



## Posttraumatic stress and sleep: Differential relations across types of symptoms and sleep problems

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### ABSTRACT

Posttraumatic stress symptoms and self-reported sleep problems reliably covary. The current study investigated how posttraumatic stress symptom clusters (i.e., hyperarousal, avoidance, and reexperiencing) relate to trouble initiating and maintaining sleep and nightmares. Participants included traumatic event-exposed respondents from the NCS-R. Results suggested that posttraumatic stress symptom severity is related to trouble initiating and maintaining sleep and nightmares. Investigation of symptom clusters indicated that reexperiencing symptoms were related to trouble initiating and maintaining sleep and nightmares, while hyperarousal symptoms were related to trouble maintaining sleep and nightmares. Findings partially support both reexperiencing and hyperarousal-based models of the relation between sleep and posttraumatic stress.

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Insomnia, defined as problems falling and staying asleep or non-restorative sleep that persist longer than one month and result in functional impairment (APA, 2000), is one of the most common health problems in the United States. As many as 70 million people report insomnia that results in an estimated \$15 billion in health care costs and \$50 billion in lost productivity per year (U.S. Surgeon General, 2004), with prevalence rates ranging from 30 to 35% (Breslau, Roth, Rosenthal, & Andreski, 1996). Negative effects of insomnia include daytime fatigue, problems with concentration and memory, irritability, and an increase in errors and mistakes in work-related tasks (Roth & Ancoli-Isreal, 1999). High comorbidity rates between chronic insomnia and various types of psychopathology, including major depression, anxiety disorders, and substance use disorders have been documented (Eaton & Kessler, 1985). Indeed, 40% of persons with chronic insomnia meet criteria for at least one type of comorbid psychiatric problem (Drake, Roehrs, & Roth, 2003). Moreover, sleep problems are directly related to functional impairment above and beyond asso-

ciations with comorbid conditions (Roth et al., 2006), highlighting the importance of understanding factors related to sleep problems generally, as well as among people with comorbid problems specifically.

Sleep problems commonly co-occur with anxiety disorders broadly and with posttraumatic stress disorder (PTSD) more specifically. In fact, there is a consistent relation between self-reported sleep problems and posttraumatic stress symptoms (Ohayon & Shapiro, 2000). Among those with PTSD, symptom severity positively covaries with self-reported sleep problems (Germain, Buysse, Shear, Fayyad, & Austin, 2004). For example, among a sample of 367 people with PTSD, increases in self-reported sleep problems paralleled increases in PTSD symptom severity (Germain et al., 2004). These data suggest an association between severity of general self-reported sleep problems and global posttraumatic stress symptom levels among individuals with current diagnoses of PTSD. Within the higher-order, global posttraumatic stress symptom level construct, three specific types of symptoms have been described: (1) reexperiencing aspects of the traumatic event (e.g., nightmares, flashbacks); (2) avoidance of traumatic event cues (e.g., avoiding reminders of the event); and (3) hyperarousal (e.g., increased startle response, feeling on-edge, irritability; APA, 2000).

No single evidence-based theory has been established that explains how specific sleep problems and PTSD symptom clusters relate. However, multiple theories have been proposed to account for the global association between posttraumatic stress symptoms

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and self-reported sleep problems (Harvey, Jones, & Schmidt, 2003). Broadly, hyperarousal-based theories have suggested that sleep may be disrupted among individuals with elevated PTSD symptoms as a result of intrusions of anxious arousal (e.g., awakenings, body movement; Mellman, 1997). At least two pathways have been hypothesized to result in this elevated nighttime anxious arousal among people with PTSD. First, functional changes in the sensitivity of the noradrenergic system may result in a generally greater level of hyperarousal, thereby leading to trouble falling and staying asleep (Pillar, Malhotra, & Lavie 2000). Second, physiological sensations elicited by an increase in respiration rate during sleep may act as interoceptive traumatic event-relevant conditioned stimuli (Jones & Barlow, 1990; Woodward et al., 2000) that trigger nightmares. Based on hyperarousal theories in this domain, it is likely that relatively elevated hyperarousal symptoms of posttraumatic stress are related to greater problems with (1) sleep onset, (2) sleep maintenance, and (3) nightmares.

In other theoretical work aiming to explain PTSD-sleep problem comorbidity, scholars have suggested that reexperiencing symptoms may result in trouble initiating and maintaining sleep. Here, theory suggests that traumatic event-related thoughts are conditioned stimuli that elicit a conditioned waking response. Specifically, escape from the negative emotional state elicited by traumatic event-related thoughts negatively reinforces waking (Krakow et al., 2001). Accordingly, traumatic event-related thoughts present prior to sleep onset and during sleep are likely to interfere with sleep onset and sleep maintenance, respectively. Nightmares are also likely related to daytime reexperiencing symptoms. Daytime reexperiencing symptoms are theorized to be the result of a failure to fully elaborate, integrate, and process traumatic event related stimuli and subsequent information (Ehlers & Clark, 2000). A separate line of research has demonstrated that the frequency of nightmares increases as a result of daytime emotional distress and ineffective coping (Nielsen & Levin, 2007). These lines of research indirectly suggest that daytime reexperiencing symptoms are likely to positively covary with nightmares as each marks insufficiently processed traumatic event-related information that results in distress. Collectively, it is likely that reexperiencing symptoms, aside from nightmares, would evidence unique relations with problems with (1) sleep onset, (2) sleep maintenance, and (3) nightmares.

Relatively limited theoretical and empirical work has suggested a model for the role of avoidance symptoms of posttraumatic stress in sleep problems. A cognitive theory of insomnia suggests that individuals with insomnia employ thought and image-control strategies to avoid negative emotions throughout the night (Harvey, 2002). Importantly, these attempts are counterproductive and actually increase cognitive and physiological arousal that impedes sleep onset (Harvey, 2002; Harvey & Bryant, 1998, 1999). People with elevated levels of posttraumatic stress symptoms endorse relatively elevated use of control-oriented strategies, including avoidance, to manage cognitive-affective experiences (Tull, Jakupcak, Paulson, & Gratz, 2007). Taken together, it is possible that elevated posttraumatic stress-related avoidance of negative thoughts and images during the night via thought and imagery control strategies may paradoxically lead to greater cognitive and physiological arousal, thereby interfering with sleep onset and maintenance.

While several theoretical predictions have been advanced to describe the general relation between sleep problems and posttraumatic stress symptoms the predictive utility of these models focused on various aspects of the posttraumatic stress syndrome has not been evaluated. Furthermore, prior research does not allow for conclusions regarding how sleep problems relate to the broader posttraumatic stress symptom continuum because these tests have focused on the upper end of the symptom continuum by studying

samples of people with PTSD. In fact, latent structure analyses indicate that posttraumatic stress symptoms are dimensional in nature (as opposed to taxonic), with PTSD representing the upper end of the continuum (Ruscio, Ruscio, & Keane, 2002). Moreover, despite evidence linking posttraumatic stress symptom severity and severity of sleep problems, no study has examined how specific types of sleep problems (e.g., falling asleep, staying asleep, nightmares) may relate to the different posttraumatic stress symptom clusters (Maher, Rego, & Asnis, 2006). Addressing this gap would advance both (1) contemporary efforts aimed at explaining the general overlap between sleep problems and posttraumatic stress (Harvey et al., 2003) and (2) research aimed at improving sleep problems experienced by people with PTSD (Germain, Shear, Hall, & Buysse, 2007).

Given this backdrop, the three specific aims in this study were to examine how PTSD total symptom severity and severity of specific PTSD symptom clusters differentially relate to (1) trouble initiating sleep, (2) trouble maintaining sleep, and (3) nightmares. To address these aims, we tested nine specific hypotheses and three exploratory hypotheses. First, to extend the findings of Germain et al. (2004) we tested the hypotheses that relatively elevated posttraumatic stress symptom severity would significantly predict the presence of (1) trouble initiating sleep, (2) trouble maintaining sleep, and (3) nightmares (Germain et al., 2004). Second, it was predicted that hyperarousal and reexperiencing PTSD symptom clusters would evidence unique relations with (1) problems initiating sleep, (2) problems maintaining sleep, and (3) nightmares, above and beyond associations with the other symptom clusters. Finally, exploratory analyses were conducted to examine the relations between avoidance symptoms and (1) trouble initiating sleep, (2) trouble maintaining sleep, and (3) nightmares.

## 1. Method

The sample for the current study was drawn from the National Comorbidity Survey-Replication (NCS-R), a nationally representative epidemiological study designed to assess the prevalence and correlates of a number of psychiatric disorders. Detailed descriptions of methods, weighting, and sampling procedures have been described elsewhere (Kessler et al., 2004). Due to the focus on traumatic event exposure, we selected specific cases from the broader data set. This specialized sampling reduced the representativeness of the sample and therefore the complex sample module was not employed for data analysis.

All respondents ( $n = 9282$ ) participated in a one-hour diagnostic interview (Part I). A subgroup of the sample ( $n = 5692$ ) also received a follow-up assessment (Part II) focused on additional disorders, correlates, risk factors, and consequences of psychopathology. Participants who completed the assessment in Part II included all respondents who met criteria for any lifetime core disorder in Part I plus a probability subsample of other respondents.

### 1.1. Participants

Participants included a subsample of persons who completed Part II of the assessment. Inclusion criteria for the current study included endorsement of exposure to at least one DSM-IV-defined traumatic event (APA, 1994; see Table 1) as well as completion of all relevant PTSD symptom and sleep-related items. A total of 722 participants (524 females;  $M_{Age} = 41.80$ ,  $SD = 14.20$ ) were included. Of this sample, 34.5% met criteria for PTSD within the last 12 months, 36% endorsed trouble falling asleep, 44% reported trouble maintaining sleep, and 66.1% experienced nightmares. Ethnicity was as follows: 72.8% Caucasian, 13.4% African American, 8.3% Hispanic, and 5.5% categorized as "Other."

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