Research Facilitation

Sleep and Operational Stress

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Background

Difficulty sleeping is a common reaction to stress. Due to the inordinately high number of stressors faced by deployed military service members, sleep problems are a common occurrence in this population. A recent study found that 74% of deployed military personnel rated their quality of sleep as significantly worse in the deployed environment compared to sleep at home.[1] Sleep difficulty is also a common complaint among veterans returning from deployment, most notably those returning from deployments to Operation Enduring Freedom in Afghanistan and Operation Iraqi Freedom in Iraq.[2] Sleep problems occur not just during and immediately after deployment but can continue for several months and up to several years.[2, 3] These problems can lead to difficulty in several areas of functioning, including psychomotor, mood, autonomic and immune functioning, and may also contribute to the development of numerous medical and psychological conditions.[4-7] Sleep problems in and of themselves are associated with poor performance and a reduced quality of life.[6]

Sleep disorders include a wide range of medical and psychological conditions: insomnia, nightmares, sleep apnea and restless legs syndrome, as well as difficulty with wakefulness and alertness.[8] These disorders can restrict quality restorative sleep, which is essential for optimal daily functioning and emotional health. Insomnia, nightmares and sleep apnea can result in poor concentration, agitation or irritability and impaired emotional coping. Poor sleep can also lead to increased negative emotions in the short term, such as anger and sadness, and is a risk factor for depressive and anxiety disorders in the long term.[5, 9, 10] Chronic sleep restrictions may negatively affect the body's stress systems, which enable us to deal with everyday challenges. By changing these stress systems, sleep restriction may sensitize individuals to stress-related disorders, including cardiovascular diseases and mood disorders.[4]

Difficulty sleeping is a core symptom of post-traumatic stress disorder (PTSD), depression and generalized anxiety disorder, all of which are common post-deployment psychological health problems.[11] Symptoms of sleep dysfunction are also typically the most resistant to treatment of these psychological health problems. Insomnia has been shown to hamper treatments for depression and anxiety, and could present a greater risk for later distress in these patients.[12] Given the extensive literature on the stigma associated with PTSD,[11] treatment for sleep problems could serve as an opportunity to initiate treatment of co-morbid PTSD, depression or generalized anxiety. Since such high rates of sleep disturbance are currently reported by service members, reporting symptoms of sleep disturbance does not appear to be associated with as much of a stigma.

Published November 2009

Prevalence

General Populations

Normal adults sleep between six and nine hours per night, and the normal sleep stage distribution is as follows: stages 1+2: 47% to 60% of sleep; stages 3+4: 13% to 23% of sleep; and rapid eye movement (REM) sleep accounts for 20% to 25% of sleep. REM latency (amount of time it takes for the first onset of REM sleep) is between 70 and 100 minutes, and wakefulness within sleep usually accounts for less than 5% of the night.[13]

In a large international study using the DSM-IV symptomatology for insomnia, 27.2% of a general adult population sample reported difficulty sleeping at least three times per week. This was further divided into either difficulty initiating sleep (10.1%), difficulty maintaining sleep (disrupted sleep: 18.0%; early morning awakening: 10.9%) or non-restorative sleep (8.9%). Of those with difficulty sleeping, 48.5% were concurrently suffering from a DSM-IV sleep and/or mental health disorder.[14]

Military Populations

A study published in 2007 from Walter Reed Army Medical Center reported that 34% of OIF war veterans described struggling with sleep a year after their deployment. Their sleep difficulties ranged from trouble falling asleep, staying asleep or sleeping too much.[15]

Research conducted at the Naval Medical Center San Diego found that 41% of service members reported having sleep problems after returning from deployment to Iraq or Afghanistan.[2] Three months later, 36% of these patients continued to report sleep problems. Those who reported sleep problems upon returning from deployment had more PTSD symptoms at the three-month follow-up than those with no sleep problems. Moreover, sleep complaints were problematic for service members deployed to regions other than Iraq and Afghanistan, with 25% having reported sleep problems directly after returning from deployment and 20% reporting problems three months later.

A large study[3] of Vietnam veterans found insomnia and nightmares to be more common among veterans than civilians, with the most frequent sleep troubles found among veterans with PTSD (see table below):

Reanalysis of Sleep Disturbances from National Vietnam Veterans Readjustment Study[3]				
Sleep Disturbance (reported as occurring sometimes or more frequently)	**Vietnam Combat Veterans With PTSD**	**Vietnam Combat Veterans Without PTSD**	**Vietnam-era Veterans**	**Civilians**
Sleep-onset insomnia	44.0%	5.5%	9.4%	5.0%
Sleep maintenance insomnia	90.7%	62.5%	63.1%	52.9%
Nightmares	52.4%	4.8%	5.7%	3.4%

Sleep and Mental Health

Insomnia is quite frequent in the general population and is often co-morbid with mental health disorders. A large study using a general population sample found that of the 19% of people with insomnia that impaired daytime functioning, 28% had a concurrent mental health diagnosis and 26% had a history of psychiatric illness. Severe and/or chronic insomnia are predictors of a psychiatric history.[16]

Depression and Anxiety

- There is a strong association between abnormal sleep and depression, with roughly three-quarters of depressed patients having insomnia symptoms. In addition, hypersomnia is present in about 40% of young depressed adults and 10% of older patients and is found predominantly in females. These sleep symptoms have a major impact on quality of life for depressed patients and are a strong risk factor for suicide.[17]

- A large prospective study of a general adult population found that insomnia is found to commonly co-occur with either anxiety or depression; insomnia also is a risk factor for the development of anxiety disorders.[10]

Substance Abuse

A clinically important relationship between sleep disturbance and alcohol use has been demonstrated, although the strength and direction of the association is unclear.[18] Alcohol can restrict sleep to lighter stages in which individuals are more likely to awaken, and avoiding alcohol is often recommended to improve sleep.[19] Conversely, chronic sleep disturbance may lead to heavier alcohol use. Sleep disturbances caused by excessive worry in a sample of the

general population were associated with a two-fold increased risk for alcohol-related problems several years later. Risk was highest for those with sleep disturbance and co-occurring anxiety disorders or dysphoria.[20] Additionally, a study of female rape victims with PTSD suggested that sleep difficulties may contribute to alcohol use in this population.[21]

Military personnel serving in support of OEF and OIF have higher rates of both mental health problems and potentially hazardous alcohol use after deployment. A 2004 study found that the percentage of U.S. Army participants who met criteria for depression, generalized anxiety or PTSD rose from 9.3% to 17.1% after deployment to Iraq. Likewise, the percentage of Army participants who reported wanting or needing to cut down on their alcohol consumption rose from 12.5% to 20.6% after service in Iraq.[11] Some of these problems could be explained by the sleep disturbances experienced by service members both during and after deployment.

PTSD

Sleep disruption is one of the most commonly reported symptoms after exposure to a traumatic event.[22] For most people, this reaction is transient and their sleep will return to normal. However, for some people, the sleep disturbances become a chronic condition and can be both a risk factor for PTSD and a primary symptom of the disorder.

A growing body of evidence suggests that disturbed sleep is a core feature of PTSD rather than just a secondary symptom.[5] According to DSM-IV criteria, sleep disturbances are incorporated into the definition of PTSD: recurrent nightmares, included in the re-experiencing cluster (criteria B) and sleep difficulty, included in the hyperarousal cluster (criteria D).[8] However, in addition to being a symptom, several studies have identified insomnia as a predictor of PTSD development.[5] The mechanism for this is explained thusly: "With disturbed sleep any (critical) event will be more difficult to process and more likely to result in emotional complaints, and an extremely critical event will therefore be more likely to result in PTSD." There is also evidence that disturbed sleep is a residual symptom after successful PTSD treatment and sleep-focused therapy can alleviate both sleep problems and PTSD symptomatology. These findings support the notion that disturbed sleep is not merely a secondary symptom of PTSD, but rather a core feature of the disorder that often warrants its own treatment to achieve remission.[5]

Sleep problems also have an impact on the symptom severity of PTSD. Evidence has also shown that in people exposed to trauma, sleep disturbance severity correlates positively with PTSD symptom severity.[23, 24] Such factors as age, gender, trauma type and PTSD chronicity have minimal impact on sleep quality in PTSD patients.[23] Further, the quality of sleep significantly impacts perceived mental health and the severity of PTSD symptoms unrelated to sleep, regardless of psychotropic medication, co-morbid conditions, alcohol use and trauma-related characteristics.[25]

Several studies have described the prevalence and characteristics of sleep disturbances in PTSD:

- Subjective reports of sleep disturbance indicate that 70% to 91% of PTSD patients have difficulty falling or staying asleep.[26]

- Nightmares are reported by 19% to 71% of PTSD patients, depending on symptom severity and exposure to physical aggression.[26]
- Recent findings suggest that sleep-disordered breathing and sleep movement disorders are more common in patients with PTSD than in the general population, and these disorders may contribute to the brief awakenings, insomnia and daytime fatigue in patients with PTSD.[26]
- A recent meta-analysis identified increased stage 1 sleep, decreased slow wave sleep and increased REM density as consistent alterations of sleep in PTSD versus control groups.[27]
- Recurrent awakenings, threatening dreams, thrashing movements during sleep and awakenings with startle or panic features represented the most prevalently reported sleep-related symptoms in combat veterans with PTSD. Sleep disturbances were reported significantly more frequently in combat veterans with PTSD versus combat veterans without PTSD.[28]
- The combat veterans with PTSD reported significantly fewer hours of sleep than combat veterans without PTSD (mean = 5.3, SD = 1.6, versus mean = 6.5, SD = 1.3) ($t = 2.9$, d.f. = 56, $p<0.05$).[28]
- Insomnia and nonrestorative sleep were endorsed as significant problems by 59% to 73% of participants with PTSD versus 19% to 38% of participants without PTSD.[28] The table below illustrates the differences in sleep quality between the two groups:

Sleep characteristics of combat veterans with PTSD and healthy controls[28]

Measure*	**Combat Veterans with PTSD (N=21)**	**Comparison Subjects (N=8)**
	Mean (SD)	Mean (SD)
Sleep efficiency (%)	81.1 (11.5)	90.1 (3.4)
Awake time (min)	49.9 (46.8)	20.3 (8.0)
Micro-awakenings	12.9 (10.9)	5.7 (3.3)

* All findings significant at $p<0.01$

Sleep and Traumatic Brain Injury

Research demonstrates that a full spectrum of common sleep disorders occurs in patients with chronic traumatic brain injury (TBI).

- A TBI sleep study found a high prevalence of sleep disorders (46%) and excessive daytime sleepiness (25%) in adults at least three months post-TBI. Of note, sleepy TBI study participants may be more impaired than comparable non-sleepy TBI study participants, yet be unaware of problems. Given the high prevalence of obstructive sleep apnea (23%), post-traumatic

hypersomnia (11%), and narcolepsy (7%) in this population, there is a clinical indication for evaluations with polysomnography and multiple sleep latency tests.[29]

Among patients with chronic TBI presenting with sleep complaints:

- Hypersomnia was the presenting complaint in 50% of cases, mostly due to sleep apnea, narcolepsy and periodic limb movement disorder.
- Insomnia was the presenting complaint in 25% of cases; of these, half of the sample had sleep maintenance insomnia and high Beck Depression Inventory scores, and the remainder had sleep onset insomnia and high Hamilton Anxiety Scale scores.
- Parasomnia was the presenting complaint in 25%; the most frequent parasomnia was REM behavior disorder (RBD).
- Social, occupational and psychological functioning of adults with TBI was inversely correlated with stage 1 sleep disruption, sleep efficiency and wake during sleep.
- Social, occupational and psychological functioning of adults with TBI was not significantly correlated with wake before sleep and stage-shifts.
- 53% had an average sleep onset latency <5 minutes, and 32% also had two or more sleep onset REM periods.[30]

Sleep in the Military

Combat Exposure

- Combat exposure is highly correlated with reports of nightmares, moderately correlated with sleep onset insomnia and only weakly associated with sleep maintenance insomnia.
- Frequency of nightmares has a strong relationship to level of exposure to war zone trauma even after accounting for non-sleep PTSD symptoms, co-morbid psychiatric disorders, substance abuse and general medical illness.[3]

Deployment

- 74% of deployed military personnel reported their quality of sleep as significantly worse in the deployed environment.
- 40% had a sleep efficiency (total sleep time/time spent in bed) of less than 85%, and 42% had a sleep onset latency of more than 30 minutes.
- Night-shift workers had significantly worse sleep efficiency and more problems getting to sleep and staying asleep as compared to day-shift workers.[1]

Given that combat exposure and deployment in general have been linked to more sleep problems, and insomnia has been identified as a risk factor for PTSD, current operational environments have the potential to promote the development of PTSD and other mental/physical disorders via sleep disturbance.

Pharmacologic Treatment

Pharmacologic interventions, despite their potential side effects, are often the front-line therapy chosen by physicians and mental health providers for the treatment of insomnia. These medications, which include benzodiazepines, non-benzodiazepines and antihistamines, vary in their effectiveness as well as their side-effect profiles.

- The authors of an insomnia treatment review article advised that hypnotics generally should be prescribed for short periods only in cases of insomnia, with frequency and duration of use customized to each patient's circumstances. Long-term use of benzodiazepines may lead to withdrawal and significant side effects. Newer-generation non-benzodiazepines, such as zolpidem, may be better choices for treating chronic insomnia due to their better safety profile.[31]

- Several studies have indicated a beneficial effect of prazosin for treating PTSD-related nightmares. Prazosin, which is used to treat high blood pressure, has been shown to reduce nightmares in patients with both combat- and noncombat-related trauma.[32] The drug has also been shown to improve overall sleep quality and patients' sense of well-being and ability to function on a daily basis.[33]

- A six-week open-label trial found that quetiapine administered to combat veterans with PTSD significantly improved their sleep over the trial period (Pittsburgh Sleep Quality Index scores decreased from 15.82 to 7.89).[34]

- In a recent pilot study, the anticonvulsant drug topiramate was effective in reducing nightmares and overall PTSD symptom severity in combat veterans with PTSD.[35]

- Selective serotonin reuptake inhibitors (SSRIs) are commonly used to treat PTSD, and they may also have a small beneficial effect on sleep disruption in PTSD patients. Olanzapine, administered concurrently with SSRIs, may be an effective treatment for nightmares and insomnia, although it can cause significant side effects. Still other medications, including zolpidem, buspirone, gabapentin and mirtazapine, have also been found to improve sleep in patients with PTSD. In contrast, evidence suggests that benzodiazepines, TCAs and MAOIs are not useful for the treatment of PTSD-related sleep disorders.[26]

Non-Pharmacologic Treatment

Many non-pharmacologic interventions have been shown to be effective in treating insomnia, including cognitive behavioral therapy (CBT), stimulus-control therapy (sleep hygiene), relaxation, paradoxical intention and sleep restriction. Such therapies could be employed in a larger number of patients with positive results, especially for those patients who may be experiencing medication side effects. This is of particular importance for service members in operational environments in which pharmacological treatments might not be available or ideal, given the potential side effects. Some

complementary and alternative medicine therapies may also hold promise for the treatment of insomnia and should be investigated as an alternative to medication.[36]

- A review of insomnia treatment options indicates that treatment should begin with non-pharmacologic therapy, addressing sleep hygiene issues and exercise. Exercise has been shown in some studies to improve sleep as effectively as benzodiazepines. There is also good evidence to support the effectiveness of CBT for the treatment of insomnia.[31]

- CBT has been shown to be more effective than a wait-list control for the treatment of nocturnal panic (waking abruptly from sleep in a state of panic), a common phenomenon among patients with panic disorder.[37]

- Stimulus control therapy, relaxation, paradoxical intention, sleep restriction and CBT met criteria for empirically supported psychological treatment for insomnia.[38]

- Both prolonged exposure and cognitive processing therapy significantly decreased sleep dysfunction in a sample of women with PTSD. No differences were seen between treatments.[39]

Conclusion

Due to work schedules, sleeping conditions, combat exposure and the inherently stressful nature of military operational environments, sleep problems are common among service members both during and after deployment. These problems may contribute to the development of alcohol abuse, PTSD and other mental health disorders and are linked to decreased mental and physical functioning and an overall decreased quality of life. Studies have shown that while disturbed sleep is a core component and predictor of PTSD, therapy that incorporates treatment for sleep disturbances can alleviate both sleep problems and PTSD symptomatology. Sleep problems are also common among patients with chronic TBI, depression and anxiety and may be treated with a variety of pharmacologic and non-pharmacologic approaches. Managing stress and optimizing sleeping conditions both during and after deployment, as well as seeking treatment for sleep and other mental health problems, is essential to reducing the burden of sleep disorders among U.S. military service members.

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Table 1. Sleep and Operational Stress Literature Cited

Author	Objective	Participants/Design	Results
Peterson et al, 2008	To evaluate symptoms of sleep disturbance and insomnia in deployed military personnel.	156 deployed military personnel were assessed with Military Deployment Survey of Sleep.	74% of participants rated their quality of sleep as worse in the deployed environment, 40% had a sleep efficiency of <85%, and 42% had a sleep onset latency of >30 minutes.
McLay et al, in preparation	To investigate insomnia and PTSD symptoms following deployment.	Post-deployment records were reviewed of 1449 initial post-deployment screenings and 775 follow-ups 3 months later.	At initial screen, insomnia was the most commonly endorsed PTSD symptom. 41% of those who had been to Iraq or Afghanistan reported sleep problems. Those who initially reported any insomnia had significantly higher overall scores for PTSD severity at follow up than did service members without such a complaint.
Neylan et al, 1998	To evaluate the role of combat exposure and PTSD on sleep disturbances among veterans.	1,200 male Vietnam theater veterans, 412 male Vietnam era veterans, and 450 male civilian comparison subjects were assessed by questionnaire.	Frequent nightmares were found exclusively in subjects diagnosed with current PTSD at the time of the survey (15.0%). In the sample of veterans who served in Vietnam, combat exposure was strongly correlated with frequency of nightmares, moderately correlated with sleep onset insomnia, and weakly correlated with disrupted sleep maintenance.
Meerlo et al, 2008	To review how inadequate sleep can affect the body.	Literature review	Insufficient sleep, by acting on stress systems, may sensitize individuals to stress-related disorders. Indeed, epidemiological studies suggest that sleep complaints and sleep restriction may be important risk factors for a variety of diseases that are often linked to stress, including cardiovascular diseases and mood disorders.
Spoormaker & Montgomery, 2008	To evaluate the role of sleep disturbance in PTSD.	Literature review	A growing body of evidence shows that disturbed sleep is more than a secondary symptom of PTSD-it seems to be a core feature.
Szentkiralyi et al, 2009	To provide an overview of how sleep disorders can affect other areas of functioning.	Literature review	Sleep problems are associated with psychological and social dysfunction and a reduced quality of life.
Zisapel 2007	To evaluate the effects of inadequate sleep.	Literature review	Deviant sleep patterns are associated with increased risks of morbidity, poor quality of life and mortality.

Author	Objective	Participants/Design	Results
Ford & Kamerow, 1989	To assess the relationship between sleep problems and psychiatric disorders in a community sample.	Community sample of 7954 individuals assessed by questionnaire at baseline and 1 yr follow-up.	40% of those with insomnia and 46.5% of those with hypersomnia had a psychiatric disorder compared with 16.4% of those with no sleep complaints. Risk for developing major depression was higher among those with insomnia at both time points.
Neckelmann et al, 2007	To study the relationship of insomnia to the development of anxiety disorders and depression in a population-based sample.	Participants without significant anxiety and depression at baseline were assessed in 2 surveys, at baseline and approximately a decade later (N=25,130).	Anxiety at follow-up was associated with insomnia at baseline, follow-up and both time points. Results are consistent with insomnia being a risk factor for the development of anxiety disorders.
Hoge et al, 2004	To assess the mental health of members of the armed services who have participated in OEF/OIF.	Members of combat infantry units (three Army and one Marine Corps unit) were assessed by a survey that was administered either before their deployment to Iraq (n=2530) or 3-4 months after their return from combat duty in Iraq or Afghanistan (n=3671).	The percentage of study subjects whose responses met the screening criteria for major depression, generalized anxiety, or PTSD was significantly higher after duty in Iraq (15.6 to 17.1 percent) than after duty in Afghanistan (11.2 percent) or before deployment to Iraq (9.3 percent).
Cukrowicz et al, 2009	To examine the influence of a number of psychological factors on the effectiveness of an early intervention program targeting anxiety and depression.	A non-clinical sample of college students were treated with an early intervention program and assessed pre- and post-treatment for depression, anxiety, and sleep difficulties.	The effectiveness of the intervention program on symptoms of depression was moderated by insomnia; symptoms of anxiety by past post-traumatic stress disorder (PTSD) and specific phobia as well as sleep problems related to nightmares.
Ohayon & Roth, 2001	To provide new guidelines to assess insomnia prevalence.	A cross-sectional telephone survey on sleep problems was done with 24,600 general population-based subjects.	27.2% of the sample reported difficulty initiating sleep (DIS) (10.1%) or maintaining sleep (DMS) (disrupted sleep (DS): 18.0%; early morning awakening (EMA): 10.9%) or nonrestorative sleep (NRS) (8.9%) at least three times per week; 48.5% of them were concomitantly suffering of a DSM-IV sleep/mental disorder.
Hoge et al, 2007	To investigate the association of combat-related PTSD with physical health.	2,863 soldiers were studied using self-administered screening instruments 1 year after their return from combat duty in Iraq.	16.6% of OIF veterans met screening criteria for PTSD. 34% of OIF war veterans reported struggling with sleep a year after their deployment.

Author	Objective	Participants/Design	Results
Ohayon & Roth, 2003	To determine how the chronicity of insomnia affects the relationship of insomnia with psychiatric disorders and how often subjects with chronic insomnia have antecedents of psychiatric disorders.	A cross-sectional telephone survey on sleep problems was done with 14,915 general population-based subjects.	About 28% of subjects with insomnia had a current diagnosis of mental disorders and 25.6% had a psychiatric history. Presence of severe insomnia, diagnosis of primary insomnia or insomnia related to a medical condition, and insomnia that lasted more than one year were predictors of a psychiatric history.
Nutt et al, 2008	To review sleep problems as symptoms of depression.	Literature review	About three quarters of depressed patients have insomnia symptoms, and hypersomnia is present in about 40% of young depressed adults and 10% of older patients. The symptoms cause huge distress, have a major impact on quality of life, and are a strong risk factor for suicide.
Stein & Friedmann, 2005	To review evidence of an association between disturbed sleep and alcohol use.	Literature review	Clinical investigations support a relationship between sleep disturbance and alcohol use, there is uncertainty in the strength and direction of the association.
Crum et al, 2004	To assess the risk of alcohol-related problems among individuals with self-reported sleep disturbances because of worry.	A population sample was given a survey assessment in 1981 (n=3481) and again in 1993-96 (n=1920).	Sleep disturbances caused by excessive worry were associated with a two-fold increased risk for alcohol-related problems several years later. Risk was highest for those with sleep disturbance and co-occurring anxiety disorders or dysphoria.
Nishith et al, 2001	To assess the relationship between sleep difficulties and drinking motives in individuals with PTSD.	74 female rape victims were assessed for PTSD symptoms, depression, sleep difficulties, and drinking motives.	Sleep difficulties were significantly related to drinking motives for coping with negative affect.
Kato et al, 1996	To assess the frequency of short-term, post-traumatic symptoms among evacuees of the Hanshin-Awaji earthquake.	67 evacuees of the Hanshin-Awaji earthquake were assessed 3 weeks and 8 weeks after the earthquake.	Sleep disruption is one of the most commonly reported symptoms after exposure to a traumatic event.

Author	Objective	Participants/Design	Results
Germain et al, 2004	To determine the influence of various factors on the severity of sleep disturbance in PTSD outpatients.	367 PTSD outpatients were assessed for sleep disturbances and other characteristics.	Increased severity of sleep disturbances paralleled increasing overall PTSD severity.
Krakow et al, 2001	To investigate the relationship between sleep quality and PTSD.	151 sexual assault survivors were assessed for PTSD and sleep quality via questionnaires.	Poor sleep quality was correlated with more severe PTSD symptoms.
Belleville et al, 2009	To assess the impact of sleep disturbances on PTSD symptom severity and perceived health.	92 treatment-seeking adults with PTSD were assessed by questionnaire on PTSD severity, sleep, health and alcohol use.	Sleep quality significantly impacts perceived mental health and the severity of PTSD symptoms unrelated to sleep, regardless of psychotropic medication, co-morbid conditions, alcohol use and trauma-related characteristics.
Maher et al, 2006	To review the literature on sleep disturbances in patients with PTSD.	Literature review	70-91% of patients with PTSD have difficulty falling or staying asleep. Nightmares are reported by 19-71% of patients, and sleep disordered breathing (SDB) and sleep movement disorders are more common in patients with PTSD than in the general population.
Mellman et al, 1995	To assess physiological correlates of symptomatic sleep events in PTSD.	The study data included surveys on sleep symptoms in combat veterans with and without PTSD (N = 58), sleep diary records from combat veterans with PTSD (N = 52), and overnight sleep recordings obtained from 21 combat veterans with PTSD and eight comparison subjects not exposed to combat.	Sleep disturbances were reported significantly more frequently in combat veterans with PTSD versus combat veterans without PTSD.
Kobayashi et al, 2007	To clarify sleep symptoms in people with PTSD using polysomnographic studies.	Literature review/meta-analysis	PTSD patients had more stage 1 sleep, less slow wave sleep, and greater rapid-eye-movement density compared to people without PTSD.
Castriotta et al, 2007	To determine the prevalence and consequences of sleepiness and sleep disorders after TBI.	87 adults at least 3 months post TBI were assessed via questionnaire and polysomnography tests.	There is a high prevalence of sleep disorders (46%) and of excessive daytime sleepiness (25%) in subjects with TBI.

Author	Objective	Participants/Design	Results
Verma et al, 2007	To examine the spectrum of sleep disorders in patients with chronic TBI and determine if the severity of sleep disorder is related to severity of chronic TBI.	Records were reviewed of 60 adult patients with TBI who presented with sleep-related complaints 3 months to 2 years following TBI. Records included questionnaires and polysomnograms.	A full spectrum of common sleep disorders occurs in patients with chronic TBI. Hypersomnia was the presenting complaint in 50% of the sample, while the other 50% was split evenly between insomnia and parasomnia.
Ramakrishnan & Scheid, 2007	To review literature on the treatment options for insomnia.	Literature review	Insomnia treatment should begin with nonpharmacologic therapy, addressing sleep hygiene issues and exercise. Hypnotics generally should be prescribed for short periods only, and long-term treatment of chronic insomnia may be best accomplished with newer-generation nonbenzodiazepines.
Taylor et al, 2008	To review the efficacy of prazosin for the treatment of PTSD-related nightmares.	Literature review	Therapy with prazosin resulted in a reduction in PTSD-related nightmares in patients with both combat- and noncombat-related trauma.
Miller, 2008	To review the literature on prazosin for the treatment of PTSD sleep disturbances.	Literature review	Prazosin improves sleep quality and patients' sense of wellbeing and ability to function in daily activities.
Robert et al, 2005	To determine the effect of quetiapine on sleep disturbances in combat veterans with PTSD.	Open-label trial of quetiapine administered to 20 combat veterans with PTSD.	Quetiapine administered to combat veterans with PTSD significantly improved their sleep over the 6-week trial period.
Alderman et al, 2009	To examine the effects of topiramate on sleep and its effectiveness as add-on therapy for the management of combat-related PTSD.	An 8-week open-label pilot study of topiramate was conducted with 43 male combat veterans with PTSD.	Topiramate was effective in reducing nightmares and overall PTSD symptom severity in combat veterans with PTSD.
Kierlin, 2008	To review nonpharmacologic treatments for insomnia.	Literature review	Methods such as cognitive-behavioral therapy, stimulus-control therapy, relaxation, paradoxical intention, and sleep restriction are efficacious treatments that mental health practitioners can consider in the treatment of insomnia.

Author	Objective	Participants/Design	Results
Craske et al, 2005	To test the efficacy of an adaptation of cognitive-behavioral treatment for nocturnal panic.	43 participants with nocturnal panic were assigned to cognitive-behavioral treatment or wait-list control groups.	Cognitive-behavioral treatment was more effective than the wait-list control for the treatment of nocturnal panic.
Morin et al, 2006	To review the efficacy of psychological and behavioral treatments for persistent insomnia.	Literature review	Stimulus control therapy, relaxation, paradoxical intention, sleep restriction and cognitive-behavioral therapy met criteria for empirically supported psychological treatment for insomnia.
Galovski et al, 2009	To compare the differential effects of cognitive processing therapy and prolonged exposure on health-related concerns and sleep impairment within individuals with PTSD.	A sample of female, adult rape survivors with PTSD (N = 108) were assessed for sleep impairment and health concerns after treatment with cognitive processing therapy or prolonged exposure.	Both prolonged exposure and cognitive processing therapy significantly decreased sleep dysfunction in the sample of women with PTSD.

Abbreviations:
PTSD= Posttraumatic Stress Disorder
OEF= Operation Enduring Freedom
OIF= Operation Iraqi Freedom
TBI= Traumatic Brain Injury