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A Preliminary Examination of the Effect of Cognitive Processing Therapy on Sleep Disturbance Among Veterans with Military Sexual Trauma-Related Posttraumatic Stress Disorder

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Abstract

Veterans who have experienced military sexual trauma (MST) report numerous psychosocial difficulties including sleep disturbance and posttraumatic stress disorder (PTSD). Cognitive Processing Therapy (CPT) has been shown to effectively reduce total PTSD symptoms among veterans with MST-related PTSD; however, sleep disturbance may persist after successful treatment. Sleep disturbance is associated with suicidal self-directed violence, substance use, and poorer physical health. Identification of if and when CPT can sufficiently address sleep disturbance may help to determine when adjunctive interventions may be indicated. The current study described the rate of sleep disturbance in a sample of veterans with MST-related PTSD before and after CPT. In an exploratory analysis, potential baseline predictors (i.e., sociodemographic, PTSD symptoms, trauma-related cognitions, depression, physical health) of change in sleep disturbance following CPT were assessed. A secondary analysis of 72 male and female veterans enrolled in a randomized clinical trial examining the efficacy of CPT for MST-related PTSD was conducted. Most veterans reported clinically significant sleep disturbance at baseline (100%) and post-treatment (89%). A significant relationship between clinically significant change in PTSD symptoms and resolution of sleep disturbance was not identified. Using hierarchical multiple linear regression, potential predictors of change in sleep severity following CPT were assessed; however, no significant predictors were identified in this exploratory analysis. These results are consistent with previous research describing high residual rates of sleep disturbance in veterans with PTSD, despite reductions in overall PTSD symptoms. Future research should focus on identifying effective augmentation strategies for CPT to specifically address sleep disturbance.

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Keywords

sleep; military sexual trauma; posttraumatic stress disorder; cognitive processing therapy; veterans

Military sexual trauma (MST), defined as "psychological trauma, which… resulted from a physical assault of a sexual nature, battery of a sexual nature, or sexual harassment which occurred [during military service]" (U.S. Code, Title 38 § 1720D), is endorsed by approximately 28% of female veterans and 1.5% of male veterans accessing services at Veterans Affairs Medical Centers (MST Support Team, 2017). Veterans who have experienced MST have a high likelihood of having a working relationship with the perpetrator, and at times this requires the veteran who has experienced MST to rely on the perpetrator for protection in dangerous situations (Surís & Lind, 2008). Further, it may be difficult for a veteran who has experienced MST to distance themselves from the perpetrator due to military requirements, and reporting MST may negatively affect unit cohesion/social support which traditionally buffer against the stressors of military service (Surís & Lind, 2008). Considering these attributes, it is unsurprising that MST is associated with negative psychosocial consequences. Compared to veterans who did not report MST, veterans who reported MST had significantly greater sleep disturbance (Jenkins et al., 2015), as well as increased rates of suicidal self-directed violence (Kimerling, Makin-Byrd, Louzon, Ignacio, & McCarthy, 2016), greater substance use/abuse (Surís & Lind, 2008), and poorer physical health (Surís, Lind, Kashner, & Borman, 2007). Veterans who have experienced MST are also at increased risk for interpersonal violence post-military (Surís, Holliday, Weitlauf, North, & the Veteran Safety Initiative Writing Collaborative, 2013a).

Posttraumatic stress disorder (PTSD) is one of the most commonly studied consequences of MST (Williamson, Holliday, Holder, North, & Surís, 2017), and veterans who have experienced MST have been shown to have greater likelihood of developing PTSD compared to veteran survivors of other sexual traumas (i.e., childhood and civilian sexual assault; Surís, Lind, Kashner, Borman, & Petty, 2004) as well as combat trauma (Kang, Dalager, Mahan, & Ishii, 2005). Cognitive Processing Therapy (CPT) is an evidence based treatment for PTSD that has consistently been shown to be an effective treatment for both civilian- and military-related PTSD across multiple meta-analyses (Haagen, Smid, Knipscheer, Kleber, & McHugh, 2015; Watts et al., 2013). CPT is also the only treatment that has been specifically validated as an efficacious treatment for veterans with MST-related PTSD (Surís, Link-Malcolm, Chard, Ahn, & North, 2013b), even though effect sizes of CPT in veterans with MST related PTSD may be lower than in veterans with combat-related PTSD (Zalta et al., 2018).

While prior work has been informative, meta-analyses and research trials have largely focused on reductions in overall PTSD symptoms (Haagen et al., 2015; Watts et al., 2013); however, this approach does not consider that all PTSD symptoms may not resolve in a uniform way following treatment. For example, among civilian women with sexual assault-related PTSD, sleep disturbance is a commonly endorsed symptom that frequently does not fully remit following PTSD treatment (Galovski, Monson, Bruce, & Resick, 2009; Gutner, Casement, Gilbert, & Resick, 2013). Similarly, Pruiksma and colleagues (2016) found that

sleep disturbance was frequently endorsed at baseline in a study of active duty service members who primarily experienced combat-related PTSD. Sleep disturbance in their sample persisted following CPT, even among those who benefitted from treatment (Pruiksma et al., 2016). It is particularly important that these symptoms do not improve, as greater sleep disturbance in individuals diagnosed with PTSD is associated with multiple negative consequences including increased rates of suicidal self-directed violence (Malik et al., 2014), greater substance use/abuse (Vandrey, Babson, Herrmann, & Bonn-Miller, 2014), and poorer physical health (Clum, Nishith, & Resick, 2001).

Rates of clinically significant sleep disturbance and the efficacy of CPT in treating sleep disturbance have not yet been studied among veterans with MST-related PTSD. Considering the negative consequences of MST and lower overall treatment effect sizes (Zalta et al., 2018) coupled with the negative psychosocial consequences of sleep disturbance, a better understanding of sleep disturbance among treatment seeking Veterans with MST-related PTSD is needed. Specifically, it is important to describe the rate of sleep disturbance among veterans with MST-related PTSD, to understand if CPT adequately addresses sleep disturbance in this population, and to identify baseline factors that are associated with reduction in sleep disturbance symptoms following CPT for MST-related PTSD.

Many factors that are associated with PTSD have also been studied within the context of sleep disturbance, including PTSD criteria themselves (i.e., re-experiencing, hyperarousal, avoidance symptoms), depression symptoms, and physical health functioning. Re-experiencing symptoms and hyperarousal symptoms (but not avoidance symptoms) were shown to perpetuate sleep disturbance (Babson et al., 2011). Additionally, sleep disturbance was highly correlated with greater depression symptom severity, even after excluding sleep difficulties as a depression symptom (Pigeon, Campbell, Possemato, & Ouimette, 2013). Comorbid major depressive disorder was also associated with fewer improvements in overall PTSD symptom severity following PTSD treatment among veterans (Sripada et al., 2017), potentially influencing changes in sleep disturbance symptoms following treatment. Physical health functioning has been associated with sleep disturbance and was shown to be less likely to improve following PTSD treatment in individuals with sleep complaints (Belleville, Guay, & Marchand, 2011). Importantly, these associations are based on diverse patient populations with PTSD related to a variety of trauma types (e.g., combat trauma, civilian sexual assault, childhood sexual abuse, motor vehicle accidents). This may limit the ability to draw inferences specific to veterans with MST-related PTSD. However, it is possible that the presence or severity of these factors may predict improvements in sleep disturbance following CPT for MST-related PTSD the direct association between these factors and sleep disturbance as well as treatment outcome. In addition, trauma-related negative cognitions (NCs) have been shown to mediate the relationship between combat trauma and sleep disturbance (Dedert et al., in press); however, the relationship between NCs and sleep disturbance has not been assessed in MST-related PTSD. Considering that NCs are a critical treatment target and mechanism of change during CPT for veterans with MST-related PTSD (Holliday, Holder, & Surís, 2018), it is important to investigate the effects of NCs on improvement in sleep disturbance specifically.

The current study had three aims. The first aim was to identify the rate of sleep disturbance in a sample of veterans with MST-related PTSD. The second aim was to assess the degree to which sleep disturbance persisted following CPT for MST-related PTSD, even among individuals who responded to treatment. The final aim was an exploratory investigation of whether specific factors measured prior to treatment (i.e., sociodemographic factors, PTSD related hyperarousal truncated, PTSD related re-experiencing, PTSD related avoidance, depression symptom severity truncated, NCs, and physical health functioning) predicted change in sleep disturbance from pre- to post-CPT treatment.

Method

Participants

The current study was a secondary analysis of data collected during a randomized clinical trial (RCT) examining the efficacy of CPT in treating MST-related PTSD (Surís et al., 2013b). Veterans were recruited from a large, southwestern Veterans Affairs Medical Center between 2007 and 2010 via posted advertisements, recruitment letters, and clinician referral. Inclusion criteria were: 1) veteran with a diagnosis of MST-related PTSD; 2) MST that occurred at least 3 months before baseline assessment; 3) at least one clear memory of the MST; and 4) psychiatric medication stability (i.e., unchanged in the 6 weeks before baseline assessment). Exclusion criteria were: 1) substance dependence/abuse in the 3 months before baseline assessment; 2) current psychotic symptoms; 3) unstable bipolar disorder; 4) severe cognitive impairment; 5) concurrent enrollment in a psychotherapy for PTSD; 6) involvement in a violent intimate partner relationship; and/or 7) suicidal/homicidal intent warranting immediate intervention. The study was approved by the local Institutional Review Board, and each veteran provided informed consent before participation. Of the veterans enrolled in the original RCT (n = 161), 32 veterans were excluded due to not meeting inclusion/exclusion criteria. Of the randomized veterans (n = 129), 57 male and female veterans were randomly assigned to receive Present Centered Therapy (PCT) and were therefore excluded from the current analysis which focused on veterans who received CPT. The final sample used for data analysis in the current study included 72 male and female veterans who were randomized to receive CPT. Due to attrition which is common in PTSD trials (Imel, Laska, Jakupcak, & Simpson, 2013), sample size for individual analyses varied between 40 and 72 participants.

Measures

Additionally, a sociodemographic questionnaire was used to assess age, education, gender, and racial-ethnic self-identification. Both age and education were measured continuously (i.e., years of age and years of education). Gender and racial-ethnic self-identification were measured categorically. Veterans were able to endorse multiple race/ethnicity categories or write-in another race/ethnicity that was not represented; however, to generate sufficient cell sizes, veterans were categorized based on the three largest race/ethnicity categories: Black, non-Hispanic; White, non-Hispanic; and veterans of other racial-ethnic self-identifications.

PTSD diagnosis was established with the Clinician Administered PTSD Scale (CAPS; Blake et al., 1995), a 30-item semi-structured interview that is used to assess the frequency and

intensity of DSM-IV-TR (American Psychiatric Association, 2000) criteria for PTSD. The CAPS has strong inter-rater reliability and strong concurrent validity to other measures of PTSD (Weathers, Keane, & Davidson, 2001). PTSD symptom severity was assessed using the PTSD checklist (PCL; Weathers, Litz, Herman, Huska, & Keane, 1993), a 17 item self-report measure that assesses a patient's perceived intensity of each of the DSM-IV-TR (American Psychiatric Association, 2000) PTSD symptoms. The psychometric reliability and validity of the PCL has been shown across a variety of versions and populations (Wilkins, Lang, & Norman, 2011). Since the PCL includes items to reflect all of the DSM-IV-TR criteria, the scale can be subdivided to reflect symptom criteria scores (i.e., re-experiencing, avoidance, and hyperarousal). When the PCL is utilized in this way, internal consistency has been shown to be good to excellent (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996). For the present study, the sleep item was removed from the hyperarousal symptom criteria (i.e., hyperarousal-truncated) to prevent overlap in symptoms (Hughes, Jouldjian, Washington, Alessi, & Martin, 2013).

The Quick Inventory of Depressive Symptomatology-Self Report 16 item Version (QIDS-SR_{16}) was used to assess self-reported symptoms of depression as well as presence and severity of sleep disturbance (Rush et al., 2003). The QIDS-SR_{16} is a 16-item self-report measure that assesses how much a participant endorses each of the DSM-IV-TR (American Psychiatric Association, 2000) symptoms of depression. Scores of the total QIDS-SR_{16} range from 0–27, with higher scores indicating higher depressive symptom severity. The QIDS-SR_{16} has strong concurrent validity to measures of depression symptomatology and strong internal consistency (Cameron et al., 2013; Reilly et al., 2015), and has been validated for use in veterans with military-related PTSD (Surís, Holder, Holliday, & Clem, 2016). When used as a measure of depression in the current study, the QIDS-SR_{16} was truncated by removing the sleep items (i.e., QIDS-SR_{16} truncated) as is common in research of constructs with overlap (Swanson, Flynn, Adams-Mundy, Armitage, & Arnedt, 2013). As a measure of sleep disturbance in the current study, only the three QIDS-SR_{16} sleep items which correspond to difficulty with falling or staying asleep and waking too early were utilized. Consistent with methodology by Soehner, Kaplan, & Harvey (2014), sleep disturbance was considered clinically significant and present if a veteran endorsed any one of the following criteria (1) QIDS-SR_{16} item 1: > 2; (2) QIDS-SR_{16} item 2: = 3; or (3) QIDS-SR_{16} item 3: > 1. Severity of sleep disturbance was calculated by summing the first three items of the measure, with scores ranging from 0–9 and higher scores indicating greater sleep disturbance. As a measure of sleep disturbance severity, the QIDS-SR_{16} shows strong convergent validity with sleep efficiency as calculated using a sleep diary (Manber et al., 2005).

The 36-item Short-Form Health Survey (SF-36) was used to assess physical health functioning (Ware, Snow, Kosinski, & Gandek, 1993). The SF-36 is a self-report measure that generates scores for eight domains to develop two composite scores, the Mental Health and Physical Health Composite Scores. For the present study, only the Physical Health Composite Score (PCS) was utilized, which measures physical functioning, physical role functioning, bodily pain, and general health (Ware et al., 1993). While question anchors and scoring varies based on the domain assessed, higher scores on the SF-36 indicate greater functioning. The domains which generate the PCS score have been shown to have good to

excellent internal consistency, strong test-retest reliability at two weeks, and strong construct validity (Brazier et al., 1992).

The Posttraumatic Cognitions Inventory (PTCI) was used to assess NCs (Foa, Ehlers, Clark, Tolin, & Orsillo, 1999). The PTCI is a self-report measure that assesses for NCs related to self, self-blame, and the world, with higher scores indicating more problematic NCs. The PTCI total score has demonstrated excellent internal consistency and strong convergent and discriminant validity in a sample of veterans, including veterans who have experienced MST (Sexton, Davis, Bennett, & Morris, 2018).

Procedure

Participants were randomized to treatment condition (i.e., CPT or PCT) following a baseline assessment that included administration of the CAPS, QIDS-SR_{16}, PCL, SF-36, PTCI, a sociodemographic form, and additional study measures which were not utilized in the current study. Data from the QIDS-SR_{16} and PCL administered at 1 week post-treatment were also used for the current study. The version of CPT utilized in the RCT consisted of 12 1-hour weekly, individual psychotherapy sessions and included a written trauma account, a version of CPT now referred to as “CPT+A” (Resick, Monson, & Chard, 2017). For additional details regarding study procedures and assessment measures administered, see Surís and colleagues (2013b).

Methodology by Schnurr and colleagues (2007) was used for supervision and fidelity monitoring procedures, with fidelity criteria defined by Monson and Price (2003). Therapists were trained to provide CPT by treatment experts, and received weekly, in-person, group supervision. As detailed in Holder, Holliday, Williams, Mullen, & Surís (2018), significant differences between therapist fidelity to the CPT protocol were observed in the psychotherapy RCT, such that veterans treated by therapists with “good” fidelity experienced greater symptom reduction compared to veterans treated by therapists with “below average” treatment fidelity. For the purpose of the present study, veterans were assigned to fidelity condition (i.e., “Good” and “Below Average”) based on the procedure of Holder and colleagues (2018).

Analytic Plan

Rate of clinically significant sleep disturbance and sleep disturbance severity were calculated using descriptive statistics at both baseline and posttreatment. Change in symptom severity was calculated from pre- to post-treatment using a paired-samples *t*-test. In addition, frequency of clinically significant sleep disturbance at 1 week post-treatment was compared between veterans who did and did not have clinically significant improvement in PTSD symptom severity (i.e., reduction in PCL score of 12 or greater; Steenkamp, Litz, Hoge, & Marmar, 2015) using a Fisher’s Exact Test due to limited cell size. Finally, severity of sleep disturbance (i.e., sum of QIDS-SR_{16} items 1–3) at post-treatment was compared between veterans who did and did not experience clinically significant improvement using an independent samples *t*-test.

In an exploratory analysis to identify predictors of change in sleep disturbance from pre- to post-treatment, a hierarchical multiple linear regression analysis was conducted. Guidelines

by Tabachnick and Fidell (2013) were utilized, as appropriate, to ensure that assumptions (i.e., normality, linearity, homoscedasticity, independence of errors, multicollinearity) of multiple linear regression were met. Change in QIDS-SR_{16} sleep disturbance score from baseline to 1 week posttreatment was entered as the criterion variable. The first block consisted of simultaneously entered demographic variables (i.e., age, education, gender, racial-ethnic self-identification), and the second block included predictor variables (i.e., PCL hyperarousal-truncated, PCL re-experiencing, PCL avoidance, QIDS-SR_{16}-truncated, PCS, PTCI, and psychotherapist fidelity group) entered in a stepwise fashion.

Results

Sociodemographic characteristics of the full sample and the sample that completed post-treatment follow-up are presented in Table 1. Using Fisher's Exact Test, a relationship between gender and completion of post-treatment follow-up was found ($p = .025$) such that male participants were more likely than female participants to complete the post-treatment follow-up. No other significant differences in any sociodemographic characteristics were observed between participants who did and did not complete post-treatment follow-up.

At baseline 100% ($n = 72$) of veterans in the CPT sample endorsed clinically significant sleep disturbance using criteria established by Soehner and colleagues (2014), with high severity of sleep disturbance ($M = 7.01$; $SD = 1.89$). At posttreatment, sleep disturbance data was available for 45 veterans. No significant differences in severity of sleep disturbance were observed at baseline between participants who did and did not complete post-treatment follow-up $t(70) = .336$, $p = .738$. Among veterans who completed the post-treatment follow-up, 11% ($n = 5$) no longer met criteria for clinically significant sleep disturbance after treatment. Significant improvement in sleep disturbance was observed from pre- ($M = 6.96$; $SD = 1.80$) to post-treatment ($M = 5.24$; $SD = 2.62$) using a paired samples t-test, $t(44) = 4.10$, $p < .001$, $d = 0.61$.

Among participants with available sleep severity data at post-treatment follow-up, two did not complete the PCL, resulting in a sample of 43 participants who had PTSD and sleep disturbance data available at follow-up. Of this sample, 55.8% ($n = 24$) experienced clinically significant change in PTSD symptom severity as measured by the PCL. A two-sided Fisher's Exact Test was utilized to identify relationships between clinically significant improvement in PTSD symptom severity and resolution of sleep disturbance, with no significant relationship observed ($p = 0.363$). Veterans who did experience clinically significant improvement in PTSD symptoms experienced significantly fewer sleep disturbance symptoms ($M = 4.46$; $SD = 2.32$) compared to those who did not experience clinically significant change in PTSD symptoms ($M = 6.11$; $SD = 2.75$), as assessed by an independent samples t-test, $t(41) = 2.13$; $p = .039$, $d = 0.65$.

Of the 45 participants who completed post-treatment follow-up, complete data for the exploratory hierarchical multiple regression analysis were available for 40 veterans. Descriptive statistics for the predictor variables are in included in Table 2. The Durbin-Watson statistic for the model was 2.00, indicating independence of errors (Tabachnick & Fidell, 2013). Finally, multicollinearity was not observed using standard cutoffs (Tol < .2;

VIF > 10; Tabachnick & Fidell, 2013). Simultaneous entry of sociodemographic factors (i.e., block 1) did not significantly predict change in severity of sleep disturbance $F(5, 34) = 1.12$, $p = .368$. Further, none of the predictor variables significantly improved the model when entered in a stepwise fashion (i.e., block 2). In the final model, none of the included variables significantly predicted change in severity of sleep disturbance from pre- to post-treatment ($p > .05$; see Table 3).

Discussion

Consistent with previous research in civilians and veterans (Galovski et al., 2009; Gutner et al., 2013; Pruiksma et al., 2016), clinically significant sleep disturbance was prominent in our sample of veterans diagnosed with MST-related PTSD, affecting 100% of the sample at baseline. The rates of clinically significant sleep disturbance before treatment appeared to be higher in this sample of veterans with MST-related PTSD compared to a sample of active duty military personnel with primarily combat-related PTSD (Pruiksma et al., 2016). These findings appear to be consistent with existing research indicating that rate and severity of sleep disturbance among veterans who have experienced MST compared to veterans without MST (Jenkins et al., 2015), as well as existing research that has consistently described greater severity of a variety of psychosocial symptoms among veterans who have experienced MST (Surís & Lind, 2008).

Also consistent with previous research (Galovski et al., 2009; Gutner et al., 2013; Pruiksma et al., 2016), clinically significant sleep disturbance remained prevalent at post-treatment despite significant change in severity of PTSD symptoms from pre- to post-treatment. Veterans who experienced clinically significant change in PTSD symptom severity experienced greater change in sleep disturbance severity; however, there was not a statistically significant relationship between clinically significant change in PTSD symptoms and reduction in clinically significant sleep disturbance. While CPT may be effective in reducing total PTSD symptom severity and result in modest improvements in sleep disturbance, CPT may not reduce sleep disturbance below clinical significance. This may be particularly important for veterans with MST-related PTSD, considering this population may have poorer overall treatment outcomes compared to veterans with other trauma types (Zalta et al., 2018).

In an exploratory analysis of predictors of change in sleep disturbance symptoms, none of the hypothesized psychosocial predictors of change in severity of sleep disturbance (i.e., PTSD symptom criteria severity, depression, NCs, physical health symptoms) were significant. This may suggest that reduction in severity of sleep disturbance following CPT is an idiosyncratic, patient-specific response; is the result of a variable that was not assessed as part of this RCT; or is the result of a variable that has not yet been identified as influencing sleep disturbance. Consistent predictors of symptom improvement have been difficult to identify following Cognitive Behavioral Therapy for Insomnia (CBTi), one of the most effective interventions for insomnia (Qaseem et al., 2016). Greater perception of physical health has also been shown to predict greater improvement in insomnia after CBTi (Van Houdenhove, Buyse, Gabriels, & Van den Bergh, 2011), inconsistent with the present study. However, perceived physical health was considerably worse in the present sample

compared to the study by Van Houdenhove and colleagues (2011). The severity of physical health concerns in the current sample is consistent with literature that describes poorer physical health among veterans who have experienced MST (Surís et al., 2007). Dysfunctional beliefs about sleep, a factor that is not commonly assessed in PTSD treatment, have also been shown to predict improvement in sleep following CBTi (Espie, Inglis, & Harvey, 2001). These beliefs may represent a predictor of improvement in PTSD-related sleep disturbance that remains understudied. Considering the difficulty in identifying predictors of improvement in sleep symptoms following treatment of both primary insomnia and in this preliminary investigation, novel predictors (e.g., genetic factors) other than commonly assessed psychosocial factors warrant additional investigation.

The relationship between sleep disturbance and PTSD is multifaceted. Some evidence suggests that biological/physiological effects of PTSD enhances sleep disturbance (e.g., rapid eye movement-related dysfunction, abnormal noradrenergic activity), while other evidence supports the effect of sleep-related anxiety (e.g., safety related sleep fears, fear of nightmares) on sleep disturbance in individuals diagnosed with PTSD (Lamarche & De Koninck, 2007). Further, there is debate among researchers as to whether sleep disturbance predisposes an individual to PTSD or PTSD results in sleep disturbance (Germain, 2013; Lamarche & De Koninck, 2007). The complex relationship between sleep disturbance and PTSD suggests that sleep disturbance may not be best understood as a uniform PTSD-specific symptom. Harvey (2001) argues that considering sleep disturbance to be “secondary” or a “symptom” negatively affects patient outcomes. For some patients, sleep disturbance may be better conceptualized as a comorbidity than as a symptom of PTSD, considering that effective intervention for PTSD has not been shown to consistently or substantially improve sleep disturbance in this and other studies (Galovski et al., 2009; Gutner et al., 2013; Pruiksma et al., 2016) and that sleep disturbance may precede development of PTSD. Existing research suggests that adjunctive interventions may be required to adequately address PTSD-related sleep disturbance. Hypnosis has been studied asone potential adjunctive intervention to improve PTSD-related sleep disturbance, with initial support for this adjunctive intervention (Galovski, Harik, Blain, & Elwood, 2016). Additional clinical trials are also in progress investigating sequencing CBTi with CPT (Pigeon et al., 2013).

Despite the strengths of the current study, there are several limitations. First, the sample size for some statistical analyses was limited due to drop-out in the parent RCT, as is typical in PTSD psychotherapy RCTs (Imel et al., 2013). Per guidelines by Austin and Steyerberg (2015), sample size in the exploratory regression analysis was sufficient to minimize statistical bias in regression coefficients and standard errors; however, a larger and more diverse (e.g., racial-ethnic self-identification, gender) sample would be useful to increase statistical power, confirm findings, and increase generalizability. With a larger sample, it may be beneficial to stratify analyses based on sociodemographic or other characteristics (e.g., gender) to identify whether effects vary by subgroups. Restricted range (i.e., few veterans experiencing change in sleep disturbance) may have also affected the ability to detect significant predictors of change in the exploratory analysis. Additionally, as this was a secondary analysis of a larger RCT, the potential predictors of change were limited by measures included in the original RCT. While the predictors included in this study have

established relationships to sleep disturbance and represent those that are typically assessed in individuals who have experienced trauma, it is possible that other factors that were not included would predict change in sleep disturbance (e.g., dysfunctional beliefs about sleep). The sleep disturbance assessed in our study may have resulted from pre-existing insomnia, and CPT may be less effective in treating insomnia that is not trauma-related. Therefore, future research should aim to distinguish trauma-related and non-trauma-related sleep disturbance, and identify whether trauma-focused treatments may be more effective in treating sleep disturbance that is more strongly related to PTSD. Finally, the measure utilized to assess sleep disturbance (i.e., QIDS-SR_{16}) was not designed to measure sleep disturbance. Despite this, the QIDS-SR_{16} has been validated as a measure of sleep disturbance with similar performance to standard measures of sleep disturbance (i.e., sleep diaries).

The present study was the first to describe the rate of sleep disturbance among veterans with MST-related PTSD before and after an evidence-based treatment for PTSD (i.e., CPT). Rates of sleep disturbance were high in our sample and remained high following treatment. Further, hypothesized predictors of change in sleep disturbance were non-significant in an exploratory analysis. In the context of growing evidence that evidence-based treatments for PTSD do not resolve sleep disturbance alone, researchers, clinicians and patients should be aware that adjunctive sleep treatments may be required for optimal treatment outcomes, and particularly for veterans with MST-related PTSD. Further, sleep disturbance may not be best understood as a uniform symptom. Distinction between trauma-related sleep disturbance and comorbid (potentially pre-existing) sleep disturbance may be important for identifying individuals that will require adjunctive interventions. Future research should focus on effectively augmenting traditional PTSD EBTs with interventions to specifically target and address sleep disturbance.

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Table 1

Baseline Characteristics of the Sample

Variable	Completed Post-treatment Follow-up (*n* = 45)		Did Not Complete Post-treatment Follow-up (*n* = 27)		Full Sample (*N* = 72)	
	M	***SD***	***M***	***SD***	***M***	***SD***
Age	46.53	9.08	43.63	11.09	45.44	9.91
Years education	14.51	1.96	13.74	2.01	14.22	2.00
Severity of Sleep Disturbance[a]	6.96	1.80	7.11	2.06	7.01	1.89
	n	**%**	***n***	**%**	***n***	**%**
Racial-Ethnic Self-Identification						
White, non-Hispanic	18	40.00	12	44.44	30	41.67
Black, non-Hispanic	17	37.78	11	40.74	28	38.89
Other Racial-Ethnic Self-Identification	10	22.22	4	14.81	14	19.44
Gender						
Female	34	75.55	26	96.29	60	83.33
Male	11	24.44	1	3.70	12	16.67
Clinically Significant Sleep Disturbance[b]						
Yes	45	100.00	27	100.00	72	100.00
No	0	0.00	0	0.00	0	0.00

[a]Severity of Sleep Disturbance calculated by summing the first three items of the Quick Inventory of Depressive Symptomatology, Self-report Version.

[b]Clinically Significant Sleep Disturbance identified using methodology by Soehner and colleagues (2014).

Table 2

Hypothesized Predictors of Improvement in Sleep Disturbance at Baseline

Variable	*M*	*SD*
PCL - Avoidance	26.90	4.82
PCL - Hyperarousal Truncated	16.23	3.27
PCL - Re-experiencing	19.63	4.61
PCS	37.15	10.50
PTCI	148.83	33.31
QIDS-SR_{16} Truncated	13.70	4.86
	n	**%**
Psychotherapist Fidelity		
“Good”	17	42.50
“Below Average”	23	57.50

Note. PCL = Posttraumatic Stress Disorder Checklist; PCS = Physical Health Composite of the Short-Form Health Survey; PTCI = Posttraumatic Cognitions Inventory; QIDS-SR_{16} = Quick Inventory of Depressive Symptomatology, Self-Report Version.

Table 3

Predictors of Improvement in Sleep Disturbance

Block 1 (Simultaneous Entry)	***b***	***SE***	***β***	***P***
Age	−0.08	0.05	−0.25	.143
Gender	0.24	1.15	0.04	.833
Education	0.06	.281	0.04	.831
Black, Non-Hispanic	−2.44	1.24	−0.41	.058
White Non-Hispanic	−2.02	1.25	−0.35	.116
Block 2 (Excluded after Stepwise Entry)				***P***
Psychotherapist Fidelity				.507
PCL - Avoidance				.622
PCL - Hyperarousal Truncated				.479
PCL - Re-experiencing				.491
PCS				.243
PTCI Total Score				.962
$QIDS\text{-}SR_{16}$ Truncated				.695

Note. PCL = Posttraumatic Stress Disorder Checklist; PCS = Physical Health Composite of the Short-Form Health Survey; PTCI = Posttraumatic Cognitions Inventory; $QIDS\text{-}SR_{16}$ = Quick Inventory of Depressive Symptomatology, Self-Report Version.