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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.

Keywords

sleep; posttraumatic stress; hyperarousal; reexperiencing; avoidance

Insomnia, defined as problems falling and staying asleep or nonrestorative sleep that persist longer than one month and result in functional impairment (American Psychiatric Association [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 30–35% (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-Israel, 1999;). High comorbidity rates between chronic insomnia and various types

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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 et al., 2003). Moreover, sleep problems are directly related to functional impairment above and beyond associations 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 et al., 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 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, 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., 2003) 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 counter-productive 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, Jones, & Schmidt, 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 and colleagues (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.

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.

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; Please 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.”

Measures

Traumatic Event Exposure and Posttraumatic Stress Symptoms—The WMH-CIDI (a structured diagnostic interview; Kessler et al., 2004) was used to assess traumatic event exposure and symptoms of posttraumatic stress. Within the PTSD module of the interview, respondents were asked to identify whether or not they had experienced a number of potentially traumatic events. For each positively endorsed event, they were asked to report whether they felt in danger and/or identified a threat to their physical integrity. They also were asked to report on their peritraumatic emotional experience (i.e., did they feel terrified or frightened, shocked or horrified, helpless, and/or numb during the event). Respondents with multiple DSM-IV-defined traumatic event experiences were asked to identify the most distressing of these events, and then all participants were asked to report on the presence or absence of 17 posttraumatic stress symptoms falling within the reexperiencing, avoidance, and hyperarousal symptom clusters. Consistent with prior research (Weathers, Keane, & Davidson, 2001), severity indices for each of the reexperiencing, avoidance, and hyperarousal symptom clusters were computed by summing the total number of positively endorsed items within each symptom cluster. Total symptom severity score was calculated by summing the number of positively endorsed items across symptom clusters. To avoid conflating posttraumatic stress and sleep measures, the posttraumatic stress symptom items measuring sleep problems and nightmares were excluded from the calculation of the hyperarousal and reexperiencing symptom cluster scores as well as the total symptom severity score.

Sleep Problems—Participants were asked to endorse presence or absence of a number of sleep-related problems for a period lasting two weeks or longer during the past year. These questions related to problems associated with sleep onset difficulties, sleep maintenance difficulties, and nightmares. Three dichotomous variables (“I have trouble falling asleep,” “I have trouble staying asleep,” and “I have distressing nightmares,”) were employed to index sleep onset difficulties, sleep maintenance difficulties, and nightmares. This measurement approach is consistent with prior research (Babson et al., 2008; Roth et al., 2006).

Covariates—All analyses statistically controlled for variance associated with 12-month histories of major depressive episodes (MDE)¹, drug dependence, age of respondent, gender, and age of traumatic event exposure as these factors are associated with both PTSD (Kessler, et al.,1995) and sleep problems (Roberts, Shema, Kaplan, & Strawbridge, 2000). Each of these factors was obtained as part of the WMH-CIDI.

Results

Zero-Order Relations

Table 2 lists phi and point biserial zero-order relations that were examined among all of the primary variables.

Hypothesis Tests

Symptom Severity—Three sets of hierarchical logistic regression analyses were used to test the main study hypotheses (see Tables 3–5). The first analysis examined the unique relation of total posttraumatic stress symptom severity with the likelihood that respondents would report sleep onset difficulties, sleep maintenance difficulties, and nightmares, after statistically controlling for associations with the covariates described above. Relatively greater total posttraumatic stress symptom severity was significantly related to an increased likelihood of the presence of sleep onset difficulties (Wald = 23.31, $p < .001$), sleep maintenance difficulties (Wald = 18.53, $p < .001$), and nightmares (Wald = 44.09, $p < .001$). Analyses were also conducted comparing individuals with and without a diagnosis of PTSD. Results were consistent with findings using the continuous measure of posttraumatic stress symptoms (Please see Table 6.)

Hyperarousal Symptoms—To explore the unique relation of each specific posttraumatic stress symptom clusters in predicting sleep difficulties, separate analyses were conducted using individual symptom clusters as predictor variables while controlling for the effects of the other symptom clusters. The first of these models examined the unique relation of hyperarousal symptoms controlling for both reexperiencing and avoidance symptom severity as well as the other identified covariates. Results indicated hyperarousal symptom severity was nonsignificantly related to sleep onset difficulties (Wald = .52, *ns*). However, hyperarousal symptoms were related to both sleep maintenance problems (Wald = 5.19, $p < .05$) and nightmares (Wald = 6.38, $p < .05$).

Reexperiencing Symptoms—The unique association of reexperiencing symptoms with sleep difficulties, above and beyond relations with avoidance and hyperarousal symptom severity and the other covariates, was then examined. Results indicated that elevated reexperiencing symptom severity was related to an increased likelihood of the presence of sleep onset difficulties (Wald = 12.61, $p < .001$), sleep maintenance difficulties (Wald = 4.01, $p < .05$), and nightmares (Wald = 17.06, $p < .001$) above and beyond variance accounted for by factors entered into earlier steps of the model.

Avoidance Symptoms—A regression analysis was then conducted to examine the association between avoidance symptom severity and sleep difficulties, above and beyond both hyperarousal and reexperiencing symptom severity and the other covariates. Results indicated avoidance symptom severity was not significantly related to sleep onset difficulties

¹Twelve month major depressive episode was tested as a moderator of the relation between PTSD symptom severity and both sleep onset and maintenance problems. Results were nonsignificant (Wald = .67, *ns*; Wald = 2.84, *ns*; respectively). This suggests PTSD symptom severity relates to sleep problems in the same manner for those with and without depression

(Wald = 2.53, *ns*), sleep maintenance difficulties (Wald = .93, *ns*), or nightmares (Wald = 2.06, *ns*).²

Discussion

Research has demonstrated a link between posttraumatic stress symptoms and self-reported sleep problems (Ohayon & Shapiro, 2000). However, no study has investigated how specific sleep problems may be related to specific clusters of posttraumatic stress symptoms. The current study aimed to fill this gap by testing nine specific hypotheses and three exploratory hypotheses. Consistent with the first three hypotheses, results suggest a positive association between global posttraumatic stress symptom severity and self-reported difficulties with sleep onset, sleep maintenance, and nightmares. These findings are consistent with those of prior studies (Germain et al., 2004; Krakow et al., 2001) and extend them to the relation between total posttraumatic stress symptom severity and nightmares.

Hyperarousal symptoms were related to trouble maintaining sleep and nightmares, but not sleep onset, after accounting for variance associated with covariates. These findings are partially consistent with hyperarousal-based theories of the relation between sleep problems and posttraumatic stress (Mellman, 1997; Woodward et al., 2003). However, these findings are inconsistent with controlled research linking elevated arousal to problems with sleep initiation (e.g., Bonnet & Arand, 2010). This pattern of results suggests posttraumatic stress-related hyperarousal is playing a unique role in problems maintaining sleep and nightmares. Replication and extension of the current findings will be important in increasing confidence in this inference.

Reexperiencing symptoms were related to all sleep outcomes (difficulty initiating and maintaining sleep as well as nightmares), even after accounting for variance associated with the current covariates. This finding is consistent with theoretical models that highlight the role of reexperiencing symptoms of posttraumatic stress in the relation between sleep problems and PTSD (Krakow et al., 2001). Here, reexperiencing symptoms in the form of pre-sleep cognitive activity may elicit pre-sleep anxiety and/or avoidance of sleep, thereby leading to difficulties initiating sleep (Kobayashi et al., 2008; Uhde, 2000). These results also are consistent with theoretical work suggesting posttraumatic stress-related reexperiencing symptoms are likely to interfere with sleep maintenance (Krakow et al., 2001). However, they extend such work by demonstrating that reexperiencing symptoms, independent of nightmares, are related to problems with sleep maintenance. Additional research focused on the mechanism linking daytime reexperiencing symptoms to problems with sleep maintenance is now needed.

Finally, results suggested that avoidance did not significantly relate to troubles initiating sleep, maintaining sleep, or nightmares after controlling for the covariates employed here. This initial finding suggests posttraumatic avoidance symptoms may not be uniquely related to sleep problems above and beyond other aspects of the posttraumatic stress syndrome. These null findings also are consistent with the limited focus on avoidance symptoms in contemporary theoretical work aiming to explain linkages between PTSD and sleep problems (Harvey et al., 2003). Nonetheless, further research on the relation between sleep problems and posttraumatic stress-related avoidance is needed. It remains possible that within a sample of people with chronic PTSD, where avoidance is likely more severe and

²Analyses were also conducted based on the 4-factor solution of PTSD in which avoidance and numbing symptoms are separated. Results yielded non-significant findings for both avoidance and numbing symptoms for trouble falling asleep (Wald = 2.27, *ns*; Wald = .01, *ns*; respectively), staying asleep (Wald = 2.12, *ns*; Wald = .08, *ns*; respectively), and nightmares (Wald = 2.84, *ns*; Wald = .67, *ns*; respectively).

resulting in increased cognitive and physiological arousal linked to problems with sleep onset (Harvey, 2002; Harvey & Bryant, 1998, 1999), avoidance symptom severity may demonstrate a unique relation with sleep problems. Given this first study of how posttraumatic stress symptom subtypes relate to sleep problems across a wide range of posttraumatic stress symptoms, researchers are now well-positioned to test these refined hypotheses among individuals diagnosed with PTSD. Future studies also should broaden the definition of avoidance to be more inclusive. For example, people with PTSD may avoid sleep due to anxiety related to posttraumatic nightmares (Uhde, 2000). This type of avoidance may not have been captured by the index of avoidance employed herein, which was specific to avoidance of traumatic event cues.

Inferences here are constrained by study limitations. First, trouble initiating and maintaining sleep and nightmares were measured via a brief self-report interview. Although self-report measures of sleep appear to have adequate reliability and validity (Monk et al., 2003), future research would benefit from a more in-depth assessment of sleep problems that integrates both self-report and objective sleep measures. For example, studies should employ multi-method assessment of sleep problems that includes objective sleep indicators such as actigraphy and polysomnography.

Second, this study is cross-sectional and correlational and therefore neither causal nor temporally-oriented conclusions can be drawn. Future research would benefit from including prospective designs in order to inform etiology and maintenance-focused conclusions and implications. Third, the current study did not examine how relations investigated may vary by traumatic event type. Future research should investigate if different types of traumatic event exposures are differentially related to sleep problems. Fourth, the sample was biased in at least two ways. While the current sample, by design, endorsed a wider range of posttraumatic stress symptom levels than a sample with PTSD, the NCS-R interview procedures required the presence of at least one reexperiencing and one avoidance symptom to continue administering the hyperarousal symptom questions. Thus, the sample did not include the entire range of possible posttraumatic stress symptom levels. Also, the sex composition of the sample was biased in favor women. For these reasons, generalizability of the current findings may be relatively constrained. Finally, analytic error needs to be carefully considered when interpreting the results of this study. The current study aimed to balance the liberal use of conducting several analyses that aimed to describe a wide array of understudied relations within the sleep problem – posttraumatic stress area with the conservative approach of employing a strict covariance procedure in an effort to isolate unique associations between specific facets of sleep problems and posttraumatic stress symptom types. Accordingly, the current approach may have inflated the chance of types I or II error. With the current associations now outlined, future studies can focus on relations documented herein and employ an approach designed to reduce the likelihood of such analytic error.

Limitations of the current investigation notwithstanding, results suggest that individuals suffering from posttraumatic stress-related reexperiencing and hyperarousal symptoms may be experiencing difficulty with sleep initiation, maintenance, and nightmares. Given the importance of sleep to quality of life, assessment of all types of specific sleep problems is warranted when treating people with posttraumatic stress-related symptoms. Indeed, evidence suggests sleep problems may exacerbate posttraumatic stress symptoms (Mellman et al., 2002) and efficacious CBT for PTSD does not appear to fully ameliorate sleep problems (Galovski et al., 2009; Zayfert & DeViva, 2004). To maximize treatment gains for people with PTSD, sleep problems may need to be targeted in integrated PTSD – sleep problem treatment protocols or via separate sleep-focused treatment modules added to PTSD treatments (DeViva et al., 2005). Future studies may examine the efficacy of integrating a

sleep hygiene (Stepanski & Wyatt, 2003) or nightmare rescripting (Davis & Wright, 2005) component to the treatment of PTSD. Increasing the effects of PTSD treatments for reducing sleep problems may in turn increase the efficacy of these treatments for reducing PTSD by virtue of decreasing sleep deprivation-related hyperarousal and anxious reactivity.

In conclusion, this study investigated relations among difficulty with sleep onset and maintenance, nightmares, and severity of specific posttraumatic stress symptom clusters. Results indicated total posttraumatic stress symptom severity related to difficulty initiating and maintaining sleep and nightmares. Furthermore, reexperiencing symptoms were related to difficulty initiating and maintaining sleep, and nightmares, while hyperarousal symptoms were related to difficulty maintaining sleep and nightmares. Our findings partially support both reexperiencing and hyperarousal-based models of the relation between sleep and posttraumatic stress and may be employed in the further refinement of integrated models of why people suffering from elevated posttraumatic stress so frequently experience severe levels of sleep problems.

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Table 1**Type and Percentage of Traumatic Event Exposure**

1. Unexpected Death of a Loved One	23.5% (n= 169)
2. Sexual Assault	21.0% (n= 151)
3. Other	10.1% (n= 71)
4. Physical Assault by Someone Known	7.1% (n=51)
5. Serious Accident	6.2% (n=45)
6. Physical Assault by a stranger	4.3% (n=31)
7. Childhood Physical Assault	3.6% (n=26)
8. Witness a Death (murder, accidental)	3.5% (n=26)
9. Combat/War Zone	3.4% (n=26)
10. Child's Serious Illness	3.3% (n=24)
11. Life-threatening Illness	2.8% (n=20)
12. Trauma of a loved one	2.5% (n=18)
13. Witness Physical Assault	2.2% (n=16)
14. Stalked	2.2% (n=16)
15. Natural or Man-Made Disaster	1.6% (n=11)
16. Refused to Indicate	1.6% (n=13)
17. Caused a Death (murder; accidental)	.7% (n=5)
18. Saw Atrocities	.4% (n=3)
19. Kidnapped	.1% (n=1)
20. Toxic Chemical Exposure	.1% (n=1)

Table 2
Phi and Pearson Biserial Correlation Coefficients for all Dependent and Independent Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1 Age	-	.06 ^b	-.12 ^{b**}	-.06 ^b	.42 ^{b**}	-.16 ^{b**}	-.13 ^{b**}	-.12 ^{b**}	-.14 ^{b**}	-.03 ^b	.07 ^b	-.09 ^{b*}
2 Sex	-	-	-.02 ^a	.01 ^a	-.05 ^b	-.14 ^{b**}	-.09 ^{b*}	-.12 ^{b**}	-.12 ^{b**}	-.14 ^a	.05 ^a	-.02 ^a
3 MDE Drug	-	-	-	.08 ^{a*}	-.04 ^b	.21 ^{b**}	.12 ^{b**}	.19 ^{b**}	.19 ^{b**}	.24 ^{a**}	.22 ^{a**}	.11 ^{a**}
4 Dependence	-	-	-	-	-.05 ^b	.07 ^b	.05 ^b	.06 ^b	.04 ^b	.02 ^a	.01 ^a	.07 ^a
5 Age at Trauma	-	-	-	-	-	-.19 ^{b**}	-.14 ^{b**}	-.16 ^{b**}	-.15 ^{b**}	-.01 ^b	.02 ^b	-.15 ^{b**}
6 Total Symptoms	-	-	-	-	-	-	.74 ^{b**}	.87 ^{b**}	.73 ^{b**}	.21 ^{b**}	.19 ^{b**}	.29 ^{b**}
7 Hyperarousal	-	-	-	-	-	-	-	.45 ^{b**}	.39 ^{b**}	.13 ^{b**}	.15 ^{b**}	.23 ^{b**}
8 Avoidance	-	-	-	-	-	-	-	-	.45 ^{b**}	.17 ^{b**}	.14 ^{b**}	.21 ^{b**}
9 Reexperiencing	-	-	-	-	-	-	-	-	-	.21 ^{b**}	.16 ^{b**}	.27 ^{b**}
10 Sleep Onset Sleep	-	-	-	-	-	-	-	-	-	-	.58 ^{a**}	.07 ^a
11 Maintenance	-	-	-	-	-	-	-	-	-	-	-	.05 ^a
12 Nightmares	-	-	-	-	-	-	-	-	-	-	-	-

Note: $n = 722$.

* $p < .05$,

** $p < .01$;

^a phi correlations;

^b point biserials;

MDE = major depressive episode in the last 12 months; Drug Dependence = meeting criteria for substance dependence in the last 12 months; Total symptoms = total posttraumatic stress symptoms after removing sleep problem-specific item.

Table 3

Individual Variable Contributions in Predicting Sleep Onset

	B	OR	95% CI	p	% Cases Classified
PTSD Symptom Severity					
<i>Base rate</i>					61.8%
<i>Step 1</i>					65.5%
Age	0.01	1.00	0.99 – 1.01	ns	
Sex	0.28	1.33	0.94 – 1.88	ns	
MDE	1.08	2.94	2.10 – 4.10	<.01	
Drug dependence	0.08	1.08	0.21 – 5.68	ns	
Age at trauma	0.01	1.00	0.99 – 1.01	ns	
<i>Step 2</i>					66.8%
PTSD Symptom Severity	0.13	1.14	1.08 – 1.20	<.01	
Hyperarousal					
<i>Base rate</i>					61.8%
<i>Step 1</i>					65.5%
Age	0.01	1.00	0.99 – 1.01	ns	
Sex	0.28	1.33	0.94 – 1.88	ns	
MDE	1.08	2.94	2.10 – 4.10	<.01	
Drug dependence	0.08	1.08	0.21 – 5.68	ns	
Age at trauma	0.01	1.00	0.99 – 1.01	ns	
<i>Step 2</i>					66.3%
Reexperiencing	0.32	1.38	1.17 – 1.64	<.01	
Avoidance	0.10	1.10	1.00 – 1.21	ns	
<i>Step 3</i>					66.3%
Hyperarousal	0.06	1.06	0.91 – 1.24	ns	
Reexperiencing					
<i>Base rate</i>					61.8%
<i>Step 1</i>					65.5%
Age	0.01	1.00	0.99 – 1.01	ns	
Sex	0.28	1.33	0.94 – 1.88	ns	

	B	OR	95% CI	p	% Cases Classified
MDE	1.08	2.94	2.10 – 4.10	<.01	
Drug dependence	0.08	1.08	0.21 – 5.68	ns	
Age at trauma	0.01	1.00	0.99 – 1.01	ns	
<i>Step 2</i>					67.0%
Avoidance	0.14	1.15	1.04 – 1.27	<.01	
Hyperarousal	0.12	1.13	0.97 – 1.31	ns	
<i>Step 3</i>					66.3%
Reexperiencing	0.31	1.36	1.15 – 1.62	<.01	
Avoidance					
<i>Base rate</i>					61.8%
<i>Step 1</i>					65.5%
Age	0.01	1.00	0.99 – 1.01	ns	
Sex	0.28	1.33	0.94 – 1.88	ns	
MDE	1.08	2.94	2.10 – 4.10	<.01	
Drug dependence	0.08	1.08	0.21 – 5.68	ns	
Age at trauma	0.01	1.00	0.99 – 1.01	ns	
<i>Step 2</i>					67.2%
Reexperiencing	0.35	1.42	1.20 – 1.68	<.01	
Hyperarousal	0.10	1.10	0.95 – 1.28	ns	
<i>Step 3</i>					66.3%
Avoidance	0.08	1.09	0.98 – 1.20	ns	

Note: MDE = major depressive episode; B = Standardized B; 95 % CI= 95% Confidence Interval; OR = odds ratio.

Table 4

Individual Variable Contributions in Predicting Sleep Maintenance

	B	OR	95% CI	p	% Cases Classified
PTSD Symptom Severity					
<i>Base rate</i>					54.7%
<i>Step 1</i>					61.9%
Age	0.02	1.02	1.01 – 1.03	<.01	
Sex	–0.12	0.88	0.63 – 1.24	ns	
MDE	1.07	2.90	2.07 – 4.07	<.01	
Drug dependence	–0.07	0.94	0.18 – 5.00	ns	
Age at trauma	–0.01	1.00	0.99 – 1.01	ns	
<i>Step 2</i>					65.0%
PTSD Symptom Severity	0.11	1.12	1.06 – 1.17	<.01	
Hyperarousal					
<i>Base rate</i>					54.7%
<i>Step 1</i>					61.9%
Age	0.02	1.02	1.01 – 1.03	<.01	
Sex	–0.12	0.88	0.63 – 1.24	ns	
MDE	1.07	2.90	2.07 – 4.07	<.01	
Drug dependence	–0.07	0.94	0.18 – 5.00	ns	
Age at trauma	–0.01	1.00	0.99 – 1.01	ns	
<i>Step 2</i>					63.2%
Reexperiencing	0.21	1.23	1.05 – 1.44	<.05	
Avoidance	0.08	1.09	0.99 – 1.20	ns	
<i>Step 3</i>					65.1%
Hyperarousal	0.17	1.19	1.03 – 1.38	<.05	
Reexperiencing					
<i>Base rate</i>					54.7%
<i>Step 1</i>					61.9%
Age	0.02	1.02	1.01 – 1.03	<.01	
Sex	–0.12	0.88	0.63 – 1.24	ns	

	B	OR	95% CI	p	% Cases Classified
MDE	1.07	2.90	2.07 – 4.07	<.01	
Drug dependence	-0.07	0.94	0.18 – 5.00	ns	
Age at trauma	-0.01	1.00	0.99 – 1.01	ns	
Step 2					63.3%
Avoidance	0.08	1.08	0.99 – 1.19	ns	
Hyperarousal	0.21	1.23	1.06 – 1.42	<.01	
Step 3					65.1%
Reexperiencing	0.17	1.18	1.00 – 1.39	<.05	
Avoidance					
Base rate					54.7%
Step 1					61.9%
Age	0.02	1.02	1.01 – 1.03	<.01	
Sex	-0.12	0.88	0.63 – 1.24	ns	
MDE	1.07	2.90	2.07 – 4.07	<.01	
Drug dependence	-0.07	0.94	0.18 – 5.00	ns	
Age at trauma	-0.01	1.00	0.99 – 1.01	ns	
Step 2					65.1%
Reexperiencing	0.19	1.21	1.04 – 1.41	<.05	
Hyperarousal	0.20	1.22	1.06 – 1.40	<.01	
Step 3					65.1%
Avoidance	0.05	1.05	0.95 – 1.16	ns	

Note: MDE = major depressive episode; B = Standardized B; 95 % CI= 95% Confidence Interval; OR = odds ratio.

Table 5

Individual Variable Contributions in Predicting Nightmares

	B	OR	95% CI	p	% Cases Classified
PTSD Symptom Severity					
<i>Base rate</i>					66.3%
<i>Step 1</i>					67.5%
Age	-0.01	1.00	0.99 – 1.01	ns	
Sex	-0.14	0.87	0.61 – 1.24	ns	
MDE	0.46	1.59	1.10 – 2.29	<.05	
Drug dependence	20.2	591294543	0.00 –	ns	
Age at trauma	-0.02	0.98	0.97 – 0.99	<.01	
<i>Step 2</i>					67.1%
PTSD Symptom Severity	0.18	1.20	1.14 – 1.27	<.01	
Hyperarousal					
<i>Base rate</i>					66.3%
<i>Step 1</i>					67.5%
Age	-0.01	1.00	0.99 – 1.01	ns	
Sex	-0.14	0.87	0.61 – 1.24	ns	
MDE	0.46	1.59	1.10 – 2.29	<.05	
Drug dependence	20.2	591294543	0.00 –	ns	
Age at trauma	-0.02	0.98	0.97 – 0.99	<.01	
<i>Step 2</i>					68.1%
Reexperiencing	0.40	1.49	1.27 – 1.76	<.01	
Avoidance	0.12	1.13	1.02 – 1.25	<.05	
<i>Step 3</i>					68.8%
Hyperarousal	0.22	1.25	1.07 – 1.45	<.01	
Reexperiencing					
<i>Base rate</i>					66.3%
<i>Step 1</i>					67.5%
Age	-0.01	1.00	0.99 – 1.01	ns	
Sex	-0.14	0.87	0.61 – 1.24	ns	

	B	OR	95% CI	p	% Cases Classified
MDE	0.46	1.59	1.10 – 2.29	<.05	
Drug dependence	20.2	591294543	0.00 –	ns	
Age at trauma	–0.02	0.98	0.97 – 0.99	<.01	
Step 2					67.4%
Avoidance	0.14	1.16	1.05 – 1.28	<.01	
Hyperarousal	0.28	1.33	1.15 – 1.54	<.01	
Step 3					68.8%
Reexperiencing	0.35	1.42	1.20 – 1.68	<.01	
Avoidance					
Base rate					66.3%
Step 1					67.5%
Age	–0.01	1.00	0.99 – 1.01	ns	
Sex	–0.14	0.87	0.61 – 1.24	ns	
MDE	0.46	1.59	1.10 – 2.29	<.05	
Drug dependence	20.2	591294543	0.00 –	ns	
Age at trauma	–0.02	0.98	0.97 – 0.99	<.01	
Step 2					69.2%
Reexperiencing	0.39	1.48	1.26 – 1.73	<.01	
Hyperarousal	0.26	1.29	1.12 – 1.49	<.01	
Step 3					68.8%
Avoidance	0.08	1.08	0.97 – 1.20	ns	

Note: MDE = major depressive episode; B = Standardized B; 95 % CI= 95% Confidence Interval; OR = odds ratio.

Table 6

PTSD Diagnostic Status in Predicting Sleep Onset, Sleep Maintenance, and Nightmares

	B	OR	95% CI	p	% Cases Classified
Sleep Onset					
<i>Base rate</i>					61.8%
<i>Step 1</i>					66.9%
Age	0.00	1.00	0.98 – 1.01	ns	
Sex	0.28	1.33	0.96 – 1.84	ns	
MDE	1.11	3.02	2.21 – 4.14	<.01	
Drug dependence	0.51	1.66	0.35 – 7.85	ns	
Age at trauma	0.00	0.99	0.98 – 1.00	ns	
<i>Step 2</i>					67.2%
PTSD Diagnostic Status	0.65	1.83	1.33 – 2.51	<.01	
Sleep Maintenance					
<i>Base rate</i>					61.8%
<i>Step 1</i>					63.4%
Age	0.02	1.02	1.01 – 1.03	<.01	
Sex	0.11	0.89	0.65 – 1.23	ns	
MDE	1.11	3.03	2.20 – 4.16	<.01	
Drug dependence	0.38	1.47	0.30 – 7.11	ns	
Age at trauma	0.01	0.99	0.98 – 1.00	ns	
<i>Step 2</i>					64.7%
PTSD Diagnostic Status	0.65	1.92	1.41 – 2.63	<.01	
Nightmares					
<i>Base rate</i>					61.8%
<i>Step 1</i>					63.0%
Age	0.01	0.99	0.98 – 1.00	ns	
Sex	0.13	0.87	0.62 – 1.21	ns	
MDE	0.55	1.73	1.23 – 2.42	<.01	
Drug dependence	0.95	2.59	0.30 – 22.05	ns	
Age at trauma	0.01	0.99	0.97 – 0.99	<.01	

	B	OR	95% CI	<i>p</i>	% Cases Classified
<i>Step 2</i>					63.9%
PTSD Diagnostic Status	0.62	1.86	1.32 – 2.59	<.01	

Note: MDE = major depressive episode; B = Standardized B; 95 % CI= 95% Confidence Interval; OR = odds ratio.