THE EFFECTS OF BIKRAM-STYLE HOT YOGA ON POSTTRAUMATIC STRESS AND DEPRESSIVE SYMPTOMS IN A MILITARY POPULATION

BY

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The dissertation of Brenda Ann Mueller, "The Effects of Bikram-style Hot Yoga on Posttraumatic Stress and Depressive Symptoms in a Military Population," approved by Amy Tillery, PhD, has been accepted and approved by the Faculty of the California School of Forensic Studies, Fresno campus, is in partial fulfillment of the requirements for the Degree of Doctor of Philosophy in Clinical Forensic Psychology.

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DEDICATION

This dissertation is dedicated to my parents, who met while both were in the Air Force, and my friend, Mac Hughey, a 3-tour Vietnam veteran.

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ABSTRACT OF THE DISSERTATION

The Effects of Bikram-style Hot Yoga on Posttraumatic Stress and Depressive Symptoms in a Military Population

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This study investigated the effects of Bikram-style hot yoga on symptoms of posttraumatic stress and depression in military service members. Treatments demonstrating empirical effectiveness are needed to address a current mental health crisis within the United States military. Prior research regarding the effects of yoga practices on PTSD and depression is limited, but indicates that yoga is a promising treatment for both conditions. Bikram-style hot yoga was selected as the intervention due to its suspected therapeutic benefit and the absence of prior research testing its effectiveness for psychological impairments. Current or former military service members who practice hot yoga comprised the experimental group; those who do not practice yoga or meditation comprised the control group. All participants completed the Posttraumatic

Stress Disorder Checklist – Military Version, the Inventory of Depressive Symptomatology, a brain injury screen, and a demographics questionnaire.

It was hypothesized that the experimental group would evidence fewer symptoms of PTSD and depression than controls; this hypothesis was supported by the data ($F = 7.10$, $p < .01$, $\eta^2 = .031$; $F = 25.15$, $p < .001$, $\eta^2 = .103$, respectively). It was further hypothesized that symptoms of PTSD (Hypothesis 2) and depression (Hypothesis 3) would negatively correlate with the duration and frequency of hot yoga practice. Hypothesis 2 was partially supported by the data, such that among yoga participants who suspected they have PTSD, the frequency, but not duration, of their hot yoga practice significantly correlated with lower PTSD scores ($r = -.325$, $p < .05$). Likewise, Hypothesis 3 was partially supported by the data such that for female yoga participants, the duration, but not frequency of their hot yoga practice was associated with significantly lower depression scores ($r = -.311$, $p = .005$).

The results of the current study suggest that hot yoga is an effective treatment for both PTSD and depression among military personnel.

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INTRODUCTION

Purpose Statement

The purpose of this research project was to investigate the effects of a Bikram-style hot yoga practice on posttraumatic stress and depressive symptoms. This study focuses attention on a specific population: U.S. military service members. American Armed Forces service personnel who practice Bikram-style hot yoga represent this study's experimental participants. Experimental participants' posttraumatic stress and depressive symptom scores were evaluated in comparison to scores of a control group comprised of military service members naïve to hot yoga. Additionally, experimental participants were surveyed to evaluate the duration and the frequency of their hot yoga practice as it relates to symptoms of posttraumatic stress and depression. Bikram-style hot yoga, the independent variable, is generally defined as a Hatha yoga-based practice. Originally developed thousands of years ago, Hatha yoga established the tenets of a yogic life, including the use of yoga postures (physical exercises), controlled breathing, meditative practices, and moral conduct to unite mind, body, and spirit (Herrick & Ainsworth, 2000; Riley, 2004). Hatha yoga seeks to develop calmness and balance within practitioners in order to facilitate innate psychological, physiological, and spiritual healing processes (Valente & Marotta, 2005). A Bikram-style hot yoga practice utilizes a standardized set of yoga postures and breathing exercises, which are performed in front of mirrors in a heated and humidified studio.

Symptoms of Posttraumatic Stress Disorder (PTSD) and depression comprised the dependent variables in this study. According to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR), the characteristic feature of Posttraumatic Stress Disorder is the development of persistent symptoms following exposure to a traumatic event (American Psychiatric Association [APA], 2000). PTSD is categorized as an Axis I anxiety disorder and its symptoms are divided into three distinct symptom clusters: reexperiencing, avoidant, and arousal symptoms. Examples of reexperiencing or intrusive symptoms include recurrent memories of the trauma, nightmares, hallucinations, and "flashbacks" to the event. Flashbacks are defined as dissociative states during which the person relives the traumatic event and "behaves as though experiencing the event at that moment" (APA, 2000, p. 464). Traumatized individuals may also react with significant psychological or physiological distress to certain "triggers" -- occurrences that remind them of the traumatic event (APA, 2000). For instance, a soldier may fearfully "duck and cover" at the sound of a car backfire. Avoidant PTSD symptoms include detachment from loved ones, amnesia, and deliberate efforts to avoid thoughts or feelings about the trauma. Arousal symptoms include insomnia, irritability, anger, hypervigilance, exaggerated startle response, and difficulty concentrating (APA, 2000).

A clinical diagnosis of PTSD requires first establishing that an individual has been exposed to a threatening event that caused them "intense fear, helplessness, or horror" (APA, 2000, p. 467). Thus, PTSD is the only psychiatric disorder for which there is a specified causal element (trauma event) as part of the diagnostic criteria (Mello et al., 2009). Furthermore, the nature of the trauma (direct or indirect; personal or

random) is known to affect symptom development and treatment response (Telles, Singh, Joshi, & Balkrishha, 2010). The *DSM-IV-TR* identifies a number of traumatic stressors, many of which are experienced by military service members, including combat, sexual assault, incarceration as a prisoner of war, witnessing violent death, and viewing dead bodies or body parts. Although not specifically mentioned by the *DSM-IV-TR*, killing another human being is also a traumatic experience and a significant predictor among military personnel for developing PTSD (Maguen, et al., 2009). A PTSD clinical diagnosis also mandates that symptoms endure for at least one month and cause significant distress or functional impairment (APA, 2000). If PTSD symptoms resolve within three months, the diagnosis is specified as acute; otherwise it is considered chronic.

The current research project concentrates on military-related PTSD. PTSD symptoms associated with stressful military experiences were assessed; however, a clinical PTSD diagnosis was not required for study participation. PTSD symptoms were measured using the Posttraumatic Stress Disorder Checklist – Military Version (PCL-M).

PTSD is a complex disorder, and as such is frequently co-morbid with other psychiatric disorders particularly substance use, anxiety, and major depression (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). For this reason, depressive symptoms comprise a secondary dependent variable assessed in this study. The *DSM-IV-TR* classifies depression as an Axis I mood disorder and defines several forms of depression including major depression, dysthymia, postpartum onset and seasonal pattern depression. Depression occurs on a wide-ranging continuum; symptoms can be mild to

severe, be episodic or chronic, appear only once in an individual's life or recur frequently, and resolve quickly or persist despite treatment (APA, 2000). Depressive symptoms include appetite changes, sleep disturbances, lack of interest in pleasurable activities, fatigue, poor concentration, and changes in mood such as increased sadness, anxiety, irritability, and feelings of hopelessness (APA, 2000). Most people will experience at least a few depressive symptoms during the course of their lifetime; clinical depression is diagnosed when *DSM-IV-TR* criteria, including the presence and persistence of specific depressive symptoms, are met. This study evaluated symptoms of depression, but did not require a clinical diagnosis for participation. Depressive symptoms were measured by the Inventory of Depressive Symptomatology – Self Report (IDS-SR_{30}).

Along with PTSD and depressive symptoms measures, a traumatic brain injury screen (TBI) screen and demographics questionnaire were included in the survey. A TBI screen assessed probable TBI history, and was included due to the high rate of TBI among military service members deployed to Iraq or Afghanistan (Okie, 2005; Okie, 2006) and the frequent co-morbidity of TBI and military-related PTSD (Carlson et al., 2010).

Active duty, reserves, or retired U.S. military service members comprised the study sample. The experimental group included military personnel who have tried Bikram-style hot yoga. Potential experimental group participants were contacted via Bikram yoga studios located throughout the United States. The control group included military personnel who do not practice yoga or meditation. The control group was recruited through Qualtrics.com, an online research company specializing in data

collection. A military population was selected for evaluation because prior research suggests that they may benefit from practicing hot yoga and because there is a need for research regarding effective PTSD and depression treatments specific to this population (Adamson et al., 2008; Sher & Yehuda, 2011). Although research regarding the effect of yoga practices on PTSD and depression is limited, existing literature indicates that yoga could be a promising treatment for both conditions, either separately or when co-morbid. Several studies have reported positive effects of yoga practices on PTSD symptoms in survivors of natural disasters (Descilo et al., 2010; Telles, Naveen, & Dash, 2007; Telles, et al., 2010) in civilians traumatized by war (Gordon, Staples, Blyta, Bytyqu, & Wilson, 2008) and in military personnel (Stoller, Gruel, Cimini, Fowler, & Koomar, 2012; Telles, Bhardwaj, Kumar, Kuman, & Balkrishna, 2012). Additionally, a number of yoga studies have found positive effects on depressive symptoms (Mehta, & Sharma, 2010; Pilkington, Kirkwood, Rampes, & Richardson, 2005), including two studies that reported a reduction of depressive symptomatology among veterans (Carter, & Byrne, n.d.; Groessel, Weingart, Johnson, & Baxi 2012). Although other yoga styles have been studied extensively, only one unpublished study has examined the mental health benefits of hot yoga (Mueller, Forward, & Tillery, 2010). In addition, much of the earlier yoga research has been hampered by poor methodological design, such as the lack of a standardized yoga protocol (Arpita, 1990). The current study seeks to address that limitation by incorporating an independent variable, Bikram-style hot yoga, which employs a comparatively uniform and consistent procedure.

Accordingly, the current research project hypothesized that:

Hypothesis 1: Study participants with exposure to hot yoga will report fewer PTSD and fewer depressive symptoms than controls.

Hypothesis 2: Scores on the PCL-M will be negatively correlated with duration and frequency of hot yoga practice.

Hypothesis 3: Scores on the IDS-SR_{30} will be negatively correlated with duration and frequency of hot yoga practice.

The goal of this research was to evaluate the presumed mental health benefits for military personnel who have chosen to practice hot yoga as a self-care strategy. For various reasons, many military service members are not receiving formal treatment for PTSD or depression (Seal et al., 2010) and therefore might be willing to engage in a self-care health strategy, especially if it is effective. The current research project sought to determine if hot yoga has an effect on PTSD and depressive symptoms and whether correlations exist between reduced PTSD and depressive symptoms and the practice of hot yoga.

Background

According to U. S. Department of Defense (DOD) statistics, more than two million U.S. military personnel have been deployed to Iraq (Operation Iraqi Freedom [OIF] or Operation New Dawn [OND]) or Afghanistan (Operation Enduring Freedom [OEF]) since the launch of the Global War on Terror (GWOT) in October 2001 (as cited by Veterans for Common Sense, 2010). An increasing amount of evidence suggests that a mental health crisis is developing within the OIF/OND/OEF military service member

cohort (Adamson et al., 2008; Seal, et al., 2010; Sher et al., 2011). Although all warfare is stressful, there are several factors unique to the present GWOT that are converging to create a "perfect storm" for psychological distress among U.S. soldiers.

First, the GWOT has endured for more than 11 years, the longest period of prolonged conflict since the Vietnam War, nevertheless, the U.S. military remains an all-volunteer force (Adamson et al., 2008). In contrast, from 1964 to 1975 when mandatory conscription was in place it is estimated that up to 4.4 million service personnel were deployed to Vietnam or the surrounding areas (Koenen, Stellman, Sommer, Jr., & Stellman (2008). Thus, during the Vietnam War nearly twice as many service members were available for combat duties. The current lack of substantial numbers of new recruits has resulted in longer deployments (typically 12 to 15 months), multiple deployments, and shortened time periods (usually one year or less) between subsequent deployments.(Adamson et al., 2008; Zoroya, 2008). Citing DOD documents obtained through the Freedom of Information Act, the veterans' advocacy group, Veterans for Common Sense, reports that, as of April 2010, more than 800,000 military service members (or approximately 40% of total personnel deployed) have been deployed at least twice. Nearly 14,000 soldiers have spent three to four cumulative years in combat (Veterans for Common Sense, 2010).

Ironically, record low fatality rates are another factor contributing to the increasing number of mental health injuries experienced by U.S. troops in Iraq and Afghanistan. Compared to lethality rates ranging from 24% to 30% during World War II, Korea, Vietnam, and the Persian Gulf wars, only 10% of wounded OIF/OND/OEF soldiers succumb to war-related injuries (Gawande, 2004). Kevlar helmets, improved

body armor and advances in combat medicine, including the development of surgical "Fast Teams " (mobile units that travel to combat zones and are capable of setting up a complete field hospital in less an hour), have resulted in soldiers surviving battle events and injuries that in prior wars would likely have proved fatal (Hundley, 2004). Unfortunately, the now survivable injuries, inflicted by devastating modern weaponry, are also frequently far more severe and traumatic than in the past (Hundley, 2004).

Likewise, the use of Kevlar helmets has resulted in high survivability rates for soldiers exposed to blasts, but it has also resulted in a rate of traumatic brain injury (TBI) among OIF/OND/OEF soldiers that is unprecedented compared to previous wars (Okie, 2005). In fact, traumatic brain injury is now regularly referred to as a "signature wound" for U.S. soldiers deployed to Iraq and Afghanistan (Robertson, 2006; Williams, & Mulhall, 2009). The Brain Injury Association of America defines TBI as "an alteration in brain function, or other evidence of brain pathology, caused by an external force." (Brain Injury Association, 2011, p. 1). According to a study performed at Walter Reed Army Medical Center between January 2003 and February 2005, 59% of blast-exposed patients were found to have a traumatic brain injury (Okie, 2006); of those diagnosed with TBI, 56 percent of the injuries were deemed moderate or severe and 44 percent were assessed as mild (Okie, 2005). Furthermore, although mild TBIs may not result in catastrophic neurological injuries, their enduring psychiatric effects can be devastating for soldiers and their families (Prigatano, 1992). A recent study by the Rand Corporation estimated that 19% of all OIF/OND/OEF service members have experienced a TBI (Adamson et al., 2008); currently that would mean roughly 400,000 soldiers have a probable TBI.

Relevance to Clinical Forensic Psychology

It is not surprising that multiple studies indicate high prevalence rates for both PTSD and depression among military populations (Adamson et al., 2008; Carlson, et al., 2010; Koenen et al., 2008). In a review of the existing literature Adamson et al. (2008) found an estimated PTSD prevalence rate ranging from 5% to 15% among OIF/OND/OEF service members; their own research found a PTSD prevalence rate of 14%. Among Vietnam veterans, Kulka et al. (1990) found 30.9% lifetime PTSD prevalence rate and 30 years after the end of the Vietnam War, Koenen et al. (2008) found a current PTSD prevalence rate of 10%, suggesting the potential for long-term chronicity in military-related PTSD. Although in their own research Adamson et al. (2008) found a 14% depression prevalence rate, a literature review produced depression rates ranging from 2% to 10%, which led the researchers to conclude that among OIF/OND/OEF service members PTSD is somewhat more prevalent than depression. Furthermore, Carlson et al. (2010) conducted a study examining the comorbidity between TBI and psychiatric diagnoses. The researchers reviewed the administrative records for 13,201 veterans who received care at Department of Veterans Affairs (VA) facilities and found that of those who screened positive for a TBI and who also had a confirmed TBI diagnosis (n = 836), more than 85% were found to have at least one psychiatric diagnosis and 64% had two or more psychiatric diagnoses. The most common diagnoses were PTSD (63.9%) and depression (46.3%). Among veterans who screened positive for TBI, but who did not have a confirmed TBI diagnosis (n = 1,443), nearly 80% had at least one psychiatric diagnosis and 55% had two or more psychiatric

diagnoses; again, the most common diagnoses were PTSD (60.8%) and depression (42.9%). Veterans who screened negative for TBI (n = 10,992) were also found to have substantial mental health problems: 40% had at least one psychiatric diagnosis and 23.7% had two or more psychiatric diagnoses; once again, the most common diagnoses were PTSD (18.4%) and depression (21.7%). Nonetheless, veterans with positive TBI screens were three times more likely to have PTSD and twice as likely to have depression compared to veterans with negative TBI screens. These results suggest that the estimated 400,000 soldiers with probable TBI are also highly likely to have concomitant or secondary psychiatric illnesses.

Despite alarmingly high prevalence rates, a recent study indicates that less than 10% of Iraq and Afghanistan veterans newly diagnosed with PTSD receive the course of treatment recommended by the VA health services (Seal, et al., 2010). Additionally, recent research suggests that pharmacological medications commonly prescribed to military personnel to treat PTSD and depression may be largely ineffective (Friedman, Marmar, Baker, Sikes, & Farfel, 2007; Krystal et al., 2011). The standard pharmacological treatment for military-related PTSD is to first prescribe anti-depressants and if PTSD symptoms persist, the second course of treatment is the addition of anti-psychotic medications (Krystal, et al., 2011). Friedman et al. (2007) examined the effects of a 12-week program of the anti-depressant Sertraline, a selective serotonin reuptake inhibitor (SSRI), in a sample of 169 veteran outpatients with diagnosed PTSD. The researchers found no significant differences between Sertraline and placebo for PTSD, depression, or anxiety symptom reduction. The vast majority (89%) of VA PTSD patients treated with drug therapy are prescribed SSRIs

(Mohammed, & Rosenheck, 2008). Moreover, Krystal et al. (2011) examined the efficacy of a six-month adjunctive treatment of PTSD with the second-generation antipsychotic (SGA) Risperidone. Study participants were military veterans who met the criteria for service-related PTSD and who had previously not responded to treatment with SSRIs and other antidepressants. The researchers found that Risperidone was no more effective than placebo in reducing PTSD, depression, anxiety, or in improving quality of life. Nearly 20% of VA-treated veterans with PTSD are prescribed second-generation antipsychotics, like Risperidone, despite the fact that SGAs are not FDA-approved for the treatment of PTSD (Krystal et al., 2011).

Emergent consequences of untreated or poorly treated PTSD and depression among U.S. veterans are particularly relevant to clinical forensic psychology. A recent report published by the U.S. Army found that from 2008 through 2011, in addition to record levels of alcohol abuse, sex crimes within the Army increased 32%, domestic abuse increased 50% and child abuse increased 62% (Department of the Army, 2012). The researchers noted that greater reporting might account for a portion of this escalation; nevertheless, the study results indicate that criminal activity within the Armed Forces has been rising. In addition, noteworthy anecdotal evidence indicates that an increasing number of current and former military service members are becoming involved with the criminal justice system via the commission of crimes (Department of the Army, 2009; Levin, 2008; Marek, 2008; Riley, & Roeder, 2009; Smith, 2009; U.S. Senate, 2010). In 2009, the U.S. Army conducted an epidemiological study following a dramatic increase in violent crimes involving soldiers from Fort Carson, Colorado (Department of the Army, 2009; Smith, 2009). Although researchers noted that they

were unable to compare the violent crime rate of the Fort Carson combat unit to other combat units because "criminal data was not available," the researchers nevertheless reported that since 2003 violent crime arrest rates have increased throughout the Army (Department of the Army, 2009, p.ES-2). Additional anecdotal evidence of increasing military-initiated crime includes the recent establishment of "veterans' courts" throughout the United States (Levin, 2008; Marek, 2008; Riley, et al., 2009). Judges in several states have created veterans' courts in response to the more frequent appearance of military personnel in their courtrooms (Levin, 2008; Marek, 2008). Veterans' courts are modeled after the diversionary drug courts, which allow a criminal defendant to choose treatment over incarceration (U.S. Senate, 2010). Judges presiding over veterans' courts have acknowledged that TBI and mental illnesses, such as PTSD and depression, may play a role in military-initiated crimes (Levin, 2008; Marek, 2008). Federal lawmakers have also recognized the escalating problem of veteran crime. On March 1, 2010, the Senate Judiciary's Subcommittee on Crime and Drugs convened a special hearing entitled, "Evaluating the Need for Greater Federal Resources to Establish Veterans' Courts" (U.S. Senate, 2010).

Also, of particular import to clinical forensic psychology is the epidemic of suicide among returning OIF/OND/OEF service members. On June 28, 2011, Staff Sgt. Jared Hagemann drove to a training area at Joint Base Lewis McChord in Washington State and shot himself in the head (Eldridge, 2011). Staff Sgt. Hagemann had previously deployed eight times to either Iraq or Afghanistan, and had received orders to return to Afghanistan for his ninth deployment (Eldridge, 2011). For four consecutive years (2009 - 2012), the number of military suicides has exceeded the number of combat

deaths in Iraq and Afghanistan (Donnelly, 2011; Kerns, 2013). In 2010, at least 468 active-duty or reserve personnel committed suicide (Donnelly, 2011). Moreover, approximately 20% of the over 30,000 suicides each year in the U.S. are carried out by military veterans (Hefling, 2010). Sher et al.(2011) have deemed it "a moral imperative" to find effective solutions for the mental injuries afflicting U.S. service members (p. 601). The Rand Corporation study concluded that "Addressing PTSD, depression, and TBI among those who deployed to Afghanistan and Iraq should be a national priority…more research is needed to evaluate innovate treatment methods, since not all individuals benefit from the currently available treatments" (Adamson et al., 2008, p. 451-452). Although yoga has existed for thousands of years, the application of yogic practices for the treatment of PTSD and depression nevertheless represents a novel approach in contemporary mental health care.

The above introduction establishes the purpose and the rationale for this study: the need for research regarding effective, evidence-based treatments for PTSD and depression in a military population.

Chapter 2

LITERATURE REVIEW

Complementary and Alternative Medicine

Among psychologists and other mental health professionals there is a growing appreciation of the mind-body connection and of the need for therapies that utilize this connection (Strasen, 1999). Complementary and alternative medicine (CAM) therapies have been defined as "a group of diverse medical and health care systems, practices, and products that are not generally considered part of conventional medicine" (National Center for Complementary and Alternative Medicine [NCCAM], 2013). Complementary therapies are those employed in addition to conventional or Western treatments; "alternative medicine" refers to therapies that replace traditional medicine (NCCAM, 2013). CAM therapies include natural products (e.g., nutritional supplements and herbal medicines), manipulative and body-based therapies (e.g., chiropractic treatments and therapeutic massage), energy therapies (e.g., light therapy, Reiki, and qi gong), substantially different medical systems (e.g., Ayurvedic and traditional Chinese medicine), and mind-body practices, such as meditation and yoga (NCCAM, 2013). NCCAM defines mind-body practices as treatments that "focus on the interactions among the brain, mind, body, and behavior, with the intent to use the mind to affect physical functioning and promote health" (p. 1).

Between 2002 and 2007, there was a greater than 2% increase in the use of CAM in the United States (Barnes, Bloom, & Nahin, 2008). A 2007 National Health

Interview Survey reported that approximately 38% of adults and nearly 12% of children use CAM (Barnes et al., 2008). Several studies have indicated that 22.4% - 53.6% of adults experiencing mild to severe depression use CAM (Unutzer et al., 2000; Kessler et al., 2001). Barnes et al. (2008) reported that several mind-body practices, including yoga and meditation, were among the ten most utilized CAM therapies. Since 2002, use of yoga, meditation, and deep breathing exercises significantly increased in the United States, with an estimated 18 million adult yoga practitioners (Barnes et al., 2008).

Research indicates several possible explanations for increased CAM use in the United States. First, with the rising costs of traditional health care, many patients are opting for lower-cost, alternative health care solutions (National Institute of Health, 1992). Additionally, a trend toward more active patient participation in individual health care may be driving greater interest in CAM, including self-care strategies, such as yoga (Herrick et al., 2000). Herrick et al. (2000) suggest this growing interest in self-care represents an important shift toward an internal locus of control that places more emphasis on personal responsibility for one's health. In addition, Barnes et al. (2008) found that most CAM use is complementary, suggesting that for many individuals traditional therapies are failing to completely resolve their health complaints. A 1998 nationally representative survey reported that 85% of yoga practitioners endorsed the belief that using both conventional and alternative health care therapies was superior to using either method on its own (Saper, Eisenberg, Davis, Culpepper, & Phillips, 2004). Thus, CAM may be particularly appropriate for health issues, such as PTSD and depression, which do not respond or only partially respond to conventional therapies. Finally, the significant increase of yoga use in particular may be attributable to its

overall effectiveness. Saper et al. (2004) reported that 90% of respondents indicated that yoga had been either "very helpful" or "somewhat helpful" to them. The efficacy of yoga may be enhanced by its lack of harmful side effects (e.g., worsening depression, suicidal thoughts, extrapyramidal motor symptoms, weight gain, dry mouth, nausea, diarrhea, indigestion, insomnia, sexual dysfunction) associated with pharmacological interventions commonly used to treat PTSD and depression (Krystal et al., 2011; Reeves, & Ladner, 2010; Tucker et al., 2003; Vanderkooy, Kennedy, & Bagby, 2002).

Yoga

Yoga has been variously defined and described. Valente et al. (2005) report the following definition of yoga: "a technique used to still the mental fluctuations of the mind to reach the central reality of the true self" (p. 70). Yoga has also been defined as, "an ancient form of meditation used to bring awareness and balance to one's life and to develop human physiological, psychological, and spiritual potentials" (Valente et al., p.71). The word "yoga" originated in the Sanskrit language and means to join or yoke mind, body, and spirit (Herrick et al., 2000). The Tibetan word for yoga, "*nejor*," has several meanings including, "'original' or 'authentic knowledge' or 'understanding,'" which Brown and Gerbarg (2009) refer to as the "true self," according to Western psychology (p. 55). To ancient "yogis" (practitioners of yoga), yoga was primarily a spiritual endeavor aimed at achieving self-awareness or enlightenment (Brown et al., 2009).

The history of yoga is uncertain. Stone artifacts depicting yoga postures (e.g., lotus pose, headstand) have been discovered in the Indus River valley in Southeast Asia, suggesting yoga practices originated more than 6,000 years ago (Dhyansky, 1987). The

first known written documentation of yogic philosophy is found in the *Vedas*, sacred Indian texts compiled approximately 5,000 years ago during the Vedic civilization (Feuerstein, 1999). Most modern yoga is based on the *Yoga Sutras*, a text written approximately 2,000 years ago by the Indian sage Patanjali (Herrick et al., 2000), who was heavily influenced by the earlier teachings of the *Vedas* (Frawley, n.d.). In the *Yoga Sutras*, Patanjali outlines the eight elements of a complete yoga practice: postures (physical exercises, typically involving stretching), controlled breathing (deep, diaphragmatic, and rhythmic), meditation, concentration, sensory withdrawal, moral restrictions (e.g., nonviolence, ethical behavior, and sexual restraint), moral observances (e.g., contentment, discipline, and devotion), and self-actualization (Herrick et al., 2000).

According to De Michelis, the introduction of yoga to the Western world is generally attributed to the Hindu yogi Swami Vivekananda, who in 1893 gave a presentation on yogic philosophy and practices at the World's Parliament of Religions held in conjunction with the World's Fair in Chicago (as cited in Nagarajan, 2005). As practiced today in the United States, most yoga does not retain the spiritual elements outlined in the *Yoga Sutras*. Instead, Western yoga programs typically focus on postures and breathing with some attention given to concentration and meditative components. The practice of Bikram-style hot yoga involves postures, controlled breathing, concentration, and meditation.

Yoga postures or "*asanas*" were designed to improve the health of the spine and the functioning of internal organs (O'Neill, 2007). *Asanas* stretch and massage all parts of the body, including internal organs, and thus improve the functioning of the muscular,

digestive, endocrine, respiratory, central nervous, reproductive, urinary and autonomic nervous systems (Arpita, 1990). Additionally, combining deep breathing with stretching releases tension, increases oxygen levels and speeds up the flow of blood throughout the body, including the brain (Peck, Kehle, Bray, and Theodore, 2005).

Performing yoga postures followed by focused relaxation has been found to effect the autonomic nervous system (ANS) by deactivating the sympathetic division of the ANS and stimulating the parasympathetic division and thus providing a sense of calm, emotional balance, tranquility, and increased concentration (Sarang, & Telles, 2006). Examples of yoga postures include balanced standing, forward and backward bends, and spine twists (Riley, 2004). Many yoga sessions begin and end with the S*avasana* pose, which translates as "corpse" or "dead body" pose (Choudhury, 2000). *Savasana* is a pose of total relaxation wherein yoga practitioners lay flat on their backs with their arms at their sides and attempt to achieve absolute stillness of mind and body. There are approximately 2,000 yoga postures, but research has demonstrated that substantial benefit can result from practicing just 20 postures (Herrick et al., 2000).

Known as "*pranayama*," yogic breathing is a fundamental component of both traditional and modern yoga practices (Brown et al., 2009). As a stand-alone treatment, *pranayama*, which in Sanskrit means "control or expansion of the life force energy," has been shown to provide both physiological and psychological benefits (Brown et al., 2009, p. 55; Sarang et al., 2006). For instance, holding one's breath after inhalation increases energy, while holding one's breath following exhalation can have a calming effect on emotions (Herrick et al., 2000). Yogic and Buddhist philosophies instruct that merely by controlling one's breath, a person can control their mind, and thus affect their

emotions and the physical health of their body (Brown et al, 2009). According to Brown and Gerbarg (2005), yogic breathing techniques have "the potential to relieve anxiety, depression, post-traumatic stress disorder, chronic pain and many stress-related medical illnesses" (p. 189). Breathing is primarily controlled through a reciprocal relationship between the brain and the autonomic nervous system and is thus both a voluntary and involuntary body function. Voluntarily manipulating one's breath can adjust imbalances in the body's stress response system, improving brain health and emotional regulation (Brown et al, 2009). Improving self-regulation of emotions is an important factor in healing PTSD (Emerson, Sharma, Chaudhry, & Turner, 2009). There are a number of yogic breathing techniques, including abdominal breathing, alternate nostril breathing, breathing against airway resistance, and breath holding (Brown et al, 2005).

Other yogic elements include concentration or "*Dharana,*" which is defined as maintaining a single point of awareness over time (Herrick et al, 2000.). The meditative component of yoga ("*Dhyama*") represents progressively deeper concentration and serves to calm the mind and improve focus and awareness (Riley, 2004).

There are several different styles of yoga currently practiced in the United States. Most of these styles derive from the Hatha tradition of yoga and include postures, breathing, concentration, and meditative techniques (Riley, 2004). Iyengar yoga is known for its use of props such as blocks, belts, and chairs, and is well suited for individuals with definite physical limitations (Riley, 2004; Shapiro & Cline, 2004). The Iyengar style places an emphasis on precise technical alignment of postures, with each posture held statically for several minutes. In contrast, Ashtanga yoga, often called "flow yoga" requires practitioners to quickly and fluidly move in and out of a

standardized series of postures (Herrick et al., 2000). Kundalini yoga focuses much attention on breath work and its postures are designed to affect various energy zones ("*chakras*") located up and down the spinal column (Arpita, 1990). Bikram-style hot yoga involves a series of 26 postures including 2 breathing exercises, which are performed in a heated and humidified yoga studio (Choudhury, 2000).

Despite yoga's growing popularity as an alternative health care therapy, very little Western scientific research has been performed to test its efficacy and benefits (Saper et al., 2004). Saper et al. reported that a Medline search for articles published between 1975 and 2002 produced only 43 randomized controlled studies of yoga. This compares to over 400 studies concerning acupuncture conducted during a similar time frame. However, since 2005 there has been a significant increase in the number of published yoga studies (Mehta et al., 2010). Historically, most yoga research has been carried out in India (Derezotes, 2000), although the number of yoga studies carried out in the United States is increasing (Mehta et al., 2010). Notably, most yoga research in the United States has been conducted by graduate students to fulfill masters thesis or doctoral dissertation requirements (Arpita, 1990). Much of the earlier yoga research focused on yoga's physiological effects; whereas, current research trends suggest a developing interest in testing yoga's effect on mental processes (Mehta et al., 2010).

Most yoga research has involved short-term (three weeks to six months) interventions and has employed small sample sizes, thus limiting generalizability (Saper et al., 2004). This may be due to the fact that, at least in the United States, much of the yoga research has been carried out by graduate students. Furthermore, evaluating yoga research can prove difficult in part due to a lack of uniformity in defining the yoga

treatment (Arpita, 1990). For example, some researchers have employed yoga interventions that include postures, breathing, and meditative components, while others test for effects achieved from a single yoga element, such as postures or breathing alone. Additionally, most yoga styles lack a standard protocol. Selection and order of yoga postures can vary from class to class, as can the competence and teaching methods of instructors, even within the same yoga style.

Military-Related Posttraumatic Stress Disorder

As previously noted, Posttraumatic Stress Disorder (PTSD) is an anxiety disorder, which develops as an intense reaction to a traumatic event and is defined by three hallmark constellations of symptoms: persistent reexperiencing of the trauma through recurrent and intrusive recollections or nightmares, persistent avoidance of associations with the trauma, and persistent symptoms of hyperarousal (APA, 2000). PTSD was first formally recognized as a clinical diagnosis in 1980 when it appeared in the Diagnostic and Statistical Manual of Mental Disorders, Third Edition (DSM-III) (Scurfield, & Wilson, 2003). *DSM-III* criteria were clustered according to three symptom domains (e.g., reexperiencing, numbing, and other) and required at least one reexperiencing symptom, at least one numbing symptom, and two miscellaneous symptoms to confirm a PTSD diagnosis (Skodol et al., 1996). Current research regarding the PTSD construct has proposed the removal of all numbing and dysphoric symptoms from the next version of the DSM due to the potential for this group of symptoms to overlap with affective disorders and confound diagnosis (Gros, Simms, & Acierno, 2010). Although PTSD diagnostic criteria are the same for both civilian and

military populations, the experience and expression of the disorder can vary greatly between groups (Stewart, & Wrobel, 2009) and therefore, the remainder of this literature review will focus on research regarding military- or combat-related PTSD.

Combat and Operational Stress Reaction (COSR), a stress response similar to PTSD, is a mental health condition exclusively identified within military populations (Department of the Army, 2009). COSR is defined as a maladaptive reaction or behavior, resulting from exposure to combat or operational stressors, that leaves a soldier temporarily unfit for military duty (Adamson et al., 2008). Operational stressors are defined as situations associated with residing in a war zone (Department of the Army, 2009). Examples of common operational stressors include hostile environmental conditions, such as extreme heat or cold and prolonged separation from friends and family (Department of the Army, 2009). COSR responses range from mild to severe and include freezing under fire, uncontrollable shaking, nightmares, "*thousand-yard stare*," indifference to danger, vomiting, crying easily and duty-related misconduct, such as disobeying orders or perpetrating criminal violations of the Uniform Code of Military Justice (Department of the Army, 2009, p.1-7). Although COSR has symptoms in common with PTSD, it is not a clinical diagnosis. COSR is further distinguishable from PTSD in that COSR symptoms are temporary and typically do not require conventional mental health treatment (Adamson et al., 2008). However, if COSR responses become severe, prolonged and are unattended by a soldier's military superiors, there is a risk that COSR will develop into PTSD (Department of the Army, 2009).

Throughout the recorded history of warfare there have been reports of soldiers suffering psychological injuries as a result of their combat experiences (Gabriel, 2002).

In the late 17th century, the first formal clinical diagnosis of such injuries was termed "nostalgia" or "the Swiss disease" due to the numbers of young Swiss soldiers afflicted with the illness after being forcibly conscripted into foreign armies (Jones, Sparacino, Wilcox, Rothberg, & Stokes, 1995). Military doctors from other countries began identifying a similar condition among their troops; German physicians called this combat response *heimweh* (homesickness), the French referred to it as *maladie du pays* (also meaning homesickness) and the Spanish called it *estar roto* ("to be broken") (Bentley, 2005, p. 2). Symptoms of nostalgia included "melancholy, incessant thinking of home, disturbed sleep or insomnia, weakness, loss of appetite, anxiety, cardiac palpitations [also called 'soldier's heart' or 'exhausted heart'], stupor and fever" (Bentley, 2005, p. 2).

Nostalgia, which was considered an organic disorder, was first recognized in significant numbers in the United States during the Civil War, primarily among the youngest soldiers (Jones et al., 1995). Soldiers with nostalgia were considered cowards and rather than receive treatment, many were just summarily discharged (Bentley, 2005; Jones et al., 1995). As noted by Bentley (2005), "They were put on trains with no supervision, the name of their home town or state pinned to their tunics, others were left to wander about the countryside until they died from exposure or starvation" (p.3). Yet this response represented progress compared to how military commanders had historically dealt with soldiers suffering from PTSD-like conditions. In Roman times, if combat units displayed indications of emotional trauma, they were "decimated," which referred to the practice of killing every tenth soldier as punishment for unit weakness (Dugdale-Pointon, 2005). Military physicians of the Civil War era believed that the best

way to deal with conditions such as nostalgia, was too screen out psychiatrically unfit soldiers prior to battle, thereby preventing mental casualties before they happened (Bentley, 2005).

During WWI combat stress was referred to as "shell shock," primarily due to the trench warfare that subjected soldiers to repeated artillery barrages (Jones et al., 1995). "Shell-shock" soldiers presented with classic combat stress symptoms, including traumatic dreams, exaggerated startle response, irritability, trembling or stupor (Birmes, et al. 2003). "Shell shock" was considered a psychological injury with a physiological basis (Bentley, 2005); military psychiatrists theorized that a soldier's emotional collapse was the result of the concussive effects of numerous blasts that literally shook a soldier's brain at a cellular level (Jones et al., 1995). However, this theory was rejected when it was shown that many soldiers who were never exposed to blasts were also breaking down (Bentley, 2005; Jones et al., 1995). Many psychiatrists came to believe it was fear that caused "shell shock" symptoms, not a physical injury to the nervous system (Bentley, 2005). By whatever mechanism, at the end of the war, "shell shock" casualties (159,000) outnumbered deaths (116,516) (Bentley, 2005).

At the start of WWII, military psychiatrists, as they had done during the Civil War, recommended screening out men predisposed to succumb to battle stress (Jones et al., 1995); approximately 1.6 million potential inductees were rejected for military service for mental unfitness (Jones et al., 1995). Despite these preventative measures, following four years of brutal combat, in the Army alone, 504,000 soldiers were discharged for psychiatric reasons (Shephard, 2003). A study carried out during the war reported finding no difference in the number of bravery medals received by combat

soldiers with mental health discharges compared to wounded soldiers (Jones et al., 1995). This prompted military psychiatrists to investigate reasons other than inherent weakness or constitutional deficiencies to explain the high rates (37.5%) of "war neurosis" among combat soldiers (Bentley, 2005). Research during this era concentrated on social factors, such as unit cohesion and morale, military leadership, and family and community support (Shephard, 2003). Gradually, the focus began to shift away from individual psychopathology and toward social and environment factors influencing behavior; by the end of the war, the condition's new name was "combat exhaustion" or "battle fatigue" (Bentley, 2005). According to Jones et al. (1995), the most important lesson learned during WWII was the importance of combat unit cohesion in preventing battle fatigue.

The Vietnam War presented military psychiatry with new challenges: an unpopular war, the lack of unit cohesion due to regular rotations out of one's unit, and substantial alcohol and drug (primarily marijuana, heroin, and hallucinogens) use and abuse among soldiers including combat soldiers (Jones, et al., 1995). Soldiers self-medicated their psychological injuries and "drug dependence" was frequently the primary psychiatric diagnosis (Jones et al., 1995). Although the Vietnam War veteran cohort is associated with high rates of lifetime occurrences of PTSD (Kulka et al. 1990), during the course of the war, rates of combat fatigue were unexpectedly low (Jones et al., 1995). The Vietnam War represents the first contemporary war wherein the rates of psychiatric casualties did not coincide with levels of combat intensity, but rather escalated following the end of the war (Jones et al., 1995). Increased rates of PTSD in Vietnam War veterans over the passage of time may have been a function of the *DSM*-

III's recognition of PTSD as an official clinical diagnosis in 1980. However, this observation of delayed-onset PTSD and increases in severity of symptoms years after combat has been reported in recent literature regarding Operation Desert Storm reservists who deployed to the Persian Gulf (Southwick et al., 1995) and severely injured soldiers wounded in combat in Iraq or Afghanistan (Grieger, 2006). Moreover, current research indicates that most cases of military-related PTSD are long-term chronic, in part evidenced by the numbers of Vietnam War era veterans still receiving treatment decades after their trauma exposure (Friedman et al., 2007).

Researchers have identified a number of risk factors associated with developing military-related PTSD. Demographic factors linked to higher rates of PTSD among soldiers include young age, less education, lower military rank, and being unmarried (Grieger; 2006; Iversen et al. 2008). War-related PTSD risk factors include length of deployment, combat exposure, experience as a prisoner of war, battle injuries and unit cohesion (Armistead,-Jehle, Johnston, Wade, & Ecklund, 2011; Dikel, Engdahl, & Eberly, 2005; Koren, Norman, Cohen, Berman, & Klein, 2005). Not surprisingly, intensity of combat exposure is one of the most consistent predictors of PTSD (Armistead,-Jehle et al., 2011). Multiple studies have found a positive relationship between both the number and the severity of combat experiences and the prevalence and severity of PTSD symptoms (Armistead,-Jehle et al., 2011; Hoge, et al., 2004; Miller, Wolf, Martin, Kaloupek, & Keane, 2008; Southwick et al., 1995).

As mentioned in the introduction, between 2005 and 2008 a spate of violent crimes, including homicides, rapes, domestic violence assaults, shootings, stabbings, and kidnappings committed by soldiers stationed at Fort Carson, Colorado drew the attention

of the U.S. Army (Garamone, 2009; Smith, 2009). Fort Carson's commander, Army Major General Mark A. Graham, commissioned a task force to uncover possible risk factors associated with the violent crimes (Garamone, 2009). A majority of the crimes were perpetrated by soldiers from a single combat brigade (nicknamed the "Lethal Warriors"), which deployed multiple times to Iraq and had a unit casualty rate at least double the rate of units similar in size (Riley et al., 2009; Smith, 2009). The Army researchers carried out a detailed examination of each of the homicides, surveyed 2,700 soldiers, including members of the unit in question, conducted focus groups with 400 soldiers, and performed a comparison study of other combat units involving an additional 20,000 soldiers (Department of the Army, 2009). With regard to soldiers implicated in homicides or attempted homicides, the Army researchers found that prior to their crimes, 10 of the 14 (71%) had been diagnosed with a mental disorder or mental injury, including 6 (43%) diagnosed with either PTSD, Anxiety Disorder (unspecified) or Acute Stress Reaction, 5 (36%) diagnosed with Affective Disorder (depression), and 4 (29%) diagnosed with TBI or TBI symptoms; 9 (64%) of the soldiers had been prescribed psychotropic medication, including 8 (57%) who were prescribed antidepressants. The researchers interviewed 9 of the homicide defendants and 5 indicated they had witnessed "unethical conduct" in Iraq and that this contributed to their psychological difficulties upon returning to the United States (p. B-6). Most of the men also reported feeling "unsafe" unless they had a weapon on their person (p. B-6). In evaluating the "Lethal Warriors (LW)" combat brigade as a whole, researchers found that soldiers from that unit had significantly more post-deployment mental health diagnoses, including significantly more PTSD, acute stress, anxiety disorders (other than

PTSD), mood disorders, substance-related disorders, and TBI when compared to other combat brigades. Additionally, soldiers within the LW unit who were involved in moderate or high intensity combat situations were significantly more likely to engage in aggressive behavior, abuse alcohol and self-report mental health problems. Soldiers involved in high intensity combat were also significantly more likely to commit crimes, including acts of domestic violence. The Army researchers concluded that a possible link exists between degree of combat intensity, which was measured by death rates, post-deployment mental disorder rates and "negative behavioral outcomes" (p. E-3).

One of the most frequently researched protective factors is the role of social support in mitigating the development of military-related PTSD (Jelusic et al., 2010). Poor social support, pre-and post-combat, has been associated with greater risk for developing PTSD (Iversen et al., 2008); whereas, greater social support has been shown to moderate the effects of PTSD (Armistead,-Jehle et al., 2011). In a study involving Israeli combat soldiers, researchers found that soldiers with a documented history of Combat and Operational Stress Reaction (COSR) reported significantly less emotional support from their military superiors than soldiers without a COSR history (Solomon, Mikulincer, & Hobfoll, 1986). Likewise, Dikel et al. (2005) found that the lack of post-war social support significantly predicted more severe PTSD among 160 former WWII or Korean prisoners of war. Furthermore, in a comparison of Croatian war veterans, researchers found that veterans without PTSD reported having significantly more social support including emotional support, companionship, financial and practical assistance, and guidance than veterans receiving treatment for PTSD (Jelusic et al., 2010).

Unit cohesion offers a powerful form of social support within military organizations and is defined as "the degree to which soldiers feel committed to and supported by their military units" (Armistead,-Jehle et al., 2011, p. 81). Strong unit cohesion has been shown to have a moderating effect on the relationship between combat exposure and the development of PTSD (Armistead,-Jehle et al., 2011). Pre-deployment unit cohesion has also been a reported as protective factor against future PTSD (Brailey, Vaseterling, Proctor, Constans, & Friendman, 2007). Due to the palliative effects of social support on PTSD symptoms, Jelusic et al. (2010) recommended that PTSD treatments include components that strengthen social support systems and encourage interpersonal relationships. Of note, the group format of Bikram-style hot yoga classes wherein students perform all yoga poses in unison under the direction of yoga instructor, creates a socially supportive environment reminiscent of a cohesive military unit; it is not uncommon for hot yoga students to feel a sense of camaraderie with their fellow yogis (principal researcher's personal experience and observation).

Military-Related Posttraumatic Stress Disorder and Depression Co-morbidity

As previously noted, military-related PTSD is frequently co-morbid with other psychiatric illnesses, including depression, TBI and substance use (Adamson et al., 2008). Among military populations, PTSD comorbidity prevalence rates have been reported up to 74.7% (Marcinko et al., 2006); depression is the most commonly reported co-morbid condition (Calabrese et al., 2011; Ikin, Creamer, Sim, & McKenzie, 2010; Skodol, 1996). Approximately 50% of military personnel with PTSD have been

reported to have co-occurring depression (Calabrese et al., 2011; Ikin, et al., 2010). Research regarding co-morbid military-related PTSD-depression is relatively recent and has focused on prevalence rates, symptom severity, symptom overlap and chronology of the development of dual diagnosis.

In one early study, Skodol et al. (1996) sought to evaluate the relationship between PTSD and co-morbid psychiatric diagnoses. According to the researchers:

> Four explanations seem possible for elevated rates of other mental disorders in people with PTSD: a) pre-existing disorders constitute a vulnerability to PTSD; b) other disorders are subsequent complications of PTSD; c) the disorders co-occur because of shared risk factors; and d) comorbidity is a result of measurement artifact, i.e., the symptoms of PTSD are such that by definition, they artificially increase the chance of certain other diagnoses being made. (p.717)

Skodol et al. (1996) sampled 617 Israeli war veterans with combat experience. Of the veterans with PTSD, approximately 60% met the criteria for another mental disorder. The categories of disorders significantly associated with PTSD included major depression, "any affective disorder," substance abuse and personality disorders. Furthermore, the number of disorders attributed to each veteran significantly and positively correlated with their PTSD symptom scores (e.g. triple comorbidity was associated with more severe PTSD symptoms than dual diagnosis). Additionally, comorbidity was significantly related to veterans seeking treatment. The researchers also compared disorder rates to onset dates; they presumed that if a co-morbid disorder predated a veteran's combat experience, it could be a "predisposing vulnerability factor" for later developing PTSD (p. 720). It was also presumed that if a co-morbid disorder developed after a veteran's final combat experience, then it could be a complication of PTSD. It was further presumed that if both disorders developed at about the same time,

then they likely shared risk factors or had symptom overlap. The researchers found no disorders that had onset dates prior to combat exposure, suggesting that following trauma exposure, PTSD is the prevailing disorder. This finding is supported by Ginzburg, Ein-Dor, & Solomon (2010), who also found that PTSD predicts depression, but not the reverse. Additionally, Skodol et al. (1996) found that Major Depressive Disorder (MDD) was significantly associated with onset post combat and concurrent with PTSD development, leading the researchers to conclude that depression is either a complication that develops out of severe PTSD or the two disorders have shared vulnerabilities.

Among the questions researchers have sought to answer is how the co-morbid PTSD-depression condition affects patient outcomes relative to either condition alone. In one such study, Iken et al. (2010) surveyed 5,352 Australian Korean War veterans 50 years following the end of the war to evaluate the prevalence of co-morbid PTSD-depression, PTSD and depression symptom severity, quality of life and life satisfaction, and how war factors, such as deployment history, were associated with co-morbidity, PTSD alone or depression alone. Study participants completed self-report questionnaires, which were then grouped according to one of four conditions: veterans with neither PTSD nor depression (61.8%), veterans with co-morbid PTSD and depression (16.8%), veterans with PTSD only (15.3%), and veterans with depression only (6.2%). Of veterans with PTSD, 52% met the study criteria for co-morbid PTSD and depression. Compared to the veteran group with neither condition, the depression-only group and the co-morbid group reported significantly lower scores on all life satisfaction and quality of life measures, including impairments in physical and

psychological health, social relationships, and environmental factors such as financial resources. The PTSD-only group also reported lower life satisfaction/quality of life scores but the effect sizes were not as large as for the other groups. In addition, the co-morbid group reported significantly more severe PTSD symptoms and more severe depression symptoms than the PTSD-only group or the depression-only group. Extreme combat exposure was the only war factor that distinguished co-morbidity from the other groups. Three war factors (lower military rank, moderate heavy to heavy levels of combat exposure, and deployment prior to the ceasefire) were significantly associated with PTSD-only and co-morbid PTSD. No war factors predicted depression alone, leading the researchers to conclude that depression without PTSD in aging veteran populations may be unrelated to military trauma. The researchers further posited that given their shared predictive variables concerning trauma exposure, both PTSD alone and co-morbid PTSD-depression represent the same traumatic stress construct, with comorbidity appearing at the extreme end of the pathological continuum. The researchers concluded that, "all else being equal, lower levels of trauma exposure are likely to result in less severe, 'simpler' PTSD. Higher level trauma exposures are likely to precipitate more severe and complex psychopathological outcomes…in the current data, comorbidity is predicted by more severe levels of trauma exposure than PTSD alone, and is associated with more severe impairment" (p. 284).

In an effort to more precisely understand the relationship between the symptoms of PTSD and the symptoms of depression in a co-morbid condition, Gros et al. (2010) performed an exploratory factor analysis of a combined set of all criteria symptoms for both disorders. Participants included 149 treatment-seeking veterans who completed the

Beck Depression Inventory–II (BDI-II) and the PTSD Checklist-Military Version (PCL-M). Participants were also assessed for PTSD and depression by a clinician. Within the final research sample, 45% were diagnosed with co-morbid PTSD and MDD, 36.2% with PTSD-only, 14.1% with neither disorder, and 4.7% with MDD-only. The researchers found that a two-factor model presented as the best fit for the combined symptoms. PTSD intrusive, avoidant, and hyperarousal symptoms loaded cleanly and strongly on the PTSD factor. However, several PTSD symptoms loaded more strongly on the depression factor or failed to load on either factor, while none of the depressive symptoms loaded on the PTSD factor. PTSD symptoms consistent with dysphoria (e.g., loss of interest in things, feeling as if future will be cut short or difficulty concentrating) and numbing (e.g., feeling distant/cut off or feeling emotionally numb) were found to be more specific to depression than PTSD. Moreover, these nonspecific PTSD symptoms were significantly associated with comorbidity and more severe depression. The researchers theorized that perhaps PTSD symptoms of dysphoria and numbing do not actually represent PTSD, but are instead indicative of the symptom overlap between PTSD and MDD. Gros et al. (2010) recommend that all treatments for PTSD include methods proven effective for treating depressive symptomatology as well.

As previously cited, current research appears to be in agreement regarding the mental health injuries that predominate among soldiers deployed to wars in Iraq and Afghanistan; those injuries are PTSD, depression, and TBI (Adamson, 2008). Evidence also exists that conventional PTSD and depression therapies are failing to provide significant symptom relief for substantial numbers of military personnel (Albright, & Thyer, 2010; Alvarez et al., 2011; Friedman et al, 2007; Krystal et al. 2011).

Anecdotally included among this evidence is the U.S. Army's recent announcement of a $4 million program to fund research into complementary and alternative treatments for PTSD and depression (Shachtman, 2008); this makes the current research project not only clinically relevant, but also timely.

Yoga for Posttraumatic Stress Disorder – Prior Research

To date, a very limited number of studies have evaluated the effects of yoga on PTSD symptoms, and even fewer have explored the effects on military-related PTSD. In a non peer-reviewed study, researchers at the Justice Resource Institute's Trauma Center Yoga Program in Brookline, Massachusetts conducted a program evaluation to assess the relative effectiveness of its yoga program compared to Dialectical Behavior Therapy (DBT) (Emerson et al., 2009). Sixteen female study participants were randomly assigned to either eight weekly sessions of a 75-minute yoga class or a DBT group. Symptom changes were assessed via self-report measures of PTSD, positive and negative affect, and body awareness. Although results were not statistically significant, the researchers found that compared to the DBT group, yoga participants reported greater reductions in all PTSD symptoms, including the severity of hyperarousal symptoms, along with greater improvements in vitality and body attunement. Evaluating this study is difficult because the authors reported no data, did not specify the measures used, and provided limited information regarding the yoga and DBT interventions. Nevertheless, initial indications suggest the effectiveness of yoga for PTSD symptom reduction.

Several studies have examined the impact of yogic practices on PTSD symptoms resulting from experiencing natural disasters. Telles, et al., (2007) examined the effect of a one-week yoga intervention on PTSD-related symptoms among 47 survivors of the 2004 Indian Ocean tsunami. One month following the tsunami, researchers recruited study volunteers among a population of displaced persons living in refugee camps. Study participants self-rated the severity of their fear, anxiety, sadness, and disturbed sleep by marking visual analog scales (VAS); the left end of the scale represented a score of "0" and the right end represented a score of"10." The researchers calculated scores by measuring the distance in millimeters from the left side of the scale to the participant's marked rating. Telles et al. (2007) also recorded each participant's breath rate, heart rate, and skin resistance, as measurements of physiological distress. Assessments were administered prior to the first yoga session and again a week later. Study participants attended daily, hour-long yoga sessions, which consisted of yoga postures, controlled breathing exercises, and guided relaxation in *savasana* pose. Researchers performed paired samples *t*-tests and found statistically significant ($p < .05$) decreases in participants' fear, anxiety, sadness, disturbed sleep, and breath rates. Researchers also conducted Pearson correlation coefficient tests to assess for correlations between the self-rated distress variables (fear, anxiety, sadness, disturbed sleep) and the physiological variables (heart rate, breath rate, and skin resistance). No specific results were reported; however, the researchers noted that no significant correlations were found. Limitations of this study include the absence of a control group and the lack of a validated psychological assessment instrument, which presumably would have been difficult to administer given the circumstances of the research.

Nevertheless, the study's findings indicate that even short-term yoga interventions are capable of substantially improving symptoms of PTSD in a recently traumatized population.

As a follow-up to Telles et al. (2007), Telles et al. (2010) studied the effects of a one-week yoga program on survivors of a devastating flood in Bihar, India in 2008. Twenty-two study participants were divided into two groups: yoga intervention (n = 11) and wait list control (n = 11). Beginning one month following the flood, the yoga group participated in daily, hour-long yoga sessions for seven days. Just as Telles et al. (2007) had done before them, Telles et al. (2010) used visual analog scales (VAS) to measure fear, anxiety, sadness and disturbed sleep. In order to assess autonomic nervous system function, the researchers also recorded heart rate variability (HRV) and respiration. Measurements were taken before and after the week-long yoga program, which included yoga postures, voluntarily regulated breathing exercises, and guided relaxation in *savasana* pose. Researchers performed a repeated measures ANOVA and found no significant differences between the yoga and control groups for any of the variables; however, paired samples t-tests revealed a significant decrease in sadness (p = .042, following Bonferroni correction) within the yoga group and a significant increase in anxiety within the control group. Study limitations included the lack of a validated assessment measure; the researchers noted that they opted to use VAS because all study participants had less than seven years of education. When comparing results to the previous study involving tsunami survivors (wherein researchers found significant results for all emotional distress variables), Telles et al. (2010) suggested that their lack of significant findings could be attributed to a smaller sample size and participants in

this study had previous exposures to traumas. As noted earlier, prior research does indicate that multiple traumas can result in more persistent symptomatology (Hoge et al., 2004).

Eight months after the 2004 Indian Ocean tsunami, Descilo et al. (2010) studied the effects of a yogic breathing program alone and in combination with trauma exposure therapy on PTSD and depression among 183 tsunami survivors. Study participants were living in refugee camps, as many were too traumatized to return to their villages by the ocean. All participants were pre-screened for PTSD symptoms using the Posttraumatic Stress Disorder Checklist (PCL); individuals were included in the study if they scored above 50, a cutoff point that predicts PTSD diagnosis with a sensitivity of .82 and a specificity of .84 (Weathers, Litz, Herman, Huska, & Keane, 1993). Participants were assigned to one of three groups: yoga breath (n = 60), breath + exposure therapy (n = 60), or wait list control (n = 63). The controlled breathing intervention consisted of an eight-hour program taught over four days in two-hour increments and included four yogic breathing techniques designed to balance autonomic nervous system function. The yoga breath group was also encouraged to perform the breath techniques for 20 minutes each day on their own and attend weekly group sessions; treatment adherence was not verified. The combined treatment group was first given the yogic breath intervention and then three-five individual sessions of trauma exposure therapy lasting one-three hours each. Assessments were given at baseline, 6, 12, and 24 weeks and included the PCL, the Beck Depression Inventory (BDI), and a general health questionnaire. The researchers performed a repeated measures ANOVA and reported significant ($p < .001$) effects at each post intervention evaluation point, on PTSD,

depression and general health for both treatment groups compared to controls. There were no statistically significant differences between treatment groups; the addition of the trauma exposure therapy added only modest improvement to the effects of the yoga breath intervention alone. Study limitations included a lack of blindness between research staff and study participants, giving rise to the possibility that participants exaggerated symptom improvement in order to gratify researchers, who they likely associated with providing aid to the refugee camps. However, the significant reduction in PTSD and depression symptoms reported by the treatment groups versus the controls suggests that yogic breathing techniques, even as a stand-alone treatment, may provide considerable relief for traumatized individuals.

In one of the only yoga-based studies to focus on war-related traumatization, Gordon et al. (2008) examined the effect of a 12-session mind-body group program on PTSD symptoms in 82 high school students in Suhareka, Kosovo. Six years prior to the study, the Suhareka region was the subject of intense warfare and "collateral damage" -- one of the largest massacres of civilians took place here; 20% of students in the area lost one or both of their parents, a majority of the population was forcibly relocated and 90% of homes were destroyed. At the time of the study, in an unpublished survey Gordon (2006) found a PTSD prevalence rate of 45.1% among high school students living in Suhareka (as cited in Gordon et al., 2008). All study participants in Gordon et al. (2008) met the criteria for a PTSD diagnosis as determined by the Harvard Trauma Questionnaire (HTQ), which was also used to measure PTSD symptom reduction post intervention and at a three-month follow-up. Participants were assigned to either a wait-list control group or one of three small treatment groups with approximately 10 students

per group. Local high school teachers who received training from the U.S.-based Center for Mind-Body Medicine administered the mind-body intervention. The intervention program combined self-expression therapies (e.g., art, talk, and dance) with mind-body practices, such as meditation, controlled breathing, relaxation, and guided imagery. Unlike with trauma exposure therapy, the participants were not required to discuss their traumatic experiences; they were merely offered the opportunity to do so if they chose. The treatment group met for two hours twice a week for six weeks. Researchers performed a mixed-model repeated measures (ANOVA) and reported significantly decreased PTSD scores for the treatment group compared to controls ($p < .001$) with partial $\square^2$ of 0.282, indicating a relatively large effect size; PTSD scores remained significantly lower than baseline when assessed at the three-month follow-up. Researchers also performed a post hoc analysis to separately examine PTSD symptom clusters; significant reductions were found for all three symptoms clusters (reexperiencing, avoidance, and arousal) and decreases were maintained at follow-up. After the initial program was completed, control group participants were provided the mind-body intervention; they also showed a statistically significant reduction in PTSD symptoms. The most potentially problematic study limitation was that the teachers who administered the mind-body intervention also conducted the assessments; therefore, it is possible that students sought to please the teachers by reporting greater symptom improvement. Nonetheless, in assessing the apparent effectiveness of the mind-body treatment on PTSD, the researchers highlighted several factors, including the stress-reducing effects of the mind-body practices and the social support offered by the group program.

Few yoga studies have employed a military population, and even fewer have specifically examined PTSD; however, two recent studies examined yoga's effect on anxiety among service members. In a randomized controlled trial, Telles, et al. (2012) examined state anxiety in a group of Indian army recruits trained for combat. A group of 140 male soldiers with no prior yoga experience were randomly assigned to one of two intervention groups: yoga postures combined with regulated *pranayama* breathing ($n = 70$) or breath awareness only ($n = 70$). The intervention for the yoga group involved 15 minutes of physical postures (*asanas*) and 30 minutes of regulated breathing, including specific breathing exercises known to promote a calming effect. The breath awareness only group was tasked with sitting in a relaxed state with their eyes closed, breathing normally, and simply focusing on the air moving in and out of their nose. A group of civilian males ($n = 20$) of approximately the same age served as the control group; for their intervention, control group participants listened to meditative music. Sessions for all three groups lasted for 45 minutes. Each participant only took part in a single session. Participants were administered the State-Trait Anxiety Inventory (STAI) before and after each session. Researchers performed a factorial ANOVA, comparing pretest and posttest scores for the three groups. The yoga group demonstrated significant reductions in anxiety symptoms ($p < .001$). The control group (meditative music) also demonstrated improvements in anxiety scores; however, the results fell short of significance. Limitations of the study included the single session yoga intervention and the lack of a military control group.

In another recent study, Stoller et al. (2012) conducted a randomized controlled trial that examined the effect of a specially-designed yoga intervention on symptoms

related to combat stress (specifically, sensory processing impairment and anxiety) among military service members deployed to Iraq. The yoga treatment consisted of *pranayama* breathing, physical postures (*asanas*), meditation, final relaxation (*savasana*), inspirational readings, positive affirmations, and meditative music; each yoga class was 75 minutes long. Study participants were randomized to either treatment ($n = 35$) or control ($n = 35$) groups. The treatment group was expected to participate in at least nine yoga sessions during the three-week trial; although 10 participants failed to complete the requisite number of yoga sessions, they were included in the final data analysis. Before and after the intervention, all participants were administered the Adolescent/Adult Sensory Profile (AASP), the State-Trait Anxiety Inventory (STAI) and a "quality of life" questionnaire designed by the researchers. Pretest-posttest analysis was conducted using one-sided independent sample *t* tests. The yoga treatment group reported significantly lower state and trait anxiety scores compared to controls ($p < .001$) and statistically significant improvement for 16 of 18 quality of life variables; no significant improvement was found with regard to sensory processing. However, the researchers noted that treatment participants' pretest sensory processing scores were comparable to stateside civilians such that significant change would not be expected. Additionally, the researchers found that both male and female yoga participants demonstrated significantly less anxiety than controls. Study limitations included a skewed sample with regard to sensory processing scores and relatively small sample size. Nonetheless, both Stoller et al. (2012) and Telles et al. (2012) provide evidence for the use of yoga interventions for anxiety for both male and female military service members.

While there is paucity of research evaluating the complete constellation of PTSD symptoms, multiple studies have shown the benefits of yoga for symptoms or conditions associated with PTSD, including insomnia (Harinath et al., 2004; Khalsa, 2004; Telles et al., 2007), anxiety (Derezotes, 2000; Kirkwood, Rampes, Tuffrey, Richardson, & Pilkington, 2005; Lavey et al., 2005; Shapiro et al., 2007; Stoller et al., 2012; Streeter et al., 2010; Telles et al., 2012; Waelde, Thompson, & Thompson, 2004), anger (Berger & Owen, 1992; Derezotes, 2000; Lavey et al., 2005; Shapiro et al., 2007), substance abuse (Khalsa, Khalsa, Khalsa, & Khalsa, 2008; Raina, Chakraborty, Basit, Samarth, & Singh, 2001; Shaffer, LaSalvia, & Stein, 1997; Vedamurthachar, et al., 2006), physiological arousal (Shapiro et al., 2007; Telles et al., 2007), and concentration (Kumar, & Telles, 2009; Sharma, Das, Mondal, Goswami, & Gandhi; 2006).

Yoga for Depression – Prior Research

Virtually all published yoga research indicates that yoga is effective for treating depression; however, most studies have been encumbered by at least one methodological limitation (Pilkington, et al., 2005; Mehta, et al., 2010). To date, two systematic reviews of the literature regarding yoga's effect on depression have been performed. The first study (Pilkington, et al., 2005) reviewed the yoga literature through 2004. Pilkington et al. (2005) located 35 clinical yoga or yoga-based studies, five of which met their inclusion criteria: randomized and controlled, participants assessed for depression or diagnosed with a depressive disorder, outcome measures included depression scales, and interventions included yoga postures, not just meditation or mindfulness stress reduction exercises. All five studies reported significant positive effects on depressive symptoms.

Notably, no serious adverse effects were reported. However, the researchers were unable to determine the relative effectiveness of the various yoga interventions due to lack of standardization within and among the treatments. The researchers also noted that in two of the five prior studies, participants were all under the age of 30; Pilkington et al. expressed concern about whether or not yoga is a viable treatment for older individuals or those with physical limitations. However, a review of recent yoga literature reveals a number of studies in which yoga study participants were over 40 years old (Krishnamurthy & Telles, 2007; Taylor, Booth-LaForce, Elfen, McGrath, & Thurston, 2008; Waelde, et al., 2004), over 60 years old (Chen et al., 2008), had significant physical disabilities (Carson, et al., 2007; Oken, et al., 2004), or were elderly and disabled (Donesky-Cuenco, Nguyen, Paul, Carrieri-Kohlman, 2009; Greendale, Huang, Karlamangla, Seeger, Crawford, 2009).

A second systemic examination of yoga for depression literature was conducted by Mehta et al. who reviewed the relevant English-language literature published since the conclusion of Pilkington et al.'s study, specifically literature published between 2005 and June 2010. Mehta et al. focused their evaluation on studies that measured depression or depressive symptoms and included any style of yoga. Unlike Pilkington et al., Mehta et al. included quasi-experimental and pretest-posttest design studies whether or not they were randomized or controlled. The researchers did, however, exclude qualitative design studies. Mehta et al. located 18 studies, 17 of which reported significant positive effects of yoga on depressive symptoms. Javnbakht, Kenari, & Ghasemi (2009), the lone study to not report significantly positive findings, did report improvements in depression levels, albeit not significant (as cited in Mehta et al., 2010).

Mehta et al. identified limitations of the reviewed studies, including small sample sizes, lack of ethnic diversity among participants, and only a few studies included young participants. The researchers recommended that future yoga for depression studies employ yoga styles not yet tested.

In a relevant, but non peer-reviewed study, Carter et al. (n.d.) examined the effect of yoga as an adjunctive treatment for a group of eight male war veterans who had been in long-term psychiatric treatment. All participants had a primary diagnosis of PTSD with or without Major Depressive Disorder. All participants had depressive symptomatology and had been prescribed anti-depressant medication, specifically sertraline, an SSRI. The mean age of the veterans was 60.25; the minimum age was 53 and the maximum age was 84. Participants attended hour-long yoga sessions once a week for six weeks. The yoga intervention consisted of a specific series of poses, which was created by B.K.S. Iyengar and described in his book, *Yoga: The Path to Holistic Health.* The Iyengar yoga pose series was designed to alleviate depression symptoms and includes many back-bending postures, which prior research has associated with improving positive mood (Shapiro et al., 2004). Depression symptoms were assessed via self-report using the Center for Epidemiological Studies Depression Scale (CES-D) and clinician ratings using the Hamilton Depression Rating Scale (HAM-D). No assessments were given to test for improvement of PTSD symptoms. Although the researchers reported no specific data (only graphs with data points), they indicated that all veteran participants experienced a significant reduction in depressive symptoms. The researchers noted that two symptoms, anger and insomnia, were less affected by the depression sequence of postures. In response, the researchers ran a second the trial,

using an anger management (sedating) series of poses, along with the addition of regulated breathing (*pranayama*) and relaxation (*savasana*). Following the second trial, anger and insomnia improved, but depression did not show the same degree of improvement as during the first trial. The researchers suggested that a combination of depression-specific poses, along with a sedating sequence, could be used to treat all related symptoms. The researchers noted that they developed a series of poses to treat PTSD symptoms and their research is ongoing.

One other study was located that explored the effects of a yoga intervention on symptoms of depression among military service members. Groessel et al. (2012) examined the benefits of yoga for military veterans with chronic low back pain (CLBP). A total of 53 study participants completed outcome assessments of pain, depression, energy/fatigue and quality of life before and after a 10-week Anusara yoga program, which included 32 yoga poses that were selected for their reputed benefits for CLBP. Study participants attended on average 5.4 yoga classes during the trial; some participants also practiced at home. Repeated measures analyses of covariance (ANCOVAs) were performed to analyze the pretest and posttest scores. Among the findings reported by researchers was that compared to male veterans, female veterans had significantly greater improvements in depression scores. Study limitations included the lack of a control group and a small sample size, particularly with regard to female participants. Nonetheless, the study provides evidence for the efficacy of yoga for depression in military service members, especially female service members. Additionally, the findings of Groessel et al. (2012) suggest that mind-body interventions,

like yoga may provide additional mental health benefits as a result of improvements in physical health.

The principal researcher was unable to locate any published studies examining the mental health effects of Bikram-style hot yoga. However, in an unpublished masters thesis familiar to the current researchers, Mueller et al. (2011) found statistically significant improvements in depressive and mood symptoms following a one-month hot yoga intervention. Eleven adult participants who were new to hot yoga attended on average 16 (SD = 7.2) hot yoga classes during the month of the study. Participants completed the Inventory of Depressive Symptomatology – Self Report ($IDS\text{-}SR_{30}$) and the Positive and Negative Affects Schedule (PANAS-X) at baseline and after the intervention. The mean change in $IDS\text{-}SR_{30}$ scores was 13 (SD = 4.1), a 49% decrease from baseline. The researchers performed pre-post paired sample *t*-tests with Bonferroni correction, which yielded an α level of $p = .007$ (.05/7). Statistical significance was found for improvements in depressive symptoms, positive affect, positive emotion, serenity, and fatigue. Negative affect and negative emotion were in the direction of improvement, but were not significant. Study limitations included the lack of a control group and a small sample size. Nevertheless, the results suggest the effectiveness of hot yoga in the treatment of depressive symptoms.

Bikram-style Hot Yoga

Every Bikram-style hot yoga class follows a standard protocol. Each yoga session is 90 minutes long and employs the same 26 *asanas*, or postures, including 2 breathing exercises (Choudhury, 2000; Appendix A). The yoga poses are always

performed in the same sequence, which begins and ends with a breathing exercise. Each pose is performed twice. The initial 12 poses are performed standing; the standing series takes approximately 60 minutes to complete (Makofsky, 2011). The remaining 30 minutes consists of poses performed lying down or in a seated position (Makofsky, 2011). The recommended breathing method is through the nose with the mouth shut (Choudhury, 2000).

Bikram-style hot yoga is distinguishable from other Hatha yoga styles in several fundamental ways. First, all instructors at Bikram-affiliated yoga studios have been certified through teacher training programs designed and directed by Bikram Choudhury, the creator of Bikram hot yoga. Bikram-trained instructors memorize a monologue, which they deliver throughout the 90-minute class. The monologue includes instruction about how to achieve each posture with proper alignment. Bikram-trained instructors do not perform the poses; they lead the class by conveying the prescribed directions. It should be noted, however, that although Bikram-trained instructors are mandated to deliver the Bikram-copyrighted monologue, many instructors "go off script," paraphrasing the memorized monologue, and adding in inspirational stories or other personalizations (principal researcher's observation).

Second, Bikram-style hot yoga mandates the use of mirrors as a tool to enhance the effectiveness of the practice (Choudhury, 2007, p. 95). Bikram hot yoga studios are outfitted with full-length mirrors at the front of the room; some studios also have mirrors on the side walls. Mirrors are used so that students can see and correct mistakes in their posture alignment. Students are instructed to not look around the room at other students and to focus solely on their own yoga practice. Consequently, use of mirrors also

promotes concentration, which in turn fosters meditation. Instructors direct students to maintain eye contact with themselves as much as possible throughout the 90-minute class. Between poses, students are encouraged to remain completely still and, during the standing portion of the class, to stare straight ahead into the mirror. Of note, difficulty concentrating is a shared criterion symptom for both PTSD and depression (APA, 2000); therefore, presumably this aspect of Bikram-style hot yoga could be challenging, but also potentially beneficial for individuals with PTSD, depression, or a co-morbid condition.

The most distinguishing feature of Bikram-style yoga is the addition of heat and humidity. Bikram yoga studios are heated to a minimum of 100 degrees, with a recommended ideal temperature of 105 degrees (Choudhury, 2007, p. 74). Choudhury, a native of India, introduced heat into his yoga studios in order to mimic the ambient conditions in which he was taught yoga in his homeland (Choudhury, 2007). Choudhury analogizes performing yoga in a heated room to a blacksmith using heat to forge steel; the heat "softens' the body and thus increases flexibility (Choudhury, 2007, p. 74). Along with heat, Bikram yoga studios utilize added humidity of at least 40% to encourage continual sweating (Eisenbraun, 2011) making, ambient conditions in a Bikram yoga studio closely resemble those of a sauna.

Bikram-style hot yoga was chosen as the independent variable in the current study for several reasons. First, while other styles of yoga have been evaluated for their effects on PTSD, hot yoga is as yet untested. Secondly, hot yoga is fundamentally different from other yoga styles due to the use of heat and humidity. Thirdly, hot yoga has previously been shown to be effective at reducing depressive symptoms in an adult

population. Finally, Bikram-style yoga's standardized protocol, including relatively uniform instruction, renders it uniquely well-suited for research purposes.

Hypotheses

The purpose of this study is to assess the effects of hot yoga on PTSD and depressive symptoms in a military population. The PTSD Checklist – Military Version (PCL-M), a self-report measure, was used to evaluate PTSD symptoms. The Inventory of Depressive Symptomatology - Self-Report ($IDS\text{-}SR_{30}$) was used to measure symptoms of depression. Military service members who practice hot yoga were hypothesized to show fewer PTSD and depressive symptoms than controls. Also, a negative relationship is predicted between duration and frequency of hot yoga practice and PTSD and depressive symptoms. Specifically, the current research project hypothesized the following:

Hypothesis 1: Study participants with exposure to hot yoga will report fewer PTSD and fewer depressive symptoms than controls.

Hypothesis 2: Scores on the PCL-M will be negatively correlated with duration and frequency of hot yoga practice.

Hypothesis 3: Scores on the IDS-SR will be negatively correlated with duration and frequency of hot yoga practice.

Chapter 3

METHOD

Procedures for Analyzing Data

The current research project hypothesized that military service members who practice hot yoga will report fewer PTSD and depressive symptoms than service members who do not practice any style of yoga or meditation. Additionally, it was predicted that duration and frequency of hot yoga practice would be negatively associated with PTSD and depressive symptoms. Specific hypotheses are as follows:

Hypothesis 1: Study participants with exposure to hot yoga will report fewer PTSD and fewer depressive symptoms than controls.

Hypothesis 2: Scores on the PCL-M will be negatively correlated with duration and frequency of hot yoga practice.

Hypothesis 3: Scores on the IDS-SR will be negatively correlated with duration and frequency of hot yoga practice.

This research project used the Statistical Packages for the Social Sciences (SPSS, version 19) to analyze the data garnered from the surveys and demographic questionnaire. To assess significance within the analyzed data, alpha (α) was set at .05. Descriptive statistics were performed to compute frequencies, means, and standard deviations for demographic data. To test Hypothesis 1, a multivariate analysis of variance (MANOVA) was used to analyze mean differences between the experimental group and the control group. Recent prior literature informs that yoga may be more

beneficial for female veterans than male veterans, particularly with regard to depressive symptoms (Groessel, et al., 2012); therefore, gender was included in the analysis. With regard to Hypothesis 1, "exposure" to Bikram-style hot yoga was defined as regularly practicing hot yoga. Regular practice was operationalized as currently attending two or more yoga classes per week. To test Hypotheses 2 & 3, bivariate correlations were performed to examine the relationship between the independent variable (hot yoga) and the dependent variables (PTSD and depression) with regard to duration and frequency of hot yoga practice. Gender was included in the analysis per information from prior literature (Groessel et al., 2012). With regard to Hypotheses 2 and 3, "duration" was operationalized as the number of weeks an individual has regularly practiced hot yoga and "frequency" was operationalized as the number of times an individual practiced hot yoga in the past month.

Participants

Participants were eligible for inclusion in the study if they were active duty, reserves, or retired U.S. military personnel. Study participants who have tried Bikram-style hot yoga comprised the experimental group; study participants who have never practiced hot yoga comprised the control group. A total of 347 participants completed the survey, including 214 experimental participants and 133 controls. A total of 121 experimental participants met the "exposure" criteria (attending two or more classes per week) and were included in the analysis of Hypothesis 1. A total of 103 control group participants who did not practice any other style of yoga or meditation were included in the control sample (see Table 1). Experimental participants who provided a response

other than "0" for the frequency question ("How many times did you practice Bikram hot yoga in the past month?") and for the duration question ("How long have you regularly practiced Bikram hot yoga?") were included in the analysis for testing Hypotheses 2 and 3. A total of 137 experimental group participants met these criteria.

Outcome Measures

Four outcome measures were used in this study: Posttraumatic Stress Disorder Checklist – Military Version (PCL-M; Weathers, Huska, & Keane, 1991), Inventory of Depressive Symptomatology – Self Report ($IDS\text{-}SR_{30}$; Rush et al., 1986), Department of Veterans Affairs Traumatic Brain Injury Screening Instrument, and a demographics questionnaire. Each measure is described briefly below.

Posttraumatic Stress Disorder Checklist – Military Version (PCL-M; Weathers, Huska, & Keane, 1991)

The PCL-M is a public domain 17-item self-report assessment of PTSD symptoms (Appendix B). Completion time is approximately 5-10 minutes. The PCL-M measures the 17 PTSD symptom criteria described in the *DSM-IV-TR*. Respondents rate to what degree they have been bothered by each symptom during the previous month. Items are measured on a scale of 1 to 5 (1 = "Not at all," 2 = "A little bit," 3 = "Moderately," 4 = "Quite a bit," and 5 = "Extremely." An example of a PCL-M item that measures an arousal PTSD symptom asks the participant to rate to what extent they feel "jumpy or easily startled." The PCL-M was designed specifically for use with military personnel and includes language to evaluate trauma associated with "stressful

military experiences." A score of 50 or higher is considered positive for PTSD (Greiger, 2006).

In samples of Vietnam and Persian Gulf veterans, the PCL-M demonstrated good internal consistency, .96 and .97 respectively (Weathers, et al. 1993). Weathers et al. (1993) found a test-retest reliability of .96 over a two to three-day period for Vietnam veterans. In addition, the PCL-M has demonstrated strong convergent validity with other PTSD measures, including the Mississippi Scale for PTSD (.85 to .93) and the Impact of Events Scale (.90).

Inventory of Depressive Symptomatology – Self Report (IDS-SR$_{30}$; Rush et al., 1986)

The IDS-SR$_{30}$ is a public domain 30-item measure to assess the severity of depressive symptoms (Appendix C). Completion time is approximately 10-15 minutes. The IDS-SR$_{30}$ measures the nine criterion symptom domains required by the *DSM-IV-TR* to diagnose a major depressive episode, including sad mood, concentration, self-criticism, suicidal ideation, interest, energy/fatigue, sleep disturbance, appetite/weight gain or loss, and psychomotor agitation. The IDS-SR$_{30}$ also measures other symptoms commonly associated with depression, including irritability, anxiety, mood quality, sexual interest, bodily aches and pains, digestive problems, phobic symptoms, interpersonal rejection sensitivity, and leaden paralysis. Each item is measured on a scale from 0 to 3. An IDS-SR$_{30}$ exemplar item asks the participant to what degree they feel sad: 0 = "I do not feel sad," 1 = "I feel sad less than half the time," 2 = "I feel sad more than half the time," and 3 = "I feel sad nearly all of the time." [IDS-SR$_{30}$

depression scoring guidelines are as follows: 0-13 = none; 14-25 = mild; 26-38 = moderate; 39-48 = severe; 49-61 = very severe (Rush et al., 2003).]

The IDS-SR_{30} has demonstrated good internal consistency with a Cronbach's alpha of .92 (Trivedi et al., 2004). IDS-SR_{30} scores have been reported to highly correlate (c=.83) with patients with Major Depressive Disorder (Trivedi et al., 2004). In addition, Rush, Gullion, Basco, Jarrett, & Trivedi (1996) found high correlations between the IDS-SR_{30} and other depression measures, specifically the Hamilton Rating Scale (c=.84) and the Beck Depression Inventory (c=.93).

Department of Veterans Affairs Traumatic Brain Injury Screening Instrument (Carlson et al., 2010)

The VA TBI screen is a public domain four-item instrument to assess for traumatic brain injury (Appendix D, Section III, Questions 3-6). It takes less than five minutes to complete. The first question asks whether or not a person has been exposed to any blasts, or experienced any accidents or injuries (that could have led to a brain injury). The second question inquires about indications of a brain injury (e.g., losing consciousness, "seeing stars," not remembering the event) experienced "immediately" following the event referenced in the first question. The third and fourth questions ask about chronic and current symptoms of brain injury, including sensitivity to light, balance problems, and headaches. For purposes of this study, if a participant provided affirmative responses for each of the four questions, the participant was coded as having a probable TBI. This researcher was unable to locate any published reliability or validity data for the VA TBI screen. However, Carlson et al. (2010) note that questions

"roughly equivalent" to the VA TBI screen have been used by other researchers to assess for possible TBI among military populations (p.19).

Demographics Questionnaire

Participants completed a short demographics questionnaire to evaluate the age, gender, race, and education level of the research sample (see Appendix D). Additionally, the questionnaire provided the researcher with information regarding participants' military service, health history, including PTSD and depression, and yoga experience. The demographics questionnaire contained 36 items and completion time was less than five minutes.

Procedures for Collecting Data

All survey materials were translated into electronic format using Qualtrics survey software. To recruit experimental group participants, a link to the survey was posted on the Facebook page for Bikram Yoga headquarters, along with the Bikram Yoga website. Also, on three separate occasions a survey link was emailed to Bikram teachers and yoga studios throughout the United States. Yoga studio owners were asked to either post the survey link on their studio website or studio Facebook page, or forward the link via email to potential study participants. In addition, study announcement fliers (Appendix E) were sent to studio owners for posting in their yoga studios.

To recruit control group participants, a research panel of eligible participants was purchased from Qualtrics. Additional control group participants were located by

employing a snowball sampling method. Recruitment of experimental and control groups began on January 12, 2012 and was terminated on April 5, 2013.

The first screen of the online survey introduced participants to the study and contained the Informed Consent Agreement (Appendix F). Participants were instructed to read the Informed Consent Agreement and indicate their consent in order to proceed to the questionnaires. The order of the online survey was as follows: Demographic questionnaire Sections I, II and III including TBI screen, followed by the IDS-SR_{30}, then the PCL-M, and finally, demographic questionnaire Section IV, which contained questions regarding yoga experience. The yoga experience section was placed at the end of the survey so that the experimental group and control group took a nearly identical survey up until Section IV, the final section. If a participant answered "No" to the question "Have you ever tried Bikram-style hot yoga?" they became part of the control group and the next and final question they were shown was the question that asked if they had any additional comments.

Apart from not answering the yoga questions, the only other survey distinctions for control group participants recruited via Qualtrics was the addition of three "attention filter" questions and one military knowledge question. During a "soft launch" of the Qualtrics panel recruitment, in which data was collected from a small number of potential participants, the principal researcher, in conjunction with the Qualtrics-assigned project manager, determined that quality control checks were necessary in order to ensure the integrity of the data. It was suspected some potential participants were likely "straight-lining," or in other words, were proceeding through the survey without reading the questions and rather than providing considered responses, were

merely selecting random answers. This determination was made in part because many soft launch participants were completing the survey in an impossibly short time frame (< 5 minutes). Therefore, the decision was made to add three "attention filter" questions to the survey in order to weed out participants engaged in "straight lining" or other inattentive behavior. For example, the question "Have you been reading these instructions? Please select 'Yes'" was inserted into the survey. The attention filter questions were dispersed throughout the survey: one was placed directly following the traumatic brain injury screener, another was placed directly ahead of the IDS-SR_{30}, and the third attention filter question was included as the final question of the PCL-M (Appendix G).

A review of the demographic data following a second test launch revealed an abnormally high percentage of Qualtrics-recruited control group participants (> 40%) claiming to have been diagnosed with PTSD; the principal researcher suspected that some of these participants were feigning military service. To rectify this possible corruption of the data, a question designed to test participants' military knowledge was added to survey. The military knowledge question, "If you were on a U.S. military base and you wanted to buy a week's worth of groceries, you would shop at the: a) Mess Hall, b) VA, c) Commissary, or d) Armed Forces Food Supply" was inserted into the initial demographics section of the survey directly following the question regarding participants' education level (see Appendix G). This question was crafted such that it would be easily answered by individuals with military experience in any branch of the U.S. Armed Forces, but difficult to answer for someone without a history of military service. Due to the above-outlined quality control issues, individuals (n = 35) who

completed the survey during the first two test launches were excluded from data analysis. Only individuals (n = 100) who completed the survey after quality control checks were in place were included in the control group.

All survey instruments were self-administered by participants. A self-report methodology was employed to allow respondents to feel more comfortable about revealing private information, for example, regarding any health concerns. For purposes of this study, a self-report methodology was necessary in order to contact potential participants separated from the researchers by significant geographical distance. Following the completion of the surveys, participants were thanked, and again provided with contact information of the principal investigator.

Protection of Human Participants

The principle investigator (PI) completed the National Institute of Health (NIH) "Protecting Human Research Participants" online training and developed the study in accordance with the NIH policies. In consideration of the right of human research subjects to act as autonomous agents, potential participants were presented with an Informed Consent Agreement. Potential participants were able to privately and thoroughly review both documents before making a decision regarding study participation. The Informed Consent Agreement explained the duration and general purpose of the study, all research procedures, including precisely what is expected of study participants, and the study's possible risks and benefits. The Informed Consent Agreement further informed potential subjects that their participation was entirely voluntary and that they could withdraw from the study at any time without suffering a

penalty from the researcher, the university, the yoga instructors, or any individual involved with the study. Additionally, research participants were given the faculty supervisor's and principle investigator's contact information, including the PI's cell phone number.

The study was reviewed by the Institutional Review Board (IRB) of the California School of Forensic Studies at Alliant International University; approval was received on December 8, 2011 and November 1, 2012. No human subjects were recruited or enrolled without IRB approval. To ensure confidentiality, participants were automatically assigned an identification number by Qualtrics, the survey software used in this study. To ensure anonymity, participants were not asked for any identification or contact information.

Chapter 4

RESULTS

Data Screening

Prior to demographic analyses and hypothesis testing, data was screened for accuracy and missing values using Statistical Packages for the Social Sciences (SPSS, version 19). Several visibly incorrect responses were located for the age variable and number-of-months-deployed variable. These erroneous values were excluded from demographic analyses.

Additionally, data screening revealed a suspiciously large number of "0" values for the variables frequency and duration of yoga practice. It was subsequently determined that when the electronic version of the survey was created, the frequency and duration variables were erroneously assigned default values of "0," such that if a participant did not answer these questions, a value of "0" was entered into the data field. Since "0" was also a potential response to both the frequency and duration questions, it was not possible to distinguish an actual response from a missing value. Regarding the duration question in particular, it was suspected that a majority of the "0" scores were missing values. A review of the hot yoga participants' comments revealed that many service members had a difficult time quantifying how long they have regularly practiced yoga. Many participants commented about how aspects of military service (e.g., deployment, living on a military base, living on a ship) precluded maintaining a current or consistent practice. It is surmised, therefore, that many participants skipped the

duration question because they were unsure how to answer it. With regard to the large number of "0" values for the frequency variable ("How many times did you practice hot yoga last month?"), it seems equally probable that these values are missing values or actual responses reflecting the absence of a current yoga practice. Given that scores of "0" for duration and frequency were unreliable, they were not included in hypothesis testing. Following the removal of "0" scores, the distribution of data for the frequency and duration variables remained positively skewed, therefore, nonparametric statistics were employed to test Hypotheses 2 and 3.

A review of PTSD and depression scores revealed possible "floor effects" with a majority of participants in both the experimental and control groups reporting few, if any, PTSD or depressive symptoms. This finding is not surprising given that most military service members do not suffer from PTSD or depression, and the current study did not confine participation to military personnel with clinical diagnoses. Therefore, measurable effects of the hot yoga intervention would be unexpected for these asymptomatic participants and additional analyses were conducted to account for this potential confound.

Description of the Sample Population

A total of 347 participants completed the survey, including 214 experimental participants and 133 controls. All participants were current or former U. S. military service members. Experimental participants were those who had tried hot yoga; control participants were those who had not. The experimental group included 120 (56%) women and 94 (44%) men; the control group included 42 (32%) women and 91 (68%)

men. The mean age was 38.2 years (experimental) and 36.0 years (control). Both groups were predominantly Caucasian (experimental: [65%]; control: [75%]). The groups differed significantly in level of education; 72.4% of the experimental group had achieved at least a four-year degree compared to 35.3% of controls. With regard to current military status, the experimental group included 99 active duty (46%), 94 former/retired (44%) and 21 reserve (10%) service members. The control group included 70 active duty (53%), 50 former/retired (38%) and 13 reserve (10%) service members. Branch of service was fairly evenly matched across both groups with respective percentages for experimental and controls as follows: Army (31/39), Air Force (19/20), Navy (29/20), Marine Corps (16/14), National Guard (2/5), and Coast Guard (3/2). The majority of respondents from both groups reported having been deployed at least once (experimental [74%]; control [62%]). Both groups reported substantial amounts of total time deployed (experimental: 19.4 months; control: 25.8 months). Table 1 shows demographics, by gender, for sample population used in testing Hypothesis 1.

TABLE 1

Means and Frequencies for Military, PTSD and Depression Demographics, Combined and by Gender, for Hypothesis 1 Data Sample

	Hot Yoga			No Yoga		
Demographic variable	Males (*n* =53)	Females (*n* = 8)	Total (*n* = 21)	Males (*n* =75)	Females (*n* = 8)	Total (*n* =103)
Age, mean	45.7	35.3	39.5	38.1	32.9	36.7
Race, % Caucasian	59.3	63.8	61.8	78.7	64.3	74.8
Education, %						
High school/GED	5.6	2.9	4.1	14.7	14.3	14.6
Some college	9.3	15.9	13.0	38.7	7.1	30.1
2-yr college	7.4	5.8	6.5	18.7	39.3	24.3
4-yr college	31.5	34.8	33.3	18.7	25.0	20.4
Master's	42.6	37.7	39.8	8.0	10.7	8.7
Professional	3.7	2.9	3.3	1.3	3.6	1.9
Military status, %						
Active duty	25.9	44.9	36.3	32.0	35.7	33.0
Reserves	9.3	7.2	8.1	8.0	21.4	11.7
Former/retired	64.8	47.8	54.8	60.0	42.9	55.3
Branch of service, %						
Air Force	5.6	30.4	19.5	20.0	21.4	20.4
Army	38.9	26.1	31.7	41.3	32.1	38.8
Coast Guard	N/A	2.9	1.6	4.0	N/A	2.9
Marine Corps	27.8	7.2	16.3	16.0	7.1	13.6
Navy	24.1	33.3	29.3	10.7	35.7	17.5
Reserves	3.7	N/A	1.6	8.0	3.6	6.8
Deployed*	83.3	56.5	68.5	73.3	35.7	63.1
Countries of deployment, %						
Afghanistan	24.1	11.6	16.9	20.0	10.7	17.5
Iraq	46.3	33.3	38.7	38.7	14.3	32.0
Kuwait	35.2	11.6	21.8	26.7	7.1	21.4
Vietnam	13.0	1.4	6.5	1.3	N/A	1.0
Other	38.9	34.8	36.3	40.0	21.4	35.0
Total mos. deployed, mean	24.5	17.4	21.2	28.1	14.6	26.0
Tested PTSD*	25.9	26.1	26.0	29.3	21.4	27.2
Suspected PTSD*	35.2	29.0	31.7	34.7	35.7	35.0
Diagnosed PTSD*	20.4	15.9	17.9	18.7	14.3	17.5
Treated PTSD*	22.2	15.9	19.4	18.7	14.3	17.5
Diagnosed Depression*	33.3	36.2	35.0	41.3	42.9	41.7

Abbreviation. PTSD = Posttraumatic Stress Disorder

Note. * = % Yes

Statistical Results –Hypothesis 1

Hypothesis 1 stated that current or former military service members who regularly practice Bikram-style hot yoga would report fewer PTSD and fewer depressive symptoms than service members who do not practice any style of yoga or meditation. Hypothesis 1 was supported by the data. To test this hypothesis, a multivariate analysis of variance (MANOVA) was performed to analyze the mean differences between the hot yoga group and the no yoga group (see Table 2 for means and standard deviations). As noted earlier, gender was included in the analysis to test conclusions of prior research (Groessel et al., 2012). Additionally, because prior literature informs that PTSD and depression are related constructs with substantial overlap (Skodol et al., 1996) and an initial analysis indicated a significant correlation between the PTSD and depression scores in the current study ($r = .799$, $p < .001$), PTSD and depression scores were combined in the multivariate analysis to form an aggregate variable representing overall mental health. A statistically significant difference was found between the hot yoga group and the no yoga group ($F = 14.85$, $p < .001$, $\eta^2 = .119$), such that hot yoga practitioners evidenced lower combined PTSD/depression scores than the no yoga group. The impact of gender on combined PTSD/depression scores was also found to be statistically significant ($F = 3.42$, $p = .035$, $\eta^2 = .030$) with females evidencing lower combined scores than males. No statistically significant difference was found in the interaction between practicing hot yoga and gender ($F = 2.55$, $p = .080$).

TABLE 2

Means and Standard Deviations for PTSD, and Depression Measures as a Function of Hot Yoga Practice and Gender

	PCL-M		*IDS-SR$_{30}$*	
Group (*n*)	*M*	*SD*	*M*	*SD*
Males				
Practice hot yoga (53)	31.81	16.70	36.87	12.68
Do not practice yoga (75)	35.24	16.08	41.89	13.36
Females				
Practice hot yoga (68)	26.60	11.60	33.72	8.78
Do not practice yoga (28)	34.39	13.01	45.68	11.85
Combined (males & females)				
Practice hot yoga (121)	28.88	14.24	35.10	10.74
Do not practice yoga (103)	35.01	15.25	42.92	13.02

Note. Means for the IDS-SR$_{30}$ do not include scores for Questions 11, 12, 13, or 14; these scores were removed from the analysis due to multiple response errors; PCL-M = Posttraumatic Stress Disorder Checklist – Military Version; IDS-SR$_{30}$ = Inventory of Depressive Symptoms – Self Report.

Univariate results demonstrated the effects of hot yoga and gender on PTSD and depression separately (see Table 3 for MANOVA and ANOVA *F* values). Testing revealed a statistically significant difference between the hot yoga group and the no yoga group with regard to both PTSD and depression ($F = 7.10$, $p < .01$, $\eta^2 = .031$; $F = 25.15$, $p < .001$, $\eta^2 = .103$, respectively), with the hot yoga group demonstrating lower PTSD and lower depression scores than the no yoga group. No statistically significant effect was found for gender on PTSD or depression ($F = 2.07$, $p =$ ns; $F = .04$, $p =$ ns, respectively). The interaction of hot yoga and gender produced a statistically significant difference for depression scores ($F = 4.19$, $p < .05$, $\eta^2 = .019$), such that female yoga practitioners evidenced significantly lower depression scores compared to female controls than male yoga practitioners compared to male controls. No statistical significance for the interaction of hot yoga and gender was uncovered for PTSD ($F = 1.07$, $p =$ ns). These results indicated that hot yoga benefitted both male and female yoga practitioners with regard to PTSD and depression; however, hot yoga was more beneficial for females with regard to depression. A similar pattern of females benefitting more than males was found for PTSD as well; however, it did not attain statistical significance (see Figures 1 and 2 for a visual representation of this pattern).

TABLE 3

Multivariate and Univariate Analyses of Variance F *Ratios for Hot Yoga and Gender Effects on PTSD and Depression*

		ANOVA *F*	
Variable	MANOVA *F*	PCL-M	IDS-SR_{30}
Hot yoga	14.86***	7.10**	25.15**
Gender	3.41*	2.07	.04
Hot yoga x Gender	2.55	1.07	4.19*

Note. *F* ratios are Wilks' Lambda calculation of *F*.
*$p < .05$. ** $p < .01$. *** $p < .001$.

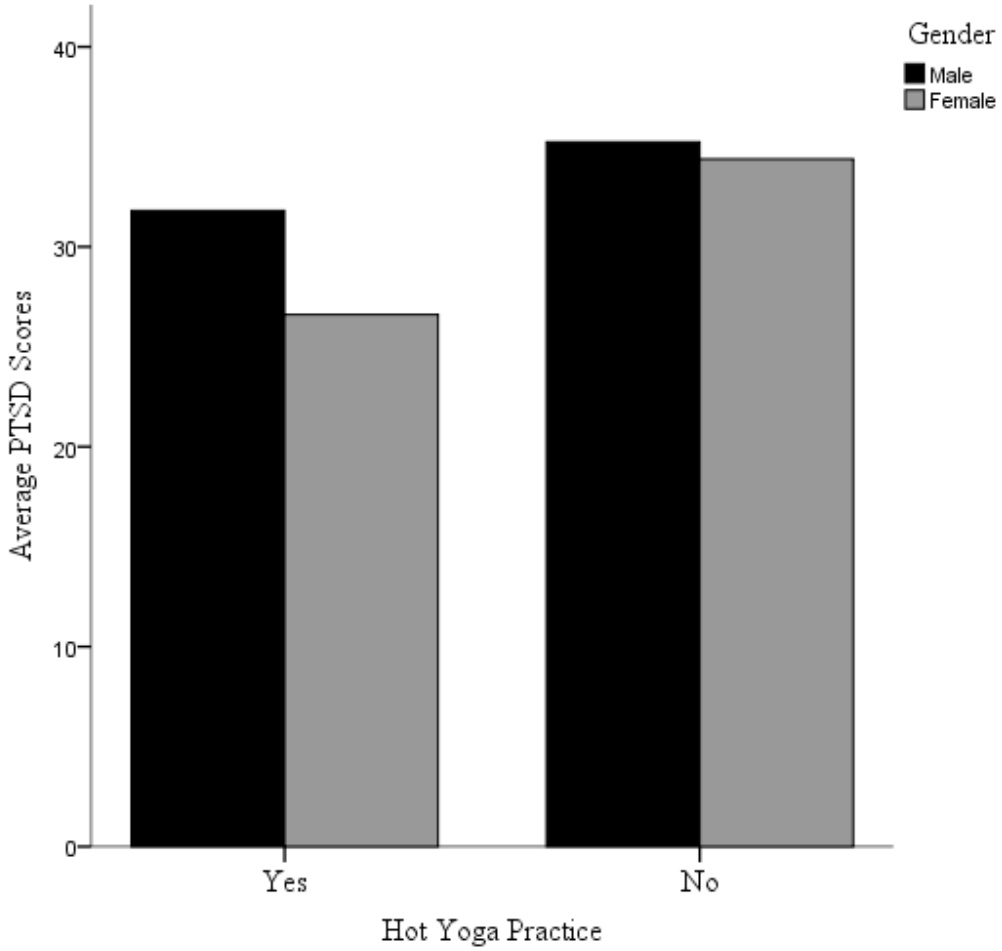

Figure 1. Comparison of PTSD scores based on yoga practice and gender.

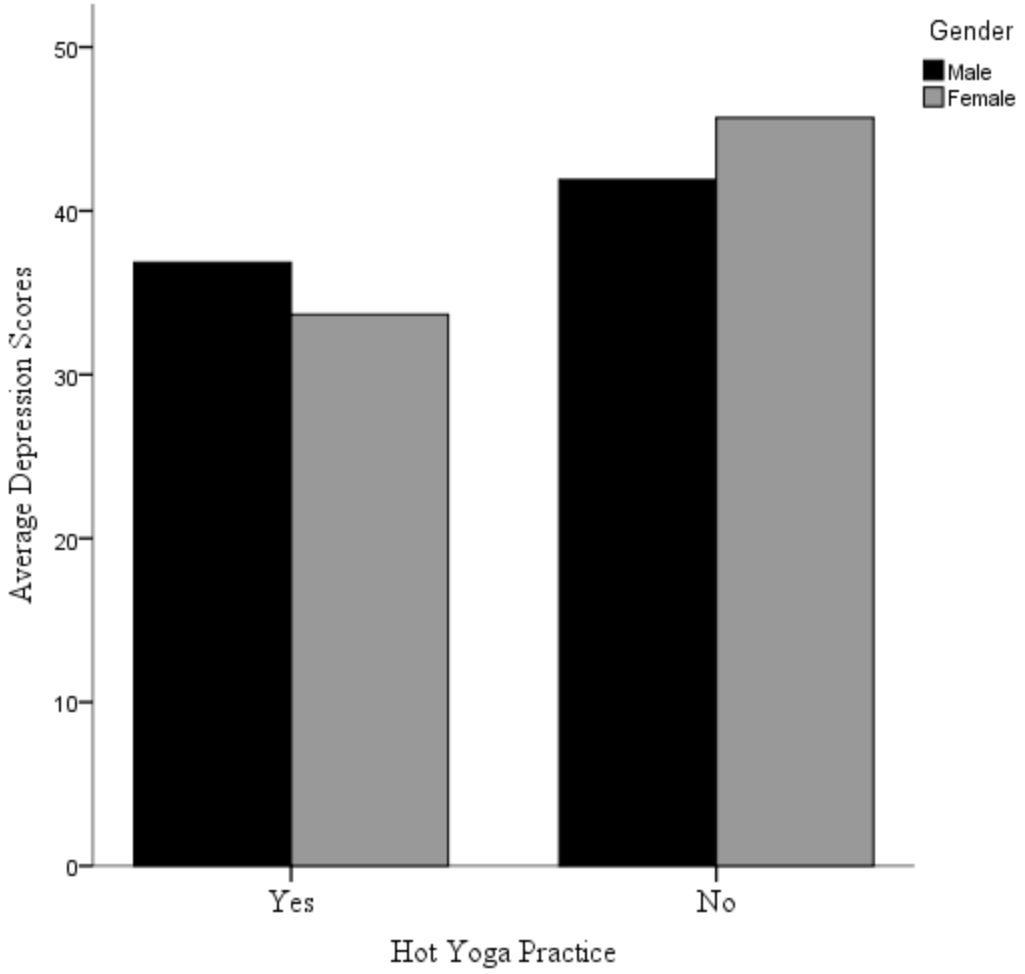

Figure 2. Comparison of Depression scores based on yoga practice and gender.

Statistical Results - Hypothesis 2

Hypothesis 2 stated that PTSD scores would be negatively correlated with duration and frequency of Bikram-style hot yoga practice. This expectation was partially supported by the data. To test Hypothesis 2, a Spearman bivariate correlation was performed to examine the relationship between hot yoga practice and PTSD. Additional analyses were conducted to examine potential effects of gender. With regard to the overall sample (combined males and females), no statistically significant relationship was found between the duration or frequency of study participants' hot yoga practice and PTSD scores (r = -.062, p = ns; r = .036, p = ns). Likewise, neither duration nor frequency of hot yoga practice was associated with males' PTSD scores (r = -.065, p = ns; r = -.035, p = ns) or females' PTSD scores (r = -.106, p = ns; r = .350, p = ns). A review of hot yoga practitioners' PTSD scores indicated possible "floor effects," with a majority of practitioners reporting low scores such that variability was limited. Therefore, follow-up analysis was performed to examine the relationship between duration and frequency of hot yoga practice and PTSD scores, with the sample confined to participants who endorsed demographic item "Have you ever suspected that you have PTSD?" Among participants who suspected PTSD (n = 41), it was found that duration was not associated with PTSD scores (r= -.017, p = ns); however, frequency was significantly correlated with lower PTSD scores (r = -.325, p < .05).

Statistical Results - Hypothesis 3

Hypothesis 3 stated that depression scores would be negatively correlated with duration and frequency of Bikram-style hot yoga practice. This expectation was

partially supported by the data. To test Hypothesis 3, a Spearman bivariate correlation was performed to examine the relationship between hot yoga and depressive symptoms. Gender-specific analyses were again conducted. With regard to the overall sample (combined males and females), no statistically significant relationship was found between the duration or frequency of study participants' hot yoga practice and depression scores (r = -.116, p = ns; r = -.022, p = ns). When gender was viewed separately, neither duration nor frequency of hot yoga practice was related to males' depression scores (r = -.098, p = ns; r = .031, p = ns); however, females' depression scores were significantly influenced by duration (r = -.311, p = .005), but not frequency (r = -.077, p = ns). To account for possible "floor effects," follow-up analysis was performed to examine the relationship between duration and frequency of hot yoga practice and depression scores, with the sample confined to participants who endorsed demographic item "Have you ever been diagnosed with depression?" Among participants with a history of clinical depression (n = 47), it was found that neither duration nor frequency influenced depression scores (r = -.054, p = ns, r = -.259; p = ns). However, results indicated a negative relationship between duration and frequency and depression scores, and a trend toward significance with regard to frequency.

Chapter 5

DISCUSSION

Overview and Discussion of Research Findings

The purpose of the current research project was to investigate the effects of a hot yoga practice on posttraumatic stress and depressive symptoms among military service members. Prior research has indicated positive effects of yoga on PTSD symptoms for survivors of natural disasters (Descilo et al., 2010; Telles et al., 2007; Telles et al., 2010), for civilians traumatized by war (Gordon et al., 2008), and for military personnel (Stoller et al., 2012; Telles et al., 2012). Prior research has also indicated positive effects of yoga on depression (Mehta et al., 2010; Pilkington et al., 2005) and on depressive symptoms among military service members (Carter et al., n.d.; Groessel et al., 2012). In addition, hot yoga has been demonstrated to improve depressive symptoms (Mueller et al., 2010). In the absence of published reports regarding the mental health effects of hot yoga, the current study hypothesized that hot yoga practitioners would demonstrate fewer PTSD and depressive symptoms compared to a control group of non-practitioners. This hypothesis was supported by the data. It was further hypothesized that frequency and duration of hot yoga practice would be negatively correlated with PTSD and depressive symptoms. This expectation was partially supported by the data.

Study results indicated that hot yoga significantly benefits both male and female service members with regard to posttraumatic and depressive symptoms. This finding

was bolstered by participants' ratings of hot yoga and their individual comments. Hot yoga participants were asked to rate how helpful hot yoga has been for them on a scale of 1 to 10, with 1 meaning "not helpful at all" and 10 meaning "very helpful." A majority of participants (51.3%) rated hot yoga as a "10;" the mean rating was 8.83 (*SD* = 1.67). Additionally, participants' comments were overwhelmingly favorable regarding their experience with hot yoga. Respondents reported improvements in attention, focus, coping with stress, anxiety, obsessive thinking, sleep, physical and mental energy, anger, and depression, among other mental health benefits. Respondents also reported feeling calmer, balanced, stable, and social. Multiple participants commented that they feel a sense of accomplishment when they practice. Reported physical benefits included improvements in blood pressure, breathing, digestion, migraine headaches, and chronic pain, to name a few.

Most commenters reported experiencing both mental and physical benefits from their hot yoga practice. The interaction of mental and physical effects are illustrated in the comments below:

> I view the mental benefits of Bikram as exceptionally useful for me; however, I think it is very important not to dismiss the physical benefits. Bikram yoga challenges me mentally, which is good. It also physically is giving me back my flexibility and agility, which is also healing me mentally and emotionally. I hope you can understand that.

> It had a wonderful effect on my attention and focus in class, which lead to a comfort and peace after the class. Bikram yoga had an overall positive effect on my diet, emotional wellbeing, and physical health.

Prior literature offers support for physically-based treatments for PTSD and depression (van der Kolk, 2004). PTSD and depression treatments that incorporate a physical component may be especially relevant for military populations given the

physical nature of military work (deployment, combat, physical training) and the prospect of work-related injuries. Mind-body interventions, such as hot yoga, improve mental and emotional health in part by improving physical health. Additionally, prior research informs that military service members frequently do not seek treatment for mental health problems due to feelings of shame surrounding mental illness and fears of negative repercussions with regard to their careers (Adamson et al., 2008). Physically-based treatments, like hot yoga, allow service members to bypass the stigma regarding mental illness that has historically predominated military culture. Service members can receive mental health treatment without having to publically or even privately acknowledge that they are in need of treatment; this removes the treatment barriers caused by stigma and misgivings often associated with participating in mental health care within the military.

The group format of Bikram-style hot yoga may also contribute to its effectiveness for PTSD and depression in military service members, in particular. Prior literature informs that poor social support both before and after deployment is associated with greater risk of developing PTSD (Iversen et al., 2008; Solomon et al., 1986). Likewise, greater social support and a sense of "unit cohesion" has been demonstrated to have a moderating effect on PTSD symptoms and serve as a protective factor against the development of PTSD (Armistead-Jehle et al., 2011; Brailey et al., 2007; Dikel et al., 2005; Jelusic et al., 2010). In addition, both PTSD and depression are associated with tendencies to withdraw socially (APA, 2000); therefore, treatments that include a social component offer opportunities to directly address impairments in social functioning. Several participants in the current study referenced the sense of camaraderie that is often

experienced among hot yoga practitioners; the following comments illustrate the impact of the group practice:

> When I first came back from deployment, I did not want to have any interaction whatsoever with strangers and immediate friends and family. However, this period of doing yoga consistently has finally allowed me to enjoy friends and family interactions. I will probably not stop doing yoga in fear that I will slip back to the morose agoraphobic person I became after deployment.
>
> I think military people love the sense of community they have while serving. When they separate out of the military, you lose that. That's what I love about Bikram Yoga….It's nice to have that sense of community and belonging again.

Similarly, the "sauna effects" (e.g., heat and humidity) of hot yoga may also effect positive change, particularly when combined with the group dynamic. Reported benefits of sauna use include lowered blood pressure, improved lung function, improved mood, and decreased anxiety (Hannuksela, & Ellahham, 2001; Kuusinen, & Heinonen, 1972). Moreover, the practice of group sweating has been shown to accelerate and intensify the effects of group psychotherapy (Colmant, Eason, Winterowd, Jacobs, & Cashel, 2005). Group sweating practices have existed for thousands of years among various world cultures including for example, the Finish sauna, the Russian *bania*, Turkish *hamman*, Greek and Roman bath houses, and the Native American sweat lodge (Colmant, & Merta, 2000). Historically, group sweating has been promoted for both its practical and therapeutic value. For instance, Native American sweat lodges traditionally have been used not only for bathing but also for socialization, cleansing the body and mind, encouraging group cohesion, and preparing for war (Colmant, & Merta, 1999). Contemporary therapeutic uses of the sweat lodge include as an adjunctive treatment for alcoholism, substance abuse, and juvenile delinquency (Colmant et al., 1999). Hence,

the group sweat experience may be especially appropriate for a military culture that values unit cohesion and may enhance the benefits of yoga.

A pattern emerged during the current study that suggested female service members may experience greater mental health benefits than male service members from practicing hot yoga; however, this finding should be interpreted with caution due to the small number of female control group participants (n = 28) compared to female yoga practitioners (n = 68).

Study results also indicated that among yoga practitioners who suspect they have had PTSD, both duration and frequency of yoga practice were negatively correlated with PTSD symptoms; however, only frequency was significantly associated with lower PTSD scores. A negative relationship was also found for duration and frequency of yoga practice and depression; however, just females' depression scores were found to significantly correlate with duration. A trend toward significance with regard to frequency was also observed.

Additional Findings

A traumatic brain injury (TBI) screen was included in the current study to gather information regarding the practice of hot yoga among military service members with probable TBI. Only a small number of participants from the experimental group (n = 13) met the criteria for probable TBI and regular yoga practice; therefore, although these participants were included in the analysis of the study's hypotheses, separate, in-depth analyses were not performed. However, a Pearson Chi-Square analysis was conducted to test the frequency of TBI among hot yoga practitioners as compared to controls.

Results indicated that TBI was significantly more prevalent among service members who do not practice yoga than among regular hot yoga practitioners ($\chi^2 = 8.625$, $p = .037$). This result indicates that service members with TBI are significantly less likely to practice hot yoga. Possible explanations for this finding are numerous; for example, demographic variables such education, military rank, or income may account for the variance in frequency of TBI between the experimental and control groups. It is recommended that future research investigate the use of hot yoga by service members with TBI.

Delimitations of the Study

Hot yoga was chosen as the independent variable in this study for reasons outlined in Chapter 2; however, the principal investigator acknowledges that prior research indicates that other mind-body therapies may also be effective at reducing symptoms of PTSD and depression in a military population. Specifically, transcendental meditation (Brooks & Scarano, 1985; Rosenthal, Grosswalk, Ross, & Rosenthal, 2011) and other styles of meditation, including Integrative Restoration (iRest) therapy (Kearney, Simpson, & Johnson, 2010; Omonishi, Matheny, Gagne, Williams, & Ashby, 2010; Stankovic, 2011), other yoga styles (Carter et al., n.d.) and although not tested in a military population, Sudarshan Kriya Yogic (SKY) breathing has demonstrated significant efficacy in treating both PTSD and depression in civilian populations (Brown, & Gerbarg Part I and Part II, 2005; Janakiramaiah, et al., 2000).

It is also acknowledged that Bikram-style hot yoga is a rigorous practice, and as such, requires more physical effort and arguably more mental effort than is required by

other more conventional, commonly prescribed therapies. Therefore, it is understood that this type of intervention would be difficult to adhere to for many people for a variety of reasons. For instance, Bikram-style hot yoga may be inappropriate for a solider recently engaged in combat with severe, acute PTSD. This research project does not attempt to evaluate the adherence rate of a hot yoga practice. Additionally, a Bikram-style hot yoga intervention requires specific "equipment" (e.g., heat, humidity and mirrors) that might be difficult to deliver in certain circumstances, for example, in a war zone. This study produces no finding with regard to the feasibility of implementing a hot yoga program within a military setting.

Limitations of the Study

Due to the online distribution of the survey materials it was not possible to calculate an accurate response rate, and thus, generalizability was limited. Furthermore, in the current study hot yoga was evaluated for its effects on military service members who have self-selected to engage in its practice. These individuals represent a specific and unique population; whether or not the results that are attributed to them can be achieved by others is beyond the scope of the present investigation.

Additionally, although an online self-report methodology is useful for surveying participants at a distance, this approach provides arguably greater opportunity for participant inattentiveness and fraud. In this case, a test launch of the survey revealed that a number of Qualtrics-solicited participants were likely "straight-line responding" and/or feigning military service. As reported earlier, attention filters and a military knowledge question were inserted into the final questionnaire to protect against this

potential corruption of the data. Nevertheless, the general lack of accountability that accompanies online surveys could have threatened the reliability of the results.

Participant bias is another potential study limitation. In addition to reporting very positive personal experiences with hot yoga, many participants commented that they would like to see military mental health and physical training programs include hot yoga. The following quotations exemplify this sentiment:

> I really could have used Bikram yoga on deployment…If the military put some funding toward Bikram training, I think it would really help prevent a lot of stress and injuries.
>
> The military should incorporate Bikram yoga into the MWR facility classes offered on base. It's a great way to gain balance from our PRT requirements and relieve stress and tension from long days on ships.
>
> Let's get the military onboard the Bikram yoga train!

Although this enthusiasm is understandable given the demonstrated benefit of hot yoga for participant service members, this potential bias may have resulted in an under-reporting of symptoms. It is also highly likely that military service members who have benefitted from a hot yoga practice were more apt to participate in the study than those who feel differently about their experience.

Another study limitation was the lack of normal distribution with regard to the frequency and duration variables such that it was necessary to employ nonparametric statistics to test Hypotheses 2 and 3. The positively skewed distribution was in part due to a large number of "0" values, which were an invalid combination of missing values and participant responses. After these unreliable values were excluded from analysis, the data remained positively skewed, which was likely attributable to the irregularity and infrequency of most participants' current yoga practice, combined with a few dedicated

practitioners who practice more frequently and consistently. This supposition is supported by participant comments, many of which included mention of the challenges of maintaining a yoga practice while on active duty or reserve military status.

Possible floor effects with regard to PTSD and depression scores represent an additional study limitation. Although additional analyses were conducted to account for this potential confound, the large number of low scores may have masked the effect of duration or frequency of hot yoga practice on PTSD and depressive symptoms.

Future Research

The current study provides significant evidence for the beneficial effect of hot yoga on PTSD and depressive symptoms in both male and female military service members; therefore, confirmatory analyses are recommended. To improve upon the current study, future researchers should conduct randomized, controlled pretest-posttest design studies to more precisely measure this effect. The inclusion of physiological measures would add an objective component to the self-report methodology, providing investigators with further insight into yoga practitioners' subjective experience. For example, measurements of heart rate, cortisol levels, and blood pressure could offer valuable information regarding hot yoga's mechanism of effect and the interaction of physiological and psychological outcomes, or otherwise stated, the mind-body effect. In addition, the inclusion of the trauma source (e.g. combat, sexual assault, or operational stressors) among dependent variables could indicate the extent of the utility of hot yoga for military-related PTSD. Future research should also evaluate whether hot yoga's beneficial effect could be preventative if applied proactively. For instance, studies

investigating the effect of a hot yoga intervention administered prior to deployment are recommended.

The results of this study also indicate that duration, and especially frequency of hot yoga practice are associated with fewer PTSD and depressive symptoms; however, more research is needed to investigate this relationship, including quantifying the "dose" of hot yoga necessary to achieve clinically-relevant symptom improvement. To improve upon the current research, future correlation studies should take into account the often-interrupted yoga practice of many military service members. To avoid confounding floor effects, researchers should attempt to confine participant samples to service members with current PTSD or depression diagnoses. Study findings also suggest that female service members may benefit more from hot yoga than male service members; this finding merits further exploration. The current study did not attempt to equally distribute participants between groups according to gender; however, it is recommended that future researchers do so in order to evaluate the specific impact of gender on outcomes.

Future research could also investigate the role of hot yoga's "sauna effects" and group dynamic on PTSD and depression symptom reduction among military personnel in particular.

Implications for Clinical Forensic Psychology

The findings of the current study support the use of hot yoga to significantly reduce posttraumatic stress and depressive symptoms among military service members, along with improving their overall mental health. This finding has implications in the

field of clinical forensic psychology because the potential consequences of untreated or poorly treated military-related PTSD or depression can include veteran involvement with both the civil and criminal justice systems (Department of the Army, 2009; Department of the Army, 2012; Levin, 2008; Marek, 2008). Anger, aggressive behavior, and substance abuse are strongly associated with military-related PTSD (Savarese, Suvak, King, & King, 2001; Taft et al., 2007); these outcomes in particular have forensic implications. Moreover, although no conclusion is made regarding the generalizability of the current study's results to other populations, this research adds to a substantial body of prior literature that has found yoga, of any style, effective in treating symptoms of trauma and depression among various populations, including forensic populations (Derezotes, 2000; Franzblau, Echevarria, Smith, & Van Cantfort, 2008).

Conclusion

The current study provides empirical evidence for the use of hot yoga as an effective treatment for symptoms of posttraumatic stress and depression among military service members. Study results indicate that hot yoga significantly reduces PTSD and depressive symptoms among male and female veterans alike.

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APPENDICES

Appendix A

Bikram-style Yoga 26 Postures in Sequence

English	Sanskrit
1. Standing Deep Breathing	Pranayama Series
2. Half Moon Pose with Hands To Feet Pose	Ardha-Chandrasana with Pada-Hastasana
3. Awkward Pose	Utkatasana
4. Eagle Pose	Garudasana
5. Standing Head To Knee Pose	Dandayamana-Janushirasana
6. Standing Bow Pulling Pose	Dandayamana-Dhanurasana
7. Balancing Stick Pose	Tuladandasana
8. Standing Separate Leg Stretching Pose	Dandayamana-Bibhaktapada-Paschimotthanasana
9. Triangle Pose	Trikanasana
10. Standing Separate Leg Head To Knee Pose	Dandayamana-Bibhaktapada-Janushirasana
11. Tree Pose	Tadasana
12. Toe Stand Pose	Padangustasana
13. Corpse Pose	Savasana
14. Wind Removing Pose	Pavanamuktasana
15. Cobra Pose	Bhujangasana
16. Locust Pose	Salabhasana
17. Full Locust Pose	Poorna-Salabhasana
18. Bow Pose	Dhanurasana
19. Fixed Firm Pose	Supta-Vajrasana
20. Half Tortoise Pose	Ardha-Kurmasana
21. Camel Pose	Ustrasana
22. Rabbit Pose	Sasangasana
23. Head To Knee Pose	Janushirasana
24. Stretching Pose	Paschimottanasana
25. Spine Twisting Pose	Ardha-Matsyendrasana
26. Blowing In Firm	Kapalbhati in Vajrasana

Appendix B

PTSD Checklist Military Version (PCL-M)

Below is a list of problems and complaints that veterans sometimes have in response to stressful military experiences. Please read each one carefully, put an "X" in the box to indicate how much you have been bothered by that problem in *the last month*.

No.	Response:	Not at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
1.	Repeated, disturbing *memories*, *thoughts*, or *images* of a stressful military experience?					
2.	Repeated, disturbing *dreams* of a stressful military experience?					
3.	Suddenly *acting* or *feeling* as if a stressful military experience were happening again (as if you were reliving it)?					
4.	Feeling *very upset* when *something reminded* you of a stressful military experience?					
5.	Having *physical reactions* (e.g., heart pounding, trouble breathing, or sweating) when *something reminded* you of a stressful military experience?					
6.	Avoid *thinking about* or *talking about* a stressful related to it?					
7.	Avoid *activities* or *situations* because *they remind you* of a stressful military experience?					
8.	Trouble *remembering important parts* of a stressful military experience?					
9.	Loss of *interest in things that you used to enjoy?*					
10.	Feeling *distant* or *cut off* from other people?					
11.	Feeling *emotionally numb* or being unable to have loving feelings for those close to you?					
12.	Feeling as if your *future* will somehow be *cut short?*					
13.	Trouble *falling* or *staying asleep?*					
14.	Feeling *irritable* or having *angry outbursts?*					
15.	Having *difficulty concentrating?*					
16.	Being *"super alert"* or watchful on guard?					
17.	Feeling *jumpy* or easily startled?					

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Appendix C

Inventory of Depressive Symptomatology (IDS-SR)

Please circle the one response to each item that is most appropriate to how you have been feeling over the past 7 days.

1. Falling asleep:

0 I never took longer than 30 minutes to fall asleep.
1 I took at least 30 minutes to fall asleep, less than half the time (3 days or less out of the past 7 days).
2 I took at least 30 minutes to fall asleep, more than half the time (4 days or more out of the past 7 days).
3 I took more than 60 minutes to fall asleep, more than half the time (4 days or more out of the past 7 days).

2. Sleep during the night:

0 I didn't wake up at night.
1 I had a restless, light sleep, briefly waking up a few times each night.
2 I woke up at least once a night, but I got back to sleep easily.
3 I woke up more than once a night and stayed awake for 20 minutes or more, more than half the time (4 days or more out of the past 7 days).

3. Waking up too early:

0 Most of the time, I woke up no more than 30 minutes before my scheduled time.
1 More than half the time (4 days or more out of the past 7 days), I woke up more than 30 minutes before my scheduled time.
2 I almost always woke up at least one hour or so before my scheduled time, but I got back to sleep eventually.
3 I woke up at least one hour before my scheduled time, and couldn't get back to sleep.

4. Sleeping too much:

0 I slept no longer than 7–8 hours/night, without napping during the day.
1 I slept no longer than 10 hours in a 24-hour period including naps.
2 I slept no longer than 12 hours in a 24-hour period including naps.
3 I slept longer than 12 hours in a 24-hour period including naps.

5. Feeling sad:

0 I didn't feel sad.
1 I felt sad less than half the time (3 days or less out of the past 7 days).
2 I felt sad more than half the time (4 days or more out of the past 7 days).
3 I felt sad nearly all the time.

6. Feeling irritable:

0 I didn't feel irritable.
1 I felt irritable less than half the time (3 days or less out of the past 7 days).
2 I felt irritable more than half the time (4 days or more out of the past 7 days).
3 I felt extremely irritable nearly all the time.

7. Feeling anxious or tense:

0 I didn't feel anxious or tense.
1 I felt anxious (tense) less than half the time (3 days or less out of the past 7 days).
2 I felt anxious (tense) more than half the time (4 days or more out of the past 7 days).
3 I felt extremely anxious (tense) nearly all the time.

8. Your state of mind in response to good or desired events:

0 I was in a better state of mind which lasted for several hours when good events occurred.
1 I was in a better state of mind but I didn't feel like my normal self when good events occurred.
2 I was in a better state of mind only somewhat to a rather limited range of desired events.
3 My state of mind wasn't better, even when very good or desired events occurred in my life.

9. State of mind in relation to the time of day:

0 There was no usual relationship between my state of mind and the time of day.
1 My state of mind often related to the time of day because of my circumstances (e.g.: being alone, working).
2 In general, my state of mind was more related to the time of day than to my circumstances.
3 My state of mind was clearly and predictably better or worse at a particular time each day.

9A. Was your state of mind typically worse in the morning, afternoon or evening? (Circle the one that applies, if any.)

9B. Were variations to your state of mind attributed to your circumstances? (yes or no) (circle one)

10. Your state of mind:

0 My state of mind was normal.
1 I was sad, but this sadness was pretty much like the sadness I would feel if someone close to me died or left.
2 I was sad, but this sadness was a little bit different from the sadness I would feel if someone close to me died or left.
3 I was sad, but this sadness was very different from the type of sadness associated with grief or loss.

Please complete either 11 or 12 (not both)

11. Decreased appetite:

0 There was no change in my usual appetite.
1 I ate somewhat less often or smaller amounts of food than usual.
2 I ate much less than usual and only by forcing myself to eat.
3 I rarely ate within a 24-hour period, and only by really forcing myself to eat or when others persuaded me to eat.

12. Increased appetite:

0 There was no change in my usual appetite.
1 I felt a need to eat more frequently than usual.
2 I regularly ate more often and/or greater amounts of food than usual.
3 I felt driven to overeat both at mealtime and between meals.

Please complete either 13 or 14 (not both)

13. Decreased weight (within the last 14 days):

0 There was no change in my weight.
1 I feel as if I've had a slight weight loss.
2 I've lost 2 pounds (about 1 kilo) or more.
3 I've lost 5 pounds (about 2 kilos) or more.

14. Increased weight (within the last 14 days):

0 There was no change in my weight.
1 I feel as if I've had a slight weight gain.
2 I've gained 2 pounds (about 1 kilo) or more.
3 I've gained 5 pounds (about 2 kilos) or more.

15. Concentration/decision making:

0 There was no change in my usual capacity to concentrate or make decisions.
1 I occasionally felt indecisive or found that my attention wandered.
2 Most of the time, I found it hard to focus or to make decisions.
3 I couldn't concentrate well enough to read or I couldn't make even minor decisions.

16. Perception of myself:

0 I saw myself as equally worthwhile and deserving as other people.
1 I put the blame on myself more than usual.
2 For the most part, I believed that I caused problems for others.
3 I thought almost constantly about major and minor defects in myself.

17. View of my future:

0 I had an optimistic view of my future.
1 I was occasionally pessimistic about my future, but for the most part I believed things would get better.
2 I was pretty certain that my immediate future (1-2 months) doesn't hold much promise of good things for me.
3 I saw no hope of anything good happening to me any time in the future.

18. Thoughts of my own death or suicide:

0 I didn't think of suicide or death.
1 I felt that life was empty or wondered if it was worth living.
2 I thought of suicide or death several times a week for several minutes.
3 I thought of suicide or death several times a day in some detail, or I made specific plans for suicide or actually tried to take my life.

19. General interest:

0 There was no change from usual in how interested I was in other people or activities.
1 I noticed that I was less interested in people or activities.
2 I found I had interest in only one or two of the activities I used to do.
3 I had virtually no interest in the activities I used to do.

20. Energy level:

0 There was no change in my usual level of energy.
1 I got tired more easily than usual.
2 I had to make a big effort to start or finish my usual daily activities (for example: shopping, homework, cooking or going to work).
3 I really couldn't carry out most of my usual daily activities because I just didn't have the energy.

21. Capacity for pleasure or enjoyment (excluding sex):

0 I enjoyed pleasurable activities just as much as usual.
1 I did not feel my usual sense of enjoyment from pleasurable activities.
2 I rarely got a feeling of pleasure from any activity.
3 I was unable to get any pleasure or enjoyment from anything.

0

1 Sometimes I got headaches or pains in my stomach, back or joints but these pains were only temporary and they didn't stop me from doing what I needed to do.

2 I had these sorts of pains most of the time.

3 These pains were so bad they forced me to stop what I was doing.

23. Other bodily symptoms:

0 I didn't have any of these symptoms: heart pounding fast, blurred vision, sweating, hot and cold flashes, chest pain, palpitations, ringing in my ears, or shaking.

1 I had some of these symptoms but they were mild and were only temporary.

2 I had several of these symptoms and they bothered me quite a bit.

3 I had several of these symptoms and when they occurred I had to stop doing whatever I was doing.

27. Panic/phobia symptoms:

0 I had no panic attacks or specific fears (phobias) (such as animals or heights).

1 I had mild panic attacks or fears that didn't usually change my behaviour or stop me from functioning.

2 I had significant panic attacks or fears that forced me to change my behaviour but didn't stop me from functioning.

3 At least once a week, I had panic attacks or severe fears that stopped me from carrying on my daily activities.

28. Constipation/diarrhea:

0 There was no change in my usual bowel habits.

1 I had intermittent constipation or diarrhea which was mild.

2 I had diarrhea or constipation most of the time but it didn't interfere with my day-to-day functioning.

3 I had constipation or diarrhea for which I took medicine or which interfered with my day-to-day activities.

29. Sensitivity to others:

0 I didn't feel easily rejected, slighted, criticized or hurt by others at all.

1 I occasionally felt rejected, slighted, criticized or hurt by others.

2 I often felt rejected, slighted, criticized or hurt by others, but these feelings had only slight effects on my relationships or work.

3 I often felt rejected, slighted, criticized or hurt by others and

these feelings impaired my relationships and work.

30. Feeling weighted down/physical energy:

0 I didn't experience the physical sensation of feeling weighted down and without physical energy.

1 I occasionally experienced periods of feeling physically weighted down and without physical energy, but without a negative effect on work, school, or activity level.

2 I felt physically weighted down (without physical energy) more than half the time (4 days or more out of the past 7 days).

3 I felt physically weighted down (without physical energy) most of the time, several hours a day, several days a week.

Appendix D

Demographic Survey

SECTION I – General Information

Age: _____

Gender: Female _____ Male _____

Ethnicity: African American_____ Asian American _____

Caucasian _____ Hispanic _____

Other *(Please specify)* _____

Highest Level of Completed Education: High School/GED _____

Associate's degree _____ Bachelor's degree _____ Master's degree _____

Doctoral degree _____

SECTION II – Military Service Information

Current military status: Active Duty _____ Retired _____ Reserves _____

Branch of Service: Air Force _____ Army _____ Coast Guard _____

Marine Corps _____ National Guard/Reserves _____ Navy _____

Country of Deployment (Check all that apply): Iraq _____ Afghanistan_____

Kuwait _____ Vietnam _____ Korea _____ Germany _____

Other (*Please specify)*_____

Number of Times Deployed: _____

Return Date of Most Recent Deployment (Mo/Yr): _____

Total Time Spent Deployed (In months): _____

SECTION III – Health History

During any of your military deployments did you experience any of the following events? *(Check all that apply)*:

Blast _____
Vehicular accident/crash (including aircraft) _____
Fragment wound or bullet wound above the shoulders _____
Fall _____

Did you have any of these symptoms IMMEDIATELY afterwards? *(Check all that apply)*:

Losing consciousness/"knocked out" _____
Being dazed, confused, or "seeing stars" _____
Not remembering the event _____
Concussion _____
Head injury _____

Did any of the following problems begin or get worse afterwards? *(Check all that apply)*:

Memory problems or lapses _____
Balance problems or dizziness _____
Sensitivity to light _____
Irritability _____
Headaches _____
Sleep problems _____

In the <u>past week</u>, have you had any of the following problems? *(Check all that apply)*:

Memory problems or lapses _____
Balance problems or dizziness _____
Sensitivity to light _____
Irritability _____
Headaches _____
Sleep problems _____

Have you ever been tested for Posttraumatic Stress Disorder (PTSD)? Yes_____
No_____ Don't know _____

Have you ever suspected that you have PTSD? Yes_____ No_____

Have you ever been diagnosed with PTSD? Yes_____ No_____

If yes, date of PTSD Diagnosis (Mo/Yr): _____

PTSD Treatments Tried *(Check all that apply)*: Group Psychotherapy _____

Individual Psychotherapy _____ Prescription medication _____

EMDR (Eye Movement) _____ Prolonged Exposure Therapy _____

EFT (Tapping) _____ Cognitive Processing Therapy _____

Couples/Family Psychotherapy _____

Other (*Please specify*) _____

PTSD Treatments Currently Using *(Check all that apply)*: Group Psychotherapy _____

Individual Psychotherapy _____ Prescription medication _____

EMDR (Eye Movement) _____ Prolonged Exposure Therapy _____

EFT (Tapping) _____ Cognitive Processing Therapy _____

Couples/Family Therapy _____

Other (*Please specify*) _____

On a scale of 1 to 10 please rate the effectiveness of each of the PTSD treatments you have tried and/or are currently using.

Have you ever been diagnosed with depression? Yes_____ No_____

Have you ever participated in psychotherapy to treat depression? Yes_____ No_____

Have you ever been prescribed medication for depression? Yes_____ No_____

SECTION IV – Yoga Experience

Do you currently practice yoga?
Yes_____ No_____

Do you currently practice meditation or any other mindfulness exercise?
Yes_____ No_____

Have you ever tried Bikram-style hot yoga? Yes_____ No_____

When did you first start practicing Bikram-style hot yoga? (Mo/Yr) _____

How often do you currently practice Bikram-style hot yoga? (# of times/week) _____

How long have you *regularly* practiced Bikram-style hot yoga? "Regularly" is defined as practicing at least 2 times per week, on average.

Years _____ Months _____ Weeks _____

How many times did you practice Bikram-style hot yoga in the past month? _____

On a scale of 1 to 10, please rate how helpful Bikram-style hot yoga has been for you? _____

Have you experienced any negative side effects from practicing Bikram-style hot yoga?

Yes_____ No_____

Is there anything else you would like the researchers to know about your experience practicing Bikram-style hot yoga?

OR

Is there anything else you would like the researchers to know about military-related stress?

Appendix E

Study Announcement Flier

ATTENTION MILITARY SERVICE MEMBERS

IF YOU ARE ACTIVE DUTY, RESERVES OR RETIRED UNITED STATES MILITARY, YOU ARE ELIGIBLE TO PARTICIPATE IN THE STUDY.

AII VETERANS OF ANY ERA ARE ENCOURAGED TO PARTICIPATE.

This research project will examine the effect of Bikram-style hot yoga on military-related stress. Study participation requires about 15 minutes of your time to fill out an online questionnaire.

Your participation may help researchers gain important information regarding effective treatments for military-related stress.

If you are interested, please go to the Bikram-style website (www.Bikram-styleyoga.com) and then go to the "VA and Military" webpage where you will find a link to the study.

Appendix F

Informed Consent Agreement

Alliant International University
5130 E. Clinton Way
Fresno, California 93727

You are being asked to participate in a research study. However, before you give your consent to be a volunteer, we want you to read the following to be sure that you understand what your participation will involve.

INVESTIGATORS

Brenda Mueller, MA (559) 240-8022
Amy Tillery, PhD (559) 253-2203

PURPOSE OF THE RESEARCH

The purpose of this study is to investigate military-related stress in active duty, reserves, or retired military service members.

PROCEDURES TO BE FOLLOWED DURING THE RESEARCH

If you agree to participate in this research you will first read this Informed Consent document. You will then be asked to answer an online survey, which will contain questions regarding stress, your military service experience and your health history. It will take approximately 15 minutes to complete the online survey.

RISKS

Participants in this study are subjected to minimal risk. Minimal risk indicates the risk of harm anticipated in this study is not expected to be greater than that ordinarily encountered in daily life or during the performance of routine psychological tests. It is important that you understand that you may stop participating in this study at any point for any reason, without any negative consequences from the researchers, the university, or any other individuals involved in this study. If while completing the questionnaires, or after, you experience discomfort and feel the need to talk to someone regarding thoughts or feelings related to these questions, please contact the researchers and you will be provided a list of clinical referrals.

BENEFITS OF THE RESEARCH

Although it cannot be guaranteed that you will benefit from participation, the results of this study may help researchers gain important knowledge about effective treatments for military-related stress.

CONFIDENTIALITY

You have a right to privacy and no information identifying you will be solicited. In addition, all responses will remain confidential. In order to ensure anonymity and confidentiality, an identification number will be associated with your completed online survey instead of your name. The results of this study may be published in scientific journals or be presented at medical conferences, as long as you are not identified and cannot be reasonably identified.

QUESTIONS ABOUT THE RESEARCH

Should you have any questions about the research or any additional concerns, please contact Dr. Amy Tillery at (559) 253-2203 or Brenda Mueller at (559) 240-8022. If you would like a copy of the study results, please contact Brenda Mueller upon termination of the study.

PARTICIPANT RIGHTS AND RESEARCH WITHDRAWAL

Your participation in this study is voluntary. You may refuse to participate or withdraw once the study has started. In either case, you will not be penalized.

We have tried to explain all the important details about the study to you. If you have any questions that are not answered here, your research investigators will be happy to give you more information.

ACKNOWLEDGMENT AND CONSENT

I acknowledge that I have read this agreement. I agree to participate in the study.

Appendix G

Survey Quality Control Questions

Attention Filter #1

In order to make sure that we have your attention, please select "Concussion" from the answers below:

- ❑ Losing consciousness/"knocked out"
- ❑ Being dazed, confused, or "seeing stars"
- ❑ Not remembering the event
- ❑ Concussion
- ❑ Head injury
- ❑ None

Attention Filter #2

Have you been reading these instructions? Please select "Yes".

- ❍ Yes
- ❍ No

Attention Filter #3

	Not at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
To continue, please select "A little bit"	❍	❍	❍	❍	❍

Military Knowledge Question

If you were on a U.S. military base and you wanted to buy a week's worth of groceries, you would shop at the:

- ❍ Mess Hall
- ❍ VA
- ❍ Commissary
- ❍ Armed Forces Food Supply