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EFFICACY OF A COGNITIVE-BEHAVIORAL TREATMENT FOR INSOMNIA AMONG AFGHANISTAN AND IRAQ (OEF/OIF) VETERANS WITH PTSD

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University

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Abstract

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Sleep disturbances are a core and salient feature of PTSD and can maintain or exacerbate associated symptoms. Recent research demonstrates that cognitive-behavioral sleep-focused interventions improve sleep disturbances as well as PTSD symptoms. The present study is a randomized controlled trial comparing Cognitive Behavioral Therapy for Insomnia (CBT-I) to a waitlist control group. Conducted at a Veterans Affairs Medical Center, the study: 1) compared subjective outcome measures of sleep amongst veterans assigned to either a treatment group (CBT-I) or a waitlist control group; (2) examined the influence of the intervention on measures of PTSD, general mood and daytime functioning, comparing veterans in a treatment group to those in a waitlist control group and (3) examined

the effect of the CBT-I intervention using objective measures of sleep for veterans included in the treatment arm of the study.

Study participants were (n = 40) combat veterans who served in Afghanistan and/or Iraq (OEF/OIF). Participants were randomized to either a CBT-I treatment group or a wait-list control group. Those in the treatment condition participated in four CBT-I sessions over six weeks. CBT-I included sleep restriction, stimulus control, cognitive restructuring, sleep education, sleep hygiene and imagery rehearsal therapy. All participants completed subjective and objective measures at baseline and post-treatment. At six weeks post treatment, veterans who participated in CBT-I reported improved sleep, a reduction in PTSD symptom severity and PTSD-related nightmares, as well as a reduction in depression and distressed mood compared to veterans in the waitlist control group. When controlling for current participation in evidence-based PTSD treatment, veterans in the CBT-I group reported a reduction in PTSD symptom severity while their waitlist counterparts demonstrated an increase in these PTSD symptoms. Veterans in the treatment group also reported improved objectively measured sleep quality between baseline and posttreatment.

These data suggest that CBT-I is an effective treatment for insomnia, nightmares and PTSD symptoms in OEF/OIF veterans with combat related PTSD and should be used as an adjunctive therapy to standard PTSD treatment.

Efficacy of a Cognitive-Behavioral Treatment for Insomnia among Afghanistan and Iraq (OEF/OIF) Veterans with PTSD

The current conflicts in Iraq and Afghanistan have resulted in thousands of military personnel returning home psychologically damaged and wounded. Estimates indicate that approximately 20% of these military personnel will develop Posttraumatic Stress Disorder (PTSD) post deployment (Seal, Metzler, Gina, Bertenthal, Maguen & Marmar, 2009; Hoge, McGurk, Thomas, Cox, Engel, & Castro, 2008). Sleep disturbances are a core feature of PTSD and yet they rarely garner non-pharmacologic therapeutic attention (Harvey, Jones & Schmidt, 2003). Furthermore, insomnia and chronic nightmares are often resistant to standard pharmaceutical and psychological treatments of PTSD (Zayfert & DeViva, 2004; Galovsi, Monson, Bruce, & Resick, 2009). Such sleep disturbances have a significant impact on overall PTSD and can maintain and/or exacerbate PTSD severity (Spoormaker & Montgomery, 2008; Belleville, Guay, & Marchand, 2009). Recent research has shown that sleep-focused interventions can improve both sleep disturbances and PTSD symptoms (DeViva, Zayfert, Pigeon, & Mellman, 2005; Germain, Shear & Buysse, 2007; Ulmer, Edinger & Calhoun, 2011).

The purpose of the present study is to examine the effects of a brief cognitive-behavioral intervention (four sessions) for PTSD-related insomnia in Operation Enduring Freedom and Operation Iraqi Freedom (OEF/OIF) veterans. To date, there have been very few investigations of such treatment with OEF/OIF veterans. The goals of the proposed intervention are to create significant improvements in sleep as well as decrease the severity of PTSD symptoms from which these veterans suffer. If proven to be effective, this treatment approach can be implemented as a time- and cost-effective adjunct to the standard PTSD

treatment and in turn provide a more comprehensive and high quality approach to services for veterans diagnosed with PTSD.

The present study begins with a review of the literature on posttraumatic stress disorder and the co-occurrence of PTSD with insomnia and chronic nightmares. Theories behind the co-occurrence of PTSD and sleep disturbances as well as physical and psychological implications are reviewed. Finally a review of cognitive behavioral therapy for insomnia (CBT-I) and imagery rehearsal therapy (IRT) as therapeutic interventions for insomnia and chronic nightmares, respectively, are discussed and examined within the context of current research looking at the implications for these interventions for treating PTSD and more specifically, combat-related PTSD.

As stated above, this study will evaluate the implementation of a brief cognitive-behavioral intervention for insomnia amongst OEF/OIF veterans using a randomized controlled trial. Veterans diagnosed with PTSD will be assigned to either a Cognitive Behavioral Therapy for Insomnia treatment (CBT-I) group or to a waitlist control group. Given the impact of poor sleep on PTSD maintenance, this study aims to determine whether insomnia focused treatment will result in both better sleep and decreased PTSD symptom severity. Subjective measures of sleep, PTSD symptom presentation and overall mood and daytime functioning will be collected at baseline and two weeks posttreatment for participants in both groups. It is hypothesized that after four sessions of CBT-I, veterans in the treatment group will report improved sleep, decreased PTSD symptom severity and an overall improvement in mood and daytime functioning compared to their waitlist counterparts. Objective outcome measures of sleep will also be collected for veterans in the

treatment group at baseline and posttreatment. If the treatment is effective, veterans should show improvements on these objective measures of sleep at a two-week follow-up.

Review of the Literature

Posttraumatic Stress Disorder (PTSD)

Posttraumatic stress disorder (PTSD) is a clinical syndrome that is characterized by reexperiencing of a traumatic event, avoidance of reminders of the event, and physiological hyperarousal symptoms that occur for more than one month after exposure to a traumatic event (APA, 2000). A traumatic event can include a violent crime, natural disasters or combat exposure, and must be associated with a threat to the integrity of the self and/or others. While exposure to such trauma is not rare – it is estimated that about 60% of the population will be witness to a traumatic event - it has been found that only 8-14% of the population will develop PTSD after being witness to trauma. The chances of being exposed to trauma and consequently developing PTSD are estimated to be higher for individuals who are victims of interpersonal violence (Breslau et al., 1998) and who are combat veterans (15-30%) (Weiss et al., 1992).

Emerging data examining the current conflicts in Afghanistan and Iraq indicates that the long term effects of living through chronic trauma during combat are taking a significant toll on the mental health of military personnel (Tanielian et al., 2008; Hoge et al., 2008). It is estimated that approximately 20% of soldiers will develop PTSD, most likely during post-deployment (Seal et al., 2009; Hoge et al., 2008). More recently, researchers argue that this estimate is likely to rise over time given the nature of these conflicts and the multiple deployments involved (Germain, Buysse, & Nofzinger, 2008).

Sleep disturbance and PTSD. Sleep disturbance is a core feature of posttraumatic stress disorder (PTSD) (Spoormaker & Montgomery, 2008; Germain, Shear, Hall & Buysse, 2007) and some have identified it as a hallmark symptom of PTSD (Ross, Ball, Sullivan, &

Caroff, 1989). Insomnia and nightmares are diagnostic symptoms of PTSD and symptom severity is related to trouble initiating sleep, maintaining sleep and nightmares (APA, 2000). Recent research suggests that reexperiencing symptoms of PTSD are specifically related to trouble initiating sleep, maintaining sleep and nightmares while hyperarousal symptoms are related to trouble maintaining sleep and nightmares (Babson et al., 2011). In addition to such sleep difficulties, sleep disordered breathing and periodic leg movement are frequently reported by individuals diagnosed with PTSD (Krakow et al., 2001; Maher, Rego & Asnis, 2006). For the purposes of this research proposal however, the focus will be limited to insomnia and nightmares.

Insomnia is defined as a disorder of initiating or maintaining sleep and nonrestorative sleep for at least one month (APA, 2000). Further, in order to meet *DSM-IV* criteria, the sleep disturbance must cause clinically significant distress or impairment in social, occupational or other important areas of functioning (APA, 2000). In particular, insomnia can include difficulties falling asleep, frequent awakenings throughout the night, and early awakenings in the morning. The etiology of insomnia is theorized to be dependent on predisposing, precipitating and perpetuating factors (Spielman, 1986).

Large studies conducted with both civilian and combat populations indicate that 70-91% of participants with PTSD have difficulties falling or staying asleep (Ohayon & Shapiro, 2000; Neylan et al., 1998). Further, results from these studies indicate a high correlation between PTSD symptom severity and sleep disturbances. In one research study that assessed sleep disturbances in participants with PTSD from the general population, it was found that sleep disturbances affected 70% of the PTSD participants (Ohayon & Shapiro, 2000). In another study, 44% of Vietnam veterans with PTSD reported difficulty falling asleep

(compared to 5.5% of veterans without PTSD) and 91% reported difficulty maintaining sleep (Neylan et al., 1998). In addition, insomnia has been found to be predictive of PTSD such that in one study examining accident victims, insomnia symptoms reported soon after the injury were associated with an increased risk for PTSD at a one-year follow-up (Koren, Arnon, Lavie, & Klein, 2002). More recently, researchers (Picchioni et al., 2010) assessed whether sleep disturbances (insomnia and nightmares) mediate the relationship between combat stressors and other health symptoms in Iraq war veterans. Examining the archival data of 576 Army veterans who responded to a packet of questionnaires three months after a 15-month deployment, these researchers found that insomnia and nightmares partially mediate the relationship between combat stressors and mental health symptoms. Based on these findings, they concluded that sleep disturbances might contribute to and/or maintain other mental health symptoms frequently observed post combat such as PTSD and depression.

In contrast to the aforementioned research based on subjective measures, studies using objective measures have yielded more inconsistent findings (Calhoun, Wiley, Dennis, Means, Edinger, & Beckham, 2007; Mellman, Pigeon, Nowell, & Nolan, 2007). Objective measures in this research include polysomonography (PSG) or actigraphy. PSG involves placing surface electrodes on the scalp and face to measure physiological activity such as electrical activity of the heart, brain wave patterns, muscle activity, and eye movements while an individual is sleeping. Based on these measurements, an individual's "sleep architecture" can be better understood (Harvey, Jones & Schmidt, 2003). Actigraphy, a less "resource intensive" process, monitors human rest/activity cycles and from this movement infers sleep. In particular, actigraphy includes a movement detector and memory storage on a

watch-like device that can be worn continuously for one week or longer (Lichstein et al., 2006). Although the actigraph cannot assess specific sleep architecture, the validity of actigraphy as a comparable measure to PSG has been well established (Calhoun, 2007). Further, the actigraphy is more sensitive than subjective sleep diaries for measuring sleep disturbance and fragmentation.

Studies implementing these objective measures (PSG and Actigraphy) in laboratory settings have produced findings that do not consistently support subjective complaints of poor sleep in patients diagnosed with PTSD. In a recent study testing PSG recordings of ten young-adult PTSD patients within 1 to 3.5 years after a traumatic event, Habukawa and colleagues (2007) found that PTSD patients demonstrated significantly poorer sleep, reduced sleep efficiency and increased awakening from rapid eye movement (REM) sleep compared to the control participants. In two studies examining sleep disturbance in participants with combat related PTSD, increased eye movement density was associated with combat related PTSD (Mellman, Nolan, Hebding, Kullick-Bell & Dominguez, 1996; Ross et al., 1994). Two other studies (Breslau et al., 2004; Mellman et al., 2002) similarly observed REM interruption in PTSD patients. Breslau and colleagues (2004) compared PSG recordings of 71 participants with lifetime PTSD to a control and found that patients with PTSD reported higher rates of brief arousal from REM sleep and that shifts to lighter sleep and wake were specific to REM sleep and significantly different than non-REM sleep. However results from this study failed to find objective evidence of clinically relevant sleep disturbances in patients with PTSD. Such a lack of objective evidence is consistent with other findings (Klein, Koren, Arnon & Lavie, 2003; Lavie, 2001) that suggest subjective reports of sleep disturbances to be incongruent with objective measures. Mellman and researchers (2002)

prospectively examined twenty-one injured participants within one month of a traumatic event and found more PSG measured fragmented REM sleep in patients who developed PTSD compared to those who had not. These researchers replicated these findings, in a recent study examining thirty-five PTSD patients in the early aftermath of trauma (Mellman et al., 2007). Despite the objective findings of sleep disturbances observed in patients with PTSD, there still exists a discrepancy between these observations and those detected using subjective measures such as sleep diaries (Germain, 2009).

With respect to the inconsistent results of these objective studies conducted in laboratory settings, some researchers argue that laboratory research on sleep is problematic in that it does not mirror the same associations and learned behaviors that occur in the natural sleep environment. Further, these researchers claim that patients with PTSD may actually get better sleep in the absence of conditioned cues for bad sleep and nightmares (Germain, Hall, Shear, Nofzinger & Buysse, 2006; Calhoun et al., 2007). In a recent pilot study using in-home PSG, Germain and colleagues (2006) found that individuals with PTSD showed longer sleep latency (time to fall asleep) and reduced sleep time compared to controls in a sample of adult crime victims. Other researchers (Calhoun et al., 2007) objectively examined sleep disturbance among women with PTSD in their home environment using actigraphy and found that relative to controls, participants with PTSD had poorer sleep efficiency, increased sleep latency and more restless sleep. Thus it appears that findings from home-based studies using these objective measures are more consistent and further support the connection between PTSD and insomnia.

Chronic Nightmares in PTSD. Sleep disturbances for patients with PTSD are also characterized by chronic nightmares (Phelps, Forbes, & Creamer, 2008; Davis & Wright,

2007; Harvey, Jones, & Schmidt, 2003), which are conceptualized as one of the "re-experiencing symptoms" of PTSD (Phelps et al., 2008). In a recent study examining individuals exposed to trauma, it was found that individuals diagnosed with PTSD were more likely to report experiences of nightmares and sleep disturbance than individuals without PTSD (Davis, Byrd, Rhudy, & Wright, 2007). A growing body of evidence also suggests that nightmares are associated with insomnia and body movements during sleep (DeViva, Zayfert, & Mellman, 2004; Germain & Nielsen, 2003) and that they can trigger fear about falling and staying asleep (Krakow et al., 2001). Consistent with this evidence has emerged a theoretical model that views the experience of nightmares as an independent sleep disorder that is comorbid with, rather than secondary to, PTSD (Moore and Krakow, 2010). Current research showing the negative impact of chronic nightmares on sleep supports this theory (Krakow et al., 2004; Krakow et al., 2001). In a recent study that prospectively examined the extent to which posttraumatic nightmares determined development of insomnia symptoms in motor vehicle accident victims, it was found that nightmares reported three months after the accident significantly predicted sleep maintenance problems at a one-year follow-up (Kobayashi, Sledjski, Spoonster, Fallon, & Delahanty, 2008).

In research looking at the general population (Ohayon & Shapiro, 2000), participants with PTSD were more likely to report nightmares (19%) compared to the non- PTSD sample (4%). Furthermore, it has been found that the presence and severity of posttraumatic nightmares are associated with symptom severity (Mellman, David, Bustamante, Torres & Fins, 2001) and specifically severity of reexperiencing symptoms (Davis, 2009; Spoormaker & Montgomery, 2008).

A significant amount of research has also looked at posttraumatic nightmares in combat populations. Within this group, chronic nightmares are considered a "persistent feature of chronic combat-related PTSD" (Forbes, Phelps, McHugh, Debenham, Hopwood & Creamer, 2003, p. 509). In studies conducted by Neylan and colleagues (1998), 52% of Vietnam veterans reported that they experienced nightmares compared to 5% of veterans without PTSD. As the research suggests, chronic nightmares are a significant component of the posttrauma response (Davis, 2009; Phelps et al., 2008) and are considered a “hallmark” of combat related PTSD (Harb, Cook, Gehrman, Gamble & Ross, 2009).

The Effect of Insomnia and Chronic Nightmares on Functioning with PTSD. As independent syndromes, insomnia and nightmares have been shown to have a negative impact on health, functioning, and quality of life and can lead to problems with depression and anxiety (Rybarczyk & Mack, 2009; Germain et al., 2007). From this perspective, it stands to reason that sleep disturbances such as insomnia and chronic nightmares would serve to both exacerbate and maintain PTSD-related symptoms, particularly given that sleep has a "restorative function" and is important for "emotional processing" (Harvey, Jones, & Schmidt, 2003). Several studies have sought to further understand this impact and show that such sleep disturbances play a significant role and are not merely secondary posttraumatic stress symptoms (Krakow et al., 2004).

As mentioned previously, Koren, Arnon, Lavie, and Klein (2002) found that sleep disturbances have "prognostic significance" for participants with PTSD. Specifically, they found that sleep complaints made one month after a traumatic event predicted PTSD one year later. Mellman and colleagues (2001) found that complaints of nightmares within one month of the traumatic event predicted greater PTSD symptom severity six weeks later. Such

findings support the idea that sleep disturbances (insomnia and nightmares) contribute to difficulties with daytime functioning. "If deprived of adequate sleep, one would expect the trauma survivor to be more sensitized to, reactive to, and therefore more avoidant of exposures to reminders of the trauma whereas a well-rested state would enhance an individual's capacity for coping" (Rothbaum & Mellman, 2001, p. 485).

Further, researchers (Krakow et al., 2001) argue that both daytime and nighttime disturbances in adaptive functioning may interfere with the processing of the traumatic event as well as increase symptoms of anxiety, and that current treatment approaches to PTSD could benefit from evidence-based treatments used in the field of sleep medicine (Krakow et al., 2004). Effective treatment of insomnia and chronic nightmares thus should result in improvement in daytime functioning (Morin, 2003; Rybarczyk, Stepanski, Fogg, Lopez, Barry & Davis, 2005; Germain, 2008). Given these findings and empirically supported arguments, it becomes increasingly clear that specific interventions focusing on sleep disturbances warrant consideration. The next section will focus on such cognitive behavioral conceptualizations and treatment approaches to insomnia and chronic nightmares.

Insomnia and Chronic Nightmares

Insomnia. As noted previously, insomnia is defined as a disorder of initiating or maintaining sleep and nonrestorative sleep for at least one month (APA, 2000). Morin (2004) suggests that in addition to these APA diagnostic criteria, clinicians should be in the habit of identifying specific “markers” that will help in making more clinically meaningful insomnia diagnoses. He specifically identifies these markers as (1) the amount of time required to fall asleep and (2) the duration of awakenings. Such specificity, he suggests, will assist in clinicians’ understanding of the nature of a patient’s insomnia. He also asserts that total sleep

time is not a sufficient indicator of "non restorative sleep" because of individual differences in sleep needs. Rather, inadequate sleep (insomnia) develops as a result of fragmented and unconsolidated sleep, which can be better understood when assessing for these markers.

Within the past two decades, a diathesis-stress conceptualization of insomnia has become the standard theoretical framework from which researchers examine and treat insomnia (Spielman, 1986; Webb, 1988; Drake, Roehrs, & Roth, 2003; Morin, 2004). According to this model, "predisposing factors" (i.e. a predisposition to a sensitive sympathetic arousal system) together with "precipitating events" (i.e. a stressful event such as a trauma or a medical condition) contribute to the development of a sleep disturbance such as insomnia. Further this model posits that this insomnia is maintained by "perpetuating mechanisms." In particular, cognitive and behavioral factors that emerge with the development of insomnia sustain and perpetuate insomnia. Based on this theory, researchers hold that insomnia treatment must in turn focus on these perpetuating mechanisms (Morin, 2004; Spielman, 1986; Edinger, 2005). Specifically, it is argued that treatment of insomnia should target beliefs about sleep and habits related to an individual's sleep behaviors that maintain abnormal sleep patterns. The specifics of such an intervention will be further detailed below.

Insomnia Intervention. To date, the most common treatment approach for insomnia has been pharmacotherapy (Edinger et al., 2009). However, although it has been found that pharmaceutical approaches may be effective in the short term, long-term use has been found to involve a risk of dependency and tolerance (National Institutes of Health, 2005). Alternatively, psychological approaches to insomnia (cognitive and behavioral) designed to focus on sleep disruptive beliefs and habits have proven to be as effective as

pharmacotherapy in the short-term and more effective in the long term (Smith et al., 2002; Sivertsen et al., 2006). In a randomized controlled trial comparing cognitive behavioral therapy for insomnia (CBT-I) and Zopiclone (Lunesta), Sivertsen and colleagues (2006) found that at a six-month follow-up CBT-I participants increased their sleep efficiency (the ratio of time asleep to time in bed) while those participants receiving Zopiclone showed a decrease in sleep efficiency. Furthermore, a recent review of thirty-seven insomnia treatment studies conducted from 1998-2004 (Morin et al., 2006) confirmed the efficacy of CBT-I and indicated that such a treatment approach leads to sleep improvements that persist in the long term. A more current meta-analysis reviewing insomnia treatment studies published from 1990-2009 (Okajima, Komada, & Inoue, 2011) that utilized both subjective and objective measures found further support for the efficacy of CBT-I although the objective measures showed more modest treatment effects relative to the subjective outcomes. (This finding is consistent with the research mentioned earlier regarding the discrepancies observed between objective and subjective measures of sleep.)

Overall these findings indicate that CBT-I is an effective cognitive- behavioral approach to treating insomnia. Cognitive-behavioral treatment of insomnia in this research includes a multi-component approach including behavioral and cognitive techniques for addressing insomnia. Such an approach involves the acquisition of self-management skills (Bastien, Morin, Ouellet, Blais, & Bouchard, 2004) and has shown to be as effective as medication with longer lasting effects (Goodie, Isler, Hunter & Peterson, 2009).

Cognitive-behavioral treatments for insomnia (CBT-I) combine sleep restriction (restricting time spent awake in bed) and stimulus control (restricting sleep-incompatible activities and enforcing a consistent sleep-wake schedule) as a means of standardizing an

individual's sleep schedule (Edinger & Carney, 2008) and consolidating sleep over a shorter period of time in bed (Morin, 1993). As mentioned previously, insomnia is a disorder of fragmented and disrupted sleep, not necessarily a disorder of too little sleep. As such, the primary goal of CBT-I is to consolidate a patient's sleep so that it is more efficient and more restorative. Relaxation training, sleep hygiene (focusing on health practices and environmental factors) and cognitive restructuring (Morin, 2003; Rybarczyk et al., 2005) are additional treatment components of CBT-I.

Studies implementing this multi-component treatment approach indicate greater efficacy than single component treatments (Morin et al., 1994; 2006). The majority of the evidence supporting this claim comes from studies conducted with patients diagnosed with primary insomnia. Edinger and colleagues (2001) tested the efficacy of a six-week group treatment of insomnia for seventy-five participants diagnosed with primary insomnia. The study compared CBT-I, progressive muscle relaxation (PMR), and a sham behavioral intervention. Relative to patients in the PMR group and the placebo group, patients who received CBT-I demonstrated greater sleep efficiency improvements and significant outcomes. In an effectiveness trial comparing outcomes of primary care patients treated with CBT-I to those in a waitlist control, Espie and colleagues (2001) found CBT-I to be superior on primary (sleep latency and wakefulness during the night) and secondary outcome measures (76% of the participants originally taking hypnotic medication had stopped completely at posttreatment). As the efficacy of CBT-I for primary insomnia became increasingly more established, Edinger and colleagues (2007) sought to determine the optimal amount of sessions needed for CBT-I to be effective. In a randomized clinical trial, eighty-six adults diagnosed with primary insomnia were given individual sessions of CBT-I

for one, two, four or eight weeks. Results from this study indicate that four individual, bi-weekly sessions represents the optimal dosing for CBT-I.

As is evident, the literature supports this non-pharmaceutical approach as a viable and favorable alternative for treating patients with primary insomnia. The story is somewhat different with respect to insomnia that occurs along with a psychological or medical disorder. Until recently, sleep disorders in the context of psychological or medical disorders have been viewed as secondary. For example, in patients with PTSD, sleep disorders are most often treated as a condition that is an underlying symptom of PTSD. Thus it is believed that if the PTSD is treated, the sleep disorder symptoms will resolve (Spoormaker & Montgomery, 2008). As stated previously, it is now commonly accepted that insomnia and daytime functioning can have a bi-directional affect on each other and thus the etiology of insomnia or a concurrent disorder is difficult to determine (Lichstein, Wilson, & Johnson, 2000; Stepanski & Rybarczyk, 2006). As such, there has been a shift in the conceptualization of insomnia from a syndrome that is "secondary" to other disorders to one that is "comorbid" with other disorders (Stepanski & Rybarczyk, 2006).

Along with this recent paradigm shift has been a surge in research looking at treatment efficacy for insomnia that affects both nighttime and daytime functioning with patients for whom insomnia is comorbid with other psychological or medical disorders (Lichstein, Rybarczyk, & Dillon, in press; Peterson, Rumble & Benca, 2008; Smith, Huang & Manber, 2005). In a recent review, Smith, Huang & Manber (2005) concluded that CBT-I is useful in both improving sleep and psychological and medical conditions. In a randomized waitlist control study testing the efficacy of four sessions CBT-I with forty-four older adults diagnosed with insomnia associated with a medical or psychiatric condition, Lichstein and

colleagues (2000) found that wake after sleep onset, sleep efficiency and overall quality of sleep were significantly improved at post treatment and at a three-month follow-up. In another study that randomly assigned sixty patients with insomnia comorbid with chronic pain to CBT-I or a waitlist control condition, Currie and colleagues (2000) found that patients in the CBT-I condition were significantly improved on self-report measures of sleep onset latency, wake after time asleep onset, sleep efficiency, and sleep quality and showed less nighttime motor activity as measured by actigraphy. Similarly, a study of CBT-I administered to ten women with non-metastic breast cancer revealed significant improvements in total wake time and sleep efficiency as evidenced by both self-report and polysomnographic data (Quesnel, Savard, Simard, Ivers, & Morin 2003). Moreover, results from this study indicate an association between CBT-I and significant improvements of mood, general and physical fatigue, and global dimensions of quality of life. Dirksen and Epstein (2008) found that CBT-I led to significant improvements in fatigue, depression, trait anxiety, and quality of life for seventy-two women who were three months posttreatment for breast cancer. Finally, Watanabe and colleagues (2011) found that in patients with residual depression and refractory insomnia, cognitive- behavioral therapy for insomnia combined with treatment as usual (i.e. medication) produced greater treatment effects for insomnia and depression over treatment as usual.

Further evidence of the efficacy of CBT-I for comorbid insomnia is indicated in a study of fifty-one older adults with comorbid insomnia associated with a medical illness. Rybarczyk and colleagues (2002) compared the effects of CBT-I, relaxation training and a waitlist control group. At posttreatment, CBT-I participants demonstrated greater improvements compared to waitlist participants on self-report measures of sleep efficiency,

wake after sleep onset time and overall sleep quality. Participants in the relaxation condition, on the other hand, had significantly greater improvement for total sleep time. Further, more CBT-I participants (54%) met criteria for clinically significant improvement at posttreatment and at follow-up compared to the relaxation group (34%) and the waitlist control group (6%). None of the interventions were associated with improvement of sleep continuity as measured by actigraphy.

These findings were further supported in a more recent study (Rybarczyk et al., 2005) in which ninety-two older adults with a medical condition (osteoarthritis, coronary artery disease, or pulmonary disease) were randomly assigned to classroom CBT-I or stress management and wellness (SMW) training (placebo condition). Compared to the SMW group, participants in the CBT-I condition showed significant improvement on a variety of self-report measures including sleep efficiency, sleep latency, time awake after sleep onset, naps per day, daytime impairment caused by sleep problems, global measures about sleep and beliefs about sleep. In addition, the treatment efficacy rate for CBT-I was 78% compared to 24% for the SMW condition.

Taken together, these studies support the theory that cognitive-behavioral treatment for insomnia is beneficial for patients suffering from both insomnia as well as psychological or medical conditions. Furthermore, they provide evidence that CBT-I for comorbid insomnia may affect secondary outcomes such as depression, anxiety, fatigue and global and cognitive dimensions of quality of life (Lichstein, Rybarczyk, & Dillon, in press; Dirksen & Epstein, 2008; Manber, Edinger, Gress, San Pedro-Salcedo, Kuo, & Kalista, 2008; Rybarczyk et al., 2005; Bastien et al., 2004).

CBT for Insomnia (CBT-I) Nuts and Bolts.

Sleep Scheduling. Sleep scheduling includes a combination of *stimulus control* and *sleep restriction* (Morin & Espie, 2004) and is considered "the heart of the entire intervention" (Morin, 1993). Stimulus control is based on the assumption that individuals with insomnia may engage in behaviors in the bed and bedroom that are incompatible with sleep. Specifically, when the bedroom is a place for activities such as reading, watching television, eating, and talking on the phone, to name a few, difficulties with sleep may be maintained by the association of the bedroom as a place of arousal rather than sleep (Bootzin, 1972; Engle-Friedman, Bootzin, Hazlewood & Tsao, 1992). Likewise, lying in bed awake (trying to go to sleep, waking up in the middle of the night or early in the morning) can further strengthen the association of bedroom and wakefulness (Morin & Espie, 2004). Stimulus control treatment thus focuses on creating the bedroom as a stimulus for sleep. Patients are instructed to get out of bed if they are unable to fall asleep in 15-20 minutes, to avoid using the bedroom for any activities other than sleep and sexual activity, to lie down to sleep only when tired and to get up at the same time everyday.

Sleep restriction concentrates on helping the patient make their sleep more efficient. That is, sleep restriction attempts to reduce awakenings, have patients' time in bed be more reflective of the amount of time they are actually sleeping, and thus make sleep a more compressed, continuous, and efficient process (Spielman, Saskin, & Thorpy, 1987). For the patient with insomnia, sleep is often fragmented and thus one of the main goals of sleep restriction is to consolidate a patient's sleep over a shorter amount of time in bed (Morin, 1993). Sleep restriction treatment is first conducted by assessing how much time a patient is actually sleeping through the night otherwise known as total sleep time (TST). Once the TST is determined a sleep window can be established. The patient's rising time is used as an

anchor and the time at which the patient goes to bed is determined by subtracting the TST from this anchor (Spielman, Saskin, & Thorpy, 1987; Morin 2004).

Sleep Hygiene. Sleep hygiene refers to behavioral and environmental changes that patients can make to facilitate good sleep. Lifestyle habits such as drinking caffeine and alcohol at night or exercising close to bedtime are typical behaviors that can interfere with sleep. Similarly, room temperature, lighting, and volume can also affect sleep. Thus sleep hygiene focuses on eliminating such factors that hinder rather than promote good sleep.

Cognitive Restructuring. Research indicates that patients with insomnia hold maladaptive and dysfunctional cognitions about sleep (Morin, Stone, Trinkle, Mercer & Remsberg, 1993; Morin & Espie, 2004). In particular, these patients worry about the negative consequences of insomnia and express unrealistic expectations about sleep needs as well as hopelessness and helplessness about the lack of control they have of their sleep. It has been shown that these maladaptive beliefs are associated with insomnia and that when changed they are significantly associated with sleep improvement (Edinger, Wohgemuth, Radtke, Marsh, & Quillian, 2001a; 2001b). Cognitive restructuring thus aims to change these dysfunctional beliefs by identifying and challenging these thoughts.

Combined, these four components (stimulus control, sleep restriction, sleep hygiene and cognitive restructuring) make up the CBT-I protocol as outlined by Morin (1993). The next section will focus on the theory and treatment approaches for chronic nightmares.

Chronic Nightmares.

Three-Factor Model of Post-Traumatic Nightmare Development and Maintenance. Based on the cognitive-behavioral model of insomnia discussed above, Davis (2009) suggests a three-factor model in understanding post-trauma nightmares that similarly

includes predisposing, precipitating and perpetuating factors. According to Davis (2009) predisposing factors include any pretrauma history that might make an individual more vulnerable to developing nightmares. Precipitating factors may include the trauma itself or the response to the traumatic event. Finally, as Krakow and Zadra (2006) argue, the factors that cause chronic nightmares to develop may not be the same factors that make them chronic. A host of cognitive, behavioral as well as physiological factors may be at play in maintaining and perpetuating these nightmares. This model is consistent with the current research mentioned earlier that views chronic nightmares as an independent sleep disorder.

Treatment of Chronic Nightmares. Until recently, treatment for chronic nightmares has typically been addressed using psychopharmacology (Raskind et al., 2003; 2007; Krystal & Davidson, 2007; Gehrman & Harb, 2010). More recently however, Imagery Rehearsal Therapy (IRT) has emerged as an effective and time-efficient intervention for treating chronic nightmares. Consistent with the theoretical model of chronic nightmares as an independent sleep disorder, IRT is based on a cognitive-behavioral paradigm that posits that nightmares are a "learned behavior disorder" akin to sleep disorders and that nightmares are especially prevalent in individuals with poor imagery capabilities (Moore & Krakow, 2010). In the general population, chronic nightmares have been successfully treated using imagery rehearsal therapy (IRT) both independently and as an adjunct to CBT-I (Krakow et al., 2000; Lamarche & DeKoninck, 2007). Standard IRT protocol (Krakow & Zadra, 2010) covers four sessions in which the first two sessions serve as introduction and education about nightmares, their connection to insomnia and consequent effects on daytime functioning and other disorders such as PTSD. During this first part of the protocol the patient is introduced to the concept of imagery and imagery skills are practiced and rehearsed at home. For the last two

sessions, the focus is on the nightmares themselves with an emphasis on attempting to change "the learned behavior", that is the nightmare. Specifically, patients are asked to choose a nightmare of moderate distress (for initial sessions) and then to change that nightmare. Patients are given non-directive instructions and told to "change the nightmare anyway you wish" (Niedhardt et al., 1992). Next patients are instructed to write down the changed dream and then rehearse this rescripted dream in imagination for 5-20 minutes daily. Protocol stresses the notion that IRT is not meant to be an exercise in exposure; in fact this is highly discouraged as the goal is not to create arousal in patients. Studies indicate that IRT is effective in reducing nightmare distress and nightmare frequency and that these changes are maintained at follow-up (Krakow & Zadra, 2006; Krakow et al., 2001; Germain, 2003).

Given the centrality of insomnia and nightmares to the functioning of individuals diagnosed with PTSD, one might assume that these well-validated treatments have already been well-established in the research and treatment of PTSD-related sleep disturbances. The current state of the research, however, suggests something different.

Insomnia and Nightmare Intervention for PTSD

Historically, insomnia intervention has not been the first line of treatment or even included as a specific component of PTSD treatment. Despite the *DSM-IV* definition of PTSD, sleep disturbances are often considered secondary to PTSD, and as a result, insomnia and chronic nightmares have not garnered much therapeutic attention on their own (Harvey, Jones, & Schmidt, 2003; Krakow et al., 2007). However, recent research indicates that evidence-based treatments for PTSD are not sufficient in significantly reducing sleep disturbances for this population (Galovski, Monson, Bruce, & Resick, 2009). To date, pharmacological approaches have been the treatment of choice for PTSD-related sleep

disturbances (Lamarche & DeKoninck, 2007). Although some studies indicate the efficacy of pharmaceutical treatments, as discussed previously, there is little evidence suggesting long-term efficacy of medications for insomnia and the risk of dependence is greater for those who use medications for prolonged periods (Morin & Espie, 2004). Researchers (Krakow et al., 2007; DeViva, Zayfert, Pigeon, & Mellman, 2005) argue that the frequency with which trauma survivors diagnosed with PTSD experience insomnia and nightmares, often after receiving CBT treatment for PTSD, warrants specific clinical non-pharmacological attention.

Recent research in support of this argument has shown that sleep-focused interventions for individuals with PTSD can indeed reduce sleep disturbances as well as reduce overall PTSD symptoms (Krakow et al., 2001a; 2001b; 2006; Forbes et al., 2003; Germain & Nielsen, 2003; Germain et al., 2007). These studies have implemented IRT alone or a combination of CBT-I and IRT (Germain et al., 2007; Krakow et al., 2001, 2006). Table 1 summarizes this research.

IRT for Trauma Related Nightmares. Krakow, Hollifield and colleagues (2001) found that implementation of IRT was associated with a significant reduction in number of nightmares per week, improved sleep, and decreased mean PTSD severity from severe to moderate, and that these effects were maintained at three and six month follow-up. Extending this research, Krakow, Johnston and colleagues (2001) looked at the effect of IRT, sleep hygiene, stimulus control, sleep restriction, and cognitive restructuring as an intervention for trauma-related insomnia. This study of sixty-two crime victims found that sleep quality and insomnia severity improved significantly after treatment and that these improvements were associated with significant, moderate effects for measures of PTSD severity, anxiety and depression.

Combination of CBT-I and IRT for Trauma Related Insomnia and Nightmares. In a recent pilot study, seven adult victims of violent crimes (three men and four women) with a diagnosis of PTSD received one 90-minute session that combined CBT-I and IRT (Germain et al., 2007). At posttreatment (six to eight weeks after the intervention), patients reported clinically significant improvements in sleep quality and significant improvements in overall daytime PTSD symptom severity.

Such findings provide promising evidence as to the efficacy and efficiency of this specialized treatment for individuals with PTSD. Although the research in this area is limited, the work that has been conducted suggests that such specific treatments are beneficial, especially when sleep disturbance is not addressed by traditional cognitive behavioral treatments of PTSD. The studies reviewed in this section, however, do not include participants diagnosed with PTSD related to being in a war-zone. The following section discusses recent research examining the effects of cognitive-behavioral treatments of insomnia and traumatic nightmares for veterans diagnosed with combat-related PTSD. These studies have implemented IRT alone, CBT-I alone or a combined approach using both CBT-I and IRT.

Insomnia and Nightmare Intervention for Combat-Related PTSD

IRT for Combat-Related Posttraumatic Insomnia and Nightmares. The research on psychological treatment of sleep disturbances experienced by individuals with combat-related PTSD is limited as well. Chronic nightmares have received a recent surge in research interest in the combat population. In a pilot study, Forbes, Phelps, McHugh and colleagues (2001; 2003) examined the efficacy of group administered imagery rehearsal therapy (IRT) on posttraumatic nightmares in twelve male Vietnam veterans with chronic PTSD. Treatment

consisted of six, weekly, 90-minute sessions. Participants, ranging in age from 45-50, completed self-report measures and sleep diaries for one week prior to treatment, posttreatment, and at a three and twelve-month follow-up. At the end of treatment, and at the three and twelve-month follow-up, findings indicated significant reductions in nightmare frequency and intensity. Further, improvements in overall PTSD, depression and anxiety were maintained at twelve months posttreatment.

In a case series that followed, eleven soldiers deployed to Iraq with a primary complaint of chronic nightmares, Moore and Krakow (2007) found that four individual sessions of IRT were associated with clinical improvements of acute nightmares, posttraumatic stress symptoms, and insomnia severity. Lu and colleagues (2009) in an uncontrolled study of fifteen male veterans from various combat theaters found that IRT was not associated with immediate post-treatment improvements. However, when assessed at a three-month follow-up, veterans reported a decrease in nightmare frequency and reduction of PTSD symptoms. Similarly, the efficacy of IRT was studied using chart review of VA medical records of veterans seeking treatment for chronic nightmares. In this analysis, IRT treatment completers reported significant decreases in frequency and intensity of nightmares, severity of insomnia and PTSD symptoms (Nappi, Drummond, Thorp & McQuaid, 2010).

CBT-I for Combat-Related Posttraumatic Insomnia and Nightmares. Insomnia interventions for combat related PTSD have received even less attention. One recent study conducted at the VA in Ann Arbor, Michigan (Perlman, Arnedt, Earnheart, Gormon, & Shirley, 2008) looked at a group administration of CBT-I for twenty veterans (ages ranging from 26-84 years) with chronic insomnia who had been diagnosed with at least one medical condition (chronic pain, hypertension, gastroesophageal reflux disorder, diabetes, lung

disease, bladder incontinence, liver disease) and at least one psychiatric disorder (depression, bipolar disorder, PTSD, GAD, panic, social anxiety). (It should be noted that the only exclusion criteria for this study was a diagnosis of PTSD with recurrent combat related nightmares.) The CBT-I groups were conducted weekly over eight to ten weeks and lasted 75 minutes. Findings from this group administration, based on self-report measures, indicated significant improvement of sleep efficiency as well as total sleep time. Furthermore, patients reported significant improvements in daytime functioning (less depression, anxiety and fatigue).

Combination of CBT-I and IRT for Combat-Related Posttraumatic Insomnia and Nightmares. Four more recent studies have examined a combined treatment approach of CBT-I and IRT with combat veterans. In a 2007 pilot study investigating the efficacy of seven to eight sessions of combined CBT-I and IRT in a sample of eleven Iraq war veterans, significant reductions were observed in nightmare frequency, PTSD symptoms and sleep quality (Harb et al., 2009). In 2009, Swanson and colleagues assessed a combined ten-session CBT-I/IRT group intervention with nine veterans of various combat theaters diagnosed with PTSD. Posttreatment, veterans who participated in treatment reported improvement in sleep quality and a reduction in insomnia severity, nightmare frequency and nightmare distress although no significant decreases in PTSD symptoms were reported. In another randomized controlled trial in which sixty-one Vietnam veterans were randomized to either an IRT treatment condition or an active comparison condition including psychoeducation about PTSD and nightmares as well as elements from Morin's CBT-I protocol (2006), a change in sleep quality and PTSD symptom severity was found for both groups however veterans who

received IRT, did not improve more than veterans in the comparison group on outcome variables of nightmare frequency and sleep quality (Cook et al., 2010).

More recently, using a randomized parallel group experimental design, Ulmer and colleagues (2011) examined the efficacy of a combined intervention for combat-related sleep disturbances in veterans from various combat theaters. Specifically, participants randomized to the treatment group received six bi-weekly, one-hour, individual sessions of CBT-I and IRT (the first three sessions focused on CBT-I while the last three sessions were dedicated to IRT). The control group received treatment as usual by their primary care physician. Relative to the control group, veterans who participated in the intervention reported reductions in PTSD symptoms and insomnia severity, improvements in sleep quality and sleep diary outcome measures. However the intervention did not produce a significant treatment effect for depression as was predicted.

Given the strong evidence for the efficacy of CBT-I treatment for individuals with PTSD, it is clear that continuing to examine and understand the effects of such an intervention for combat-related PTSD is an important area of research. To date, very few studies have looked at cognitive-behavioral approaches for insomnia and nightmares in this population and only a handful of studies have researched this treatment approach with the OEF/OIF veteran population.

Table 1.

Articles assessing behavioral treatments (CBT-I and IRT) for posttraumatic insomnia and nightmares

Author, year	*n*	Participants	Control Group	Treatment	Objective Measures Used	Results
Krakow et al. (2001)	62	Crime victims	No	Ten hour group treatment of IRT with sleep hygiene, stimulus control and sleep restriction.	No	Significant improvements in sleep quality and decreases in sleep impairment, nightmare frequency, PTSD symptom severity and depression at 3-month follow-up.
Krakow et al. (2001)	168	Female victims or rape or other sexual assault.	Yes	Three sessions of IRT (two 3-hour sessions spaced 1 week apart with a 1-hour follow-up 3 weeks later).	No	Significant decrease in chronic nightmares, PTSD symptom severity and improvement in sleep quality.
Germain et al., 2007	7	Male and female crime victims	No	One 90-minute individual session: IRT, Stimulus control & Sleep Restriction	No	Posttreatment (6-8 weeks) significant improvements found in sleep quality & overall PTSD symptom severity
Forbes et al., 2001; 2003	12	Vietnam veterans	No	Group administered IRT (six weekly, 90-minute sessions)	No	Significant reductions in nightmare frequency and intensity.
Moore & Krakow, 2007	11	Soldiers deployed to Iraq	No	Four individual sessions of IRT	No	Improvements of acute nightmares, posttraumatic stress symptoms, insomnia severity
Lu et al., 2009	15	Male veterans of various combat theaters	No	Six week, 90-minute IRT group of 3-5 veterans	No	No significant post-treatment improvements. However, at 3-month follow-up, found significant decreases in nightmare frequency and reduction of PTSD symptoms
Nappi et al.,	58	Veterans of	No	Four to five treatment sessions		Significant decreases in frequency and

2010		different eras of service		of IRT lasting 1 (individual) or 2 (group) hours.		intensity of nightmares, severity of insomnia, and PTSD symptoms
Perlman et al., 2008	20	Veterans of different eras of service	No	Group administered CBT-I. Eight-ten weekly sessions (75 minutes each).	No	Significant improvement of sleep efficiency and total sleep time. Significant improvements also seen in daytime functioning (less depression, anxiety and fatigue).
Harb et al., 2009	11	Iraq war veterans	No	Six session of combined CBT-I and IRT.	No	Significant reductions in nightmare frequency, PTSD symptoms and sleep quality
Swanson et al., 2009	9	Veterans of various combat theaters	No	Ten sessions of combined CBT-I and IRT	No	Significant improvement in sleep quality and reduction in insomnia severity, nightmare frequency, and nightmare distress.
Cook et al., 2010	61	Vietnam veterans	Yes	Treatment condition (IRT) vs. active (psychotherapy) comparison (psychoeducation about PTSD and nightmares with elements of CBT-I)	No	Significant change in sleep quality and PTSD symptom severity found for both groups. Veterans who received IRT did not improve more than veterans in the comparison group on variables of nightmare frequency and sleep quality.
Ulmer et al., 2011	20	Veterans of various combat theaters	Yes	Six bi-weekly, 1-hour individual sessions (3 sessions of CBT-I and 3 sessions of IRT, in that order) or waitlist control.	No	Significant reductions in PTSD symptom severity and insomnia severity compared to a wait list control. Significant improvements in sleep quality and decreases in sleep onset latency and wake after sleep onset.

PTSD and Operation Enduring Freedom/Operation Iraqi Freedom Military Personnel

Statement of the Problem. To date, it is estimated that 1.64 million U.S. troops have been deployed for Operation Enduring Freedom and Operation Iraqi Freedom (OEF/OIF) in Afghanistan and Iraq, respectively (Tanielian et al., 2008). Unlike previous U.S. wars, these two conflicts are unique in that soldiers are surviving at rates that at one time would have been inconceivable. Advances in trauma care along with improved body armor are allowing military service members to survive once fatal experiences. Unfortunately, this survival comes at a cost.

It is estimated that roughly 20% of these military personnel will struggle with Posttraumatic Stress Disorder (PTSD) after they return home from deployment (Hoge, McGurk, Thomas, Cox, Engel, & Castro, 2008). Sleep disturbances are a core feature of PTSD and are exhibited as both re-experiencing symptoms (nightmares) and hyperarousal symptoms (insomnia). The gold-standard treatment for combat related PTSD is considered exposure therapy (Prolonged Exposure and Cognitive Processing Therapy) and these interventions have been shown to have beneficial effects on PTSD severity (Karlin, Ruzek, Chard, Eftekari, Monson, Hembree, Resick & Foa, 2010). However, in and of itself exposure therapy does not seem to have a strong treatment effect on PTSD-related sleep disturbances and insomnia often persists in the absence of nightmares and hypervigilance (Zayfert & DeViva, 2004). This suggests that these PTSD related sleep disturbances might develop into independent disorders that demand intervention above and beyond standard exposure therapy. In fact, research shows that such sleep disturbances may even maintain and/or exacerbate PTSD symptom severity and thus become a barrier to standard treatment (Spoormaker & Montgomery, 2008).

As discussed here, treatments for PTSD-related sleep disturbances have proven to be effective at reducing posttraumatic insomnia and nightmares as well as daytime PTSD severity. This proposal seeks to examine the efficacy of such an intervention implemented at the Hunter Holmes McGuire Veterans Administration Medical Center with a focus on OEF/OIF veterans, given the relative paucity of research assessing cognitive- behavioral insomnia treatments for insomnia with this specific population.

The research supporting the efficacy of CBT-I for individuals with PTSD, along with the growing number of military personnel returning home with PTSD, demands an increased focus on the treatment of this population. To date, research examining the effects of insomnia treatment in combat-related PTSD is limited in several ways. The pilot studies noted above (Forbes et al, 2001; Moore and Krakow, 2007) included a small sample size and did not have a control group; thus it is not possible to infer a causal relationship between the treatment and symptom changes. The group intervention conducted at the VA (Perlman et al., 2008) was similarly limited in that there was no control group and that PTSD related nightmares were considered exclusionary criteria. Two studies cited using a combined treatment approach of CBT-I and IRT (Harb et al., 2009; Swanson, Favorite, Horin & Arnedt, 2009) were also limited in their small sample size and uncontrolled design. To date, only one study has used a randomized control design to examine the efficacy of a combined intervention approach to treating combat-related sleep disturbances (Ulmer et al., 2011). This study demonstrated the efficacy of combined treatment with a veteran combat population but was limited due to its small sample size (n =22) and lack of objective measures. The proposed research should add to the literature by addressing these limitations.

The investigation examines whether Cognitive Behavioral Therapy of Insomnia (CBT-I; Morin, 1994; 2006) combined with an abbreviated protocol of Imagery Rehearsal Therapy (IRT; Krakow et al., 2000; 2006) is beneficial and therapeutic for OEF/OIF veterans diagnosed with PTSD for whom insomnia is a major concern. The CBT-I protocol included four individual sessions addressing cognitive and behavioral issues related to sleep and nightmares. Past studies, although limited, have demonstrated the efficacy of this combined intervention with significant improvements in sleep and reductions in PTSD severity (DeViva, Zayfert, Pigeon, & Mellman, 2005; Germain, Shear, Hall, & Buysse, 2007; Harb et al., 2009; Ulmer et al., 2011). If proven to be effective, future research should seek to include veterans of all conflicts.

As described in more detail below, this study will be a randomized control trial, and intervention components will include CBT-I integrated with elements of IRT. Further, the research will be conducted in a Veterans Affairs Medical Center with recently returning troops, one of only a few studies within this line of research. Based on the literature reviewed, it is believed that effective treatment of insomnia and chronic nightmares should result in improvement in PTSD symptoms and daytime functioning in addition to an improvement in sleep quality and a decrease in frequency and intensity of nightmares (Morin, 2003; Rybarczyk et al., 2005; Germain, Buysse, & Nofzinger, 2008).

Aims and Hypotheses. The specific aims of this study are to: (1) using a randomized control trial, compare subjective outcome measures of sleep amongst OEF/OIF veterans assigned to either a treatment group (CBT-I) or a waitlist control group; (2) examine the influence of the intervention on subjective measures of PTSD, general mood and daytime functioning, comparing OEF/OIF veterans in a treatment group to those in a waitlist control

group and; (3) to examine the effect of a CBT-I intervention using objective measures of sleep for these veterans included in the treatment arm of the study.

Based on the literature and the aims of this study, it was hypothesized that: (1) veterans in the treatment group would report improvement on self-report sleep measures (sleep diaries and sleep related questionnaires) compared to the wait-list control group. These outcomes broadly included sleep quantity, sleep quality, and insomnia severity. In addition it was hypothesized that participants in the treatment group would show significant reductions in dysfunctional beliefs and attitudes about sleep compared to waitlist controls. (2) Relative to the waitlist-control condition, individuals assigned to the treatment condition would show reductions in PTSD severity and improvements in mood and daytime functioning This hypothesis is based on the literature indicating that insomnia has significant causal effects on psychosocial functioning, physical functioning and quality of life; and (3) Participants in the treatment group would show increased sleep quantity (total sleep time) and quality (sleep onset latency, wake after sleep time, sleep efficiency), according to objective measures, following treatment. It was expected that they would maintain these treatment gains at the follow-up assessments.

Methods

Objectives of Proposed Study

The primary goal of this study is to examine whether Morin's (2003) Cognitive Behavioral Therapy for Insomnia (CBT-I) combined with elements of Imagery Rehearsal Therapy (IRT) is a useful therapeutic adjunct for OEF/OIF veterans with PTSD.

This study was approved by both Virginia Commonwealth University's Institutional Review Board under the title "Effects of a Cognitive-Behavioral Treatment for Combat

Related Sleep Disturbances in Veterans with PTSD", protocol number HM12565 as well as the Hunter Holmes McGuire Veterans Affairs Medical Center's Institutional Review Board under the same title "Effects of a Cognitive-Behavioral Treatment for Combat-Related Sleep Disturbances in Veterans with PTSD", ID number 01560.

Study Site

The study took place at the mental health clinic of the Hunter Holmes McGuire Veterans Affairs Medical Center in Richmond, VA.

Experimental Overview

Veterans enrolled in the mental health clinic and participating in the OEF/OIF Outreach Program at the McGuire VAMC were invited to participate in a randomized controlled trial comparing CBT-I to a waitlist control group. For the treatment group, the study involved baseline assessment followed by four individual sessions of CBT-I and a posttreatment assessment. For the control group, the study involved baseline assessment, a six-week waitlist period in which the participants were contacted weekly, follow-up assessment and then the option to participate in treatment. Follow-up assessments for those who participated in treatment occurred at six to nine months postintervention.

At baseline, participants who provided informed consent completed questionnaires assessing sleep quality and sleep quantity, insomnia severity, beliefs and attitudes about sleep, post-traumatic severity, nighttime symptoms of PTSD, mood and daytime functioning. At posttreatment and 6-9 month follow-up, participants were asked to complete a follow-up packet consisting of the same questionnaires administered at baseline.

Participants

Participants were recruited in person and by phone by the lead investigator, Skye Ochsner Margolies, M.A. from November 2009 to May 2010. Recruitment was conducted in several ways: The investigator was invited to present the study during the last ten minutes of ongoing group sessions focusing on PTSD (i.e. PTSD Boot Camp and Young Guns) and interested veterans were invited to speak with the investigator about the study. Therapists working in the PTSD Clinic, as well as those in the general Mental Health Service, also made referrals to the study, at which time veterans were either seen that day or contacted by phone. Finally, the OEF/OIF Outreach Program social worker provided the investigator with a list of veterans who fit PTSD diagnostic criteria for the study and these veterans were contacted, screened, and if eligible, invited to participate in the study.

Informed consent was obtained in the presence of John Lynch, PhD, as required by the McGuire VAMC's IRB. Once informed consent was obtained, the participant was provided with a copy of the consent document and the original consent form was retained by the research team and filed in a locked drawer.

Inclusion Criteria. In order to be randomized to the study, participants needed to meet the following criteria: (a) be a veteran of either OEF and/or OIF (b) have a diagnosis of Posttraumatic Stress Disorder as determined by the intake conducted through the PTSD Clinic and/or the Mental Health Service Clinic (c) be currently experiencing symptoms of sleep disturbance which was determined by the investigator of the study who screened for current symptoms of sleep disturbance specifically defined as (1) at least three episodes of insomnia per week for at least six months (an episode is defined as taking at least 30 min to fall asleep, being awake for at least 60 min after falling asleep, or accumulating less than 6.5

hr of sleep per night) and (2) daytime consequences of insomnia, such as fatigue, irritability, or difficulty concentrating. This definition is based on typical research criteria (Rybarczyk et al., 2005; Perlman et al., 2008) and research diagnostic criteria as operationalized by a work group commissioned by the American Academy of Sleep Medicine (Edinger et al., 2004).

Exclusion Criteria. Individuals were ineligible for study participation if they: (1) met criteria for current (within the last six months) history of alcohol or substance dependence or abuse, bipolar or any psychotic disorder, and severe, untreated major depression; (2) were previously diagnosed with sleep apnea that was not treated; (3) were diagnosed with a seizure disorder as recent research has shown that for certain patients (diagnosed with bipolar or seizure disorder) sleep deprivation is risky as it may facilitate a manic episode and lower the seizure threshold (Smith, Huang, & Manber, 2005). Exclusionary criteria were assessed both through electronic medical records as well as during an in-person screening with the investigator prior to consent. These exclusionary criteria were determined by using the standard in current research (Rybarczyk et al., 2005; Germain, Shear, & Buysse, 2007). Participation was not restricted by age, gender, race/ethnicity, medication or other comorbidity.

Study Procedures

Baseline Assessment. During the initial session in which consent was obtained, veterans were informed that the study would involve a baseline assessment (approximately 45 minutes) and a follow-up assessment. If participants had been randomized to the treatment group, they were told they would be participating in four sessions of CBT-I and that these sessions would occur weekly with a two-week break between the second and third session. For participants in the waitlist control group, they were informed that they would be

contacted weekly over the next six weeks, after which they would fill out follow-up questionnaires and then have the option of participating in CBT-I treatment. Veterans in the waitlist control group filled out questionnaires before and after the six-week treatment time and were offered the CBT-I treatment once the initial phase was completed.

Measures at Baseline. Basic demographic information was obtained from the McGuire VAMC's electronic medical record. All measures were administered after participants consented to participate in the study and following the six-week treatment window. The following measures were administered:

Sleep Diaries were completed during the two-week baseline assessment period and for two weeks posttreatment after having filled out questionnaires. The *actigraph*, which was only used by veterans who were initially randomized to the treatment group, was worn for one week during the two-week baseline assessment and posttreatment periods.

Sleep Diary. (*see Appendix A)* The Sleep Diary (Morin, 2003) is a self-report record that is completed by participants each morning for two weeks prior to treatment, during the six-week treatment phase, and for two weeks after completion of treatment. Diaries include information about patients' bed and rising time, sleep-onset latency (SOL), frequency and total duration of awakenings (wake time after sleep-onset; WASO). Measures derived from diaries include total sleep time (TST), SOL, WASO, total wake time (TWT =SOL + WASO) and sleep efficiency (SE = [TST ÷ Time in Bed] x 100%) (Edinger et al., 2007). As a complement to this information, participants also rated their quality of sleep.

Actigraphy. Activity data was collected with an Actigraph recorder (Ambulatory Monitoring, Inc., Ardsley, New York). This system is a wrist monitor that contains a piezoelectric linear accelerometer that records both intensity and frequency of movement.

Such movement was used to determine sleep disturbance and fragmentation throughout the night (Lichstein et al., 2006). Total sleep time and sleep efficiency were computed using the software analysis program that was provided with the device. Participants wore the Actigraph on the wrist of their non-dominant hand for one week. A 30-second epoch length was used for data collection as this allowed for sufficient sensitivity to make use of the analysis software for sleep scoring. When the one-week assessment was completed, participants turned in the actigraph along with their sleep diaries and the data from the Actigraph was downloaded and stored in a PC at the McGuire VAMC.

PTSD Symptom Scale- Self Report (PSS-SR; Foa, Riggs, Dancu & Rothbaum, 1993). See Appendix B. The PSS is a self-report, 17-item measure reflecting the *DSM-IV* symptoms of PTSD. Symptom frequency is assessed by calculating symptoms endorsed in subscales (a) Re-experiencing (5 items), Avoidance (7 items) and Arousal (5 items). The PSS-SR has high internal consistency and good test-retest reliability (Foa et al., 1993).

Pittsburgh Sleep Quality Index (PSQI). See Appendix C. The PSQI (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) is a self-report 19-item measure designed to assess sleep quality during the past month. Seven domains of sleep difficulties are assessed by the PSQI: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Together, the sum of these scores for these domains yields one global score of overall sleep quality. Higher scores are a reflection of poorer sleep quality. The PSQI has a high test-retest reliability and good validity in particular for patients with primary insomnia (Backhaus. Junghanns, Broocks, Riemann, & Hogen, 2002) . Furthermore, in a recent consensus statement, it was

recommended that the PSQI be used in all treatment outcome studies as a means of standardizing insomnia research (Buysse, Ancoli-Israel, Edinger, Lichstein, & Morin, 2006).

Pittsburgh Sleep Quality Index Addendum for PTSD (PSQI-A). See Appendix D. The PSQI-A is an addendum to the PSQI and is designed to assess the frequency of disruptive nocturnal behavior (DNB), a hallmark symptom of PTSD. Specifically, participants rate the frequency of seven items that reflect DNB: general nervousness, memories or nightmares of traumatic experience, severe anxiety or panic not related to traumatic memories, bad dreams not related to traumatic memories, episodes of terror or screaming during sleep without fully awakening, and episodes of acting out dreams, such as kicking, punching, running or screaming (Germain, Hall, Krakow, Shear & Buysse, 2005). The PSQI-A has proven to be a reliable instrument with high internal consistency and good convergent validity with good sensitivity to change (Germain et al., 2005).

Insomnia Severity Index (ISI). See Appendix E. The ISI is a seven-item measure (Bastien, Vallieres & Morin, 2001) that yields a global score of sleep impairment. Participants rate sleep difficulty in terms of its severity, degree of interference with daily functioning, noticeability of such impairment to others, level of distress and overall satisfaction with sleep. This scale has good internal validity and appropriate test–retest reliability over a two-week interval. Scores vary between 1 and 5 (higher scores equal greater levels of impairment).

Dysfunctional Beliefs and Attitudes About Sleep Scale (DBAS). (*See Appendix F).* The DBAS (Morin, 1993) is a 30-item self-report scale designed to assess sleep-related beliefs and attitudes. The items measure various beliefs, attitudes, expectations, and attributions about sleep and insomnia. These cognitions reflect several conceptually derived themes such

as sleep requirement expectations, causal attributions and perceived consequences of insomnia, control and predictability of sleep, and beliefs about sleep-promoting practices. Items include a 3-inch visual analog scale, with strongly disagree and strongly agree descriptors at each end of the scale. Higher scores on the DBAS reflect more dysfunctional beliefs about sleep and misattributions of the consequences of insomnia. The DBAS has reported good internal consistency and has demonstrated measurement sensitivity to cognitive-behavioral treatment (Espie, Inglis, Harvey & Tessier, 2000; Edinger et al., 2009). Subscale scores will be calculated by using the mean scores on the items that make up the DBAS-16. Subscales include: (1) expectations for sleep; (2) worry/helplessness about sleep; (3) consequences of insomnia; and (4) beliefs about the importance of medication for sleep. The DBAS-16 represents a more streamlined version of the DBAS that is now more commonly used in the literature (Morin, Vallieres & Ivers, 2007). The DBAS-16 has good reliability and higher internal consistency than the DBAS (Carney et al., 2010).

Insomnia Treatment Evaluation Questionnaire (ITEQ). (*See Appendix G).* The ITEQ was developed by Mimeault and Morin (1999) for measuring insomnia treatment plausibility. Using a 100-mm visual analog scale ranging from *not at all* to *extremely*, participants rate the following about the treatment: (a) if the rationale made sense, (b) how acceptable the treatment was for them, (c) suitability for their sleep problems, and (d) expected effectiveness for their sleep problems.

Patient Health Questionnaire (PHQ). (*See Appendix H).*The PHQ (Spitzer, Kroenke, Williams, et al., 1999) is a modified version of Prime-MD, which consisted of a patient questionnaire and a clinician evaluation guide. The PHQ is a combination of these two components in a three-page self-report measure. The PHQ assesses eight diagnoses, which

are divided into threshold diagnoses (major depressive disorder, panic disorder, bulimia nervosa) and subthreshold diagnoses (other depressive disorder, other anxiety disorder, alcohol abuse/dependence, binge eating disorder, somatoform disorder). The PHQ has diagnostic validity comparable to the original clinician administered instrument (Spitzer, Kroenke, Williams, et al., 1999). For the purposes of this study, only the depression subscale was analyzed due to a printing error in the questionnaires that were administered in the study.

The Profile of Mood States (POMS). (*See Appendix I).* The POMS (McNair, Lorr, & Droppleman, 1971) is a 65-item self-report measure of affective states for the past week. Patients are asked to rate each item using five levels of severity. Affective states are measured by six subscales tapping into the following dimensions: vigor, tension, depression, anger, fatigue, and confusion. It has good test–retest reliability, predictive construct, and concurrent validity (McNair et al., 1971). The POMS total mood disturbance score can be used as an overall indicator of distress.

Intervention

Cognitive Behavioral Therapy for Insomnia with Imagery Rehearsal Therapy. The intervention consisted of four, 60-minute individual sessions (Edinger et al, 2007; Morin, 2003) largely based on Morin's (2003) insomnia treatment program with the added component of IRT. Skye Ochsner Margolies (SOM), M.A. provided the treatment after being trained by Bruce Rybarczyk, PhD who is an expert in sleep medicine. John Lynch, Ph.D. was on site at the McGuire VA Medical Center as a supervisor. Additionally, the treatment provider (SOM) met on a regular basis with Dr. Rybarczyk at VCU to discuss treatment progress. Sessions were conducted at the Hunter Holmes McGuire VA Medical Center during a six-week treatment period (there was a two week break between the second and

third session). The treatment arm closely followed Morin's (1993, 2003) insomnia treatment protocol with the addition of imagery rehearsal therapy components. The adaptation of IRT used in this study was based on the study conducted by Germain and colleagues (2007) in which CBT-I and IRT were combined in a one-session treatment for PTSD-related sleep disturbances in a population of seven adult victims of violent crimes. In particular, this modified and abbreviated version of IRT specifically focused on the rationale and application of imagery rescripting. Each session in this study included an educational component about sleep and behaviors or cognitions that promote or interfere with sleep quality, a review of the patient's sleep log and a discussion aimed at resolving problems the patient experienced in implementing the techniques (Rybarczyk et al., 2005).

Following a brief review on the basics of sleep and sleep architecture, the therapist reviewed the sleep diary with the participant and explained the rationale for sleep restriction. During this first session, a new sleep schedule was derived based on how many hours the patient was reportedly asleep, in contrast to how much time the participant was spending in bed. The veteran chose a wake-up time that fit with his or her schedule and from that anchor, a bedtime was established. If time permitted, Imagery Rehearsal Therapy (IRT) was also introduced in the first session to help patients restructure frequent nightmares that contribute to their insomnia. If there was not enough time during this first session, IRT was briefly introduced in session one and then more comprehensively discussed during the second session. In session, veterans were asked to select a nightmare they have had and to write it down in the first person. They were then asked to rewrite the nightmare in any way they wish so that the content is neither unpleasant nor distressing. They were then given time for an imaginal rehearsal of the new dream. Participants were told to practice this rescripted dream

at home at least three times a day for a minimum of five minutes (Germain et al., 2007). It should be noted that the investigator experienced difficulty having many of the participants engage in this portion of treatment. This issue will be addressed further in the Discussion section.

The behavioral component of the intervention included sleep-scheduling --combining both stimulus control (Bootzin & Epstein, 2000) and sleep restriction therapy (Spielman, Saskin & Thorpy, 1987) -- and sleep hygiene (Morin, 2004). These concepts were introduced in the first and second sessions and were reviewed throughout treatment. Sleep scheduling was designed to (1) help patients strengthen their associations between the bed/bedroom and sleep and (2) establish a consistent sleep-wake schedule. Participants were instructed to (a) go to bed only when sleepy, (b) get out of bed when unable to sleep and lie awake in bed no longer then fifteen minutes, (c) use the bed for sleep only (reading, television, and talking on the phone should be done in another room; sex is the only activity that is allowed in the bed), (d) wake up at the same time every morning and (e) avoid daytime naps.

Sleep hygiene education was used to introduce the patient to general guidelines about health practices and environmental factors that may either facilitate or interfere with sleep. Habits such as exercise, diet, substance use, light, noise, and temperature were a focus (Morin, 2006). The cognitive aspect of this CBT-I treatment was designed to change patients' "beliefs, expectations, appraisals, and attributions" (Morin, 2003) about insomnia. The cognitive component of the proposed treatment included cognitive restructuring and IRT (mentioned above). The main targets of cognitive restructuring were (a) unrealistic expectations about sleep needs and daytime functioning, (b) misconceptions and false attributions about the causes of insomnia, (c) distorted perceptions of insomnia's

consequences, and (d) faulty beliefs about sleep-promoting practices (Morin, 2003). In session, the therapist guided the patient in identifying dysfunctional sleep cognitions, challenging their validity and reframing these cognitions into more adaptive beliefs. Cognitive restructuring was performed throughout treatment.

Waitlist Control Group. Veterans in the waitlist control group completed baseline sleep diaries and questionnaires. During the six-week waitlist period, participants were contacted on a weekly basis. After six weeks, veterans completed another set of sleep diaries and questionnaires. At this point, they were offered the CBT-I treatment.

Follow-Up Assessments.

Two-Week Follow-Up. Two weeks after the fourth session, participants were asked to complete a follow-up packet, including each questionnaire that was administered prior to treatment. During those two weeks, all participants still completed sleep diaries and veterans in the treatment condition wore the actigraph for one week. Both the sleep diaries and the actigraph were handed in at this follow-up assessment. For the waitlist control group, participants received this same packet of questionnaires including two weeks of sleep diaries, which they completed and returned to the investigator after two weeks. Assessments were administered by the investigator and for those individuals who participated in treatment, they were reminded that the investigator would be in touch with them to complete a follow-up packet of assessments equivalent to the ones they had just completed.

Six to Nine Month Follow-Up. All participants who completed treatment were mailed a follow-up packet of questionnaires and sleep diaries.

Dependent Measures

Dependent measures included scores related to the following domains and derived from the following measures (1) Sleep: sleep diaries, ISI, PSQI, DBAS and Actigraph; (2) PTSD Symptom Severity: PTSD-SR and PSQI-A; and (3) Mood and overall Quality of Life: POMS and PHQ.

Specifically, sleep was measured by examining sleep quality (sleep efficiency, sleep onset latency, wake after sleep onset –WASO) and sleep quantity (total sleep time), as recorded in participant sleep diaries. Averages over two weeks of sleep diary recordings were calculated to derive mean scores for sleep onset latency, wake after sleep onset and total sleep time. A ratio of mean total sleep time to mean time in bed was calculated to determine a percentage value for sleep efficiency: (SE = [TST ÷ Time in Bed] x 100%). Actigraphy recordings also provided data for sleep variables measuring sleep quality and sleep quantity for the treatment condition. Further related to sleep, total scores were derived from the ISI, PSQI and the DBAS, measures that assess insomnia severity, sleep quality and beliefs about sleep, respectively. On the ISI, higher scores are indicative of more severe insomnia. For the PSQI, high scores indicate poor sleep quality and on the DBAS, high scores reflect dysfunctional thoughts about sleep. PTSD symptom severity was measured using the total sum of scores of items assessing re-experiencing, arousal, and avoidance symptoms from the PSS-SR. Nighttime sleep disturbances related to PTSD were measured using the total sum of scores from the PSQI-A. Mood was evaluated by using total sums of the depression subscale of the PHQ. Distress was measured using the total sum of scores from the POMS while component scores derived from the POMS were also used to examine daytime functioning: tension, depression, vigor, anger, confusion and fatigue.

Data Analysis

Descriptive statistics were computed to examine subject characteristics. T-test and chi-square analyses were run to examine sample representativeness and potential generalizability. These analyses also examined whether there were significant differences between treatment conditions at baseline. T-test and chi-squares further examined whether there were group differences on demographic variables.

Hypothesis #1. The first hypothesis predicted that, relative to the waitlist-control condition, individuals assigned to the treatment condition would show increased sleep quantity (total sleep time) and quality (decreased sleep onset latency, decreased wake after sleep onset, and increased sleep efficiency). It was also posited that relative to the veterans in the waitlist control condition, veterans participating in treatment would show a decrease in insomnia severity (ISI) and sleep difficulties (PSQI) and demonstrate more realistic cognitions related to sleep (DBAS). (This analysis was also included to serve as a manipulation check on the cognitive component of the treatment.) Furthermore, it was predicted that these treatment gains would be maintained at the follow-up assessment.

Intent to treat analysis was conducted to test Hypothesis #1. Specifically, baseline responses were carried over to posttreatment responses for participants who did not complete treatment or complete posttreatment questionnaires. Short-term effects were tested using a Condition (treatment condition versus waitlist control condition) x Time (baseline and posttreatment) repeated measures multivariate analysis of covariance (MANCOVA) for subjective measures of sleep recorded in the sleep diary (sleep efficiency, wake after sleep onset- WASO, sleep onset latency and total sleep time). Condition x Time repeated measures ANOVAS were used to examine self-reported feelings about sleep as measured by the ISI,

the PSQI and the DBAS. Interaction effects were examined with post-hoc analyses, specifically repeated measures ANOVAS and independent samples t-tests.

Longer-term effects (measured at six to nine month follow-up) were examined using repeated-measures ANOVA (treatment condition at baseline, posttreatment, and 6-9 month follow-up) in order to examine maintenance of treatment gains (sleep diary variables and sleep related questionnaires) for all veterans who participated in treatment.

Hypothesis #2. The second hypothesis predicted that, relative to the waitlist-control condition, individuals assigned to the treatment condition would show reductions in PTSD severity and improvements in mood and daytime functioning.

A Condition (treatment condition versus waitlist control condition) x Time (baseline versus posttreatment) repeated measures ANOVA was conducted in order to examine whether veterans in the treatment condition experienced reductions in PTSD severity, improved mood, and better daytime functioning compared to individuals in the waitlist control condition. A Condition x Time repeated measures ANCOVA was conducted in order to examine PTSD related nighttime disturbances. Baseline scores on the PSQI-A were used as a covariate to control for baseline differences between the treatment and control group. Interaction effects and post-hoc analyses were examined.

Hypothesis #3. The third hypothesis predicted that veterans in the treatment condition would show increased sleep quantity (total sleep time) and quality (sleep onset latency, wake after sleep onset, and sleep efficiency) as recorded by actigraphy. Actigraphy-measured effects were tested by using a repeated measures analysis of variance (ANOVA) to look at objective sleep efficiency, WASO, sleep onset latency, and total sleep time over time (baseline to posttreatment).

Results

Demographics

Table 2 summarizes demographic characteristics for the entire sample and separately for the treatment condition and waitlist control conditions. These data were obtained from the McGuire VAMC's electronic medical record. Overall, veterans randomized to the study were in their late-30's (mean = 37.7 years, SD=9.1), 90% were men and over 60% identified as Black. Many of the veterans were participating in PTSD treatment while also participating in this study. Overall, 65% of veterans were involved in some form of treatment for PTSD (group and/or individual). Group treatment involved PTSD support groups focusing specifically on OEF/OIF veterans. Individual treatment involved evidenced based approaches including Prolonged Exposure Therapy and Cognitive Processing Therapy. Participation in group therapy included 45% of the total sample while participation in individual treatment for PTSD included 42.5% of the total sample. Comparisons for veterans randomized to the treatment condition and the waitlist control condition were made using independent t-tests for continuous measures and chi-square analyses for categorical measures. No group differences were observed.

Table 2.

Participant Characteristics: Treatment Condition (n =20) and Waitlist Control (n =20)

	Treatment Group % or *M (SD)*	Waitlist Control % or *M (SD)*	Total Sample % or *M (SD)*
Age (years)	36.43 *(9.3)* range: 24-54	39.11 *(8.9)* range: 21-52	37.7 *(9.1)* range: 21-54
Sex			
% Male	90%	90%	90%
% Female	10%	10%	10%
Race			

% White	40%	40%	40%
% Black	60%	60%	60%
PTSD Treatment			
Group Treatment	50%	40%	45%
Individual Treatment	40%	45%	42.5%
Group and Individual Treatment	65%	65%	65%

Data Screening and Manipulation Checks

Outliers and Tests of Normality. Frequency distributions and univariate statistics were examined for evidence of non-normality and outliers. Kolmogorov-Smirnov and Shapiro-Wilk statistics and visual inspection of the data plotted on histograms were used to test for normality of the data and to detect outliers. Over the course of two assessments (baseline and posttreatment assessment) outliers were detected for three of the sleep diary variables, including: $n = 1$ on sleep efficiency at baseline ($z = 3.73$), $n = 1$ for sleep onset latency at baseline ($z = 4.8$), and $n = 1$ ($z = 4.98$) at posttreatment; $n = 2$ for wake after sleep onset at baseline ($z = 2.98$ and $z = 3.2$) and $n = 1$ at posttreatment ($z = 3.55$). Homogeneity of variance of the dependent variables was evaluated to ensure assumptions of the statistical method were not violated. Outliers for any raw scores were changed to represent two standard deviations above the mean.

Success of Randomization. Out of $n = 40$ participants who completed randomization, $n = 20$ (50%) were randomized to the treatment condition and $n = 20$ (50%) were randomized to the waitlist control condition.

Analyses were run to examine whether there were significant baseline differences between veterans randomized to experimental and control groups (see Table 3 for means and standard deviations). No significant differences were found for most sleep diary variables

(sleep onset latency, WASO, and total sleep time), baseline beliefs about sleep (DBAS), severity of insomnia (as rated on the ISI), global sleep quality (as measured by the PSQI), PTSD severity (PSS-SR), overall distress as well of reported depression, tension, vigor, anger, fatigue or confusion as measured by the POMS and depression as measured by the depression subscale of the PHQ. Veterans in the treatment condition also reported less frequent nighttime PTSD symptoms (as measured by the PSQI-A) than those in the waitlist control condition (M = 9.7, [SD=3.9] versus M = 11.4, [SD = 6.4], respectively), t (34) = 1.2, $p < .05$.

Table 3.

Baseline Comparisons: Treatment Condition (n = 18) and Waitlist Condition (n = 16)

	Treatment Group % or *M (SD)*	Waitlist Control % or *M (SD)*	Total Sample % or *M (SD)*
Sleep Efficiency	71.5 % (11.5)	76.6% (5.2)	73.9 % (9.3) range: 51 – 90%
Sleep Onset Latency (minutes)	33.4 (20.4)	28.7 (15.6)	30.4 (16.1) range: 7 - 63
Wake After Sleep Onset	36.9 (23.6)	40.9 (20.2)	38.8 (21.8) range: 9 - 78
Total Sleep Time (minutes)	282.4 (93.7)	333.6 (112.4)	306.5 (104.6) range: 135 - 519
Insomnia Severity (ISI)	19.85 (3.8)	21.4 (3.9)	20.6 (3.9) range: 13 - 28
Sleep Quality (PSQI)	14.75 (2.9)	14.82 (3.5)	14.78 (3.2) range: 8 - 20
Beliefs about Sleep (DBAS)	54.50 (10.6)	58.18 (12.3)	49.2 (11.4) range: 20 - 75
PTSD Symptom Severity (PSS-SR)	41.23 (13.9)	44.5 (13.4)	42.68 (13.6) range: 13 - 72

Nighttime PTSD symptoms (PSQI-A)*	9.7 (3.9)	11.38 (13.4)	10.44 (5.2) range: 20 - 21
Overall Distress (POMS)	117 (28.5)	118.44 (38.5)	117.68 (33) range: 49 - 181
Depression (POMS)	22.89 (12.8)	22.75 (15.1)	22.82 (13.8) range: 1 - 54
Tension (POMS)	20.39 (7.5)	21.56 (8.5)	20.9 (7.9) range: 8 - 36
Vigor (POMS)	10.94 (5.6)	11.19 (5.5)	11.1 (5.5) range: 1 - 24
Anger (POMS)	22.56 (9.6)	22.31 (12)	22.44 (10.6) range: 2 - 39
Confusion (POMS)	14.5 (4.3)	14 (5.6)	14.26 (4.9) range: 4 - 22
Fatigue (POMS)	16 (5.1)	17.81 (6.5)	16.85 (5.8) range: 1 - 24
Depression (PHQ-9)	13.31 (3.8)	13.18 (5.9)	13.26 (4.8) range: 4 -25

* = Significant baseline differences between veterans randomized to experimental and control groups

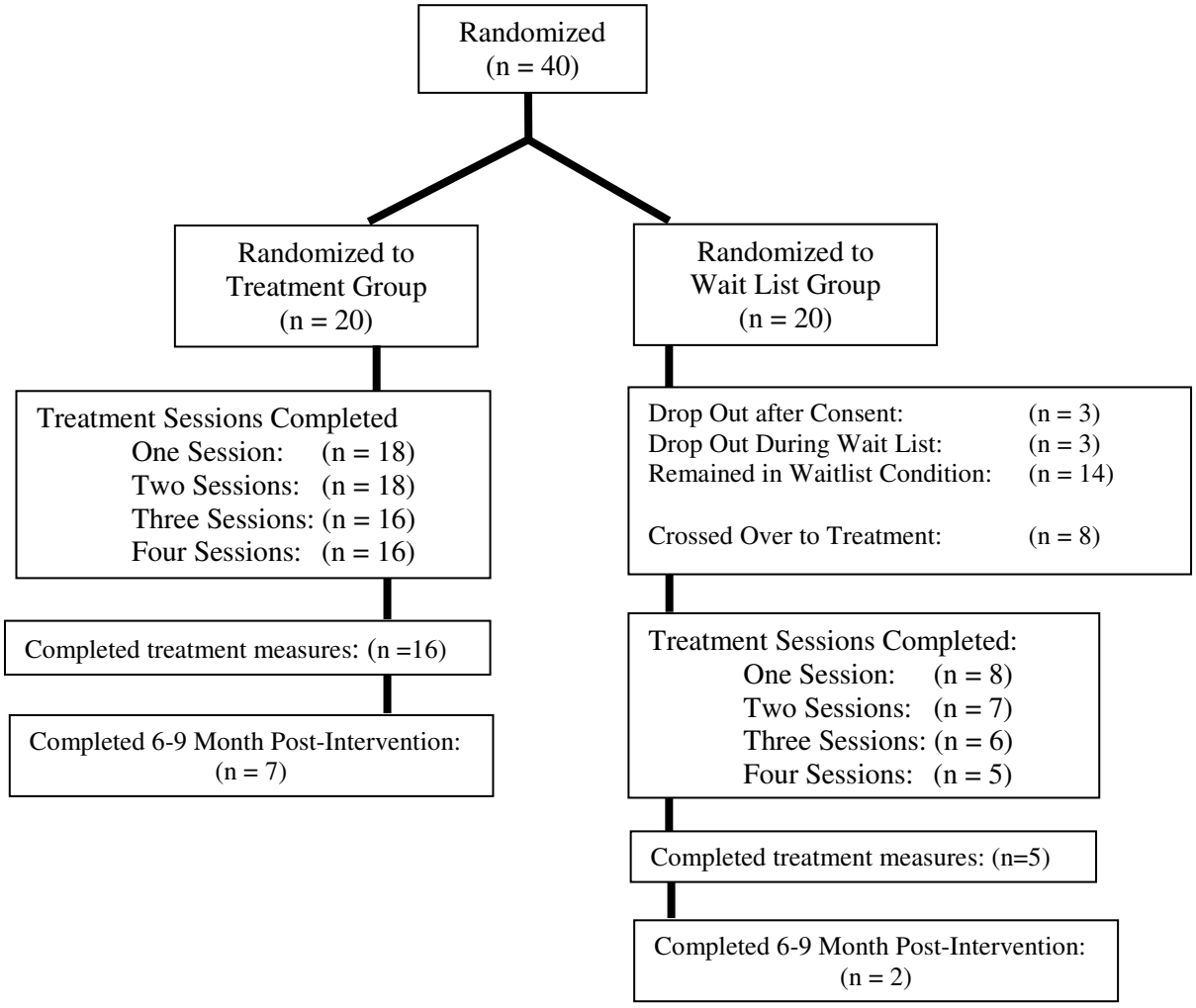

Figure 1. Flow chart of participants through study.

Attrition. As depicted in Figure 1, rates of compliance with the treatment and waitlist condition varied with 80% of participants in the treatment condition (n =16) completing treatment while 70% of participants remained in the waitlist control condition (n =14) from baseline to six-week follow-up. Chi-square analyses reveal no significant differences in rates of attrition between groups. Chi-square analyses and t-tests comparing completers and noncompleters on demographics and baseline data revealed no significant differences either.

Of the veterans in the treatment condition, two participants dropped out shortly after consenting and before completing baseline questionnaires and two dropped out after two

sessions of CBT-I. Reasons for drop out included employment, arrest, and lost to follow-up. Of the veterans in the waitlist control condition, two participants consented to participate but did not show up for collection of baseline data and four participants completed baseline questionnaires but were not available for follow-up. (Two participants completed some of the follow-up questionnaires but not all.) Of the eight wait-list control participants who crossed over to treatment, five participants completed treatment. The three participants who dropped out of treatment after having crossed over did so for reasons including pregnancy, a motorcycle accident and lost to follow-up.

Treatment Plausibility. The ITEQ, administered to participants at the baseline assessment, was used to assess participants' perception of the insomnia treatment after being introduced to the general rationale and concepts during the consenting process. Both groups had total mean scores indicating that overall they found the treatment to be moderately plausible (maximum rating = 100) for the total score (CBT-I = 71, waitlist = 63). On the first two items, veterans from both treatment conditions endorsed high acceptability of the treatment: treatment credibility (CBT-I = 82, waitlist = 77) and treatment acceptability (CBT-I = 73, waitlist = 64). On the last two ITEQ items, participants' scores demonstrated moderate acceptability: appropriateness for their sleep difficulties (CBT-I = 67, waitlist = 57) and their expectation for how effective the treatment was going to be for their sleep problem (CBT-I = 60, waitlist = 55). There were no significant differences between groups for the total ITEQ score or for any of the individual ITEQ items.

Hypothesis #1

The first hypothesis stated that veterans in the treatment condition would show treatment gains on sleep diary variables and sleep-related questionnaires relative to veterans

in the waitlist control condition. An initial intent to treat analysis was conducted for primary sleep variables.

Sleep Diary Variables. A repeated-measures MANOVA was conducted to assess the overall Condition x Time interaction of sleep diary variables (sleep efficiency, sleep onset latency, total sleep time and wake after sleep onset). For those participants who failed to complete sleep diaries at posttreatment, their baseline response was used as their posttreatment response. Consistent with the first hypothesis, the analyses found a significant Condition x Time interaction across the four sleep variables with a large effect size, F (4,29) = 5.4, p = .002, η_p^2 = .428.

Univariate analyses produced significant Condition x Time interactions for the following sleep variables: sleep efficiency $F(1,32) = 23.08$, $p < .001$, $\eta_p^2 = .419$ (see Figure 2); sleep onset latency $F(1,32) = 15.23$, $p < .001$, $\eta_p^2 = .322$ (see Figure 3); and WASO $F(1,32) = 7.43$, $p = .01$, $\eta_p^2 = .188$ (see Figure 4). The effect for Total Sleep Time was not significant, $F(1,32) = 3.31$, , $p = .08$. $\eta_p^2 = .094$. (See Table 4 for mean scores) although trended in the anticipated direction. The effect size for all significant sleep diary variables fell in the large range.

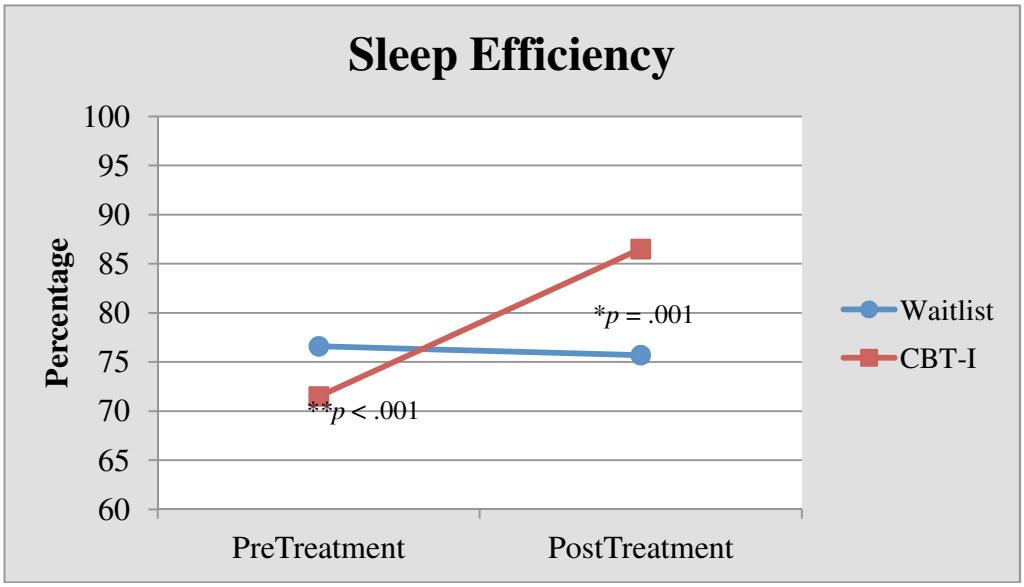

Figure 2. Sleep efficiency at pretreatment and posttreatment for the two conditions (treatment condition [CBT-I] compared with waitlist control condition).
** Indicates the significant difference between CBT-I and Waitlist conditions at posttreatment.*
*** Indicates the significant pretreatment to posttreatment difference for each condition.*

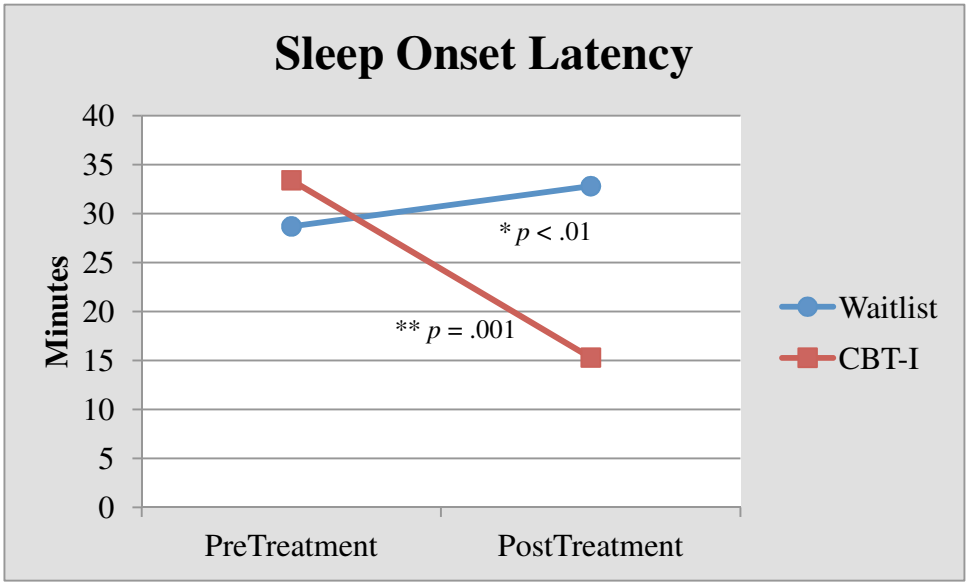

Figure 3. Sleep onset latency at pretreatment and posttreatment for the two conditions (treatment condition [CBT-I] compared with waitlist control condition).
** Indicates the significant difference between CBT-I and Waitlist conditions at posttreatment.*
*** Indicates the significant pretreatment to posttreatment difference for each condition.*

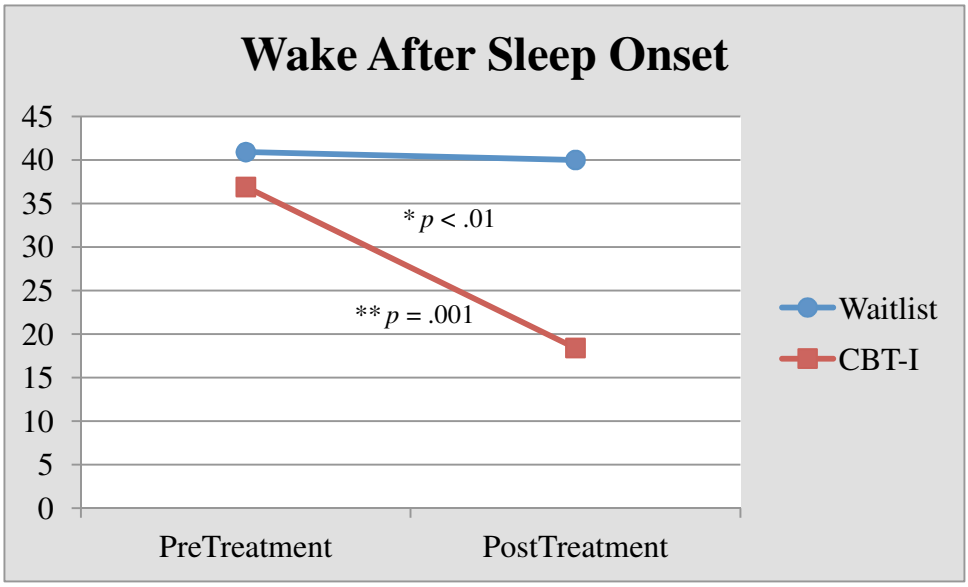

Figure 4. Wake after sleep onset at pretreatment and posttreatment for the two conditions (treatment condition [CBT-I] compared with waitlist control condition).
** Indicates the significant difference between CBT-I and Waitlist conditions at posttreatment.*
*** Indicates the significant pretreatment to posttreatment difference for each condition.*

As can be seen in Table 17 (Appendix J), the treatment group demonstrated significantly improved sleep efficiency, $F(1,17) = 30.17$, $p < .001$, a significant decrease in sleep onset latency $F(1,17) = 16.23$, $p = .001$, and significantly decreased wake after sleep onset $F(1,17) = 15.82$, $p = .001$. The waitlist group did not demonstrate significant change on any sleep related variables. Although the Total Sleep Time analysis did not result in a significant Condition x Time interaction, the treatment group showed a marginal trend toward increased sleep, $F\ (1, 17) = 3.6$, $p = .08$. All nonsignificant p's $> .11$.

Table 4.

Mean (and standard deviation) of CBT-I on Sleep Diary Variables: Treatment Condition (n=18) and Waitlist Condition (n = 16)

	Baseline M *(SD)*		Post-Treatment M *(SD)*		Effect Size
	CBT-I	Waitlist	CBT-I	Waitlist	
Sleep Efficiency	71.5 % (11.6)	76.6 % (5.2)	86.5 % (6.8) [c, ***]	75.7 % (9.0)	.399
Sleep Latency (minutes)	33.4 (20.4)	28.7 (15.6)	15.3 (9.4) [c, **]	32.8 (24.1) [a]	.27
Total Sleep Time (minutes)	282.4(93.7)	333.63(112.4)	311.7 (98)	327.4 (98.5)	.049
Wake After Sleep Onset (minutes)	36.9 (23.6)	40.9 (20.2)	18.4 (13.8) [c, **]	40.0 (23.4)	.126

[a] $p < .05$; [b] $p < .01$; [c] $p < .001$ (letters indicate that CBT-I or Waitlist condition was significantly different at posttreatment compared to that condition's baseline value)
*$p < .05$; **$p < .01$; *** $p < .001$ (asterisks *indicate that CBT-I and Waitlist conditions were significantly different at posttreatment.)*

Sleep Questionnaires. See Table 5 for sleep questionnaire means by group. Similar treatment effects were observed for severity of insomnia as measured by the Insomnia Severity Index (ISI). In particular, using intent to treat analyses, a significant Condition x Time interaction was found for severity of insomnia corresponding to a large effect size, $F(1,35) = 16.24$, $p < .001$, $\eta_p^2 = .317$ (see Figure 5). The decrease in insomnia severity reported by veterans in the treatment condition revealed an improvement from moderately severe insomnia to sub-threshold insomnia $F(1,19) = 22.41$, $p < .001$, $\eta_p^2 = .541$. Veterans in the waitlist control condition showed no significant changes over time and remained in the moderately severe insomnia category.

Clinically significant improvements on the ISI were measured by using the criterion for normal sleep (No clinically significant insomnia = score of 7 or below; subthreshold insomnia = score of 8-14). At posttreatment of the participants who completed posttreatment questionnaires, three in the treatment condition remitted from insomnia (3/15 or 20%) and seven participants were insomnia responders (8/15 or 53.3%). Only one participant in the waitlist condition (1/12 or 8.3%) remitted from insomnia.

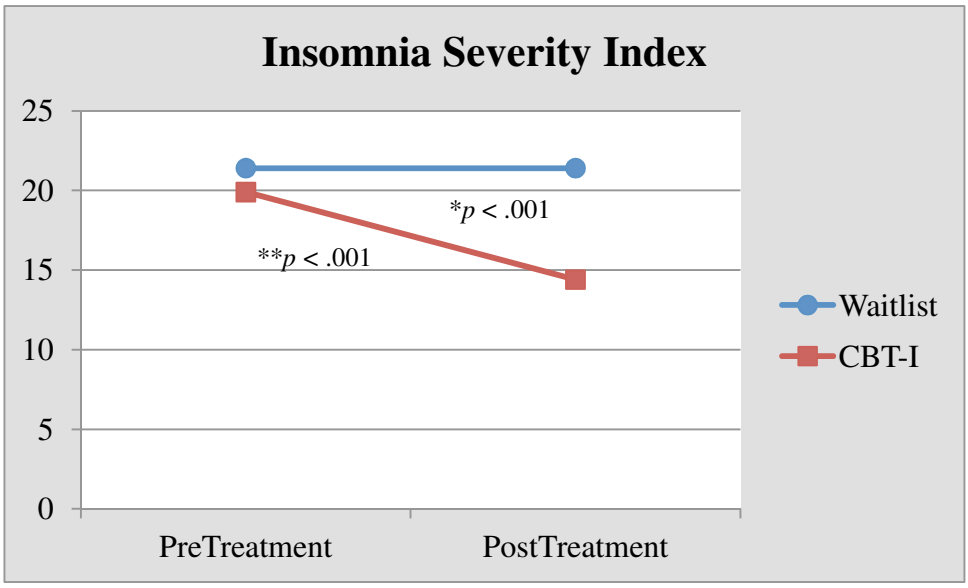

Figure 5. Insomnia severity (ISI) at pretreatment and posttreatment for the two conditions (treatment condition [CBT-I] compared with waitlist control condition).
** Indicates the significant difference between CBT-I and Waitlist conditions at posttreatment.*
*** Indicates the significant pretreatment to posttreatment difference for each condition.*

On a measure of overall sleep quality (PSQI global sleep score), analyses revealed a significant Condition x Time interaction with a large effect size, $F(1,35) = 25.28$, $p < .001$, $\eta_p^2 = .419$ (see Figure 6). From baseline to posttreatment, individuals in the treatment condition reported overall better sleep quality and a decrease in sleep difficulties (as measured by a decrease in the global score of the PSQI), $F(1,19) = 27.58$, $p < .001$, $\eta_p^2 = .592$, while waitlist condition individuals showed no significant changes from baseline to posttreatment.

Recommendations for using the PSQI clinically and in research suggest a cutoff score of 5 (a lower score indicates fewer general sleep disturbances) (Buysee et al., 2006). At posttreatment, of the participants who completed posttreatment questionnaires, three in the treatment condition reported normal sleep based on the PSQI criterion (3/15 or 20%) while no veterans in the waitlist group achieved normal sleep at posttreatment.

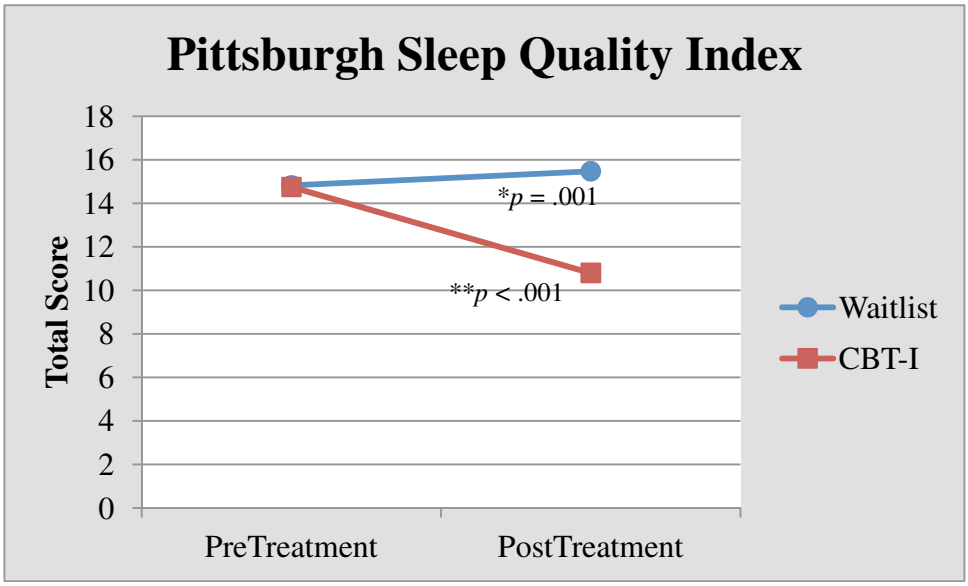

Figure 6. Overall sleep quality (PSQI) at pretreatment and posttreatment for the two conditions (treatment condition [CBT-I] compared with waitlist control condition).
* *Indicates the significant difference between CBT-I and Waitlist conditions at posttreatment.*
** *Indicates the significant pretreatment to posttreatment difference for each condition.*

On a measure assessing beliefs and attitudes about sleep (DBAS), intent to treat analyses revealed treatment effects trending in the expected direction, F (1, 34) = 2.6, p = .116, η_p^2 = .071. As can be seen in Table 5, veterans who participated in treatment reported more functional beliefs about sleep with treatment whereas waitlist counterparts reported slightly more dysfunctional thinking about sleep.

These data were also analyzed using the more streamlined version of this instrument, the DBAS-16 (Morin, Vallieres, & Ivers, 2007). This abbreviated version includes four subscales. Analyses of the DBAS-16 items revealed treatment effects also trending in the

expected direction, F (1, 34) = 3.42, p = .073, η_p^2 = .091 with a large effect size (see Figure 7). Follow-up analyses examining the individual subscales demonstrated a significant Condition x Time interaction for the medication subscale F (1,33) = 7.72, p = .009, η_p^2 = .189, suggesting that treatment had a significant impact on participant beliefs about the need for medication to achieve better sleep. Veterans in the treatment group showed a trend in the expected direction suggesting that cognitive-behavioral treatment for insomnia is associated with modified beliefs about the role of medication in sleep. Treatment did not significantly affect participants' expectations for sleep, worry about sleep or their beliefs about the consequences of insomnia, the three other DBAS-16 subscales.

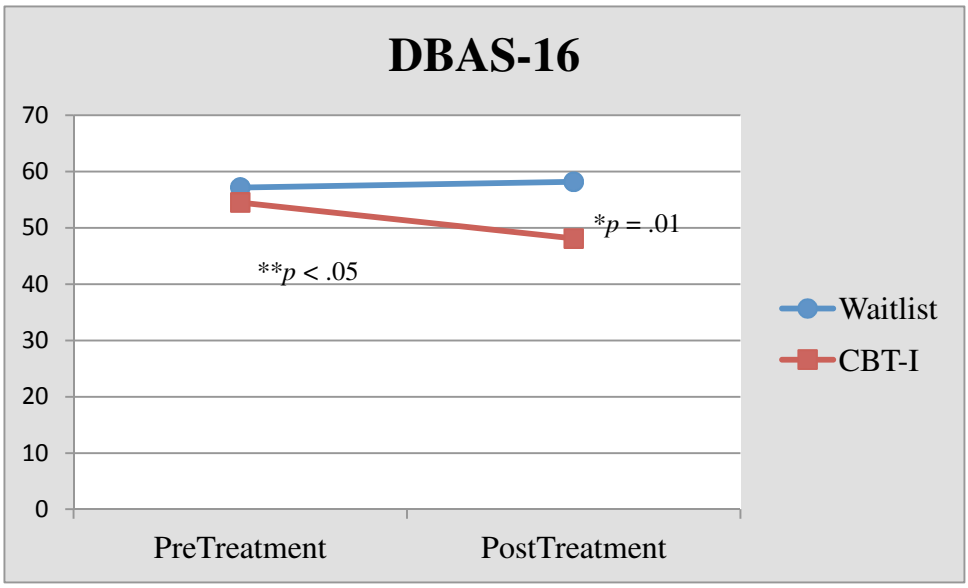

Figure 7. Beliefs about sleep (DBAS-16) at pretreatment and posttreatment for the two conditions (treatment condition [CBT-I] compared with waitlist control condition).
* *Indicates the significant difference between CBT-I and Waitlist conditions at posttreatment.*
** *Indicates the significant pretreatment to posttreatment difference for each condition.*

Table 5.

Mean (and standard deviation) of Subjective Measures of Sleep: Treatment Condition (n=20) and Waitlist Condition (n = 17)

	Baseline M *(SD)*		Post-Treatment M *(SD)*		Effect Size
	CBT-I	Waitlist	CBT-I	Waitlist	
Insomnia Severity (ISI)	19.9 (3.8)	21.4 (3.9)	14.4(5.9)[c, ***]	21.4 (4.3)	.317
Sleep Quality (PSQI) [A]	14.8 (2.9)	14.8 (3.4)	10.8 (4.2) [c, ***]	15.5 (3.3)	.419
Beliefs about Sleep (DBAS-16)	54.50 (10.6)	58.18 (12.3)	48.1 (11.7)[a, **]	58.18 (12.3)	.091

Note. ISI = Insomnia Severity Index; PSQI = Pittsburgh Sleep Quality Index; DBAS = Dysfunctional Beliefs and Attitudes about Sleep
[A] Lower ratings indicate better sleep
[a] $p < .05$; [b] $p < .01$; [c] $p < .001$ *(letters indicate that CBT-I or Waitlist condition was significantly different at posttreatment compared to that condition's baseline value)*
*$p < .05$; **$p < .01$; *** $p < .001$ (asterisks *indicate that CBT-I and Waitlist conditions were significantly different at posttreatment.)*

Hypothesis #2.

The second hypothesis stated that as a result of treatment, veterans in the treatment condition would report a decrease in PTSD symptom severity and an improvement in daytime functioning. Mean baseline and posttreatment scores are available in Tables 8 and 9. Because of the significant results on measures of sleep, intent to treat analysis was not used to test Hypotheses #2 and #3. Rather, participants who failed to complete questionnaires at baseline or posttreatment were not included in these analyses.

PTSD Severity. Consistent with hypotheses, the treatment group and waitlist group reported significantly different trends in PTSD severity from baseline to posttreatment, Condition x Time $F(1, 25) = 16.71$, $p < .001$, $\eta_p^2 = .401$ (see Figure 8) with a large effect size. Means are reported in Table 8. Compared to pretreatment, veterans in the treatment condition

reported a significant decrease in PTSD symptom severity at posttreatment, $F(1,14) = 12.39$, $p < .01$, whereas veterans in the waitlist control condition showed a significant *increase* in PTSD symptom severity from pre- to posttreatment, $F(1,11) = 5.58$, $p < .05$.

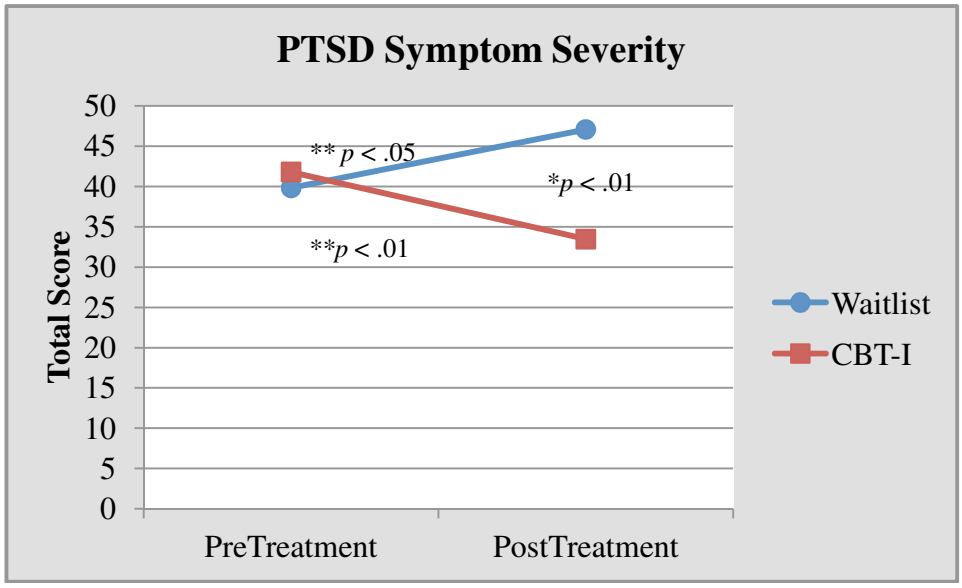

Figure 8. PTSD Symptom Severity at pretreatment and posttreatment for the two conditions (treatment condition [CBT-I] compared with waitlist control condition).
** Indicates the significant difference between CBT-I and Waitlist conditions at posttreatment.*
*** Indicates the significant pretreatment to posttreatment difference for each condition.*

Follow-up analyses looked at whether participation in PTSD treatment (individual or group) changed the impact of the intervention on PTSD symptom presentation. A 2 (Group) x 2 (current PTSD treatment/no current PTSD treatment) x 2 (pre-post treatment) repeated measures ANOVA was conducted and demonstrated that the significant Condition x Time interaction was maintained $F(1,23) = 13.45$, $p = .001$, $\eta_p^2 = .369$. As can be seen in Table 6, Veterans who received both CBT-I and PTSD treatment as usual showed reduced PTSD severity from baseline to posttreatment while their waitlist counterparts showed increased PTSD severity over time. Furthermore, veterans who participated in CBT-I but were not involved in VA delivered PTSD treatment also demonstrated reduced PTSD severity from

pre to posttreatment whereas the one veteran receiving neither CBT-I nor PTSD treatment reported an increase in PTSD symptom severity. These findings suggest that participation in CBT-I could have an additive effect to traditional PTSD treatment.

Table 6.

Mean (and standard deviation) of CBT-I and PTSD Treatment on PTSD Severity

	Baseline		PostTreatment	
	CBT-I	Waitlist	CBT-I	Waitlist
In PTSD Treatment[a]	42 (15.9)	39.82 (11.9)	36.55 (13.8)	45 (6.8)
Not in PTSD Treatment[b]	41.25 (9.7)	40	25 (10.6)	70

[a] Eleven veterans in the treatment condition and eleven veterans in the waitlist control condition were participating in VA PTSD treatment.
[b] Four veterans in the treatment group did participate in PTSD treatment while one veteran in the waitlist control was not in PTSD treatment.

As can be seen in Figure 9, a repeated measures ANCOVA revealed significant Condition x Time interaction for nighttime symptoms of PTSD as measured by the PSQI-A, $F(1,23) = 7.30$, $p = .01$, $\eta_p^2 = .241$. The baseline Total Score of the PSQI-A was used as a covariate. Effect size for this analysis was considered large. Participants in the treatment condition reported fewer nighttime related PTSD symptoms $F(1,14) = 6.62$, $p = .02$ while waitlist counterparts showed no significant changes over time.

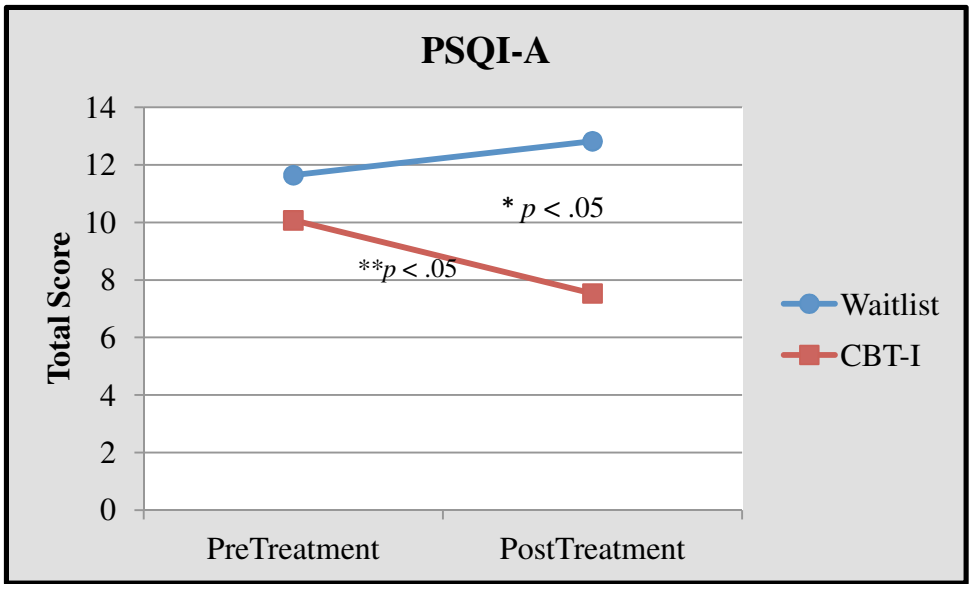

Figure 9. PTSD related nighttime disturbances pretreatment and posttreatment for the two conditions (treatment condition [CBT-I] compared with waitlist control condition).
** Indicates the significant difference between CBT-I and Waitlist conditions at posttreatment.*
*** Indicates the significant pretreatment to posttreatment difference for each condition.*

The PSQI-A contains a question about nightmare frequency per week. It was hypothesized that as a result of CBT-I, veterans in the treatment condition would report a decrease in nightmare frequency. Because an independent measure of nightmare frequency was not included in this study, the response to one of the items of the PSQI-A ("1c. During the past month, how often have you had trouble sleeping because you had memories or nightmares of a traumatic experience?") was used to explore the effect of treatment on nightmare frequency. Table 7 details the frequency with which participants reported having nightmares at baseline and posttreatment. Analysis of this item reveals a significant Condition x Time interaction, $F(1,24) = 5.24$, $p < .05$, $\eta_p^2 = .179$. Further analyses demonstrated that participants trended in the anticipated direction such that veterans in the waitlist control condition reported more nightmares over time ($p = .05$). Veterans in the treatment condition reported a nonsignificant decrease in trauma related nightmare frequency ($p = .21$).

Table 7.

Frequency of nightmares reported on Question 1C, PSQI-A from baseline to posttreatment.

	Baseline		PostTreatment	
	CBT-I	Waitlist	CBT-I	Waitlist
Not during the past month	10%	18.75%	26.66%	8.33%
Less than once a week	20%	6.25%	13.33%	0%
One to two times a week	40%	18.75%	26.66%	33.33%
Three times or more a week	30%	56.25%	33.33%	58.33%

Table 8.

Mean (and standard deviation) of CBT-I on PTSD Severity: Treatment Condition (n =15), Waitlist Condition (n = 12)[A].

	Baseline M (SD)		PostTreatment M (SD)		Effect Size
	CBT-I	Waitlist	CBT-I	Waitlist	
PTSD Symptom Severity	41.8(14.2)	39.8(11.4)	33.5(13.7)[b, **]	47.1(9.7)	.401
Nighttime PTSD symptoms (PSQI-A)	10.1(3.6)	11.6(5.8)	7.5(5.6)[a, *]	12.8(5.4)	.241
Nightmare Frequency (PSQI-A, question # 1c)	2.0 (1.0)	2.0 (1.2)	1.7 (1.2)	2.5 (.93)[a]	.179

A: n=11 for waitlist condition's response to PSQI-A
[a] *p < .05;* [b] *p < .01;* [c] *p < .001 (letters indicate that CBT-I or Waitlist condition was significantly different at posttreatment compared to that condition's baseline value)*
*$p < .05$; **$p < .01$; *** $p < .001$ (asterisks *indicate that CBT-I and Waitlist conditions were significantly different at posttreatment.)*

Mood Symptoms and Daytime Functioning. Mood and daytime functioning was measured using the POMS and the PHQ (see Table 9 for pretreatment and posttreatment means). With respect to overall mood symptoms and daytime functioning, a significant

Condition x Time interaction with a large effect size was found when looking at overall distress as measured by the total score of the POMS, $F(1,24) = 8$, $p < .01$, $\eta_p^2 = .25$, (see Figure 9). Specifically, treatment condition participants reported a decrease in overall distress at posttreatment $F(1,13) = 6.12$, $p < .05$, $\eta_p^2 = .32$, while waitlist control participants showed no significant changes in level of distress over time.

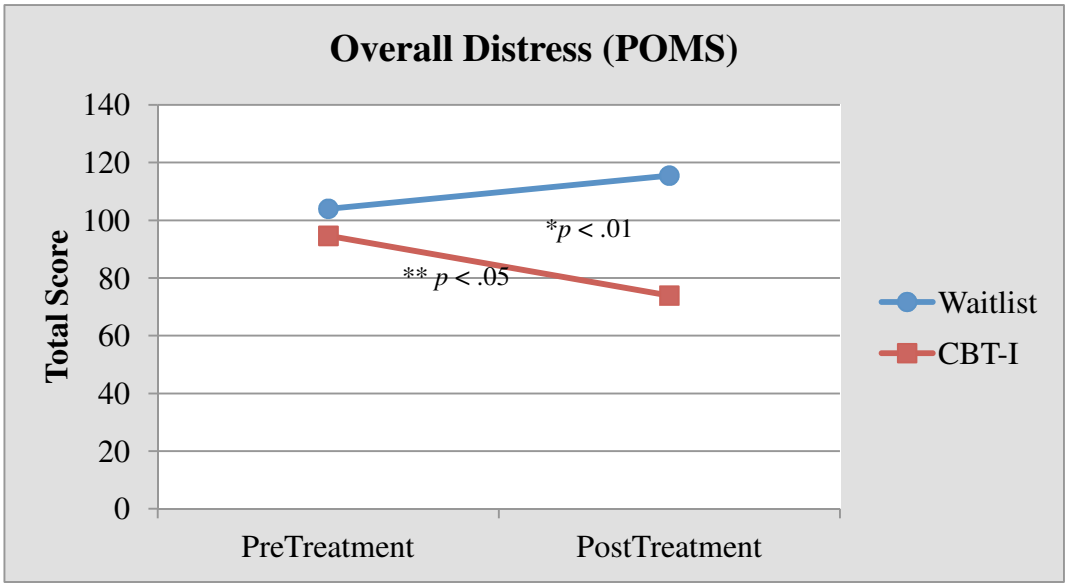

Figure 10. Overall distress pretreatment and posttreatment for the two conditions (treatment condition [CBT-I] compared with waitlist control condition).
** Indicates the significant difference between CBT-I and Waitlist conditions at posttreatment.*
*** Indicates the significant pretreatment to posttreatment difference for each condition.*

Significant interactions of Condition x Time were found for the POMS mood and daytime functioning domains of depression F (1,24)= 6.5, $p < .05$; tension F (1,24) = 5.7, $p < .05$; anger $F(1,24) = 5.3$, $p < .05$; confusion $F(1,24) = 9.4$, $p = .005$; and fatigue $F(1,24) = 5.2$, $p < .05$. No significant difference was observed for the component score of vigor (See Table 9 for mean scores and Table 22 in Appendix J for ANOVAs).

Participants in the treatment condition reported decreased tension $F(1,13,) = 6.53$, $p = .02$, anger $F(1,13) = 4.94$, $p < .05$, confusion $F(1,13)=7.8$, $p = .01$, and fatigue $F(1,13) =$

5.9, $p < .05$ while participants in the waitlist condition showed no significant changes over time for any of these component scores. Follow-up to the significant Condition x Time interaction for depression revealed that mean scores trended in opposite directions for each group such that veterans in the treatment group indicated less depression posttreatment while their waitlist counterparts reported greater levels of depression posttreatment (p's < .10). Table 23 in Appendix J lists all ANOVAs.

As can be seen in Figure 11, veterans in the treatment condition reported significantly less depression (as measured by the depression subscale of the PHQ) at posttreatment than they did before treatment, whereas the waitlist control group showed no significant change over time, Condition x Time, $F(1,21) = 16.2$, $p = .001$, $\eta_p^2 = .435$. The effect size of this interaction was considered large. Both groups reported moderate levels of depression at baseline, whereas at post-treatment the treatment group reported mild depression and the waitlist control group continued to report moderate levels of depression. At baseline 73.5% of waitlist participants and 84.2% of treatment condition participants reported moderate or greater levels of depression on the PHQ. At post-treatment, 94.7% of the veterans in the waitlist condition and 57% of veterans in the treatment condition reported moderate or greater levels of depression.

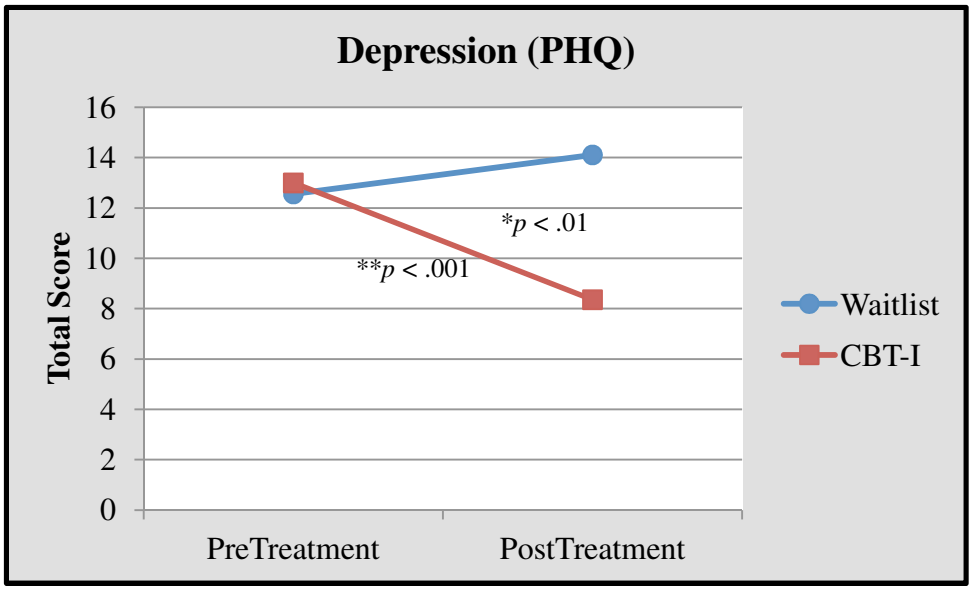

Figure 11. Depression ratings (PHQ) at pretreatment and posttreatment for the two conditions (treatment condition [CBT-I] compared with waitlist control condition).
** Indicates the significant difference between CBT-I and Waitlist conditions at posttreatment.*
*** Indicates the significant pretreatment to posttreatment difference for each condition.*

Table 9.

Mean (and standard deviation) of CBT-I on Mood Symptoms: Treatment Condition (n = 14), Waitlist Condition (n = 12)[A].

	Baseline M *(SD)*		PostTreatment M *(SD)*		
	CBTI	Waitlist	CBT-I	Waitlist	Effect Size
Overall Distress (POMS)	94.5 (29.7)	104.3 (36.8)	73.8 (36.6)[a, **]	115.5 (26.2)	.25
Depression (POMS)	22.3 (12.6)	24 (16.3)	17.1 (13.9)[*]	29.3 (13.3)	.214
Tension (POMS)	20.3 (7)	22.6 (9.2)	16.1 (5.3)[a, **]	24.1 (6)	.192
Vigor (POMS)	10.9 (4.8)	10.8 (5.9)	11.6 (5.1)	11.2 (7.6)	.002
Anger (POMS)	21.9 (8.5)	22.6 (12.3)	16.4 (10.7)[a, *]	25.9 (10.7)	.180
Confusion (POMS)	14.2 (3.8)	14.1 (5.1)	11.6 (4.6)[a, **]	16.6 (4.5)	.281

Fatigue (POMS)	15.8 (5.4)	18 (7.1)	11.8 (5.8) [a, ***]	19.6 (3.3)	.179
Depression (PHQ)	13 (3.3)	12.6 (5.1)	8.4 (4.7) [c, **]	14.1 (2.8)	.435

A : n=9 for waitlist condition responding to PHQ-9
[a] *p < .05;* [b] *p < .01;* [c] *p < .001 (letters indicate that CBT-I or Waitlist condition was significantly different at posttreatment compared to that condition's baseline value)*
*$p < .05$; **$p < .01$; *** $p < .001$ (asterisks *indicate that CBT-I and Waitlist conditions were significantly different at posttreatment.)*

Hypothesis #3

The third hypothesis stated that veterans in the treatment condition would demonstrate gains on objective sleep measures as recorded by actigraphy. The mean baseline and posttreatment scores for those who completed treatment are listed in Table 10. It should be noted that of the fifteen veterans who completed treatment, four (26.6%) did not provide a complete set of actigraphy data. One veteran did not use the actigraph due to technical problems. Three of these participants did provide baseline data but not two-week follow-up data because of errors in downloading the data or initializing the watch device and loss of the actigraphy.

As can be seen in Table 10, actigraphy scores demonstrated gains in sleep efficiency, $F(1,9) = 7.25$, $p < .05$, $\eta_p^2 = .446$. Prior to treatment, their recorded efficiency was below the ideal level of 85% (Morin, 2003), whereas after four sessions of CBT-I, veterans demonstrated efficient sleep. Significant gains in wake after sleep onset were also observed in the treatment condition, $F(1,9) = 7.18$, $p < .05$, $\eta_p^2 = .444$. A trend towards significant decreases in sleep onset latency with treatment was also found, $F(1,9) = 3.89$, $p = .08$, $\eta_p^2 = .302$. Lack of significance may be due to a lack of power (.422) in these analyses. Analyses revealed no significant improvements in total sleep time.

Table 10.

Means (and standard deviations) of Cognitive Behavioral Treatment of Insomnia (CBT-I) on Objective and Subjective Sleep Measures: Treatment Condition (n =9)

	Actigraphy		Sleep Diary	
	Baseline M *(SD)*	PostTreatment M *(SD)*	Baseline M *(SD)*	PostTreatment M *(SD)*
Sleep Efficiency	81.3% (6.1%)	86.5% (3.5%)*	71.9% (12.5%)	88% (6.2%)***
Sleep Latency (minutes)	20.23 (19.55)	6.8 (8.19)	34 (22.5)	15.77 (10.69)**
Wake After Sleep Onset (minutes)	61.67 (22.46)	49.35 (12.04)*	36.15 (22.69)	15.77 (8.77)**
Total Sleep Time (minutes)	427.45 (79.67)	422.33 (84.9)	296.23 (91.32)	334.31 (86.13)

* $p < .05$, ** $p < .01$, *** $p < .001$ (*p values indicate significant changes between baseline and posttreatment.*)

Follow-Up Analyses

Repeated measures ANOVAs were conducted in order to examine whether veterans who completed treatment maintained improvements six to nine months post treatment. Only eleven participants completed follow-up data. Of these eleven, two sets of data were sent back to the VA but never found thus data from only nine participants were analyzed. Two of these nine participants were originally in the waitlist group and had crossed over to treatment. As a result of such low participation for follow-up assessment, follow-up analyses demonstrate statistical power below Cohen's (1988) recommended .80 for all outcome variables with the exception of subjectively reported sleep efficiency (sleep diary), insomnia severity (ISI), overall sleep quality (PSQI) and fatigue (POMS fatigue subscale).

Sleep Diary Variables. A repeated-measures ANOVA revealed that veterans reported significant increases in sleep efficiency between time points, $F(2, 16) = 11.16$, p

=.001, η_p^2 = .58. Post-hoc analyses using Bonferroni correction revealed that sleep efficiency was significantly improved from baseline to posttreatment ($p < .05$) but not from baseline to follow-up assessment ($p = .07$). Pairwise comparisons demonstrated a significant decline in sleep efficiency from posttreatment to follow-up ($p < .05$). Despite this decline, at follow-up veterans still reported sleep efficiencies of 85.3%, which is considered just above the cutoff for clinically efficient sleep.

Repeated measures ANOVAs also revealed that veterans reported significant improvements in sleep onset latency, wake after sleep onset, and total sleep time between time points: sleep onset latency ($F(2, 16) = 3.61$, $p = .05$, $\eta_p^2 = .311$), wake after sleep onset ($F(2, 16) = 5.67$, $p = .01$, $\eta_p^2 = .415$) and total sleep time ($F(2, 16) = 4.23$, $p = .03$, $\eta_p^2 = .346$). Although pairwise comparisons using Bonferroni correction did not reveal significant differences between time-points (pretreatment, posttreatment, follow-up) for these sleep diary variables, veterans reported continued improvement from baseline. However they did not maintain posttreatment gains. Table 11 lists sleep diary variable means for all time points.

Table 11.

Means (and standard deviations) of CBT-I on Sleep Diary Variables

	Baseline M (*SD*)	PostTreatment M (*SD*)	Follow-Up M (*SD*)
Sleep Efficiency	76.3% (11.2)	90.9% (3.9)*	85.3% (4.6)
Sleep Onset Latency	27.56 (23.5)	9.56 (6.9)	16.11 (8.5)
Total Sleep Time	318.67 (73.2)	397 (78.9)	361 (65.6)
Wake After Sleep Onset	36.1 (25.2)	13.29 (7.8)	26.11 (18.2)

* $p < .05$ (*p values indicate significant changes between baseline and posttreatment.*)

Sleep Questionnaires. As can be seen in Table 12, decreases in insomnia severity were maintained at follow-up assessment. A repeated-measures ANOVA determined that insomnia severity differed significantly between time points, $F(2, 16) = 6.2$, $p = .01$, $\eta_p^2 = .44$. Post-hoc tests using the Bonferroni correction revealed that CBT-I was associated with a reduction in insomnia severity from pretreatment to posttreatment ($p < .05$) and from pretreatment to follow-up assessment ($p < .05$). No significant differences between means were observed from posttreatment to follow-up assessment ($p > .18$) suggesting that treatment gains were maintained from posttreatment to follow-up assessment.

Consistent with hypotheses, increases in overall sleep quality (as measured by a decrease in the total score of the PSQI) were maintained at follow-up assessment. A repeated measures ANOVA found that overall sleep quality differed significantly between time points $F(2, 16) = 21.8$, $p < .001$, $\eta_p^2 = .73$. Post-hoc tests using the Bonferroni correction revealed that CBT-I was associated with an increase in overall sleep quality from pretreatment to posttreatment ($p < .001$) and from pretreatment to follow-up assessment ($p < .05$). No significant differences were observed from posttreatment to follow-up assessment ($p > .06$) suggesting that treatment gains were maintained over time. Analyses comparing beliefs about sleep over time (DBAS and DBAS-16) for those who completed treatment and follow-up assessment were underpowered and revealed no significant findings.

Table 12.

Means (and standard deviations) of CBT-I on Subjective Measures of Sleep

	Baseline M (*SD*)	PostTreatment M (*SD*)	Follow-Up M (*SD*)
Insomnia Severity	18.22 (3.3)	11.89 (5.4)*	13.22 (4.9)*
Pittsburgh Sleep Quality Index	13.67 (3.3)	7.56 (3.6)**	9.89 (4.1)*

DBAS	44.62 (7.8)	39.2 2(7.2)	44.01 (10.2)
DBAS-16	50.77 (10.75)	41.56 (6)	47.12 (10.4)

* $p < .05$, ** $p < .001$ (*p values indicate significant changes from baseline.*)

PTSD Severity. Table 13 displays means for ratings of PTSD symptom severity (PSS-SR), PTSD related nighttime disturbances (PSQI-A), and PTSD nightmare frequency (PSQI-A, Question 1c). Repeated-measures ANOVAs for all sets of means were underpowered and revealed no significant differences over time.

Table 13.

Means (and standard deviations) of CBT-I on PTSD Symptom Severity

	Baseline M (*SD*)	PostTreatment M (*SD*)	Follow-Up M (*SD*)
PTSD Symptom Severity	37.67 (11)	31.33 (15)	32.56 (14.8)
PSQI-Addendum	8.56 (4.2)	6.89 (5.5)	9.11 (5.8)
PSQI-A (Question 1c)	1.78 (.97)	1.33 (1.2)	1.78 (1.2)

Mood Symptoms and Daytime Functioning. Table 14 displays means for ratings of mood and daytime functioning as measured by the POMS and the PHQ. A repeated-measures ANOVA found that ratings of fatigue differed significantly over time, $F(2, 16) = 6.04$, $p = .01$, $\eta_p^2 = .43$. Post-hoc tests using the Bonferroni correction, however, were not statistically significant between time points, all p's $> .06$. Repeated-measures ANOVAs for all other sets of means revealed no significant differences over time.

Table 14.

Means (and standard deviations) of CBT-I on Mood Symptoms and Daytime Functioning

	Baseline M (*SD*)	PostTreatment M (*SD*)	Follow-Up M (*SD*)
Overall Distress (POMS)	80.89 (19.6)	66.22 (29.1)	77.44 (39.4)

Depression (POMS)	15.89 (9.2)	11.56 (12)	17.89 (13.86)
Tension (POMS)	16.78 (6.3)	14.11 (6.2)	16.78 (8.33)
Vigor (POMS)	11.56 (6.3)	12.11 (5.9)	12.67 (7.1)
Anger (POMS)	19.34 (8.4)	13.22 (9.7)	17.33 (12.1)
Confusion (POMS)	12.78 (2.6)	9.78 (3.5)	10.67 (4.1)
Fatigue (POMS)	17.33 (5.19	10.44 (6.5)	14.78 (5.5)
Depression (PHQ)	11 (2.9)	8.63 (6)	7.25 (4.9)

Discussion

The purpose of the present study was to examine the efficacy of an insomnia intervention for OEF/OIF veterans diagnosed with PTSD and for whom insomnia was a major complaint. A randomized controlled trial design was used with participants randomized to either a treatment condition or a waitlist control condition. Based on a recent search of the literature, this is the first randomized control trial of CBT-I focusing on the OEF/OIF veteran population. Veterans in the treatment condition participated in four, one-hour sessions of individual treatment. Treatment included the standard protocol for cognitive behavioral treatment of insomnia (CBT-I) and elements of imagery rehearsal therapy (IRT). It was hypothesized that individuals in the treatment condition would report greater improvements on subjective measures of sleep relative to veterans in a waitlist control condition. It was also hypothesized that individuals in the treatment condition would experience greater reductions in PTSD severity and improvement in mood and daytime functioning compared to their waitlist counterparts. Finally, it was hypothesized that veterans who participated in the intervention would report improvements on objective measures of sleep after treatment. The findings reported here support the three hypotheses proposed.

Overall, the results of this study suggest that an intervention consisting of CBT-I combined with elements of IRT is an effective insomnia treatment for OEF/OIF veterans struggling with PTSD.

Effects of CBT-I and IRT on Subjective Measures of Sleep

In support of the first hypothesis, results from the present study indicate that veterans who participated in the intervention demonstrated greater improvements in subjectively measured sleep than waitlist control participants. Veterans in the treatment condition reported clinically meaningful improvements in sleep efficiency posttreatment. Sleep efficiency is considered normal at a rate of 85% or higher (Morin, 1993). In this study, 11% of veterans in the treatment condition reported sleep efficiency of 85% or higher at baseline. At posttreatment 75% of these treatment participants reported sleep efficiency equal to or greater than 85%. Veterans in the treatment condition also reported significant improvements in sleep onset latency and wake after sleep onset compared to their waitlist control counterparts. Improvements in sleep onset latency and wake after sleep onset translate to improvements in initiating sleep and maintaining sleep, respectively, two criteria that are assessed when diagnosing insomnia. Taken together, these findings suggest an overall improvement in *sleep quality* observed in veterans in the treatment group whereas veterans in the waitlist control group demonstrated no such improvement in sleep quality. The primary goal of CBT-I is to have the patient achieve improved sleep quality: more consolidated sleep that is less fragmented and has fewer disruptions. These findings suggest this primary goal was obtained for veterans who participated in treatment. Furthermore, these data, specifically the large effect sizes, are in line with those reported in the most recent meta-analysis of CBT-I (Okajima et al., 2011).

Treatment did not significantly improve total sleep time. As discussed, the primary focus of this insomnia intervention is first to improve sleep quality (sleep efficiency, wake after sleep onset, sleep onset latency) and to ensure less fragmented and more consolidated sleep. Once good sleep quality has been established, quantity of sleep (i.e. total sleep time) can be added to and thus improved upon, if needed. As noted in the introduction, Morin (2004) argues that total sleep time, considered alone, is not a good index of insomnia because of individual differences in sleep needs, and thus might not be a good index of improved sleep. Furthermore, as Buysee (2010) and others have observed total sleep time is often reduced with concurrent improvements in sleep quality variables. Given that Total Sleep Time remained relatively the same for both groups in this study but that sleep efficiency, sleep onset latency and wake after sleep onset changed in the desired direction for veterans in the treatment group, it can be concluded that the intervention helped veterans achieve more consolidated and less fragmented sleep, which is a primary goal of the intervention.

Furthermore, veterans in the treatment condition demonstrated clinically significant changes in sleep and met criteria for normal sleep at posttreatment as measured by subjective sleep questionnaires (ISI and PSQI). Veterans who were in the waitlist control condition reported no such change from baseline to posttreatment. Effect sizes for the significant baseline to posttreatment findings of insomnia severity and sleep quality were large (insomnia severity= .722 and sleep quality = .790). These large treatment effects compare to those reported by Ulmer and colleagues (2011).

Posttreatment findings differed significantly between veterans in the treatment condition and those in the waitlist condition. Veterans who participated in treatment reported subthreshold insomnia after completion of CBT-I while their waitlist control counterparts

reported clinical levels of insomnia of moderate severity over time as measured by the ISI. Similarly, an increase in sleep quality as measured by the PSQI was observed in the treatment group compared to the waitlist control group.

A trend approaching a significant interaction was observed for beliefs about sleep, as measured by the Dysfunctional Beliefs and Attitudes About Sleep Scale (DBAS) and DBAS-16. From baseline to posttreatment, veterans in the treatment group reported more functional beliefs about sleep, and this change over time was significant (Table 18, Appendix J). Veterans in the treatment condition specifically reported more realistic beliefs about the role of medication on sleep. Veterans in the waitlist condition demonstrated relatively no change in their sleep cognitions from baseline to posttreatment. These posttreatment findings were significant between treatment and waitlist conditions.

Studies similar to the one reported here (Ulmer et al., 2010; Swanson et al., 2009), have not assessed for changes in cognitions about sleep as measured by the DBAS or DBAS-16. This measure is a standard instrument in the insomnia intervention literature (Buysse et al., 2006) as it is sensitive to changes in beliefs about sleep as a result of cognitive-behavioral treatment for insomnia. Future research should continue to assess the impact of CBT-I on cognitions about sleep with this population and explore the possibility that cognitive shifts are perhaps more difficult with this veteran population.

Overall, results from this study demonstrate that CBT-I combined with elements of IRT is quite effective in improving sleep with an OEF/OIF veteran population. These improvements are consistent with current research (Swanson et al., 2009; Ulmer et al., 2011) demonstrating CBT-I alone or in combination with elements of IRT show promising outcomes with veterans and, more specifically to this study, that the intervention works well

with veterans recently deployed to Iraq and/or Afghanistan. The treatment used in this study produced significant treatment effects in many of the same domains as those found in the clinical outcomes described by Ulmer and colleagues (2011), including subjectively measured, sleep efficiency, sleep onset latency, wake after sleep onset, sleep quality (PSQI), and insomnia severity (ISI). These results are also consistent with those observed by Swanson and colleagues (2009) where significant treatment effects of a combined approach (CBT-I and IRT) were seen for sleep quality and insomnia severity. This study is a novel contribution to the literature as it is the first to show these sleep improvements in a randomized control trial with a focus on OEF/OIF veterans.

Effects of CBT-I and IRT on PTSD Symptoms

PTSD Symptom Severity. In support of the second hypothesis, veterans in the treatment condition demonstrated significant reductions in trauma symptom severity, while waitlist control participants' scores reflected a nonsignificant trend toward increasing symptom severity from baseline to posttreatment. These findings and the large effect sizes are also consistent with those presented by Ulmer and colleagues (2011) where PTSD symptom severity decreased (as measured using the PTSD Checklist- Military Version). Interestingly, interventions directly addressing PTSD symptoms do not have an equivalent carry over effect for insomnia (Belleville, Guay, & Marchand, 2010).

As noted in the Demographics section of Results, 65% of veterans in the study were concurrently participating in individual and/or group treatment. Follow-up analyses revealed that of these veterans, those in the CBT-I condition showed reduced PTSD severity from pre to posttreatment while their waitlist counterparts reported an increase in PTSD symptom severity over the same period of time despite participation in PTSD treatment. Similarly, the

veterans receiving CBT-I but not receiving PTSD treatment reported reduced PTSD severity from pre to posttreatment while the one veteran receiving neither CBT-I nor PTSD treatment showed an increase in PTSD symptom severity. This demonstrates that a brief intervention of CBT-I can reduce PTSD symptom severity in OEF/OIF veterans, possibly independent of PTSD treatment. Given the mounting prevalence of PTSD diagnoses in this veteran population, such an intervention offers an efficient and accessible adjunct to current treatments of PTSD. Future research should more systematically follow and measure participant involvement in PTSD treatment along with CBT-I as a means of assessing the therapeutic effect of using CBT-I as an adjunctive therapy to the gold standard, evidence-based PTSD treatments.

PTSD-Specific Sleep Disturbances. Veterans who participated in treatment also reported significant decreases in PTSD-specific sleep disturbances (based on results from the PSQI-A) compared to veterans in the waitlist condition, whose scores trended towards an increase in PTSD-specific sleep disturbances, further supporting hypothesis two. These findings differ from those reported by Ulmer and colleagues (2011) who did not observe a significant difference between groups at posttreatment for PTSD-specific disruptive nocturnal behaviors, as measured by the PSQI-A. This may have been related to the fact that the OEF/OIF veterans had PTSD that was of a shorter duration, and therefore more responsive to intervention, than the veterans who participated in the Ulmer et al. study. Additionally, Ulmer et al. (2011) demonstrated trends that may have proved significant with a larger sample size than utilized in the pilot study (9 in each group).

Exploratory analyses were conducted to assess the Condition x Time interaction of the traumatic nightmare item on the PSQI-A since traumatic nightmares were a target of

intervention. The analysis revealed that the groups significantly differed with treatment. The treatment group reported a decrease in nightmares at posttreatment and the waitlist group reported an increase in traumatic nightmare frequency, although neither of these trends was statistically significant. For the variable of nightmare frequency, the Ulmer et al. study (2011) did yield significant reductions in nightmares from treatment. However, it should be noted that the Ulmer study required that participants report having nightmares to be eligible and the participants did, in fact, report more than four nightmares per week on average. This is contrasted to the present study in which nightmare frequency was not a requirement for eligibility. As such, the present study may not have had enough power to detect modest changes in nightmare frequency relative to the Ulmer study (2011). Additionally, the present study failed to include nightmare frequency as a measure on the sleep diary, as was done in the Ulmer study, thereby providing a much more sensitive and continuous measure of nightmare frequency. Future studies should add this measure to the daily diary report, as was done in the Ulmer study.

It is possible that some of the IRT skills acquired during treatment protected veterans from experiencing an increase in nightmare frequency, unlike the control group, but was not sufficient for generating a decrease in nightmares. The abbreviated IRT used in this research was based on a study examining behavioral insomnia treatment for adult violent crime victims diagnosed with PTSD (Germain et al., 2007), and not with a combat population. It is possible that a combat-population, which likely has had more trauma exposure, would benefit from a more comprehensive and longer dosage of IRT than was used in this study. To date, the efficacy of IRT on PTSD-specific nightmares has been well studied in non-veteran populations (Germain, 2007; Krakow et al., 2002; Krakow et al., 2001a; Krakow et al.,

2001b). Numerous uncontrolled pilot studies conducted with veteran populations have demonstrated promising findings (Nappi et al., 2010, Harb et al., 2009; Swanson et al., 2009; Lu et al., 2009; Moore & Krakow, 2007). However, the handful of controlled studies that have been conducted with a veteran population have not been as promising. For instance, in a recent randomized control trial (Ulmer et al., 2011) that most closely parallels the study reported here, a combined intervention implementing only three sessions each of CBT-I and IRT with a mixed veteran population did not result in a significant Condition x Time interaction for trauma-related sleep quality as measured by the PSQI-A although the data trended in the anticipated direction. Given the amount of trauma to which a combat population is exposed, there may have been too few treatment sessions to effectively administer both CBT-I and elements of IRT. Standard IRT protocol recommends four sessions (Krakow & Zadra, 2010). Given the findings from the Ulmer study (2011) and the study reported here, it stands to reason that an increase in the number of sessions could potentially produce different outcomes with respect to nightmare frequency. Future research should also seek to determine the proper dose of sessions that would meet the needs of the insomnia and trauma-related sleep disturbances seen in combat veterans.

That being said, in another randomized control trial, Cook et al. (2010) found that after participating in six 90-minute sessions of IRT, Vietnam War veterans did not report a significant change in traumatic nightmare frequency compared to an active psychotherapy condition. The control in this study was a psychotherapy condition rather than a waitlist control as seen in Ulmer (2011) and the study reported here. Clearly, more controlled trials examining the effectiveness of IRT in veteran populations are warranted.

Furthermore, given the unique experience of the OEF/OIF veteran population with multiple deployments and consequently multiple traumatic events, future research should also explore how these veterans differ from other veteran populations with respect to their response to IRT. As noted previously, the therapist providing treatment experienced significant difficulty engaging many of the participants in the rescripting process of IRT. Issues that arose when introducing IRT stemmed either from participants' difficulty using imagery or in changing a traumatic nightmare effectively. Participants also appeared reluctant to discuss the traumatic memories that shape their nightmares. As a result many participants were not successful at practicing their rescripted dreams on a daily basis outside of therapy sessions. Lu et al. (2009) experienced similar difficulty in their study assessing IRT as monotherapy with male veterans of various service eras. These researchers detail participant difficulty focusing on or creating a tolerable dream and thus low compliance rate with these veterans practicing rescripted dreams. They conclude that IRT is likely more beneficial when provided as adjunctive therapy.

With respect to the specific OEF/OIF veteran population, recent research discusses the reluctance that these younger veterans demonstrate in engaging in and/or committing to mental health treatment (Hoge et al., 2004). Harb and colleagues (2009) made a concerted effort to sidestep this issue with Iraq veterans by waiting until the fourth session to introduce IRT after therapeutic alliance had already been established with three sessions of CBT-I. Their reasoning centered on the premise that this population of veterans is likely new to psychotherapy and would thus be hesitant to share distressing nightmares upon initial contact with the therapist. In the study presented here, IRT was introduced in the first session with the rationale that participants would need the time to practice the rescripted dream with the

support of the therapist. It is unclear whether the timing of IRT in this study was compromised by the participants' lack of familiarity and thus lack of therapeutic alliance with the therapist at the first session.

Despite these limitations, participants reported trends in the anticipated direction for nightmare frequency following treatment and a more sensitive measure of nightmare frequency might have detected more modest changes. Furthermore, veterans in this study who participated in treatment reported an overall significant decrease in PTSD-related sleep disturbances as a result of treatment compared to waitlist counterparts. Veterans in the waitlist control condition showed an increase in nightmare frequency while treatment participants showed trends demonstrating a decrease in nightmare frequency. These findings suggest that the intervention was associated with a reduction in PTSD-specific sleep disturbances and provide support for the second hypothesis. Furthermore, this is the first study to demonstrate these effects with a focus on an OEF/OIF veteran population.

Effect of CBT-I on Mood Symptoms

Depression. In further support of hypothesis two, PHQ depression ratings for veterans in the treatment condition decreased with treatment while depression ratings for the waitlist group increased with time, though the change was not significant. Participants from both groups reported moderate levels of depression at baseline. After treatment, veterans in the treatment group reported mean scores reflecting mild levels of depression while waitlist participants continued to report moderate depression. These findings support the claim that improvements in sleep can lead to improvements in comorbid issues such as depression, (Taylor, Lichstein, Weinstock, Sanford & Temple, 2007; Manber, Edinger, & Gress, 2008; Watanabe, 2011) although the intervention was not targeted for treatment of depression.

These results are consistent with the current literature demonstrating that CBT-I is effective in treating both sleep disturbances associated with insomnia and decreasing depressive symptoms (Watanabe, 2011; Manber et al., 2008). These findings stand out in the literature as this study is the first to show these effects with an OEF/OIF veteran cohort.

Overall Distress, Mood, and Daytime Functioning. Consistent with the above findings, these data also revealed improvements in overall distress as well as in tension, fatigue, anger, and confusion (as measured by the POMS) as a result of the intervention. Decreases in these emotions were not observed in waitlist controls. Similar to the findings associated with depression, these results demonstrate the global benefits of CBT-I and/or IRT above and beyond treating insomnia. A thorough search of the literature did not come up with other studies of PTSD combat populations looking at the effects of CBT-I and IRT on daytime symptoms measured by the POMS or similar instruments. Thus the findings of this study are unique in showing improvements in mood and daytime functioning in veterans after participation in CBT-I.

Effects of CBT-I and IRT on Objective Measures of Sleep

In support of the third hypothesis, veterans in the treatment condition demonstrated significant improvements on several objective sleep outcome variables after treatment. Actigraphy recordings of these veterans' sleep patterns revealed significant improvements in sleep efficiency and wake after sleep onset (WASO) from baseline to posttreatment, with large effect sizes of .446 and .444, respectively. In the recent meta-analysis looking at the effectiveness of CBT-I (Okajima et al., 2011) demonstrated that across 10 studies, objectively measured sleep efficiency (as measured by actigraphy and/or polysomnography) improved an average of four percent from baseline to posttreatment. The study presented

here demonstrates sleep efficiency improvements of over five percent. Sleep onset latency was also reduced with a large effect size, but this change was not statistically significant, $F(1,9) = 3.89$, $p = .08$, $\eta_p^2 = .302$. Significant improvements were not found for total sleep time. This finding is in line with conclusions drawn from the aforementioned meta-analysis (Okajima et al., 2011), in which no significant improvements were found between baseline and end of treatment for objectively measured total sleep time.

Comparison of Objective and Subjective Measures of Sleep within Treatment Condition

In this study, self-report data of sleep (as measured by sleep diaries) reflect objectively recorded measures of sleep (actigraphy) in terms of treatment outcome (see Table 10 in Results section). Analyses of both subjective and objective measures found improvements in sleep efficiency, wake after sleep onset, and sleep onset latency (although the objectively reported sleep onset latency only trended towards significance). Effect sizes for all outcomes for the those who participated in treatment were large: Sleep Efficiency (subjective: $\eta_p^2 = .721$; objective: $\eta_p^2 = .446$); Wake After Sleep Onset (subjective: $\eta_p^2 = .369$; objective: $\eta_p^2 = .444$); and Sleep Latency (subjective: $\eta_p^2 = .421$; objective: $\eta_p^2 = .286$). Compared to the medium effect sizes reported for the same objective variables in the recent meta-analysis (Okajima et al., 2011), the effects observed in this study stand out in the literature as greater than the average objective improvement reported across CBT-I studies.

As noted previously, compliance with wearing the actigraph was not as high as compliance in completing sleep diaries. Thus the actigraphy data do not reflect the entire cohort of veterans who participated in and completed treatment. However, the subset of data provides objective verification of the self-report data, which is inherently more vulnerable to

positive expectancy bias and demand characteristics. The latter is particular problematic in a situation like this where the interventionist is also conducting the study.

Numerous studies have found a discrepancy between objective and subjective measures (Germain, 2009; Habukawa et al., 2007; Breslau et al., 2004; Klein, Koren, Arnon & Lavie, 2003; Lavie, 2001). Furthermore, in a 2006 article that set forth recommendations for a standard research assessment of insomnia, researchers cautioned that while actigraphy corresponds highly with polysomnography, it is less reliable compared to sleep diaries and tends to "overscore" sleep in individuals with insomnia (Buysse, Ancoli-Israel, Edinger, Lichstein & Morin 2006). The study reported here, however, demonstrated relative consistency between sleep diary and actigraphy outcome variables. These findings more closely relate to current literature demonstrating that the often observed discrepancy between objective and subjective sleep outcome variables can be mitigated when objective measures are used in the home (as in this study) rather than in a sleep laboratory or sleep center (Germain, Hall, Shear, Nofzinger, & Buysse, 2006; Calhoun et al., 2007).

Directions for Future Research

The present study suggests a number of directions for future research. First, only one therapist conducted the intervention rather than multiple providers. Future studies assessing the efficacy of behavioral insomnia treatments at VA Medical Centers should consider including multiple providers, as this would more realistically reflect how treatment would be delivered within this setting. Having only one therapist conduct treatment and assessment was also a limitation of this study and thus future research should have separate researchers conducting treatment and assessment. Furthermore, future research studying the effects of CBT-I with this veteran population should track medication usage and prescription changes

that occur while the study is ongoing. Because this was not systematically followed in this study, we were unable to determine the role that medication played in changes in sleep behavior or emotional functioning.

Another limitation of this study is the low response rate achieved for follow-up data.[1] Of the few studies with combat veterans published in which follow-up data was collected, low response rate did not appear to be an issue (Lu et al., 2009; Forbes et al., 2003). One explanation for this study's low response rate at follow-up might be found in gaining a better understanding of this particular veteran population's attitude towards mental health treatment. In the recent study conducted by Ulmer and colleagues (2011), which included veterans of all combat theaters with PTSD-related insomnia, the only veterans who dropped out of the study were OEF/OIF veterans. This is consistent with findings suggesting that these veterans are reluctant to use VA mental health services due to stigma and barriers to care such as embarrassment and being perceived as weak (Pietrzak, 2009). Although we cannot conclude that not using VA services is a result of such noted stigmas and barriers, these participants' lack of response might be the result of a greater dismissal of VA mental health services.

As noted earlier, if chronic nightmares are going to be a focus of treatment, and they should given that they maintain difficulties with sleep (DeViva, Zayfert, & Mellman, 2004; Germain & Nielsen, 2003; Krakow et al., 2001), veterans might benefit from additional sessions of treatment that more comprehensively incorporate and balance CBT-I with IRT. To date, research assessing the appropriate number of sessions and the balance of CBT-I and IRT to be used with recently deployed veterans has not been conducted. As seen in Table 1 in the review of literature examining both veteran and non-veteran populations, the studies that

have assessed these treatment modalities with a PTSD population have varied in numbers of session (from one to ten) and in implementation of treatment (i.e., CBT-I alone, IRT alone, or a combination of CBT-I and IRT). Future research should seek to find how many sessions this protocol would ideally entail when used with a veteran population, define the balance between CBT-I and IRT, and determine whether the two treatments should be delivered within the same intervention protocol or whether they should be delivered independent of each other, either simultaneously or in sequence.

Study Implications and Clinical Applications

The present research also has a number of important implications. Given the reduction of both insomnia and PTSD symptoms in this study, treatment providers should thus assess for severity of insomnia as a standard of course with PTSD patients and, if present, should incorporate CBT-I into treatment. The treatment itself is relatively brief, cost-effective, and can be delivered as individual psychotherapy or within a group format (Bastien et al., 2004). The results of this study encourage such a treatment approach with OEF/OIF veterans.

In this study, veterans who participated in treatment reported both better sleep quality and a decrease in their PTSD symptom severity. Previous research shows that mood symptoms can be mitigated by improved sleep and that insomnia can be a predisposing factor of mood symptoms such as depression (Perlis et al., 2006) or PTSD (Koren et al., 2002; Picchioni et al., 2010), and also points to the predictive nature of disturbed sleep/chronic nightmares for consequent development of PTSD (Koren et al., 2002; Picchioni et al., 2010). Although the present research cannot determine such causality or the directional relationship of sleep and PTSD, empirical studies looking at this relationship seem warranted and

clinically relevant. For instance, might CBT-I in a non-PTSD sample of OEF/OIF veterans have protective and preventive effects for the development of future PTSD? In the meantime, clinicians should make a habit of assessing for sleep disturbances in vulnerable but non-PTSD diagnosed OEF/OIF veterans as insomnia and chronic nightmares might be early harbingers of an emerging PTSD disorder.

Conclusion

This study demonstrates strong support that a cognitive-behavioral based approach to treating combat-related, posttraumatic insomnia and nightmares is an effective and efficient adjunctive therapy to currently delivered PTSD exposure treatments provided at VA medical centers. The findings confirm that CBT-I is beneficial and therapeutic for OEF/OIF veterans diagnosed with PTSD for whom insomnia is a major concern. The findings also demonstrate that this intervention, which targets both insomnia and nightmares, has large effects in improving sleep quality and insomnia severity, and decreasing PTSD symptom severity, PTSD-related sleep disturbances, depression, and overall distress in OEF/OIF veterans. This is the first study that uses a combined CBT-I and IRT approach targeting specifically the OEF and OIF veteran population. This is also the first study to incorporate both objective and subjective measures of sleep and to assess for daytime functioning with this veteran population. Given the success of the intervention on sleep, PTSD-specific sleep disturbances, PTSD symptom severity, mood and daytime functioning, this study offers an important contribution to the literature and has timely implications in validating the use of this treatment protocol with this current veteran population. Given the staggering numbers of these veterans who are at risk for suffering from PTSD and PTSD-related sleep disturbances, implementation of cognitive-behavioral based treatments for PTSD related insomnia and

nightmares within a PTSD treatment program is an important and necessary step for mental health clinics at VA medical centers to consider.

Footnotes

[1] Once the study investigator was no longer on site at the McGuire VAMC, due to beginning internship, collecting data and contacting veterans became more difficult. During the active stage of the study, veterans were easier to contact as they were often seen after groups or appointments they already had scheduled at the VA and thus scheduling and treatment could be conducted at these times. Not being present at the VA proved to be a significant obstacle to this study in maintaining communication with many of the participants. Furthermore, two of the returned information packets were never found, although participants confirmed they had sent them in. The loss of these packets further underscores the obstacle that was caused by the physical absence of the main investigator once the active phase of the study was completed.

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Appendix A

Sleep Diary

SLEEP DIARY

Week 1

Name: _____

Date:

	10/9 Example					
1. Yesterday, I napped from ___ to ___ (note the times of all naps).	*1:50 to 2:30 p.m.*					
2. Yesterday, I took ___ mg of medication and/or ___ oz of ___ alcohol as a sleep aid.	*Ambien 5 mg*					
3. Last night, I went to bed and turned the lights off at ___ o'clock.	*11:15*					
4. After turning the lights out, I fell asleep in ___ minutes.	*40 min*					
5. My sleep was interrupted ___ times (specify number of nighttime awakenings).	*3*					
6. My sleep was interrupted for ___ minutes (specify duration of each awakening).	*10 5 45*					
7. This morning, I woke up at ___ o'clock (note time of last awakening).	*6:15*					
8. This morning, I got out of bed at ___ o'clock (specify the time).	*6:40*					
9. When I got up this morning, I felt ___. (1 = exhausted, 5 = refreshed)	*2*					
10. Overall, my sleep last night was ___. (1 = very restless, 5 = very sound).	*3*					

Appendix B

PTSD Symptom Scale: Self-Report Version (PDS; Foa et al., 1997)

Participant _____ Date_____

Directions: Below is a list of the problems that people sometimes have after experiencing a traumatic event. Read each one carefully and fill in the number (0-3) that best describes how often that problem has bothered you in the past 2 weeks. Rate each problem with respect to the traumatic event that brought you into treatment.

0 = Not at all or only one time
1 = Once per week or less/once in a while
2 = 2 to 4 times per week/half the time
3 = 5 or more times per week/almost always

Items	**0**	**1**	**2**	**3**
1. Having upsetting thoughts or images about the traumatic event that came into your head when you didn't want them to?				
2. Having bad dreams or nightmares about the traumatic event?				
2a. Having these bad dreams always center on being killed?				
3. Reliving the traumatic event, acting or feeling as if it were happening again?				
3a. Reliving the traumatic event as if I am moving in a rewind motion?				
4. Feeling EMOTIONALLY upset when you were reminded of the traumatic event (for example feeling scared, angry, sad, guilty, etc.				
5. Experiencing PHYSICAL reactions (for example, break out in a sweat, heart beats fast) when you were reminded of the traumatic event?				
6. Trying not to think about, talk about, or have feelings about the traumatic event?				
6a. And when I try hard enough NOT to think about the traumatic event I feel dizzy?				
7. Trying to avoid activities, people, or places that remind you of the traumatic event?				
8. Not being able to remember an important part of the traumatic event?				
9. Having much less interest or participating much less often in important activities?				
9a. Having much MORE interest in activities that are unimportant?				
10. Feeling distant or cut off from people around you?				
11. Feeling emotionally numb (for example, being unable to cry or unable to have loving feelings)				
11a. Feeling emotionally transparent (for example, feeling like people are unable to see me)				
12. Feeling as if your future plans or hopes will not come true (for example, you will not have a career, marriage, children, or a long life)?				
13. Having trouble falling or staying asleep? 14. Feeling irritable or having fits of anger?				
15. Having trouble concentrating (for example, drifting in and out of conversations, losing track of a story on television, forgetting what you read)?				
16. Being overly alert (for example, checking to see who is around you, being uncomfortable with your back to the door, etc.)?				
16a. Being overly aware of sensations or changes in my body?				
17. Being jumpy or easily startled (for example, when someone walks up behind you)?				
17a. Being acutely aware of smells, especially body odor?				

Appendix C

The Pittsburgh Sleep Quality Index (PSQI) is protected by copyright so it is not reproduced in this document.

Appendix D

PSQI Addendum for PTSD

INSTRUCTIONS:
Please answer the following additional questions regarding your sleep in the past month. Include any observations from your bed partner/ roommate.

1. During the past month, how often have you had trouble sleeping because you…
    a) Feel hot flashes

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

    b) Feel general nervousness

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

    c) Had memories or nightmares of a traumatic experience:

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

    d) Had severe anxiety or panic, not related to traumatic memories

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

    e) Had bad dreams not related to traumatic memories:

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

    f) Had episodes of terror or screaming during sleep without fully awakening

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

    g) Had episodes of "acting out" your dreams, such as kicking, punching, running, or screaming:

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

2. If you had memories or nightmares of a traumatic experience during sleep (question 1C above)…
    a. How much anxiety did you feel during the memories/nightmares?

    None ___ Very little ___ Moderate ___ Severe ___

b. How much anger did you feel during the memories/nightmares?

None ___ Very little ___ Moderate ___ Severe ___

c. What time of night did most nightmares/memories occur?

Early in the night ___ Middle of the night ___ Late night, near morning ___ No particular time ____

Appendix E

The Insomnia Severity Index (ISI) is protected by copyright so it is not reproduced in this document.

Appendix F

Beliefs and Attitudes about Sleep Scale

Several statements reflecting people's beliefs and attitudes about sleep are listed below. Please indicate to what extent you personally agree or disagree with each statement. There is no right or wrong answer. For each statement, place a mark (/) along the line wherever your *personal* rating falls. Try to use the whole scale, rather than placing your marks at one end of the line.

1. I need 8 hours of sleep to feel refreshed and function well during the day.

Strongly disagree _____ *Strongly agree*

2. When I don't get a proper amount of sleep on a given night, I need to catch up on the next day by napping or on the next night by sleeping longer.

Strongly disagree _____ *Strongly agree*

3. Because I am getting older, I need less sleep.

Strongly disagree _____ *Strongly agree*

4. I am worried that if I go for one or two nights without sleep, I may have a nervous breakdown.

Strongly disagree _____ *Strongly agree*

5. I am concerned that chronic insomnia may have serious consequences for my physical health.

Strongly disagree _____ *Strongly agree*

6. By spending more time in bed, I usually get more sleep and feel better the next day.

Strongly disagree _____ *Strongly agree*

7. When I have trouble getting to sleep, I should stay in bed and try harder.

Strongly disagree _____ *Strongly agree*

8. I am worried that I may lose control over my abilities to sleep.

Strongly disagree _____ *Strongly agree*

9. Because I am getting older, I should go to bed earlier in the evening.

Strongly disagree _____ *Strongly agree*

10. After a poor night's sleep, I know that it will interfere with my daily activities the next day.

Strongly disagree _____ *Strongly agree*

11. In order to be alert and function well during the day, I am better off taking a sleeping pill rather than having a poor night's sleep.

Strongly disagree _____ *Strongly agree*

12. When I feel irritable, depressed, or anxious during the day, it is mostly because I did not sleep well the night before.

Strongly disagree _____ *Strongly agree*

13. Because my bed partner falls asleep as soon as his or her head hits the pillow and stays asleep through the night, I should be able to do so too.

Strongly disagree _____ *Strongly agree*

14. I feel that insomnia is basically the result of aging, and there isn't much that can be done about this problem.

Strongly disagree _____ *Strongly agree*

15. I am sometimes afraid of dying in my sleep.

Strongly disagree _____ *Strongly agree*

16. When I have a good night's sleep, I know that I will have to pay for it on the following night.

Strongly disagree _____ *Strongly agree*

17. When I sleep poorly on one night, I know it will disturb my sleep schedule for the whole week.

Strongly disagree _____ *Strongly agree*

18. Without an adequate night's sleep, I can hardly function the next day.

Strongly disagree _____ *Strongly agree*

19. I can't predict whether I'll have a good or poor night's sleep.

Strongly disagree _____ *Strongly agree*

20. I have little ability to manage the negative consequences of disturbed sleep.

Strongly disagree _____ *Strongly agree*

21. When I feel tired, have no energy, or just seem not to function well during the day, it is generally because I did not sleep well the night before.

Strongly disagree _____ *Strongly agree*

22. I get overwhelmed by my thoughts at night and often feel I have no control over my racing mind.

Strongly disagree _____ *Strongly agree*

23. I feel I can still lead a satisfactory life despite sleep difficulties.

Strongly disagree _____ *Strongly agree*

24. I believe insomnia is essentially the result of a chemical imbalance.

Strongly disagree _____ *Strongly agree*

25. I feel insomnia is ruining my ability to enjoy life and prevents me from doing what I want.

Strongly disagree _____ *Strongly agree*

26. I avoid or cancel obligations (social, family, occupational) after a poor night's sleep.

Strongly disagree _____ *Strongly agree*

27. A “nightcap” before bedtime is a good solution to sleep problems.

Strongly disagree _____ *Strongly agree*

28. Medication is probably the only solution to sleeplessness.

Strongly disagree _____ *Strongly agree*

29. My sleep is getting worse all the time, and I don’t believe anyone can help.

Strongly disagree _____ *Strongly agree*

30. It usually shows in my physical appearance when I haven’t slept well.

Strongly disagree _____ *Strongly agree*

Appendix G

TREATMENT EVALUATION QUESTIONNAIRE
Pre Post

Name: Age :
Date:

1. Does this treatment and its rationale make sense to you?

   NOT AT ALL _____VERY MUCH SO

2. How acceptable do you consider this insomnia treatment?

   NOT AT ALL VERY
   ACCEPTABLE_____ACCEPTABLE

3. How suitable is this treatment for your sleep problem?

   NOT AT ALL VERY
   SUITABLE _____ SUITABLE

4. How effective do you expect this treatment to be for your sleep problem?

   NOT AT ALL VERY
   EFFECTIVE _____ EFFECTIVE

Appendix H

The Patient Health Questionnaire (PHQ) is protected by copyright so it is not reproduced in this document.

Appendix I

The Profile of Mood States (POMS)

Below is a list of words that describe feelings people have. Please read each one carefully. Then circle the number under the answer which best describes HOW YOU HAVE BEEN FEELING DURING THE PAST WEEK INCLUDING TODAY.

	Not at all	A little	Moderately	Quite a bit	Extremely		Not at all	A little	Moderately	Quite a bit	Extremely
1. Friendly	0	1	2	3	4	18. Blue	0	1	2	3	4
2. Tense	0	1	2	3	4	19. Energetic	0	1	2	3	4
3. Angry	0	1	2	3	4	20. Panicky	0	1	2	3	4
4. Worn out	0	1	2	3	4	21. Hopeless	0	1	2	3	4
5. Unhappy	0	1	2	3	4	22. Relaxed	0	1	2	3	4
6. Clear-headed	0	1	2	3	4	23. Unworthy	0	1	2	3	4
7. Lively	0	1	2	3	4	24. Spiteful	0	1	2	3	4
8. Confused	0	1	2	3	4	25. Sympathetic	0	1	2	3	4
9. Sorry for things done	0	1	2	3	4	26. Uneasy	0	1	2	3	4
10. Shaky	0	1	2	3	4	27. Restless	0	1	2	3	4
11. Listless	0	1	2	3	4	28. Unable to concentrate	0	1	2	3	4
12. Peeved	0	1	2	3	4	29. Fatigued	0	1	2	3	4
13. Considerate	0	1	2	3	4	30. Helpful	0	1	2	3	4
14. Sad	0	1	2	3	4	31. Annoyed	0	1	2	3	4
15. Active	0	1	2	3	4	32. Discouraged	0	1	2	3	4
16. On edge	0	1	2	3	4	33. Resentful	0	1	2	3	4
17. Grouchy	0	1	2	3	4	34. Nervous	0	1	2	3	4

	Not at all A little Moderately Quite a bit Extremely						Not at all A little Moderately Quite a bit Extremely				
35. Lonely	0	1	2	3	4	53. Furious	0	1	2	3	4
36. Miserable	0	1	2	3	4	54. Efficient	0	1	2	3	4
37. Muddled	0	1	2	3	4	55. Trusting	0	1	2	3	4
38. Cheerful	0	1	2	3	4	56. Full of pep	0	1	2	3	4
39. Bitter	0	1	2	3	4	57. Bad-tempered	0	1	2	3	4
40. Exhausted	0	1	2	3	4	58. Worthless	0	1	2	3	4
41. Anxious	0	1	2	3	4	59. Forgetful	0	1	2	3	4
42. Ready to fight	0	1	2	3	4	60. Carefree	0	1	2	3	4
43. Good natured	0	1	2	3	4	61. Terrified	0	1	2	3	4
44. Gloomy	0	1	2	3	4	62. Guilty	0	1	2	3	4
45. Desperate	0	1	2	3	4	63. Vigorous	0	1	2	3	4
46. Sluggish	0	1	2	3	4	64. Uncertain about things	0	1	2	3	4
47. Rebellious	0	1	2	3	4	65. Bushed	0	1	2	3	4
48. Helpless	0	1	2	3	4						
49. Weary	0	1	2	3	4						
50. Bewildered	0	1	2	3	4						
51. Alert	0	1	2	3	4						
52. Deceived	0	1	2	3	4						

Appendix J

Analysis of Variance Tables for All Analyses

Table 15.

Repeated-Measures Multivariate Analysis of Variance: Effects of Cognitive Behavioral Treatment of Insomnia (Condition X Time) on Sleep Diary

Source	*df*	*Error df*	*F*	η_p^2	*P*
Sleep Diary	4	29	5.42	.428	.002

Table 16.

Repeated-Measures Analysis of Variance for Effects of Cognitive Behavioral Treatment of Insomnia (Condition X Time) on Sleep Diary Variables

Variable	*df*	*Error df*	*F*	η_p^2	*P*
Sleep Efficiency	1	32	23.08	.419	.000
Sleep Onset Latency	1	32	15.23	.322	.000
Total Sleep Time	1	32	3.31	.094	.078
Wake After Sleep Onset	1	32	7.43	.188	.010

Table 17.

Repeated-Measures Analysis of Variance for Effects of CBT-I over time on Sleep Diary Variables Within Each Group

Variable	*Df*	*Error df*	*F*	η_p^2	*P*
			Treatment Condition		
Sleep Efficiency	1	17	30.17	.64	.000
Sleep Onset Latency	1	17	16.23	.488	.001

Total Sleep Time	1	17	3.57	.174	.076
Wake After Sleep Onset	1	17	15.82	.482	.001
			Waitlist Control		
Sleep Efficiency	1	15	.279	.018	.605
Sleep Onset Latency	1	15	1.55	.094	.232
Total Sleep Time	1	15	.31	.020	.584
Wake After Sleep Onset	1	15	.043	.003	.838

Table 18.

Repeated-Measures Analysis of Variance for Effects of CBT-I (Condition X Time) on Insomnia Severity and Overall Sleep Quality

Variable	*Df*	*Error df*	*F*	η_p^2	*p*
Insomnia Severity (ISI)	1	35	16.24	.317	.000
Overall Sleep Quality (PSQI)	1	35	25.28	.419	.000
Beliefs About Sleep (DBAS-16)	1	34	3.42	.091	.073

Table 19.

Repeated-Measures Analysis of Variance for Effects of CBT-I over time for Insomnia Severity and Overall Sleep Quality

Variable	*Df*	*Error df*	*F*	η_p^2	*p*
			Treatment Condition		
Insomnia Severity (ISI)	1	19	22.4	.541	.000

Overall Sleep Quality (PSQI)	1	19	27.58	.59	.000
Beliefs About Sleep (DBAS-16)	1	18	6.05	.251	.024
			Waitlist Control		
Insomnia Severity (ISI)	1	16	0	0	1.0
Overall Sleep Quality (PSQI)	1	16	2.11	.117	.165
Beliefs About Sleep (DBAS-16)	1	16	.51	.003	.824

Table 20.

Repeated-Measures Analysis of Variance for Effects of Cognitive Behavioral Treatment of Insomnia (Condition X Time) on PTSD Symptom Severity and PTSD Related Nighttime Disturbances

Variable	*Df*	*Error df*	*F*	η_p^2	*p*
PTSD Symptom Severity	1	25	16.71	.401	.000
PSQI-A	1	23	7.3	.241	.01

Table 21.

Repeated-Measures Analysis of Variance for Effects of CBT-I over time for PTSD Symptom Severity and PTSD Related Nighttime Disturbances

Variable	*Df*	*Error df*	*F*	η_p^2	*p*
			Treatment Condition		
PTSD Symptom Severity	1	14	12.39	.469	.003
PSQI-A	1	14	6.62	.321	.022

		Waitlist Control			
PTSD Symptom Severity	1	11	5.58	.336	.0381
PSQI-A	1	10	1.84	.155	. 205

Table 22.

Repeated-Measures Analysis of Variance for Effects of Cognitive Behavioral Treatment of Insomnia (Condition X Time) on Mood Symptoms and Daytime Functioning

Variable	*Df*	*Error df*	*F*	η_p^2	*p*
Depression (PHQ-9)	1	21	16.17	.435	.001
Overall Distress (POMS)	1	24	8	.25	.009
Depression (POMS)	1	24	6.5	.214	.017
Tension (POMS)	1	24	5.69	.192	.025
Vigor (POMS)	1	24	.039	.002	.845
Anger (POMS)	1	24	5.28	.180	.031
Confusion (POMS)	1	24	9.36	.281	.005
Fatigue (POMS)	1	24	5.23	.179	.031

Table 23.

Repeated-Measures Analysis of Variance for Effects of CBT-I over time for Mood Symptoms and Daytime Functioning (POMS and PHQ)

Variable	*Df*	*Error df*	*F*	η_p^2	*p*

			Treatment Condition		
Depression (PHQ-9)	1	13	28.9	.697	.000
Overall Distress (POMS)	1	13	6.12	.320	.028
Depression (POMS)	1	13	3.2	.198	.097
Tension (POMS)	1	13	6.54	.335	.024
Anger (POMS)	1	13	4.94	.275	.045
Confusion (POMS)	1	13	7.79	.375	.015
Fatigue (POMS)	1	13	5.9	.312	.03
			Waitlist Control		
Depression (PHQ-9)	1	8	1.23	.133	.301
Overall Distress (POMS)	1	11	2.38	.177	.152
Depression (POMS)	1	11	3.44	.238	.091
Tension (POMS)	1	11	.752	.064	.404
Anger (POMS)	1	11	1.23	.101	.291
Confusion (POMS)	1	11	3	.214	.111
Fatigue (POMS)	1	11	.768	.065	.400

Table 24.

Repeated-Measures Analysis of Variance: Effects of CBT-I on Objective Measures of Sleep (Actigraphy) over time (Treatment Group)

Variable	*Df*	*Error df*	*F*	η_p^2	*p*
Sleep Efficiency	1	9	7.25	.446	.025
Sleep Onset Latency	1	9	4.88	.352	.054
Total Sleep Time	1	9	.056	.006	.82
Wake After Sleep Onset	1	9	7.18	.444	.025

Vita

Skye Ochsner Margolies was born on June 4, 1973 in New Orleans, LA and is an American citizen. She graduated from Georgetown University in 1995 with a Bachelors of Science in Languages and received her Master of Arts in psychology at the University of Richmond in 2005.

Skye enrolled in Virginia Commonwealth University's Clinical Psychology program in the fall of 2005. In 2009, she received funding as a predoctoral Rehabilitation Research Fellow to complete dissertation research on the efficacy of cognitive behavioral therapy for insomnia with OEF/OIF veterans diagnosed with PTSD at the McGuire Veterans Administration Medical Center. She completed her internship at Eastern Virginia Medical School in the summer of 2011 and expects to graduate December, 2011.