefs about sleep). Given that veterans have endorsed the impact that pain has had on their sleep quality in other studies (e.g., Koffel et al., 2016; Polley et al., 2013), the investigator hypothesized a significant and positive relationship between the levels of pain intensity/interference and pain-related beliefs about sleep. That is, as pain intensity/interference increases, pain-related beliefs about sleep would increase as well.

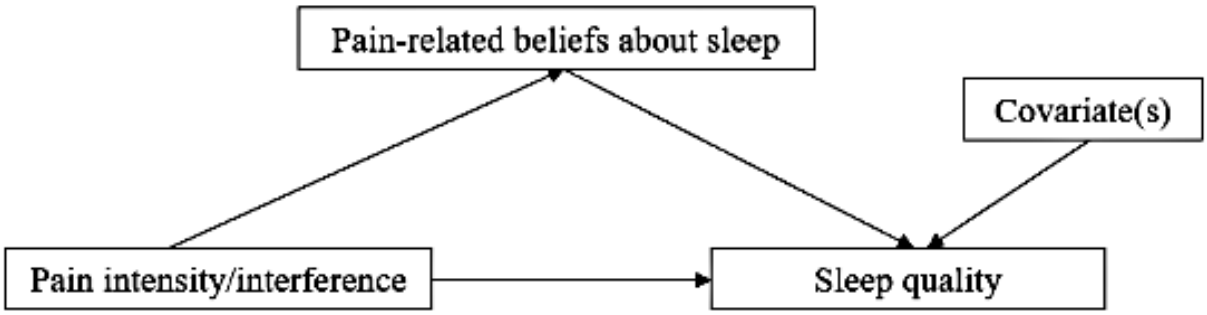
Hypothesis 4 (Pain acceptance and pain-related beliefs about sleep). The investigator hypothesized a negative correlation between veterans' levels of pain acceptance and their pain-related beliefs regarding sleep. That is, as levels of pain acceptance increases, pain-related beliefs about sleep would decrease.

Hypothesis 5 (Pain-related beliefs about sleep as a mediator of the association between pain and poor sleep quality). Prior veteran studies have demonstrated a direct, positive relationship between pain intensity and poor sleep quality (Koffel et al., 2016; Lew et al., 2010), as well as pain-related thoughts about sleep and poor sleep quality (Afolalu et al., 2016). As seen in Figure 1, the investigator hypothesized that pain-related beliefs about sleep would mediate the effect that pain has on poor sleep. In other words, veterans' pain-related

thoughts, as they relate to sleep, would explain much of the pain intensity-poor sleep relationship. According to Lewis and colleagues (2009), age and PTSD are also associated with sleep quality; thus, these variables were considered as potential covariates.

Figure 1

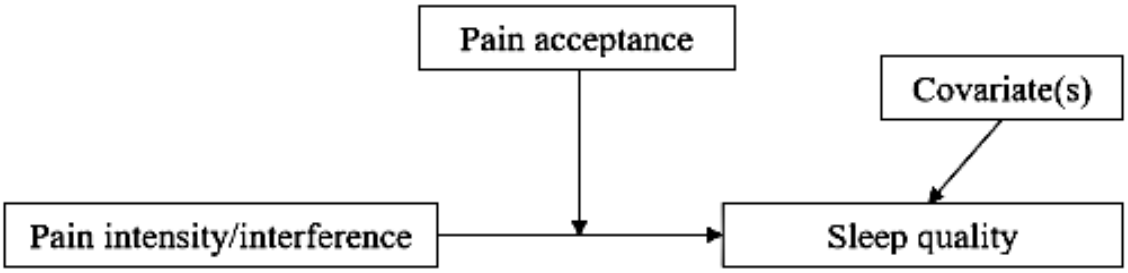
Conceptual Mediation Model for Hypothesis #5



Hypothesis 6 (Pain acceptance as a moderator between pain and poor sleep quality). Many studies have examined the use of pain acceptance in lowering levels of perceived pain as well as co-occurring negative emotions (Cook, et al., 2015; Kratz et al., 2007; McKracken, 1998; Veehof et al., 2011), yet there is limited literature demonstrating the impact pain acceptance has on the veteran population and other cooccurring consequences of chronic pain, such as poor sleep quality. Thus, the investigator hypothesized that, as a moderator, levels of pain acceptance would weaken the relationship between pain intensity levels and poor sleep quality. That is, even in the presence of intense levels of pain, if veterans exercise more acceptance regarding their pain, poor sleep quality would be lower than those who exercise lower levels of pain acceptance. As prior studies have found that age and PTSD are associated with sleep quality, these variables were considered as potential covariates (Lewis, Creamer, & Failla, 2009). Prior studies have demonstrated a direct, positive relationship between pain intensity and poor sleep quality (Koffel et al., 2016; Lew et al., 2010). Also, regardless of pain intensity, studies have determined that higher levels of pain acceptance are negatively correlated with pain-related health outcomes, such as depression, anxiety, and general mobility (Cook, et al., 2015; McKracken, 1998). As poor sleep quality is another pain related health-outcome, the investigator determined higher levels of pain acceptance would act as a protective factor in regards to poor sleep quality as well. As prior studies have found that age and PTSD are associated with sleep quality, these variables were considered as potential covariates. See Figure 2.

Figure 2

Conceptual Moderation Model for Hypothesis #6



CHAPTER II

METHOD

Participants

This study recruited 102 post-9/11 veterans ranging from 18 to 64 years of age (M = 29.4; SD = 6.13). In order to determine that the participants were veterans, two effective screening questions were asked at the beginning of the study to ensure they served: "What is the acronym for the locations where final physicals are taken prior to shipping off for basic training?" and, "What is the acronym for the generic term the military uses for various job fields?" (Lynn & Morgan, 2016). Lynn and Morgan demonstrated these two questions help ensure that all participants are veterans. As this study aimed to recruit recent-era veterans an additional screening question asked participants if they are a post-9/11 veteran. A total of 13 veterans were recruited through the use of flyers/online list-serve, 23 through social media, and nine through announcements at veteran organization meetings. In addition to these recruitment avenues, 57 student veterans were recruited from the psychology online research participation system; student veteran participants were compensated with research credit. No other compensation was provided. All of the participants were treated in accordance with the ethical standards and guidelines set by the university human subjects committee and the American Psychological Association (APA). This study obtained approval through the ODU Institutional Review Board (IRB) panel.

Procedure

This study used Qualtrics, an online survey platform, to collect the data. In order to protect the anonymity of the participants, no identifying information (e.g., name, birth date, social security number, etc.) was asked of the participants for this study. Prior to starting the

survey, participants were asked to read and acknowledge their understanding of the participant consent form. Then they were presented with a page asking if they were a military veteran; this included the two veteran screening questions described above. If they reported that they were not a veteran, they were thanked and notified that they did not qualify for the study. If they stated that they were a veteran, they moved to the demographics portion of the questionnaire; see Appendix I. Next, participants completed the measures in the following order: Pittsburgh Sleep Quality Index, Pain Enjoyment General Activity Scale, Pain-related Beliefs About Sleep, Chronic Pain Acceptance Questionnaire-8, PTSD Check List-5, and the DSM-5 Self-Rated Level 1 Cross-Cutting Symptom Measure-Adult. This order was based on the importance of the measure; more important measures were included earlier in the study in case participants withdrew in the middle of the survey. At the end of the survey, referral information was provided for the participants.

Measures

The following is a list of self-report measures that were used throughout the course of this study.

Sleep quality. The Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989; see Appendix A) is the most widely used measure to assess sleep quality. It contains 18 items to examine participants' sleep quality scores. These items include four open-ended questions asking about bedtime, sleep latency, wake-time, and total sleep time. The next section lists sleep disturbances, including feeling too hot/cold, coughing or snoring loudly, getting up to use the bathroom, having bad dreams, etc., that may disrupt their sleep. Respondents were asked to select the degree that these factors cause sleep disturbances in the past month on a four-point Likert scale (0 = *not during the past month* and 3 = *three or more*

times a week). The next three questions provide the same four-point Likert scale and ask participants during the past month how often they have taken medication to help them sleep, have had trouble staying awake while engaged in daily activities, and have had difficulties getting things done. Lastly, it includes a subjective rating of sleep quality asking participants on a four-point Likert scale (3 = *very bad* and 0 = *very good*), "During the past month, how would you rate your sleep quality overall?" Combined, these items produce a global sleep quality score that is comprised of seven component scores. These seven component scores measure sleep quality based on sleep latency, sleep duration, one's subjective view of their own sleep quality, sleep disturbances, sleep efficiency, daytime dysfunction, and use of sleep medications. Thus, the higher the global PSQI score, the poorer the sleep quality. The highest global score one can obtain is 21; scores above 5 indicate poor sleep (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). A total of 87 veterans, over 85%, scored above 5 on this measure; thus, the overwhelming majority endorsed poor sleep quality.

Psychometric properties of the PSQI have been well established (Yu et al., 2012). Carpenter and Andrykowski (1998) demonstrated both internal consistency and reliability of component and global PSQI scores in a general population, with Cronbach's alphas at .80, across multiple participant groups, including pain populations. The current study found internal consistency, Cronbach's alpha of .79. Although correlations between other constructs, such as mood and depression were low, $r < .37$, correlations between global PSQI scores and reported sleep problems were high, $r > .69$, $p < .001$ (Carpenter & Andrykowski, 1998). Construct validity has also been established with significant correlations with similar constructs, including the Insomnia Severity Index (ISI; Bastien, Vallières, & Morin, 2001) $r = .80$, $p < .05$ (Morin,

Belleville, Bélanger, & Ivers, 2011). This measure has also been used and validated in post-9/11 veteran samples (Hughes, Ulmer, Hastings, Gierisch, Workgroup, & Howard, 2018).

Additionally, questions were added to investigate the frequency, duration, and time of day any naps were taken. These questions included, "Do you take naps?", "If Yes, how often are your naps?", "How long are your naps on average?", and "What time(s) of the day do you usually nap?"

Pain. The Pain Enjoyment and General Activity scale (PEG) is a 3-item measure that gauges the intensity and the interference with both the enjoyment of life and general activity (Krebs, et al., 2009; see Appendix B). The pain intensity item provides an 11-point Likert scale (0 = *no pain* to 10 = *pain as bad as you can imagine*) and asked participants, "What number best describes their pain on average in the past week?" The other two items are also based on an 11-point Likert scale (0 = *does not interfere* to 10 *completely interferes*). The items ask, "What number best describes how, during the past week, pain has interfered with your enjoyment of life" and "… general activity," accordingly. All three items have a total score of 10, with higher scores relating to higher levels of pain intensity and interference with both the enjoyment of life and general activity. Significant correlations with other established sleep measures, such as the overall pain distress and Brief Pain Inventory Questionnaires (BPIQ; Tan, Jensen, Thornby, & Shanti, 2004), were also established in this same sample, *r*s = .77 - .95. This measure has also been validated in a veteran sample (Matthias, McGuire, Kukla, Daggy, Myers, & Bair, 2015).

In order to attain more specific, qualitative information regarding the participant's pain, three additional questions were added to this section that asked about the nature, frequency, and duration of the pain. These open-ended questions asked, "What type of pain do you have?", "How often do you experience this pain", and "How long have you been experiencing this pain?"

Additionally, the PROMIS Adult Short Form v1.0 – Pain Interference 6b (PROMIS-PI SF 6b; Amtmann et al., 2010; see Appendix C) is a 6-item measure used to assess pain interference. This self-report measure asks five questions based on a 5-point Likert scale (1 = N*ot at all* to 5 *Very much*). Examples of these items include, in the past seven days "How much did pain interfere with your enjoyment of life?" and "How much did pain interfere with your day-to-day activities?" The last item is also based on a 5-point Likert scale (1 = *Never* to 5 *Rarely*) asking participants in the past seven days "How often did pain keep you from socializing with others?" A global score is produced by summing individual item scores. Scores ranged from 6 to 30, with higher scores indicating higher levels of pain interference. Askew and colleagues (2013) demonstrated internal consistency reliability of the PROMIS-PI SF 6b, with Cronbach's alpha at .94. The Cronbach's alpha for this measure was .96 for this study. This measure has also been used in a veteran sample (Matthias, McGuire, Kukla, Daggy, Myers, & Bair, 2015).

Pain-Related Beliefs about Sleep. The Pain-Related Beliefs and Attitudes about Sleep (PBAS; Afolalu et al., 2016; see Appendix D) is a 10-item measure that examines inflexible beliefs as they relate to the relationship of the sleep-pain interaction. Participants were asked to rate the level to which they agree with each statement, presented with an 11-point Likert scale for all 10 items (0 = *strongly disagree* to 10 = *strongly agree*). The scale is divided into two factors – pain as a primary cause of insomnia, and inevitable consequences of insomnia on pain and coping – each comprised of five items. Examples of the items related to the pain as a primary cause of insomnia component include, "The pain is always there when you try to have a good night's sleep," and "When I am in pain, I simply can't get to sleep no matter how hard I try." Items related to the inevitable consequences of insomnia on pain and coping include, "I won't be able to cope with the pain if I don't sleep well," and "I get very annoyed when the pain

wakes me up." Each component score ranges from 0 to 50, with a combined score being a maximum of 100 points. The higher the score, the more severe the pain-related thoughts about sleep. Afolalu and colleagues (2016) demonstrated internal consistency reliability in samples with participants who experienced both pain- and sleep-related problems with a Cronbach's alpha at .84; internal consistency for this study was found to have a Cronbach's alpha .96. They also determined significant correlations with similar measures, including the Dysfunctional Beliefs About Sleep (DBAS-16; Morin, Vallières, & Ivers, 2007), Insomnia Severity Index (ISI; Bastien, Vallières, & Morin, 2001), and the Anxiety and Preoccupation about Sleep Questionnaire (APSQ; Jansson-Fröjmark, Harvey, Lundh, Norell-Clarke, & Linton, 2011), *r*s = .37 - .65, $p < .001$. As a hallmark of this present study is to examine these pain-related beliefs in post-9/11 veteran sample, it is the first one to use this measure exclusively in this population.

Two of the items on the PBAS questionnaire were slightly modified for the use of this study. Since many of the veterans may meet the desired population, but may not have a diagnosis of insomnia or meet criteria for the disorder, "/ poor sleep" was added after "insomnia" in items 1 and 10. The reflected change reads as, "My insomnia*/ poor sleep* is largely a result of the pain and there is nothing I can do about it," and "The insomnia*/ poor sleep* is taking away one of my few breaks from the pain." Again, the focus is not necessary on a clinical sample of veterans with diagnosed sleep problems, but rather those that experience poor sleep quality in this population. Also, many veterans may not get care for sleep problems or receive care not in the Veterans Health Care System.

Pain acceptance. The 8-item Chronic Pain Acceptance Questionnaire (CPAQ-8; Fish, McGuire, Hogan, Morrison, & Stewart, 2010; see Appendix E) is a shortened version of the 20-item original used to assess one's level of acceptance in relation to their pain. The CPAQ-8 is

a two-factor measure with four of the items representing activity engagement and the other four factoring into the pain willingness component. Participants were asked to rate how true each of the items are based on a seven-point Likert scale (0 = Never true to 6 = always true). Examples of the activity engagement items include, "I am getting on with the business of living no matter what my level of pain is," and "I lead a full life even though I have chronic pain." Examples of the pain willingness items include, "Keeping my pain level under control takes first priority whenever I am doing something," and "Before I can make any serious plans, I have to get some control over my pain." The pain willingness component also includes a reverse-scored item, "My worries and fears about what pain will do to me are true." Each factor has a maximum of 24 points with a combined score of 48, with higher scores represent increased levels of pain acceptance. Internal reliability for pain willingness and activity engagement had a Cronbach's alpha = .68 and .86, respectively, with all items at .81 (Fish, Hogan, Morrison, Stewart, & McGuire, 2013). The Cronbach's alpha for the pain willingness and activity engagement scales were both found to be at .82, yet the total item internal reliability for all items was .59 for the current study. Since the Chronbach's alphas were higher for the component scores compared to the combined score for the CPAQ-8, analyses that used this measure were run using the individual component scores as well. Fish and colleagues (2013) also determined construct validity was established with similar measures, including the Pain Self-Efficacy Questionnaire (PSEQ; Nicholas, 2007) and the Acceptance and Action Questionnaire-II (AAQ-II; Bond, et al., 2011), *r*s = .48 - .72, $p < .001$. This measure has also been used and validated in a veteran sample (Cook, et al., 2015).

PTSD screener. The revised version of the PTSD Checklist for the DSM-5 (PCL-5; Blevins et al., 2015; see Appendix F) is a 20-item measure used to indicate symptoms of PTSD. As PTSD is strongly associated with sleep quality, this measure was used as a covariate in the

following analyses (Lewis, Creamer, & Failla, 2009). The PCL-5 asks participants to rate how much they have been bothered by each item in the past month. The participants were provided a five-point Likert scale (0 = *Not at all* to 4 = *Extremely*). Examples of the items include, "Avoiding memories, thoughts, or feelings related to the stressful experience," and "Feeling jumpy or easily startled." The scores from each item are added, and the measure produces one global score ranging from 0 to 80. Higher scores indicate more severe levels of PTSD symptoms. It is recommended that individuals who score above 33 on this measure are likely to meet criteria for a PTSD diagnosis. Over 63% (n = 64) of individuals in this study were above this recommended cut-off. Blevins and colleagues (2015) demonstrated strong internal consistency with a Cronbach's alpha at .94 and convergent validity *r*s = .74 - .85. The current study found a Cronbach's alpha at .97. This measure has also been validated in a post-9/11 veteran sample (Tanev, Federico, Terry, Clark, & Iverson, 2019).

Mental health screener. The DSM-5 Self-Rated Level 1 Cross-Cutting Symptom Measure- Adult (American Psychiatric Association, 2013; see Appendix G) was used to used to provide descriptive information about the sample. It contains 23 items that assesses 13 mental health domains. These domains include depression, anger, mania, anxiety, somatic symptoms, suicidal ideation, psychosis, sleep problems, memory, repetitive thoughts and behaviors, dissociation, personality functioning, and substance use. The measure asks participants, "During the past two (2) weeks, how much (or how often) have you been bothered by the following problems?" Participants were provided with a five-point Likert scale (0 = *Not at all* to 4 = *Nearly every day*). Examples of the items include, "Little interest or pleasure in doing things?" and "Feeling detached or distant from yourself, your body, your physical surroundings, or your memories?" Bravo, Villarosa-Hurlocker, and Pearson (2018) examined internal consistency for

the eight domains that contained multiple items and found Cronbach's alphas at .61 - .84; this study found a Cronbach's alpha between .72-.92 with the exception of mania and substance use at .50 and .30 respectively. They also examined conversion validity of all 13 domains and found significant, positive correlations ranging with similar mental health measures *r*s = .19 – 67. This measure has also been validated in veteran samples (Bravo, Kelley, Mason, Ehlke, Vinci, & Redman, 2020).

TBI screener. As TBIs are linked to both poor sleep quality and pain, the HELPS Brain Injury Screening Tool (HELPS; Picard, M., Scarisbrick, & Paluck, 1991; see Appendix H) was used to assess history of a TBI and provide additional descriptive information about the sample. This is a 5-item measure that asks participants to select yes or no for the following questions, "Have you ever Hit your Head or been Hit on the Head?", "Were you ever seen in the Emergency room, hospital, or by a doctor because of an injury to your head?", "Did you ever Lose consciousness or experience a period of being dazed and confused because of an injury to your head?", "Do you experience any of these Problems in your daily life since you hit your head?", and "Any significant Sickness?" An individual is likely to have had a brain injury if they answer yes to items 1, 2, or 3 and yes to items 2 or 3 and report 2 or more symptoms listed under the fourth item.

Demographic questionnaire. This study included a demographic questionnaire that assessed the participants' sex, age, sexual orientation, race/ethnicity, living situation, occupation, education, and relationship status. In addition to the demographic information described above, the author added specific questions that access military information. This includes their type of discharge, current military status, rank upon discharge, years of enlistment, years in the service,

branch of service, and military occupation. Questions about the duration, number of, and nature of deployments were also asked (see Appendix I).

Attention checks. Four questions were asked throughout the course of the survey to ensure that the participants are reading and accurately answering the questions. These questions are, “I was born on planet earth,” “Please leave this item blank,” and “Choose the third answer.” Additionally, age was asked twice to ensure reliability in participant answers.

CHAPTER III

RESULTS

Descriptive Information

Although 125 individuals completed the survey, 23 participants failed to accurately respond to at least one of the four attention checks. Thus, data from 102 participants were used for hypothesis testing. Of these 102 participants, 65 identified as male and 37 as female. The majority of participants identified as Caucasian (79%), followed by African American (8%), other (7%; comprised of 4% multiracial & 3% Hispanic), Asian/Pacific Islander (4%), and Native American (2%). The majority of participants identified as being heterosexual (71%) followed by homosexual (14%), mostly heterosexual (8%), bisexual (6%), mostly homosexual (2%). While 65 participants met criteria for a provisional PTSD diagnosis, based on their PCL-5 score (>33), 31 participants had a positive score (>2) on the HELPS TBI screening tool. Additionally, somatic symptoms (61%) and sleep problems (56%) were the top two domains endorsed on the DSM-5 Self-Rated Level 1 Cross-Cutting Symptom Measure-Adult. See Table 1 for additional demographic information, including employment and marital status. See Table 2 for additional mental health domains.

Participants' military history and service-connected disabilities varied as well. Exactly 50% of the participants were deployed to a combat zone. Of these 51 individuals, 5 stated they received a combat-related injury. Out of the 102 participants, 5 endorsed a combat injury, and 57 reported having a service-connected disability, with an average service-connected percentage approximately 60%. See Tables 3-5 for additional information regarding participants' branch affiliation as well as their military and deployment history.

Table 1

Employment and Marital Status Demographics

Variable	*n*	*%*
Employment Status		
Unemployed	12	11.76
Part-time	22	21.57
Full-time	51	50
Disabled	10	9.80
Retired	4	3.92
Student	40	39.22
Marital Status		
Single	26	25.49
Married	54	52.94
Separated	1	0.98
Divorced	22	21.57
Widowed	0	0
Cohabitating	5	4.90

Note. The sum for both the employment and marital statuses are greater than the total sample size (*n*=102) as participants were given the option to identify as having multiple employment and marital statuses.

Table 2

Positive Mental Health Screeners (N = 100)

Mental Health Domain	n (positive scores)	%
Depression	44	44
Anger	39	39
Mania	48	48
Anxiety	53	53
Somatic Symptoms	61	61
Suicidal Ideation	20	20
Psychosis	18	18
Sleep Problems	56	56
Memory	27	27
Repetitive Thoughts and Behaviors	23	23
Dissociation	24	24
Personality Functioning	46	46
Substance Use	53	53

Note. Criteria for meeting each mental health domain was determined in accordance with the DSM-5 Self-Rated Level 1 Cross-Cutting Symptom Measure-Adult threshold for further inquiry (American Psychiatric Association, 2013).

Table 3

Branch and Current Status

Demographic	n	M
Branch		
Army	30	29.41
Navy	40	39.22
Air Force	11	10.78
Marines	22	21.57
Coast Guard	1	0.98
National Guard	3	2.94
Reserves	10	9.80
Current Status		
Veteran	74	72.55
National Guard/Reserves	9	8.82
Active Duty	19	18.63

Table 4

Military Demographics

Demographic	*n*	*Range*	*M*	*SD*
Year Entered the Military	102	1972-2019	2007	9.37
Years in the Military	102	1-34	8.36	6.47
Months OEF/OIF/OND	88	1-48	14.5	8.84
Year of Last Deployment	102	2000-2019	2012	6.27
# of Deployments	102	0-11	2.12	2.43
% Service Connection	57	10-100	60.05	24.27

Note. Operation Enduring Freedom (OEF); Operation Iraqi Freedom (OIF); and Operation New Dawn (OND).

Table 5

Type of Deployment

Demographic	*n*	*%*
OEF	38	37.25%
OIF	29	28.43%
OND	6	5.88%
Humanitarian	12	11.76%
Other	45	44.12%
Combat Zone	51	50.00%
Combat OEF	33	32.35%
Combat OIF	19	18.63%
Combat OND	3	2.94%
Combat Other	15	14.71%

Note. Operation Enduring Freedom (OEF); Operation Iraqi Freedom (OIF); and Operation New Dawn (OND).

Power Analysis

In order to determine the number of participants needed for the study, a power analysis was conducted using G*Power 3.1.9.2 (Faul, Erdfelder, Buchner, & Lang, 2009). As it is the primary model of interest, the investigator used the moderation interaction for this power analysis. Cohen (1992) recommends alpha coefficients at α = .05 and power at .80. As the interaction effect between pain intensity/interference and pain acceptance on sleep quality has yet to be investigated, a conservative estimate of these associations, a small-to-medium effect size of f^2 = .085 was used for this power analysis. Since the moderated regression model includes interaction effects and two covariates, age and PCL-5 scores, the investigator included a total of five predictors. Using these criteria, a minimum sample size of 157 participants was recommended for this study. As there were 102 participants for this study, the sample size, as determined by the a priori power analysis, was 55 participants under the suggested recruitment number.

Although the sample size for the study was under the proposed number for the a priori power analysis, a post-hoc power analysis was run, using G*Power 3.1.9.2, for the mediation model (Faul, Erdfelder, Buchner, & Lang, 2009). As these variables have not been examined before, the effect size used in the a priori power analysis was an estimation; thus, the post-hoc analysis used the indirect effect size from the mediation analysis in this study, f^2 = .195. As recommended by Cohen (1992) an α = .05 and power of .80 was used for the analysis. Additionally, four predictors were used, which included the two initial predictors, the interaction effect, as well as the one covariate used in the model. It was estimated that a minimum of 67 participants were needed to conduct this analysis. As 101 participants were included, it appears that a sufficient sample size to meet the recommended power for this study.

Pain

A total of 86 participants in this study endorsed at least some level of pain; the average level on the 10-point scale (0 = *no pain* to 10 = *pain as bad as you can imagine*) was *M* = 3.55 (*SD* = 2.53). When those who denied any pain were removed, the average level of pain increased to *M* = 4.21 (*SD* = 2.19). The average PROMIS pain interference score for the sample was *M* = 14.36 (*SD* = 6.87). These scores ranged from the lowest score one could obtain (6) to the highest possible score (30), with higher scores indicating higher levels of pain interference. It is also noteworthy that scores were significantly higher in women (*M* = 16.70, *SD* = 6.94) than in men (*M* = 13.03, *SD* = 6.52) on this scale $t(100) = 2.673$, $p = .009$. See Table 6 for additional information regarding participants' pain scores.

Chronic Pain Acceptance

Participants' Chronic Pain Acceptance Questionnaire (CPAQ) totals ranged from 16 to 48, with higher scores indicating higher levels of acceptance regarding one's pain; the average CPAQ score was *M* = 30.83 (*SD* = 7.66). When examining the two component scores of the CPAQ, participants endorsed higher levels on the activity engagement (*M* = 16.89, *SD* = 5.96) component when compared to the pain willingness (i.e., one's willingness to disengage from the struggle to control/avoid their pain (*M* = 13.94, *SD* = 6.11) component, $t(101) = 3.19$, $p = .002$. Specifically, participants were more likely to agree with statements such as, "I am getting on with the business of living no matter what my level of pain is," and "When my pain increases, I can still take care of my responsibilities." They were less likely to disagree with pain willingness items such as, "I avoid putting myself in situations where my pain might increase," and "My worries and fears about what pain will do to me are true." This result demonstrates that although participants were likely to report engaging in activities, many of them are also likely to remain

focused on efforts to control or avoid their pain. See Table 7 for additional information regarding participants' pain acceptance scores.

Sleep

The vast majority of participants in this study endorsed significantly poor levels of sleep quality, as evidenced by high Pittsburgh Sleep Quality Index scores. The average score for the sample was *M* = 9.98; *SD* = 4.44. It is important to note that scores above 5 indicate poor sleepers, and 85% of the sample in this study were above the threshold, which is comparable to other studies involving members of the post-9/11 veteran population at around 89% (Plumb, Peachey, & Zelman, 2014). Participant bedtimes ranged from 8:00PM to 4:00AM, with an average bedtime of *M* = 11:13PM; *SD* = 1.64 hours. It takes participants anywhere between 1-300 minutes to fall asleep, *M* = 44.50; *SD* = 41.87. Participants reported receiving anywhere between 3 and 13 hours of sleep per night; the average number of hours asleep was *M* = 6.15; *SD* = 1.47. Sleep efficiency (time asleep over time in bed) percentages varied from 46.67% to 100%; *M* = 79.15%; *SD* = 16.62. The average wake time ranged from 3:00AM to 1:00PM, with an average wake time of *M* = 6:47AM; *SD* = 1.94 hours. See Table 8 for more specific information regarding PSQI component and global scores.

Table 6

Pain Scores

Measure	*M*	*SD*	*Range*	*α*
PEGS Total	10.14	7.94	0-30	.95
Intensity	3.55	2.53	0-10	-
Enjoyment	3.25	2.86	0-10	-
Activity	3.33	2.94	0-10	-
PROMIS Pain Interference	14.36	6.87	6-30	.96

Table 7

Chronic Pain Acceptance Questionnaire (CPAQ-8)

Measure	*M*	*SD*	*Range*	*α*
CPAQ Total	30.83	7.66	16-48	.59
Activity Engagement	16.89	5.96	0-24	.82
CPAQ1	4.75	1.47	0-6	-
CPAQ3	4.06	1.95	0-6	-
CPAQ5	3.94	2.19	0-6	-
CPAQ6	4.14	1.75	0-6	-
Pain Willingness	13.94	6.11	0-24	.82
CPAQ2	3.50	1.82	0-6	-
CPAQ4	4.21	1.80	0-6	-
CPAQ7	2.86	1.98	0-6	-
CPAQ8	3.37	1.98	0-6	-

**Note*. CPAQ1: *"I am getting on with the business of living no matter what my level of pain is;"* CPAQ3: *"Although things have changed, I am living a normal life despite my chronic pain;"* CPAQ5: *"I lead a full life even though I have chronic pain;"* CPAQ6: "*When my pain increases, I can still take care of my responsibilities;"* CPAQ2: *"Keeping my pain level under control takes first priority whenever I am doing something;"* CPAQ4: *"Before I can make any serious plans, I have to get some control over my pain;"* CPAQ7: *"I avoid putting myself in situations where my pain might increase;"* and CPAQ8: *"My worries and fears about what pain will do to me are true."* All Pain Willingness items are reverse scored (i.e., CPAQ2, CPAQ4, CPAC7, and CPAQ8).

Table 8

Pittsburgh Sleep Quality Index (PSQI)

Measure	*M*	*SD*	*Range*	*α*
PSQI Global	9.98	4.44	0-21	.79
Component 1: Subjective Sleep Quality	1.56	.71	0-3	-
Component 2: Sleep Latency	1.83	1.00	0-3	-
Component 3: Total Sleep Time	1.57	.98	0-3	-
Component 4: Sleep Efficiency	1.57	1.02	0-3	-
Component 5: Sleep Disturbances	1.70	.66	0-3	-
Component 6: Sleep Medications	1.19	1.24	0-3	-
Component 7: Daytime Dysfunction	1.39	.94	0-3	-

Pain-Related Beliefs and Attitudes About Sleep

The average score for Pain-Related Beliefs and Attitudes about Sleep for this sample was $M = 27.07$ ($SD = 27.47$); note that scores ranged from 0-100, with higher scores indicating more severe pain-related thoughts regarding sleep. When examining the two component scores of this measure, participants endorsed similar levels of the inevitable consequences of insomnia on pain and coping ($M = 14.08$, $SD = 14.64$) component when compared to the pain as a primary cause of insomnia ($M = 12.99$, $SD = 13.86$) component, $t(101) = 1.44$, $p = .153$. As this measure was designed for clinical populations, scores for this study are higher than those examined in previous studies; for example, Rovner and colleagues (2014) found that levels of pain acceptance in a group of 1775 patients diagnosed with chronic musculoskeletal pain endorsed much lower levels of pain acceptance at $M = 9.45$, ($SD = 5.46$). When examining the individual items on the measure, participants were more likely to agree with the following statements: “The pain is always there when you try to have a good night’s sleep,” “I get very annoyed when the pain wakes me up,” and “Not sleeping well is going to make my pain worse the next day.” Refer to Table 9.

Combined Measure Data

To clearly examine and compare the means, standard deviations, and ranges from all of the measures, refer to Table 10.

Table 9

Pain-Related Beliefs and Attitudes about Sleep (PBAS)

Measure	*M*	*SD*	*Range*	*α*
PBAS Combined	27.07	27.47	0-100	.96
PPCI	12.99	13.86	0-50	.95
PBAS1	2.25	2.78	0-10	-
PBAS2	2.76	3.06	0-10	-
PBAS3	3.13	3.45	0-10	-
PBAS4	2.58	2.83	0-10	-
PBAS5	2.27	2.27	0-10	-
PCIPC	14.08	14.64	0-50	.93
PBAS6	3.73	3.7	0-10	-
PBAS7	3.30	3.65	0-10	-
PBAS8	2.05	2.86	0-10	-
PBAS9	2.43	2.89	0-10	-
PBAS10	2.57	3.32	0-10	-

**Note.* PPCI (Pain as a Primary Cause of Insomnia) and PCIPC (Inevitable Consequences of Insomnia on Pain and Coping). PBAS1: *"My insomnia/poor sleep is largely a result of the pain and there is nothing I can do about it;* PBAS2: *"With the pain, I can never get myself comfortable in bed;"* PBAS3: *"The pain is always there when you try to have a good night's sleep;"* PBAS4: *"When I am in pain, I simply can't get to sleep no matter how hard I try;"* PBAS5: *"I know I can't sleep through the night because the pain will wake me up;"* PBAS6: *"I get very annoyed when the pain wakes me up;"* PBAS7: *"Not sleeping well is going to make my pain worse the next day;"* PBAS8: *"I won't be able to cope with the pain if I don't sleep well;" PBAS9: "Unless I get rid of the pain, I won't sleep well;"* and PBAS10*: "The insomnia/ poor sleep is taking away one of my few respites from the pain."*

Table 10

Combined Measure Data

Measure	*n*	*M*	*SD*	*Range*	*Potential Range*
Poor Sleep Quality (Pittsburgh Sleep Quality Index: PSQI) Global	102	9.98	4.44	0-21	0-21
Pain Intensity (Pain Enjoyment and General Activity scale-Item1: PEG)	102	3.55	2.53	0-10	0-10
Pain Interference (PROMIS Adult Short Form- Pain Interference: PROMIS-PI SF 6b)	102	14.36	6.87	6-30	6-30
Pain-related Beliefs About Sleep (Pain-Related Beliefs and Attitudes about Sleep: PBAS) Combined	102	27.07	21.47	0-100	0-100
Pain Acceptance (Chronic Pain Acceptance Questionnaire: CPAQ-8) Combined	102	30.83	7.66	16-48	0-48
PTSD (PTSD Checklist for the DSM-5: PCL-5)	101	24.42	20.50	0-78	0-80

Statistical Analyses

Prior to conducting the analyses, data were cleaned and statistical assumptions were tested and addressed. All variables of interest were assessed for normality using histograms. Outliers were identified as any item more than 1.5 interquartile ranges from the end of the boxplot; no outliers were identified. Skewness and kurtosis were also determined as insignificant as all variables of interest fell between -2.00 and 2.00 for both measures.

The only missing data for any of the variables used in the following analyses was for the PTSD checklist for DSM-5 for one participant. This participant exited out of the study before the end of the survey and did not answer any items on this questionnaire. Data from this participant was removed from any analyses using the PTSD checklist for DSM-5.

Pain and poor sleep quality. It was hypothesized that there would be a positive correlation between veterans' levels of pain and their poor sleep quality, such that increased reports of pain would be correlated with poorer sleep quality. Scores from the intensity scale of the Pain Enjoyment and General Activity scale were used to determine levels of pain, and the Pittsburgh Sleep Quality Index global score was used to determine sleep quality. Additionally, this correlation was conducted using the scores from the PROMIS Pain Interference - Short Form 6b as the predictor. Due to the continuous nature of these measures, Pearson correlations were conducted to test this hypothesis.

As hypothesized, there was a significant, positive correlation between levels of pain intensity and poor sleep quality $r(100) = .47$, $p < .001$. This relationship shows that as levels of pain intensity increase, so do endorsements of poor sleep. There was also a significant, positive correlation between participant accounts of pain interference and poor sleep quality $r(100) = .59$,

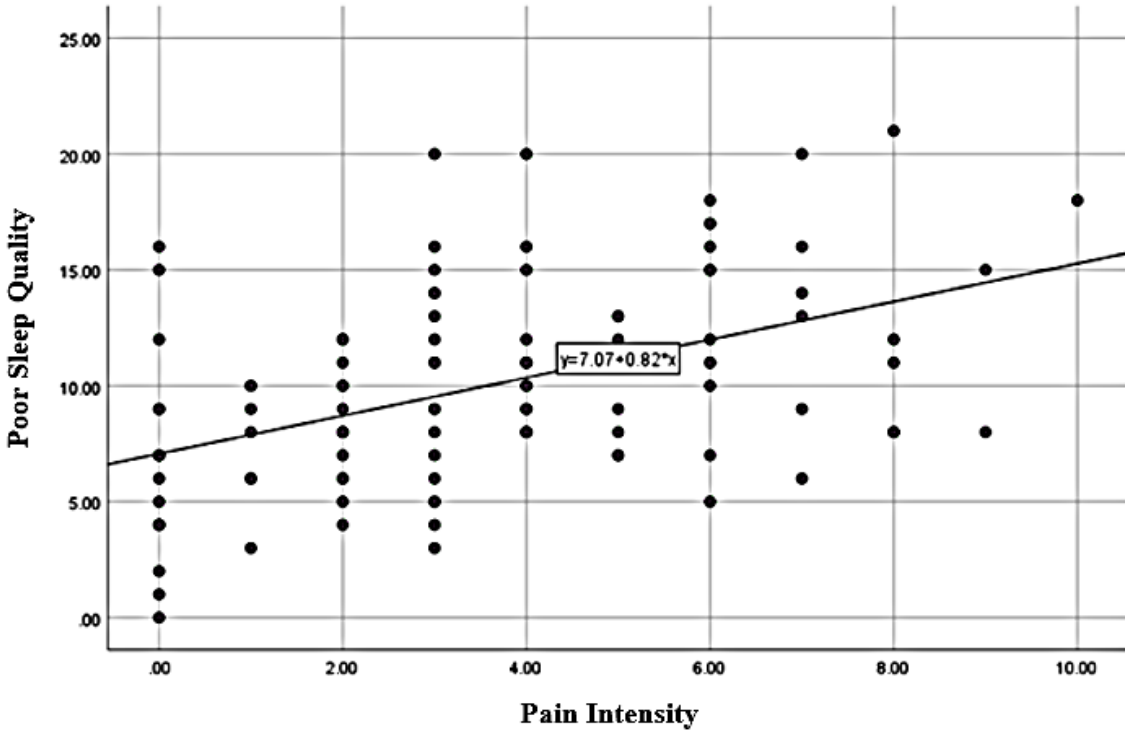
$p < .001$. This relationship demonstrates that as levels of pain interference increase, accounts of poor sleep do as well. See Figures 3 and 4.

Pain-related beliefs about sleep and poor sleep quality. It was hypothesized that pain-related beliefs about sleep would be positively correlated with poor sleep. The Pain-Related Beliefs and Attitudes about Sleep scale was used to determine the level of pain-related beliefs as they relate to sleep, and the Pittsburgh Sleep Quality Index global score was used to determine sleep quality. Due to the continuous nature of the Pain-Related Beliefs and Attitudes about Sleep scale and Pittsburgh Sleep Quality Index, a Pearson correlation was conducted to test this hypothesis.

As hypothesized, there was a significant, positive relationship between Pain-Related Beliefs and Attitudes about Sleep and the Pittsburgh Sleep Quality Index global scores $r(100) = .66$, $p < .001$. This relationship suggests that higher pain-related beliefs about sleep are associated with poor sleep quality. See Figure 5. Follow-up correlations were conducted to compare the strength of the Pain-Related Beliefs and Attitudes about Sleep factor scores, pain as a primary cause of insomnia and inevitable consequences of insomnia on pain and coping, as they relate to sleep quality within this sample. A significant relationship was found between pain as a primary cause of insomnia and Pittsburgh Sleep Quality Index global scores $r(100) = .68$, $p < .001$. Additionally, a significant relationship between the inevitable consequences of insomnia on pain and coping factors and poor sleep quality $r(100) = .60$, $p < .001$.

Figure 3

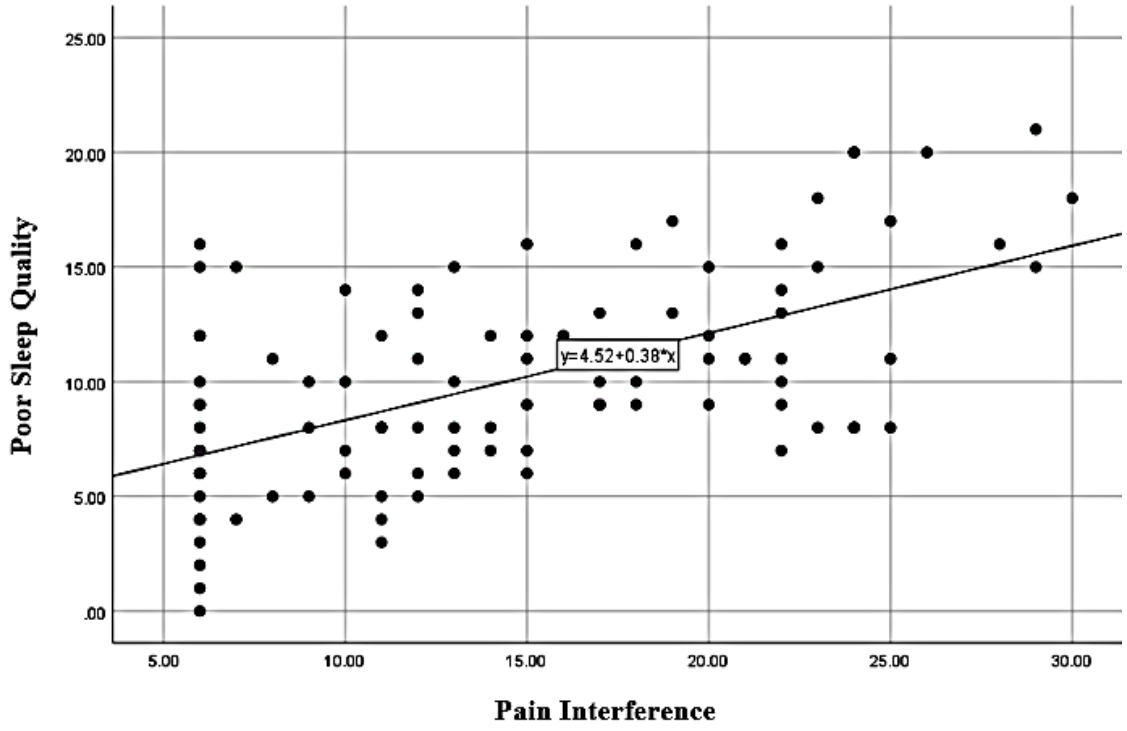
Association Between Pain Intensity and Poor Sleep Quality



**Note.* $R^2 = .22$

Figure 4

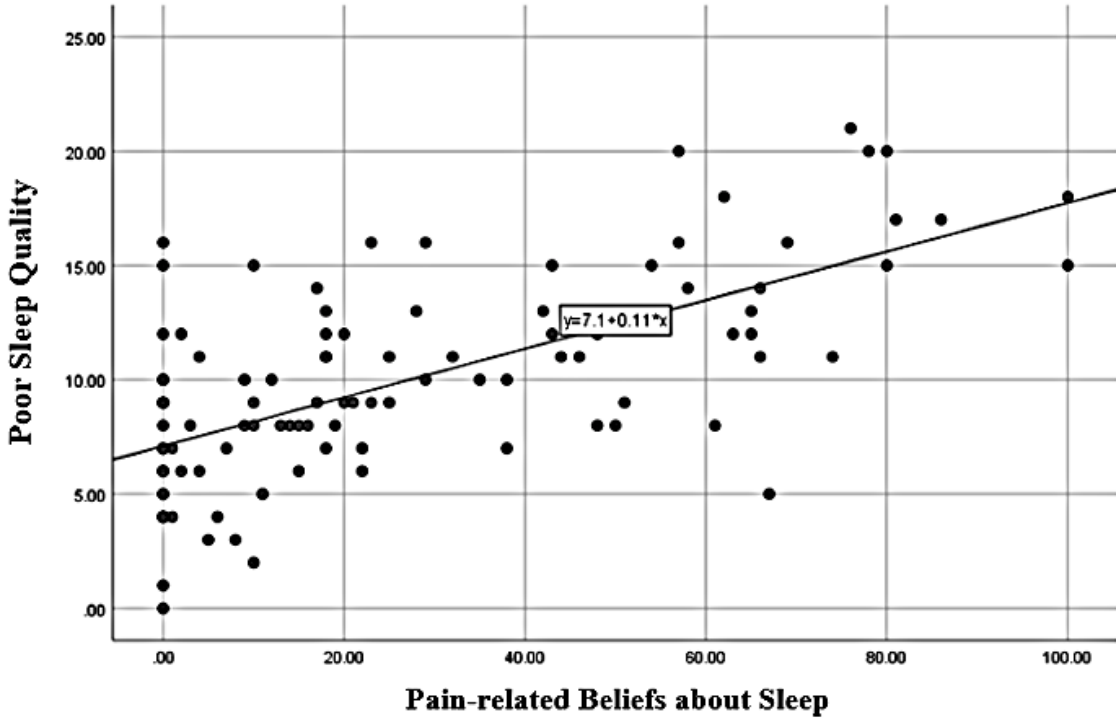
Association Between Pain Interference and Poor Sleep Quality



**Note.* R^2 = .35

Figure 5

Association Between Pain-Related Beliefs about Sleep and Poor Sleep Quality



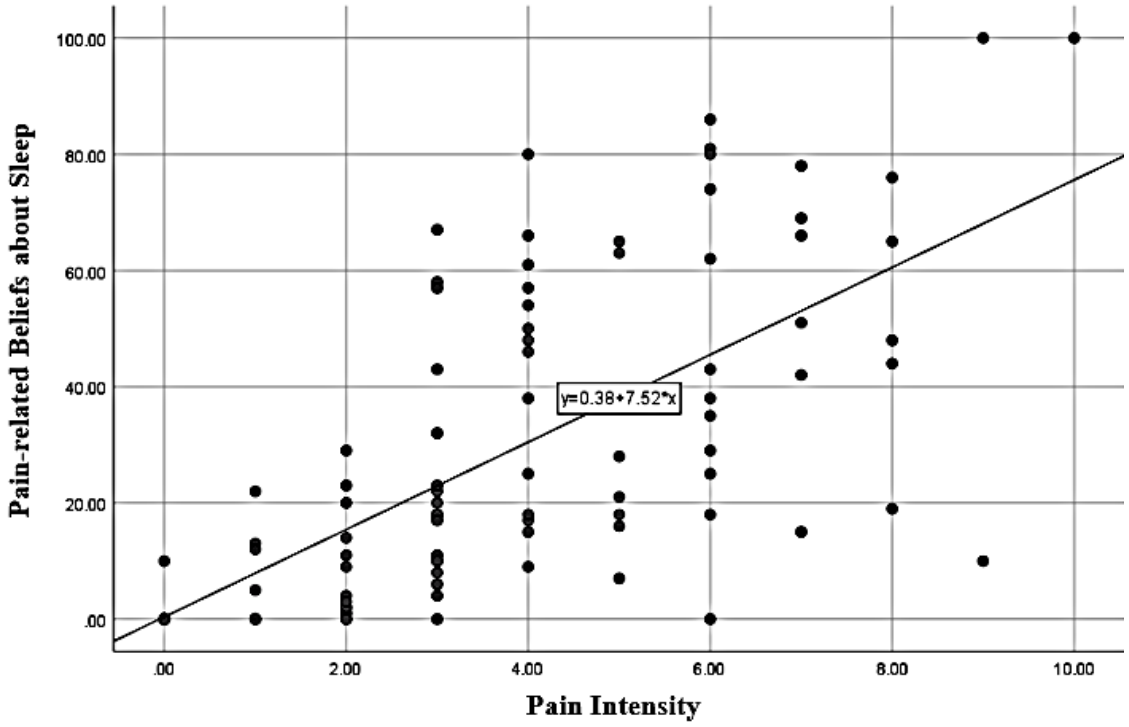
**Note.* R^2 = .43

Pain and pain-related beliefs about sleep. It was hypothesized that levels of pain intensity and interreference would be positively correlated with pain-related beliefs about sleep. The pain intensity scale of the Pain Enjoyment and General Activity scale was used to measure participants' levels of pain intensity, and the PROMIS Pain Interference - Short Form 6b was used to measure pain interference. The Pain-Related Beliefs and Attitudes about Sleep was used as the criterion as it determines the level of pain-related beliefs as they relate to sleep. Due to the continuous nature of these measures, two Pearson correlations were conducted to test this hypothesis.

As hypothesized, there was a significant, positive correlation between levels of pain intensity and pain-related beliefs of sleep, $r(100) = .69$, $p < .001$. This result suggests that these two variables are significantly correlated and that higher levels of pain intensity are associated with an increase in pain-related beliefs about pain. There was also a significant, positive correlation between participants' accounts of pain interference and their endorsements of pain-related beliefs of sleep $r(100) = .79$, $p < .001$. This relationship demonstrates that as levels of pain interference increases, accounts of pain-related beliefs about pain do as well. See Figures 6 and 7.

Figure 6

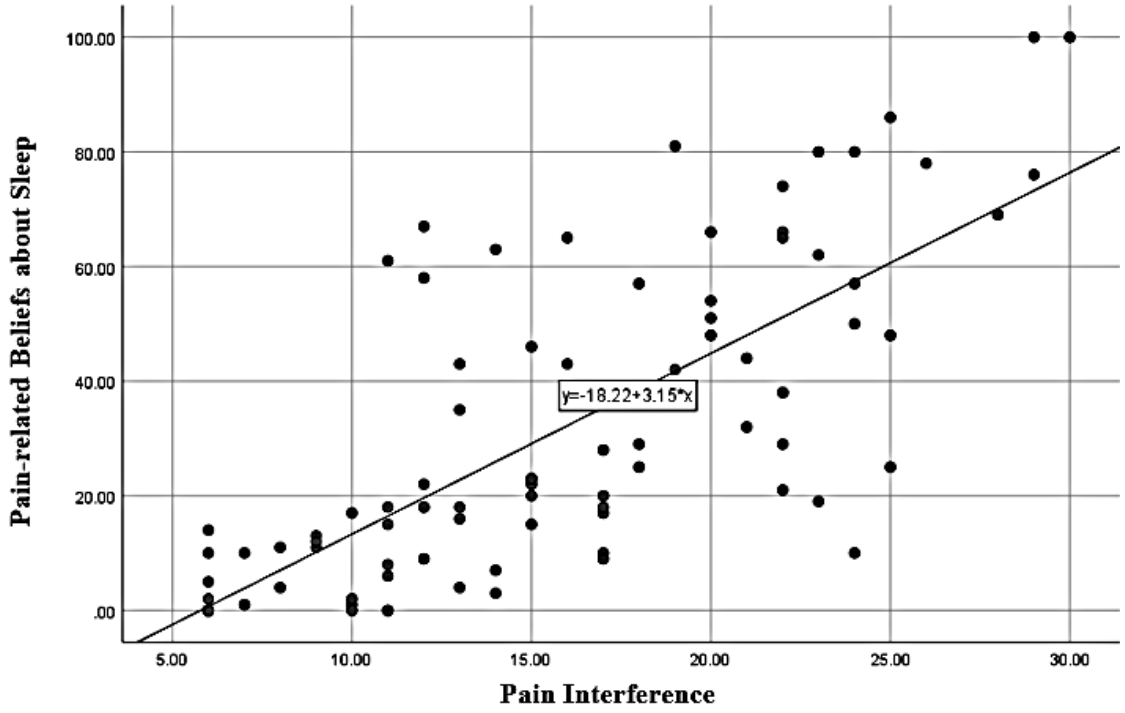
Association Between Pain Intensity and Pain-Related Beliefs About Sleep



**Note.* R^2 = .48

Figure 7

Associations Between Pain Interference and Pain-Related Beliefs About Sleep



**Note.* R^2 = .62

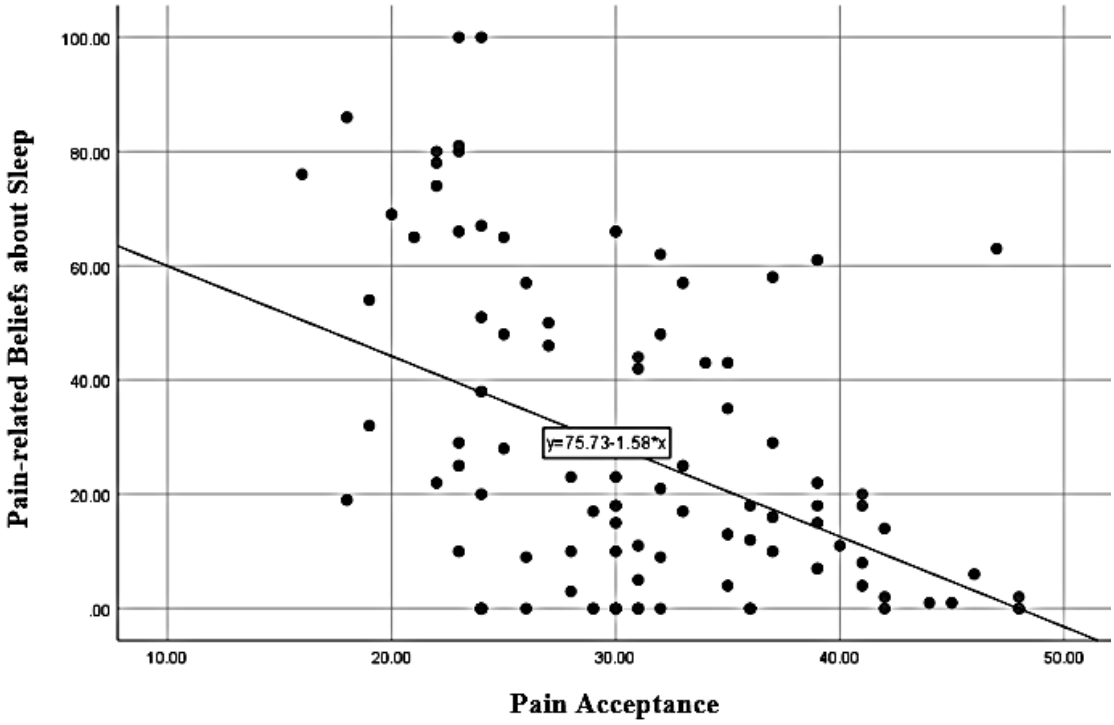
Pain acceptance and pain-related beliefs about sleep. It was hypothesized that pain acceptance would be negatively correlated with pain-related beliefs about sleep. Scores from the Chronic Pain Acceptance Questionnaire-8 were used to determine levels of pain acceptance, and the Pain-Related Beliefs and Attitudes about Sleep scores were used to determine the level of pain-related beliefs as they relate to sleep. Due to the continuous nature of the Chronic Pain Acceptance Questionnaire-8 and the Pain-Related Beliefs and Attitudes about Sleep, a Pearson correlation was conducted to test this hypothesis.

As hypothesized, there was a significant, negative correlation between levels of pain acceptance and pain-related beliefs about sleep $r(100) = -.44$, $p < .001$. See Figure 8. This result suggests that as levels of acceptance of one's pain increases, pain-related beliefs about sleep decrease. Follow-up correlations were conducted to identify the relationship between the chronic pain acceptance questionnaire factors, pain willingness and activity engagement. Although there was a significant, negative correlation between pain willingness and pain-related beliefs about pain scores, $r(100) = -.63$, $p < .001$, the test to address whether activity engagement and pain-related beliefs about pain was not significant, $r(100) = .08$, $p < .399$. Thus, as one's willingness to disengage from the struggle to control/avoid their pain increases, they are less likely to have pain-related thoughts that obtain to their sleep. However, participants' willingness to engage in activities, despite their level of pain, was not related to their pain-related thoughts regarding sleep.

Correlation Matrix. To examine the relationship between each of the variables used in hypotheses 1-4, refer to Table 11.

Figure 8

Association Between Pain Acceptance and Pain-Related Beliefs about Sleep



**Note.* R^2 = .19

Table 11

Correlation Matrix

Measure		*Sleep Quality*	*Pain Intensity*	*Pain Interference*	*Pain-related Beliefs About Sleep*	*Pain Acceptance*
Sleep Quality	Pearson Correlation	1	.468**	.589**	.658**	-.323**
(Pittsburgh Sleep Quality	Sig. (2-tailed)		.000	.000	.000	.001
Index: PSQI)	N	102	102	102	102	102
Pain Intensity	Pearson Correlation	.468**	1	.821**	.693**	-.357**
(Pain Enjoyment and General	Sig. (2-tailed)	.000		.000	.000	.000
Activity scale-Item1: PEG)	N	102	102	102	102	102
Pain Interference	Pearson Correlation	.589**	.821**	1	.789**	-.524**
(PROMIS Adult Short Form-	Sig. (2-tailed)	.000	.000		.000	.000
Pain Interference: PROMIS-PI	N	102	102	102	102	102
SF 6b)						
Pain-related Beliefs About Sleep	Pearson Correlation	.658**	.693**	.789**	1	-.440**
(Pain-Related Beliefs and	Sig. (2-tailed)	.000	.000	.000		.000
Attitudes about Sleep: PBAS)	N	102	102	102	102	102
Pain Acceptance	Pearson Correlation	-.323**	-.357**	-.524**	-.440**	1
(Chronic Pain Acceptance	Sig. (2-tailed)	.001	.000	.000	.000	
Questionnaire: CPAQ-8)	N	102	102	102	102	102

Pain-related beliefs about sleep as a mediator for pain intensity and poor sleep quality. It was hypothesized that pain-related beliefs about sleep would mediate the relationship between pain intensity and poor sleep quality. This mediation was conducted using SPSS PROCESS v3.3 (model 4) macro syntax in SPSS. This model examined the direct relationship between the predictor and criterion variable, as well as the indirect effect through the mediator (Hayes, 2012). PROCESS uses 5,000 bootstrap samples to provide asymmetric, bias-corrected confidence intervals. According to Hayes, the method of using asymmetric bootstrap confidence intervals is one of the most widely recommended approaches. Pain-Related Beliefs and Attitudes about Sleep scores were used as the mediator; the intensity scale of the Pain Enjoyment and General Activity scale as the predicter; and the Pittsburgh Sleep Quality Index global score as the criterion. Additionally, this model was conducted using scores from the PROMIS Pain Interference - Short Form 6b as the predictor as well. As age and PTSD symptoms have been found to be correlated with sleep quality (Lewis, Creamer, & Failla, 2009), these variables were tested as potential covariates prior to running the model. Although age was not related to sleep quality scores, $B < 0.01$, $SE = 0.05$, $p = .999$, there was a significant correlation between PTSD checklist and sleep quality scores, $B = 0.13$, $SE = 0.02$, $p < .001$. For every 1-unit increase in PTSD checklist for DSM-5 scores, the predicted Pittsburgh Sleep Quality Index value increased by .13. Thus, PTSD checklist for DSM-5 scores were included as a covariate in this model. Although there are other disorders, such as depression and anxiety, that are correlated with sleep quality, the decision was made to only include PTSD (Adams & Kisler, 2013), as there is a high degree of comorbidity between PTSD and both depression and anxiety (Ginzburg, Ein-Dor, & Solomon, 2010). Other potential covariates were left out of this model to avoid over-fitting.

As hypothesized, there was a statistically significant indirect effect of pain intensity on poor sleep quality using pain-related beliefs as a mediator, standardized indirect effect = 0.43, 95% C.I. (0.18, 0.71). In step one of this model, the regression of pain intensity on sleep quality was significant $B = .431$, $t(98) = 2.89$, $p = .005$. Step two of the model demonstrated that regression of pain intensity onto the mediator, pain-related beliefs about sleep, was significant $B = 5.90$, $t(98) = 7.46$ $p < .001$. Step three of the model confirmed that pain-related beliefs controlling for pain intensity was also significant $B = .07$, $t(97) = 4.17$, $p < .001$. Step four of the analysis demonstrated that, when controlling for pain-related beliefs about sleep, pain intensity is no longer a significant predictor of sleep quality, $B = .00$, $t(97) = -.02$, $p = .98$. A follow-up Sobel test was conducted and further established the presence of full mediation ($z = 3.63$, $p < .001$). Thus, the relationship between levels of pain intensity and poor sleep quality are better explained through the indirect effect of pain-related beliefs as the mediator.

There was also a statistically significant indirect effect after replacing pain intensity scores with the PROMIS pain interference scores in this model, standardized indirect effect = 0.16, 95% C.I. (0.05, 0.30). In step one of this model, the regression of pain interference on sleep quality was significant $B = .232$, $t(98) = 4.07$, $p < .001$. Step two of the model demonstrated that regression of pain interference onto the mediator, pain-related beliefs about sleep, was significant $B = 2.68$, $t(98) = 9.44$ $p < .001$. Step three of the model confirmed that pain-related beliefs controlling for pain interference was also significant $B = .06$, $t(97) = 3.16$, $p = .002$. Step four of the analysis demonstrated that when pain-related beliefs about sleep is controlled for in the model, pain interference is no longer a significant predictor of sleep quality $B = .07$, $t(97) = .90$, $p = .37$. A follow-up Sobel test was conducted and further establish the presence of full mediation ($z = 3.00$, $p = .003$). Thus, the relationship between pain interference and sleep quality

is more sufficiently explained by the indirect relationship through pain-related beliefs about sleep. See Figures 9 and 10.

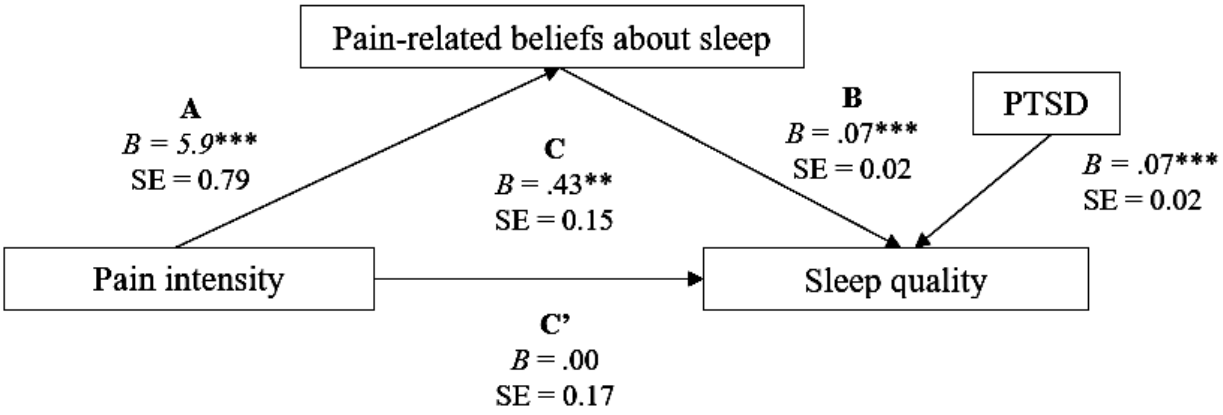
Pain acceptance as a moderator between pain intensity and poor sleep quality. It was hypothesized that pain acceptance acts as a moderator by decreasing the impact that pain intensity has on sleep quality. That is, at higher levels of pain acceptance, the relationship between pain intensity and levels of pain intensity and pain intensity and sleep quality are attenuated, such as higher levels of pain acceptance reduce these associations, and sleep quality decreases. Using PROCESS v3.3 (model 1) macro syntax in SPSS, a moderated regression analysis was conducted. Chronic Pain Acceptance Questionnaire-8 scores were used as the moderator when the intensity scale of the Pain Enjoyment and General Activity scale is regressed unto Pittsburgh Sleep Quality Index global scores. Additionally, this model was conducted using the scores from the PROMIS Pain Interference - Short Form 6b as it was regressed unto the Pittsburgh Sleep Quality Index global scores as well. This model was used to identify the presence of the main effect, and more importantly, the interaction effect of the moderator and predictor value on the criterion variable (Hayes, 2012). As PTSD checklist for DSM-5 scores were significantly related to sleep quality scores, $B = 0.13$, $SE = 0.02$, $p < .001$. For this reason, PCL-5 scores were included as a covariate in this model.

Contrary to the hypothesis, the interaction effect between pain acceptance and pain intensity was not significant ($F(1, 96) = .642$, $p = .425$, $R^2 = .004$). There was also a non-significant interaction effect when pain intensity was replaced by the PROMIS pain interference scores ($F(1, 96) = .833$, $p = .364$, $R^2 = .005$). Thus, higher levels of chronic pain acceptance did not moderate the association between pain intensity/interference and sleep quality in post-9/11 veterans. Follow-up correlations were conducted replacing the Chronic Pain Acceptance

Questionnaire-8 combined scores with the two component scores, pain willingness and activity engagement. Interaction effects between pain willingness and both pain intensity and pain interference were not significant ($F(1, 96) = .273$, $p = .603$, $R^2 = .002$) and ($F(1, 96) = .027$, $p = .870$, $R^2 = .000$) respectively. Similarly, the interaction effects between activity engagement and both pain intensity and pain interference were not significant as well ($F(1, 96) = 3.464$, $p = .066$, $R^2 = .020$) and ($F(1, 96) = 1.616$, $p = .207$, $R^2 = .009$) respectively. This demonstrated that neither higher levels of pain willingness or activity engagement moderated the association between pain intensity/interference and sleep quality in the sample.

Figure 9

Pain-Related Beliefs Mediated Relationship Between Pain Intensity and Sleep Quality

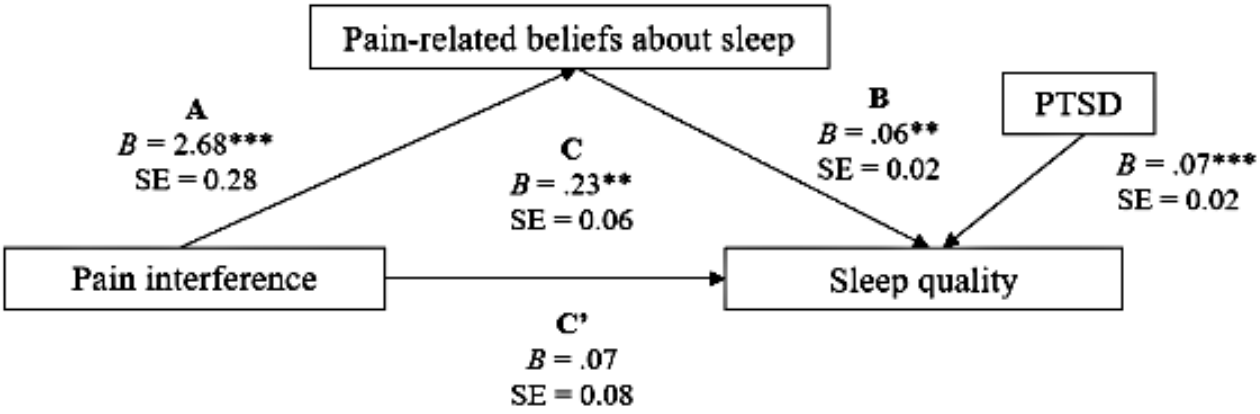


** = $p < .01$.

*** = $p < .001$.

Figure 10

Pain-Related Beliefs Mediated Relationship Between Pain Interference and Sleep Quality



** = $p < .01$.

*** = $p < .001$.

CHAPTER IV

DISCUSSION

As hypothesized, many of the relationships between factors of both pain and sleep examined in prior studies focused on civilian populations were observed within this post-9/11 veteran sample. As the most frequently endorsed difficulties within this sample was related to somatic complaints and sleep issues, it is important to explore these relationships to identify implications for the post-9/11 veteran population.

Pain and Poor Sleep Quality

Similar to what has been demonstrated in other veteran samples, pain was associated with sleep quality (Koffel, et al., 2016; Lew et al., 2010). Moreover, somatic complaints and sleep were the top two health complaints reported, with 61% reporting somatic complains and 56% reporting sleep problems. These results, coupled with findings by previous studies, emphasize the magnitude of sleep and comorbid somatic complaints and need for treatments that addresses both sleep problems and pain among recent-era veterans concerns. While there are treatments that are aimed to assist either chronic pain (i.e. opiates, physical therapy, injections, etc; Turk, Wilson, & Cahana 2011) or sleep issues (i.e. the use of CPAP machines or CBT-I; Polley et al., 2013 & Trockel, Karlin, Taylor, & Manber, 2014) independently, there is a lack of treatments that are designed to assist with these problems simultaneously. Thus, there is a need for improved care that aims at assisting both of these problems, as they are commonly found within the post-9/11 veteran population as comorbid conditions.

As both pain and sleep difficulties are prevalent in veterans, it is important to understand the relationship that these two variables have with one another. Although the present study was correlational and unable to determine the impact of one variable on the other, given the strong

association between sleep difficulties and pain identified here, and the long-term impact these problems have in veterans (Koffel, et al., 2016; Lew et al., 2010), findings warrant evidence-based treatments for pain. For example, treatments such as ACT for chronic pain and yoga have the potential to also assist with sleep (Holtzman & Beggs, 2013; Wetherell et al., 2011). In addition, evidence-based treatments for sleep, such as CBT-I may also have the potential to indirectly assist with pain (Trockel, Karlin, Taylor, & Manber, 2014) and are needed for this population.

Pain-Related Beliefs About Sleep and Sleep Quality

Findings suggest a significant positive correlation between pain-related beliefs about sleep and poor sleep quality in post-9/11 veterans. Although this finding is correlational in nature, it supports the prospect that cognitive strategies aimed to address specific pain-related thoughts regarding one's sleep could assist in improving sleep quality within post-9/11 veterans. This finding is important, because many behavioral-based sleep treatments also incorporate a cognitive component, such as cognitive behavioral for insomnia (CBT-I) or acceptance and commitment therapy (ACT) techniques that are often used in conjunction with CBT-I. For example, in addition to stimulus control and sleep restriction methods, CBT-I uses cognitive interventions that aim to challenge maladaptive thoughts about sleep in efforts to reduce levels of arousal that the thoughts create (Koffel, Bramoweth, & Ulmer, 2018). Similarly, ACT strategies are also used in conjunction with CBT-I to address maladaptive thought patterns (Dalrymple, Fiorentino, Politi, & Posner, 2010). According to Dalrymple and colleagues (2010) instead of challenging the thoughts, ACT interventions for insomnia combine mindfulness and cognitive defusion strategies to nonjudgmentally observe one's thoughts in an attempt to eliminate the struggle and coinciding state-of-arousal that they cause. Thus, findings from this study reinforce

the need for cognitive-based strategies that may assist with sleep within this population. Moreover, it suggests the importance of adapting these techniques to assist with specific thoughts that veterans have regarding how their pain may influence their sleep.

Pain and Pain-Related Beliefs About Sleep

There was a positive correlation between reported levels of pain and pain-related beliefs about sleep. This finding suggests that individuals who report higher levels of pain intensity and pain interference are also likely to report higher levels of pain-related beliefs regarding their sleep. Therefore, it is possible that lowering levels of pain intensity or pain interference may lower levels of pain-related beliefs about sleep, and vice versa. This finding supports the use of evidence-based techniques that have an impact on reducing levels of pain, such as relaxation or mindfulness interventions, due to their potential to also reduce the impact that the pain can have on their thoughts (Dunford & Thompson, 2010). It is also possible that the use of cognitive strategies, like cognitive restructuring or defusion techniques, could be adapted to mitigate the impact that the pain-related beliefs about sleep have and indirectly lower levels of pain.

Pain Acceptance and Pain-Related Beliefs About Sleep

The findings suggested a negative correlation between pain acceptance and pain-related beliefs about sleep in this sample. This demonstrates that higher levels of pain acceptance are related to lower levels of pain-related beliefs about sleep. Similarly, Cook and colleagues (2015) demonstrated that elevated levels of pain acceptance strongly predict lower levels of disability in the veteran population. In addition to preventing the development of disability, Esteve and colleagues (2007) found that acceptance-based treatments can positively impact pain-related beliefs that assist in maintaining positive mood. This finding supports the notion that avoiding pain does not alleviate pain; however, leaning into the pain, in efforts to increase acceptance,

appears more beneficial. It is likely that higher levels of pain acceptance may also assist with one's thoughts and perceptions on how their pain impacts their sleep. As such, treatments like ACT for chronic pain, which work to promote pain acceptance, may also reduce pain-related beliefs that individuals have regarding their sleep.

Pain-Related Beliefs About Sleep as a Mediator for Pain Intensity and Poor Sleep Quality

One of the more noteworthy findings was the mediation analyses that showed pain-related beliefs about sleep as an effective mediator between the pain-sleep quality relationship. This finding suggests that the relationship between pain and poor sleep quality is more comprehensively explained through the pain, to pain-related beliefs about sleep, to sleep quality pathway and not the direct effect that pain may have on one's sleep quality. Although past studies have looked at the direct relationship between pain and sleep quality, this study is the first to examine the role of pain-related thoughts on the pain-sleep connection among post-9/11 veterans. This finding is consistent with Tang and colleagues (2012) who found in their study of chronic pain patients that it is not the pain that directly leads to poor sleep; rather, it is the cognitive arousal, that is, pain-related beliefs about sleep, that impacts sleep quality.

Furthermore, the finding that pain-related beliefs appear to mediate the pain-sleep qualify association suggests that when treating veterans with pain it may be advantageous for mental health providers to address the thoughts that veterans have regarding the pain-sleep relationship. This notion is specifically important in post-9/11 veterans who often experience chronic pain (Cifu et al., 2013). In many cases when pain levels are consistent and there is little to do to minimize the pain intensity or interference, this model suggests that interventions that may work to curtail these pain-related beliefs about sleep may have a direct impact on improving sleep quality. Again, stressing the importance for the use of cognitive-based interventions, such as

CBT and ACT techniques employed to directly influence the impact that thoughts have on the individual. For veterans who are ambivalent to traditional therapy models, evidence supports the use of mindfulness-based applications that aim to reduce worry can improve sleep quality as well (Brewer, Roy, Deluty, Liu, & Hoge, 2020); perhaps altering these apps to assist with pain-related beliefs about sleep could yield even more effective at improving sleep quality within the veteran population. Addressing pain-related beliefs about sleep are likely to be more beneficial than efforts to decrease pain intensity or interference.

Pain Acceptance as a Moderator Between Pain Intensity and Poor Sleep Quality

Varying levels of pain acceptance did not moderate the relationship between pain intensity/interference and poor sleep quality. This finding suggests that those with higher levels of pain acceptance may not be more resilient to the impact that pain may have on their sleep quality. Although levels of pain acceptance were negatively correlated with poor sleep quality, $r(100) = .32$, $p = .001$, pain acceptance did not buffer the pain-sleep quality relationship. Thus, there might be other variables that assist with the impact that increasing pain acceptance has on lowering levels of pain interference and subsequently assisting with sleep. For example, higher levels of pain acceptance are related to more activity engagement (Fish, Hogan, Morrison, Stewart, & McGuire, 2013). Specific activities, such as mindfulness and yoga, have been linked to increased sleep quality in chronic pain populations (Black, O'Reilly, Olmstead, Breen, & Irwin, 2015; Lazaridou et al., 2019); it is possible that chronic pain acceptance increases willingness to engage in activities, and depending on the activities the individual is engaged in, sleep quality can be improved.

Another factor that may have influenced the results are those who participated, yet endorsed little to no pain. Perhaps those veterans not experiencing pain automatically score low

on acceptance of pain, because they do not have any pain that they need to accept. However, it is possible, that if these individuals had higher levels of pain, they may have lower levels of pain acceptance associated with pain. It is likely that these results would look different if only individuals endorsing moderate-to-high levels of pain or diagnosed with chronic pain were to participate in this study. In other words, since the Chronic Pain Acceptance Questionnaire was developed for a clinical population, perhaps it does not translate to individuals who do not experience any symptoms of pain. Thus, it may be less appropriate for those who have little-to-no pain. It is important to consider this possibility in future research.

Additionally, Rovner and colleagues (2019) determined that the Chronic Pain Acceptance Questionnaire can be used to place individuals into one of fours different clusters. They propose that the two component scores can be used to place individuals into one of four clusters: individuals may score high in both pain willingness and activity engagement; high in pain willingness and low in activity engagement; low in pain willingness and high in activity engagement; or low in both pain willingness and activity engagement. It is proposed that this four-cluster model may better explain induvial experiences of pain acceptance. Perhaps increased scores in one or more of the clusters would buffer the pain/sleep relationship.

Limitations

Many participants failed the attention checks; perhaps finding ways to make this survey shorter would have assisted with greater accuracy in responding. Furthermore, the overall recruitment number was lower; perhaps casting a wider net to recruit participants from additional veterans-related groups outside of the southeast Virginia region would produce more fruitful recruitment numbers. Additionally, recruitment should also focus on obtaining participants from a clinical population and targeting veterans who identify having difficulties with pain and sleep.

There are a number of factors regarding generalizability of these results. The primary method of recruitment for the study was through the use of the psychology online research participation system. Thus, 56% (n = 57) of participants were student veterans. Perhaps there are additional factors that impact these participants in terms of their sleep quality and levels of pain compared to other post-9/11 veterans not currently enrolled in college courses. For example, college students tend to have non-traditional sleep schedules that are not aligned with their circadian rhythm; Orzech, and colleagues (2011) found that, on average, college students are likely to fall asleep well past midnight. Also, there was a greater proportion of female veterans who completed this survey compared to the entire post-9/11 veteran population. As this study demonstrated gender differences for pain interference, perhaps this sample would not reflect the general post-9/11 veteran population. Additionally, the majority of individuals who took this study are currently living in the southeastern region of Virginia. As Norfolk, Virginia is home to the world's largest naval base, Naval Station Norfolk, there was an overrepresentation of veterans who served in the Navy. In fact, 39.22% of participants served in the Navy; this compares to the national average of 21.38% (NCVAS, 2018). Additionally, Army members were underrepresented in this study; 29.41% of this sample served in the Army compared to 44.52% found in the larger veteran population (NCVAS, 2018). Although prior studies have found similar rates of insomnia between service members in different branches, perhaps there are differences in levels of reported pain (Mysliwiec et al., 2013).

As these analyses are correlational in nature, it is important to understand that the correlation does not indicate causation. More specifically, many of the variables examined in this study may impact on one another. For example, due to the bi-directional nature of pain and sleep quality, it is also difficult to fully determine which variable proceeds the other. Additionally,

there are a number of other genetic, environmental, and social influences that impact on both pain and sleep quality; it is difficult to isolate these factors.

Future Directions

As this is the first study to examine these specific factors within the post-9/11 veteran population, it serves as a platform for continued research in this area. Although there were significant relationships between the factors related to pain and sleep explored in this study, future research should aim to continue to examine the exact mechanisms behind these relationships and use these findings to implement more effective treatments to assist this population. Additionally, it is important to examine other factors that may contribute to the presentations of both sleep and pain difficulties in this population, including but not limited to aspects of culture, diversity, and the comorbidity of other physical and mental health diagnoses that impact both pain and sleep quality. As there are so many factors that are already known to contribute to both pain and sleep quality, it is imperative for researchers to continue to identify the primary factors that impact both sleep and pain within the post-9/11 veteran population. For instance, it is difficult to ignore other common disorders in this population, such as TBIs and PTSD, and the complicated and reciprocal effects they have on both sleep and pain (Balba et al., 2018). As these disorders are directly linked to both pain and sleep issues, future research needs to identify exact mechanisms between these factors and in efforts to assist veterans who exhibit comorbid conditions. Furthermore, it should be a priority to both identify and implement effective treatments that target these factors.

This study demonstrated the influence that pain-related beliefs about sleep has on mediating the relationship between sleep quality on both pain intensity and interference. Future research endeavors should continue to focus on the impact that these thoughts have on sleep

quality. While it is uncommon for individuals to have control over their pain, perhaps treatments should focus on examining effective ways to mitigate or change the relationship that veterans have with these thoughts, such as additional cognitive-based strategies (e.g., mindfulness, thought defusion, cognitive restructuring, etc.) that target pain-related thoughts about sleep. This could play an important role in lessening the impact that pain has on veterans' sleep.

Although elevated levels of acceptance regarding one's pain did not act as a moderator between pain and sleep quality, it is important to continue to look into the role that pain acceptance may play in this relationship. As higher levels of catastrophizing about one's pain has been associated increased sleep disturbances (Buenaver et al., 2012), and pain acceptance works to decrease pain catastrophizing, future studies should continue to examine how pain acceptance may play into this relationship. With so many aspects of treatment that impact both sleep and pain, studies should focus on targeting techniques that effectively weaken the relationship between sleep and pain in this population.

CHAPTER V

CONCLUSIONS

As comorbid conditions related to pain and sleep are highly endorsed within the post-9/11 veteran population, relationships between these factors were explored in this study. Significant positive correlations were found between pain and poor sleep quality, pain-related beliefs about sleep and poor sleep quality, as well as pain and pain-related beliefs about sleep. A significant, negative correlation was found between pain acceptance and pain-related beliefs about sleep. Although this study found pain-related beliefs were consistent with a mediation impact – that is, the association between pain and sleep was mediated or explained by pain-related beliefs – pain acceptance did not moderate the association between pain and poor sleep quality. Future research should continue to examine ways to decrease the impact that pain-related thoughts about sleep have on sleep quality. Researchers should also continue to explore specific mechanisms of change that more effectively explain the pain-sleep relationship in efforts to more effectively assist this population.

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Appendix A

Pittsburgh Sleep Quality Index

Instructions: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions. During the past month,

1. When have you usually gone to bed? _____
2. How long (in minutes) has it taken you to fall asleep each night? _____
3. When have you usually gotten up in the morning? _____
4. How many hours of actual sleep do you get at night? (This may be different than the number of hours you spend in bed) _____

5. During the past month, how often have you had trouble sleeping because you…	Not During the Past Month	Less than Once a Week	Once or Twice a Week	Three or More Times a Week
a. Cannot get to sleep within 30 minutes				
b. Wake up in the middle of the night or early morning				
c. Have to get up to use the bathroom				
d. Cannot breathe comfortably				
e. Cough or snore loudly				
f. Feel too cold				
g. Feel too hot				
h. Have bad dreams				
i. Have pain				
j. Other reason(s), please describe, including how often you have had trouble sleeping because of this reason(s):				
6. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?				
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?				
	Very Good	Fairly Good	Fairly Bad	Very Bad
9. During the past month, how would you rate your sleep quality overall?				

10. Do you take naps?
    a. If Yes, how often are your naps?
    b. How long are your naps on average?
    c. What time(s) of the day do you usually nap?

Appendix B

Pain Enjoyment and General Activity Scale

1. What number best describes your pain on average in the past week?

0	1	2	3	4	5	6	7	8	9	10
No pain										Pain as bad as you can imagine

2. What number best describes how, during the past week, pain has interfered with your enjoyment of life?

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

3. What number best describes how, during the past week, pain has interfered with your general activity?

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

Appendix C

PROMIS Pain Interference – Short Form 6b

Please respond to each item by marking one box per row. In the past 7 days…

	Not at all	**A little bit**	**Somewhat**	**Quite a bit**	**Very much**
How much did pain interfere with your enjoyment of life?					
How much did pain interfere with your ability to concentrate?					
How much did pain interfere with your day to day activities?					
How much did pain interfere with your enjoyment of recreational activities?					
How much did pain interfere with doing your tasks away from home (e.g., getting groceries, running errands)?					
	Never	**Rarely**	**Sometimes**	**Often**	**Always**
How often did pain keep you from socializing with others?					

Appendix D

Pain Related Beliefs About Sleep

Rate your level of agreement with each statement between 0 “strongly disagree” and 10 “strongly agree.”

___1. My insomnia/ poor sleep is largely a result of the pain and there is nothing I can do about it.

___2. With the pain, I can never get myself comfortable in bed.

___3. The pain is always there when you try to have a good night’s sleep.

___4. When I am in pain, I simply can’t get to sleep no matter how hard I try.

___5. I know I can’t sleep through the night because the pain will wake me up.

___6. I get very annoyed when the pain wakes me up.

___7. Not sleeping well is going to make my pain worse the next day.

___8. I won’t be able to cope with the pain if I don’t sleep well.

___9. Unless I get rid of the pain, I won’t sleep well.

___10. The insomnia/ poor sleep is taking away one of my few respites from the pain.

Appendix E

Chronic Pain Acceptance Questionnaire- 8

Below you will find a list of statements. Please rate the truth of each statement as it applies to you. Use the following rating scale to make your choices. For instance, if you believe a statement is 'Always True,' you would fill in a 6 in the blank next to that statement.

0 – Never true
1 – Very rarely true
2 – Seldom true
3 – Sometimes true
4 – Often true
5 – Almost always true
6 – Always true

___ 1. I am getting on with the business of living no matter what my level of pain is

___ 2. Keeping my pain level under control takes first priority whenever I am doing something

___ 3. Although things have changed, I am living a normal life despite my chronic pain

___ 4. Before I can make any serious plans, I have to get some control over my pain

___ 5. I lead a full life even though I have chronic pain

___ 6. When my pain increases, I can still take care of my responsibilities

___ 7. I avoid putting myself in situations where my pain might increase

___ 8. My worries and fears about what pain will do to me are true

Appendix F

PTSD Checklist- 5

Instructions: Below is a list of problems that people sometimes have in response to a very stressful experience. Please read each problem carefully and then circle one of the numbers to the right to indicate how much you have been bothered by that problem in the past month.

0 = Not at all
1 = A little bit
2 = Moderately
3 = Quite a bit
4 = Extremely

In the past month, how much were you bothered by:

___1. Repeated, disturbing, and unwanted memories of the stressful experience?
___2. Repeated, disturbing dreams of stressful experiences?
___3. Suddenly feeling or acting as if the stressful experience were actually happening again (as if you were actually back there reliving it)?
___4. Feeling very upset when something reminder you of the stressful experience?
___5. Having strong physical reactions when something reminded you of the stressful experience (for example, heart pounding, trouble breathing, sweating)?
___6. Avoiding memories, thoughts, or feelings related to the stressful experience?
___7. Avoiding external reminders of the stressful experience (for example, people, places, conversations, activities, objects, or situations)?
___8. Trouble remembering important parts of the stressful experience?
___9. Having strong negative beliefs about yourself, other people, or the world (for example, having thoughts such as: I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)?
___10. Blaming yourself or someone else for the stressful experience or what happened after it?
___11. Having strong negative feelings such as horror, anger, guilt, or shame?
___12. Loss of interest in activities you used to enjoy?
___13. Feeling distant or cut off from other people?
___14. Trouble experiencing positive feelings (for example, being unable to feel happiness or have loving feelings for people close to you)?
___15. Irritable behavior, angry outbursts, or acting aggressively?
___16. Taking too many risks or doing things that could cause you harm?
___17. Being “superalert” or watchful or on guard?
___18. Feeling jumpy or easily startled?
___19. Having difficulty concentrating?
___20. Trouble falling or staying asleep?

Appendix G

DSM-5 Self-Rated Level 1 Cross-Cutting Symptom Measure- Adult

Instructions: The questions below ask about things that might have bothered you. For each question, circle the number that best describes how much (or how often) you have been bothered by each problem during the past TWO (2) WEEKS.

During the past TWO (2) WEEKS, how much (or how often) have you been bothered by the following problems?	**None** Not at all	**Slight** Rare, less than a day or two	**Mild** Several days	**Moderate** More than half the days	**Severe** Nearly every day
1. Little interest or pleasure in doing things?					
2. Feeling down, depressed, or hopeless?					
3. Feeling more irritated, grouchy, or angry than usual?					
4. Sleeping less than usual, but still have a lot of energy?					
5. Starting lots more projects than usual or doing more risky things than usual?					
6. Feeling nervous, anxious, frightened, worried, or on edge?					
7. Feeling panic or being frightened?					
8. Avoiding situations that make you anxious?					
9. Unexplained aches and pains (e.g., head, back, joints, abdomen, legs)?					
10. Feeling that your illnesses are not being taken seriously enough?					
11. Thoughts of actually hurting yourself?					
12. Hearing things other people couldn't hear, such as voices even when no one was around?					
13. Feeling that someone could hear your thoughts, or that you could hear what another person was thinking?					

14. Problems with sleep that affected your sleep quality over all?					
15. Problems with memory (e.g., learning new information) or with location (e.g., finding your way home)?					
16. Unpleasant thoughts, urges, or images that repeatedly enter your mind?					
17. Feeling driven to perform certain behaviors or mental acts over and over again?					
18. Feeling detached or distant from yourself, your body, your physical surroundings, or your memories?					
19. Not knowing who you really are or what you want out of life?					
20. Not feeling close to other people or enjoying your relationships with them?					
21. Drinking at least 4 drinks of any kind of alcohol in a single day?					
22. Smoking any cigarettes, a cigar, or pipe, or using snuff or chewing tobacco?					
23. Using any of the following medicines ON YOUR OWN, that is, without a doctor's prescription, in greater amounts or longer than prescribed [e.g., painkillers (like Vicodin), stimulants (like Ritalin or Adderall), sedatives or tranquilizers (like sleeping pills or Valium), or drugs like marijuana, cocaine or crack, club drugs (like ecstasy), hallucinogens (like LSD), heroin, inhalants or solvents (like glue), or methamphetamine (like speed)]?					

Appendix H

HELPS Brain Injury Screening Tool

1. Have you ever Hit your Head or been Hit on the Head? Yes No

2. Were you ever seen in the Emergency room, hospital, or by a doctor because of an injury to your head? Yes No

3. Did you ever Lose consciousness or experience a period of being dazed and confused because of an injury to your head? Yes No

4. Do you experience any of these Problems in your daily life since you hit your head? Yes No

Headaches; dizziness; anxiety; depression; difficulty concentrating; difficulty remembering; difficulty reading, writing, calculating; poor problem solving; difficulty performing your job/school work; change in relationships with others; poor judgment (being fired from job, arrests, fights)

5. Any significant Sickness? Yes No

Appendix I

Demographic Questionnaire

Have you served (or currently serving) in the armed forces *(Army, Navy, Air Force, Marines, National Guard, or Reserves)* post 9/11/2001?

a. Yes
b. No

NOTE: Those who click "Yes" will be sent to the next section of the survey. Those who click "No" will be thanked and sent to the end of the study.

1. Age (in years): _____

2. Sex:
a. Male
b. Female
c. Transgender
d. Other

3. How do you define your sexual identity? Would you say that you are:
a. Only homosexual
b. Mostly homosexual
c. Bisexual
d. Mostly heterosexual
e. Only heterosexual
f. Other (specify):_____.

5. Marital Status:
a. Single, Never Married
b. Married
c. Separated
d. Divorced
e. Widowed
f. Cohabitating

6. Employment Status (Please check all that apply):
a. Unemployed
b. Employed (Part-time)
c. Employed (Full-time)
d. Disabled
e. Retired
f. Fulltime Student

7. Are you Hispanic, Latino, or of Spanish Origin?
{Choose one}
a. No, not of Hispanic, Latino, or Spanish Origin
b. Yes, Mexican, Mexican American, Chicano
c. Yes, Puerto Rican

d. Yes, Cuban
e. Yes, another Hispanic, Latino, or Spanish Origin

8. Race (Please check and clarify if needed)
___ African American
___ Asian or Pacific Islander
___ Caucasian
___ Native American
___ Other (how would you describe your race?)

9. How did you hear about this survey?
a. I saw an announcement online/or from a listserv
b. It was announced in a student organization or other meeting I attended
c. A friend or family member told me about it or sent me the link
d. ODU SONA
e. Other: _____

11. What is your zip code? _____

12. What is your current military status?
a. Veteran
b. National Guard/Reserve
i. What branch of the Reserves/NG? _____
c. Active duty
d. I have never been in the military

13. How many years were/have you been in the military? ___

14. In what year did you enter the military? ___

15. What was/is your job in the military-please be specific? ___

16. Did you serve in a region that supported Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn initiatives (OEF/OIF/OND)? ___
b. If yes, how many months (all together) did you serve in a region that supported OEF/OIF/OND? ___

17. How many deployments (90 days or more) since you joined the military in support of:

	0	1	2	3	4	5 or more
Operation Iraqi Freedom (OIF)						
Operation Enduring Freedom (OEF)						
Humanitarian mission (non-OIF/OEF)						

Other (non-OIF/OEF)						

18. What branch of the military did you serve/are you serving in?
    a. Army
    b. Navy
    c. Air Force
    d. Marines
    e. Coast Guard
    f. National Guard
    g. Reserves (Army, Air Force, Navy, National Guard, Marines)

19. Did you serve in a Combat Zone?
    a. Yes
    b. No

20. Please indicate combat zones served in:
    a. Desert Storm
    b. OEF
    c. OIF
    d. OND
    e. Other

21. Were you physically injured/ wounded in combat?
    a. Yes
    b. No

22. Do you have a Service-Connected Disability?
    a. Yes
    b. No
        If Yes, Total Percent: ___

23. Are you currently on active duty or on active reserve?
    a. Yes
    b. No

VITA

John L. Schwartz, Jr.

Old Dominion University
Department of Psychology
Norfolk, VA 23529

Education

Ph.D. **Virginia Consortium Program in Clinical Psychology,** *Norfolk, VA*
Clinical Psychology, 2021
Advisors: Michelle Kelley, Ph.D. & Skye Ochsner-Margolies, Ph.D.

M.S. **Francis Marion University,** *Florence, SC*
Applied Psychology (Track: Clinical/Counseling Psychology), 2015
Advisors: Farrah Hughes, Ph.D. & Ronald Murphy, Ph.D.

B.S. **Michigan State University,** *East Lansing, MI*
Psychology (Tracks: Military Science and Pre-Medicine), 2013
Advisor: Kimberly Fenn, Ph.D.

Background

John L. Schwartz, Jr. is a fifth-year doctoral candidate in the Virginia Consortium Program in Clinical Psychology. He is currently a Captain in the United States Army as a Clinical Psychology Intern at Womack Army Medical Hospital. His research primarily focuses on aspects of insomnia and chronic pain as they relate to veterans. Similar to his research, he has a passion for working in integrated health care settings providing care to service members who have comorbid insomnia and physical conditions.

Selected Presentations and Publication

Schwartz, J., Ochsner Margolies, S., & Kelley, M. (2019). The relationship between mindfulness, stress, and sleep quality in student veterans. Poster session presented at the Society of Sleep Behavioral Medicine Conference, Birmingham, AL.

Schwartz, J., Ochsner Margolies, S. (2019). Cognitive behavioral and acceptance-based group treatment for insomnia (CBT-I) & (ACT) in adults with comorbid chronic insomnia and chronic pain. Poster session presented at SLEEP, San Antonio, TX.

Ochsner Margolies, S., & Schwartz, J. (2018). Non-pharmaceutical therapies for sleep dysfunction and gastrointestinal health. In Sleep Effect on Gastrointestinal Health and Disease: Translational Opportunities for Promoting Health and Optimizing Disease Management. New York, NY: NOVA Science.