Impact of Sleep Disturbances on PTSD Symptoms and Perceived Health

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Abstract: More than two-thirds of individuals with PTSD report significant sleep difficulties that correlate positively with PTSD symptom severity. The aim of the study was to assess the impact of sleep disturbances on PTSD symptom severity and perceived health. Ninety-two volunteer treatment-seeking adults with PTSD were administered a Structured Clinical Interview for DSM-IV (SCID; First, Spitzer, Gibbon and William, 1996), and a series of questionnaires assessing PTSD symptom severity, perceived health, sleep, and alcohol use. Results from regression analyses revealed that sleep quality has an impact on PTSD symptom severity and perceived mental health, even when the effect of other potential confounding variables (sociodemographic data, trauma-related characteristics, psychiatric comorbidities, alcohol, and psychotropic medication use) is controlled for. The present study highlights the important influence sleep has on the severity of PTSD symptoms. Future studies could explore whether the addition of interventions focusing on sleep help optimize PTSD treatment.

Key Words: Sleep, posttraumatic stress disorder, trauma, health.

(*J Nerv Ment Dis* 2009;197: 126–132)

Sleep disturbances are features commonly encountered in PTSD. Persistent difficulties falling or remaining asleep, and recurrent nightmares figure among criteria used to diagnose PTSD (American Psychiatric Association, APA, 2001). More than two-thirds (70%) of a sample of individuals with PTSD recruited in the community reported sleep disturbances and 40% met criteria for primary insomnia disorder (Ohayon and Shapiro, 2000). Subjective sleep disturbances associated with PTSD include difficulties initiating sleep, disrupted sleep, early morning awakenings, nightmares, and other parasomnias (Ohayon and Shapiro, 2000); such disturbances have been shown to be of equivalent severity to those associated with primary insomnia or depression (Germain et al., 2005a; Krakow et al., 2001; Inman et al., 1990). Symptoms of anxiety during sleep, agitation, and body movements are additional specific features characterizing sleep among individuals with PTSD (Inman et al., 1990). Results regarding objective sleep data obtained with polysomnography have traditionally been inconsistent and inconclusive (Harvey et al., 2003). However, a recent meta-analytic review of polysomnography data showed with more certainty that patients with PTSD had significantly more stage 1 sleep, less slow wave sleep, and greater rapid eye movement sleep density compared with people without PTSD (Kobayashi et al., 2007).

Although it is widely recognized that disturbed sleep is often part of the clinical portrait in PTSD, few attempts have been made to understand the relationship between sleep difficulties and this anxiety disorder. It is unclear whether or when disturbed sleep is a symptom of PTSD or an associated yet independent problem. The impact of disturbed sleep on the severity of PTSD symptoms remains poorly understood. In a study assessing clinical correlates of poor sleep quality in PTSD, Germain et al., 2004 found an association between PTSD severity and sleep disturbance, with no influence of gender, age, types of trauma, PTSD chronicity, or psychiatric comorbidity on sleep. However, sleep-related items, assessing difficulty falling, or staying asleep, and nightmares, were comprised within the main measure of PTSD severity. Therefore, the possibility that both sleep and PTSD measures tapped into the same concept, that is sleep difficulties, could not be ruled out. DeViva et al., (2004) found that nightmares and depression accounted for unique variance in the presence of severe insomnia among treatment-seeking civilians with PTSD. However, sleep difficulties were evaluated with a single question drawn from a structured clinical interview intended to diagnose PTSD, rather than with a validated instrument designed for this purpose.

Levels of sleep disturbances have been shown to strongly correlate with PTSD symptom severity (Krakow et al., 2001); such that the more severe the PTSD symptoms the more disturbed is sleep expected to be. However, several confounding factors may obfuscate the relationship between sleep and PTSD. Psychiatric comorbidity, poor health status, and alcohol abuse are three characteristics frequently encountered among individuals with PTSD, and among individuals with insomnia. It has been suggested that comorbidity with other psychiatric disorders associated with sleep disturbances explains the presence of sleep difficulties in PTSD (Pillar et al., 2000). For example, depression increased by 2.53 times the risk of reporting severe insomnia among patients with PTSD (DeViva et al., 2004). A second factor possibly confounding the relationship between sleep and PTSD is health status. Decreased health-related quality of life has been observed in both PTSD (Mendlowicz and Stein, 2000) and insomnia (Zammit et al., 1999) populations. Findings in samples of police officers (Mohr et al., 2003) and women victim of sexual assault (Clum, et al., 2001) showed that sleep had a considerable impact on health quality regardless of PTSD severity and psychological distress. A third characteristic, alcohol use and abuse, is frequently encountered among PTSD sufferers (Mills et al., 2006). Alcohol use before going to bed has also been found to lead to light, fragmented sleep and early morning awakenings (Roehrs, 1993). Furthermore, the presence of sleep difficulties may enhance the probability for drinking as a way to cope with negative effect associated with PTSD (Nishith et al., 2001). Taken together, any attempt at understanding the relationship between sleep disturbances and PTSD should take psychiatric comorbidity, health status, and alcohol use into account.

To date, no study has assessed the unique contribution of sleep difficulties, measured with a validated instrument designed for this purpose, in PTSD severity while controlling for possible confounding factors. The current study aimed to assess the influence of sleep disturbances on PTSD symptom severity and perceived health. A second goal was to explore clinical correlates of sleep disturbances in PTSD. A priori hypotheses were that sleep difficulties would explain a significant amount of variance of PTSD symptom

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ISSN: 0022-3018/09/19702-0126

DOI: 10.1097/NMD.0b013e3181961d8e

severity and perceived health after controlling for sociodemographic and trauma-related characteristics, psychiatric comorbidity, as well as psychotropic medication and alcohol use. There was no a priori hypothesis regarding the associations between sleep and sociodemographic, trauma-related, and clinical characteristics, given the paucity of data in the literature regarding this matter and the exploratory nature of this second goal.

METHOD

Participants and Procedure

Participants were recruited through media advertisement and references from hospitals in the Montreal metropolitan area in Quebec, Canada. The study was conducted at the research center of a psychiatric hospital. All participants had to present PTSD as their primary diagnosis, and their spouse, or a significant other had to accept to participate in the study, given that the objective of the mother-study was to assess the effect of social support in PTSD treatment. Exclusion criteria included: (a) being less than 18 years old; (b) history of aggression by the spouse or significant other (The reason these participants were initially excluded is related to the primary goal of the mother study, i.e., to assess the effect of social support in PTSD treatment. For this study, the participant's spouse or significant other had to accept to participate to assessment and to a few treatment sessions. Since the standardized treatment under study was not designed to deal with marital violence, individuals with a history of violence by their current spouse were excluded to avoid the possibility of exacerbating existing relational problems.); (c) presence of alcohol or substance abuse/dependence, and (d) past or present psychotic episode, bipolar disorder, or organic mental disorder.

A total of 583 individuals were screened by a brief phone interview, 215 of which were invited to a thorough initial clinical assessment, and 158 actually presented themselves to their appointment. Ninety-four individuals initially met criteria for PTSD and were included in the treatment study. After signing a consent form, participants were administered a clinical interview assessing psychiatric disorders, including PTSD (Structured Clinical Interview for DSM-IV, SCID; First et al., 1996). Clinical interviews were conducted by masters or doctoral level psychologists, who had received extensive training in using the SCID. Participants completed self-report questionnaires at home and returned them at their first treatment session. Ninety-two participants provided sufficient data to be included in the current analyses.

Measures

The Modified PTSD Symptom Scale—Self-Report (MPSS-SR)

The MPSS-SR (Falsetti et al., 1993) is a 17-item self-report questionnaire assessing frequency and severity of PTSD symptoms. Symptoms correspond to those listed in DSM-IV (APA, 2001). Total score ranges from 0 to 119. The French version of the MPSS-SR has shown good psychometric properties in clinical samples (Guay et al., 2002). In the current study, the MPSS-SR total score was used as the main indicator of PTSD symptom severity. To clarify relationship between the MPSS-SR and measures of sleep, the total score was computed without including items no. 2 (recurrent distressing dreams of the event), and no. 13 (difficulty falling or staying asleep).

The Medical Outcome Survey—Short Form–12 (SF-12)

The SF-12 (Ware et al., 2007) is a self-completed questionnaire assessing health-related quality of life. The SF-12 yields 2 components, assessing perceived mental and physical health. Both components were computed using the norm-based method, relying on a 1998 US population sample as the normative sample (Ware et al., 2007). A French version of the SF-36, of which the SF-12 is an abbreviated form, has been validated (Dauphinee et al., 1997); however, no psychometric data on the specific SF-12 French version are currently available. In the present study, we used the Physical Health Component Score and the Mental Health Component Score as respective indicators of perceived physical and mental health.

The Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989) is a 19-item self-report questionnaire assessing 7 components of sleep quality: (a) subjective sleep quality, (b) sleep latency, (c) sleep duration, (d) sleep efficiency, (e) sleep disturbances, (f) use of sleep medication, and (g) impairment of daytime functioning. Each component is rated on a 0 to 3 scale. A global sleep quality score, ranging from 0 to 21, is obtained by summing each component's score. Validation studies with individuals suffering from insomnia or various psychiatric and medical disorders have shown good internal consistency, test-retest reliability, and overall validity (Buysse et al., 1989). Validation of the French version has yielded satisfactory results (Blais et al., 1997). We used the validated PSQI total score as the main variable targeting sleep quality. We reported scores on the PSQI 7 components to detail different aspects of sleep.

Questionnaire on Alcohol Use

Alcohol use was assessed with 7 items drawn from the Quebec Health Survey (Bellerose et al., 1996). Five items, offering a dichotomous response choice (no = 0; yes = 1), targeted: (a) lifetime use of alcohol, (b) use of alcohol in the last 12 months, (c) criticisms by members of entourage regarding alcohol use, (d) thoughts about the need to decrease alcohol use, and (e) feelings of guilt related to alcohol use. Two additional open-ended questions (assessing number of times respondent has consumed 5 drinks and more in the last 12 months in 1 occasion, and number of times respondent has gotten drunk in the last 12 months) were recodified as follows: 0 time = 0, 1 to 4 times = 1, and 5 times and more = 2. One last question targeted the need to consume alcohol at time of rising to calm oneself or to recover from a hangover (never = 0; seldom = 1; often = 2; and almost every day = 3). The sum of the 7 items could range from 0 to 12. We used this total score as a continuum of alcohol use, representing complete abstinence at one end and severe alcohol abuse/dependence at the other. We also singled out the question targeting number of times respondent has gotten drunk in the last 12 months (number of inebriation episodes).

The Beck Depression Inventory—Second Edition

The Beck Depression Inventory—Second Edition (BDI-II) (Beck et al., 1996) includes 21 items enumerating depression symptoms. For each item, a list of 4 statements describes different symptom intensity. The respondent chooses the statement reflecting best his or her state during the last 7 days. The BDI has been extensively validated and good psychometric properties have been reported for the French version used in the present study (Gauthier et al., 1982). The BDI total score was used to describe the sample, and considered as a covariable in assessing relationship between sleep psychotropic medication use. To avoid multicollinearity problems, item no. 16 (changes in sleeping patterns) was not included in the calculation of BDI total score.

The Beck Anxiety Inventory

The Beck Anxiety Inventory (BAI) (Beck and Steer, 1990) is a 21-item self-report questionnaire targeting cognitive and somatic symptoms of anxiety. Each item is rated on a 0 to 3 scale. Total

score ranges from 0 to 63, with higher scores indicating greater anxiety. The French version presents good test-retest reliability, internal consistency, factorial and discriminant validity (Freeston et al., 1994). Like the BDI, the BAI total score was used to describe the sample, and considered as a covariable in assessing the relationship between sleep and psychotropic medication use.

Data analyses

To assess the unique contribution of sleep difficulties in PTSD symptom severity and perceived health, 3 sets of hierarchical multiple regression analyses were performed, with PTSD symptom severity (MPSS-SR total score), perceived physical health (SF-12 physical health component score), and perceived mental health (SF-12 mental health component score) as separate predicted variables. In each analysis, the same 9 predictors were entered as 4 blocks. The first 3 blocks were entered as a control for potential effects of sociodemographic, trauma-related, and clinical characteristics on PSTD severity and perceived health. The first block consisted of gender, age, and marital status (the latter was dichotomized, with single, separated, and divorced participants in one group, and married participants and participants living in a common-law relationship, in another). These 3 sociodemographic variables have previously been identified as having a significant impact on sleep (Ohayon, 2002) and possibly on PTSD as well (Guay et al., 2006). The second block included 2 trauma-related characteristics (time interval since trauma and number of different traumatic events), and the third block was composed of psychiatric comorbidities and correlates (comorbid mood disorder, comorbid anxiety disorder, alcohol use, and use of psychotropic medication). Finally, PSQI total score was entered as the fourth block. Clinical correlates of sleep quality were explored through a series of univariate analyses of variance, and effect sizes associated with each mean comparison was assessed with the calculation of the η^2.

RESULTS

Sociodemographic and Clinical Characteristics of Participants

The final sample was composed of 92 individuals with PTSD. Of the 66 women (71.7%) and 26 men (28.3%), most spoke French (88.3%), and their age ranged from 18 to 68 years ($M = 39.57$, $SD = 12.94$). More than half (52.2%) were employed (with 29.2% on sick leave), 32.6% were unemployed, 8.7% were students, and 5.4% were retired. Most participants were either married (22.0%) or in a common-law relationship (26.4%), whereas 36.3% were single and 15.4% were divorced or separated. More than half (56.2%) had a college education or higher. Annual income was lower than 20,000 CAD for 42.9% of the sample, between 20,000 and 40,000 CAD for 35.2%, and higher than 40,000 CAD for 22.0%.

According to the SCID assessments, PTSD diagnosis was rated as moderate or severe in most cases (30.8% and 56.5%, respectively). (For 6 participants, PTSD was rated as subclinical or impartial remission. Two participants were 2 symptoms short on criterion C, 1 participant was 1 symptom short on criterion C, 1 participant was 1 symptom short on criterion B and 1 short on criterion C, 1 participant was 1 symptom short on criterion C and 1 on criterion D, and 1 participant was 3 symptoms short on criterion C and 1 short on criterion D. For all of these participants except 1, missing symptoms required to attribute PTSD diagnosis were present, but of subclinical intensity.) Types of reported trauma associated with the development of PTSD included the following: physical aggression or threats (34.8%), vehicle accidents (27.2%), witnessing or being confronted with an event that happened to others (15.2%), sexual aggression (8.7%), and marital violence (6.5%). Participants reported an average of 3.67 different traumatic events during lifetime ($SD = 2.37$), and for half of the participants, the trauma most likely linked to current PTSD symptoms had occurred within the last 2 years. The average time interval since trauma was 62.16 months ($SD = 76.39$). Almost half (48.9%) had a comorbid major depression disorder (MDD), and 40.7% had one or more comorbid anxiety disorder. Two-thirds of the sample (67.8%) was taking at least psychotropic medication.

The mean score on the questionnaire on alcohol use was 3.21 ($SD = 2.46$), suggesting a low alcohol consumption on average. The mean MPSS-SR score was 68.00 ($SD = 19.55$), with 78 individuals (85.7%) reporting a score of 50 or over. The mean global PSQI score ranged from 2 to 21 ($M = 11.53$, $SD = 4.78$). Only 11 participants had global PSQI scores equal to or less than 5, suggesting no problem with sleep. The BDI mean total score indicated overall moderate to severe depression levels, and the BAI total scores suggested significant anxiety symptoms. Normative comparison of SF-12 physical and mental health component scores to the 1998 US population indicated that, on average, participants were in the 25th lowest percentile; when compared with a sample of individuals with depression, their scores were positioned between the 25th and the 50th percentile (Ware et al., 2007).

Impact of Sleep on PTSD Symptoms Severity and Perceived Health

Results from hierarchical multiple regression analyses indicated that together, all 4 blocks (composed of sociodemographic data, trauma-related characteristics, psychiatric comorbidities, and correlates, and overall sleep quality) accounted for 38.5% of PTSD symptom severity variance, $F(10,73) = 6.201$, $p < 0.001$ (Table 1). The blocks composed of sociodemographic and trauma-related characteristics did not significantly contribute to the model. The third block (psychiatric comorbidities and correlates) provided a significant 28.0% increase in R^2, $F_{inc}(4,74) = 8.281$, $p < 0.001$ (F_{inc} is the incremental F ratio that indicates whether a block significantly increases R^2 above the R^2 predicted by the variables already in the equation [Tabachnik and Fidell, 2001]), with comorbid MDD and use of alcohol as significant predictors. The addition of PSQI total score (fourth block) in the model provided a significant 8.4% increase in accounting for PTSD symptom severity variance, $F_{inc}(1,73) = 11.316$, $p = 0.001$.

Hierarchical multiple regression analyses were repeated with SF-12 physical and mental health component scores as predicted variables. For perceived physical health, the model was not statistically significant. Neither block significantly accounted for variance associated with perceived physical health (Table 2). Although PSQI total score added a significant contribution to the model, $F_{inc}(1,72) = 4.416$, $p = 0.039$, it was not large enough for the overall R^2 to reach significance criterion, $F(10,72) = 1.535$, $p = 0.145$. Results with SF-12 mental health component score as the predicted variable are presented in Table 3. Together, all 4 blocks accounted for 25.5% of perceived mental health variance. The first block (sociodemographic data) accounted for 10.1% of the variance, $F_{inc}(3,79) = 2.971$, $p = 0.037$. The block composed of trauma-related data did not significantly contribute to the model. The third block (psychiatric comorbidities and correlates) provided a 19.2% increase in R^2, $F_{inc}(4,73) = 4.980$, $p = 0.001$, with comorbid mood as the only individual significant predictor. The addition of PSQI total score (fourth block) in the model provided a significant 4.9% increase in accounting for perceived mental health variance, $F_{inc}(1,72) = 5.428$, $p = 0.023$.

Clinical Correlates of Sleep Quality

Seven analyses of variances were performed to explore sleep quality according to gender, age, marital status, time interval since trauma, type of trauma, number of inebriation episodes in the past year, psychiatric comorbidity, and use of psychotropic medication

TABLE 1. Multiple Regression Analyses Predicting PTSD Symptoms Severity (n = 85)

	Variables	*B*	*SE B*	β	sr^2	Adjusted R^2	ΔR^2
Step 1						0.002	0.038
	Gender	−4.144	4.768	−0.097	−0.097		
	Age	0.024	0.171	0.016	0.041		
	Marital status	−6.432	4.378	−0.164	−0.162		
Step 2						0.038	0.058
	Time interval since trauma	−0.039	0.030	−0.151	−0.143		
	No. different traumatic events	1.819	0.924	0.220	0.218		
Step 3						0.300*	0.280*
	Comorbid major depression disorder	16.631	3.838	0.424*	0.450		
	Comorbid anxiety disorder	1.154	3.815	0.029	0.035		
	Use of alcohol	−1.665	0.788	−0.210**	−0.238		
	Use of psychotropic medication	7.685	4.115	0.181	0.212		
Step 4						0.385*	0.084*
	PSQI total score	1.461	0.434	0.366*	0.384		

*$p < 0.01$.
**$p < 0.05$.

TABLE 2. Multiple Regression Analyses Predicting Perceived Physical Health among Individuals with PTSD (n = 83)

	Variables	*B*	*SE B*	β	sr^2	Adjusted R^2	ΔR^2
Step 1						−0.009	0.028
	Gender	2.264	2.955	0.086	0.086		
	Age	−0.143	0.106	−0.152	−0.150		
	Marital status	1.025	2.724	0.043	0.042		
Step 2						−0.014	0.019
	Time interval since trauma	0.018	0.019	0.114	0.106		
	No. different traumatic events	−0.540	0.579	−0.108	−0.106		
Step 3						0.017	0.078
	Comorbid major depression disorder	−4.485	2.817	−0.186	−0.183		
	Comorbid anxiety disorder	3.557	2.795	0.145	0.147		
	Use of alcohol	0.562	0.578	0.115	0.113		
	Use of psychotropic medication	−2.758	3.005	−0.106	−0.107		
Step 4						0.061	0.051*
	PSQI total score	−0.659	0.314	−0.263*	−0.240		

*$p < 0.05$.

(Table 4). For use of psychotropic medication, BDI and BAI total scores were both entered as covariables to decrease possible confounding effects of depressive and anxiety symptoms on sleep. Significant differences were found only for psychiatric comorbidity and use of psychotropic medication. There was a significant decrease in sleep quality associated with the presence of psychiatric comorbidity. Partial η^2 indicated an effect size within the medium to large range: psychiatric comorbidity accounted for 9.1% of the overall variance related to sleep quality. A posteriori Tukey HSD tests indicated one significant difference, that is, between individuals with PTSD only, and those with PTSD with comorbid MDD and 1 or more comorbid anxiety disorders, $p = 0.039$. Individuals using psychotropic medication also reported decreased sleep quality regardless of the severity of anxious and depressive symptoms. Partial η^2 indicated an effect size within the medium to large range: use of psychotropic medication accounted for 8.5% of the overall variance related to sleep quality. Gender, age, marital status, type of trauma, time interval since trauma, and number of past inebriation episodes did not impact sleep.

DISCUSSION

The present study aimed to assess the contribution of sleep disturbances in accounting for sleep-unrelated PTSD symptom severity and perceived health, and to explore clinical correlates of sleep disturbances in PTSD. Results confirmed a priori hypothesis that sleep quality had an impact on PTSD symptom severity, even when the effect of other potential confounding variables (sociodemographic data, trauma-related characteristics, psychiatric comorbidities, and alcohol and psychotropic medication use) was statistically accounted for. The present results only partially confirmed the a priori hypothesis regarding the impact of sleep on perceived health in PTSD, given that sleep explained a unique portion of variance associated with perceived mental health, but not perceived physical health. Exploration of clinical correlates of sleep in PTSD indicated more severe sleep difficulties among individuals suffering from comorbid MDD and one or more comorbid anxiety disorders in addition to PTSD, and among those using psychotropic medication regardless of the severity of their anxious and depressive symptoms.

TABLE 3. Multiple Regression Analyses Predicting Perceived Mental Health among Individuals With PTSD (n = 83)

	Variables	*B*	*SE B*	*β*	sr^2	Adjusted R^2	ΔR^2
Step 1						0.067	0.101*
	Gender	−0.626	2.397	−0.028	−0.029		
	Age	0.190	0.086	0.239*	0.240		
	Marital status	3.682	2.21/	0.181	0.184		
Step 2						0.046	0.003
	Time interval since trauma	0.004	0.015	0.027	0.027		
	No. of different traumatic events	−0.219	0.474	−0.052	−0.053		
Step 3						0.210**	0.192**
	Comorbid major depression disorder	−8.215	2.132	−0.404**	−0.411		
	Comorbid anxiety disorder	1.416	2.115	0.069	0.078		
	Use of alcohol	0.755	0.437	0.183	0.198		
	Use of psychotropic medication	−0.858	2.274	−0.039	−0.044		
Step 4						0.255**	0.049*
	PSQI total score	−0.549	0.236	−0.260*	−0.265		

*$p < 0.05$.
**$p < 0.01$.

Gender, age, marital status, time interval since trauma, trauma type, and alcohol use had no incidence on sleep quality.

The present findings add to earlier reports of significant sleep difficulties among individuals experiencing a various range of traumatic events and suffering from PTSD (Ohayon and Shapiro, 2000). The mean PSQI total score observed in the current sample (11.53) was similar to others reported in samples of outpatients with PTSD (Germain et al., 2004), women with PTSD reporting sleep difficulties (Germain et al., 2005), crime victims with nightmares and PTSD (Krakow et al., 2001), and in Buysse et al., (1989) original PSQI validation work with patients suffering from insomnia and depression. Similar to earlier findings reported by Germain et al., (2004), age, gender, marital status, type of trauma, and time interval since traumatic event did not have an impact on sleep quality. Sleep quality may be an important issue for the majority of individuals with PTSD, no matter what their clinical presentation is. Indeed, only 11 participants from our sample (12.0%) had a PSQI total score suggestive of a satisfying sleep quality.

Psychiatric comorbidity among individuals with PTSD appeared to somewhat decrease sleep quality, especially when participants suffered from comorbid MDD and one or more comorbid anxiety disorder in addition to PTSD. Decrease in sleep quality because of psychiatric comorbidity in PTSD has not been consistently reported (DeViva et al., 2004; Germain et al., 2004). Current results suggest that the relationship between sleep and PTSD symptoms severity, or between sleep and perceived mental health, is not fully mediated by psychiatric comorbidity. A significant portion of the variance of PTSD symptom severity (8.4%) and of perceived mental health (4.9%) remained attributable to sleep quality, even after variance due to the presence of other psychiatric disorders was accounted for.

Results from cross-sectional studies have suggested that sleep may be an important mediator of physical health in PTSD (Clum et al., 2001; Mohr et al., 2003). Unexpectedly, we did not find a significant association between sleep and perceived physical health. The discrepancy in findings may be explained by the use of different instruments to assess health, and the focus on different populations (women victim of sexual assault in Clum et al.'s study, and police officers in Mohr et al.'s study). Also, the cross-sectional nature of this (and prior) study prevents the assessment of the longitudinal effect of sleep on physical health in PTSD patients. Although it is generally recognized in sleep medicine that alcohol use may lead to more fragmented sleep (Roehrs, 1993), we did not find any effect of alcohol use on sleep in PTSD patients. These unexpected results contrast with findings identifying sleep difficulties as an important factor associated with alcohol use (Nishith et al., 2001). However, given the exclusion of individuals with alcohol abuse or dependence disorders, the absence of a significant association between these variables in the current study might be attributable to a floor effect and should therefore be interpreted with extreme caution. The relationship between sleep, health, and alcohol use in PTSD necessitates further investigation, as it seems to greatly vary according to population characteristics and assessment instruments.

The unique contribution of sleep in accounting for PTSD symptom severity has several implications for the prevention, assessment, and treatment of PTSD. On the prevention level, persistent sleep problems after a traumatic event may be an early indicator that clinical attention is warranted. Longitudinal studies have previously identified sleep as an early predictor of the development of PTSD (Koren et al., 2002). Further, regarding assessment and treatment of PTSD, unsatisfying sleep may exacerbate difficulties related to PTSD, especially those related to DSM-IV criterion D (concentration, hypervigilance, irritability, etc.). Recent observations in victims of a major industrial fire indicated that sleep might contribute to attention dysfunction many years after the trauma (Meewisse et al., 2005). Efficiently assessing sleep problems and addressing them during PTSD treatment may help optimize clinical interventions.

Several factors may limit the generalization of these findings. First, our sample consisted of volunteers engaging in a psychological treatment study, and thus may not represent individuals with PTSD usually seen in community medical or psychiatric settings. Results may not generalize to patients with PTSD who had suffered from physical aggression, threat, or sexual violence from their spouse, or marital violence, as participants who had been victims of these kinds of trauma from their current spouse were initially excluded. It is noteworthy, however, that most participants had PTSD deemed severe by trained clinical evaluators and reported a wide range of traumatic events, comorbid conditions, and sleep

TABLE 4. Means and Standard Deviations of PSQI Total Score According to Sociodemographic, Trauma-Related, and Clinical Data

	n	*M*	*SD*	*df* Numerator	*df* Denominator	*F* Value	Partial η^2
Gender (n = 90)				1	88	0.637	0.007
Women	65	11.78	4.86				
Men	25	10.88	4.59				
Age (n = 90)				4	85	0.856	0.039
18–29	27	11.89	4.49				
30–39	21	12.90	4.48				
40–49	18	10.56	4.72				
50–59	19	10.57	5.56				
60+	5	11.00	4.85				
Marital status (n = 89)				1	87	0.862	0.010
Single, separated, or divorced	45	12.03	4.56				
Married or in common-law relationship	44	11.09	5.02				
Time since trauma (n = 90)				3	86	0.132	0.005
<1 yr	18	10.89	4.35				
1–2 yr	27	11.64	4.48				
3–4 yr	15	11.73	5.68				
5 yr +	30	11.71	5.02				
Type of trauma (n = 88)				5	84	1.087	0.061
Physical aggression/threats	32	11.78	5.03				
Sexual aggression	8	10.00	4.34				
Marital violence	6	15.00	3.41				
Vehicle accidents	24	11.36	4.82				
Witnessing/learning events to others	14	10.21	4.92				
Other	6	12.50	4.14				
No. times respondent got drunk in the last year (n = 89)				2	86	0.638	0.015
0	58	11.65	4.91				
1–4 times	22	10.59	4.74				
5 times +	9	12.56	4.16				
Psychiatric comorbidity (n = 90)				3	86	2.880[a]*	0.091
PTSD only	32	9.81	4.40				
PTSD w/anxiety disorder	15	11.20	5.12				
PTSD w/mood disorder	21	12.52	4.43				
PTSD w/both mood and anxiety disorders	22	13.30	4.81				
Use of psychotropic medication (n = 88)				1	86	7.940[b]*	0.085
Yes	60	12.53	4.67				
No	28	9.54	4.57				

[a]A posteriori Tukey HSD tests indicated one significant difference, that is, between individuals with PTSD only and those with PTSD and both comorbid mood and anxiety disorders, $p = 0.039$.

[b]To control the effect of anxiety and depression symptom severity on relation between sleep and use of psychotropic medication, an ANCOVA was also performed, with BDI and BAI total scores entered as covariables. Difference between groups on PSQI total score remained significant, $F(1,82) = 4.067$, $p = 0.047$, partial $\eta^2 = 0.047$.

*$p < 0.05$.

problems. Published data on sleep and PTSD are often drawn from individuals already reporting sleep difficulties. The fact that sleep was not part of the study's selection criteria strengthens the external validity of our results. Second, the cross-sectional nature of the present study does not allow conclusions about causal relationships between sleep and PTSD. Further studies are necessary to test hypotheses regarding sleep disturbances as a precipitating or maintaining factor of PTSD. Third, with the exception of psychiatric diagnoses, results heavily relied upon data from self-report questionnaires that are subject to memory and motivational biases. Further examinations of the impact of sleep disturbances of the severity of PTSD symptoms should include objective (PSG) data. Nevertheless, subjective evaluation, with its limitations, is an appropriate way to assess sleep difficulties (Buysse et al., 2006) and may have more clinical resonance than results from sleep laboratory, which are not readily accessible for most health professionals. Finally, the exclusion of individuals with alcohol abuse or dependence disorders may have limited the range of the results on the alcohol use variable and thus precluded the detection of a significant effect of alcohol use on sleep.

The scientific interest on the relationship between sleep and PTSD is relatively new. Several aspects remain to be clarified. As was highlighted by Harvey et al., (2003), the specificity of sleep disturbances in PTSD, compared with those in other anxiety disor-

ders, is unclear. To clarify discrepancies in findings, the mediating effect of sleep on physical health in PTSD should be assessed with longitudinal designs. Further, the impact of sleep disturbances on the development of PTSD awaits confirmation. If early sleep difficulties predict later development of PTSD, the next step would be to investigate whether preventive interventions focusing on sleep would short-circuit the development of full-blown PTSD after exposure to a trauma. The impact of known effective treatments for PTSD on sleep difficulties also requires empirical evaluation.

The present study highlights the important role sleep plays in PTSD. Sleep appears to have a unique contribution in accounting for the severity of PTSD symptoms. Sleep also impacts how individuals with PTSD perceive their own mental health. Most individuals with PTSD present significant sleep difficulties regardless of their clinical presentation. Knowing the specific features of sleep in PTSD, and assessing the need to address sleep problems in PTSD treatment will help refine interventions with individuals suffering from this greatly distressing disorder.

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