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Residual Sleep Problems Predict Reduced Response to Prolonged Exposure among Veterans with PTSD

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Abstract

Objective(s)—While evidence-based treatments exist for posttraumatic stress disorder (PTSD), a significant sub-set of veterans continue to meet criteria for PTSD after treatment. Sleep problems may affect treatment retention and predict efficacy for PTSD treatments.

Methods—The present study used data from a clinical trial of Prolonged Exposure therapy (PE) administered to veterans (N=154) to evaluate whether residual sleep symptoms remained after treatment completion, and if so, whether these residual sleep symptoms were associated with higher levels of PTSD and comorbid depression at the end of treatment. Participants (ages 20 to 75 years old; 35.7% Black; 54.5% married) completed demographic questions, symptom assessments, and engagement-related surveys.

Results—Hierarchical multiple linear regression models demonstrated that changes in sleep were significant predictors of PTSD and depression symptom reduction above and beyond the influence of demographic and engagement factors (e.g., therapy satisfaction).

Conclusions—Greater residual sleep symptoms were predictive of smaller treatment gains. Findings illustrate the potential significance of sleep during the course of PTSD treatment, leading to several important clinical assessment and treatment implications.

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Compliance with Ethical Standards

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Informed Consent: Informed consent was obtained from all individual participants included in the study.

Keywords

PTSD; Prolonged Exposure; Sleep problems; Veterans; Depression; Treatment Engagement

The lifetime prevalence of posttraumatic stress disorder (PTSD) in the general population is estimated at 8.3% (Kilpatrick et al., 2013), though prevalence is even higher among veteran samples, with estimates as high as 38.7% for point prevalence (Miller et al., 2013). PTSD is associated with significant comorbidity, including psychiatric comorbidities such as insomnia (McLay, Klam, & Volkert, 2010), depression (Breslau, Davis, Peterson, & Schultz, 2000), substance use disorders (Jacobsen, Southwick, & Kosten, 2001); as well as increased severity of pain (Otis, Keane, & Kearns, 2003), physical illness (Bosarino, 2004), risk for suicide ideation and completion (Gradus et al., 2010; Jakupcak, et al., 2009), relationship problems (Monson, Taft, & Fredman, 2009), and reduced satisfaction with life and daily functioning (Schnurr, Lunney, Bovin, & Marx, 2009). One report estimated 4 to 6.2 billion (2007) dollars in societal cost for PTSD and depression in OIF/OEF veterans over a period of just two years, with more than half of the economic burden stemming from loss in productivity (Tanielan & Jaycox, 2008).

The enormous cost of PTSD to society and to the individual has spurred decades of research refining treatments, resulting in development and validation of several effective psychotherapies, including Cognitive Processing Therapy, Prolonged Exposure therapy and Eye Movement Desensitization and Reprocessing (Foa, Keane, Friedman, & Cohn, 2008). Despite large effect sizes observed across empirically supported treatments for PTSD (Bradley, Greene, Russ, Dutra, & Westen, 2005; Powers, Halpern, Ferenschak, Gilihan, & Foa, 2010), there is still much room for improvement. A close examination of clinical trials reveals that a sub-set of patients drop out of treatment (ranging from 20–40% in military populations; Gros, Price, Yuen, & Acierno, 2013; Reger et al., 2016; Resick et al., 2016; Steenkamp, Litz, Hoge, & Marmar, 2015; Hembree et al., 2003), and a sub-set of patients who complete empirically supported treatments are non-responsive, with 20–35% of patients still meeting diagnostic criteria for PTSD after treatment completion (Cahill & Foa, 2004). Similarly, a review of 55 clinical trials testing empirically supported treatments for PTSD concluded that, “nonresponse rates exceeded 50% on at least some measures in many studies” (p. 136, Schottenbauer, Glass, Arnkoff, Tendick, & Gray, 2008). Another review using data from 36 studies examining effects of evidence based treatment specifically for military-related PTSD found that 60–72% of patients retained their PTSD diagnosis after treatment (Steenkamp, Litz, Hoge & Marmar, 2015).

Although there are many potential factors that may be related to treatment non-response (e.g., pre-treatment severity, trauma type, environmental factors, psychological and cognitive comorbidities; Schottenbauer et al., 2008), sleep problems are among the most promising, and potentially most modifiable, explanatory factors (Morin et al., 2009). Sleep problems are endorsed by 70–91% of PTSD patients (Maher, Rego, & Asnis, 2006). Even among patients who complete cognitive behavioral treatment for PTSD, 48% report residual symptoms of sleep disturbance (Zayfert & DeViva, 2004). Preliminary qualitative evidence collected from clinical PTSD populations that have engaged in cognitive behavioral therapy suggests that

residual sleep problems may hinder treatment response (DeViva, Zayfert, Pigeon, & Mellman, 2005), with other case studies suggesting that patients with PTSD may receive additional benefits from interventions specifically targeting sleep symptoms (Baddeley & Gros, 2013; DeViva, Zayfert, Pigeon, & Mellman, 2005).

The present study examined data from a clinical trial of Prolonged Exposure therapy (PE) administered in the VA to evaluate whether residual sleep symptoms remained after treatment completion, and if so, whether these residual sleep symptoms were associated with higher levels of PTSD and comorbid depression at the end of treatment. Based on the past preliminary findings (DeViva et al, 2005; Zayfert & DeViva, 2004), we hypothesized that changes in sleep symptoms would be significantly predictive of PTSD symptom changes during PE, in that smaller improvements in sleep would be associated with smaller improvements in overall PTSD symptoms. Given that engagement in therapy is predictive of treatment efficacy, engagement variables were examined to control for effects of therapy satisfaction, number of therapy sessions attended, and service delivery condition (i.e., telehealth or in person).

Methods

Participants

Participants were recruited primarily through referrals from physicians and other medical staff at a large southeastern VA medical center (VAMC) and its affiliated community-based outpatient clinics. Eligibility was determined by an in-person intake assessment delivered by masters-level clinicians. Veterans and military personnel meeting DSM-IV-TR criteria for PTSD per the Clinical Administered PTSD Scale (CAPS) were eligible (Blake, Weathers, Nagy, et al., 1995). The CAPS is a semi-structured clinical interview designed specifically for assessing PTSD diagnosis and evidences excellent psychometric properties, including strong convergent and discriminant validity, as well as adequate test-retest and interrater reliability (Blake, Weathers, Nagy, et al., 1995; Weathers, Keane, & Davidson, 2001). Veterans from all theaters that met eligibility criteria were included. Exclusion criteria were active alcohol or substance dependence within the past 6 months, an active psychotic disorder, and severe suicidal ideation with plan and intent. Alcohol dependence was assessed by chart review as well as by using the Alcohol Use Disorders Identification Test, and substance dependence was assessed using the Drug Abuse Screening Test. Suicidal ideation was assessed using question #9 (suicidal thoughts or wishes) on the Beck Depression Inventory-II and by directly asking the veteran about intent to harm him/herself. Participants receiving psychiatric medication were also not excluded, but were required to be stable on their medication for at least 3 weeks before starting treatment. For the purposes of the present study, all study procedures were required for participation (i.e., completed therapy and assessments of satisfaction).

Participants ($N = 154$) were predominantly male (96%), ranged in age from 20 to 75 years ($M = 41.6$ years; $SD = 14.0$), about half were married (54.5% married, 22% never married, 18.8% separated/divorced), and the majority identified as Caucasian (58.4% Caucasian; 35.7% African American). More than half of the sample (57.8%) reported no suicidal ideation at baseline, and many reported that they were employed (39.6%). Some of the

participants (39%) were classified as disabled, which was defined as anyone having a VA-rated service connection (e.g., to physical and/or mental health disabilities).

Procedures

A full description of the study procedures is reported elsewhere (Strachan, Gros, Yuen et al., 2012). All protocols were approved by the local VAMC Research and Development committee as well as the Institutional Review Board at the affiliated university. Participants meeting eligibility requirements were randomized to PE delivered in person (PE-IP) or via home-based telehealth (PE-HBT). All participants consented to receive eight to twelve 90-minute sessions of PE administered by three masters-level therapists, all with experience in conducting exposure-based therapy for PTSD in prior clinical trials. The specific number of sessions for each participant was determined on a case-by-case basis, taking the participant's progress into account. The mean number of sessions completed was 10.1 ($SD = 1.5$) with 30% of participants receiving the maximum of 12 sessions. After completing treatment, participants were administered a one-week post-treatment assessment that consisted of a structured clinical interview (CAPS) and a battery of self-report scales measuring psychological symptoms, satisfaction, and overall perceptions (i.e., the PTSD Checklist-Military Version (PCL-M), the Beck Depression Inventory-II (BDI-II), and the Charleston Psychiatric Outpatient Satisfaction Scale (CPOSS), respectively, see below. Clinical assessors were blind to participant condition.

Measures

PTSD—PTSD symptoms were measured via the PTSD Checklist–Military version (PCL-M; Weathers, Huska, & Keane, 1991). The PCL-M is a 17-item self-report measure that assesses severity of distress associated with each of the 17 symptoms of DSM-IV PTSD on a five-point scale (1 = not at all, 5 = extremely). The PCL-M has good convergent and discriminant validity and demonstrates adequate test-retest reliability and internal consistency among veteran samples (Wilkins, Lang, & Norman, 2011).

Depression—The BDI-II is a 21-item measure designed to assess the cognitive, affective, behavioral, motivational, and somatic symptoms of depression in adults and adolescents (Beck et al., 1996). Each item is rated on a 0 to 3 scale with different responses based on the targeted symptom content. The BDI-II has demonstrated excellent test–retest reliability over a 1-week interval ($r = .93$), excellent internal consistency ($\alpha s < .92$), and convergent and discriminant validity in multiple samples (Beck et al., 1996).

Sleep—Items from the Clinician Administered PTSD Scale (CAPS, Blake et al., 1995) were used to form baseline and post-treatment sleep composite variables using the sum of the Likert responses to the items related to intensity and frequency of sleep disturbances. More specifically, the structured interview question assessing frequency of sleep disturbances asked “Have you had any problems falling or staying asleep? How often in the past month (week)?,” with Likert response options of the following: Never (0), Once or twice (1), Once or twice a week (2), Several times a week (3), Daily or almost every day (4). Similarly, the intensity of sleep disturbances was assessed with the question “How much of a problem did you have with your sleep (How long did it take you to fall asleep? How often

did you wake up in the night? Did you often wake up earlier than you wanted to? How many total hours did you sleep each night?)” with Likert response options ranging from none (0), mild (1), moderate (2), severe (3), to extreme (4).

Engagement variables—Therapy satisfaction was measured via the CPOSS. The CPOSS is a 16-item measure assessing four domains of treatment satisfaction (Frueh, Pellegrin, & Elhai, 2002; Gros, Stauffacher, Acierno et al., 2013). Example items assessing satisfaction include: “helpfulness of the services you have received,” “respect shown for your opinions about treatment,” “overall quality of care provided,” and “would you recommend this clinic to a friend or family member.” The CPOSS has evidenced good psychometric properties and is a predictor of post-intervention treatment outcomes (Gros, Stauffacher, Acierno et al., 2013). Number of therapy sessions attended was also included as an engagement variable and was operationalized as the sum total of PE sessions attended either in person or via telehealth by the participant. Treatment condition was included to control for any engagement effects of participants who received PE via telehealth versus in person.

Statistical Analyses

Hierarchical multiple linear regression models were used to predict changes in PCL-M and BDI-II. The statistical significance level was set a priori at $p < .05$. Analyses included responses from participants who completed treatment as well as participants that were considered treatment dropouts determine by the number of sessions completed (i.e., 5 sessions or less). Separate hierarchical regression models were used to test the effect of sleep disturbances on post-intervention PTSD and depression symptoms while controlling for demographics, engagement variables (e.g., number of therapy sessions attended, patient satisfaction and perceptions of quality of service received using the CPOSS, treatment condition), and baseline levels of symptoms. Variables included in each block for each model were: 1) participant demographic characteristics including age, marital status, employment status, and race; 2) baseline PTSD or depressive symptoms and the baseline CAPS sleep composite scores (sum of frequency and intensity); 3) engagement variables including number of intervention sessions completed, overall quality of care provided (CPOSS), and telehealth versus in-person therapy format (treatment condition); and 4) residual change in CAPS sleep composite scores (predicting post-intervention CAPS sleep composite scores from baseline CAPS sleep composite scores).

Results

Preliminary Analyses

Baseline depressive symptoms averaged a mean score of 28.67 ($SD = 12.4$; ranged from 6–61) with a post-intervention depressive symptoms mean score 20.35 ($SD = 14.87$; ranged from 0–52). For PTSD symptoms, baseline PCL scores were consistent with meeting full PTSD diagnostic criteria and averaged a mean score of 63.26 ($SD = 12.16$; ranged from 33–85). Post-intervention PCL scores yielded an average of 46.27 ($SD = 19.39$; ranged from 17–85). For more description of the sample, please refer to the principal study by Acierno and colleagues (2017). Of the sample, 91% of the participants ($N=136$) positively endorsed sleep problems (Yes or No) for Criterion D of the PTSD DSM I diagnosis. CAPS sleep

composite scores averaged a mean score of 6.29 ($SD = 1.97$; ranged from 0–8) at baseline and an average mean score of 4.64 ($SD = 3.03$; ranged from 0–8) at post-intervention. CPOSS scores yielded an average score of 69.79 ($SD = 10.24$; ranged from 31–80). All intercorrelations between independent variables included in the regression models were < 0.42 .

Univariate and multivariate outliers, as well as normality and linearity, were examined and found within normal ranges. Regarding univariate normality, skewness ($-.52$ to $.61$) and kurtosis (-0.25 to -1.18) were not problematic for baseline nor post intervention variables since values for asymmetry and kurtosis between -2 and $+2$ are considered acceptable in order to prove normal univariate distribution (George & Mallery, 2010). Plots of residuals of the final steps of each regression model (Normal P-P Plot using SPSS v.21) demonstrated that errors of the regression line adhered to assumptions of normality.

Hierarchical Regression

Two hierarchical regression models (with four steps per regression model) were used to examine the effects of sleep disturbances on reduction of depressive symptoms or PTSD symptoms after controlling for demographic variables, engagement variables, and baseline levels at pre-intervention of depression and PTSD scores. For post-intervention depressive symptoms (post-BDI Score), variables entered in stage one of the regression were age, marital status, employment, and race, and these variables did not contribute significantly to the regression model ($R^2 = .04$, $F_{\text{inc}}(4, 36) = 0.34$, $p = .85$). Adding the baseline CAPS sleep composite item and baseline depressive symptoms in stage two of the regression explained an additional 44.9% of the variation in post-intervention depressive symptoms and contributed significantly to the model ($F_{\text{inc}}(2, 34) = 14.82$, $p < .001$). Addition of the engagement variables in stage three of the regression model did not contribute significantly ($R^2 = .06$, $F_{\text{inc}}(3, 31) = 1.33$, $p = .28$). However, the addition of the post-intervention sleep item explained an additional 5.8% of variation in post-intervention BDI scores above and beyond the effects of baseline symptoms, and the increase in variance explained was statistically significant ($F_{\text{inc}}(1, 30) = 4.38$, $p = .04$). When all independent variables were included in step four of the regression model predicting post-intervention depressive symptoms, baseline BDI scores ($\beta = .63$, $p < .001$) and the residual change scores predicting post-CAPS sleep composite from base-CAPS sleep composites ($\beta = .27$, $p = .04$) were statistically significant predictors.

A similar pattern of results was observed for the hierarchical regression analysis examining the effects of sleep on improvement of PTSD symptoms at the end of treatment (see Table 2). Demographic variables entered in stage one of the regression model did not predict significant variance in post-intervention PCL scores ($R^2 = .05$, $F_{\text{inc}}(4, 35) = 0.41$, $p = .80$). As with the first model, addition of baseline levels of PTSD symptoms and the CAPS baseline sleep composite score in stage two explained an additional 32.2% of the variance in post-intervention PTSD symptoms and contributed significantly to the model ($F_{\text{inc}}(2, 333) = 8.40$, $p = .001$). While including engagement variables (attendance, patient satisfaction, treatment format) did not add significantly to the prediction of the model ($R^2 = .08$, $F_{\text{inc}}(3, 30) = 1.51$, $p = .23$), addition of the residual change CAPS sleep composite scores in stage

four significantly predicted post-intervention PCL scores above and beyond the effects of other variables ($R^2 = .07$, $F_{inc}(1, 29) = 4.22$, $p = .05$) and explained 7% of the variance of PTSD symptoms after the intervention. When all independent variables were entered in the model in stage four, statistically significant predictors included residual changes in sleep disturbances from baseline to post-intervention ($\beta = .29$, $p = .049$) and baseline PCL scores ($\beta = .48$, $p = .002$), with marginal trends from CPOSS scores after the intervention ($\beta = -0.25$, $p = .08$).

Discussion

The present study investigated relations between changes in sleep disturbances and overall improvements in PTSD and depressive symptoms during treatment for PTSD. The general findings demonstrated that, even after controlling for baseline symptomatology, reduction in sleep disturbance over the course of treatment predicted lower PTSD and depression symptoms at post-treatment, above and beyond the influence of demographic and engagement factors. The pattern of findings was replicated across analyses for both PTSD and depression outcome measures, using sleep items from the CAPS structured interview. These findings highlight the potential significance of improvements in sleep during the course of PTSD treatment, leading to several important clinical assessment and treatment implications.

As hypothesized, residual sleep disturbance symptoms were positively associated with post-treatment PTSD and MDD symptoms. These findings are consistent with previous studies, which identified that residual sleep disruptions are present in participants following cognitive behavioral therapy for PTSD (Zayfert & DeViva, 2004), and that there are synergistic relations between PTSD symptoms and sleep disruptions (DeViva, Zayfert, & Mellman, 2004). However, the present study found an interaction between these two factors (residual sleep disruptions post-treatment and synergistic relations) that also influenced treatment, in that smaller improvements in sleep symptoms were predictive of smaller improvements in symptoms of PTSD and MDD above and beyond other factors. These findings add to the growing literature on comorbid or co-occurring sleep disorders and related residual sleep disturbances following evidence-based psychotherapies for various psychiatric disorders (Pruiksma et al., 2016; McHugh et al., 2014) as well as medical conditions (Stepanski & Rybarczyk, 2006).

From a clinical perspective, there may be a few possible explanations for these findings. First, the common mechanisms of treatment in exposure therapy for PTSD are primarily focused on avoidance, and less so on associated symptoms such as sleep (Foa, Hembree, & Rothbaum, 2007). For example, the manual for Prolonged Exposure makes very little mention to sleep, apart from the explanation of common reactions of trauma in the initial psychoeducation. Although the use of daily relaxation (reduce baseline anxiety), situational exposures (reduce hypervigilance), and imaginal exposures (reduce intrusive memories and nightmares) could result in indirect improvements in sleep (Galovski, Monson, Bruce, & Resick, 2009), the lack of a direct intervention for sleep may limit its full improvement and allow for residual symptoms to continue to interfere with overall functioning. Related, it is unclear whether the sleep impairment studied was PTSD-related sleep symptoms or a

comorbid sleep disorder. Comorbid sleep disorders, such as nightmare disorder, sleep apnoea, and periodic limb movements, are both commonly-occurring with PTSD and less responsive to PTSD-specific treatments (Spoormaker & Montgomery, 2008).

An additional explanation for these results could be found in the basic sciences research for PTSD and rapid eye movement (REM) sleep disturbance. For example, studies often use shock conditioning and extinction paradigms in humans to provide an analogue for fear extinction in exposure-based therapies for anxiety. Recent experimental research in this basic science paradigm demonstrates that REM sleep deprivation disrupts fear extinction (Spoormaker et al., 2010), and that sleep is critical for generalization of fear extinction learning (Pace-Schott et al., 2009). These findings have been applied to the PTSD treatment literature more recently, with related hypotheses that chronic sleep disruption may lessen the efficacy of PTSD treatments (Germain, 2013).

Given these findings and related hypotheses, the clinical assessment and treatment of PTSD and related conditions should be expanded accordingly to include sleep disturbance and disorder(s). As reviewed elsewhere, there are a number of psychometrically-sound questionnaires and interviews that assess the sleep disorders and related symptoms, including the Global Sleep Assessment Questionnaire, Pittsburgh Sleep Quality Inventory, Holland Sleep Disorders Questionnaire and Sleep-50 (Klingman, Jungquist, & Perlis, 2016). Measures of this type should be incorporated into PTSD assessment materials to better inform treatment practices and better understand specific aspects of sleep (e.g., difficulty falling asleep, frequent waking, Insomnia Disorder, poor sleep hygiene, etc.) that contribute to more persistent trauma symptomatology. Relatedly, treatments found effective for sleep disorders, such as Cognitive Behavioral Therapy for Insomnia, could be provided before, integrated within, or after PTSD treatments to potentially better address these comorbid conditions/symptoms (Taylor & Pruiksma, 2014). In fact, some researchers have argued that standalone treatments for sleep may be more apt to address comorbid PTSD and sleep disturbance than PTSD-specific treatments (Spoormaker & Montgomery, 2008). According to Spielman's model of insomnia (Spielman & Glovinsky, 1991), sleep difficulties can evolve into a separate persistent problem through conditioning. While PTSD treatments do not address learned associations between arousal and sleep environment, treatment for sleep, such as CBT for Insomnia, can target the learned associations that may have precipitated the sleep disruptions. Additional research is needed in these areas to determine the best choice or combination of choices for these comorbid symptoms/conditions.

There are several limitations of the present study. The sample was limited to veterans diagnosed with PTSD, and PTSD related to combat exposure. The sample also was comprised almost entirely of men. Apart from the sample, the procedures were limited to a single treatment, PE, and without a specific measure for sleep impairment/disorder(s). The limitation of the measures is particularly notable in that sleep was assessed from the clinical diagnostic interview for PTSD. Although the findings were consistent across depression and PTSD self-report measures and sleep items, sleep specific measures, as described earlier, should be included in future studies. The inclusion of more detailed questionnaire(s) to assess sleep dysfunction may provide further benefit of determining whether PTSD treatment has a differential influence on particular types of sleep problems. For example, if

prolonged exposure therapy produced particularly marked reductions in nightmares, we may see greater reductions in difficulty staying asleep relative to difficulty falling asleep over the course of treatment. It is also possible that different types of sleep problems (e.g., initial, middle, or terminal insomnia) could have different influences on the learning mechanisms that PTSD treatments, such as prolonged exposure therapy, depend upon. Thus, a more detailed assessment of subtypes of sleep dysfunction may be useful to include in future research.

The present study investigated the relations between changes in sleep disturbance and PTSD and MDD symptoms during the course of PE for PTSD. Greater residual sleep disruptions were predictive of smaller treatment gains in the symptoms of PTSD and MDD. These findings bridged the gap between previous studies on the relations between sleep and PTSD symptom severity as well as studies on residual sleep symptoms following PTSD treatments. The results may be explained through clinical and basic science understanding of the interactions between sleep and PTSD symptoms during treatment and are consistent with conditioning models of insomnia (Spielman & Glovinsky, 1991). However, fortunately, evidence-based assessments and psychotherapies exist for sleep symptoms/disorder(s) that can be easily delivered with/incorporated into existing PTSD treatment protocols, for potentially improved patient outcomes (Baddeley & Gros, 2013; Spoormaker & Montgomery, 2008; Taylor & Pruiksma, 2014).

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Table 1
Hierarchical Regression Analysis: Sleep Predicting Post-Intervention Depressive Symptoms

Variable	B	SE B	β	p	R ²	R ²
Step 1						.04
Age	.04	.20	.04	.83		
Marital Status	-3.85	3.79	-.20	.32		
Employment status	-.16	4.99	-.01	.96		
Race	.56	2.95	.03	.85		
Step 2					.49***	.45***
Age	.20	.16	.20	.21		
Marital Status	-2.89	2.96	-.15	.34		
Employment status	-1.96	3.77	-.07	.61		
Race	2.34	2.28	.13	.31		
CAPS Baseline Sleep	1.26	.94	.18	.19		
Baseline BDI Score	.95	.18	.71***	<.001		
Step 3					.54***	.06
Age	.27	.17	.27	.12		
Marital Status	-4.33	3.21	-.23	.19		
Employment status	-1.97	3.73	-.07	.60		
Race	1.99	2.35	.11	.40		
CAPS Baseline Sleep	1.13	.93	.16	.23		
Baseline BDI Score	.91	.18	.68***	<.001		
Number of Sessions Completed	-2.12	1.40	-.20	.14		
Treatment condition	-1.10	1.95	-.07	.58		
CPOSS Total Score	-.18	.18	-.13	.33		
Step 4					.60*	.06*
Age	.22	.16	.22	.18		
Marital Status	-2.45	3.12	-.13	.45		
Employment status	-2.98	3.57	-.10	.41		
Race	2.176	2.24	.12	.34		
CAPS Baseline Sleep	.98	.89	.14	.28		

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Variable	B	SE B	β	p	R ²	R ²
Baseline BDI Score	.84	.18	.63***	<.001		
Number of Sessions Completed	−1.95	1.33	−.19	.16		
Treatment condition	−.90	1.86	−.06	.63		
CPOSS Total Score	−.24	.18	−.17	.17		
Residual Change CAPS Base to Post	1.36	.65	.27*	.05		

Note. BDI = Beck's Depression Inventory; CPOSS = Charleston Psychiatric Outpatient Satisfaction Scale

*
p < .05
**
p < .01

p < .001

Table 2
Hierarchical Regression Analysis: Sleep Predicting Post-Intervention PTSD Symptoms

Variable	B	SE B	β	p	R ²	R ²
Step 1					.05	
Age	.19	.26	.15	.48		
Marital Status	-5.43	4.90	-.22	.28		
Employment status	3.51	6.55	.09	.60		
Race	.73	3.83	.03	.85		
Step 2					.37***	.32***
Age	.30	.23	.24	.19		
Marital Status	-4.31	4.27	-.18	.32		
Employment status	1.98	5.51	.05	.72		
Race	-1.30	3.29	-.06	.70		
CAPS Baseline Sleep	.93	1.34	.10	.49		
Baseline PCL Score	1.00	.25	.58***	<.001		
Step 3					.45	.08
Age	.18	.24	.14	.45		
Marital Status	-1.57	4.61	-.07	.74		
Employment status	2.06	5.39	.05	.71		
Race	-.07	3.35	-.003	.98		
CAPS Baseline Sleep	1.06	1.32	.12	.43		
Baseline PCL Score	.90	.25	.52***	<.001		
Number of Sessions Completed	2.23	2.01	.17	.28		
Treatment condition	-3.89	2.80	-.20	.17		
CPOSS Total Score	-.38	.26	-.21	.16		
Step 4					.52*	.07*
Age	.12	.23	.09	.60		
Marital Status	1.18	4.58	.05	.80		
Employment status	.20	5.20	.01	.97		
Race	.39	3.19	.02	.90		
CAPS Baseline Sleep	.98	1.25	.11	.44		

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Variable	B	SE B	β	p	R ²	R ²
Baseline PCL Score	.82	.24	.48**	.002		
Number of Sessions Completed	2.49	1.92	.19	.20		
Treatment condition	-3.62	2.66	-.19	.19		
CPOSS Total Score	-.46	.25	-.25	.08		
Residual Change CAPS Base to Post	1.92	.93	.29*	.05		

Note. PCL = PTSD Symptom Checklist; CPOSS = Charleston Psychiatric Outpatient Satisfaction Scale

*
 $p < .05$
**
 $p < .01$

 $p < .001$