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# ASSOCIATIONS BETWEEN CHRONIC PAIN AND SOCIAL FUNCTIONING IN PRIMARY CARE

by

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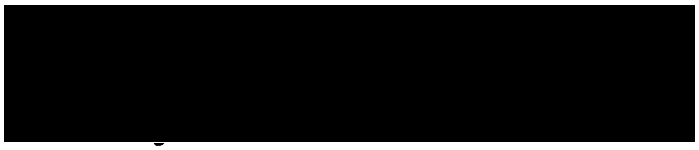

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# ABSTRACT

Title of Thesis: Associations Between Chronic Pain and Social Functioning in Primary Care

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Chronic musculoskeletal pain and reduced social functioning are public health concerns that increase one's risk for morbidity or mortality over time. To add to the literature, this study examined the relation among chronic musculoskeletal pain, social functioning, and loneliness in Department of Defense (DoD) beneficiaries treated for chronic pain in primary care. We hypothesized: 1a) Social functioning would be negatively correlated overall with pain; 1b) The difference between social functioning at baseline to last treatment appointment would not be statistically significant; 2) Participants with higher social functioning at baseline would demonstrate greater reductions in pain; and 3) Social functioning scores would be negatively correlated with loneliness scores at r =-.30 or greater. The findings supported Hypothesis 1b, $t(33) = .03$, $p = .98$, and partially supported Hypotheses 1a, 2, and 3. Importantly, participants experienced a statistically significant reduction in pain over time, $t(33) = 2.85$, $p < .01$.

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## CHAPTER 1: Overview of Chronic Pain, Social Functioning, and Loneliness in Primary Care

Global estimates suggest chronic pain impacts 20% of the population (25). Chronic pain is a common and costly public health problem in the United States (59); more than 80% of physician visits are related to chronic pain (34), resulting in estimated annual direct and indirect costs ranging from $560 to $630 billion (25). Chronic pain impacts some populations disproportionately.

Chronic musculoskeletal pain is common throughout the military and is a leading cause of medical separation from the armed forces (82). Indeed, 40% to 50% of the more than $1.5 billion per year paid by the Department of Defense to disabled veterans is allocated to those with musculoskeletal conditions (33). As of 2017, there were 18.2 million veterans living in the United States and less than half of all veterans received care at a Veterans Affairs medical center, suggesting that most veterans sought or received care from civilian primary care providers (PCPs) (82).

Chronic pain is a biopsychosocial phenomenon—instigated and influenced by biological, environmental, psychological, and social factors—that requires innovative non-pharmacological treatments to address factors beyond the physical pain to promote long-term functional outcomes (25). Prescription medications may help temporarily reduce pain, depending on the pain location and intensity. Nonetheless, pain abolishment is often an impossible goal to achieve for those with chronic pain even with the strongest medications available such as opioids, which risk addiction and dependence (25). Therefore, "non-opioid and non-pharmacologic treatments should be tried before opioids, and the dose and duration of opioids should be limited" (25, p. 174). However, primary care physicians are more inclined to prescribe medications, including opioids, for chronic pain because of time constraints and the appeal of a "quick fix" treatment versus

nonsteroidal anti-inflammatory drugs (NSAIDs), physical therapy, or other biopsychosocial options (65). Often, PCPs endorse insufficient training for, and low satisfaction with, treating individuals with chronic pain (78). As a result, PCPs often provide insufficient treatment for chronic pain in primary care encounters (62; 65).

Interactions between chronic pain and psychosocial factors have important implications for the overall functioning of the individual. Pain and chronic pain have been associated with poor psychological health, including increased distress, depression, anxiety, loss of identity, and social isolation (16; 67). Social well-being, which is partially determined by social connectedness and experiences of loneliness, is important for biopsychosocial health (39). Poor social well-being is associated with significant health risks in older adults, including morbidity through infection, depression, cognitive decline, and higher mortality rates (21).

However, there has been limited prospective and longitudinal research examining relations between social well-being and chronic musculoskeletal pain using validated measures. Positive social well-being is associated with momentarily reduced pain sensitivity and robust social ties can buffer against pain (50). In contrast, higher levels of pain intensity and frequency are linked to poorer social functioning and increased loneliness (11). Nonetheless, there is a dearth of research on chronic musculoskeletal pain and social well-being constructs specifically over time, and available research has methodological limitations. It is critical to understand how social well-being factors, such as social functioning and loneliness, may contribute over time to an individual's pain experience or influence pain treatment outcomes, particularly in primary care settings where individuals with chronic musculoskeletal pain often seek care. Lastly, primary care settings are uniquely poised to screen for social well-being indicators such as social functioning or loneliness. Indeed, individuals with poor social well-being are more likely to

utilize primary care and individuals in poor health are more likely to report poor loneliness (64). Screening primary care patients could inform how social well-being may discretely exacerbate or maintain an individual's chronic pain.

## Chronic Pain

This section includes the definition of chronic pain and describes why chronic pain is important. Research literature on chronic pain in primary care contexts is also discussed.

### *Definition of Chronic Pain*

The International Association for the Study of Pain defines pain as "an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage" (69, p. 2). This definition encompasses the fact that the cause of pain, particularly chronic pain, is often unknown (22; 67). Pain lasting longer than three months is labeled chronic pain (16; 67), which impacts one in three American adults annually (25). There are many forms of pain, including digestive, arthritic, pelvic, orofacial, and cancer-related pain (58). Biomedical models previously defined pain as a consequence of identifiable tissue damage (59). Given that pain chronification, the process by which transient pain becomes chronic, cannot be linked to tissue damage (72), biopsychosocial models have emerged in the literature and help explain the biological, psychological, and social variables that instigate and influence the subjective experience of pain (34; 59). These models also shape pain treatment options with the biomedical model emphasizing pharmaceuticals and interventional pain treatment such as surgery (22; 25), and the biopsychosocial model backing interdisciplinary approaches (33; 79) such as cognitive-behavioral therapy (34; 59).

*Importance of Chronic Pain*

Chronic pain undermines an individual's functioning and contributes to economic losses. According to the Centers for Disease Control and Prevention (CDC), more than 25 million Americans as of 2014 were disabled because of a pain condition and close to one-quarter of Americans experienced functioning limitations at least one day per month because of pain (17). Further, lost productivity and absenteeism in 2003 contributed to $61.2 billion of lost time, according to the American Productivity Audit, and more than 12% of the entire U.S. workforce reported missing work time in a two-week period because of pain (75). Given that most chronic pain, particularly musculoskeletal pain, develops from common injuries, rates of chronic pain are unlikely to decline. For example, in Texas from 2008 to 2011 the common causes of musculoskeletal pain conditions such as falls, accidental injury, and motor vehicle accidents increased by 38%, 37%, and 11% respectively (62).

Chronic pain—musculoskeletal pain in particular—increases one's risk for mental and physical health issues. As noted above, often there is "no direct linear relationship between the amount of detectable physical pathology and the reported pain intensity" (22, p. 20). Thus, pain, without an identified cause, is often regarded as psychosomatic (16; 22; 67). The challenges linked with chronic pain, to include not being believed by physicians, other healthcare providers, and loved ones, take a toll on an individual's mental and physical health over the long term (16; 67). Indeed, research supports the link between pain and poor health. The consequences of chronic musculoskeletal pain can include an increased risk for depression, anxiety, social isolation, and loss of identity (9; 25; 67). Though estimates vary, some 35% or more of individuals with chronic pain experience comorbid depression or anxiety, mental health issues that can sustain pain (25). Lastly, those with severe chronic pain are at risk for sleep problems

and cardiovascular issues such as hypertension due to the stress of their condition, as well as reduced quality of life (32).

*Chronic Musculoskeletal Pain in Primary Care*

Individuals with chronic musculoskeletal pain often seek diagnosis and treatment from PCPs (29). Despite the opioid epidemic in the United States and physician awareness regarding the risk for abuse and dependence on medications, opioids remain a leading treatment for pain (62; 65). Interviews of patients with chronic pain suggest physicians perceive them as "lazy" or fabricating pain "in their head" (67) Similarly, PCPs were more likely to perceive a patient as "difficult" if the individual asked more questions and reported higher pain (43; 62). Indeed, physicians may rely on opioids or other medications because of time constraints, discomfort with other treatments, or a lack of knowledge of non-pharmacological options (62; 65). Such reliance minimizes the importance of biopsychosocial factors, comorbid physical and mental health issues, and patient quality of life (16; 23; 25; 62).

*Biopsychosocial Factors and Chronic Pain*

Evidence has accumulated demonstrating the importance of contextual social and psychological factors in the experience of pain, in contrast to the medical model (23). Through such research, several risk and protective factors have been identified in relation to pain experiences over time. A body of research indicates pain experiences are not equal across demographic categories, environments, or types of chronic pain (23). Widely recognized influential variables impacting pain experiences include socioeconomic status, location (rurality), race, sex, and age (23). Female sex and African American race in particular are demographics that research indicates experience greater prevalence and severity of pain and its impacts in the United States (31). Comorbid mental health conditions such as anxiety and depression are also

likely to worsen an individual's experience with pain (16; 23). Further, researchers are increasing their study of factors such as social well-being to understand how such variables impact an individual's experience with pain (49). Humans are social beings and poor social functioning and experiences of loneliness are increasingly recognized as important within the context of chronic pain (50).

## Chronic Pain, Social Functioning, and Loneliness

Social well-being refers to how an individual functions in the social realm and can include both objective and subjective aspects (11). Two important components of social well-being include social functioning and loneliness. Both social functioning and loneliness have important relations with chronic pain. The following sections describe what is known about the relations between social functioning and loneliness with chronic pain.

### *Definition of Social Functioning*

Social functioning refers to "how well people maintain social activities like visiting family, friends, neighbors, or other groups in the face of physical or emotional problems" or the extent to which one's social activities are impacted by health and psychological functioning (11, p. 218). Research suggests subjective measures such as those assessing perceived isolation (13) or social disconnectedness (21) in terms of social functioning and loneliness are superior predictors of health than objective measures such as partner status or social network size (38). As a result, researchers are increasingly focusing on social well-being constructs such as social functioning in the context of physical health conditions such as chronic musculoskeletal pain (11; 30; 38; 74). Although poor social functioning is not a mental health diagnosis in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), relational and

social elements are recognized as important in terms of social anxiety and overall functioning with the inclusion of multiple Z codes covering social issues (7).

*Importance of Social Functioning*

Poor social functioning is associated with detrimental physical and mental health. Research indicates that individuals who have small social networks, low participation in social activities such as religious or volunteer activities, infrequent contact with social network members, and a lack of diversity of groups within their social network face greater health risks (21). Specifically, the lack of positive social ties is a critical risk factor for morbidity and mortality (13) with individuals with poor social indicators facing a greater risk for chronic diseases such as cardiovascular disease, diabetes, and several cancers (57). Indeed, health is interconnected with one's perception of their relationships as social network analyses and studies on older adults indicate (8; 30). Further, individuals with poor social indicators face decreased life expectancy and poorer mental and cognitive health (39). Indeed, individuals with poor social indicators face greater morbidity through infection, depression, or cognitive decline, as well as higher mortality rates (21).

*Chronic Pain Impacts Social Functioning*

Chronic pain impacts an individual's willingness and ability to socialize and seek social support (58). Qualitative research (80) supports the notion that pain impacts one's relationships in terms of reducing their social engagement, either to evade pain or to prevent feeling misunderstand in terms of their pain experience (24). Indeed, "chronic pain conditions place individuals at an increased risk of social isolation, smaller social network size, and reduced social role functioning, all of which have negative implications for pain interference and pain intensity over time" (50, p. 2229). Changes in social roles and relationships because of pain are

distressing for individuals experiencing chronic pain, particularly when coupled with the fact that chronic pain is viewed as a psychological problem (22; 50; 67). Lastly, cross-sectional research indicates pain is negatively correlated with social functioning (11).

Limited quantitative research indicates pain worsens social functioning. Two studies conducted by Boggero and colleagues (2019) examined longitudinal, cross-sectional, and within-person associations between pain, social functioning, loneliness, and hostility in a sample of community-dwelling adults with a range of pain levels. Study 1 examined cross-sectional data ($n$ = 741) and longitudinal data ($n$ = 549) of participants using the 36-Item Short Form Health Survey (SF-36) social functioning subscale to assess social functioning and a one item question about one's experience with loneliness in the past four weeks on a Likert scale to assess for loneliness (11). The findings indicate pain intensity and frequency were cross-sectionally linked to poorer social functioning and greater loneliness (11). Pain intensity and frequency also longitudinally predicted worse social functioning (11). Study 2 examined within person data for a subset of participants from study 1 ($n$ = 69) using one-item self-report measures rated on Likert scales to assess for both social functioning and loneliness (11). Participants on days with higher average pain reported poorer social functioning, whereas pain intensity did not impact social functioning or loneliness the next day (11).

*Social Functioning Impacts Chronic Pain*

One area of emerging research indicates social connection may reduce perceived pain. The social element of pain is a dynamic relation between the social environment and the individual experiencing pain (51). "This interplay can influence whether an individual is exposed to pain, thoughts and feelings when in pain, how pain is communicated, and the response by others to the person in pain" (51, p. 682). Indeed, neuroscience indicates physical pain and

social pain share neural pathways in the brain via the  dorsal anterior cingulate cortex (dACC), ventromedial prefrontal cortex (vmPFC), and the insula (76). Functional magnetic resonance imaging (fMRI) studies have supported findings related to reduced activity in the dACC and vmPFC implicated in affective elements of pain in participants who viewed pictures of their partners (51). For example, research suggests that social connection to attachment figures may reduce an individual's pain perception (26). Eisenberger and colleagues (2011) reported that female participants experienced reduced pain when viewing pictures of their longtime partners while experiencing a painful stimulus, indicating that individuals who perceive themselves as having greater support via a partner exhibit reduced neural activity in the dACC and anterior insula, and greater vmPFC activation, both of which reduce their pain experience.

*Definition of Loneliness*

In addition to social functioning, loneliness is another subjective component of social well-being that is important to health outcomes and is a burgeoning public health concern. Loneliness involves emotional pain that stems from feeling isolated and dissatisfied with social relationships (42). People who are lonely perceive they lack social support even if they objectively have supports (i.e. cognitive bias) (41). Therefore, lonely individuals rate their social interactions as more negative and unsatisfying, which reinforces maladaptive appraisal and leads to negative feelings and increased social withdrawal. Chronic pain, as described above, can contribute to social withdrawal and isolation, depression, anxiety, and misperceptions regarding social support, all of which can undermine social functioning and lead to loneliness onset (42; 67). Despite its high anecdotal prevalence, loneliness, like social functioning is difficult to classify (42). Specifically, each edition of the DSM (3; 4; 5; 6; 7) has neglected to include loneliness as a diagnosis.

However, it is worth noting that Japan and the United Kingdom have viewed loneliness as such an important problem that they have appointed cabinet officials to target it (18).

*Importance of Loneliness*

Loneliness in particular is associated with poor health outcomes (41). Loneliness has been linked to cardiovascular health risks in young adults and cognitive decline and dementia in old age, with seniors who are very lonely developing Alzheimer's disease at twice the rate of seniors who are less lonely (41). Research suggests loneliness and its effects accrue over time to accelerate physiological aging (40), and longitudinal studies indicate loneliness is a predictor of morbidity and all-cause mortality (41; 70), with individuals who are lonely having a 26% increased risk of death (44). A Cigna study suggests loneliness may be worse for health in terms of an early death than obesity or smoking 15 cigarettes per day (20). This is similar to the risk of mortality for individuals with poor social ties and functioning according to meta-analytic review (45).

*Chronic Pain Impacts Loneliness*

Limited longitudinal research on older populations suggests pain may impact loneliness onset, although only one study investigated chronic musculoskeletal pain specifically. A longitudinal study of 1,563 adults over age 60 found that the odds of loneliness onset at the follow-up four years later in individuals with frequent pain who were not lonely at baseline was 1.58 times higher (OR = 1.58, 95% C.I.: 1.08, 2.32) for those with pain versus those without pain at either time point (28). A separate cross-sectional, population-based study of 9,299 residents in England above age 50 reported individuals with musculoskeletal pain were at greater risk for loneliness (74). Individuals with musculoskeletal pain were 15% more likely to report being lonely (74). Despite these limited findings on pain and social functioning and loneliness, much

research is lacking specifically on chronic musculoskeletal pain and social functioning and loneliness. As a result, social interventions for chronic pain remain limited given the focus on pain as a complex biopsychosocial phenomenon.

*Loneliness Impacts Chronic Pain*

Similar to the literature on social functioning, there is scant literature examining how loneliness impacts chronic musculoskeletal pain. One longitudinal study of 461 elderly adults found that loneliness at age 70 for individuals without chronic back pain was a predictor of chronic back pain onset seven years later (48). Failure to leave the house for recreational purposes was also a predictor of back pain onset, indicating the importance of physical functioning and social engagement (social functioning) to thwart pain processes (48). Although such studies support the link between loneliness, social functioning and physical pain, questions remain in terms of applying the findings to clinical care for conditions such as chronic musculoskeletal pain. Much more research is needed to examine these relations.

*Chronic Pain, Social Functioning, and Loneliness in Primary Care*

Within the complex health care system, primary care is among the most important areas to study chronic pain and its relations with social functioning and loneliness. Individuals experiencing chronic pain are most likely to be seen by primary care physicians (29). Given the importance of social functioning to physical and mental health, the National Academy of Medicine in 2014 urged physicians to obtain data regularly from patients on social connections and social isolation, but few providers have collected such information (64). Despite the importance of social functioning on an individual's life, experience of pain, as well as physical and mental health (11), no studies were identified that examine social functioning and chronic musculoskeletal pain outcomes in primary care settings.

Similarly, no research focusing on chronic musculoskeletal pain and loneliness in primary care was identified. Loneliness is common in primary care populations (64). A recent study reported an average loneliness prevalence rate of 20% in a survey of 1,235 primary care encounters from two different US states (64). The prevalence of loneliness was higher in individuals under age 25 (33%) than in those over age 65 (11%), which supports the finding in the literature that loneliness is common at younger ages (64). Interestingly, individuals who were more lonely were also more likely to utilize healthcare services in the year prior, including emergency department visits, primary care appointments, and hospitalizations (64). This suggests a possible link between loneliness and risk for health issues such as chronic musculoskeletal pain (63).

## Research Gaps

There are numerous research gaps with the existing literature on chronic musculoskeletal pain, social functioning, and loneliness. First, most of the literature available in terms of chronic pain and social functioning focuses on pain generally or chronic pain, not musculoskeletal pain or chronic musculoskeletal pain specifically. Musculoskeletal pain is the predominant type of pain condition, particularly in military and veteran populations (33), and is a leading cause of disability worldwide (10). Further, musculoskeletal pain and its interaction with psychosocial factors may be discrete from other kinds of pain processes (58). Therefore, more research on musculoskeletal pain is needed.

Second, much more research is needed to determine the strength of the relation in either direction between chronic pain and social functioning (see Figure 1), as well as the nuances between social functioning and loneliness. Indeed, the research literature available is inconclusive regarding whether chronic paid reduces social functioning or if social functioning

impacts one's experience with chronic pain. There is some limited evidence suggesting that chronic pain undermines social functioning with scant research available to support the opposite conclusion, despite loneliness exacerbating chronic pain. In this vein, it is unclear to what extent treatment for chronic pain will improve social functioning or the opposite, if improved social functioning will decrease an individual's pain experience. As mentioned above, there is no research available on pain treatment outcomes and social functioning. Given that social functioning is related to social skills that can atrophy over time as in the case of loneliness (42), it cannot be assumed that treatment for pain or reduced pain will correspond with an automatic improvement in social functioning or loneliness as a result. Indeed, examining the complexity between social functioning and loneliness with chronic pain is critical to determine whether social well-being constructs impact chronic pain outcomes. Such findings could help to tailor social interventions for social functioning and loneliness. Third, more prospective, longitudinal, and cross-sectional research is needed on chronic musculoskeletal pain, social functioning, and loneliness. Fourth, more research is also needed on these constructs in the context of primary care where most chronic pain patients seek treatment.

There are also important methodological limitations of the available literature on chronic musculoskeletal pain, social functioning, and loneliness, including the failure to use validated measures to assess the studied constructs. In studies examining connections between pain and social functioning and loneliness, a dichotomous pain measure was used (74) or a one-item measure was used to assess pain intensity (11). There are numerous validated measures for pain, including the Pain, Enjoyment of Life, and General Activity (PEG) Scale (54). It is unclear why validated pain measures were not used in the studies reviewed. In terms of social functioning, one study used the SF-36 social functioning subscale, a measure with good predictive value in

chronic pain populations (27). Other studies, however, did not used the SF-36 social functioning subscale. Another valid measure available to assess social functioning is the BHM-20 life functioning subscale with four questions about social functioning and life enjoyment (53). The BHM-20 is used in primary care contexts (12), particularly throughout the Department of Defense (DoD) health care system. Lastly, for loneliness, several studies used a single question to assess loneliness (11; 48), which is insufficient to gauge the construct because of the stigma associated with endorsing loneliness (15).

In summary, chronic pain is an important public health concern requiring the consideration of biopsychosocial factors in its conceptualization and treatment within primary care settings. Indeed, beyond the widely known characteristics such as race, gender, age, and socioeconomic status, social well-being constructs such as social functioning and loneliness are emerging as particularly relevant to chronic pain. Research suggests chronic pain reduces social functioning, which in turn can impact chronic pain. Experiences of chronic pain can also be influenced by loneliness, another social well-being construct that is detrimental to health. Numerous research gaps exist within the limited literature available on chronic musculoskeletal pain, social functioning, and loneliness within primary care contexts. These research gaps, coupled with the methodological limitations with the existing research studies, undermine our knowledge of the relation of chronic musculoskeletal pain with social functioning and loneliness.

## CHAPTER 2: The Present Study

To investigate the relations among chronic musculoskeletal pain, social functioning, and loneliness, this study examined data from pilot study on the delivery of treatment for 44 individuals experiencing chronic musculoskeletal pain in primary care by Behavioral Health Consultants (BHCs). The pilot study focused on change in pain levels over time following treatment for chronic pain in primary care using a brief intervention treatment model in accordance with the DoD's Chronic Pain Clinical Pathway. The Pathway outlines a range of interventions that can be individualized to a variety of chronic pain conditions and integrates evidence-based biopsychosocial methods. Preliminary data suggest BHCs can improve outcomes for patients with chronic pain, but no studies have tested the feasibility or effectiveness of this approach. The pilot study addressed these gaps by testing whether BHCs could effectively treat chronic pain in primary care settings.

The literature indicates chronic musculoskeletal pain negatively impacts social functioning and is associated with increases in loneliness. Such effects include social withdrawal, increased social isolation, and a perceived lack of social support, particularly if medical providers and family members misjudge or even disbelieve the challenges inherent to the person's pain condition (22; 62; 67). Possible results include poor social well-being through reduced social functioning or loneliness onset. We hypothesize that individuals with chronic musculoskeletal pain may uniquely experience worse social functioning or loneliness.

### Specific Aims and Hypotheses

Specifically, we will investigate the relations among chronic musculoskeletal pain, social functioning, and loneliness in primary care. We will explore the association between chronic

pain and social functioning, and whether social functioning influences pain treatment outcomes. The relation between social functioning and loneliness will also be examined.

Specific Aim 1

To investigate the relation between average pain and social well-being

*Hypothesis 1a*

BHM-20 Life Functioning subscale scores (one life enjoyment and three relationship questions), will be negatively correlated with pain scores (PEG Q1)

Rationale. We hypothesized this because the literature suggests social functioning is negatively correlated with pain (see Figure 1) (11; 50).

*Hypothesis 1b*

The difference between BHM-20 Life Functioning subscale scores at baseline to last treatment appointment in those treated for pain will not be statistically significant

Rationale. We hypothesized this because the literature suggests social functioning is a discrete construct related to social skills with its own impacts on health (11; 42; 50). Although we expected social functioning (Life Functioning subscale scores) to be negatively correlated with pain scores in Hypothesis 1a, we did not expect social functioning (Life Functioning subscale scores) to change over time. Therefore, we hypothesized social functioning would not necessarily improve with pain reduction over time in response to treatment (see Figure 1).

Specific Aim 2

To examine whether social well-being impacts pain treatment results

*Hypothesis 2*

Participants reporting higher ratings of social well-being based on the BHM-20's Life Functioning subscale score at baseline, will demonstrate greater reductions in self-reported pain

on average (PEG Q1) between baseline and last treatment appointments than those with lower ratings of social well-being at baseline

Rationale. We hypothesized this because positive social well-being in the literature is associated with reduced pain sensitivity, suggesting that robust social functioning could buffer against pain (see Figure 1) (50).

Specific Aim 3

To investigate the relation between BHM-20 and loneliness measures

*Hypothesis 1*

The BHM-20 Life Functioning subscale scores will be negatively correlated with the 3-Item Loneliness Scale scores at r = -.30 or greater.

A visual data review will also be conducted given the small sample of individuals who completed the 3-Item Loneliness Scale. Such a review may reveal additional insights or avenues for future exploration regarding social well-being via social functioning and loneliness constructs.

Rationale. We hypothesized the correlation would be negative because individuals who are lonely tend to have poorer social skills—because of lack of use and atrophy over time—which would be inversely associated with social functioning (see Figure 1) (42). We selected -.30 because it is a moderate effect size and because the literature indicates the correlation between the two constructs is approximately -.48 (11).

## CHAPTER 3: Method

The investigation of the relations among chronic musculoskeletal pain, social functioning, and loneliness was completed as part of a pilot study on treatment for chronic musculoskeletal pain in primary care by BHCs. The pilot study focused on change in pain levels

over time following pain treatment in primary care using a brief, manualized non-pharmacological intervention. The loneliness measure described below was added to the pilot study for this project. Additional data were collected as part of the pilot study but were not analyzed for this thesis. The pilot study, including the addition of the loneliness measure, was approved by the Institutional Review Board (IRB) at the University of Texas Health Science Center San Antonio (UTHSA) in accordance with DoD polices covering data collection.

## Participants

The following inclusion and exclusion criteria were used to screen and recruit participants per the approved research protocol. Patient inclusion criteria for the study included: DoD beneficiaries above age 18; seeing a current Primary Care Manager (PCM) at the clinics conducting the study when the study began; referred to the BHC for pain issues; with at least one clinically diagnosed pain condition for 12 weeks or more in duration. Exclusion criteria included: Psychosis or delirium as determined by medical record review or clinical judgement; a life circumstance or medical condition that would preclude participation such as immobilization; inability to complete the informed consent process or comprehend study requirements.

See Table 1 for an overview of participant demographics, including gender, age, race, marital status, military service branch, and DoD beneficiary category.

### *Recruitment*

Forty-four adult participants were recruited from one primary care clinic located at Fort Hood in Texas. Consistent with the DoD's Chronic Pain Pathway, individuals with a chronic pain diagnosis were identified and referred to a BHC. Individuals experiencing chronic pain who were seen by a BHC were offered the opportunity to participate in the study; those who accepted consented to participate in the study. Non-consenters were still treated by the BHC.

Procedure and Materials

Following patient consent to participate in the study, individuals met with research staff and completed the research assessment measures. The BHC treated the patient consistent with the DoD Chronic Pain Clinical Pathway. The intervention used by the BHCs incorporated evidence-based biopsychosocial methods such as activity pacing, psychoeducation, acceptance, relaxation, and cognitive restructuring and behavioral modification to treat chronic pain and pain-related complaints (37). The number of appointments varied based on patient needs, treatment provided, and other unforeseen factors. For some individuals, the first BHC appointment and assessment were completed on the same day (see Figure 2).

For the purposes of this analysis, the researchers used the first appointment that the BHM-20 and the PEG were both administered (first appointment: $n = 38$; second appointment $n = 6$). The researchers determined the final appointment for the purposes of this study following a manual review of each participant's medical file. Time between appointments varied because of characteristics unique to each participant such as their schedule, and contextual factors such as the COVID-19 pandemic and changes in appointment scheduling procedures. The final treatment date was independently evaluated by the two primary investigators of the study, who were blind to the outcomes of each individual at the time. Discrepancies between the determination of the end of treatment were resolved through discussion between the two primary investigators.

Relevant timepoints used in this analysis include the baseline assessment, the last treatment appointment, the three-month assessment, and the six-month assessment (see Figure 2). The baseline assessment consisted of the intake or appointment one, which for some participants occurred on the same day as noted above. The last treatment appointment differed

for each participant and was selected by the primary investigators as described above. The three- and six-month assessments occurred three- and six months after the participant's baseline.

There are three measures pertinent to this study: The PEG questionnaire, the BHM-20, and the 3-Item UCLA Loneliness Scale. Each individual filled out the PEG and the BHM-20 at every treatment appointment and at the three- and six-month follow-up appointments. Each individual filled out the 3-Item UCLA Loneliness Scale at the three- and six-month follow-up appointments. Fewer individuals completed the UCLA Loneliness Scale ($n = 9$) as the measure was added to the pilot study after it began. The dependent variables of pain, social functioning, and loneliness were assessed by examining the participants' scores on the PEG, BHM-20 Life Functioning subscale, and the UCLA 3-Item Loneliness Scale over time.

*Measures*

Researchers used three measures to examine the relations among chronic musculoskeletal pain, social functioning, and loneliness in a sample of individuals treated in primary care.

Pain Intensity, Enjoyment and General Activity (PEG). The PEG measures pain intensity, the interference of pain on an individual's enjoyment of life, and the interference of pain on an individual's general activity. The PEG contains three items and individuals rate each item on an 11-point Likert scale (0 = *no pain,* to 10 = *pain as bad as you can imagine*). Compared to other pain measures, the PEG in two studies had good construct validity ($r = 0.60$-$0.89$ in Study 1 and $r = .77$-$.95$ in Study 2) and reliability ($\alpha = 0.73$ and $0.89$ in the two samples, respectively) (54). In addition, the PEG is sensitive to change over time (54). For the purposes of this analysis, only question 1 on the PEG was used to track pain over time. Question 1 states: What number best describes your pain on average in the past week? Question 1 was chosen to assess pain because the other two questions on the PEG pertain to enjoyment of life and general activity, themes that

overlap with the BHM-20 social functioning subscale. We will use the pain intensity question from the PEG and the Life Functioning subscale of the BHM-20 as a proxy measure for social functioning to examine the relation between pain intensity and social functioning from both directions.

Behavioral Health Measure (BHM-20). The BHM-20 questionnaire consists of 20 questions on three subscales: Well-Being, Psychological Symptoms, and Life Functioning. The questions are rated on 5-point (0-4) Likert scales. The summed scores represent behavioral health regarding distress, life satisfaction, and motivation (Well-Being subscale); depression, anxiety, panic, substance use, and risk of suicide (Psychological Symptoms subscale); and work/school/intimate social relationships and life enjoyment (Life Functioning subscale) (53). The following clinical cutoff scores are suggested: *Severe* (0 to 2.08), *Moderate* (2.08 to 2.37), *Mild* (2.38 to 2.93), and *Normal* (2.94 to 4.00) (12). According to Kopta and Lowry (2002), the BHM-20 has sufficient internal consistency and test-rest reliabilities for the subscales and total scale (>.72) (53). The complete BHM-20 measure was used in the pilot study but only the four-item Life Functioning subscale will be analyzed in this thesis project as a novel proxy for social functioning. The Life Functioning subscale consists of questions regarding one's perceived social well-being and satisfaction—"how have you been getting along in the following areas of your life over the past two weeks?"—in terms of social relationships, life enjoyment, work/school, and intimate relationships (53). Cronbach alphas for the Life Functioning subscale at baseline and last treatment appointment in our sample ($n$ = 44) were .89 and .89, respectively.

UCLA 3-Item Loneliness Scale. The 3-Item Loneliness Scale is a brief measure used to indicate whether an individual is lonely (47). The short scale was adapted from the 20-item Revised-UCLA (R-UCLA) Loneliness Scale (71). The 3-item scale uses a 3-point Likert scale (1

= *hardly ever*, 2 = *some of the time*, 3 = *often*) and scores greater than six indicate loneliness (74). Items refer to feeling without companionship, left out, or isolated (47). The 3-Item Loneliness Scale demonstrates convergent and discriminate validity (47) and has good internal consistency when given as a self-report measure (36). The alpha coefficient of reliability of the 3-Item Loneliness Scale is .72 and its correlation with the longer R-UCLA Loneliness Scale is .82 (47). The 3-Item Loneliness Scale has been used in primary care settings (64) and with veterans (55). The 3-item scale was introduced after the start of the pilot study. Loneliness data from the six-month assessment will be used to test Hypothesis 3 because more participant data was obtained than at other timepoints. Cronbach alpha for loneliness at the six-month assessment in our sample ($n$ = 9) was .82.

*Design*

This study used a prospective, observational, pragmatic design. Researchers collected participant data at baseline, during treatment, and post-treatment using multiple measures (see Figure 2). The data from this study were used to examine the relations among chronic musculoskeletal pain, social functioning, and loneliness in participants over time. The pilot study included additional self-report and activity measures not included in this analysis. Not all participants completed data across all timepoints as the loneliness measure was added later.

*Experimental Manipulations*

No experimental manipulations were used in this prospective, pragmatic study. The BHC who provided treatment did so in accordance with the DoD's Chronic Pain Clinical Pathway. Further, there were no controls used in this study. The BHC provided care consistent with the DoD's Chronic Pain Clinical Pathway, regardless of whether the individual participated in the

study. As a result, measures of pain, social functioning, and loneliness for this study were obtained for each participant during brief treatment for chronic musculoskeletal pain.

*Sample Size and Statistical Power*

Researchers collected data from 44 participants. Twelve participants had incomplete data and were excluded from the analysis of Hypothesis 1a, 1b, and 2, resulting in complete data for 32 participants. In terms of statistical power, a minimum of 38 participants were needed to obtain a difference in functional outcomes using a repeated measures t-test for the BHM-20 with an effect size of .20 (Cohen's F) with a power of .80 (37). These parameters were calculated using a Type I error rate of .05 (two tailed), the average standard deviation (.66, range .60-.75), and the average within-subject correlation (.78, range 71-.83) of the BHM-20 subscales (53). Participant attrition, human error, and the COVID-19 pandemic which required a shift to virtual healthcare undermined data collection for this study.

*Data Analysis Plan*

First, the data was examined for discrepancies. As noted above, twelve participants had incomplete data on the PEG or BHM-20 from varying timepoints (see Figure 2) and were excluded from the analysis of Hypotheses 1a, 1b, and 2. There were two individuals who lacked BHM-20 and PEG data collected on the same date and their data was excluded from the analysis. There were five individuals with only one treatment appointment, which was used as baseline data. As a result, these five participants did not have last treatment appointment data. Three participants also lacked last treatment appointment data because their final appointments with the BHC were conducted virtually and the BHM-20 and PEG were not collected. Two other participants had partially incomplete data, possibly stemming from procedural errors. Therefore, 12 participants had missing or incomplete data, reducing the sample size from $n = 44$ to $n = 32$.

For Hypothesis 3, the sample size was small because the 3-Item UCLA Loneliness Scale was introduced after the start of the pilot study. Only nine participants completed the Loneliness Scale at the six-month follow-up and only four participants completed the Loneliness Scale at three-month follow-up. Therefore, six-month follow-up Loneliness Scale and BHM-20 data were used for testing specific aim 3, resulting in a sample size of $n = 9$.

Next, data were examined for outliers and to test assumptions. Life Functioning subscale and PEG data were normally distributed. Residuals were also normally distributed. There was no evidence of heteroskedasticity or linearity which would have violated regression assumptions. In terms of loneliness data, one datapoint was identified having a value greater than two standard deviations above the mean. As a result, a more robust statistical analysis was added to our data plan. Given the small sample size ($n = 9$), the data point was not excluded from the analysis.

The hypotheses with the statistical analyses used to test each one is detailed below.

Hypothesis 1a: BHM-20 Life Functioning subscale scores (social functioning) will be negatively correlated with pain scores (PEG Q1). A Pearson correlation was used to test the relation between social functioning (BHM-20 Life Functioning subscale) and pain (PEG Q1) at baseline and then again at last treatment appointment. The two Pearson correlations—baseline and last treatment appointment—were computed into an average correlation by converting the correlation coefficients to fisher's z scores (z') using a conversion table, averaging them together, and then converting them back to a correlation coefficient using the same conversation table. The result was a computed average correlation between social functioning (Life Functioning subscale scores) and pain (PEG Q1 scores) to test Hypothesis 1a.

Hypothesis 1b: The difference between BHM-20 Life Functioning subscale scores at baseline to last treatment appointment in those treated for pain will not be statistically

significant. A repeated measures t-test was used to examine the Life Functioning subscale scores between baseline and last treatment appointment to assess for change over time. In addition, an equivalence test, two one-sided test (TOST) procedure, was used as well to test the hypothesis.

Hypothesis 2: Participants reporting higher ratings of social well-being based on the BHM-20's Life Functioning subscale score at baseline, will demonstrate greater reductions in self-reported pain on average (PEG Q1) between baseline and last treatment appointments provided by BHCs. First, a repeated measures t-test was used with PEG Q1 baseline and last treatment appointment scores to assess if change in pain over time was statistically significant. Subsequently, a linear regression model was used to examine if baseline social functioning (BHM-20 Life Functioning subscale scores) predicted pain treatment outcomes (PEG Q1 scores at last treatment appointment). We controlled for baseline pain scores. We also examined whether demographics should be controlled for using t-tests, a correlation, and a one-way ANOVA for the variables of age, military status, gender, marital status, and race/ethnicity. We then controlled for—in addition to baseline pain scores—military status and race/ethnicity in the linear regression model as the two variables were the mostly likely to confound our analyses.

Hypothesis 3: The BHM-20 Life Functioning subscale scores will be negatively correlated with the UCLA 3-Item Loneliness Scale scores at r =-.30 or greater. A Pearson correlation was used to examine the relation between social functioning (Life Functioning subscale scores) and loneliness (UCLA 3-Item Loneliness Scale scores). A Spearman correlation was also used because of the presence of an outlier in the data.

## CHAPTER 4: Results

The results for the specific aims and hypotheses are detailed below. As indicated in Table 1, most of the sample participants were female (75%), Caucasian (43%), married (86.4%), affiliated with the Army (47.7%), and a retired service member or veteran (52.2%). The mean age of the sample was approximately 45 years of age (44.5±9.34). The mean number of treatment appointments for each participant was 3.73±1.71. See Table 2 for the means and standard deviations of the study measures of pain, social functioning, and loneliness at baseline and the last treatment appointment (for the PEG Q1 and Life Functioning subscale) or the six-month follow-up (for the 3-Item Loneliness Scale and the Life Functioning subscale).

### Aim 1: Pain and Social Well-Being

Hypothesis 1a, the relation between average pain and social well-being, was examined using Pearson's *r* correlations between baseline data and last available treatment appointment data. Two separate Pearson's *r* correlations were calculated with the first being between baseline Life Functioning subscale scores and baseline PEG Q1 scores. The relation between social functioning and pain at baseline (see Figure 3) was not statistically significant, $r(40) = -.06$, $p = .71$ ($n = 42$). A second Pearson's *r* correlation was calculated between last-treatment appointment Life Functioning subscale scores and last treatment appointment PEG scores. Relations between social functioning and pain at last treatment appointment (see Figure 4) were not statistically significant, $r(32) = -.14$, $p = .43$ ($n = 34$). The correlation coefficients were then converted to fisher's z scores (z') using a conversion table, averaged together, and then converted back to a correlation coefficient using the same conversation table. The computed average correlation between social functioning and pain was $r = -.10$, $p = .57$. Although the

direction of the relation was consistent with our hypothesis, the relations between the Life Functioning subscale and PEG Q1 were not statistically significant.

Hypothesis 1b, the change in social well-being over time in those treated for pain, was examined using a paired sample t-test between Life Functioning subscale scores at baseline and last treatment appointment. Results of the dependent (paired) sample t-test indicated there were no statistically significant changes in social functioning between baseline and last treatment appointment in those treated for pain, $t(33) = .03$, $p = .98$ ($n = 34$). Further, an equivalence test was used as well to test the hypothesis (see Figure 5). Results of the two one-sided test (TOST) procedure (56) indicated that the observed effect size (dz = -.02) was within the equivalence bounds of dz = -.05 and dz = .5, $t(33) = 2.79$, $p < .01$ (n = 34). The null hypothesis test was not statistically significant, $t(33) = -.13$, $p = 0.90$. Based on the equivalence test and the null-hypothesis test combined, we concluded that the observed effect is statistically not different from zero and statistically equivalent to zero (56). The findings of both tests were consistent with our hypothesis that individuals with chronic musculoskeletal pain did not experience significant gains in social functioning after being treated by a BHC for pain.

Aim 2: Social Well-Being and Pain Treatment

Hypothesis 2, participants reporting higher ratings of social well-being at baseline will demonstrate greater reductions in pain between baseline and last treatment appointment, was examined using a repeated measures t-test and a linear regression model. First, a paired sample t-test between PEG baseline and last treatment appointment data tested whether participants experienced statistically significant change in pain over time (see Figure 6). The mean pain rating for Q1 at baseline for the sample $n = 34$ was 5.76 with a standard deviation of 2.10 (see Table 2). The maximum pain rating value on the PEG is 10. Results of the paired sample t-test

indicated individuals treated for pain did experience statistically significant changes in pain over time, $t(33) = 2.85$, $p < .01$ ($n = 34$). This finding was consistent with our hypothesis that individuals with chronic pain experienced a modest reduction in pain as a result of treatment by the BHC.

Next, a linear regression model was used to examine whether baseline Life Functioning predicted pain treatment outcomes. We controlled for baseline pain. Results of the multiple linear regression model were statistically significant, $F(2,31) = 3.83$, $p = .03$, $R^2 = .20$) ($n = 34$). However, social functioning was not a significant predictor of pain treatment outcomes in the model, $t = -.66$, $p = .51$. We also controlled for demographic factors that had potential to confound our analysis such as military status and race/ethnicity. Differences in pain levels at last treatment appointment were statistically significant between retired military or veterans and civilians, $t = 2.38$, $p = .02$. Differences in pain levels at last treatment appointment neared statistical significance in terms of race/ethnicity, $F(2,31) = 2.5$, $p = .10$. Social functioning was not a statistically significant predictor in the regression model when controlling for baseline pain and military status, $t = -1.71$, $p = .10$, or baseline pain and race/ethnicity (Other/Black), $t = -.78$, $p = .44$. Age, gender, and marital status were not statistically significant variables in t-tests or correlations. Therefore, we did not control for those demographic variables in these analyses. The lack of significance of social functioning was inconsistent with our hypothesis.

Specific Aim 3: Social Functioning and Loneliness

Hypothesis 1, to investigate the relation between the BHM-20 Life Functioning subscale and the UCLA Loneliness Scale, was examined using a Pearson's *r* correlation between six-month follow-up BHM-20 data and six-month follow-up UCLA Loneliness data (see Figure 7). The correlation between social functioning and loneliness was statistically significant, $r(7) = -$

.78, $p < .05$ ($n = 9$). This finding is consistent with our hypothesis that the correlation was greater than -.30. Further, the effect size of the correlation was greater than expected at $r(7) = -.8$, a large effect size. The very small sample size, however, indicates the data may be heavily skewed. A visual inspection of the data revealed that five participants scored below the clinical cutoff for social functioning of 2.37 (52) and two of the five participants scored higher than 6, the clinical cutoff for loneliness (47) (see Figure 8). One of the participants scored higher than two standard deviations above the mean, indicating their data was an outlier.

To compensate for the skewed results, we conducted a Spearman correlation, a nonparametric procedure. The results were not statistically significant, $r_s(7) = -.64$, $p = .07$ ($n = 9$).

## CHAPTER 5: Discussion

This study examined social well-being indicators such as social functioning and loneliness in DoD beneficiaries being treated for chronic musculoskeletal pain in primary care. Social functioning, as measured by BHM-20 Life Functioning subscales scores, was negatively associated with pain scores (PEG Q1) as the literature suggests (50), although the correlation was not statistically significant. There was no difference between social functioning at baseline compared to social functioning at last treatment appointment for pain. A statistically significant difference was found between baseline pain and last treatment appointment levels. However, social functioning—as measured by BHM-20 Life Functioning subscales scores at baseline—did not predict pain treatment outcomes as measured by PEG Q1 scores. Lastly, social functioning was negatively correlated with loneliness scores, consistent with the existing literature (11). The Pearson correlation was statistically significant and the effect size was large, greater than hypothesized. The Spearman correlation was not statistically significant but matched the negative correlation trend with a strong monotonic relationship.

### Pain and Social Well-Being

Although social functioning was negatively associated with pain scores as hypothesized, the correlation was small and not statistically significant. Given the multitude of impacts of pain on the lives of individuals with chronic musculoskeletal pain documented in the literature (9; 16; 23; 67), we expected the effect size to be greater and to find a statistically significant correlation between pain and social functioning. Indeed, initial findings from the cross-sectional literature suggest social functioning and pain are negatively correlated with a medium effect size ($r$ = -.48) (11). Therefore, our finding on pain and social functioning—at baseline ($r$ = -.06), last treatment

appointment ($r$ = -.14), for a computed average of $r$ = -.10—is at odds with the available literature.

Possible explanations for this effect could be that the individuals in our sample experienced lower overall pain at baseline than individuals in other studies, resulting in fewer impacts on their social functioning. However, the mean pain scores at baseline—5.76 with a standard deviation of 2.10 for PEG Q1 (see Table 2)—meets the definition of at least moderate pain (54), suggesting lack of pain intensity cannot necessarily explain fewer impacts on social functioning. Indeed, the mean social functioning scores for the sample $n$ = 34 was 2.52 with a standard deviation of .96 (see Table 2), which is higher than the life functioning clinical cutoff score used of 2.37 (52). Another possible explanation could stem from demographic characteristics, 75% of the sample was female and 86% of the sample was married (see Table 1). There could be sex differences in relation to pain as the literature notes (23; 31) or in terms of social functioning. Some literature suggests men and women differ in their social networks and risk factors for poor social well-being (30; 70). More research is needed to examine sex differences in social functioning in those with pain. Marital status also may have impacted social functioning scores. For example, some research indicates primary care patients and veterans who are married or living with a partner are less likely to be lonely (55; 64). Lastly, the small sample size used in this study is another possible contributing factor.

In terms of social functioning in those being treated for pain, there was no statistically significant difference between social functioning at baseline and last treatment appointment as hypothesized. We hypothesized this because although the literature indicates pain and social well-being constructs are related, the direction and the strength of the relation was unclear, including the impacts of treatment for pain on social functioning. Our finding was consistent

with our hypothesis, indicating that the relation between social functioning and pain is deserving of more research to examine the intricacies in the relation, including the contribution of social skills and loneliness to the pain experience (11; 13; 15; 42). It is plausible the link between social functioning and pain is more tenuous in certain populations than the literature suggests such as in married, Caucasian women, which was most of our sample. Alternatively, it is possible other factors contributed to the outcome such as higher baseline social functioning scores as noted above. It may also be plausible that social functioning is higher among individuals seen in primary care settings compared to individuals treated by specialty care providers. Further, it is possible that individuals with lower social functioning scores at baseline could experience improvement in social functioning when treated for pain. Our finding does not rule out this potential and more research is needed to understand the relation between social functioning and pain among DoD beneficiaries and those treated in primary care (80).

Pain Treatment Outcomes

Changes in pain scores between baseline and last treatment appointment were statistically significant as hypothesized. However, social functioning scores at baseline did not predict pain treatment outcomes as hypothesized. A possible explanation for this finding could be that mean social functioning levels at baseline were higher than the clinical cutoff scores as previously described. Another possible explanation is that our finding is a contribution to the literature in that social functioning scores are not relevant to chronic pain treatment outcomes. However, it is also possible that trajectories of social functioning over time rather than baseline data only would be a more robust predictor of pain outcomes. A more nuanced examination of such trajectories is also necessary to examine variables such as sex, race/ethnicity, military status, age, or marital status that may impact social functioning and pain in a larger sample (23). Further, it would be

useful to examine if social functioning in individuals who experienced the most improvement in pain was more relevant as compared to individuals who experienced a more modest improvement in pain.

To begin to answer whether individuals who experience the most improvement in pain or social functioning had similar or divergent pain or social functioning trajectories, we completed a visual examination of the data. Indeed, a visual examination of the data from 10 individuals whose pain scores improved the most (by two standard deviations above the mean or four or more points on the PEG, see Figure 9), indicates that five of the 10 participants also improved their social functioning as measured by the BHM-20 Life Functioning subscale score (see Figure 10). At the same time, four participants' Life Functioning subscale scores decreased from baseline to last treatment appointment (with one participant's scores remaining the same). A visual examination of the data from individuals whose Life Functioning subscale scores improved the most (by .68 or more points on the life functioning subscale in accordance with a reliable change index (52), see Figure 11) indicates that five of the nine participants also improved their pain scores (see Figure 12). However, four of the nine participants experienced an increase in their pain scores. Together, these visual analyses confound our ability to draw conclusions about the relation between chronic pain and social functioning from this small sample size. Nonetheless, the finding that pain treatment outcomes were statistically significant in this pilot study is important because it highlights the efficacy of brief, nonpharmacological interventions for pain in primary care for DoD beneficiaries (25; 62).

Social Functioning and Loneliness

Social functioning and loneliness were negatively correlated and the Pearson correlation was statistically significant as hypothesized and indicated in the literature (11). We hypothesized

a moderate effect size of -.30 or greater and reported a large effect size of -.78. This finding is consistent with the literature in that enhanced social well-being indicators such as social functioning are protective against loneliness (11; 15; 61). This finding also supports the bidirectional relation found in the literature that individuals with higher levels of loneliness reported worse social functioning (11; 55). Given the limited data points in the data set, we were not able to examine this relation longitudinally, only cross-sectionally at the six-month follow-up appointment. Therefore, this finding is preliminary in nature due to the very small sample size.

In this vein, a visual analysis of the data indicates the data of two individuals heavily skewed the results, with one participant's data qualifying as an outlier. In response, we used a nonparametric Spearman correlation, which was not statistically significant. However, the direction and the strength of the relationship between the Pearson and Spearman correlations were consistent, indicating that as social functioning decreases, loneliness tends to increase. The Spearman correlation tests for a monochronic relationship, meaning that the dependent variable either always increases or decreases as the independent variable increases (1). The Spearman correlation was close to significance, with a strong effect size, indicating that the relationship between social functioning and loneliness tends to monotonically decrease (1)—as loneliness increases, social functioning never increases; it tends to decrease. These results suggest that social functioning and loneliness have a monotonic relationship, in that the variables change together, but not necessarily at a consistent rate (2).

The same two individuals with the highest loneliness ratings described above had missing data from their last treatment appointment for pain and social functioning, limiting further analysis of their social functioning and pain levels over time. Further, three other individuals scored below the clinical cutoff for social functioning, but not above the cutoff for loneliness. It

is possible these individuals may be at risk for loneliness onset as can occur with individuals who have chronic pain as noted in the literature (28; 74). The strong negative correlation between social functioning and loneliness indicates further research is necessary, particularly in the context of primary care where individuals can be screened for social functioning challenges and referred for a social intervention or connected to programming.

## Study Limitations

This study has multiple limitations that undermine the generalizability of the results. First, the sample size was smaller than expected due to incomplete data for 12 participants, resulting in underpowered analyses for Hypotheses 1a, 1b, and 2. The sample was also smaller than expected for the third hypothesis ($n$ = 9), which is too small to interpret with confidence.

Second, this study used a subscale of a validated measure. Although the BHM-20 is a validated and commonly used measure in primary care settings, the limited number of studies available that reference Life Functioning subscale scores are in the context of therapy treatment outcomes (52; 53), not treatment outcomes related to a medical condition such as chronic musculoskeletal pain. The studies available using the Life Functioning subscale scores also do not track an individual's social well-being over time to make inferences about the constructs of social functioning or loneliness (52).

Therefore, in examining the Life Functioning subscale scores, clinical cutoff and reliable change scores found in the psychotherapy literature were used to understand the sample as described above in terms of higher baseline social functioning (52). Such an application of the clinical cutoff scores from therapy outcomes to a pain treatment sample may have been less than ideal for the purposes of this study and related analyses. Thus, the findings related to social functioning in relation to chronic pain are preliminary in nature and require additional research.

Similarly, only one item from a validated measure, the PEG was used to assess pain. The full PEG was not used for the purposes of this analysis because of the overlap in items on the PEG and the BHM-20 Life Functioning subscale regarding life enjoyment and activity. Although the use of a single item for pain in this analysis is a possible limitation, the item selected for this analysis from the PEG, average pain intensity in the past week, is valid (54).

Third, the sample demographics may have been a limiting feature that influenced the results of our analysis. Approximately half the sample was current or former military, with the other half of the sample being civilian. There could be differences between military and civilians in terms of pain, social functioning, and experiences with loneliness as some literature indicates (14; 55; 60; 79; 82). Indeed, there was a difference in pain scores at last treatment appointment between retired military or veteran participants and civilian participants as described above in the results section of Hypothesis 2. Further, the subset of individuals with loneliness scores were almost all current or former military, with only one civilian participant, which changes the generalizability of our results. A closer examination of the pain and Life Functioning subscale scores and their trajectories over time may also undermine generalizability of the findings presented above to one demographic group more than another, with implications for future research and clinical care for active duty, retirees or veterans, and DoD beneficiaries.

Lastly, it is unclear what impact the COVID-19 pandemic and subsequent isolation may have had on the individuals' participation in the study, their pain, social functioning, or loneliness. Emerging research indicates the pandemic disproportionately affected different demographics, particularly socially disadvantaged groups, suggesting our sample—comprised of 57% Black or African American, Hispanic, or other races/ethnicities that are marginalized in the United States—may have been impacted in unique, unforeseen ways (50).

## Clinical Implications and Future Directions

The findings of this study are clinically important and inform future research initiatives needed to further understand chronic pain relations with social functioning and loneliness. First, individuals experiencing pain tend to report lower social functioning. More research is needed to confirm this finding among DoD beneficiaries as well as with individuals treated in primary care settings. However, preliminary correlations suggest interventions (individual or group) for social functioning (15; 61; 66) may be necessary for individuals experiencing chronic pain as social functioning scores did not change in response to pain treatment. These findings support the notion that social functioning as a construct is deserving of its own focus and intervention to enhance over all social well-being indicators because social functioning may not indirectly improve in response to treatments for discrete health conditions such as chronic pain (15; 61; 66). Indeed, social functioning did not predict pain treatment outcomes, indicating that pain and social functioning may be more detached constructs than the existing pain literature suggests. Nonetheless, the brief intervention used for pain resulted in a statistically significant difference between pain at baseline and last treatment appointment, supporting the efficacy of the brief, nonpharmacological treatment model in primary care (25).

Interestingly, despite very few participants who completed both measures, the BHM-20 Life Functioning subscale was strongly and negatively correlated with the UCLA Loneliness Scale (i.e., reports of lower levels of life functioning were associated with higher levels of loneliness). More research with a larger sample is needed to substantiate this relation and support the use of the BHM-20 Life Functioning subscale as a tool to understand the overall social well-being of an individual treated for chronic pain in primary care. It is plausible one could report high social functioning as well as high levels of loneliness, which is why more research is

needed to understand the potential nuances in this relation. Nonetheless, the findings suggest that the BHM-20 Life Functioning subscale could be used to determine who may benefit (clinically or those at risk) from a socially-focused intervention among those experiencing chronic pain.

Further, the results of our study in conjunction with the existing literature indicate that additional demographic variables such as age, physical and mental health comorbidities, and military status may be important and relevant to the relation among chronic musculoskeletal pain, social functioning, and loneliness (see Figure 13). For example, given the relation between pain and social functioning (67; 80), particularly in older adults (21; 28; 38; 73) and those with depression (19; 35; 68), a clinical cutoff score on the Life Functioning subscale for age or those with comorbid physical and mental health problems could be of great use to primary care physicians to refer such individuals to social interventions to enhance social connection and overall social well-being (53). Further, the individuals in the small sample with UCLA Loneliness data available were coincidentally majority military or veterans, suggesting a broader comparison of social functioning and loneliness levels in a diverse demographic sample of those with chronic pain may also illuminate discrepancies in social functioning or loneliness between the military and civilian experience as the literature suggests (55; 60; 68; 77; 79; 81; 82).

In terms of policy, the findings of this analysis of pilot study data suggest that brief interventions for pain in primary care in accordance with the DoD Chronic Pain Pathway help improve pain ratings over time. These preliminary findings, if replicated in an adequately powered randomized controlled trial, would demonstrate that such non-pharmacological interventions are effective and should be continued to be used in DoD facilities and primary care settings, as well as in civilian primary care settings. The findings also suggest that the BHM-20 Life Functioning subscale could potentially be used as a screening tool to identify

servicemembers or family members who could benefit from a tailored social intervention or enhanced connection to services related to social elements either on base, within the military community, or the surrounding civilian community.

Given that the BHM-20 is widely used throughout the DoD, a new policy aimed at using the Life Functioning subscale scores as a screening tool for social interventions could be easily implemented. Indeed, social functioning and loneliness have been linked to increased suicide risk, including among service members (42; 46; 77), a fact that could also justify looking closer at social well-being indicators that are already widely accessible such as the BHM-20 Life Functioning subscale. Further, a policy adding the brief UCLA 3-Item Loneliness measure to treatment in primary care settings (64) could also help quickly screen servicemembers and their families to identify those who may benefit from social interventions and greater connectivity to social programming.

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Tables

Table 1

*Participant Characteristics (N = 44)*

| Variable | Category | N (%) or Mean ± SD |
|---|---|---|
| Gender | Male | 11 (25%) |
| | Female | 33 (75%) |
| Age | | 44.47±9.34 |
| Race | Caucasian, non-Hispanic | 19 (43.2%) |
| | Black or African American | 15 (34.1%) |
| | Hispanic | 7 (15.9%) |
| | Other, non-Hispanic | 3 (6.8%) |
| Marital Status | Married | 38 (86.4%) |
| | Separated or Divorced | 5 (11.4%) |
| | Not Married, Living with Partner | 1 (2.3%) |
| Service Branch | Army | 21 (91.3%) |
| | Navy | 1 (4.3%) |
| | Air Force | 1 (4.3%) |
| DoD Beneficiary | Retired | 17 (38.6%) |
| Category | Veteran | 6 (13.6%) |
| | Family Member | 21 (47.7%) |
| Treatment Appointments | N/A | 3.73±.1.71 |

Table 2

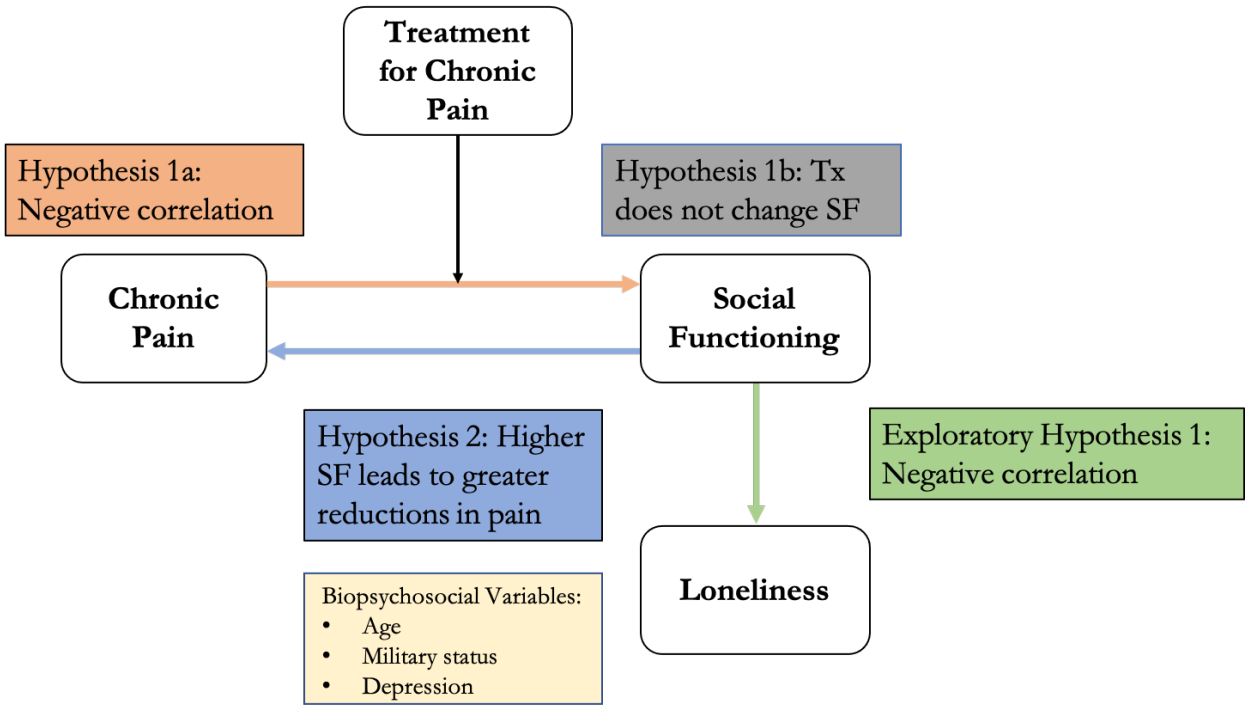
*Mean and Standard Deviations of Measures at Pertinent Timepoints*

| Variable | Baseline Mean ± SD | Last Treatment Appointment Mean ± SD | 6-Month Assessment Mean ± SD | *t*-value | *p*-value |
|---|---|---|---|---|---|
| Pain (PEG Q1) (*n = 34)* | 5.76 ± 2.10 | 4.62 ± 2.30 | N/A | 2.846 | < .01 |
| Social Functioning (BHM-20 SF Subscale) (*n = 34)* | 2.52 ± .91 | 2.49 ± .96 | N/A | .03 | .98 |
| Loneliness (3-Item UCLA Scale) (*n = 9)* | N/A | N/A | 4.78 ± 1.99 | N/A | N/A |
| Social Functioning (BHM-20 SF Subscale) (*n = 9)* | N/A | N/A | 2.39 ± .74 | N/A | N/A |

Figures

Figure 1

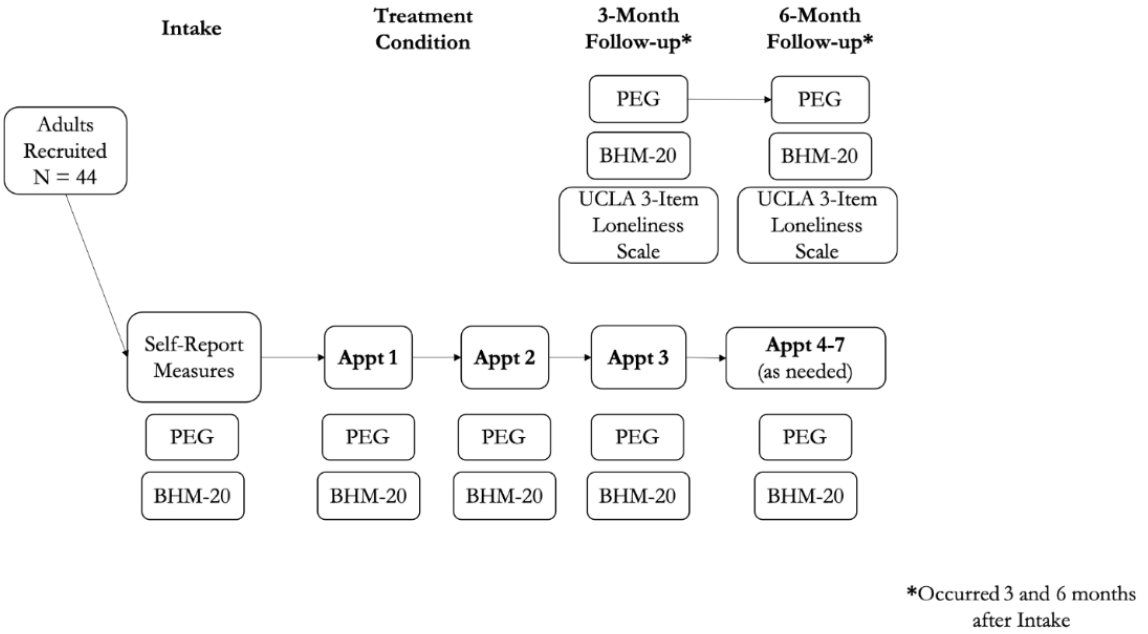
*Proposed Model of the Existing Literature on Chronic Pain, Social Functioning, and Loneliness with Additional Biopsychosocial Variables Relevant to Future Research*




*Note.* SF = Social Functioning; Current research suggests a bi-directional relation between chronic pain and social functioning. Relations between social functioning and loneliness are not well established. There is no research on chronic pain treatment and social functioning outcomes. This study and existing research suggest age, military status, and depression are important variables for future research on chronic musculoskeletal pain, social functioning, and loneliness.

Figure 2

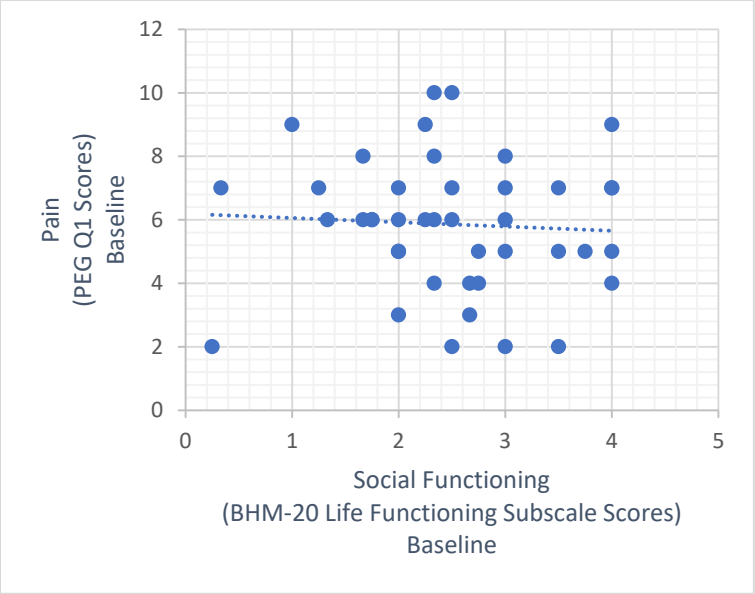
*Pilot Study Design*




*Note:* This figure depicts the observational, pragmatic design of the pilot study to examine chronic musculoskeletal pain, social functioning, and loneliness in a primary care setting.

Figure 3

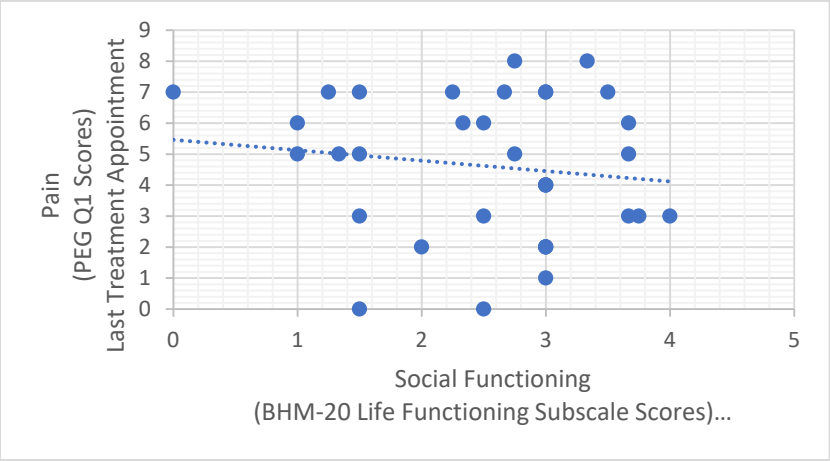
*Pain and Social Functioning Scores at Baseline*




*Note:* This figure depicts the negative correlation between pain and social functioning scores at baseline. The correlation was not statistically significant, $r(40) = -.06$, $p = .71$ ($n = 42$).

Figure 4

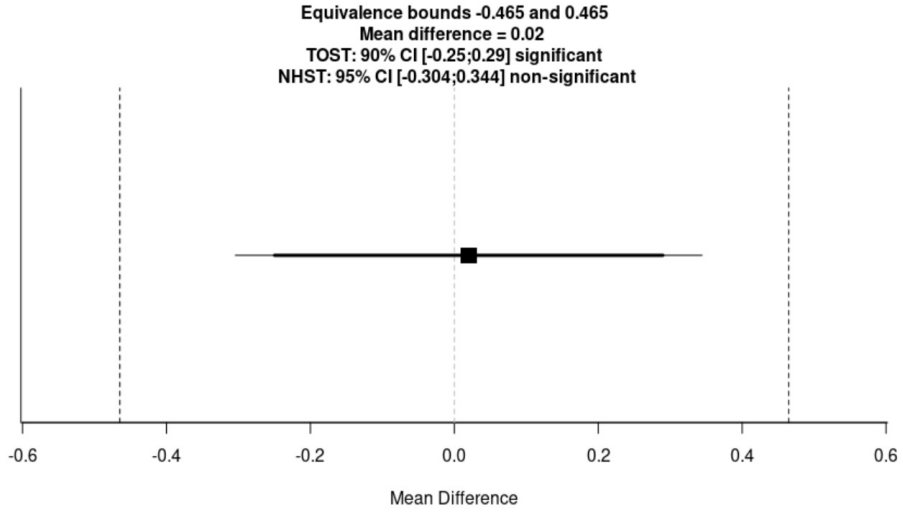
*Pain and Social Functioning Scores at Last Treatment Appointment*




*Note:* This figure depicts the correlation between pain and social functioning scores at last treatment appointment; it was not statistically significant, $r(32) = -.14$, $p = .43$ ($n = 34$).

Figure 5

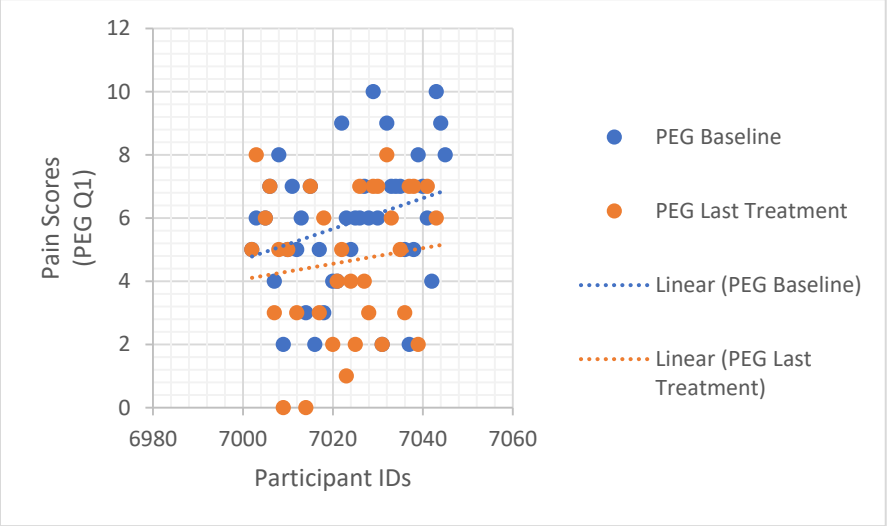
*Results of the Equivalence Test*




*Note:* This figure depicts the graph output of the equivalence test produced by R. The two one-sided test (TOST) was significant, $t(33) = 2.79$, $p < .01$ ($n = 34$). The TOST output shows the mean difference lies within the equivalence bounds and is statistically equivalent to zero.

Figure 6

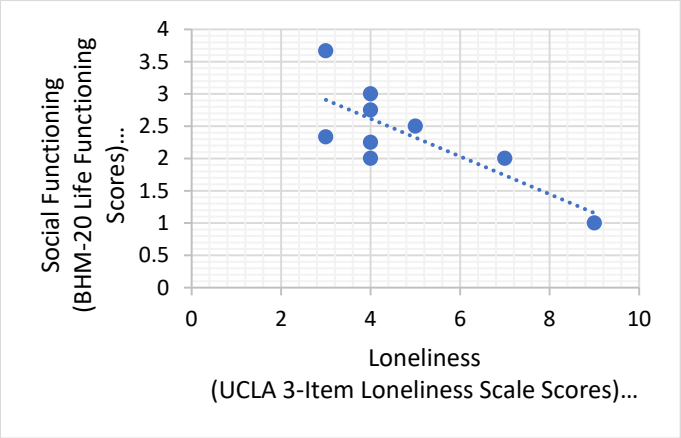
*Pain Scores at Baseline and Last Treatment Appointment*




*Note:* This figure depicts the pain scores at baseline and last treatment appointment. Results of the paired sample t-test were statistically significant, $t(33) = 2.846$, $p < .01$ ($n = 34$).

Figure 7

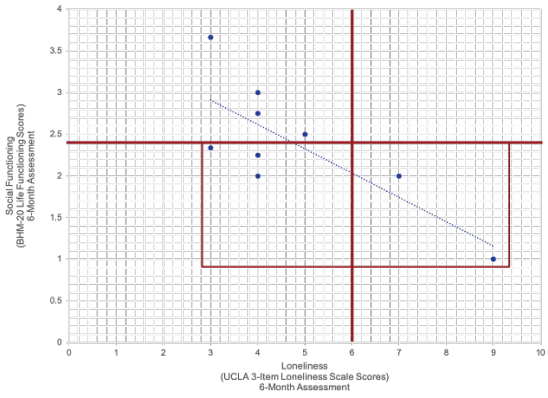
*Social Functioning and Loneliness*




*Note:* This figure depicts the negative correlation between social functioning and loneliness scores at six-month follow-up; it was statistically significant, $r(7) = -.78$, $p = .01$ ($n = 9$).

Figure 8

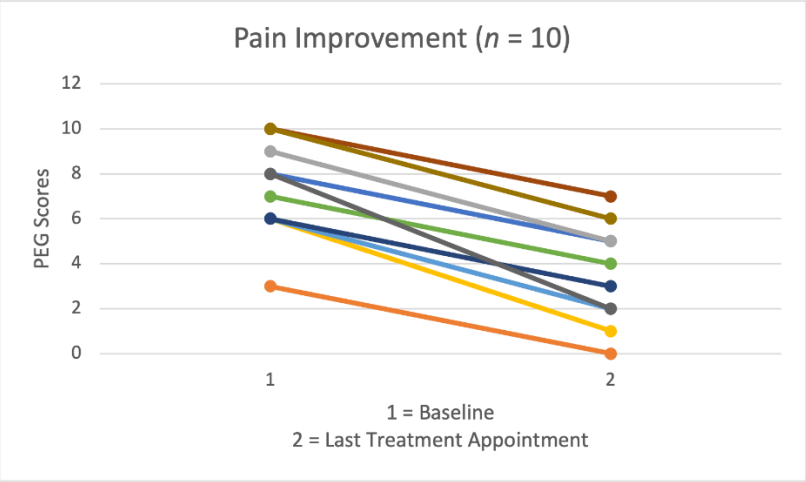
*Social Functioning and Loneliness Scores and Clinical Cutoffs*




*Note:* This figure depicts the clinical cutoff scores for social functioning (2.37) and loneliness (6) in red (47; 52). Five participants scored below the social functioning clinical cutoff and two participants scored above the loneliness clinical cutoff.

Figure 9

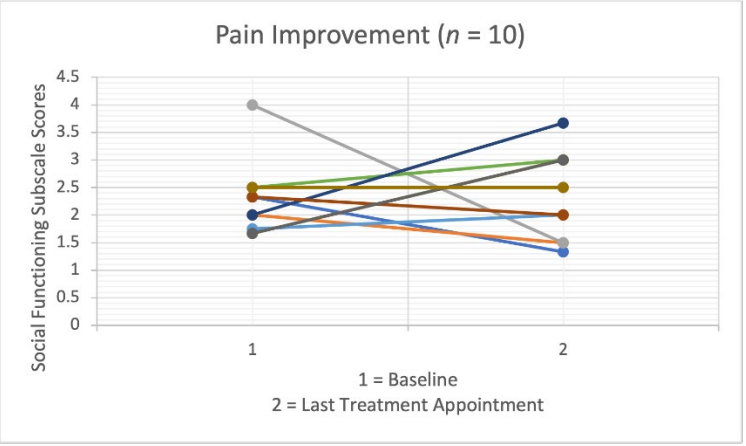
*Visual Analysis of Select Pain Scores That Decreased by Four Or More Points*




*Note:* This figure depicts the change in pain scores between baseline and last treatment appointment for 10 participants whose pain scores decreased by four or more points on the PEG.

Figure 10

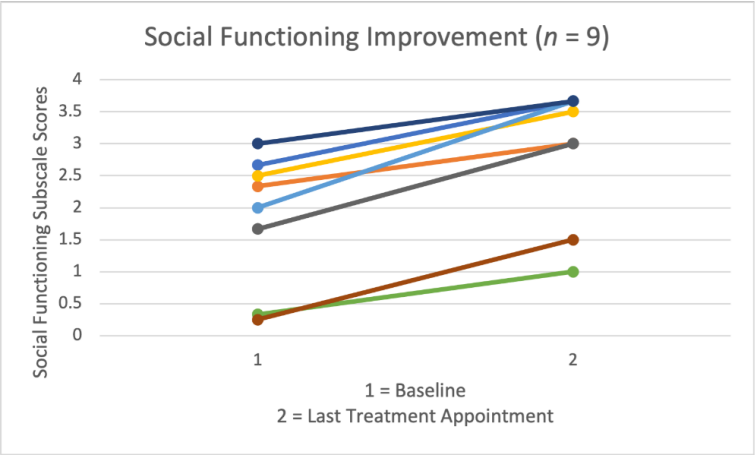
*Visual Analysis of Select Social Functioning Scores*




*Note:* This figure depicts the change in social functioning scores between baseline and last treatment appointment for the same 10 participants above whose pain scores decreased by four or more points on the PEG. Some participants' social functioning scores increased after pain treatment and other participants' social functioning scores decreased.

Figure 11

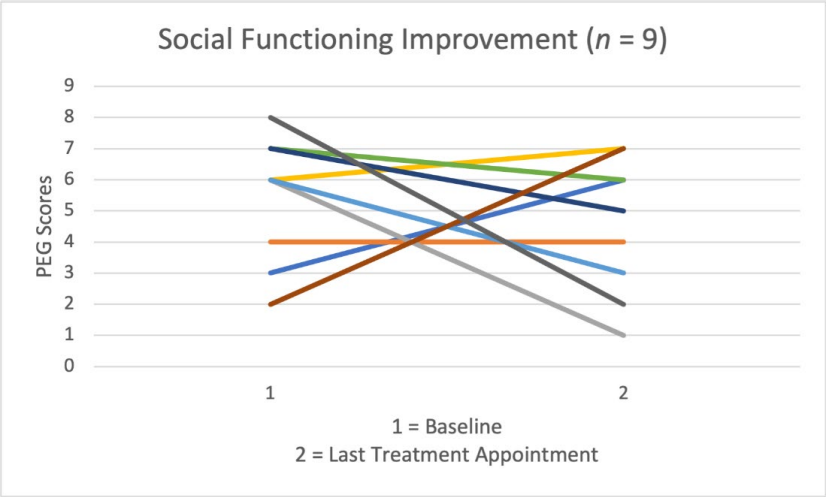
*Visual Analysis of Select Social Functioning Scores That Increased by .68 Points or More*




*Note:* This figure depicts the change in social functioning scores between baseline and last treatment appointment for 9 participants whose life functioning scores increased by .68 or more points.

Figure 12

*Visual Analysis of Select Pain Scores*




*Note:* This figure depicts the change in pain scores between baseline and last treatment appointment for the same 9 participants above whose social functioning scores increased by .68 or more points on the life functioning subscale. Some participants' pain scores improved after pain treatment and other participants' pain scores worsened.