PREDICTORS OF PAIN AND SOMATIC FUNCTIONING FOLLOWING A COMBAT DEPLOYMENT

A Thesis

by

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ABSTRACT

This study sought to identify prospective and concurrent predictors of post-deployment pain and somatic symptoms in a sample of active-duty United States Air Force (USAF) security forces that had recently returned from a high-risk ground mission in Iraq. Within the military population, nearly half (47%) of OEF/OIF veterans report experiencing pain following a deployment. Pain and somatic impairment are associated with lower quality of life, greater use of health care services, and higher rates of mental health symptoms including suicidality, substance use, sleep problems, anxiety, and depression. Moreover, veterans who have been deployed report more pain relative to veterans who have not deployed, and also report higher rates of somatic symptoms, worse general health, and greater physical and psychosocial functional impairment. Whereas considerable research has examined *consequences* of pain and somatic impairment, little research has examined psychological *predictors* of pain and somatic symptom severity.

Results indicated that intrapersonal psychological factors, particularly depression and posttraumatic stress disorder, significantly predicted pain and somatic symptoms following deployment. Following deployment, perceived barriers to treatment and difficulty with reintegration significantly predicted greater post-deployment pain symptoms. Interpersonal factors including perceived social support, marital distress, and family reintegration, were not significantly associated with pain or somatic symptoms

following deployment. The implications for clinical intervention and application of these findings will be discussed.

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CHAPTER I

INTRODUCTION

Following the terrorist attacks on September 11, 2001, more than 2.5 million troops have been deployed in support of Operations Iraqi Freedom (OIF), Enduring Freedom (OEF), and New Dawn (OND) (H. R. 1238, 2013). Many of these troops have faced multiple deployments with repeated exposure to physically demanding missions and harsh combat environments. Despite the combat training and mandatory physical fitness tests troops are required to pass, Operations OIF/OEF/OND have proven to be both psychologically and physically taxing for service members. Given the latest medical and technological advancements, injured troops are more likely than ever not only to survive deployment-related injuries but also to return to duty (Cohen et al., 2010). Aside from deployment-related injuries, the daily demands of deployment place significant physical burden on service members. For example, a service member's "battle rattle," gear and body armor that must be worn at all times when one is not on base, weighs, on average, between 80 and 110 pounds. Additionally, humvees and other forms of ground transportation frequently used by the military have poor shock absorption. Given the poor road conditions in the combat zones, each bump and dip in the road is absorbed by the passengers' bodies. Subsequently, service members' bodies endure significant physical wear and tear that is not as evident as a deployment-related injury.

When assessing deployment-related harm, researchers found that service members were more likely to be medically evacuated from a combat environment for pain-related issues than a combat-related injury, indicating the severity and prevalence of persistent pain within this population (Cohen et al., 2010). A recent study found that 47% of OIF/OEF veterans reported pain and that 48% of the entire veteran population reported experiencing pain. Much of this pain can be attributed to deployment as shown in a survey of National Guard troops in which those who deployed reported experiencing persistent pain at nearly twice the rate as those who had not experienced a deployment (Kline et al., 2010). Another study (Forman-Hoffman, Peloso, Black, Woolson, Letuchy, & Doebbeling, 2007) found that Gulf War veterans reported significantly higher rates of experiencing pain than veterans who had not deployed to the Gulf. Within this sample of Gulf War veterans, those experiencing pain were also more likely to have a lower quality of life, lower rates of employment, greater use of health care services, and higher rates of mental health symptoms. Similarly, Schwartz, Doebbling, Merchant, and Barret (1997) found that compared to service members who did not deploy to the Gulf, those who did deploy demonstrated significantly higher rates of somatic symptoms, poorer general health status, greater psychological distress, and greater health-related physical and psychosocial functional impairment.

Experiencing and tolerating pain is deeply embedded within the military culture and training. For example, the Marine Corps views pain as "weakness leaving the body" and calls upon one's character with the adage "losers quit when they feel pain, winners quit only when the mission is accomplished." For military service members and

veterans, when experiencing physical pain during deployment to the extent that it leads to removal from the current mission or deployment as a whole (i.e., before the mission is accomplished), psychological turmoil may follow, such as loss of identity or purpose, and guilt. Loss of community and social support from fellow service members may also be experienced.

Similar to community samples, pain within the veteran population is highly comorbid with psychological symptoms. Primarily, chronic pain and posttraumatic stress disorder (PTSD) are highly comorbid diagnoses (McGeary, Moore, Vriend, Peterson, & Gatchel, 2011). Additionally, both pain and PTSD are highly comorbid with persistent post-concussive syndrome (PPCS), also known as a mild Traumatic Brain Injury (TBI). To that end, pain, PTSD, and PPCS have been dubbed the "clinical triad." Research has indicated that it is uncommon for a veteran to meet criteria for one of the diagnoses without also meeting criteria for one or both of the other diagnoses. Specifically, Lew et al. (2008) found that in a sample of 340 OIF/OEF veterans at a Polytrauma Network Site, patients were more likely to have all three diagnoses in some combination than one or two diagnoses separately.

The relation between PTSD and pain is bidirectional in many cases. Asmundson, Coons, Taylor, and Katz (2002) found that one in five veterans with PTSD eventually developed pain. Alternately, veterans with pain were four times more likely eventually to develop PTSD. Asmundson et al. (2002) conceptualized this relationship using a Mutual Maintenance Model framework, such that pain may be a constant reminder of the traumatic event or circumstances, and certain components of PTSD can

maintain or exacerbate pain symptoms. Additionally, Alschuler and Otis (2012) found that in a sample of 194 veterans with pain, nearly half (48%) met or exceeded criteria for a PTSD diagnoses and those with pain and PTSD displayed more maladaptive beliefs and coping strategies related to their pain than veterans without PTSD.

Moreover, a relation between PTSD and somatic symptoms has been well established (Baker, Mendenhall, Simbartl, Magan, & Steinberg, 1997; Barrett et al., 2002). Hoge, Terhakopian, Castro, Messer, and Engel (2007) found that in a sample of OIF/OEF veterans, one in three who screened positive for PTSD had high somatic symptom severity. Psychological comorbidity with PTSD was also strongly associated with health impairment. Specifically, physical and somatic symptoms among individuals with PTSD were found to be more severe if the veteran was engaged in alcohol misuse or depressed. The most severe symptoms were among those with PTSD who were engaged in alcohol misuse *and* depressed. Analyses assessing the impact of specific PTSD symptom clusters on health impairment indicated that PTSD symptoms specific to arousal had an especially strong association with increased health impairment (Hoge et al., 2007). Similar to the Mutual Maintenance Framework previously described, attentional and psychological processes have been proposed as mediators for the association between PTSD, particularly arousal symptoms, and physical health impairment.

Pain is often accompanied by substance use, potentially as a means to cope with the pain. Despite the literature cited previously regarding poor coping strategies among patients with pain as well as the well-established high rates of alcohol use within the

military and veteran populations (Hoge, Auchterlonie, & Milliken, 2006; Jacobson et al., 2008; Seal et al., 2009), little research has been conducted on veterans' alcohol use when pain is present. Of the extant literature, Lawton and Simpson (2009) found that one in four patients with pain indicated risky or hazardous drinking behaviors on the Alcohol Use Disorder Identification Test and that this problem drinking was predicted by gender (male), high pain experiences, and low use of adaptive coping strategies such as relaxation.

Additionally, pain is also related to poor sleep quality and insomnia. Patients from a community sample with pain reported poor sleep at a rate 6-7 times greater than the general population and also reported greater levels of anxiety and depression (Menefee et al., 2000). In addition to individual functioning, sleep is also related to relationship functioning. A recent study by Hasler and Troxel (2010) found an association between couples' sleep synchrony and marital satisfaction. Given that individuals with pain are likely to have difficulties with sleeping, the presence of pain may adversely impact the marital relationship as well. Moreover, marital satisfaction has been linked to pain severity such that lower marital satisfaction is related to greater reported pain severity, although this association is inconsistent across studies (Kerns, Haythornthwaite, Southwick, & Giller, 1990; Leonard, Cano, & Johansen, 2006). More broadly, interpersonal relations, specifically perceived social support, has been found to be negatively associated with pain severity such that greater perceptions of social support are associated with decreased reported pain severity (Lopez-Martinez, Esteve-Zarazaga, & Ramirez-Maestre, 2008).

Lastly, research by Tang and Crane (2006) indicated that patients with pain have double the rate of suicide as patients without pain and that suicidal ideation was present in 20% of pain patients. Risk factors for suicide among patients with pain included intensity and duration of pain, pain-related insomnia, helplessness or hopelessness regarding their pain, and problem-solving deficits. Of particular concern is pain patients' access to lethal means of self-harm, particularly their pain medication and ease of access to firearms, especially for active military service members.

To date little research has been conducted on factors that may dispose one to be more vulnerable to developing or experiencing a greater degree of pain and other somatic complaints in the future. A meta-analysis of individuals with chronic pain found that, compared to individuals without chronic pain, they were more likely to report childhood abuse and those reporting childhood abuse reported more pain symptoms than individuals who reported experiencing pain but not childhood abuse (Davis, Luecken, & Zautra, 2005). Additionally, military sexual trauma in female veterans is associated with greater pain intensity and interference, as well as higher rates of pelvic pain, back pain, and headaches (Haskell et al., 2010; Suris & Lind, 2008). Separately, among pain patients in a clinical setting, 54% had depression and 95% experienced anxiety before the onset of their pain (Dersh, Polatin, & Gatchel, 2002; McWilliams, Goodwin, & Cox, 2004). Within that vein, Shaw et al. (2010) assessed historical psychopathology as it related to current pain symptoms. Results indicated that individuals with a lifetime diagnosis of major depressive disorder had 5 times greater risk of their pain transitioning from sub-acute to chronic following the onset of pain relative to those without a lifetime

diagnosis of major depressive disorder. Following the development of pain, several psychological factors have been identified as predictors of pain outcomes, including depression, anxiety, beliefs about pain, fear-avoidance, traumatic life events, and social support (Tunks, Crook, & Weir, 2008).

The current study seeks to identify prospective and concurrent predictors of post-deployment pain and somatic symptoms as well as contribute to the extant literature on the impact of post-deployment pain and other somatic symptoms on the lives of service members. The study also aims to further investigate the associations between pain and other somatic complaints with various facets of individual and relationship functioning.

CHAPTER II

METHOD

Participants

Participants for this study were a subset of active-duty service members from a larger longitudinal investigation of U.S. Air Force Security Forces. The original investigation assessed a variety of psychological risk and protective factors among Airmen across a year-long deployment to Iraq (Cigrang et al., 2014). Two detachments of Airmen (combined n = 318) were tasked with a high-risk mission to train Iraqi police deployed in two consecutive, 1-year deployment cycles during 2009 and 2010. Participants were assessed at three time points in the deployment cycle: pre-, peri-(during), and post-deployment. The Airmen's data were gathered 30 days prior to their deployment, again while they were deployed in Iraq, and finally 6-9 months post-deployment.

Responses from 142 Airmen were successfully matched from pre- to post-deployment. These 142 Airmen did not differ from the larger cohorts of 318 Airmen assessed prior to deployment or the 204 Airmen assessed post-deployment on any measure of demographic characteristics, individual emotional or behavioral functioning, or intimate relationship functioning (all p's > .05).

Of these 142 Airmen, a majority (93%) were male and ranged in age from 23 to 43 years (M = 27.7, SD = 6.1). On average, Airmen within the sample had 13.7 years of education (SD = 1.8, range 12-20), with the majority (60%) graduating from high school or earning their GED and not pursuing higher education. Nearly half (46%) of the

Airmen had experienced two or more deployments. A majority (66%) of the Airmen identified as Caucasian, 14% as African American, 11% as Hispanic, 5% as Asian, and 2% as Native American.

For analyses in which relationship functioning was assessed, responses from a sub- sample of 76 partnered Airmen were used. These Airmen remained in the *same* committed relationship across the deployment and their responses were matched pre- to post-deployment. These Airmen had been partnered, on average, for 5.8 years (*SD* = 4.9, range 1-23 years). A majority of the partnered Airmen were married (76%) and a majority of couples (63%) had one or more children.

Measures

Pain and Somatic Symptoms

The Patient Health Questionnaire (PHQ-15) is a 15-item subscale from the Primary Care Evaluation of Mental Disorders and assesses 14 of the 15 most common somatic symptoms as outlined in the DSM-IV (Kroenke, Spitzer, & Williams, 2002). This measure was included only following deployment. Respondents were asked to indicate during the last four weeks how bothersome various physical problems were using a three point scale: 0 (*not at all bothered*), 1 (*bothered a little*), and 2 (*bothered a lot*). This measure's convergent validity is supported through associations with decreased functional status, such as social functioning, mental health, and symptom-related difficulty in activities and relationships. This measure simultaneously assesses pain and somatic functioning. For the current study, items assessing pain and somatic symptoms were analyzed separately.

To assess pain symptoms, five items were used, including "*Stomach pain*," "*Back pain*," "*Pain in your arms, legs, or joints (knees, hips, etc.)*," "*Headaches*," and "*Chest pain.*" Items assessing pain symptoms demonstrated moderate internal consistency (α = .64, mean interitem *r* = .29). To assess somatic symptoms not related to pain, six items were used, including "*Dizziness*," "*Fainting spells*," "*Feeling your heart pound or race*," "*Shortness of breath*," "*Constipation, loose bowels, or diarrhea*," and "*Nausea, gas, or indigestion.*" Items assessing somatic symptoms demonstrated acceptable internal consistency (α = .79, mean interitem *r* = .40).

Four items from this measure were excluded from the current study. The item "*Menstrual cramps or other problems with your periods*" was excluded because the current sample was predominantly male. The items "*Feeling tired or having low energy*," and "*Trouble sleeping*" were excluded to avoid potential covariance with depressive symptoms. Lastly, the item "*Pain during sexual intercourse*" was excluded as sexual functioning was not directly applicable to the current study nor could it be well-measured with only one item.

Alcohol Use

To assess alcohol use, the Alcohol Use Disorder Identification Test (AUDIT), a well-established 10-item screening measure developed by the World Health Organization and used routinely in clinical and research applications, was used (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001). This measure assesses domains of alcohol consumption, drinking behavior (dependence), and adverse consequences of drinking. For each item, respondents rated the frequency of occurrence on a 5-point scale

(from 0-4). Airmen's alcohol use was assessed at pre- and post-deployment and demonstrated good internal consistency (α = .82, mean interitem *r* = .36; and α = .84, mean interitem *r* = .35, respectively).

Combat Experiences

Combat experiences were assessed using a 22-item measure adapted from the Peacekeeping Experiences Scale (Adler, Dolan, & Castro, 2000) that evaluates exposure to stressful combat-environment events during deployment. Airmen were asked to indicate whether or not they had experienced a particular combat event (e.g., *"being shot at*" or "*seeing dead or seriously injured Americans*"). If Airmen indicated they experienced a particular item they were asked to report the impact of each experience. Items were rated on a 5-point Likert scale with "*Did not experience*" = 1, "*No Impact*" = 2, "*A Little Impact*" = 3, "*Moderate Impact*" = 4, and "*Extreme Impact*" = 5. Airmen's combat experiences were assessed during and following deployment (α = .84, mean interitem *r* = .35 and α = .90, mean interitem *r* = .29, respectively).

Posttraumatic Stress Disorder

The PTSD Checklist—Military (PCL-M) version is commonly used to assess posttraumatic stress symptoms with 17 items corresponding to the symptoms of PTSD outlined in the Diagnostic and Statistical Manual of Mental Disorders (DSM–IV; American Psychiatric Association, 1994). For each item, Airmen rated how much they had been "*bothered by the problem in the past month*" on a 5-point scale from 1 (*not at all*) to 5 (*extremely*), with scores ranging from 17-85. Airmen were assessed before, during, and following deployment. The PCL- M demonstrated good internal consistency

at pre-deployment (α = .83, mean interitem *r* = .26), and excellent internal consistency at both peri- and post-deployment (α = .92, mean interitem *r* = .42; and α = .95, mean interitem *r* = .49, respectively).

Depression

Levels of depressive symptoms were assessed using the Patient Health Questionnaire (PHQ-9), a well-validated measure of depression comprising nine items corresponding to the criteria of the DSM-IV diagnosis of major depression (Kroenke, Spitzer, & Williams, 2001). Airmen rated the frequency with which each symptom was experienced in the past 2 weeks, from 0 (*not at all*) to 3 (*nearly every day*). Airmen were assessed at pre-deployment (α = .81, mean interitem *r* = .38), at peri-deployment (α = .86, mean interitem *r* = .40), and at post-deployment (α = .89, mean interitem *r* = .46).

Suicidal Ideation

To assess suicidal ideation, one item assessing suicidal ideation, "*Thoughts that you would be better off dead, or of hurting yourself in some way*," was taken from the PHQ-9 and was rated from 0 ("*not at all*") to 3 ("*nearly every day*") on the frequency of occurrence in the last two weeks. This item from the PHQ-9 is one of the most widely used brief screening tools for suicidal ideation across VA sites (Dobscha et al., 2013). Airmen's suicidal ideation was assessed at pre-, peri-, and post-deployment.

Post-Deployment Readjustment

The Post-Deployment Readjustment Inventory (PDRI) is a 36-item measure used to assess service members' adjustment and functioning post-deployment (Katz, Cojucar,

Davenport, Pedram, & Lindl, 2010) across six domains: career challenges, health concerns, intimate relationship problems, concerns about deployment, social difficulties, and PTSD symptoms. The health concerns subscale (5 items) and the PTSD symptoms subscale (8 items) were removed from the current analyses due to item overlap with the PHQ-15 and PCL-M. Items were rated on a 5-point rating scale from 1 ("*not at all*") to 5 ("*extremely*"), with scores ranging from 23-115. This measure demonstrated excellent internal consistency (α = .94, mean interitem r = .39).

Barriers to Mental Health Seeking

To assess perceived barriers to health seeking, 13 items adapted from the Stigma and Barriers to Care Scale (Hoge et al., 2004) were used (α = .91, mean interitem r = .44). Airmen rated each item using a 5-point Likert scale from (1 = "*Strongly Disagree*" to 5 = "*Strongly Agree*") with total scores ranging from 13-65. The scale includes two factors: barriers and stigma. Barriers to care are assessed with three items, for example, "*I don't have adequate transportation*." Concern regarding stigma is assessed using 8 items, for example, "*My leaders discourage the use of mental health services.*" Perceived barriers to mental health treatment were assessed post-deployment.

Marital Distress

The Marital Satisfaction Inventory — Brief form (MSI-B) is a 10-item screening measure designed to identify intimate relationship distress (Whisman, Snyder, & Beach, 2009). Item content reflects global distress and conflict in specific domains of affective and problem-solving communication, sexual interaction, and leisure time together. Scores range from 0-10, with half of the items coded as reflecting distress if answered

true and half as distressed if answered *false*. Marital satisfaction was assessed prior to and following deployment. The measure showed good internal consistency at pre-deployment (α = .86, mean interitem *r* = .42) and at post-deployment (α = .89, mean interitem *r* = .45).

Social Support

The Multidimensional Scale of Perceived Social Support contains 12 items reflecting the subjective adequacy of social support across three sources including family, friends, and significant other (Zimet, Dahlem, Zimet, & Farley, 1988). Items were rated on a 7-point scale ranging from 1 (*very strongly disagree*) to 7 (*very strongly agree*), with total scores ranging from 12-84. Subscales distinguishing among the three sources of social support were supported through factor analysis. This measure was administered at post-deployment and demonstrated excellent internal consistency (α = .93, mean interitem *r* = .79) within the current sample.

Post-Deployment Family Reintegration

The Post-Deployment Family Reintegration Scale includes six items assessing service members' challenges related to family reintegration following deployment. Two of the six items overlapped with a screening measure developed by Sayers, Farrow, Ross, and Oslin (2009) including "*Uncertainly about my responsibilities in the home*" and "*Feeling like I am a guest in my own home*." Four additional items assessed lack of belongingness or purpose ("*Feeling no longer needed in the household*"), adjustment to new routines ("*Dealing with new household routines established during deployment*" and "*Being given too much responsibility too soon in household tasks*"), and the

reestablishment of joint decision-making ("*Reestablishing joint decision-making in areas of finances, leisure time activities, parenting/discipline, etc.*"). Airmen rated each item according to the level of difficulty they experienced on a 5-point scale ranging from 1 (*not at all*) to 5 (*extremely*). Total scores ranged from 6 (*no difficulty with family reintegration*) to 30 (*extreme difficulty with family reintegration).*This measure demonstrated good internal consistency (α = .89, mean interitem *r* = .56).

CHAPTER III

RESULTS

The relations between prospective and concurrent predictors of interest and pain and somatic symptoms at post-deployment were first evaluated using simple linear regression and binary logistic regression analyses. Means and standard deviations for the prospective and concurrent predictors of pain and somatic symptoms are presented in Tables 1 and 2, respectively. Summaries of the univariate standardized results for predicting pain and somatic symptoms at post-deployment using linear and logistic regression are provided in Figures 1-6.

Univariate Linear Regression

Linear regression is used to predict continuous outcomes from continuous predictor variables such that one's performance on an outcome measure may be estimated given information about other relevant factors. Predicting one's outcome based upon other variables allows clinicians and researchers to estimate the severity of a negative outcome (e.g., pain) based upon scores from self-report measures assessing other individual features or disorders (e.g., PTSD).

Pre- and Peri-Deployment Predictors of Pain and Somatic Symptoms

Pre-deployment predictors of post-deployment pain and somatic symptoms were not statistically significant. Of the peri-deployment intrapersonal factors assessed, PTSD and depression demonstrated consistent associations with both pain (β = .23, $t(136) = 2.70$, $p < .01$, and β = .30, $t(136) = 3.66$, $p < .001$, respectively) and somatic

symptoms (β = .28, t(135) = 3.40, p < .01, and β = .29, t(135) = 3.55, p < .01, respectively) at post-deployment. Peri-deployment PTSD accounted for 5% of the variance in post-deployment pain symptoms (R^2 = .05, F(1, 136) = 7.26, p < .01) and 8% of post-deployment somatic symptoms (R^2 = .08, F(1, 135) = 11.58, p < .001). Moreover, peri-deployment depression accounted for 9% of the variance in post-deployment pain symptoms (R^2 = .09, F(1, 136) = 13.42, p < .001) and 9% of the variance in post-deployment somatic symptoms (R^2 = .09, F(1, 135) = 12.61, p < .01). Additionally, Airmen's report of experiencing suicidal thoughts during deployment predicted post-deployment pain symptoms (β = .22, t(137) = 2.62, p < .05) and accounted for 5% of the variance in post-deployment pain symptoms (R^2 = .05, F(1, 137) = 6.85, p < .05). Airmen's suicidal ideation during deployment did not significantly predict post-deployment somatic symptoms (p > .05).

Separately, the number of combat experiences (β = .19, t(135) = 2.26, p < .05) as well as the impact of those experiences (β = .18, t(135) = 2.12, p < .05) predicted post-deployment somatic symptoms and accounted for 4% and 3% of the variance in post-deployment somatic symptoms (R^2 = .04, F(1, 135) = 5.11, p < .05, and R^2 = .03, F(1, 135) = 4.5, p < .05, respectively). The number of combat experiences and the impact of those experiences did not significantly predict post-deployment pain symptoms (all p's > .05).

Post-Deployment Predictors of Pain Symptoms

Intrapersonal factors such as PTSD and depression demonstrated consistent concurrent associations with post-deployment pain symptoms. Airmen's reported PTSD

severity significantly predicted concurrent post-deployment pain symptoms (β = .54, $t(137) = 7.53$, $p < .001$) and explained 29% of the variance in pain symptoms at post-deployment ($R^2 = .29$, $F(1, 137) = 56.63$, $p < .001$); Airmen's reported depression severity also demonstrated a significant association with concurrent post-deployment pain symptoms ($\beta = .48$, $t(137) = 6.36$, $p < .001$) and accounted for 23% of the variance in pain symptoms at post-deployment ($R^2 = .23$, $F(1, 137) = 40.47$, $p < .001$). Lastly, Airmen's reported suicidal ideation was a significant predictor of pain symptoms following deployment ($\beta = .19$, $t(137) = 2.28$, $p < .05$) and accounted for 4% of the variance in pain symptoms ($R^2 = .04$, $F(1, 137) = 5.18$, $p < .05$).

External challenges encountered by the Airmen also significantly predicted post-deployment pain symptoms. Specifically, Airmen who reported experiencing difficulty with post-deployment reintegration were more likely to experience greater pain ($\beta = .60$, $t(132) = 8.53$, $p < .001$). This association accounted for 36% of the variance in post-deployment pain symptoms ($R^2 = .36$, $F(1, 132) = 72.71$, $p < .001$). Moreover, perceived barriers to receiving care significantly predicted concurrent post-deployment pain symptoms ($\beta = .32$, $t(134) = 3.89$, $p < .001$) and accounted for 10% of the variance in post-deployment pain symptoms ($R^2 = .10$, $F(1, 134) = 15.13$, $p < .001$).

Airmen's post-deployment reports of deployment combat experiences, the number as well as the impact of each experience, significantly predicted concurrent post-deployment pain symptoms. The number of deployment combat experiences demonstrated a strong association with post-deployment pain symptoms ($\beta = .25$, $t(135) = 3.04$, $p < .01$) and accounted for 6% of the variance in post-deployment pain

symptoms (R^2 = .06, F(1, 135) = 49.21, p < .05); moreover, the reported impact of these experiences was a significant predictor of post-deployment pain symptoms (β = .49, t(135) = 6.59, p < .001) and accounted for 24% of the variance in post-deployment pain symptoms (R^2 = .24, F(1, 135) = 43.39, p < .001).

Post-Deployment Predictors of Somatic Symptoms

Similar to pain symptoms, intrapersonal factors such as PTSD and depression demonstrated consistent concurrent associations with post-deployment somatic symptoms. Airmen's reported PTSD severity significantly predicted concurrent post-deployment somatic symptoms (β = .51, t(136) = 6.84, p < .001) and explained 26% of the variance in somatic symptoms at post-deployment (R^2 = .26, F(1, 136) = 46.83, p < .001); Airmen's reported depression severity also demonstrated a significant association with concurrent post-deployment somatic symptoms (β = .52, t(136) = 7.03, p < .001) and accounted for 27% of the variance in somatic symptoms at post-deployment (R^2 = .27, F(1, 136) = 49.44, p < .001). Airmen's suicidal ideation did not significantly predict concurrent post-deployment somatic symptoms (p > .05).

External challenges encountered by the Airmen emerged as significant predictors of post-deployment somatic symptoms. Specifically, Airmen who reported experiencing difficulty with post-deployment reintegration were more likely to experience greater somatic symptoms (β = .55, t(132) = 7.57, p < .001). This association accounted for 30% of the variance in post-deployment somatic symptoms (R^2 = .30, F(1, 132) = 57.23, p < .001). Moreover, perceived barriers to receiving care significantly predicted concurrent post-deployment somatic symptoms (β = .22, t(133) = 2.57, p < .05) yet

accounted for only 5% of the variance in post-deployment somatic symptoms (R^2 = .05, $F(1, 133) = 6.59$, $p < .05$).

Lastly, Airmen's post-deployment reports of peri-deployment combat experiences and the impact of those experiences also significantly predicted concurrent post-deployment somatic symptoms (β = .20, $t(135) = 2.38$, $p < .05$, and β = .42, $t(135) = 5.33$, $p < .001$, respectively). Number of combat experiences accounted for 4% of the variance in post-deployment somatic symptoms (R^2 = .04, $F(1, 135) = 5.67$, $p < .05$) whereas the reported psychological impact of these combat experiences accounted for 17% of the variance in post-deployment somatic symptoms scores (R^2 = .17, $F(1, 135) = 28.42$, $p < .001$).

Other potential predictor variables analyzed, including alcohol use, marital distress, social support, and difficulty with family reintegration, were not significant prospective nor concurrent predictors of post-deployment pain and somatic symptoms (all *p*'s > .05).

Univariate Logistic Regression

Logistic regression allows for categorical outcomes to be predicted from continuous or categorical predictors. Such analyses allow for predicting group categorization or assignment of individuals given certain information. Predicting group membership has valuable clinical applications as it allows one to infer the likelihood of particular subsequent behaviors, outcomes, and so on based upon their categorization on the variable of interest.

To use logistic regression analyses with the current dataset, post-deployment total pain and somatic symptoms were first dichotomized. A cut-score of 5 was used to dichotomize presence versus absence of pain and somatic symptoms, such that scores below 5 represented the absence of pain and somatic symptoms whereas scores of 5 or above indicated the presence of pain and somatic symptoms. On average, respondents were reporting at least a moderate level of distress across the spectrum of pain or somatic symptoms. In this sample, a cut-score of 5 or more identified 28% of this sample on the pain measure, and 22% of this sample on the somatic measure. Binary logistic regression analyses were conducted with predictor variables treated as continuous.

Pre- and Peri-Deployment Predictors of Pain Symptoms

Pre-deployment factors did not statistically significantly predict post-deployment pain symptoms. Intrapersonal factors, PTSD and depression, assessed during deployment were both significant predictors of post-deployment pain symptoms (β = .99, Wald = 5.41, e^{β} = 2.70, $p < .05$ and β = 1.25, Wald = 9.87, e^{β} = 3.50, $p < .01$, respectively). The exponentiation of the β coefficient (e^{β}), a representation of the odds ratio associated with a one unit change in the predictor, indicated that having at least moderate levels of PTSD and depression during deployment resulted in 2.70 and 3.50 greater odds of experiencing post-deployment pain symptoms. Suicidal ideation was not significant in predicting post-deployment pain symptoms ($p > .05$).

Pre- and Peri-Deployment Predictors of Somatic Symptoms

Pre-deployment factors did not statistically significantly predict post-deployment somatic symptoms. Peri-deployment intrapersonal factors, PTSD and depression, were

both significant predictors of post-deployment somatic symptoms (β = 1.53, Wald = 11.53, e^{β} = 4.63, $p < .001$ and β = 1.13, Wald = 6.75, e^{β} = 3.10, $p < .01$, respectively) such that Airmen who endorsed PTSD and depression would have 4.63 and 3.10 greater odds, respectively, of experiencing concurrent post-deployment somatic symptoms.

Additionally, the number of combat experiences as well as the reported psychological impact of those experiences were found to be significant predictors of post-deployment somatic symptoms (β = .08, Wald = 4.74, e^{β} = 1.08, $p < .05$ and β = .07, Wald = 5.79, e^{β} = 1.10, $p < .05$, respectively) with the odds of experiencing concurrent somatic symptoms being 1.08 and 1.10 for the number of combat experiences and the psychological impact of those experiences, respectively.

Post-Deployment Predictors of Pain Symptoms

Consistent with peri-deployment factors, post-deployment intrapersonal factors were found to significantly predict concurrent pain symptoms, including PTSD (β = 2.20, Wald = 23.66, e^{β} = 9.04, $p < .001$) and depression (β = 2.03, Wald = 17.27, e^{β} = 7.60, $p < .001$) such that Airmen who endorsed PTSD were 9.04 times more likely to experience concurrent post-deployment pain, and Airmen who endorsed depression were 7.60 times more likely to experience concurrent post-deployment pain symptoms. Additionally, Airmen's reported difficulty with reintegration (β = .05, Wald = 20.11 e^{β} = 1.06, $p < .001$) and perceived barriers to receiving treatment (β = .04, Wald = 5.61, e^{β} = 1.04, $p < .05$) were significant predictors of concurrent post-deployment pain symptoms, with the odds of experiencing concurrent pain symptoms being 1.06 and 1.04

times more likely among Airmen who reported difficulty with reintegration and perceived barriers to care, respectively. Taken a step further, in assessing the specific barriers to help-seeking (barrier versus concern about stigma), analyses indicated that external barriers or prohibitive factors, such as lack of transportation, significantly predicted Airmen's report of post-deployment pain symptoms (β = .11, Wald = 4.20, e^{β} = 1.12, $p < .05$) whereas reported concern about stigma was not significant ($p > .05$).

Lastly, as assessed following deployment, the number of traumatic experiences during deployment and the impact of these experiences, were found to be significant predictors of post-deployment pain symptoms (β = 1.0, Wald = 5.97, e^{β} = 1.10, $p < .05$ and β = .09, Wald = 16.10, e^{β} = 1.09, $p < .001$, respectively), with the odds of experiencing concurrent post-deployment pain symptoms being 1.10 and 1.09 for number of traumatic experiences and the impact of those experiences, respectively.

Post-Deployment Predictors of Somatic Symptoms

Intrapersonal psychological factors, PTSD and depression, were significant predictors of post-deployment somatic symptoms. Post- deployment PTSD significantly predicted somatic symptoms (**β** = 2.04, Wald = 16.65, e^{β} = 7.77, $p < .001$) with 7.77 greater odds of experiencing somatic symptoms if concurrently experiencing PTSD compared to Airmen who did not report post-deployment PTSD symptoms. Depression was also a potent predictor of post-deployment somatic symptoms (β = 2.90, Wald = 14.67, e^{β} = 18.17, $p < .001$) such that the odds of experiencing somatic symptoms increased 18.17 times if post-deployment depressive symptoms were also endorsed. Airmen's reported difficulty with reintegration was a statistically significant

predictor (β = .05, Wald = 15.80, e^{β} = 1.05, p < .001) with the odds of experiencing concurrent somatic symptoms being 1.05 times greater relative to Airmen who did not endorse difficulty with reintegration.

Lastly, Airmen's combat experiences and the impact of those experiences were assessed in relation to somatic symptoms. Unlike for pain symptoms, the number of traumatic experiences reported by Airmen was not a significant predictor of post-deployment somatic symptoms. However, the reported impact of traumatic experiences during deployment significantly predicted somatic symptoms (β = .09, Wald = 14.59, e^{β} = 1.10, p < .001) such that the odds of experiencing somatic symptoms were 1.10 times greater for Airmen who reported their traumatic experiences had a greater psychological impact than those who reported less psychological impact.

Odds Ratio Analyses

An odds ratio may be thought of as the effect size of the association between two conditions and can be used to compare the relative likelihood of a particular outcome occurring (e.g., post-deployment pain) given the presence of a particular factor (e.g., PTSD, depression). Odds ratios allow one to assess if exposure to a particular factor increases the risk for developing a particular outcome, as well as the magnitude of the factor relative to other factors. The magnitude of a risk factor can be interpreted such that an odds ratio value of 1 indicates that exposure to the variable does not affect the odds of the outcome; an odds ratio value greater than 1 indicates that exposure to the variable increases the odds of the outcome variable; whereas an odds ratio value less than 1 indicates that exposure to the variable decreases the odds of the outcome variable.

Building upon the logistic regression analyses in which outcome variables were dichotomized, predictor variables found to be significantly predictive of post-deployment pain and somatic symptoms were dichotomized in order to conduct odds ratio analyses. These measures were dichotomized according to cut-score recommendations from extant literature whenever possible. Specifically, the PHQ-9 was dichotomized using a cut-score of 10, which identifies at least "mild" depressive symptoms (Kroenke et al., 2001); the PCL-M was dichotomized such that scores $\geq$ 32 indicates moderate or higher levels of PTSD symptoms (Bliese et al., 2008); and post-deployment challenges with reintegration were dichotomized using a cut-score of 69 which identifies at least a moderate level of difficulty with reintegration (e.g., Cigrang et al., 2015). A median split approach was used to dichotomize the remaining predictive factors: perceived barriers to mental health treatment, the number of combat experiences, and the psychological impact of those combat experiences. Perceived barriers to mental health treatment were dichotomized such that scores $\geq$ 32 indicated many barriers were perceived. A cut-score of 7 was used for the number of combat experiences as assessed during deployment, whereas a cut-score of 13 was used for post-deployment responses, with numbers above these cut-scores indicating more combat experiences relative to others in the current sample. The reported psychological impact of those combat experiences was dichotomized at peri-deployment with a cut-score of 4 and a cut-score of 10 at post-deployment with scores above these cut-scores indicating greater psychological impact of one's combat experiences relative to others in the current sample. Results of the odds ratio analyses are summarized in Tables 3 and 4.

Pain Symptoms

As assessed during deployment, PTSD significantly predicted post-deployment pain symptoms ($\chi^2(1, n = 139) = 5.78, p < .05$). Airmen who reported moderate to high levels of PTSD symptoms during deployment were at 2.73 greater odds of reporting post-deployment pain than Airmen who reported lower levels of peri-deployment PTSD symptoms. At post-deployment, PTSD was a significant predictor of concurrent pain symptoms ($\chi^2(1, n = 139) = 27.90, p < .001$) with Airmen who endorsed post-deployment PTSD being at 9.04 greater odds of experiencing concurrent pain than Airmen who did not. Additionally, both peri- and post-deployment depressive symptoms significantly predicted post-deployment pain ($\chi^2(1, n = 139) = 9.66, p < .01$; and $\chi^2(1, n = 138) = 21.00, p < .001$, respectively); Airmen who reported at least mild depressive symptoms during deployment had 3.41 greater odds of reporting post-deployment pain symptoms whereas the same endorsement following deployment put an Airman at 7.78 greater odds of reporting concurrent pain symptoms relative to Airman who reported fewer depressive symptoms.

Both the number and the psychological impact of combat experiences, as reported at post-deployment, were significantly associated with concurrent pain symptoms ($\chi^2(1, n = 137) = 4.28, p < .05$; and $\chi^2(1, n = 137) = 6.86, p < .01$) such that Airmen who reported more combat experiences were at 2.23 greater odds of reporting concurrent pain, while Airmen endorsing greater psychological impact of those events had 2.82 greater odds of experiencing concurrent post-deployment pain.

In addition to intrapersonal factors, post-deployment pain was significantly predicted by concurrent challenges experienced with reintegration ($\chi^2(1, n = 134) = 18.24, p < .001$). Airmen who reported experiencing more difficulty with reintegration were at 6.23 greater odds of experiencing concurrent post-deployment pain symptoms than Airmen who reported less difficulty reintegrating. Lastly, perceived barriers to mental health treatment were significantly predictive of post-deployment pain symptoms ($\chi^2(1, n = 136) = 6.91, p < .05$); Airmen who reported perceiving more barriers to treatment had 2.83 greater odds of experiencing concurrent pain symptoms compared to Airmen who perceived fewer barriers to treatment.

Somatic Symptoms

Airmen's reported peri-deployment PTSD was found to be a significant predictor of post-deployment somatic symptoms ($\chi^2(1, n = 138) = 12.89, p < .001$); those with moderate to severe PTSD symptoms had 4.68 times greater odds of experiencing post-deployment somatic symptoms relative to Airmen who reported less severe PTSD symptoms. Following deployment, PTSD remained a significant predictor of post-deployment somatic symptoms ($\chi^2(1, n = 138) = 19.92, p < .001$), with Airmen in the moderate to severe range of PTSD symptoms being at 7.68 times greater odds of experiencing post-deployment somatic symptoms. Similarly, peri-deployment depression was significantly predictive of post-deployment somatic symptoms ($\chi^2(1, n = 138) = 6.82, p < .01$). Airmen who reported at least mild depression during deployment had 3.02 times greater odds of reporting post-deployment somatic symptoms. Depression remained a significant predictor of somatic symptoms following

deployment ($\chi^2(1, n = 137) = 19.29, p < .001$) such that Airmen who reported post-deployment depressive symptoms had 6.31 times greater odds of experiencing concurrent somatic symptoms.

Moreover, the psychological impact of combat experiences assessed at post-deployment was significantly associated with post-deployment somatic symptoms ($\chi^2(1, n = 137) = 8.12, p < .01$). Airmen endorsing greater psychological impact of combat experiences were at 3.51 greater odds of experiencing somatic symptoms following deployment. Although significant in the logistic regression analyses, the number and the psychological impact of combat experiences as assessed during deployment were not found to be significant predictors when these factors were dichotomized (all *p*'s > .05).

Lastly, following deployment, greater difficulty with reintegration was found to significantly predict concurrent somatic symptoms ($\chi^2(1, n = 134) = 12.82, p < .001$) such that Airmen who endorsed greater difficulty experienced 4.88 times greater odds of reporting somatic symptoms.

Multivariate Logistic Analyses

Provided the numerous factors predictive of post-deployment pain and somatic symptoms, significant predictors from univariate analyses were entered into the model simultaneously to allow for comparative analysis of their relative predictive power. Multivariate logistic regression analyses assessed significant prospective and concurrent predictors for both post-deployment pain and somatic symptoms.

Prospective Predictors of Pain and Somatic Symptoms

Peri-deployment intrapersonal factors PTSD and depression independently predicted pain symptoms following deployment. To assess each factor's relative predictive power, the factors were entered into the model simultaneously. Peri-deployment depression remained a strong significant predictor of post-deployment pain after controlling for the effects of peri-deployment PTSD ($\beta = 1.09$, Wald = 5.67, $e^{\beta} = 2.97$, $p < .05$; see Table 5).

Univariate analyses demonstrated that PTSD, depressive symptoms, number of combat experiences, and the impact of those experiences independently predicted post-deployment somatic symptoms. However, when analyzed together, none of the factors remained significant predictors of post-deployment somatic symptoms after controlling for effects of other predictors (see Table 6).

Concurrent Predictors of Pain and Somatic Symptoms

Univariate regression analyses indicated that post-deployment pain symptoms were significantly predicted by post-deployment PTSD, depressive symptoms, difficulty with reintegration, perceived barriers to care, number of traumatic experiences, and the psychological impact of the traumatic deployment experiences. However, when all factors were entered into the multivariate model simultaneously, no factors achieved levels of significance after controlling for effects of other predictors (see Table 7).

Similarly, univariate regression analyses indicated that post-deployment somatic symptoms were significantly predicted by post-deployment PTSD, depressive symptoms, difficulty with reintegration, and the psychological impact of traumatic

deployment experiences. Yet, when all factors were entered into the multivariate model simultaneously, only depression remained a significant predictor of post-deployment somatic symptoms ($\beta = 2.15$, Wald = 5.64, $e^{\beta} = 8.61$, $p < .05$; see Table 8), after controlling for effects of other predictors.

CHAPTER IV

SUMMARY AND DISCUSSION

The current study sought to identify prospective and concurrent predictors of post-deployment pain and somatic symptoms in a sample of active-duty USAF Security Forces that had recently returned from a high-risk ground mission in Iraq. Whereas substantial research has examined *consequences* of pain and somatic impairment, little research has examined psychological *predictors* of pain and somatic symptom severity. Although the current study was largely exploratory in nature, predictive factors were selected using associations between pain and somatic symptoms, and intra- and interpersonal functioning established in extant literature (Forman-Hoffman et al., 2007; Lawton & Simpson, 2009; Menefee et al., 2000; Schwartz et al., 1997; Tang & Crane, 2006).

Predictive factors were assessed at pre-, peri-, and post-deployment. Analyses indicated that no pre-deployment factors were significantly predictive of either pain or somatic symptoms following deployment. Indeed, numerous prospective peri-deployment factors and concurrent post-deployment factors emerged and retained statistical significance across analyses, with the exception of suicidal ideation. Airmen's reported suicidal ideation at peri- and post-deployment predicted greater pain severity following deployment, although this factor did not remain statistically significant when the outcome variables were dichotomized. Although previous research has indicated that suicidal ideation is significantly related to pain (Tang & Crane, 2006), the current study

likely lacked power as very few participants endorsed suicidal ideation and did so at a low level of severity.

Consistent with previous literature, intrapersonal psychological factors were significantly associated with pain and somatic symptoms (Baker et al., 1997; Barrett et al., 2002; Hoge et al., 2007, Shaw et al., 2010). Peri- and post-deployment depression and PTSD both emerged as stable and potent predictors of pain and somatic symptoms following deployment. Reporting moderate levels of depression and PTSD during deployment increased the likelihood of Airmen experiencing post-deployment pain by 3.41 and 2.73 times, respectively, and somatic symptoms by 3.02 and 4.68 times, respectively. Following deployment, the same endorsement of depression and PTSD, in most cases, doubled the odds of experiencing pain and somatic symptoms, compared to the odds established during deployment. Specifically, the likelihood of experiencing concurrent pain increased by 7.78 and 9.04 times, respectively, and somatic symptoms by 6.31 and 7.68 times, respectively.

Odds ratios analysis is the most widely used statistic in research assessing risk factors and is the primary index used to demonstrate increased risk (Bland & Altman, 2000). These features contribute to the clinical utility of odds ratios as they can be easily understood and translated to clinical conceptualization and applications. In that regard, odds ratio values can be interpreted in a similar way to that of Cohen's *d* and the corresponding effect size. Odds ratio values of 1.68, 3.47, and 6.71 correspond to Cohen's *d* values of 0.2 (small effect size), 0.5 (medium effect size), and 0.8 (large effect size), respectively (Chen, Cohen, & Chen, 2010). In the current study, peri-

deployment predictors produced small to medium effect sizes, yet the large effect sizes produced by concurrent depression and PTSD for both pain and somatic symptoms are especially notable.

PTSD and depressive symptoms were independently predictive of pain and somatic symptoms in the current study. Multivariate analyses indicated that depressive symptoms remained a significant predictive factor for both pain and somatic symptoms when controlling for the effects of other factors. Specifically, depressive symptoms uniquely predicted post-deployment pain (as assessed at peri-deployment), as well as concurrent post-deployment somatic symptoms. Although PTSD demonstrated a strong association with pain and somatic symptoms, results suggest that depressive symptoms may be a particularly potent psychological factor for predicting physical symptoms as well as conceptualizing concurrent symptom endorsement. The robust effect of the association between these intrapersonal factors and physical symptoms lends credence to the importance of differential diagnoses within both the medical and mental health fields when treating veterans. For example, as indicated by the current study's results, an Airman experiencing depressive symptoms is nearly 8 times more likely to report experiencing concurrent pain than an Airman who is not experiencing depressive symptoms. For a non-depressed Airman, treating pain directly is often appropriate and sufficient, yet for a depressed Airman targeting only the physical symptoms leaves unaddressed a catalyst from which continued physical symptoms are likely to continue to emerge. As noted by Sullivan, Edlund, Zhang, Unutzer, and Wells (2006), addressing physical symptoms in isolation is likely treating poorly differentiated states of mental

and physical pain.

In assessing the relation among pain, psychological diagnoses, and the likelihood of receiving prescription opioids from a primary care physician, researchers found that veterans with at least one pain problem and a diagnosed psychological disorder (depression, anxiety, alcohol or drug use disorder, or TBI) were significantly more likely to receive a prescription for opioids than veterans who also had at least one pain problem but no psychological disorder. Relative to the aforementioned psychological disorders, a diagnosis of PTSD was most significantly associated with receiving an opioid prescription for a pain complaint (Seal et al., 2012).

The implications of mistreating pain and psychological symptoms within this population are proving to be quite harrowing. The most recent report from the Department of Veteran Affairs (2014) estimates that more than half a million veterans are currently taking prescription opioids. Relative to veterans taking prescription opioids for pain who do not have a mental health diagnosis, veterans with comorbid psychological disorders, particularly PTSD, are at greatest risk for adverse clinical outcomes, including opioid-related accidents, self-inflicted injuries, and overdose. Even more, whereas opioid overdose is one of the leading causes of death in the United States, the overdose rate among VA patients is nearly double the national average (Bohnert, Ilgen, Galea, McCarthy, & Blow, 2011; Okie, 2010; Seal et al., 2012).

A majority of veterans (88%) receive their opioid prescription from their primary care physician yet these providers are only minimally trained in psychological assessment (Bohnert et al., 2011). Utilizing brief screening measures for PTSD (e.g.,

PCL-M) and depression (e.g., PHQ-9) at each office visit could alert physicians to any psychological distress that may be manifesting as, maintaining, or exacerbating physical symptoms. One goal of this intervention is suppressing physicians' inclination to treat physical symptoms in isolation by increasing awareness of possible psychological components and exploring alternative methods of treatment to address a primary root of the issue rather than its presentation. Moreover, consistent assessment of psychological functioning within medical settings would allow for early detection of psychological distress and would provide an opportunity for medical and mental health professionals to intervene and address psychological functioning before pain and somatic symptoms become more severe. This same approach could be applied during deployments, trainings, and at annual physical examinations – early identification of precursors for pain and somatic symptoms allow for psychological (separately or in tandem with medical) interventions before symptoms potentially become too severe or preclude execution of duties. For example, medical evacuation in combat zones is more likely to result from pain-related issues than combat-related injuries. Interventions focusing on ameliorating psychological distress to either prevent or limit the development of subsequent physical symptoms would benefit both the service member and the military as a whole as it would reduce unit attrition (i.e. effectiveness) as a result of non-combat related injuries.

In addition to depression and PTSD, Airmen's experiences during deployment including the number of combat experiences they were exposed to, as well as the subjective psychological impact of those experiences, were significant predictors of

reported pain following deployment. These predictive factors more than doubled the likelihood of an Airmen reporting pain (2.23 and 2.82 times, respectively). Whereas both the number and the psychological impact of combat experiences significantly predicted pain symptoms, only the reported psychological impact significantly predicted somatic symptoms following deployment. Airmen who reported their combat experiences as having a greater psychological impact were 3.51 times more likely to report somatic symptoms upon returning stateside (a medium effect size). Although statistically significant, considering that post-deployment data were collected 6-9 months following deployment, Airmen who continued to associate greater psychological impact with their combat experiences were likely also experiencing some degree of PTSD symptoms. Prior research suggests that there is a strong positive, linear relationship between combat experiences and post-deployment PTSD symptom levels (Hoge et al., 2004). In the current sample, PTSD was significantly correlated with the number of combat experiences and the reported psychological impact ($r = .28$, $p < .01$ and $r = .46$, $p < .001$). These factors did not demonstrate incremental predictive power when controlling for the effects of the other.

Moreover, upon returning from deployment, Airmen who reported experiencing at least moderate difficulty with the reintegration process were 6.23 times more likely to report pain symptoms and 4.88 times more likely to report somatic symptoms (large effect sizes) than Airmen who reported experiencing less difficulty. Reintegration challenges were measured across various domains including career challenges, intimate relationship problems, concerns about deployment, and social difficulties. These

subscales highlight areas in which service members returning from deployment and veterans detaching from the military alike would likely benefit from greater support in the form of intervention prior to reintegration (e.g., psychoeducation, skill-building) and continued support during the reintegration process. It is important to acknowledge, however, that the availability of programs and services does not necessarily correspond to the utilization of those resources among service members and veterans. Concerted efforts on increasing the utilization of resources, particularly targeting perceived barriers to treatment, may be an especially important focus for future research.

As it relates to the current study, Airmen who may wish to seek treatment following deployment but perceive many barriers in doing so are 2.83 times more likely to report experiencing pain. Of particular interest, when looking at specific barriers (stigma vs. lack of resources), stigma was not significantly related to pain symptoms despite previous research demonstrating it is a significant barrier to help-seeking (Clement et al., 2015; Greene-Shortridge, Britt, & Castro, 2007). While efforts have been made within the military to address the stigma associated with help-seeking, these results indicate that additional efforts should also address more pragmatic components of perceived barriers to treatment such as lack of transportation and time constraints.

Surprisingly, no interpersonal factors significantly predicted either pain or somatic symptom levels. Marital distress, difficulty with post-deployment family reintegration, and perceived social support, despite sharing similar features with domains assessed more broadly within reintegration difficulty (i.e., intimate relationship distress, social difficulties), were not significantly associated with pain or somatic symptoms.

While acknowledging that previous literature has demonstrated marital satisfaction to be inconsistently related to pain (Kerns et al., 1990; Leonard et al., 2006), research has established social support, broadly defined, as a more stable "protective factor" from negative outcomes (Lopez-Marinez et al., 2008). Moreover, individuals who perceive their family as being supportive report lower levels of pain severity than individuals who perceive themselves being part of an unsupportive family (Jamison & Virts, 1990). Thus in the current study significant, negative associations between Airmen's perceived social support, relational interactions (i.e., family reintegration), and relationship satisfaction, and reported physical functioning were expected. It is possible that within the current study these factors were too "domain specific" and a broader assessment of such domains is necessary, as demonstrated by the significant results obtained from post-deployment reintegration assessing similar areas of interest.

Lastly, although research has indicated that physical symptom severity is greater among service members engaged in alcohol use and that alcohol consumption is greater among service members with pain (Hoge et al., 2007; Lawton & Simpson, 2009), alcohol use was not significantly associated with pain nor with somatic symptoms in this sample. Relative to service members in other branches, Airmen generally have lower rates of drinking (Bray et al., 2009). As such, it is possible that alcohol may demonstrate significant predictive properties of physical symptoms in a military sample that endorses higher rates of problematic drinking behaviors.

To aid in conceptualizing the relation between psychological and physical health symptoms, several models have been proposed. Cohen and Rodriguez (1995) proposed a

broader model in which pain and psychological comorbidity are related via several bi-directional pathways such that each pathway contributes to pain and vice versa. These pathways include: biological (e.g., hormones), behavioral (e.g., maladaptive coping), cognitive (e.g., distorted thoughts), and social (e.g., support networks). Results from the current study assessed behavioral, cognitive, and social pathways and provided support for the behavioral and cognitive pathways. Although the social pathway was not supported, other models suggest that interpersonal processes may moderate the association between psychological and pain symptoms. Specifically, the Transactional Model of Health (Turk & Kerns, 1985) suggests that a couple's resources, appraisal of a potentially stressful situation, and coping efforts interact to improve or exacerbate outcomes. This model also emphasizes the influence that each partner has on the other. Because the current study did not include data from Airmen's partners, the social pathway could not be examined in this manner.

Separately, the Mutual Maintenance Model, as described by Asmundson et al. (2002), suggests that pain likely acts as a constant reminder of a traumatic event or circumstances, and that particular components of one's pathology or circumstances likely maintain or exacerbate pain symptoms. Results from this study provide support for the latter pathway – that one's pathology or circumstances (e.g., PTSD or barriers to treatment) significantly predict the degree to which one reports pain, potentially by increasing the salience of one's pain and subsequent subjective pain experience.

The current study examined predictors (primarily psychological) of physical symptoms. Even though the extant literature describes well-established associations

between psychological and physical factors, in very few cases are psychological factors used to predict physical outcomes (e.g., Shaw et al., 2010). Moreover, very little research within the military population has utilized psychological factors as predictive of physical outcomes nor done so using a prospective approach. As such, the current study utilized pre-established associations between psychological and physical factors yet was relatively exploratory in nature and had several limitations.

The sample included active-duty USAF Security Forces who were assessed across the deployment cycle. Participants within the sample were relatively homogenous and did not vary significantly with regard to age, gender, or socioeconomic background. Additionally, Security Forces within the United States Air Force is a small, specialized group of individuals potentially limiting the generalizability of results to other Airmen as well as service members in other branches of the military.

As it pertains to the measures utilized, analyses in which variables were dichotomized were done so using cut-scores established within the literature, whenever possible. However, for several variables, pre-established cut-scores did not exist and were subsequently created using a median-split approach. The cut-scores utilized for these measures were selected based on meaning for Airmen within the current sample, particularly with regard to the number of combat experiences and the psychological impact of those experiences. As such, generalization of cut-scores on these measures may be limited for other samples. Although cut-scores were necessary to conduct various analyses, the inherent risks associated with cut-scores, including the possibility of error in categorizing participants, should be acknowledged.

Separately, with any measure of self-report one must suspect some degree of biased responding. Individuals may under- or over-endorse particular items, particularly when items are assessing especially undesirable or desirable traits or behaviors. All measures used within the study were comprehensive and standardized, although they were administered remotely so the context in which the data were collected is variable, particularly for Airmen who completed the assessment while deployed to Iraq. Of particular note, the outcome variables for the current study, pain and somatic symptoms, are highly subjective personal experiences and as such can be difficult to quantify. This feature of physical symptom data also makes it difficult to generalize data more broadly relative to other subjective report data that can be more easily supported through other means of data collection, for example behavioral observation. More broadly, the operationalization of pain varies across studies which may hinder the interpretation and generalizability of results within this area of research. Acknowledging the challenges associated with using pain as a construct, the generalizability of results from the current study should be considered within the current conceptualization and measurement of physical symptoms.

Lastly, despite the predictive nature of the analyses conducted in the current study, a bi-directional association between the predictor and outcome variables seems likely. Certainly one may argue that psychological impairment or distress influenced Airmen's report of pain symptoms and severity and that their psychological distress may have artificially increased their reported physical symptom levels. It is possible that respondents did not experience pain at the level they reported. However, arguably,

identifying one's "true" experience of pain is less important. Rather, the reported degree of symptoms can be useful as a data point or marker when conceptualizing the physical and psychological functioning of an individual. Integrating data from physical and psychological examination can contribute to improved differential diagnoses, appropriate treatment plans, and better long-term outcomes.

Despite the limitations of the current study, results identify numerous prospective and concurrent predictors of post-deployment pain and somatic symptoms. The longitudinal nature of the study can be used to inform future prevention and intervention efforts across various domains (behavioral, cognitive, and social) that benefit individual functioning and the military as a whole (i.e., effectiveness, mission completion). In particular, the current study also identifies areas in which medical and mental health professionals can collaborate to ensure that service members receive the most appropriate care for their physical and psychological needs.

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APPENDIX

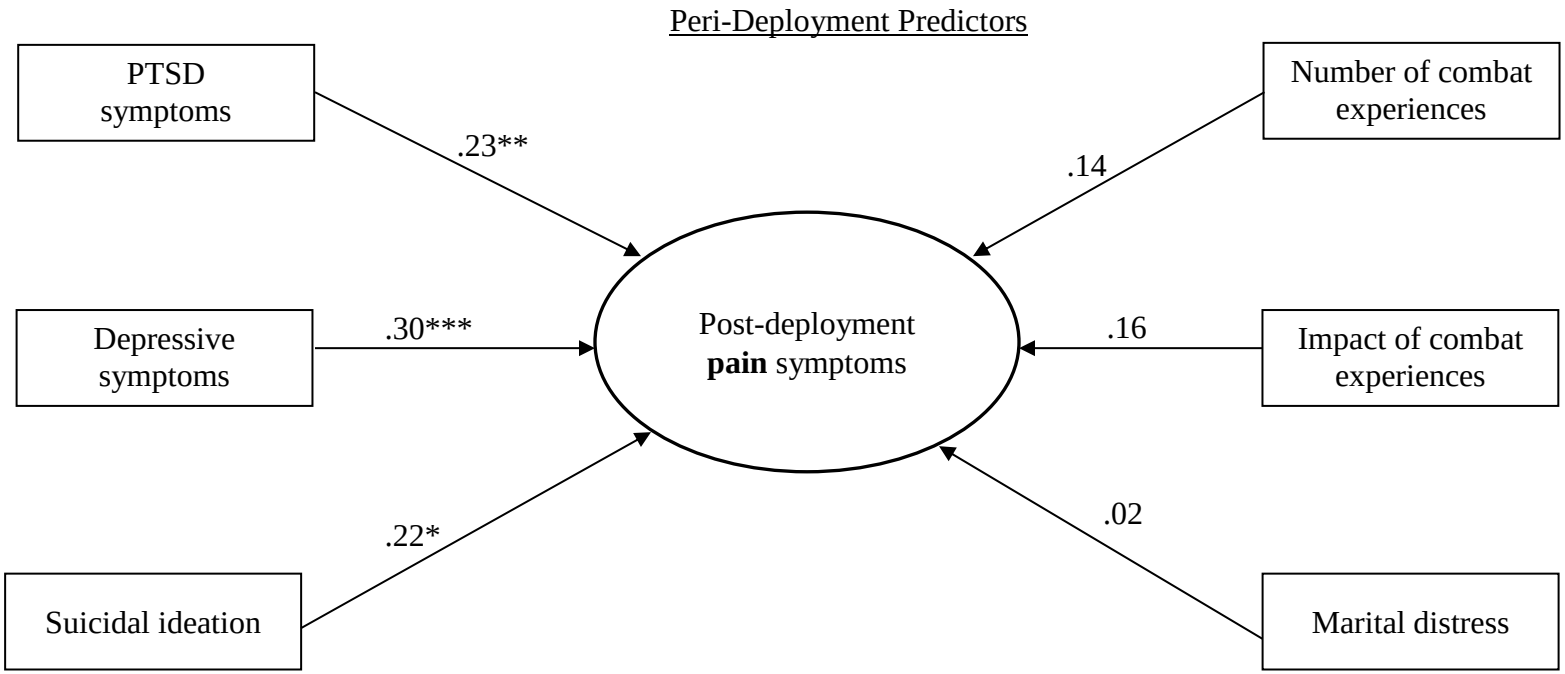

Figure 1. Linear regression analyses of post-deployment pain symptom predictors assessed at peri-deployment. Each arrow represents a one predictor linear regression analysis using prospective predictors with pain symptoms as a continuous criterion variable. Standardized beta weights are displayed. *p < .05. **p < .01. ***p < .001.

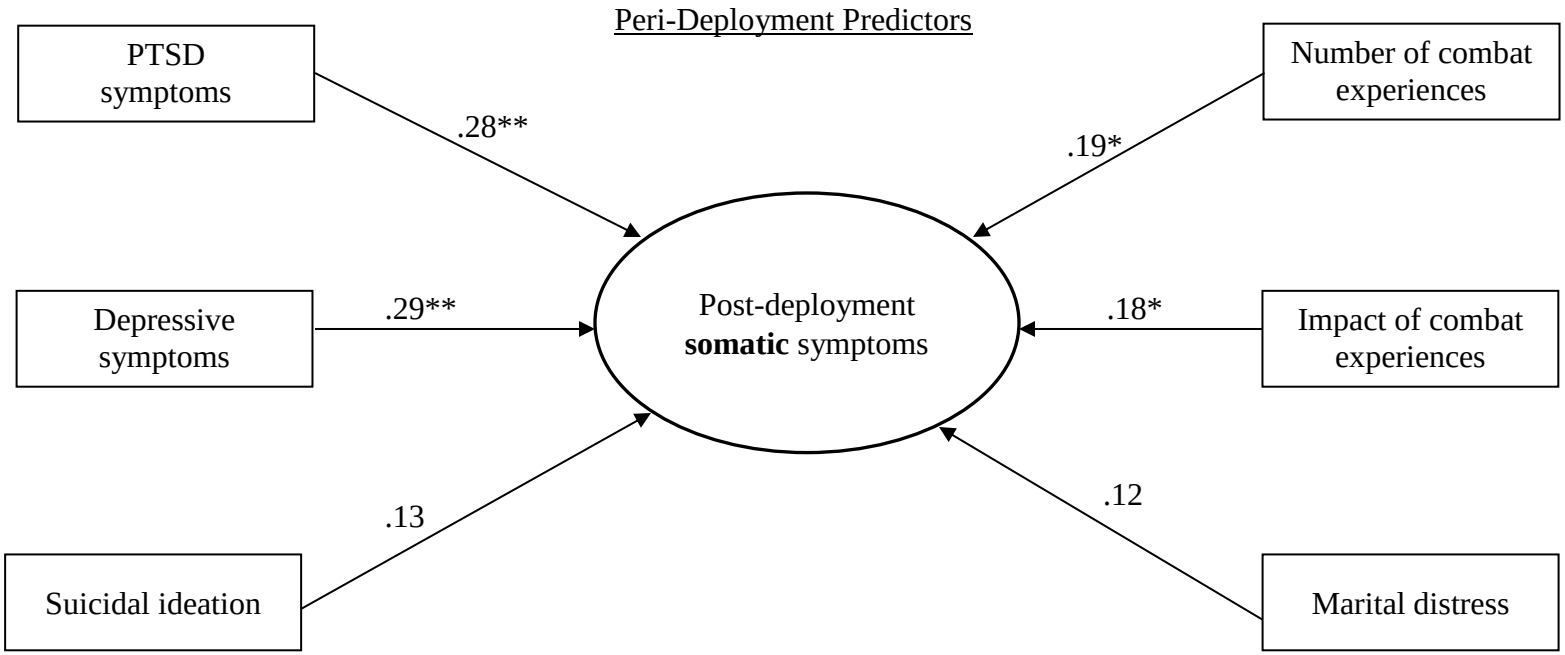

Figure 2. Linear regression analyses of post-deployment somatic symptoms from predictors assessed at peri-deployment.

Each arrow represents a one predictor linear regression analysis using prospective predictors with somatic symptoms as a continuous criterion variable. Standardized beta weights are displayed. *p < .05. **p < .01. ***p < .001.

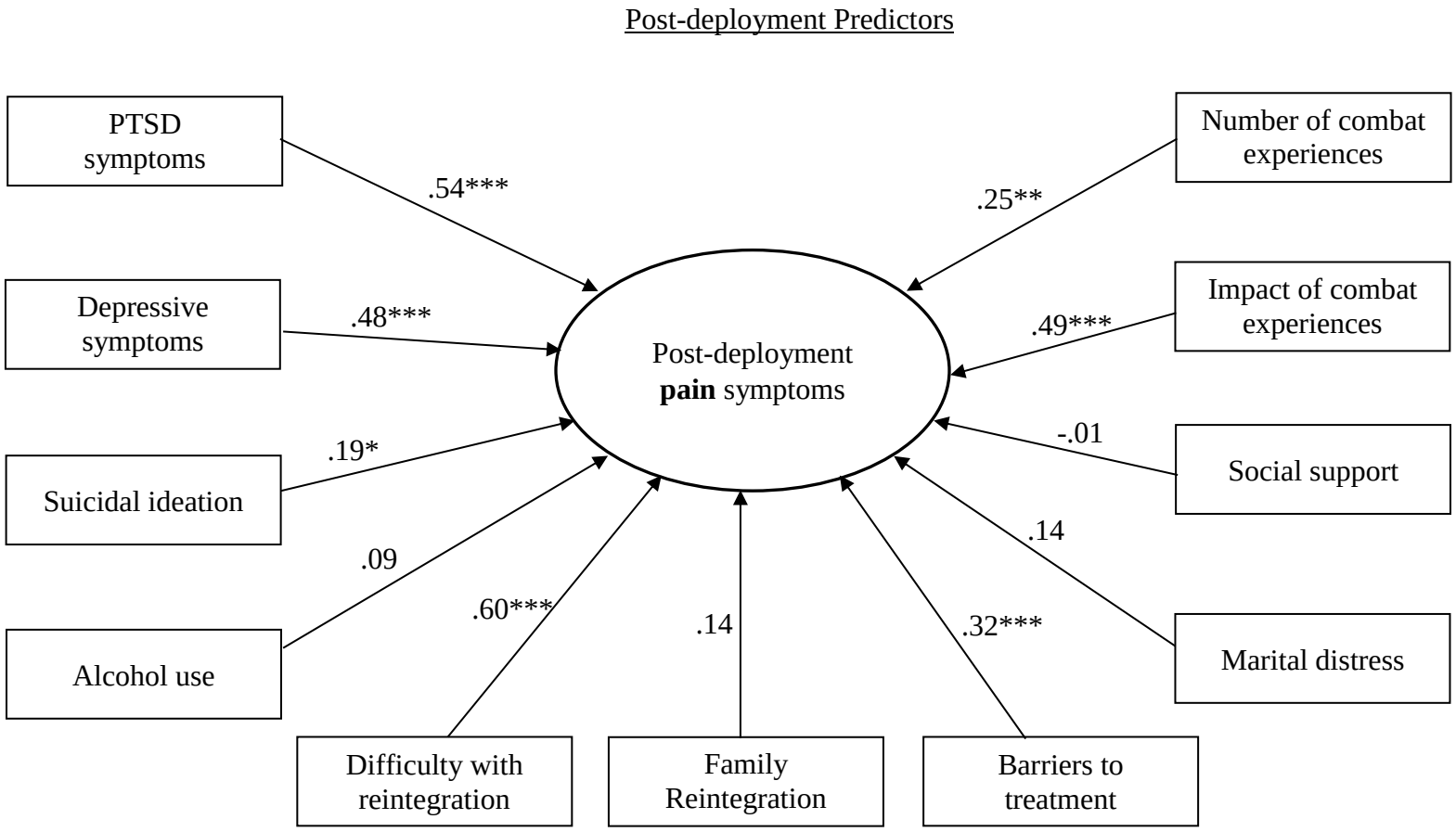

Figure 3. Linear regression analyses of post-deployment pain symptoms from predictors assessed at post-deployment. Each arrow represents a one predictor linear regression analysis using concurrent predictors with pain symptoms as a continuous criterion variable. Standardized beta weights are displayed. *p < .05. **p < .01. ***p < .001.

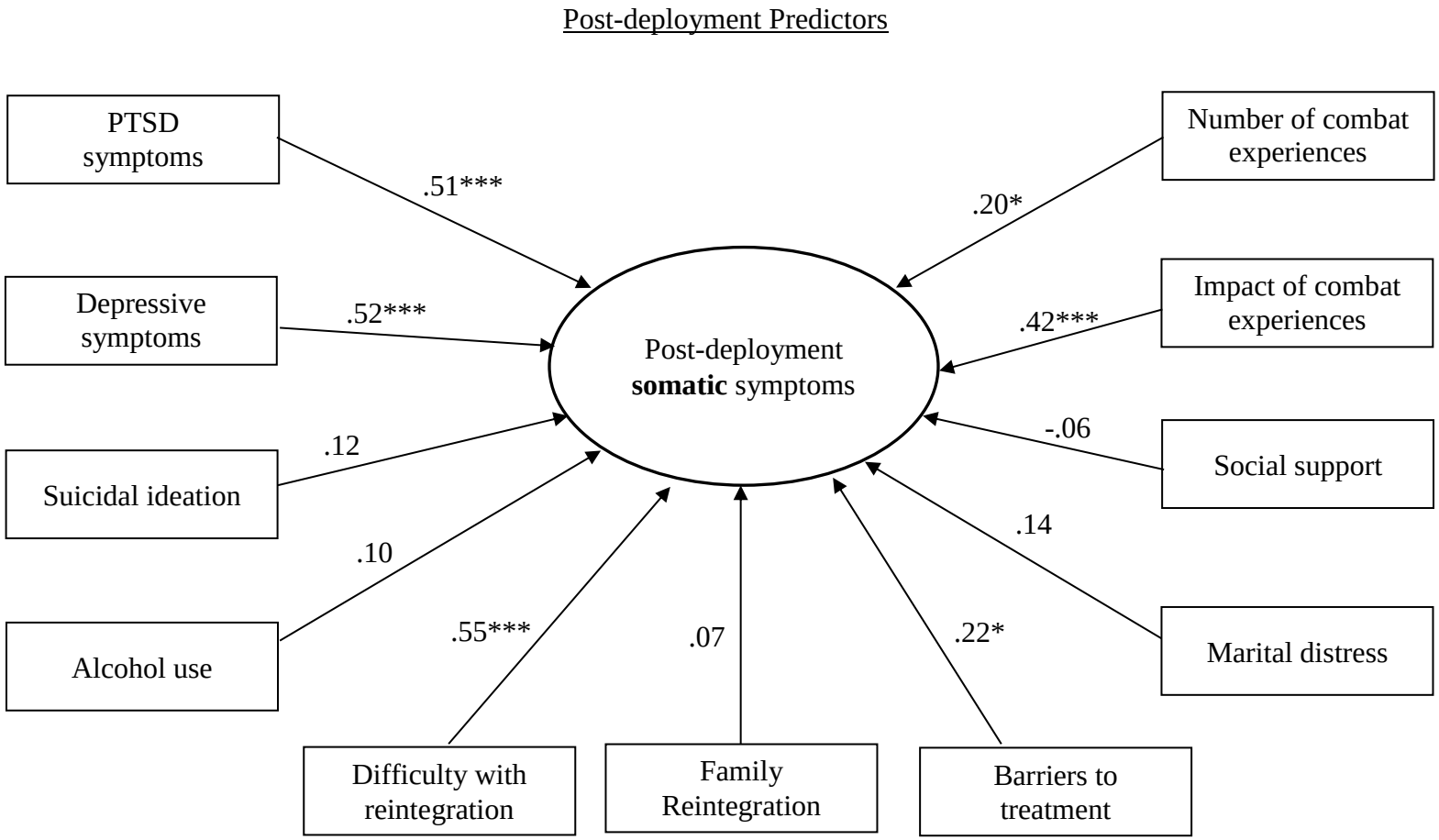

Figure 4. Linear regression analyses of post-deployment somatic symptoms from predictors assessed at post-deployment. Each arrow represents a one predictor linear regression analysis using concurrent predictors with somatic symptoms as a continuous criterion variable. Standardized beta weights are displayed. *p < .05. **p < .01. ***p < .001.

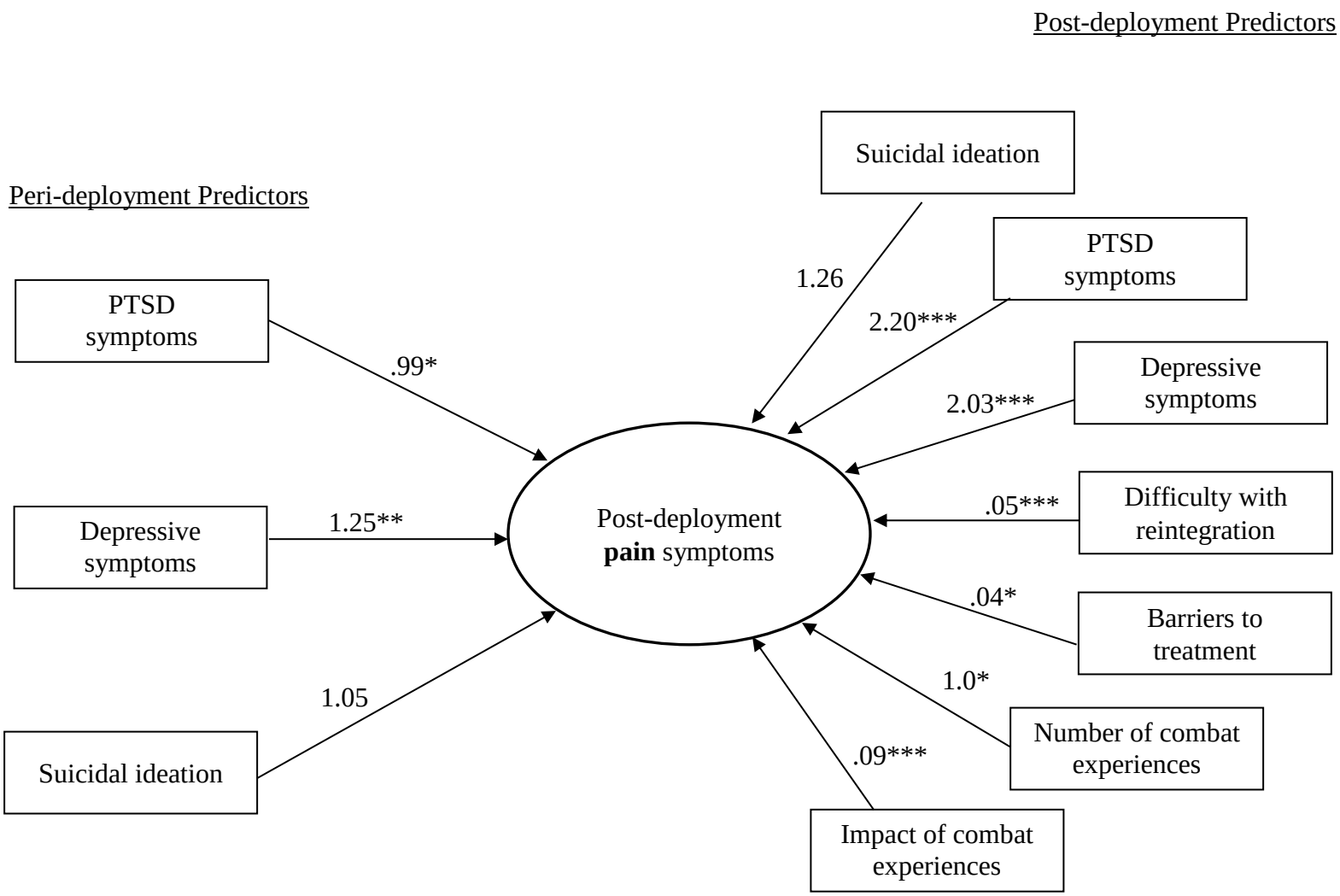

Figure 5. Logistic regression analyses of post-deployment pain symptoms from predictors assessed at peri- and post-deployment.

Each arrow represents a one predictor logistic regression analysis using prospective and concurrent predictors with pain symptoms as the dichotomous criterion variable. Standardized beta weights are displayed. *$p < .05$. **$p < .01$. ***$p < .001$.

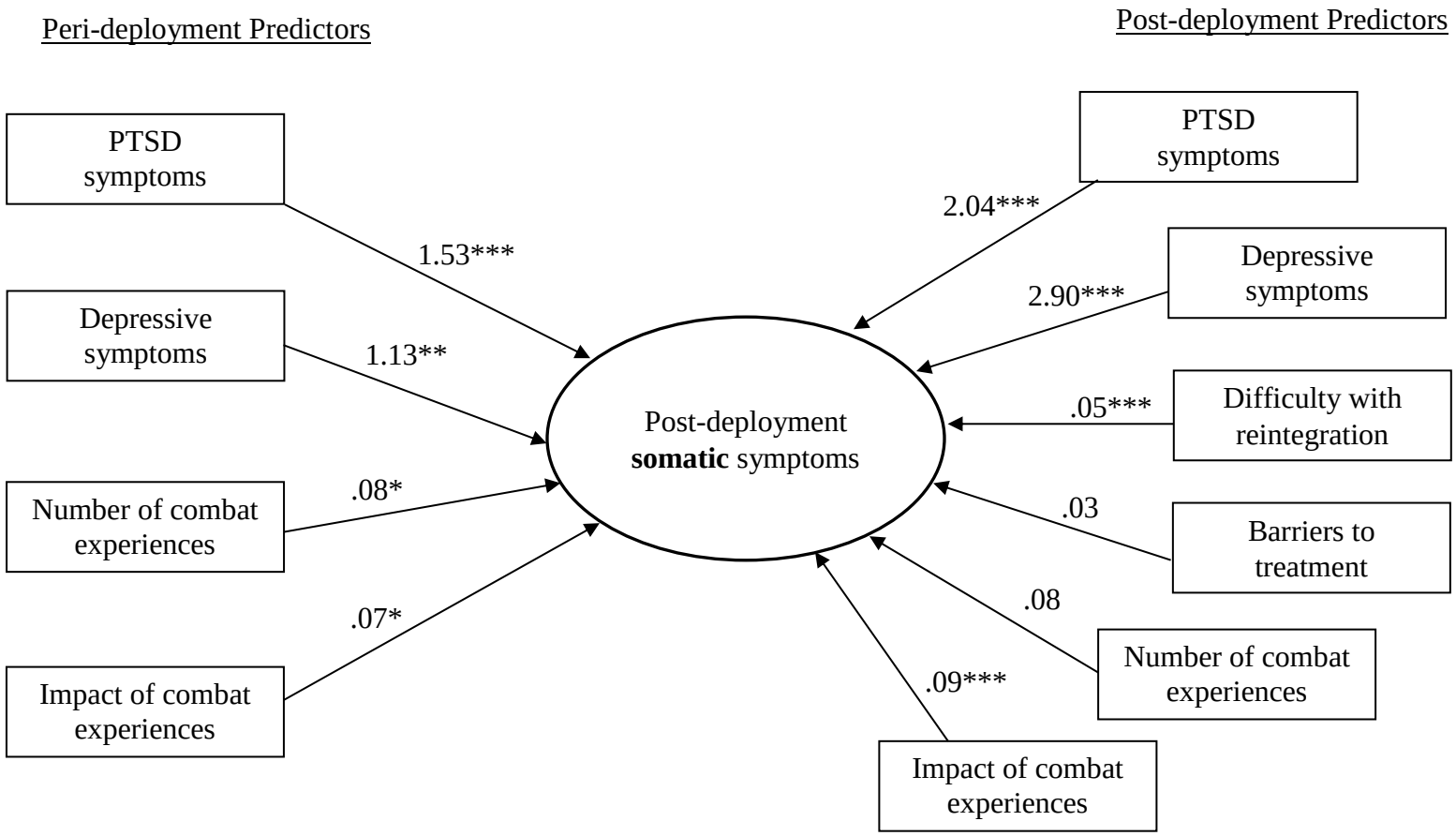

Figure 6. Logistic regression analyses of post-deployment somatic symptoms from predictors assessed at peri- and post-deployment. Each arrow represents a one predictor logistic regression analysis using prospective and concurrent predictors with somatic symptoms as the dichotomous criterion variable. Standardized beta weights are displayed. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 1

Means and Standard Deviations of Predictors by Level of Post-Deployment Pain Symptoms

	Sample	PTSD symptoms		Depressive symptoms		Suicidal ideation	
T3 Pain symptoms	*n*	T2 *M (SD)*	T3 *M (SD)*	T2 *M (SD)*	T3 *M (SD)*	T2 *M (SD)*	T3 *M (SD)*
Yes	39	30.69 (11.86)	47.85 (15.87)	7.54 (5.43)	11.15 (5.45)	0.15 (0.54)	0.13 (0.34)
No	100	24.83 (9.37)	31.43 (13.57)	4.41 (4.31)	4.96 (5.19)	0.00 (0.00)	0.06 (0.34)
Total	139	26.47 (10.43)	36.04 (13.01)	5.29 (4.84)	6.71 (5.95)	0.04 (0.29)	0.08 (0.34)
	Sample	Number of combat experiences		Impact of combat experiences		Barriers to treatment	Reintegration difficulty
T3 Pain symptoms	*n*	T2 *M (SD)*	T3 *M (SD)*	T2 *M (SD)*	T3 *M (SD)*	T3 *M (SD)*	T3 *M (SD)*
Yes	39	9.26 (5.99)	14.34 (4.87)	7.45 (7.32)	17.50 (12.10)	33.59 (11.56)	63.76 (19.62)
No	100	7.88 (5.13)	11.86 (5.24)	5.33 (5.59)	9.34 (7.51)	27.99 (12.26)	45.46 (16.63)
Total	139	8.27 (5.40)	12.55 (5.24)	5.94 (6.81)	11.61 (9.69)	29.60 (12.29)	50.65 (19.32)

Note: T2 = peri-deployment; T3 = post-deployment.

Table 2

Means and Standard Deviations of Predictors by Level of Post-Deployment Somatic Symptoms

	Sample	PTSD symptoms		Depressive symptoms		Suicidal ideation	
T3 Somatic symptoms	*n*	T2 *M (SD)*	T3 *M (SD)*	T2 *M (SD)*	T3 *M (SD)*	T2 *M (SD)*	T3 *M (SD)*
Yes	30	33.27 (13.58)	49.17 (15.52)	7.87 (5.63)	12.50 (6.11)	0.13 (0.57)	0.17 (0.59)
No	108	24.70 (8.73)	32.29 (13.39)	4.58 (4.38)	5.09 (4.76)	0.02 (0.14)	0.06 (0.23)
Total	138	26.57 (10.54)	35.96 (15.86)	5.29 (4.85)	6.71 (5.92)	0.04 (0.29)	0.08 (0.34)
	Sample	Number of combat experiences		Impact of combat experiences		Barriers to treatment	Reintegration difficulty
T3 Somatic symptoms	*n*	T2 *M (SD)*	T3 *M (SD)*	T2 *M (SD)*	T3 *M (SD)*	T3 *M (SD)*	T3 *M (SD)*
Yes	30	10.33 (6.16)	14.10 (5.71)	8.43 (7.32)	18.27 (12.00)	33.10 (10.49)	64.59 (19.33)
No	108	7.84 (5.14)	12.13 (5.00)	5.26 (5.53)	9.80 (8.14)	28.52 (12.69)	47.10 (17.49)
Total	138	8.38 (5.46)	12.56 (5.21)	5.96 (6.19)	11.66 (9.73)	29.54 (12.34)	50.88 (19.24)

Note: T2 = peri-deployment; T3 = post-deployment.

Table 3

Odds Ratio Analyses with Peri- and Post-Deployment Predictors of Post-Deployment Pain Symptoms

T3 Pain symptoms	T2 PTSD symptoms		T2 Depressive symptoms		T3 PTSD symptoms		T3 Depressive symptoms	
	Yes	No	Yes	No	Yes	No	Yes	No
Yes	14	25	26	13	31	8	33	6
No	17	83	37	63	30	70	41	58
Odds Ratio	2.73		3.41		9.04		7.78	
T3 Pain symptoms	T3 Number of combat experiences		T3 Impact of combat experiences		T3 Reintegration difficulty		T3 Barriers to treatment	
	More	Less	More	Less	Yes	No	More	Less
Yes	24	14	26	12	17	21	27	12
No	43	56	43	56	11	85	43	54
Odds Ratio	2.23		2.82		6.23		2.83	

Note: T2 = peri-deployment; T3 = post-deployment.

Table 4

Odds Ratio Analyses with Peri- and Post-Deployment Predictors of Post-Deployment Somatic Symptoms

T3 Somatic symptoms	T2 PTSD symptoms		T2 Depressive symptoms		T3 PTSD symptoms	
	Yes	No	Yes	No	Yes	No
Yes	14	16	20	10	24	6
No	17	91	43	65	37	71
Odds Ratio	4.68		3.02		7.68	
T3 Somatic symptoms	T3 Depressive symptoms		T3 Impact of combat experiences		T3 Reintegration difficulty	
	Yes	No	Yes	No	Yes	No
Yes	19	11	22	8	13	16
No	23	84	47	60	15	90
Odds Ratio	6.31		3.51		4.88	

Note: T2 = peri-deployment; T3 = post-deployment.

Table 5

Multivariate Peri-Deployment Predictors of Post-Deployment Pain Symptoms

	Post-deployment pain symptoms (yes/no)		
Model 1 (prospective predictors)	β *(SE)*	Wald's χ^2	e^{β}
T2 PTSD symptoms	.37 (.50)	.55	1.45
T2 Depressive symptoms	1.09* (.46)	5.67	2.97

Note: T2 = peri-deployment. *$p < .05$. β is the coefficient for the constant. *SE* is the standard error around the coefficient for the constant. Wald's χ^2 is a chi-square value of significance. The exponentiation of the B coefficient (e^{β}) represents the odds ratio associated with one unit change in the predictor.

Table 6

Multivariate Peri-Deployment Predictors of Post-Deployment Somatic Symptoms

	Post-deployment somatic symptoms (yes/no)		
Model 1 (prospective predictors)	β *(SE)*	Wald's χ^2	e^{β}
T2 PTSD symptoms	1.05 (.58)	3.27	2.87
T2 Depressive symptoms	.49 (.52)	.87	1.63
T2 Number of combat experiences	.05 (.05)	.96	1.05
T2 Impact of combat experiences	.00 (.05)	.01	1.00

Note: T2 = peri-deployment. β is the coefficient for the constant. *SE* is the standard error around the coefficient for the constant. Wald's χ^2 is a chi-square value of significance. The exponentiation of the B coefficient (e^{β}) represents the odds ratio associated with one unit change in the predictor.

Table 7

Multivariate Post-Deployment Predictors of Post-Deployment Pain Symptoms

	Post-deployment pain symptoms (yes/no)		
Model 1 (concurrent predictors)	β *(SE)*	Wald's χ^2	e^{β}
T3 PTSD symptoms	.91 (.68)	1.78	2.49
T3 Depressive symptoms	.81 (.67)	1.44	2.24
T3 Reintegration difficulty	.01(.02)	.29	1.01
T3 Barriers to treatment	-.00 (.02)	.04	1.0
T3 Number of combat experiences	.02 (.05)	.22	1.02
T3 Impact of combat experiences	.04 (.03)	2.06	1.05

Note: T3 = post-deployment. β is the coefficient for the constant. *SE* is the standard error around the coefficient for the constant. Wald's χ^2 is a chi-square value of significance. The exponentiation of the B coefficient (e^{β}) represents the odds ratio associated with one unit change in the predictor.

Table 8

Multivariate Post-Deployment Predictors of Post-Deployment Somatic Symptoms

	Post-deployment somatic symptoms (yes/no)		
Model 1 (concurrent predictors)	β *(SE)*	Wald's χ^2	e^{β}
T3 PTSD symptoms	.69 (.75)	.86	2.00
T3 Depressive symptoms	2.15* (.91)	5.64	8.61
T3 Reintegration difficulty	-.01 (.02)	.06	1.02
T3 Impact of combat experiences	.05 (.03)	3.25	1.06

Note: T3 = post-deployment. *$p < .05$. β is the coefficient for the constant. *SE* is the standard error around the coefficient for the constant. Wald's χ^2 is a chi-square value of significance. The exponentiation of the B coefficient (e^{β}) represents the odds ratio associated with one unit change in the predictor.