Correlates of Daytime Sleepiness in Patients With Posttraumatic Stress Disorder and Sleep Disturbance

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Objective: To assess the correlates of daytime sleepiness in patients with a lifetime diagnosis of posttraumatic stress disorder (PTSD) and ongoing sleep disturbance not due to sleep apnea or other diagnosed sleep disorders.

Method: The sample consisted of 26 veterans receiving mental health care at the Minneapolis VA Medical Center, Minneapolis, Minnesota. The Epworth Sleepiness Scale was the primary outcome measure. Other sleep-related instruments consisted of the Pittsburgh Sleep Quality Scale, a daily sleep log, and daily sleep actigraphy. In addition, data included 3 symptom ratings (Posttraumatic Stress Disorder Checklist, Clinician Administered PTSD Scale [CAPS], and Beck Depression Inventory). Data were collected from 2003 to 2005. Current and lifetime PTSD diagnoses were based on *DSM-IV* criteria and were obtained by experienced psychiatrists using the CAPS interview.

Results: Univariate analyses showed that daytime sleepiness on the Epworth Sleepiness Scale was associated with daytime dysfunction on the Pittsburgh Sleep Quality Index ($P < .001$), less use of sleeping medication ($P = .02$), and more self-rated posttraumatic symptoms ($P = .05$). Within posttraumatic symptom categories, hypervigilance symptoms were more correlated with daytime sleepiness ($P = .03$) than were reexperiencing and avoidance symptoms ($P = .09$ for both).

Conclusion: In this selected sample, daytime sleepiness was most strongly and independently associated with daytime dysfunction.

Prim Care Companion J Clin Psychiatry 2010;12(2): e1–e6

Submitted: *October 29, 2007; accepted August 4, 2009.*
Published online: *April 29, 2010 (doi:10.4088/PCC.07m00563gry).*
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The purpose of this study was to describe the types of sleep problems reported and observed in patients with lifetime posttraumatic stress disorder (PTSD) and chronic sleep disturbance not due to apnea or other sleep disorders. Various forms of sleep disturbance can interfere with work, exercise and recreation, interpersonal relationships, and instrumental activities such as driving.[1] Sleep-related problems in patients with PTSD and insomnia have included repetitive awakenings, nightmares, difficulties obtaining sufficient sleep, daytime sleepiness, and daytime dysfunction.[2–4]

Investigators have differed in their opinions regarding sleep disturbance in PTSD. One text on sleep disorders barely mentions PTSD.[5] Daytime sleepiness, awakenings, and other forms of sleep disturbance are neither universal concomitants nor core features of PTSD.[6,7] Although sleep disturbances are sometimes reported as cardinal symptoms in PTSD,[8] 2 studies, 1 using polysomnography[9] and the other using actigraphy,[10] failed to demonstrate objective evidence of sleep disturbance in posttrauma survivors.

Despite these reports, most combat veterans and rape victims with PTSD whom we studied for several months to a year with a daily life charting instrument reported sleep disturbances.[11] Our actigraphic study demonstrated that most veterans with PTSD and sleep disturbance had shortened sleep times (with prolonged sleep times in some cases) and/or increased awakenings[12]—factors that could cause daytime sleepiness. In order to study daytime sleepiness in people who had lifetime PTSD with current sleep disturbance, we sampled a mixed group of patients with diverse comorbid disorders and treatment histories, so as to obtain a sample reflecting common clinical practice.

Our primary rationale for conducting this study was to assess the sleep problems associated with PTSD in the patient's own environment rather than in a monitored laboratory, which could ameliorate the sleep disturbance. Second, we wanted to observe the patients' sleep over several days or longer, since the sleep disturbance associated with PTSD can vary from day to day. Third, we wanted to employ both objective as well as subjective measures of sleep disturbance.

This study tested the following hypotheses:

1. Daytime sleepiness would be directly correlated with subjective and objective measures of sleep awakenings and sleep duration.
2. Daytime sleepiness would be directly correlated with subjective assessment of sleep quality.

Clinical Points

- Clinicians should inquire about symptoms of daytime sleepiness in patients with posttraumatic stress disorder (PTSD).
- In patients with PTSD, it appears that daytime sleepiness is related to a self-perception of daytime dysfunction.

3. Daytime sleepiness would be associated with increased depressive symptoms but not posttraumatic symptoms.

METHOD

Sample

Study participants consisted of volunteer veterans who were receiving care at the Minneapolis VA Medical Center, Minneapolis, Minnesota. They responded to hospital posters inviting participation in a study of sleep problems in people receiving treatment for PTSD. In order to be admitted to the study, participants had to have (1) a lifetime diagnosis of PTSD, (2) a current sleep disturbance (eg, difficulty getting to sleep or staying asleep, nightmares, awakening, lack of restful sleep), and (3) stability in their medical and psychiatric disorder and its care. Data were collected from 2003 to 2005. Current and lifetime PTSD diagnoses were based on *DSM-IV* criteria and were obtained by experienced psychiatrists using the CAPS interview.

Exclusionary data included obstructive sleep apnea, other sleep disorders meeting diagnostic criteria, psychosis, dementia, delirium, active substance abuse or dependence, and homelessness. There were no restrictions by age, gender, race/ethnicity, medication, or other comorbidity than described above. Patients manifesting typical symptoms of specific sleep disturbances (eg, sleep apnea, restless legs) were dropped from the study and referred for polysomnography. The Institutional Review Board and Research Administration at the Minneapolis VA Medical Center reviewed, approved, and monitored this study. All study participants provided informed consent.

Thirty-five study participants were in the original sample. Eight of these 35 study participants met 1 or more exclusion criteria (eg, active psychosis, homelessness, active substance dependence). One participant did not provide actigraphic data and so was dropped from the study, leaving 26 study participants.

Of 26 study participants, 23 were male and 3 were female. Twenty-four participants were white, and 2 participants reported other ethnic affiliation. Three were never married, 11 divorced, 1 widowed, and 11 married. Eleven were disabled, 6 working full-time, 5 unemployed, 3 retired, and 1 working part-time. Education included 2 people who had completed grades 9 to 11, 8 high school graduates, 13 participants with some college, and 3 college graduates. Regarding current residence, 12 were living in family of marriage, 9 alone, 2 in an institutional setting, and 1 each in family of origin, with friends, and other residence. Seventeen of 26 had been in combat (a high percentage even for veterans). None of the demographic characteristics bore a statistical association with the daytime sleepiness scores. One of the 26 veterans had recovered from PTSD, and did not meet diagnostic criteria in the last year, but continued to have sleep disturbance along with posttraumatic symptoms that did not fully meet PTSD diagnostic criteria (especially reexperiencing and avoidance).

Instruments

Epworth Sleepiness Scale. This measure determines daytime sleepiness through self-rating on 8 items. Available over the last 15 years,[13] the Epworth Sleepiness Scale has shown good sensitivity for measuring daytime sleepiness in a variety of settings and research paradigms.[1] Although this is not the only sleepiness scale in use,[14] the time parameters, items, and pilot study indicated that it would be the most useful test for this study.

Participants rated how likely they would be to fall asleep in the following 8 different real-life daytime circumstances: (1) sitting and reading; (2) watching television; (3) sitting, inactive, in a public place (eg, movie theater, meeting); (4) sitting as a passenger in a vehicle; (5) lying down to rest in the afternoon when circumstances permit; (6) sitting and talking to someone; (7) talking quietly after a lunch without alcohol; and (8) sitting in vehicle, while stopped for a few minutes in traffic.

Each item was scored from 0 to 3 (0 = never doze, 1 = slight chance of dozing, 2 = moderate chance of dozing, 3 = high chance of dozing). The Epworth Sleepiness Scale score consisted of adding the scores of the 8 items, with each item weighted equally. Scores potentially ranged from 0 to 24. Correlations between the items and the total Epworth Sleepiness Scale score in this study were $P < .001$ for all of the items (with r values ranging from 0.66 to 0.93).

Since daytime sleepiness can vary over time, we obtained a self-rating of the Epworth Sleepiness Scale at entry into the project (Epworth/t1) and after 2 weeks (Epworth/t2). We then added these 2 scores together and divided by 2 to obtain a mean Epworth Sleepiness Scale score (Epworth/mean) for the 2-week period. Correlation

between Epworth/t1 and Epworth/t2 was $r = 0.76$, $P < .001$. Correlation between Epworth/t1 and Epworth/mean was $r = 0.94$, $P < .001$; and correlation between Epworth/t2 and Epworth/mean was $r = 0.94$, $P < .001$.

The Epworth/mean scores ranged from 0 to 20, with a median score of 8. The mean score was 8.8, with a standard deviation of 5.8. Skewness was 0.27 and kurtosis was –0.87.

Actigraphy. Actigraphs, which detect, measure, and record movement, have shown a high correlation with polysomnographic study of sleep and wakefulness.[15] Correlations between actigraphy and polysomnography for total sleep time have been high, in the range of 0.97.[16] Correlations for awakenings have been less consistent, with a tendency for actigraphy to underrecord "quiet awakenings" detected with polysomnography.[16,17]

Patients wore the actigraphs on the nondominant wrist 24 hours per day, except for periods when in water (eg, showering, bathing). The actigraphs used were octagonal Basic, Ultra, and Advanced models manufactured by Ambulatory Monitoring, Inc (Ardsley, New York); each model provides the same measures. The devices were worn throughout the study period, providing 7 to 14 24-hour cycles per participant; mean cycles per participant was 11.5 nights. The 24-hour cycles were dropped from the analysis if the participant had lengthy periods in which he or she did not wear the actigraph (eg, forgot to put it back on immediately after bathing). Data from the actigraphs were downloaded for analysis using Action W software from Ambulatory Monitoring, Inc. Actigraphy-based data used for this analysis included mean sleep time per participant (with its standard deviation) and mean number of awakenings per night (with its standard deviation).

Study participants were asked to wear the actigraph for 14 nights. Seven study participants complied fully with instructions, providing 14 nights of actigraphic data. The remaining 14 study participants missed some days of data collection, often due to their forgetting to put the actigraph back on after bathing.

Pittsburgh Sleep Quality Index. The Pittsburgh Sleep Quality Index (PSQI) is a 19-item self-rated assessment questionnaire, with higher scores indicating poorer sleep quality. It appraises sleep quality and sleep disturbances along 6 dimensions; see data below for details.[18]

Examples of 2 items under "daytime dysfunction" are as follows: (1) "Trouble staying awake to conduct daily activities," with a frequency response ranging from 0 = not during the past month to 3 = 3 or more times in the past week and (2) "Enthusiasm to get things done," with a severity response ranging from 0 = not a problem at all to 3 = a very big problem. A single item assesses use of sleeping medication (prescribed or over-the-counter) by frequency, with 0 = not during the past month to 3 = 3 or more times a week.

Posttraumatic Stress Disorder Checklist. The Posttraumatic Stress Disorder Checklist (PCL) is a 21-item self-reported questionnaire that assesses current posttraumatic symptoms.[19] The PCL consists of 3 subscales: reexperiencing, avoidant, and hypervigilant.

Clinician Administered PTSD Scale. The Clinician Administered PTSD Scale (CAPS) is a structured interview-based measure comprised of 30 items that correspond to the *DSM-IV* criteria for PTSD.[20] The CAPS can be used to make a current (defined as "past month") or lifetime diagnosis of PTSD. Participants were administered the CAPS diagnostic interview at baseline to assist in determining qualification for entrance into the study. The CAPS follow-up interview to assess change in symptoms was administered at the termination of the study. To qualify for the study, participants had to have a lifetime diagnosis of PTSD but did not have to meet full diagnostic criteria at that time.

Beck Depression Inventory. The Beck Depression Inventory (BDI) is a 21-item multiple choice self-reported questionnaire that assesses current depressive symptoms.[21]

Data Collection Procedure

The Epworth Sleepiness Scale, PSQI, PCL, and BDI were administered before and after the 2-week period of sleep data collection. The rating scores used for this study consisted of an average of the baseline and terminal ratings for these 4 scales. Actigraphy and sleep log data, collected on a daily basis throughout the 2 weeks, provided data on (1) mean nightly duration of sleep and (2) mean number of awakenings per night.

Data Analysis

The dependent measure was the mean Epworth Sleepiness Scale score. Seventeen independent factors potentially affecting daytime sleepiness were as follows:

(1 and 2) Actigraphic duration of sleep and awakenings
(3 and 4) Sleep log duration of sleep and awakenings
(5 to 11) Mean PSQI item scores and total score
(12) Total CAPS score on entry into the study
(13–16) Mean PCL scores (reexperiencing, avoidance, hypervigilance, and total)
(17) Mean BDI scores

Univariate analyses were conducted using the Pearson correlation test. Linear regression analyses included all univariate analyses showing correlation at 0.10 or less; the variables were entered in a stepwise fashion.

RESULTS

Comparison of Sleepiness With Sleep Ratings

Actigraphy findings. As shown in Table 1, neither sleep duration nor awakenings per night were associated with the mean Epworth Sleepiness Scale scores.

Table 1. Mean Daytime Epworth Sleepiness Scale Score Versus Other Sleep and Symptom Scale Scores in 26 Veterans With Posttraumatic Stress Disorder (PTSD) and Sleep Disturbance[a]

	Correlation With Mean Epworth Sleepiness Scale Score	
Variable	Pearson *r*	Probability
Actigraphic findings		
Sleep duration, mean	0.13	.55
Awakenings, mean	–0.32	.14
Sleep log		
Sleep duration, mean	0.30	.15
Awakenings, mean	0.06	.72
Pittsburgh Sleep Quality Scale score		
Total	–0.03	.88
Daytime dysfunction	**0.67**	**<.001**
Sleep medication use	**–0.48**	**.02**
Sleep disturbance	0.30	.15
Subjective sleep quality	0.14	.50
Sleep latency	0.12	.58
Habitual sleep efficiency	–0.06	.78
Symptom score		
PTSD Checklist, total	**0.40**	**.05**
PTSD Checklist, hypervigilance	**0.44**	**.03**
PTSD Checklist, avoidance	0.34	.09
PTSD Checklist, reexperiencing	0.34	.09
Clinician Administered PTSD Scale, current	0.36	.09
Beck Depression Inventory	0.37	.06

[a]Bolded values indicate statistical significance.

Sleep log reports. Neither sleep duration nor awakenings per night were associated with the mean Epworth Sleepiness Scale scores; see Table 1.

Pittsburgh Sleep Quality Scale. The total PSQI score was not correlated with the Epworth Sleepiness Scale score. However, of the 6 subscales, the 2-item "daytime dysfunction" subscale was directly and strongly correlated with increased daytime sleepiness on the Epworth Sleepiness Scale at $P < .001$ ($r = 0.67$). In addition, the 1-item "sleeping medication use" was inversely correlated with sleepiness to a modest extent at $P = .02$ ($r = –0.48$).

Comparison of Sleepiness With Depressive and Posttraumatic Symptoms

Posttraumatic Stress Disorder Checklist. The mean total PCL score was directly correlated with the mean Epworth Sleepiness Scale scores at $P = .05$ ($r = 0.40$). Among the 3 subscales, the PCL-hypervigilance item was most strongly correlated with Epworth Sleepiness Scale scores at $P = .03$. The PCL-reexperiencing and PCL- avoidance items both showed correlations at a nonsignificant but borderline level of $P = .09$ ($r = 0.34$).

Clinician Administered Posttraumatic Scale. The CAPS was correlated with the mean Epworth Sleepiness Scale scores at a borderline level of $P = .09$ ($r = 0.36$).

Beck Depression Inventory. The mean BDI scores were directly correlated with the mean Epworth Sleepiness Scale scores at a borderline level of $P = .06$ ($r = 0.37$).

Table 2. Linear Regression Analysis, Stepwise Method Showing Factors Independently Predicting the Mean Daytime Epworth Sleepiness Scale Score[a]

Variable	β	*t*	*P*
Analysis 1 with PTSD Checklist			
Constant	NA	1.64	.11
Daytime dysfunction	**.595**	**3.55**	**.002**
Sleep medication use	–.216	–1.22	.24
PTSD Checklist	.092	0.43	.67
Analysis 2 with Beck Depression Inventory			
Constant	NA	1.64	.11
Daytime dysfunction	**.595**	**3.55**	**.002**
Sleep medication use	–.216	–1.22	.24
Beck Depression Inventory	.049	0.22	.83

[a]Bolded values indicate statistical significance.
Abbreviations: NA = not applicable, PTSD = posttraumatic stress disorder.

Linear Regression Analysis, Stepwise

The dependent variable for the linear regression analysis was the Epworth Sleepiness Scale score. Independent variables included daytime dysfunction, use of sleeping medication, the PCL total score, and the BDI score. The CAPS score was not included in the analysis due to its similarity to the PCL score (even though its probability was < .10). Two separate analyses were run with the PCL total score and the BDI score since these 2 scales showed a high correlation with each other (which could confound the analysis).

As shown in Table 2, the 2-item "daytime dysfunction" subscale from the PSQI showed a high correlation with the Epworth Sleepiness Scale score in both analyses ($P = .002$). "Use of sleep medication" on the PSQI was not significantly related to daytime sleepiness when all of the variables were take into account. In their respective analyses, the PCL total score and the BDI score failed to show an independent relationship to the Epworth Sleepiness Scale score.

DISCUSSION

Daytime Sleepiness and Sleep Disturbance in PTSD

This study found minimal correlation between daytime sleepiness and sleep disturbance measures in patients with PTSD and sleep complaints—a counterintuitive finding. These measures included an objective measure (ie, actigraphy), a subjective measure of sleep duration and awakening (ie, sleep logs), and a measure of overall sleep quality (ie, the PSQI). A narrow distribution of scores in a highly selected sample might produce null findings, but all of the scales in this study produced a wide distribution of scores. At least 1 similar finding exists in published reports: in a study of patients with sleep apnea, daytime sleepiness and sleep measures were not correlated.[22]

One widely held clinical viewpoint holds that daytime sleepiness and other aspects of sleep disturbance in patients with PTSD may be due to comorbid depression.[23–25] With this in mind, we included the

BDI in our research instruments. However, the BDI showed only a borderline association with the Epworth Sleepiness Scale ($P = .06$) on univariate analysis. Moreover, the BDI did not independently predict the Epworth Sleepiness Scale score on the linear regression analysis. One possible explanation has been suggested by a large epidemiologic study in Japan, which found that depressive symptoms and sleep demonstrated a U-shaped relationship, with more depressive symptoms associated with sleep durations at the extremes of sleep duration (ie, less than 6 hours of sleep or more than 10 hours of sleep). Thus, in a sample with mixed sleep disturbances, depressive symptoms and sleep duration might not be associated. Future analyses will utilize 2 categories of sleep: normal = 6 to 10 inclusive hours of sleep and abnormal < 6 hours or > 10 hours of sleep.

Harvey and coworkers[26] have opined that the relationship between PTSD and sleep disturbance comprises a complex phenomenon that will require a strong theoretical base before clinical understanding is feasible. These data appear to support that contention. Many of our findings were unexpected on the basis of a current understanding of sleep. For example, the PCL hypervigilance subscale bore a stronger univariate relationship to daytime sleepiness than did depressive symptoms on the BDI. This finding plus the fact that none of these PTSD measures survived the linear regression analysis suggest that our current understandings of daytime sleepiness are insufficient to inform patients and their clinicians regarding etiology, pathophysiology, prevention, and treatment of continued sleep disturbance in long-standing cases of PTSD.

Possible Influences of Research Method on Sleep Findings in PTSD

Our findings in this study stand at an intersection between 2 divergent viewpoints regarding sleep problems in PTSD. On one hand, clinicians serving PTSD patients have reported high rates of sleep disturbance and daytime sleepiness.[3,27] On the other hand, clinical investigators using objective measures have failed to replicate these findings of sleep disturbance, which include colleagues from this study.[9,28]

One source of apparent dissonance could be sampling. In the study by Engdahl et al,[28] the participants consisted of a community sample rather than patients seeking treatment—a factor that could select for minimal sleep disturbance. Although the Engdahl sample[28] had high lifetime PTSD morbidity, our actigraphic study of sleep disturbance in PTSD indicated that older age and/or time lapse from the traumatic event might produce a diminution of sleep disturbance over time.[12] The Hurwitz et al study[9] was open to anyone with PTSD, whereas we required lifetime diagnosis of PTSD, stable clinical status, and a current sleep disturbance for entry into the study.

Another methodological factor affecting the results could be the site of data collection. To date, polysomnographic studies have been conducted over 1 or 2 nights in an institution, a setting in which the awake technician is outside of the sleeping room.[9] This setting may alleviate hypervigilance, as compared to our study in which actigraphic and other data were obtained in the patients' home setting over a 2-week period.

Sleep Medication, Daytime Dysfunction, and Daytime Sleepiness

Current use of sleep medication was associated with less daytime sleepiness on the univariate analysis ($P = .02$). However, this factor did not survive in the linear regression analysis, indicating that it did not bear an independent relationship to daytime sleepiness. Although this result could simply be a false-positive one, it could be a serendipitous finding that might be more carefully addressed in future studies.

Daytime dysfunction, a 2-item subscale on the PSQI, was strongly associated with daytime sleepiness on the univariate comparison ($P < .001$) and was the only factor to survive the 2 linear regression analyses ($P = .002$). Despite the strong association, the explanation for the link between these 2 variables is not obvious. On one hand, daytime dysfunction could produce daytime sleepiness through boredom, lack of reward from daytime endeavors, inactivity, social isolation, or other psychosocial factors. Alternatively, daytime sleepiness could produce daytime dysfunction through neurotransmitter-modulated inattention, lack of energy, or cognitive impairment from sleep deprivation. Alternatively, both daytime sleepiness and daytime dysfunction could interact in a mutually pathogenic downward spiral. Finally, both daytime sleepiness and daytime dysfunction could result separately from some common third cause (such as damage to an area of the brain that subserves both psychophysiologic domains).

The strong association of daytime sleepiness and daytime dysfunction lends import to the concept of daytime sleepiness, since it is not only a discomforting symptom, but also a disabling one if it contributes to daytime dysfunction. This finding also increases the relevance of daytime sleepiness for the clinician, since it appears to have a strong and independent relationship to daytime function. Of course, controlled clinical trials would be needed to demonstrate the efficacy of any therapeutic intervention for daytime sleepiness.

Limitations

Our study involved a relatively small number of study participants (n = 26). False-negative findings pose a risk in small samples. The number of women was limited (n = 3), as was the number of nonwhites (n = 2). Although demographic variables were not associated

with daytime sleepiness, a large sample would permit more rigorous assessment of demographic factors. Larger sample size would also permit assessment of diagnostic comorbidity (eg, current major depression or substance use disorder) and a larger number of variables. Inclusion of acute or recent cases, rather than clinically stable or "chronic" cases only, might accentuate daytime sleepiness and sleep disturbance.

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Potential conflicts of interest: The authors report no financial or other affiliations relevant to the subject of this article.
Funding/support: The Minnesota Medical Foundation at the University of Minnesota, Minneapolis, provided funding for this project.

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