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REVIEW ARTICLE

Sleep disturbances and post-traumatic stress disorder in women

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Abstract

Sleep disturbances are found in a majority of individuals diagnosed with posttraumatic stress disorder (PTSD). The purpose of this literature review is to provide information about PTSD, in addition to assessing sleep quality. Current research observes that the lifetime prevalence of PTSD diagnosis in women is increasing. Although there are several studies that have been conducted to assess PTSD and sleep, there is a gap in the research that pertains to women, PTSD, and sleep quality. The current study will compile information on the subject to aid in decreasing the gender disparity in PTSD research, which is important for treating the entire PTSD population. Using the PubMed and PsycINFO databases, a comprehensive search was conducted to find relevant research about sleep difficulties and PTSD. Sleep disturbances such as insomnia, re-current nightmares, REM sleep dysfunction, and obstructive sleep apnea (OSA) affect sleep quality in PTSD patients. The implications of this study suggest that more research should be conducted pertaining to women and PTSD with sleep difficulties. This research is needed to decrease both PTSD symptoms and sleep-related disorders.

INTRODUCTION

Although stress is not a new phenomenon of human life, the evolutionary mechanisms of managing stress have only minimally changed. In humans, stress can cause long-term changes in behavior and sleep. It has been demonstrated that both acute and chronic stressors can disrupt sleep, modifying sleep-wake architecture. In susceptible populations, stressors may lead to trauma. Trauma not only entails physical injuries, but also includes psychological effects from stressful events (Frommberger *et al.* 2014). Experiences such as abuse, combat, and natural disasters often are considered extreme stressors. Immediate threats during such experiences may result in death or injury. Ongoing psychological stressors may include economic, social, and emotional factors (Brown *et al.* 2011). Therefore, singly or in concord, chronic stress and trauma may lead to PTSD, a psychological disorder that encompasses anxiety and develops through exposure to a traumatic event. The anxi-

ety associated with this disorder often compromises an individual's ability to properly function in daily life.

PTSD often occurs in conjunction with sleep disturbances. Difficulty falling and staying asleep (insomnia) and frequent nightmares related to trauma are two of the diagnostic criteria for PTSD (American Psychiatric Association 2000). One study compared sleep disturbances in male theatre Vietnam veterans, male combat Vietnam veterans and male civilians (Neylan *et al.* 1998). Data was analyzed from a total of 2,062 subjects using the Mississippi Scale for Combat-Related Posttraumatic Stress Disorder (M-PTSD; Keane *et al.* 1988). The results showed that combat exposure in Vietnam veterans was strongly correlated with an increase in the frequency of nightmares and moderately correlated with sleep onset insomnia.

Ohayon and Shapiro (2000) conducted an experiment pertaining to sleep disturbances in 1,832 subjects with PTSD. The subjects were surveyed by telephone and the interviewers used Sleep-EVAL (a system used to conduct studies of sleep and mental disorders). Results showed that 70% of the individuals with PTSD were affected by sleep disturbances. Also, violent behaviors while sleeping – sleep paralysis, hallucinations, and sleep talking – were frequently reported in subjects with PTSD. Quality sleep is important in all individuals and those with PTSD have frequent sleep disturbances, interfering with their sleep quality. This study's implications are important for all people who have been diagnosed with PTSD.

PTSD affects both men and women around the world. However, there is a research emphasis on men in studies related to PTSD. Because there are numerous studies in males with PTSD, it is important to highlight research focused on women diagnosed with PTSD. In order to sufficiently treat PTSD and sleep issues in the whole population, there has to be a decrease in the gender disparity in PTSD research. In a recent study, researchers Jin, Xu, and Liu (2014) sought to investigate the PTSD and PTG (posttraumatic growth) in men and women (Jin *et al.* 2014). They assessed PTSD in 2,300 earthquake survivors using a self-report questionnaire. The results showed that PTSD symptoms were found more in women than men in the study. Also, the women's scores were significantly higher in the PTSD domains (re-experience, avoidance and numbness, and arousal) than men (Jin *et al.* 2014). Due to the significantly higher scores on the PTSD questionnaire, this research exemplifies the need to focus on women when researching PTSD.

PTSD is often assessed in men and women combat veterans who have been deployed to war zones. A study by Street *et al.* (2013) aimed to investigate gender-specific stressors, mental health conditions, and PTSD symptoms. The researchers hypothesized that women would be more likely to report interpersonal stressors and men would report combat-related stressors. The sample included 2,344 participants (1,137 male and 1,207 female Veterans) who completed the Scales from the Deployment Risk and Resiliency Inventory (DRRI; Vogt *et al.* 2013). The results of the study showed that the PTSD symptoms in men were equivalent to the reported PTSD symptoms in women. The study concluded that post-deployment adjustment for female veterans is proportional to male veterans' adjustment. As more women are entering the armed forces, additional research must be conducted to assess their adjustment during post-deployment.

A comprehensive search was conducted on PsycINFO and PubMed databases using the following subject headings: "PTSD", "PTSD and women", "PTSD and sleep disturbance", "PTSD and OSA", "REM Sleep", "PTSD and REM sleep", and "Obstructive Sleep Apnea". The search was not limited to specific time periods. The studies were included in the review if: (1) it consisted of individuals diagnosed with PTSD or was assessed for PTSD symptoms, (2) it evaluated sleep quality or sleep disturbances in individuals with PTSD, and (3) if the study focused on women with PTSD or sleep quality. Studies were excluded if they did not focus on PTSD or sleep quality.

Purpose of this Review

The purpose of the current review is to provide information about PTSD and sleep difficulties in women. Scientific research associated with PTSD is gaining more popularity in a variety of fields. However, there is a shortage of research that includes women as subjects, while there are numerous studies that focus on men and their experiences with sleep and PTSD. Additionally, the majority of PTSD studies that do focus on women are related to pregnancy/childbirth or sexual violence. The current review article provides a comprehensive overview of the effects of sleep quality and sleep disturbances in relation to PTSD. It also covers the diagnosis, treatment options, and long term effects of PTSD in women.

EPIDEMIOLOGY AND SYMPTOMS OF PTSD

The National Comorbidity Survey demonstrates a high prevalence of PTSD in the general population with a life span rate of 7.8% (Kessler *et al.* 1995). A recent survey from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) showed that the lifetime rate of PTSD in individuals 18 or older is 4.8% (Blanco 2013). Women have an increased lifetime prevalence of PTSD, with 10% of women developing the disorder compared to 5% of men. Additionally, women are more at risk of developing PTSD after experiencing trauma, with statistics showing 13–20% of women compared to 6–8% of men developing the disorder (Kessler *et al.* 1995). One study focused on new mothers' PTSD symptoms after an earthquake (Qu *et al.* 2012). Results from the study revealed that women with increased earthquake exposure had a higher likelihood of having PTSD and depression than women who did not experi-

ence an earthquake. Depression and PTSD were significantly correlated with sleep quality, education, income, and employment. Unemployed women, in addition to women with a lower monthly household income, had an increased risk of having PTSD and depression if they had poor sleep quality.

DIAGNOSIS AND TREATMENT OF PTSD

Individuals diagnosed with PTSD have common reactions such as an extreme, unavoidable relapse of the event that caused the trauma. They relive the event in the form of images, realistic scenes, or nightmares. Additionally, it is difficult for them to control their memories, so repressing the memories may lead to avoidance behavior. This behavior generates long lasting and chronic symptoms (Frommberger *et al.* 2014). A comprehensive list of symptoms related to PTSD are shown in Table 1 (Lydiard & Hamner 2009). The table includes traits such as intrusive recollection, avoidance, and hyperarousal (American Psychiatric Association 2000).

There are statistics which support gender differences in prescribing medication to treat PTSD with one in four American women receive psychotropic medications compared to men (Muzina *et al.* 2012). Because there is a growth of women veterans, the Department of Veterans Affairs (VA) sought to investigate gender differences in PTSD diagnoses and treatment (Benardy *et al.* 2012). From 1999 to 2009, national administrative VA data was acquired (Benardy *et al.* 2012). During the time frame, the amount of female veterans treated for PTSD tripled from 10,484 in 1999 to 36,978 in 2009. Prescriptions for benzodiazepines decreased over time for men, which was uniform with treatment guidelines. However, benzodiazepine prescriptions increased during this time from 33.4% to 38.3%. In terms of pharmacotherapy for PTSD, it is theorized that atypical antipsychotics and benzodiazepines in women may be an effort to address sleep issues such as insomnia (Benardy *et al.* 2012).

Van der Waals, Mohrs, and Foets (1993) studied sex differences among those prescribed benzodiazepines in a Dutch population. Eighty-nine percent of benzodiazepines were repeats, 70% were requests, and only 9% were authorized by a general practitioner. Moreover, women from the ages 45–64 years received these prescriptions approximately twice as often as men. The results from the studies mentioned above give evidence to the gender disparities in prescribing medication for PTSD.

Tab. 1. Criteria for PTSD (adapted from Lydiard & Hamner 2009).

Criterion A: Traumatic event in which
1. The person has experienced, witnessed, or been confronted with an event or events that involve actual or threatened death or serious injury, or a threat to the physical integrity of oneself or others, or
2. The person's response involved intense fear, helplessness, or horror.
Criterion B: Intrusive recollection (at least 1)
1. Recurrent and intrusive distressing recollections of the event, including images, thoughts, or perceptions,
2. Recurrent, distressing dreams of the event
3. Acting or feeling as if the traumatic event were recurring (includes a sense of reliving the experience, illusions, hallucinations, and dissociative flashback episodes, including those that occur upon awakening or when intoxicated)
4. Intense psychological distress at exposure to internal or external trauma-related cues
5. Physiologic reactivity upon exposure to internal or external trauma-related cues
Criterion C: Avoidant/Numbing (at least 3; not present before the trauma)
1. Efforts to avoid thoughts, feelings, or conversations associated with the trauma
2. Efforts to avoid activities, places, or people that arouse recollections of the trauma
3. Inability to recall an important aspect of the trauma
4. Markedly diminished interest or participation in significant activities
5. Feeling detachment or estrangement from others
6. Restricted range of affect (e.g., unable to have loving feelings)
7. Sense of foreshortened future (e.g., does not expect to have career, marriage, children, or normal lifespan)
Criterion D: Hyperarousal (at least 2; not present before the trauma)
1. Difficulty falling or staying asleep
2. Irritability or outbursts of anger
3. Difficulty concentrating
4. Hypervigilance
5. Exaggerated startle response
Criterion E: Duration of the disturbance (symptoms of B, C, and D) is more than one month
Criterion F: Disturbance causes clinically significant distress or impairment in social, occupational, or other important areas of functioning

Acute = Duration of symptoms is less than 3 months
Chronic = Duration of symptoms is 3 months or more

Data from privately insured patients in the United States showed that 60% of PTSD patients received psychotropic medications (Harpaz-Rotem 2008). Statistics displayed that 74.3% of those were prescribed antidepressants, 73.7% received anxiolytics or sedative-hypnotics, and 21.3% were prescribed antipsychotics. Medication use was positively correlated with increased use of mental health services and comorbid psychological disorders. In another study, diagnosis and treatment options in women were assessed (Mellman *et al.* 2003). The sample of patients with PTSD in the study were women and they utilized community mental health centers. The authors concluded that outpatients diagnosed with PTSD were aggressively treated with medication. They also noted that there are discrepancies with prescribing patterns and actual prescribing guidelines.

PTSD AND SLEEP QUALITY

As mentioned above, one of the key features of PTSD is the inability to fall or stay asleep (insomnia). In general, more sleep complaints are reported more by women than men (Germain *et al.* 2004). There are several studies that have displayed correlations between sleep disturbances and PTSD. People with PTSD have frequent reports of insomnia and nightmares related to trauma. Sleep disturbances such as these were noted immediately following trauma and months after trauma in people who eventually diagnosed with PTSD (Kobayashi *et al.* 2012). This information demonstrates a relationship between sleep disturbances and an increase in vulnerability for PTSD. Nevertheless, there is a lack of empirical evidence regarding PTSD and sleep disturbances in women, therefore research corresponding to the female population will be discussed in this section.

Calhoun (2007) conducted an experiment with only women participants to delve into sleep patterns and PTSD (Calhoun *et al.* 2007). The goal of the study was to examine sleep disturbance in the home environment with women diagnosed with PTSD. Three nights of actigraphy monitoring recorded objective data and the Davidson Trauma Scale (DTS; Davidson *et al.* 1997) along with the Pittsburgh Sleep Quality Index (PSQI; Buysse *et al.* 1989) were used to assess the subjects' subjective sleep quality. Results from the study found that the PTSD group exhibited impaired sleep, longer sleep latency, poorer sleep efficiency, and restless sleep compared to the control group. PTSD symptom severity was correlated with PSQI score ($r=0.49$, $p<0.001$) and sleep issues reported on the DTS ($r=0.60$, $p<0.001$). Lastly, actigraphy results were linked with nightmares reported by the subjects (Calhoun *et al.* 2007).

Another study was executed to describe objective and subjective sleep in battered women (Humphreys & Lee 2005). Traumatic experiences were measured by the Conflict Tactics Scale (CTS; Straus & Gelles 1990) and the Symptom Checklist 90-Revised (SCL-90R; Derogatis 1994). Objective sleep was measured with a wrist actigraph for 48-hours and an autoscoring program was used to analyze various aspects of the subjects' sleep patterns. Each participant was required to write in a sleep journal to indicate their sleep quality and their responses were coded on a scale. According to the SCL-90R scale, 70% of battered women had PTSD. Battered women who had severe and frequent attacks had a longer sleep time and a correlation between assault experience and morning fatigue was present. Increased PTSD scores were associated with decreased restfulness and self-reported poorer health. Women in transitional housing invested more time into trying to fall asleep and had more wake time after they fell asleep. Finally, the number of awakenings recorded objectively was related with subjective number of awakenings and their sleep quality rating.

Zayfert and DeViva investigated whether insomnia continued after completing cognitive behavioral therapy (CBT) for PTSD (Zayfert & DeViva 2004). Clinical psychologists dispensed the Clinician-Administered PTSD scale (CAPS; Blake *et al.* 1995) and from the 27 patients who no longer measured up to the diagnosis of PTSD following CBT, 48% of them reported lingering insomnia. The amount of individuals with residual insomnia surpassed the estimated 10–15% in the general population (Morin 2001). Even after treating PTSD with CBT, sleep quality remained compromised.

Influence of patient characteristics (age and gender), characteristics of PTSD, and psychiatric comorbidity were assessed in relation to self-reported sleep disturbances in patients with PTSD (Germain *et al.* 2004). Following PTSD diagnosis by the CAPS-1 and CAPS-2 scales, patients completed the PSQI self-report scale to aid in assessing sleep quality. One hundred-ninety women and 177 men were used in the study. From this study, it was concluded that women did not report more severe sleep disturbances than men on the PSQI. In addition, age, types of trauma, and psychiatric comorbidity did not have an impact on sleep quality or severity of sleep disturbances in this sample (Germain *et al.* 2004).

Khawaja and colleagues (2013) studied awakenings from sleep and sleep duration in the veteran population (Khawaja *et al.* 2013). The participants in the experiment included 23 veterans with lifetime PTSD and sleep disturbances that were not attributed to other existing medical conditions. To collect sleep data the experimenters used actigraphy, Beck Depression Inventory (Beck *et al.* 1961), Posttraumatic Stress Disorder Checklist (PCL; Weathers *et al.* 1993), Clinical Assessment of Posttraumatic Symptoms (Blake *et al.* (1995), Pittsburgh Sleep Quality Index (PSQI; Buysse *et al.* 1989) and Epworth Sleepiness Scale (ESS; Johns 1994). Results showed that the mean number of awakenings ranged from 4.1 to 18.4 awakenings per night, along with a group mean of 9.3 awakenings. The participants who slept between 7.0 and 8.9 hours complained of awakening during the night, daytime sleepiness, and nightmares.

In the next experiment, researchers investigated the impact of a 6.3 magnitude earthquake on the sleep quality of the survivors 2 years after the disaster (Tempesta *et al.* 2013). The self reported sleep quality was assessed in 665 citizens of L'Aquila, Italy. The study concluded that though 2 years had passed after the earthquake, reduced sleep quality and increased frequency of disruptive nocturnal behaviors were prevalent in the participants. Furthermore, the participants who were closer (less than 43.5 miles) to the epicenter of the earthquake indicated a reduction in sleep quality compared to citizens who were further away from the earth quake's epicenter.

PTSD AND REM SLEEP

Numerous research findings show that there is evidence of rapid eye movement (REM) sleep differences between patients with PTSD and healthy individuals. Quality sleep generally entails a loss in muscle tone during REM sleep, but in some patients movement occurs. Periodic limb movements (PLM) frequently occur in PTSD patients, a phenomenon that will be further discussed in this section. In this section of the current review, the relationship between REM sleep and PTSD will be emphasized. These studies will include data from both male and female subjects' perspectives.

Mellman and colleagues (2002) investigated the correlation between PTSD and uninterrupted REM sleep using polysomnographic recordings (Mellman *et al.* 2002). The study used injured individuals who had PTSD symptoms, noninjured subjects, and injured individuals without PTSD. The PTSD symptoms in the injured group were assessed 6 weeks after the traumatic injury using the Clinican-Administered PTSD scale (Weathers *et al.* 2001). Polysomnographic (PSG) recordings were acquired approximately 17 days after injury. Results revealed differences in wake during sleep with posthoc testing, demonstrating increased wake during sleep in PTSD patients than the noninjured control group. The group of subjects with PTSD displayed more REM sleep periods than the group without PTSD. In addition, the PTSD subjects had a shorter duration of continuous REM sleep that the group without PTSD and noninjured subjects.

Information about the relationship between REM sleep phenomena, subjective and objective sleep reports, and the pathogenesis of PTSD was provided by evaluating 35 subjects with traumatic injury (Mellman *et al.* 2007). In this study, the patients were given polysomnography and PTSD assessment a month after the injury, in which their PTSD condition was confirmed at 2 months. Findings from the study exhibited REM sleep duration correlated negatively with initial PTSD and insomnia severity. Also, there was significant relationship between subjective insomnia and total sleep time. Lastly, mean REM segment length was reduced in subjects with full PTSD.

Researchers suggest that there may be dysfunctional REM sleep mechanisms in individuals with PTSD (Ross *et al.* 1994). Polysomnograms from a groups of healthy combat veterans with PTSD were compared with a control group within the same age range. Results showed that tonic and phasic REM sleep measures in the PTSD group were increased during sleep recording. Elevated phasic REM sleep including rapid eye movements and leg muscle twitch bursts continued in the PTSD group during the second night of sleep recording. The outcome from this study give evidence that a lack in regulation of the REM sleep control system, more specifically phasic REM sleep, may be connected to the pathogenesis of PTSD (Ross *et al.* 1994).

Roepke and colleagues (2013) used a case study to describe the progression of sleep disturbance in a patient with PTSD (Roepke 2013). A 63-year-old male participating in psychotherapy reported having severe nightmares. Years earlier, the patient witnessed a murder of a relative and he developed PTSD. A year prior to admission to a mental health facility, the patient's partner reported his screaming and excessive movement at night. The patient remembered having nightmares and restless sleep, and because of his severe agitation at night lacerations and falling out of bed began to occur. After performing a polysomnography was performed and scored by a professional. The results showed 286 PLMs during sleep and during REM sleep, the patient had three episodes of leg movement along with rapid arm or hand movements. There were other movements such as jerks of the body, raising of the head, beating or fumbling with one hand, or vocalizations (Roepke *et al.* 2013).

OSA AND PTSD

Obstructive Sleep Apnea (OSA) is described as partial or complete cessation of breathing while sleeping due to upper airway collapse (Petersen *et al.* 2011). Lawati and colleagues reviewed the epidemiology and risk factors related to sleep apnea (Lawati *et al.* 2009). Sleep related consequences of OSA include sleep fragmentation, daytime fatigue, and may negatively impact neurocognitive function. The disease is common, with OSA prevalent in 2% of women and 9% of middle-aged men. Both OSA and PTSD can negatively impact daily life and cause sleep disturbances. Therefore sleep quality may be further decreased in the population with both disorders. In this section of the review, the relationship between OSA and PTSD will be assessed.

Research has been conducted to investigate the relationship between OSA and PTSD. According to a study of combat veterans diagnosed with PTSD, rates of OSA were high in the sample (Capaldi II *et al.* 2011). Participants in the study were active duty military personnel who had recently been deployed to Iraq or Afganistan. The participants were patients who were referred to a sleep clinic for sleep-disordered breathing, mainly

OSA. Data from polysomnographically (PSG) recorded sleep stages and sleepiness scales. Nasal and oral airflow were measured, along with tracheal sounds. Next, a review was conducted to screen for the presence of medical findings such as PTSD. Results from the study showed that 78% of the cases were diagnosed with OSA and 41.2% of the sample were diagnosed with PTSD. There were no differences with PSG measures of sleep quality in the participants except for those with PTSD, insinuating that there were more frequent arousals from sleep patients with PTSD.

Another experiment assessed the relationship between PTSD and OSA in Iraqi immigrants living in the United States (Arnetz *et al.* 2012). A random sample of immigrants who left Iraq before or after the Gulf War responded to interview questions covering trauma and physician-diagnosed and -treated OSA. OSA was more prevalent in post-Gulf War immigrants (30%) than pre-Gulf War immigrants (0.1%). Overall, the study concluded that part of the PTSD related adverse health effects seen in Iraqi immigrants is mediated by OSA.

It is estimated that approximately 2% of women and 4% of men meet the criteria for sleep apnea syndrome (OSAS) (Young *et al.* 1993). OSA stresses the systems in the body along with the functions that they perform. Jefferson and colleagues found that it takes women with OSA about 34% longer to reach the latency to the onset of REM sleep than men with OSA. Currently there is an under diagnosis of OSA in women, which may be caused by gender disparities in the sleep response to stress (Jefferson *et al.* 2014).

DISCUSSION

The present study was conducted to investigate how PTSD was related to sleep quality and sleep disturbances, with a focus on the female population. There have been numerous studies orchestrated to assess this same relationship, however most studies did not have an emphasis on women subjects. Overall, individuals with PTSD have frequent complaints about a decrease in sleep quality compared to control subjects without PTSD symptoms. Researchers found that the lacking sleep quality is due to sleep disturbances including nightmares, PLM, dysfunctions with REM sleep, OSA, and insomnia.

One strength of the study was emphasizing women because of the increase of PTSD diagnoses in the female population. There are gender discrepancies in scientific research with a tendency for researchers to use male human and animal subjects more often than female humans and animals. As more women join the armed forces and continue to experience traumatic events in everyday life, more research should be conducted to gauge how PTSD affects them in the longterm. The second strength of the study is evaluating sleep quality and sleep disturbances with individuals with PTSD. If people with PTSD have trouble sleeping because of reoccurring nightmares, REM sleep disorders, or OSA, then their PTSD symptoms could be worsened. These sleep issues could create difficulties when treating PTSD.

The limitations of the study include the unavailability of published research papers. Even when searching through Agnes Scott College, when conducting the comprehensive search using the PubMed and PsycINFO databases it was difficult to find papers with free full text. Literature reviews should have a vast amount of references. Most of the papers relevant to the search required authorization to view the full text, making substantial research unavailable for this study.

REM behavior disorder (RBD) is a parasomnia characterized by abnormal motor behavior, dream enactment and the lack of normal muscle atonia during REM sleep. Classically, RBD can be associated with neurological conditions such as Parkinson's Disease or Lewy Body Disease; however, abnormal motor behavior has also been described as a manifestation of PTSD dreams. Based upon current scoring standards, Mendelez and colleagues (2011) were able to find that phasic REM related electromyography augmentation on polysomnography is a sensitive and specific marker for clinical RBD in the veteran population, which attests to the significance of the REM dysfunction mechanisms present in PTSD (Melendez *et al.* 2011).

Future studies should further examine the underlying causes of sleep problems in PTSD patients, especially women. There are numerous studies related to the armed forces and trauma. Even though the experiences in the armed forces are extremely traumatic, focusing on PTSD in the veteran population will strengthen the idea that the general population is not susceptible to PTSD. Therefore, research should be done about developing PTSD from the distressing and scarring happenings in daily life events.

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