4-24-2013

Investigating the Relations Between Posttraumtic Stress Disorder Symptom Clusters and Chronic Pain

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INVESTIGATING THE RELATIONSBETWEEN POSTTRAUMATIC STRESS DISORDER SYMPTOM CLUSTERS AND CHRONIC PAIN

by

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A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

Major: Psychology

The University of Memphis

May 2013

ACKNOWLEDGEMENTS

I would like to thank my committee who graciously shared their wisdom and knowledge, in addition to supporting me through this process. I would also like to thank my family and friends who remained with me and helped me in whatever way they could when I needed them.

ABSTRACT

Rach, Amanda Michelle. M.S. The University of Memphis. May 2013. Investigating the Relations Between Posttraumatic Stress Disorder Symptom Clusters and Chronic Pain. Major professor: Frank Andrasik, Ph.D.

Comorbidity rates of PTSD and chronic pain in returning veterans range between 66% and 80%. To date, only a single study conducted with Vietnam veterans years after the trauma exposure has explored the unique relations between PTSD symptoms and chronic pain. The purpose of this investigation was to examine the relation between unidimensional PTSD symptom clusters and chronic pain indices in returning OIF/OEF/OND veterans. PTSD symptom clusters did not differentiate pain positive from pain negative veterans and symptom clusters were also not related to veteran report of pain severity or pain interference. Depression, as a covariate, was related to pain interference. Findings are consistent with previous literature; however, the significant relation between depression and pain interference warrants more investigation. The implications of the results for treatment planning and provision are discussed.

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Between 39% to 90% of adults report experiencing at least one significant traumatic event during their life (Breslau & Kessler, 2001; Brunet & Boyer, 1998; de Vries & Olff, 2009; Dragan & Lis-Turlejska, 2007). Despite this relatively common occurrence, epidemiological studies suggest that only a small number of individuals (7.4% to 9.2%) develop Post Traumatic Stress Disorder (PTSD) as a result of their trauma (Breslau, Davis, Andreski, & Peterson, 1991; de Vries & Olff, 2009), and studies conducted within veteran populations have found similar or significantly higher rates. A reanalysis of the National Vietnam Veterans Readjustment Study, controlling for potential symptom over-reporting, concluded that 9% of veterans met criteria for current PTSD more than a decade after combat exposure (Dohrenwend et al., 2006). Studies of veterans returning from Operation Iraqi Freedom (OIF), Operation Enduring Freedom (OEF), and Operation New Dawn (OND) report rates ranging from 5% to 42% (Carlson et al., 2009; Clark, Gironda, & Carter, 2006; Ramchand et al., 2010; Seal, Bertenthal, Miner, Sen, & Marmar, 2007).

Veterans of more recent wars may be at a higher risk for developing PTSD compared to those who have fought in earlier eras. Possible contributing factors for higher rates of PTSD in returning veterans include: the military's increasing acceptance of mental health disorders (Schell, Terri, Farmer, Jaycox, & Marshall, 2011), the higher rates of combat exposure and increased combat intensity (Hoge, Auchterlonie, & Milliken, 2006; Shen, Arkes, & Pilgrim, 2009), decreased time between deployment cycles with most veterans experiencing multiple deployments (Hosek, Kavanagh, &

Miller, 2006), and the nature of battle versus non-battle injuries (blast exposure as opposed to other mechanisms of injury) (MacGregor et al., 2009; Sayer et al., 2008).

Although PTSD is the disorder most commonly associated with a trauma exposure, studies demonstrate that physical disorders develop as well (Boscarino, 2004; Kang, Bullman, & Taylor, 2006; Lew et al., 2009; Sareen, Cox, Stein, Afifi, & Admundson, 2007), with chronic pain being one of those most frequently reported (White & Faustman, 1998). This relation is of great interest to health care providers working with returning veterans as the daily realities of military theatre (witnessing extreme human suffering, experiencing unpredictable enemy attacks, and carrying 80 pound rucksacks) is the "perfect storm" for both disorders to develop.

Using a population of treatment seeking OIF/OEF/OND veterans this study will examine the relations between unidimensional PTSD symptom clusters and chronic pain dimensions. Specifically, the ability of the four PTSD symptom clusters to predict the presence or absence of pain as well as the relation between the symptom clusters and the degree of pain severity and pain interference currently experienced by returning veterans will be tested.

Post-traumatic Stress Disorder (PTSD)

For an event to be classified as traumatic within the Diagnostic and Statistical Manual-IV-Text Revision (DSM-IV-TR) it must involve actual or threatened death, serious injury, or a threat to the physical integrity to one's self or others and result in intense feelings of fear, helplessness, or horror (American Psychiatric Association, 2000). Furthermore, the DSM-IV-TR specifies 17 symptoms that comprise the diagnosis of PTSD. These 17 symptoms are grouped into three symptom clusters, including re-

experiencing, avoidance, and hyperarousal. An individual must report at least one re-experiencing symptom, three or more avoidance symptoms, and at least two hyperarousal symptoms to be diagnosed as PTSD (APA, 2000). The symptoms must be present for at least four weeks and cause distress or impairment in social, occupational, or other areas of functioning (APA, 2000).

Within the DSM-IV-TR, PTSD is presented as a three-symptom cluster syndrome. However, findings from basic science and confirmatory factor analysis studies suggest the avoidance symptom cluster is composed of two latent variables (Amdur & Liberzon, 2001; Friedman, Resick, Bryant, & Brewin, 2011; Maestas, Benge, Pastorek, LeMaire, & Darrow, 2011; McDonald et al., 2008; Miller et al., 2010).

(Amdur & Liberzon, 2001; Friedman, Resick, Bryant, & Brewin, 2011; Maestas, Benge, Pastorek, LeMaire, & Darrow, 2011; McDonald et al., 2008; Miller et al., 2010). As such, the next edition of the Diagnostic and Statistical Manual, DSM-5, will recognize PTSD as a four-cluster syndrome (APA, 2011). The items assessing avoidance of thoughts, feelings, conversations, activities, places, or people will remain in the avoidance cluster; items assessing the inability to recall important aspects of the trauma, restricted range of emotions, and feelings of a foreshortened future will comprise the new cluster, labelled as "emotional numbing" (Friedman et al., 2011). The proposed study will use the 4 symptom cluster model of PTSD.

Pain

Nearly 50% of Americans each year see a physician because of a primary complaint of pain (Managing pain: Attitude, methodication, and therapy are keys to control., 2001). Similarly, 50% of veterans seeking medical care report experiencing pain

on a regular basis (Kerns, Otis, Rosenberg, & Reid, 2003). Studies conducted a decade ago found that chronic pain costs the U.S. economy roughly $100 billion each year in the form of lost productivity due to absenteeism and reduced work performance (Stewart, Ricci, Chee, Morganstein, & Lipton, 2003), with an estimated cost to the individual of $30 - $57 per month (Jacobs, Golmohammadi, & Longobardi, 2003). Thus, pain is both a highly prevalent and highly costly disorder for both society and individuals experiencing it.

Pain has been defined an unpleasant perceptual, sensory, emotional, and subjective experience resulting from the transduction, transmission, and modulation of sensory input (Eccleston & Crombez, 1999). Research suggests that the "output", or the reported experience of pain is filtered through a person`s genetic composition, prior learning and experiences, current psychological status (i.e., attention, arousal level), and sociocultural influences (Gatchel, 2004). Additionally, an individual's report of pain is influenced by the meaning of the situation and reinforcement contingencies (Turk & Melzack, 2011). Thus, to accurately capture the pain experience, researchers must measure multiple dimensions.

Measuring pain. Pain severity is a quantitative estimation of how much a person hurts (Turk & Melzack, 2011). Ratings of pain severity are measured most often by a numerical rating scale from 0 to 10, with ratings of (1-4), (5-6), and (7-10) corresponding to mild, moderate, and severe pain (Serlin, Mendoza, Nakamura, Edwards, & Cleeland, 1995; Turk & Melzack, 2011). In contrast, pain interference is a measure of the degree to which pain sensations "get in the way" of being able to carry out daily tasks within the domains of physical activity/recreation, social/family, and vocation (Clark et al., 2006) .

By utilizing two distinct chronic pain dimensions the present study will investigate whether differential relations exist between PTSD symptomatology and the key dimensions of pain severity and pain interference to provide a more inclusive understanding of the relation between the two disorders.

Approximately 90% of wounded soldiers survive their injuries with the majority facing significant disability due to chronic pain (Clark, Bair, Buckenmaier, Gironda, & Walker, 2007; Clark, Scholten, Walker, & Gironda, 2009). The severity of injuries sustained by OIF/OEF/OND soldiers compared to veterans serving in previous wars is unprecedented (Clark et al., 2007). Blast injuries, the signature wound of these wars, result in more extensive physical injuries, substantial hidden injuries (hearing loss), greater pain severity, and lessened remittance of pain compared to soldiers injured by other means (Clark et al., 2007, 2009). These injuries result in complex mixed pain presentations where nociceptive pain (the neural process of encoding and transmitting the pain sensation), neuropathic pain, and headaches coexist, with pain also arising from medical procedures to repair the original wound (Clark et al., 2009). Further, OIF/OEF/OND veterans also experience pain in the head, legs, and shoulders/back that is primarily musculoskeletal in nature due to overuse injuries (Clark et al., 2006, 2007; Lew et al., 2007).

Comorbidity of PTSD and Chronic Pain

Researchers hypothesize that symptoms of PTSD and pain develop after dysregulation of a central stress response system that causes fundamental changes to shared neurobiological pathways related to pain processing and stress (Asmundson, Coons, Taylor, & Katz, 2002; McLean, Clauw, Abelson, & Liberzon, 2005; Norman,

Stein, Dimsdale, & Hoyt, 2008). Research within civilian and veteran populations supports the shared pathway hypothesis as individuals experiencing PTSD are at an increased risk for developing a pain disorder (Chibnall & Duckro, 1994; Cox & McWilliams, 2002; Hickling & Blanchard, 1992), and those with a pain disorder are at increased risk for developing PTSD (Amir et al., 1997; Hickling, Blanchard, Silverman, & Schwarz, 1992; McFarlane, Atchison, Rafalowicz, & Papay, 1994). For example, studies of OIF/OEF veterans seeking medical treatment found over 95% experienced a pain problem, with between 44% to 71% also meeting PTSD criteria respectively (Clark, et al., 2007; Lew et al., 2007). Post traumatic stress disorder treatment studies with Vietnam and OIF/OEF veterans report similar rates of co-occurrence. Beckham and colleagues (1997) found more than 80% of Vietnam veterans endorsed chronic pain in at least one major body area and up to as many as four areas. Similarly, a mean number of 2.7 chronic pain sites was endorsed by OIF/OEF veterans, the most common of which was the lower back (70.5%), followed by the legs (48.3%), and the neck (31.5%) (Otis et al., 2010). Researchers also speculate that compared to Vietnam veterans, those of OIF/OEF/OND are more likely to experience both PTSD and chronic pain (Fontana & Rosenheck, 2008), potentially resulting from improved body armour, battlefield healthcare, and rapid medical evacuation leading to increased survival rates and greater life expectancy (Clark et al., 2007).

The overlap of PTSD and chronic pain diagnostic criteria may contribute to the high rates of comorbidity. For example, pain resulting from deployment injuries may be associated with emotional distress, sleep disturbances, and cognitive dysfunction (i.e., difficulty concentrating), all of which are symptoms of PTSD (Lew et al., 2009;

Nampiaparampil, 2008). The combination of the disorders is more disabling than either condition alone such that each disorder intensifies the course of the other. Research demonstrates that an individual who experiences both conditions reports greater levels of the primary condition as compared to an individual afflicted with only a single disorder (Otis et al., 2003; 2010). For example, female veterans meeting criteria for full PTSD reported the greatest amounts of bodily pain and pain interference than those suffering from subsyndromal PTSD (who reported higher pain interference than veterans without symptoms of PTSD) (Asmundson, Wright, & Stein, 2004). Research also suggests that experiencing both conditions leads to higher reports of general pain scores (Clark et al., 2007), pain severity (Geisser, Roth, Bachman, & Eckert, 1996; Smith, Egert, Winkel, & Jacobson, 2002), pain related interference (Smith et al., 2002), affective distress due to pain (Otis et al., 2010), and pain disability (Geisser et al., 1996).

Using PTSD Symptom Clusters to Predict Pain

The majority of studies investigating the relation between PTSD and chronic pain have focused on PTSD as a single construct represented either dichotomously, as the presence or absence of the diagnosis, or as a continuous total score. Exploring PTSD in this manner limits the identification of how the various aspects of PTSD influence chronic pain development and maintenance and potentially misses unique relations existing between the dimensions of PTSD and chronic pain (Cyders, Burris, & Carlson, 2011). Further, for some individuals, the experience of PTSD may be driven predominantly by a single symptom cluster. The proposed study will build upon previous research by examining the relation between the four unidimensional symptom clusters of

PTSD and two dimensions of chronic pain to increase our understanding of the physical sequelae stemming from PTSD as a result of military theatre exposure.

Three of the four studies examining relations between unidimensional PTSD symptom clusters and chronic pain have been conducted within civilian populations. Although this limits generalizability to a veteran sample, these investigations provide a rationale and support for the proposed study. The only study to investigate the relation within a veteran population found the re-experiencing symptom cluster significantly predicted the chronic pain dimensions of overall pain, pain disability, and current pain ratings (Beckham et al., 1997). Consistent with the findings of Beckham et al. (1997), using a primarily female civilian sample Phifer and colleagues (2010) found a significant positive relation between the re-experiencing cluster and pain interference. Of note, the constructs pain disability and pain interference are viewed as synonymous constructs within the literature (Tait, Chibnall, & Krause, 1990; Von Korff, Ormel, Keefe, & Dworkin, 1992). Phifer et al. (2010) also found the avoidance cluster predicted pain interference and the hyperarousal cluster predicted pain severity. The significant positive relation between hyperarousal and pain severity within civilian populations was substantiated by Cyders et al. (2011), in addition to finding a significant positive relation between the avoidance symptom cluster and pain disability (Cyders et al., 2011). Finally, a longitudinal study measuring pain as a holistic construct found the re-experiencing and hyperarousal symptom clusters at baseline predicted pain at both 3 and 12 months with 3-month hyperarousal symptoms mediating the relation between baseline and 12 month pain (Liedl et al., 2010). Taken together, these findings suggest that the hyperarousal symptom cluster is uniquely positively related to chronic pain severity; however, the role

of the re-experiencing and avoidance symptom clusters with regards to pain interference is less certain.

Treatment Studies

When PTSD and chronic pain are experienced together, compared to either disorder alone, this comorbidity appears to make treatment efforts more challenging. Smith and colleagues (2002) found that individuals experiencing chronic pain and PTSD, as compared to those with chronic pain only, did not report a decrease in pain intensity or pain interference after an intervention targeting pain alone. Additionally, Dunn, Passmore, Burke, and Chicoine (2009) found veterans diagnosed with PTSD reported no improvement in chronic pain scores from baseline to discharge compared to veterans without PTSD who did experience an improvement. Veterans undergoing psychological treatment for PTSD or chronic pain corroborate the interfering nature of the comorbidity of the disorders. They report participating in treatment is made difficult by their chronic pain symptoms that they perceive to contribute to their PTSD and conversely their PTSD symptoms that contribute to their pain (Otis et al., 2009). Further, clinical observations suggest that veterans with both disorders are less likely to engage in treatment (Otis et al., 2009). Therefore, investigating the manner in which PTSD symptoms contribute to the experience of chronic pain in combat exposed veterans is of vital importance.

The earliest treatment study of individuals with comorbid PTSD and pain consisted of three case studies. Muse (1986) concluded that treatment targeting pain symptoms failed to reduce symptoms of either disorder; however treatment targeting PTSD symptoms resulted in self-reported improvements in both. Many studies have replicated these findings with larger samples involving both civilian and veteran

populations (Hickling et al., 1992; Roth, Geisser, & Bates, 2008; Shipherd, Beck, Hamblen, Lackner, & Freeman, 2003; Shipherd et al., 2007). Shipherd and colleagues (2007) purposefully avoided addressing chronic pain symptoms while implementing a cognitive behavioral therapy (CBT) treatment for veterans with PTSD, half of which also endorsed symptoms of chronic pain. At baseline, groups differed only on their report of chronic pain. At post treatment this group difference was no longer significant due to veterans experiencing both PTSD and chronic pain reporting a significant reduction in chronic pain (Shipherd, et al., 2007). Further, a small pilot study (n = 3) integrating aspects of CBT treatment for chronic pain and cognitive processing treatment (CPT) for PTSD tailored for veterans experiencing both disorders showed promise. Two veterans experienced a reduction in chronic pain symptoms and all three no longer met PTSD diagnostic criteria (Otis et al., 2009). It seems reasonable to conclude that PTSD symptom clusters more strongly influence chronic pain than chronic pain influences PTSD symptom clusters, thus providing the justification for examining the influence of PTSD symptom clusters on chronic pain.

Rationale for the Proposed Study

The foregoing literature review demonstrates the need to better understand the relation between PTSD symptom clusters and chronic pain symptoms in returning veterans. As established by prior research (Marshall et al., 2006; Schnell et al., 2004), the hyperarousal symptom cluster likely plays a distinctive role in the relation between PTSD and chronic pain development; however, the role of re-experiencing and avoidance clusters is less well understood. The proposed study investigated the relation between PTSD symptom clusters and chronic pain dimensions in a population of returning

OIF/OEF/OND veterans seeking care at a Veterans Administration polytrauma unit. By partitioning PTSD symptoms into its unidimensional, though interrelated symptom clusters we hope to increase predictive utility with regards to both chronic pain severity and interference. To our knowledge, no studies have employed the four-cluster model of PTSD within a military population. Therefore, the nature of this study is exploratory; however, based on results from civilian research, we hypothesized that the hyperarousal cluster would predict pain severity and the re-experiencing, emotional numbing, and avoidance symptom clusters would predict pain interference.

Method

Participants

Data were obtained from the files of veterans screening positive during a first level screen and who completed their polytrauma clinic consult at the Memphis Veteran's Association Medical Center (VAMC). As veterans were not recruited specifically for study participation, the retrospective archival study design prevented informed consent. The Institutional Review Boards for the University of Memphis and the Memphis Veteran's Association Medical Center Institution approved all procedures.

Participants were 215 veterans who had completed OEF/OIF/OND deployments and were under the care of the Memphis VAMC polytrauma clinic (Table 1). The majority of the sample was male (94%), had suffered a TBI (66%), and was pain positive (90%). The mean age of veterans was 31.9 years (*SD* = 8.3), with an average percentage of service connection of 23.8 (*SD* = 33.9). One-hundred twenty-three veterans identified as Caucasian (57%), 42 as African American (19%), or 32 as Hispanic/Latino (15%); 23 veterans did not identify a race (11%). Over half of the sample served in the army (54%).

Pain positive and pain negative veterans differed on level of service-connection only (Table 2).

Instruments

Posttraumatic stress disorder. *PTSD Checklist- Civilian Version (PCL-C; Blake et al., 1995).* The PCL-C is a 17-item self-report inventory assessing the severity of PTSD symptoms. Each item is rated for the past month on a 1 (not at all) to 5 (extremely) Likert-type scale, with total scores ranging from 17 to 85 (Keen, Kutter, Niles, & Krinsley, 2008; McDonald & Calhoun, 2010). Higher scores reflect a greater degree of PTSD. The PCL-C has excellent test-retest reliability ($r = 0.96$) and internal consistencies for each symptom cluster and total score (B symptoms $r = 0.90$-0.94; C symptoms $r = 0.82$-0.92; D symptoms $r = 0.84$-0.92; total score $r = 0.94$-0.97) (Blake et al., 1995; Blanchard, Jones-Alexander, Buckley, & Forneris, 1996; Keen et al., 2008). The PCL-C also shows good convergent validity with total PTSD severity from the Clinician Administered Posttraumatic Stress Disorder Scale (CAPS) ($r = 0.79$) and the Mississippi Scale for combat related stress (M-PTSD) ($r = 0.90$) (Keen et al., 2008). The CAPS is a structured clinical interview that is considered the gold standard in assessing PTSD in individuals over the age of 15. The M-PTSD is a self-report measure assessing combat related PTSD symptoms and frequently observed associated features in veteran populations.

Pain. *Brief Pain Inventory (BPI; Cleeland, 1991).* The BPI is a brief self-report pain assessment tool measuring the dimensions of severity and interference. The severity subscale is an average of responses across four items asking individuals to report their worst, least, average, and current pain severity over the past 24 hours. The interference

subscale is an average of seven items assessing how the pain sensation interferes with general activity, mood, walking ability, work, relationships with other people, sleep, and overall enjoyment of life. Both scales are scored on a 10-point numerical scale (1, no pain/does not interfere; 10, pain as bad as you can imagine/completely interferes), with higher scores representing greater pain severity and pain interference (Serlin et al., 1995). The test-retest reliabilities for the pain severity scale are acceptable: worst pain $r = 0.93$, average pain $r = 0.78$, and current pain $r = 0.59$ (Cleeland, 1991). Pain interference test-re-test correlations range from $r = 0.81$ to 0.93 (Mendoza et al., 2004, 2006).

Depression. *Personal History Questionnaire 9 (PHQ9; (Spitzer, Kroenke, Williams, & the Patient Health Questionnaire Primary Care Study Group, 1999).* The PHQ is a brief self-report depression assessment tool designed for use in primary care settings. Items are derived from the DSM-IV classification system and assess mood, cognitive, and physical symptoms of depression over the previous two weeks. Response categories include "not at all" (scored as 0), "several days" (scored as 1), "more than half the days" (scored as 2), and "nearly every day" (scored as 3). The PHQ9 achieved high agreement ($r = .84$) with mental health professionals diagnoses (Spitzer et al., 1999). Internal reliability has been found to be excellent (Cronbach's $\alpha = .86$ to .89) (Spitzer et al., 1999; Spitzer, Williams, Kroenke, Hornyak, & McMurray, 2000).

Results

Data Analysis

Prior to conducting analyses, data were screened for violations of distributional assumptions, outliers, and multicollinearity using procedures recommended by Tabachnik and Fidell (2007). Pearson correlations were performed for all variables of interest.

To determine the ability of PTSD symptom clusters to differentiate pain positive from pain negative veterans four individual and one full model zero-order logistic regression analyses were performed. Next, only veterans endorsing pain severity and/or pain interference symptoms were included in two ordinary least-squares hierarchal regression analyses controlling for depression and relevant demographic variables. Finally, two zero-inflated gamma regression analyses were conducted to confirm the results of the logistic and ordinary least-squares (OLS) regression analyses.

Descriptive Statistics: Correlations and Preliminary Analyses

A Cronbach's alpha for the 17 PCL-C items was .95. Overall, participants experienced moderate levels of PTSD symptomatology, [re-experiencing (M = 14.62, SD = 5.70), avoidance (M = 14.33, SD = 5.74), emotional numbing (M = 6.21, SD = 2.62), and hyperarousal (M = 17.78, SD = 5.04)] and moderate levels of pain, [pain severity (M = 4.54, SD = 1.88), pain interference (M = 4.83, SD = 2.55)].

Pearson correlations between the four PTSD symptom clusters and pain indices were significant (see Table 3), with greater amounts of each symptom cluster associated with more pain. The correlations between symptom clusters and pain interference were stronger than the correlations with pain severity.

A series of regression and independent groups t-tests using categorical demographic variables (ethnicity, employment, marital status, branch), were conducted to determine demographics relevant to pain outcome variables. Depression was significantly related to the presence or absence of pain χ^2 (1,212) = 7.90, $p < .01$. Age and service connection were significantly related to both pain severity [F (1,187) = 9.06, $p < .01$; F (1,187) = 4.34, $p < .05$], and pain interference [F (1,187) = 7.84, $p < .01$; F (1,187) =

10.62, $p < .01$]. Veterans serving in the marines reported significantly lower levels of pain severity compared to veterans serving in the army, t(187) = -2.46, $p < .05$.

Predicting Pain Positive versus Pain Negative Veterans

Depression was included as a covariate in the full model logistic regression. Individual logistic regression analyses found that the re-experiencing, χ^2 (1,213) = 4.74, $p < .05$, emotional numbing, χ^2 (1,213) = 4.01, $p < .05$, and hyperarousal, χ^2 (1,213) = 7.16, $p < .01$, symptom clusters significantly differentiated pain positive from pain negative veterans. The full model regression including all symptom clusters was not significant χ^2 (1,207) = 9.69, $p > .05$. No symptom cluster differentiated pain positive or negative veterans. See Table 4 for regression coefficients, Wald chi-square and odds ratios, for each predictor.

Relation Between PTSD Symptom Clusters and Pain Severity

Table 5 shows the results of the ordinary least-squares (OLS) hierarchal regression with PTSD symptom clusters predicting pain severity. Age, service connection, marine versus army branch of service, and depression were included as covariates (step 1), with the re-experiencing, emotional numbing, avoidance, and hyperarousal symptom clusters entered in step 2. The four symptom clusters explained a significant amount of variance in pain severity scores (R^2 change = .056, F(4,172) = 3.49, $p < .01$, however clusters were not independently related to pain severity. The zero-inflated gamma regression revealed similar results. The logistic regression intercept and gamma distribution were significant t(206) = -9.28, $p < .001$ and t(206) = 1.68, $p < .05$, suggesting veterans who were pain positive or negative differed in their reports of PTSD symptom clusters; however, no cluster uniquely predicted pain severity (Table 6).

Relation Between PTSD Symptom Clusters and Pain Interference

Results of the OLS hierarchal regression investigating the relation between PTSD symptom clusters and pain interference are found in Table 7. Age, service connection, and depression were included as covariates (step 1) with the re-experiencing, emotional numbing, avoidance, and hyperarousal symptom clusters entered in step 2. The PTSD symptom clusters explained 3.4% of the variance in pain interference (R^2 change = .034, $F(4,172) = 2.53$, $p < .05$. In the final model depression was the only variable significantly related to levels of pain interference ($\beta = .409$, $p < .001$). As was found for pain severity, the intercept of the zero-inflated logistic regression was significant $t(209) = -8.66$, $p < .001$. This again suggested a difference of PTSD symptom clusters between pain positive and pain negative veterans. Different from the results of the OLS regression, depression was not significantly related to pain interference in the gamma distribution analysis (Table 8).

Discussion

This paper investigated the relations between unidimensional PTSD symptom clusters and chronic pain indices in a treatment seeking population of OIF/OEF/OND veterans. The current study tested the predictive utility of the four PTSD symptom clusters on the presence or absence of pain as well as their relation to the degree of pain severity and pain interference currently experienced by returning veterans.

No significant relation was found between PTSD symptom clusters and the presence or absence of pain. This indicates that no single cluster or combination of clusters differentiated pain positive from pain negative veterans. To our knowledge, this is the first study to examine the relation between individual symptom clusters and the

presence or absence of pain. The small number of pain negative veterans (n = 20) in the sample may be responsible for the inability to detect differences between the groups. Future studies with larger samples of pain negative participants are needed to determine the relation more conclusively.

Consistent with previous research we found re-experiencing, emotional numbing, and avoidance symptoms did not influence levels of pain severity and hyperarousal symptoms did not influence levels of pain interference. Thus, the degree of pain severity and pain interference experienced by returning veterans appeared to be independent of these symptom clusters (Beckham et al., 1997; Cyders et al., 2011; Phifer et al., 2010). However, contrary to the study hypotheses and previous research (Beckham et al., 1997; Cyders et al., 2011; Phifer et al., 2010) no significant relation between the hyperarousal symptom cluster and pain severity or the re-experiencing, emotional numbing, and avoidance symptom clusters and pain interference was found. Differences in the trauma environment and sample characteristics are discussed below as possible explanations for the disagreeing results.

Differences in the amount and length of trauma exposure across civilian and veteran PTSD populations may have contributed to the lack of support for the study hypotheses. Combat service may involve repeated exposure to traumatic events and sustained exposure to stressful environments. In contrast, civilian trauma survivors are more likely to experience a single trauma for a relatively brief period of time. Exposure to this repeated and sustained trauma environment may contribute to the higher levels of PTSD symptomatology reported by returning veterans compared to civilian PTSD patients. For example, participants in the Cyders et al. (2010) study had a mean PTSD

total score of 32 (*SD* = 13.8), whereas our sample reported a mean total score of 53 (*SD* = 17.1). In addition, the level of PTSD reported by our sample was similar to the levels reported by Vietnam era veterans as studied by Beckham and colleagues (1997). Thus, compared to civilians, returning veterans appear to experience greater PTSD symptomatology with the elevations occurring in all symptom clusters. This is consistent with an examination of our data which suggests veterans experiencing high levels of PTSD are reporting high amounts of symptomatology across the clusters, as opposed to having their PTSD attributable to one or two specific clusters. The high levels uniformly across clusters may prevent any individual cluster from uniquely contributing to levels of chronic pain. In addition, the uniform levels may also preclude the existence of our hypothesized relationship where chronic pain symptoms stemming from a traumatic experience trigger re-experiencing symptoms of PTSD or where hyperarousal PTSD symptoms cause increased muscle tension which triggers symptoms of chronic pain.

The ratio of male to female participation is a second important difference between the civilian samples used in previous research and the sample used in this study. Participants in Cyders et al. (2010) and Phifer et al. (2010) were either primarily or exclusively female. These studies reported the strongest relations between the hyperarousal cluster and pain severity and the re-experiencing and avoidance clusters with pain interference. In contrast, Beckham and colleagues (1997), who focused on an entirely male population, found no relation between hyperarousal and pain severity or avoidance and pain interference. As our sample was overwhelming male (94%), our results suggest the relations between PTSD symptom clusters and chronic pain indices may differ by gender. Future research should include a greater numbers of female

veterans to investigate the potential gender differences in the relation between PTSD symptom clusters and chronic pain. Investigating this relation within female veteran populations in particular will become easier as the number of female combatants continues to rise.

The significant relation of depression to levels of pain interference suggests depression more so than PTSD symptomatology contributes to veterans' report of how much their pain experience interferes with routine life tasks. Previous research has documented strong relations between depression and chronic pain (Bair, Robinson, Katon, & Kroenke, 2003; Koenig, 2005), and depression and PTSD (Bleich, Koslowsky, Dolev, & Lerer, 1997; Ikin, Creamer, Sim, & McKenzie, 2010), depression was treated as a covariate to isolate the unique influence of PTSD symptomatology on chronic pain scores. Results suggest future research would benefit from investigating the predictive utility of depression on chronic pain indices with populations with comorbid PTSD. This research should utilize a comprehensive depression measure capturing symptomatology consistent DSM-5 diagnostic criteria to fully investigate the relationship between the disorders.

This is the first study to examine the relation between chronic pain indices and PTSD as a four symptom cluster disorder. Although results suggest the emotional numbing cluster is not related to either pain dimension, the restricted range of this cluster should be considered. The emotional numbing cluster is made up of only two items whereas; the three remaining clusters include five or seven items respectively. Thus, the emotional numbing cluster may lack a sufficient range to account for a significant amount of variability in pain scores. Future research with larger sample sizes may be

necessary to achieve sufficient power to conclusively determine the effect of emotional numbing symptoms on chronic pain indices.

Despite the limited results, our study suggests further investigation into the relation between PTSD symptom clusters and chronic pain indices in returning veteran is necessary. Failure to find unique relations between the unidimensional PTSD symptom cluster and chronic pain dimensions is informative for treatment planning within this highly comorbid population. Results suggest PTSD treatments for returning veterans experiencing comorbid chronic pain should target PTSD symptoms across all four clusters equally as opposed to focusing on a particular cluster. In addition, understanding the unique relation between depression and pain interference and its influence on treatment efforts requires additional investigation. For example, examining the influence of concurrent depression treatment, through either behavioral (e.g., behavioral activation) or pharmaceutical (e.g., antidepressants) approaches, within PTSD treatment on chronic pain symptomatology would shed significant light on the triangular relationship between depression, PTSD, and chronic pain.

Certain limitations warrant consideration when interpreting the study results. First, the cross sectional nature of the data prevents casual inferences from being made. As both PTSD and chronic pain symptoms are known to change over time longitudinal investigations are important to illustrate how the two disorders influence each other with the progression of time. Second, the retrospective design of the study did not allow for collection of data regarding the amount of analgesic use by study participants. This is an important component to pain research as it directly influences participants' report of their

pain experience. Finally, as mentioned previously the primarily male sample likely means results do not generalize to female veterans.

Finally, the results suggest returning veterans are at high risk for experiencing both PTSD and chronic pain, as less than 1% of veterans endorsed no PTSD symptoms and only 10% reported the absence of chronic pain. Health care providers working with returning veterans should thoroughly assess for the presence of both disorders to inform treatment approaches as the disorders are highly interrelated and failure to take in to consideration the effects of one disorder may sabotage treatment efforts for the other.

Conclusion

In treatment-seeking veterans with comorbid PTSD and chronic pain there is a high degree of interrelation between PTSD symptom clusters that precludes separating them in to their individual clusters in order to economize treatment approaches. Caution should be exercised when extrapolating results to returning veterans in general as this study focused on veterans who actively sought out treatment for their mental and physical disorders. In general, treatments should target each PTSD symptom cluster equally in order to influence chronic pain symptoms.

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Table 1

Sample Demographics for the Entire Sample (N = 215)

	M (SD)
Age[1]	31.9 (8.3)
Service Connection[2]	23.8 (33.9)
TBI	N (%)
Yes	74 (34%)
No	145 (66%)
Gender[3]	
Male (%)	203 (94%)
Female (%)	13 (6%)
Ethnicity[4]	
Caucasian (%)	123 (56%)
African American (%)	42 (19%)
Latino/Hispanic (%)	32 (15%)
Not identified	18 (10%)
Employment[5]	
Full	68 (32%)
Partial	18 (8%)
None	108 (50%)
Student	22 (10%)
Branch[6]	
Army	116 (53%)
National guard	57 (26%)
Marines	23 (11%)
Navy	5 (2%)
Air force	11 (5%)
Marital[7]	
Single	54 (25%)
Married	108 (50%)
Divorced	47 (22%)
Separated	7 (3%)
PTSD	
Reexperiencing	14.6 (5.7)
Avoidance	14.3 (5.7)
Emotional Numbing	6.2 (2.6)
Hyperarousal	17.8 (5.0)

Table 2

Sample Demographics by Pain Groups

	Pain Positive (n = 195)	Pain negative (n = 20)		*p*
Age[1]	31.64 (8.2)	32.5 (9.11)	t = 0.44	ns
Service Connection[2]	25.5 (34.7)	9.5 (23.5)	t = -2.01	.05
TBI			$\chi^2 = 0.11$	ns
Yes	129 (66%)	13 (65%)		
No	66 (34%)	7 (35%)		
Gender[3]			$\chi^2 = 0.57$	ns
Male (%)	181 (94%)	18 (90%)		
Female (%)	11 (6%)	2 (10%)		
Ethnicity[4]			$\chi^2 = 4.07$	ns
Caucasian (%)	115 (65%)	7 (41%)		
African American (%)	34 (19%)	5 (29%)		
Latino/Hispanic (%)	27 (16%)	5 (29%)		
Employment[5]			$\chi^2 = 4.78$	ns
Full	56 (29%)	10 (50%)		
Partial	17 (9%)	--		
None	99 (52%)	8 (40%)		
Student	20 (10%)	2 (10%)		
Branch[6]			$\chi^2 = 2.22$	ns
Army	104 (55%)	11 (55%)		
National guard	50 (27%)	5 (25%)		
Marines	21 (11%)	1 (5%)		
Navy	4 (2%)	1 (5%)		
Air force	9 (5%)	2 (10%)		
Marital[7]			$\chi^2 = 1.17$	ns
Single	48 (25%)	6 (30%)		
Married	97 (51%)	9 (45%)		
Divorced	40 (20%)	5 (25%)		
Separated	7 (4%)	--		

Note. [1] Age unavailable for 3 veterans, [2] Service connection status unknown for 3 veterans, [3] Gender unknown for 3 veterans, [4]Ethnicity unavailable for 22 subjects, [5] employment unavailable for 3 veterans, [6] branch unavailable for 7 veterans, [7] marital status unavailable for 3 veterans.

Table 3

Pearson Correlations between PTSD Symptom Clusters and Pain Indices

	Pain severity	Pain interference
Re-experiencing	.44***	.52***
Avoidance	.39***	.51***
Emotional numbing	.41***	.49***
Hyperarousal	.45***	.52***

Note. ** p < .01. *** p < .001.

Table 4

Logistic Regression Analysis of Pain as a Function of PTSD Symptom Clusters

Variables	**B**	**S.E.**	**Wald χ^2**	**p**	**OR**
Service Connection	.14	.08	1.75	.19	1.01
Depression	.01	.01	2.78	.10	1.15
Re-experiencing	.01	.08	.01	.95	1.01
Avoidance	-.07	.09	.66	.42	.93
Emotional numbing	.00	.16	.00	.97	.99
Hyperarousal	.04	.08	.24	.63	1.04
Constant	.74	.80	.85	.85	2.09

Table 5

Ordinary Least-squares Regression Analysis for Pain Severity (N = 172)

Step		B	SE(B)	β	t	R^2	ΔR^2	ΔF
1						.26***	--	15.13***
	Age	.03	.02	.12	1.73			
	SC	.00	.00	.03	.38			
	Marines	-.70	.38	-.12	-1.85			
	Depression	.13	.02	.44	6.61			
2						.31**	.06	3.49**
	Age	.02	.02	.10	1.56			
	SC	.00	.00	.02	.25			
	Marines	-.65	.37	-.11	-1.74			
	Depression	.07	.04	.23	1.81			
	Re-experiencing	.05	.04	.15	1.24			
	Avoidance	-.04	.04	-.12	-.93			
	Emotional numbing	.09	.08	.13	1.17			
	Hyperarousal	.06	.04	.17	1.49			

Note. ** p < .01. *** p < .001 (two-tailed).

Table 6

Summary of Zero-inflated Gamma Regression Analysis for Pain Severity (N = 206)

Variable	Estimate	SE	t	p
Age	.00	.01	.59	.55
Service connection	.00	.00	.06	.95
Marines versus army	-.17	.24	-.73	.47
Depression	.02	.02	.70	.49
Re-experiencing	.01	.02	.43	.67
Emotional numbing	.02	.05	.43	.67
Avoidance	-.01	.02	-.43	.67
Hyperarousal	.02	.03	.65	.52

Table 7

Ordinary Least-squares Regression Analysis for Pain Interference (N = 172)

Step		B	SE(B)	β	t	R^2	ΔR^2	ΔF
1						.39***	--	37.18***
	Age	.04	.02	.12	2.00*			
	SC	.01	.01	.07	1.06			
	Depression	.23	.02	.58	9.60**			
2						.42*	.03	2.53*
	Age	.04	.02	.11	1.83			
	SC	.00	.00	.06	.92			
	Depression	.16	.05	.41	3.56*			
	Re-experiencing	.05	.04	.15	1.24			
	Avoidance	-.04	.04	-.12	-.93			
	Emotional numbing	.09	.08	.13	1.17			
	Hyperarousal	.06	.04	.17	1.49			

Note. * p < .05. ** p < .01. *** p < .001 (two-tailed).

Table 8

Summary of Zero-inflated Gamma Regression Analysis for Pain Interference (N = 209)

Variable	Estimate	SE	t	p
Age	.01	.01	.77	.44
Service connection	.00	.00	.40	.69
Depression	.04	.02	1.54	.13
Re-experiencing	.01	.02	.46	.64
Emotional numbing	.02	.05	.42	.67
Avoidance	-.01	.02	-.45	.66
Hyperarousal	.02	.03	.63	.52