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Benefits of Cognitive Behavioral Therapy for Insomnia for Women Veterans with and without Probable PTSD

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Abstract

Objective: This study compared the benefits of Cognitive Behavioral Therapy for Insomnia (CBT-I) for sleep, mental health symptoms, and quality of life (QoL) in a sample of women veterans with and without probable posttraumatic stress disorder (PTSD) comorbid with insomnia disorder.

Methods: Seventy-three women veterans (30 with probable PTSD) received a manual-based 5-week CBT-I treatment as part of a behavioral sleep intervention study. Measures were completed at baseline, posttreatment, and 3-month follow-up. Sleep measures included the Insomnia Severity Index (ISI), Pittsburgh Sleep Quality Index (PSQI), sleep efficiency measured by actigraphy, and sleep efficiency and total sleep time (TST) measured by sleep diary. Mental health measures included the PTSD Checklist-5 (PCL-5), nightmares per week, Patient Health Questionnaire-9 (PHQ-9), and Generalized Anxiety Disorder-7 (GAD-7) scale. QoL was measured with the Short Form-12 (SF-12). Linear mixed models compared changes over time across groups. Independent *t*-tests examined PTSD symptom changes in women veterans with probable PTSD.

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Results: Both groups demonstrated improvements across sleep (*ps*<0.001-0.04), mental health symptoms (*ps*<0.001), and QoL measures (*ps*<0.001). The probable PTSD group reported greater improvements in diary sleep efficiency (*p*=0.046) and nightmares per week (*p*=0.001) at post-treatment and in TST (*p*=0.029) and nightmares per week (*p*=0.006) at follow-up. Most participants with probable PTSD experienced clinically significant reductions in PTSD symptoms at post-treatment (66.7%) and follow-up (60.0%). Significant reductions in intrusive and arousal/reactivity symptoms were maintained at follow-up.

Conclusions: CBT-I improves insomnia, mental health symptoms and QoL among women veterans, with greater improvement in those with probable PTSD.

Keywords

insomnia; CBT-I; women; veterans; PTSD

Introduction

Cognitive Behavioral Therapy for Insomnia (CBT-I) is the recommended first-line treatment for insomnia disorder, including among individuals with comorbid psychiatric conditions (Edinger et al., 2020; Mysliwiec et al., 2020; Qaseem, Kansagara, Forciea, Cooke, & Denberg, 2016; Wu, Appleman, Salazar, & Ong, 2015). Studies have examined the impact of CBT-I in veterans with posttraumatic stress disorder (PTSD), and the results support the efficacy of CBT-I for improving sleep and mental health symptoms (DeViva et al., 2018; Gellis & Gehrman, 2011; Talbot et al., 2014). However, with the exception of Talbot et al. (2014), these studies included predominantly male patients. No studies have examined the impact of CBT-I on sleep and mental health symptoms in a sample of exclusively women veterans.

Women veterans with insomnia symptoms linked to a traumatic event demonstrate more severe insomnia and mental health symptoms and go without insomnia treatment longer than women veterans who experience insomnia that is not linked to trauma (Carlson et al., 2020). Given these differences between men and women veterans, it is not clear whether findings from previous CBT-I intervention studies can be generalized from men veterans to women veterans.

A quarter of women veterans receiving Veterans Affairs (VA) healthcare meet diagnostic criteria for both insomnia disorder and PTSD (Hughes, Jouldjian, Washington, Alessi, & Martin, 2013; Martin et al., 2017), with poor sleep being one of the most commonly reported symptoms associated with PTSD. Furthermore, PTSD treatment does not often result in insomnia remission, (Zayfert & DeViva, 2004), yet mental health symptoms, particularly depression symptoms (Tsuno, Besset, & Ritchie, 2005; Wagley, Rybarczyk, Nay, Danish, & Lund, 2013), do improve following engagement in CBT-I. Research suggests that insomnia is a risk factor for PTSD development and severity (Miller, Brownlow, & Gehrman, 2020). CBT-I may reduce PTSD symptoms, similar to CBT-I's secondary impact on depression symptoms Wagley et al., 2013); however, this has not been evaluated in women veterans.

This paper reports secondary analysis of participants who received CBT-I within a behavioral sleep intervention trial for women veterans. The primary goals of the current analyses were to: 1) compare changes in sleep from pre- to post-treatment and 3-month follow-up among women veterans with and without probable PTSD, 2) compare changes in other mental health symptoms and QoL from pre- to post-treatment and 3-month follow-up among women veterans with and without probable PTSD, and 3), examine changes in PTSD symptoms from pre- to post-treatment and 3-month follow-up among women veterans with probable PTSD. We hypothesized there would be significant improvement in sleep, mental health and QoL measures from pre- to post-treatment and 3-month follow-up among women veterans with and without probable PTSD. We also hypothesized there would be significant improvement in PTSD symptoms from pre- to post-treatment and 3-month follow-up among women veterans with probable PTSD.

Methods

Recruitment and Participants

The current study is a secondary data analysis of 73 women veterans assigned to the CBT-I arm of a behavioral sleep intervention trial (NCT02076165). The sample for that study was drawn from the population of women veterans who receive care at one large urban VA healthcare system. Women veterans were recruited through a three-step process. Women veterans with insomnia symptoms were identified using a postal survey (sent to women veterans registered with the healthcare system), a telephone screen, and a baseline assessment. Exclusion criteria included: those who self-described as too ill to participate, did not have access to transportation to the medical center, were unable to provide self-consent for participation, or were without stable housing. All other women veterans who endorsed insomnia symptoms, defined as one or more symptoms of poor sleep and daytime consequences at least three times per week, were invited to enroll in the study, and those meeting diagnostic criteria for insomnia disorder were randomized to one of the two study interventions. The diagnosis of insomnia disorder was based on Diagnostic and Statistical Manual of Mental Disorders 5th Edition (DSM-5; American Psychiatric Association, 2013) criteria using a medical chart review and information collected during the baseline assessment (see Measures section; e.g., sleep diary, Insomnia Severity Index). Diagnosis was confirmed by both a psychologist specializing in behavioral sleep medicine and board-certified sleep medicine physician.

Procedure

The study was approved by the Institutional Review Board at VA Greater Los Angeles Healthcare System. Participants completed a 9-day baseline assessment consisting of three visits to the study site. Written informed consent was obtained and all of the questionnaires were administered in an interview format to minimize cognitive burden and accommodate sensory/physical limitations. Participants were presented visual response options pertaining to each item as the item was read aloud. Not all research staff who administered questionnaires were clinicians; however, the measure of PTSD symptoms (see below) was always administered by a psychologist or social worker on the research study team. Between Visits 1 and 2, participants completed overnight home sleep apnea testing

with the WatchPAT device (Itamar Medical, Inc.). Women with moderate-severe sleep apnea (defined as AHI ≥30 or AHI ≥15 with daytime sleepiness) were excluded and referred for treatment. Between visits 2 and 3, participants wore a wrist actigraph (described below) and completed a daily sleep diary at home for one week. Participants who completed the baseline assessment and met all inclusion/exclusion criteria were randomly assigned to CBT-I (n=75) or a novel Acceptance Commitment Therapy (ACT)-based Insomnia Treatment (n=74; not reported in the current manuscript). Randomization procedures followed the CONSORT criteria for randomized trials (Schulz, Altman, & Moher, 2010).

The CBT-I program included 5 weekly 60-minute sessions with a clinical psychologist trained to deliver the study intervention. Sessions incorporated the key components of CBT-I: sleep restriction, stimulus control, cognitive therapy exercises, targeted sleep hygiene recommendations, and relaxation strategies (see Figure 1). Fidelity ratings based on 10% of the CBT-I session recordings showed high adherence to the treatment protocol (97.5%).

At the end of the final treatment session, participants wore the wrist actigraph, completed the sleep diary for one week, and repeated select measures from the baseline assessment (post-treatment visit). Three months after the last treatment session, participants again wore the wrist actigraph, kept a sleep diary, and repeated select measures from the baseline assessment (3-month follow-up visit).

Measures

Sociodemographic variables.—Age (years) was calculated using each participant's consent date minus birth date. Participants reported their race/ethnicity, years of education, annual household income, sexual orientation, relationship status, and employment status (see Table 1).

PTSD symptoms.—Participants were administered the PTSD Checklist for the DSM-5 (PCL-5) and the Life Events Checklist (LEC-5) for the DSM-5 (Weathers et al., 2013a). The PCL-5 is a 20-item self-report measure of PTSD symptoms (Bovin et al., 2016) administered by a study clinician. Individual items were summed to calculate a total score (range 0-80, higher scores indicate greater severity of PTSD symptoms). The PCL-5 contains 4 subscales that correspond to DSM-5 PTSD symptom clusters: intrusive symptoms (Criterion B), avoidance symptoms (Criterion C), negative changes in cognition and mood (Criterion D), and changes in arousal and reactivity (Criterion E; American Psychiatric Association, 2013). The PCL-5 has demonstrated strong internal reliability (α=0.94), test-retest reliability (r=0.82), and convergent validity (r's=0.74 to 0.85) (Blevins, Weathers, Davis, Witte, & Domino, 2015). A cutoff score of ≥33 is indicative of clinically significant PTSD symptoms. In the current study, participants who endorsed a Criterion A event on the LEC-5 and had a baseline total PCL-5 score of ≥33 were categorized as having probable PTSD (n=30) and participants with either no Criterion A event or a Criterion A event with a baseline total PCL-5 ≤32 were categorized has not having PTSD (n=43). Based on the recommended definition of treatment response by the VA's National Center for PTSD (National Center for PTSD, n. d.), we used a reduction in PCL-5 score of ≥10 points to define clinically meaningful change (Weathers et al., 2013b).

Insomnia.—The Insomnia Severity Index (ISI) (Bastien, Vallières, & Morin, 2001) is a 7-item instrument using Likert-type scales that measure perceived severity of insomnia symptoms from 0 (not at all) to 4 (very much). Individual items are summed to calculate a total score for each participant (range 0-28, higher scores indicate greater insomnia severity). The ISI correlates well with scores on the Pittsburg Sleep Quality Index (r=0.67) and with sleep diary measures (r's=0.32-0.91) (Bastien et al., 2001).

Sleep quality.—The Pittsburgh Sleep Quality Index (PSQI) is a widely used 18-item questionnaire that assesses sleep quality and sleep disturbances over the last month (Buysse, Reynolds III, Monk, Berman, & Kupfer, 1989). Given the short duration of the study intervention (5 weeks), we used a 1-week time frame for the PSQI. Subscale scores are calculated from individual items, then summed to calculate the PSQI global score (range 0-21, higher scores indicate worse sleep quality). PSQI score greater than 5 has a sensitivity for distinguishing between normal and abnormal sleepers of 89.6% and a specificity of 86.5% (kappa=0.75, $P<.001$) (Buysse et al., 1989).

Total sleep time (TST).—Participants completed a one-week sleep diary that was based on the Consensus Sleep Diary (Carney et al., 2012). TST was computed by subtracting awake times (time to fall asleep, time awake during the night, and time awake prior to rising in the morning) from the total time in bed. TST represents the calculated mean number of minutes women veterans slept at night across the week of diary monitoring.

Sleep efficiency.—Diary sleep efficiency was calculated by dividing total sleep time (as described above) by total time in bed (minutes from bedtime to rise time) and converting the quotient to a percentage.

Objective sleep efficiency data was calculated from data collected by a wrist actigraph (Actiwatch 2; Philips/Respironics, Bend, OR), which was worn on the nondominant wrist for 7 consecutive days and nights and measured activity levels in 1-minute epochs. Using standard data cleaning processes (Ancoli-Israel et al., 2015), the daily sleep diary nighttime periods were identified and used to estimate sleep parameters, including sleep efficiency. Automated scoring and default algorithms (medium threshold settings) were used in combination with manual scoring of bedtimes and rise times based on sleep diary values. Philips Respironics Actiware software (v. 6.0.8) calculated sleep efficiency as the percentage of epochs scored as sleep within the bedtime and rise time intervals.

Nightmares per week.—A single item from the Disturbing Dream and Nightmare Severity Index (DDNSI), a 5-item version of the Nightmare Frequency Questionnaire (Krakow et al., 2000; Krakow et al., 2002), was used to assess prior week nightmares (i.e. total number of nightmares in the past 7 nights).

Depression.—The Patient Health Questionnaire-9 (PHQ-9) is a 9-item depression module within the Patient Health Questionnaire, a self-report diagnostic instrument for common mental health disorders (Kroenke, Spitzer, Williams, & Löwe, 2010). Individual items are summed to calculate a total score (range 0-27, higher scores indicate greater depression

symptoms). The PHQ-9 has strong internal consistency (α=0.87) and good convergent and discriminant validity (Beard, Hsu, Rifkin, Busch, & Björgvinsson, 2016).

Anxiety.—The Generalized Anxiety Disorder-7 (GAD-7) scale is a 7-item self-report measure of anxiety symptoms (Spitzer, Kroenke, Williams, & Löwe, 2006). Individual items are summed to calculate a total score (range 0-21, higher scores indicate greater anxiety symptoms). The GAD-7 has strong internal consistency (α=0.89) and construct validity (Löwe et al., 2008).

Quality of life.—The 12-Item Short Form Health Survey (SF-12) is a self-report measure of health-related quality of life (QoL). The SF-12 consists of two subscales: the physical component summary score and the mental component summary score (range for each subscale is 0-100, higher scores indicate better functioning [Ware et al., 1994]). Test-retest reliability is 0.80 for the physical health component score and 0.76 for the mental health component score (Ware Jr, Kosinski, & Keller, 1996).

Data Analysis

Descriptive statistics were computed for sociodemographic variables, sleep measures, mental health measures, and mental and physical QoL at baseline for the total sample, participants with probable PTSD (PCL-5 total score of ≥33 and a history of an index traumatic event), and participants without probable PTSD (PCL-5 total of <33 or no index traumatic event). In the current study, two participants with a PCL-5 total of score ≥33 were removed from the probable PTSD group because these participants declined to briefly describe an event or described an event that did not correspond to any items on the LEC-5. To examine changes from baseline to post-treatment and baseline to 3-month follow-up in women veterans with and without probable PTSD, linear mixed models were conducted to compare changes in sleep efficiency, TST, ISI, PSQI, nightmares per week, PHQ-9, GAD-7, and SF-12. These outcome variables were selected in advance, based on a theoretical link between these metrics and CBT-I outcomes in the context of PTSD.

Among women veterans with probable PTSD, descriptive statistics were calculated to identify the number of women veterans who experienced a decrease of ≥10 points on the PCL-5 and/or remission of symptoms (PCL-5 total <33) from baseline to post-treatment and baseline to 3-month follow-up. Follow-up analyses examined changes in PTSD symptom clusters in women veterans with probable PTSD. Independent *t*-tests were performed to compare change scores on the PCL-5 subscales from baseline to post-treatment and 3-month follow-up. For all comparisons, we used $p<0.05$ to define statistical significance. The analyses were also performed with the sleep items removed from the PHQ-9 (item 3) and the PCL-5 (item 20). No significant differences were observed so, for clarity, here we report the results of the PHQ-9 and the PCL-C with sleep items included. Bivariate correlations were conducted for all outcome variables at baseline (Table S1). See Table S2 for descriptive statistics of outcomes at post-treatment and 3-month follow-up. We computed power to detect a medium-sized effect (Cohen's d=0.50 [Cohen, 1992]; alpha=0.05) for outcome variables. Power to detect a medium-sized effect ranged from 0.56-0.86 at post-treatment and from 0.50-0.82 at 3-month follow-up (Table S3).

Results

Changes in Sleep Measures

Women veterans with and without probable PTSD reported significant improvement in insomnia symptoms (ISI total score) and sleep quality (PSQI total score) at post-treatment and 3-month follow-up (see Table 2). Women veterans with and without probable PTSD reported significant improvements in diary sleep efficiency and TST at post-treatment and 3-month follow-up. Women veterans with probable PTSD reported significantly greater improvements in diary sleep efficiency at post-treatment and TST at 3-month follow-up than those without probable PTSD (see Table 3). Neither women veterans with or without probable PTSD demonstrated significant improvements in objective sleep efficiency (actigraphy) at post-treatment or 3-month follow-up.

Changes in Mental Health Symptoms and QoL

Participants with probable PTSD reported significantly greater reductions in nightmares per week at post-treatment and 3-month follow-up than those without probable PTSD (see Table 3). Women veterans with and without probable PTSD reported significant improvements in depression symptoms (PHQ-9 total score), anxiety symptoms (GAD-7 total score), and mental health QoL (SF-12 mental health component summary) at post-treatment and 3-month follow-up. Neither women with or without probable PTSD symptoms reported significant improvement in physical health QoL (SF-12 physical health component summary) at post-treatment or 3-month follow-up.

Changes in PTSD Symptoms among Women Veterans with Probable PTSD

Among the 30 women veterans with probable PTSD at baseline, 20 (66.7%) reported a clinically significant reduction in PTSD symptoms (≥10-point reduction on PCL-5; see Table 4) and 18 (60.0%) demonstrated PTSD symptom remission (PCL-5 total score <33) at post-treatment, and 17 (56.7%) demonstrated both a clinically significant reduction in and remission of PTSD symptoms at post-treatment.

Among the 26 women veterans with probable PTSD who completed the 3-month follow-up assessment, 16 (61.5%) reported a clinically significant reduction in PTSD symptoms, 16 (61.5%) demonstrated remission of PTSD symptoms, and 15 (57.7%) demonstrated both a clinically significant reduction in and remission of PTSD symptoms at 3-month follow-up. This change was accounted for by significant improvements in intrusive symptoms, avoidance symptoms, negative changes in cognition and mood, and changes in arousal and reactivity at post-treatment. These significant improvements in intrusive symptoms and changes in arousal and reactivity were maintained at 3-month follow-up.

Discussion

We found that women veterans with and without probable PTSD who underwent CBT-I showed improvements in insomnia, sleep quality, and diary sleep efficiency and TST from baseline to post-treatment and 3-month follow-up. This builds on previous studies, showing that CBT-I improves sleep among patients with comorbid psychiatric conditions, including

PTSD (DeViva et al., 2018; Talbot et al., 2014). Our findings show that women veterans with comorbid insomnia and PTSD experience sleep improvements with CBT-I, and while PTSD is sometimes viewed as a potential barrier to achieving benefits from insomnia treatment, in our study, women veterans with probable PTSD experienced significantly greater improvements in diary sleep efficiency at post-treatment and TST at 3-month follow-up compared to women veterans without probable PTSD. Neither women with nor without probable PTSD demonstrated significant improvement in objective sleep efficiency. The discrepancy between subjective and objective sleep efficiency measures has been repeatedly observed across a variety of populations (Campanini et al., 2017; Short, Gradisar, Lack, Wright, & Carskadon, 2012). The finding that women veterans experienced benefits in terms of increased TST is different from many other studies and meta-analytic reviews of CBT-I that do not show increased TST (Wu et al., 2015). The large change in TST in the women with PTSD was also remarkable; the average increase of over one hour is clinically significant and should be replicated in future research.

While improvements in sleep measures were expected, findings also demonstrated the positive impact of CBT-I on mental health symptoms and QoL. Women veterans with probable PTSD reported significant reductions in nightmares per week at post-treatment and 3-month follow-up relative to women veterans without probable PTSD, although nightmares per week was low in women without PTSD at baseline. Reduced nightmares per week may be related to increased total sleep time, as previous studies demonstrate that nightmares are more frequent when patients are sleep deprived (Creamer, Brock, Matsangas, Motamedi, & Mysliwiec, 2018; Tamanna, Parker, Lyons, & Ullah, 2014). We also found significant improvements in anxiety and depression symptoms, which builds on previous studies showing CBT-I improves mood symptoms in people without PTSD (Cunningham & Shapiro, 2018). Women veterans, regardless of probable PTSD status, reported improvements in mental health QoL at post-treatment and 3-month follow-up. These findings are consistent with research demonstrating the benefits of CBT-I on health-related QoL (Van Houdenhove, Buyse, Gabriëls, & Van den Bergh, 2011). It is unclear why improvement in physical health QoL was not observed. Consistent with prior research comparing individuals with high and low levels of PTSD symptoms (Pacella, Hruska, & Delahanty, 2013), we found that women veterans in the probable PTSD group reported poorer physical health QoL compared to those without probable PTSD at baseline; however, we did not observe changes in physical health QoL with CBT-I.

Another aim of the proposed study was to examine the impact of CBT-I on PTSD symptoms. We found that most women veterans with probable PTSD reported clinically significant reductions in PTSD symptoms (≥10 point-reduction on the PCL-5) at post-treatment and 3-month follow-up, suggesting meaningful clinical change. All PTSD symptoms clusters demonstrated significant improvements at post-treatment, but only improvements in intrusive symptoms and changes in arousal and reactivity were maintained at 3-month follow-up. Scheduled worry time (cognitive therapy strategy) and relaxation strategies are utilized in CBT-I (Pigeon, 2010) and may contribute directly to improvements in intrusive thoughts and hyperarousal. Additionally, intrusive symptoms include nightmares, which (as noted above) decreased significantly in women veterans with probable PTSD. The absence of a significant effect on avoidance symptoms at 3-month

follow-up is not entirely unexpected. With the exception of behavioral experiments, CBT-I did not directly target avoidance symptoms. Patients with PTSD may delay falling asleep at night in an effort to avoid nightmares (Aurora et al., 2010). Strategies in CBT-I may be used to limit this tendency; however, the current CBT-I protocol did not specifically target nightmares and there are no strategies in CBT-I that specifically target other PTSD avoidance symptoms. The absence of a significant effect on cognition and mood at 3-month follow-up was unexpected, given the large literature demonstrating the effects of CBT-I on depression symptoms (Cunningham & Shapiro, 2018) and our current finding that PHQ-9 scores decreased at post-treatment and 3-month follow-up.

That being said, it is important to note that CBT-I targets problematic thoughts related to sleep, not problematic thoughts related to trauma, nor does CBT-I include techniques to reduce avoidance such as exposure or behavioral activation. While adaptive responses to sleep-related thoughts may generalize to cognitions more broadly, these techniques may not necessarily impact trauma-specific cognitions. Nevertheless, CBT-I reduced depression and PTSD hyperarousal symptoms. There is clear overlap between these disorders (e.g., concentration difficulties, irritability). Future studies should examine the specific symptom changes that may account for the positive impact of CBT-I in patients with comorbid psychiatric conditions.

Strengths and Limitations

To our knowledge, this was the first study to examine the impact of CBT-I in a sample of exclusively women veterans. This study included an established 5-session CBT-I treatment protocol and a comprehensive assessment battery of well-established measures and methods. While this study possessed multiple strengths, several limitations should be noted. This was a secondary analysis of a larger behavioral sleep intervention study and current findings may not generalize beyond women veterans. Medical record review revealed that 17 participants with probable PTSD had mental health encounters in the year prior to the study. The following year, 10 participants had fewer and 7 had more mental health encounters, suggesting findings are not simply the result of concurrent treatment and/or motivation to engage in treatment. Nevertheless, future studies should examine the impact of concurrent/sequenced treatment engagement on CBT-I outcomes. Information regarding traumatic events and PTSD symptoms was limited to the LEC-5 and PCL-5, which are not sufficient to confirm a diagnosis of PTSD. Thus, we have limited our group description to "probable PTSD." It is possible that the PCL-5 measured general distress in the current study and greater mental health symptom reductions may be partially attributable to range restriction. Regardless, findings demonstrate patients with high distress benefit from CBT-I at least as much as patients with lower distress.

The current study was exploratory in nature and, as such, analyses did not include alpha adjustments for multiple comparisons; therefore, it is possible that chance might explain one particular finding, but chance alone is unlikely to explain the overall pattern of results showing significant benefits across a range of outcomes. Additionally, PCL-5 cutoff scores were examined to demonstrate that changes in PTSD symptoms were clinically important. Future studies should incorporate comprehensive PTSD assessment and explore

the temporal relationships among changes in insomnia and other symptoms and the mechanisms of change that may account for PTSD symptom improvement following CBT-I.

Implications for Clinical Practice

Current findings suggest that probable PTSD should not discourage providers from initiating CBT-I among women veterans with insomnia disorder. Presenting evidence-based treatment options for both PTSD and insomnia and supporting patient preferences is consistent with a shared decision-making approach (Elwyn et al., 2012). Previous research has demonstrated that when veterans are presented with descriptions of evidence-based treatments for PTSD and insomnia, veterans who screen positive for insomnia and PTSD report greater willingness to seek insomnia versus PTSD treatment (Gutner, Pedersen, & Drummond, 2018). There is also a growing body of literature highlighting the importance of trauma-informed care (Machtinger, Cuca, Khanna, Rose, & Kimberg, 2015). While trauma-focused treatments specifically target PTSD symptoms, trauma-informed care involves tailoring existing interventions to meet the unique needs of patients who have experienced trauma (Kelly, Boyd, Valente, & Czekanski, 2014). Current findings suggest avoidance symptoms and trauma-related cognitions may not be adequately addressed by CBT-I. Future research should develop and test trauma-informed enhancements to CBT-I to better meet the needs of patients with comorbid PTSD.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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	Topics covered	Session activities	Homework
Session 1	**Getting Started with CBT-I (sleep education, sleep hygiene and stimulus control)**		
	· Sleep education: sleep regulation, insomnia (3P model), sleep stages and macrostructure · Introduce stimulus control concepts · Lifestyle habits that enhance or hinder sleep · Introduce and explain daily sleep diary	· Discuss classical conditioning and insomnia · Action plan: sleep hygiene changes; stimulus control	· Implement action plan (sleep hygiene practices, stimulus control) · Daily sleep diary
Session 2	**Scheduling Sleep (sleep restriction therapy)**		
	· Learn about the homeostatic and circadian sleep processes · Introduce sleep restriction	· Review/discuss sleep diary · Action plan: daily sleep schedule	· Implement action plan (sleep schedule) · Daily sleep diary
Session 3	**Thoughts about Sleep (cognitive therapy)**		
	· Adjust time in bed · Discuss validity and utility of unhelpful sleep-related thoughts	· Review/discuss sleep diary · Action plan: revise sleep schedule, develop coping cards	· Implement action plan (sleep schedule; coping cards) · Daily sleep diary
Session 4	**CBT-I: Progress and Obstacles (cognitive therapy)**		
	· Adjust time in bed · Review progress and obstacles · Use cognitive strategies to address barriers to adherence	· Review/discuss sleep diary · Addressing barriers and obstacles using cognitive-therapy methods · Action plan: identify obstacles and strategies to address them	· Implement action plan (sleep schedule; strategies to address obstacles) · Daily sleep diary
Session 5	**CBT-I: Sleeping Well Over the Long-Term (relapse prevention)**		
	· Adjust time in bed · Discuss relapse prevention and coping	· Review/discuss sleep diary · Action plan for relapse prevention	· Use tools/skills for future sleepless nights

Figure 1.
Cognitive Behavioral Therapy for Insomnia (CBT-I) Protocol.

Table 1.

Sociodemographic, sleep, and mental health variables at baseline.

	Total Sample M (SD) or *n* (%) *n=73*	Without Probable PTSD Group M (SD) or *n* (%) *n=43*	With Probable PTSD Group M (SD) or *n* (%) *n=30*	*P*
Age (Years)	48.01 (13.46)	50.23 (14.15)	44.83 (11.93)	0.092
Race/Ethnicity †				
Non-Hispanic/Latina White	29 (41.10%)	19 (44.19%)	10 (36.67%)	0.47
Non-Hispanic/Latina Black/African American	26 (36.99%)	15 (34.88%)	11 (40.00%)	1.00
Hispanic/Latina	17 (23.29%)	9 (20.93%)	8 (26.75%)	0.59
Non-Hispanic/Latina American Indian/Alaska Native	0 (0.00%)	0 (0.00%)	0 (0.00%)	-
Non-Hispanic/Latina Asian American or Asian	2 (2.74%)	1 (2.33%)	1 (3.33%)	1.00
Non-Hispanic/Latina Native Hawaiian/Pacific Islander	2 (2.74%)	2 (4.65%)	0 (0.00%)	0.51
Education (Years)	16.42 (2.87)	16.42 (2.75)	16.43 (3.08)	0.98
Income				0.057
<$10,000	4 (5.63%)	4 (9.52%)	0 (0.00%)	
$10,000-20,000	8 (11.27%)	2 (4.76%)	6 (20.69%)	
$20,000-30,000	9 (12.68%)	4 (9.52%)	5 (17.24%)	
$30,000-40,000	9 (12.68%)	3 (7.14%)	6 (20.69%)	
$40,000-50,000	11 (15.59%)	7 (16.67%)	4 (13.79%)	
$50,000-100,000	15 (21.13%)	11 (26.19%)	4 (13.79%)	
>$100,000	15 (21.13%)	11 (26.19%)	4 (13.79%)	
Sexual Orientation				0.14
Heterosexual/Straight	52 (76.47%)	33 (82.50%)	19 (67.86%)	
Gay/Lesbian	14 (20.59%)	7 (17.50%)	7 (25.00%)	
Bisexual	2 (2.94%)	0 (0.00%)	2 (7.14%)	
Relationship Status				0.74
Married	30 (44.12%)	15 (37.50%)	15 (53.57%)	
Divorced	11 (16.18%)	7 (17.50%)	4 (14.29%)	
Separated	4 (5.88%)	3 (7.50%)	1 (3.57%)	
Widowed	2 (2.94%)	1 (2.50%)	1 (3.57%)	
Single/Never Married	21 (30.88%)	14 (35.00%)	7 (25.00%)	
Employment				0.16
Unemployed	34 (46.58%)	17 (39.53%)	17 (56.67%)	
Employed for wages	39 (53.42%)	26 (60.47%)	13 (43.33%)	
Insomnia (ISI Total Score)	14.52 (5.18)	12.56 (4.65)	17.33 (4.61)	<0.001
Sleep Quality (PSQI Total Score)	10.97 (3.85)	9.86 (3.42)	12.57 (3.92)	0.003
Diary Sleep Efficiency (%)	78.00 (13.52)	81.14 (10.82)	73.34 (15.83)	0.015
Diary TST (minutes)	367.49 (81.32	376.28 (70.77)	354.45 (94.67)	0.27
Objective Sleep Efficiency (%)	81.41 (7.18)	82.31 (7.42)	80.12 (6.72)	0.20

	Total Sample M (SD) or *n* (%) *n=73*	**Without Probable PTSD Group M (SD) or *n* (%) *n=43***	**With Probable PTSD Group M (SD) or *n* (%) *n=30***	***P***
Nightmares Per Week	1.88(3.24)	0.81 (1.55)	3.40 (4.31)	<0.001
Depression (PHQ-9 Total Score)	10.12 (5.41)	7.44 (3.94)	13.97 (4.91)	<0.001
Anxiety (GAD-7 Total Score)	10.15 (5.49)	7.72 (4.76)	13.63 (4.55)	<0.001
PTSD (PCL-5 Total Score)	24.41 (20.57)	9.53 (10.64)	45.73 (9.40)	<0.001
Mental QoL (SF-12 Mental)	42.06 (11.34)	46.24 (11.56)	36.07 (7.93)	0.001
Physical QoL (SF-12 Physical)	42.05 (12.87)	45.14 (12.30)	37.63 (12.56)	0.01

Note.

[†]Multiple response options can be selected, and thus percentages do not sum to 100%; ISI=Insomnia Severity Index, PSQI=Pittsburgh Sleep Quality Index, PHQ-9=Patient Health Questionnaire-9, GAD-7=Generalized Anxiety Disorder-7 Scale, PCL-5=PTSD Checklist 5, and SF-12= 12-Item Short Form Health Survey; TST=total sleep time; Lower values indicate poorer sleep efficiency and greater PSQI scores indicate poorer sleep quality; p<0.10 reported as 3 digits after the decimal point, p=0.100-.99 reported as 2 digits after decimal point, and values of .000 and 1.0 reported as <0.001 and >0.99; Valid N varies according to variable, from n=72 to n=73. p values from independent samples t-test for continuous variables; Fisher's exact test for categorical variables.

Table 2.

Analysis of change scores (baseline to post-treatment, and baseline to 3-month follow-up) among those with and without probable PTSD.

	Change (Baseline to Post-Treatment)				Change (Baseline to 3-Month Follow-up)			
	Without Probable PTSD		With Probable PTSD		Without Probable PTSD		With Probable PTSD	
	Mean (95% CI)	p-value	Mean (95% CI)	p-value	Mean (95% CI)	p-value	Mean (95% CI)	p-value
Insomnia (ISI Total Score)	−8.23 (−9.80, −6.66)	<0.001	−10.53 (−12.40, −8.67)	<0.001	−6.81 (−8.90, −4.73)	<0.001	−8.95 (−11.47, −6.44)	<0.001
Sleep Quality (PSQI Total Score)	−5.63 (−6.90, −4.37)	<0.001	−6.37 (−7.86, −4.87)	<0.001	−4.37 (−5.83, −2.90)	<0.001	−4.94 (−6.71, −2.17)	<0.001
Diary Sleep Efficiency (%)	10.84 (7.23, 14.44)	<0.001	16.63 (12.24, 21.02)	<0.001	9.44 (5.75, 13.13)	<0.001	14.89 (10.40, 19.37)	<0.001
Diary TST (Minutes)	21.56 (2.38, 40.75)	0.028	34.67 (11.31, 58.03)	0.004	28.01 (7.01, 49.00)	0.009	64.80 (39.31, 90.29)	<0.001
Objective Sleep Efficiency (%)	1.41 (−0.55, 3.37)	0.16	2.15 (−0.17, 4.48)	0.069	−0.50 (−2.75, 1.76)	0.66	1.42 (−1.32, 4.15)	0.31
Nightmares Per Week	−0.23 (−0.92, 0.45)	0.51	−2.07 (−2.88, −1.25)	<0.001	−0.36 (−1.14, 0.43)	0.37	−2.08 (−3.02, −1.14)	<0.001
Depression (PHQ-9 Total Score)	−4.79 (−6.24, −3.33)	<0.001	−6.67 (−8.40, −4.94	<0.001	−4.10 (−5.60, −2.61)	<0.001	−5.65 (−7.44, −3.86)	<0.001
Anxiety (GAD-7 Total Score)	−5.26 (−6.92, −3.59)	<0.001	−5.5 (−7.48, −3.52)	<0.001	−3.86 (5.70, −2.02)	<0.001	−4.41 (−6.61, −2.21)	<0.001
Mental QoL (SF-12 Mental)	7.00 (3.81, 10.18)	<0.001	6.31 (2.53, 10.09)	0.001	4.32 (1.17, 7.48)	0.007	6.97 (3.15, 10.80)	<0.001
Physical QoL (SF-12 Physical)	2.28 (−0.46, 5.49)	0.10	2.01 (−1.23, 5.25)	0.22	2.72 (−0.19, 5.62)	0.067	2.51 (−1.01, 6.03)	0.16

Note. Tabled values show differences in means with 95% confidence interval for the difference in brackets; p<0.10 reported as 3 digits after the decimal point, p=0.100-.99 reported as 2 digits after decimal point, and values of .000 and 1.0 reported as <0.001 and >0.99; Number of observations vary according to variable, from n=65 to n=69.

Table 3.

Change (baseline to post-treatment; and baseline to 3-month follow-up) compared by group.

	Change (Baseline to Post-Treatment) With vs. Without Probable PTSD		Change (Baseline to 3-Month Follow-Up) With vs. Without Probable PTSD	
	Mean (95% CI)	**p-value**	**Mean (95% CI)**	**p-value**
Insomnia (ISI Total Score)	−2.30 (−4.94, 0.14)	0.064	−2.14 (−5.41, 1.13)	0.20
Sleep Quality (PSQI Total Score)	−0.73 (−2.69, 1.23)	0.47	−0.57 (−2.87, 1.73)	0.63
Diary Sleep Efficiency (%)	5.79 (0.11, 11.47)	0.046	5.54 (−0.36, 11.26)	0.066
Diary TST (Minutes)	13.11 (−17.12, 43.33)	0.40	36.79 (3.77, 69.81)	0.029
Objective Sleep Efficiency (%)	0.74 (−2.29, 3.78)	0.63	1.91 (−1.63, 5.46)	0.29
Nightmares Per Week	−1.83 (−2.90, −0.77)	0.001	−1.72 (−2.95, −0.49)	0.006
Depression (PHQ-9 Total Score)	−1.88 (−4.14, 0.38)	0.10	−1.55 (−3.87, 0.78)	0.19
Anxiety (GAD-7 Total Score)	−0.24	0.85 (−2.83, 2.35)	−0.54 (−3.41, 2.32)	0.71
Mental QoL (SF-12 Mental)	−0.69 (−5.63, 4.25)	0.79	2.65 (−2.31, 7.60)	0.30
Physical QoL (SF-12 Physical)	−0.27 (−4.50, 3.97)	0.90	−0.21 (−4.78, 4.35)	0.93

Note. Tabled values show differences in means with 95% confidence interval for the difference in brackets; p<0.10 reported as 3 digits after the decimal point, p=0.100-.99 reported as 2 digits after decimal point, and values of .000 and 1.0 reported as <0.001 and >0.99.

Table 4.

PTSD symptom cluster changes among women veterans with probable PTSD from baseline to post-treatment and baseline to 3-month follow-up.

	Baseline M	Post-Treatment M	*P*	3-Month Follow-up M	*P*
PCL-5 Subscale: Items 1-5 **Intrusion Symptoms** (PTSD Criterion B) Score Range: 0-20	12.13	8.90	<0.001	9.00	<0.001
PCL-5 Subscale: Items 6-7 **Avoidance Symptoms** (PTSD Criterion C) Score Range: 0-8	5.00	3.67	0.011	3.77	0.079
PCL-5 Subscale: Items 8-14 **Negative changes to Cognition and Mood** (PTSD Criterion D) Score Range: 0-28	15.17	10.17	<0.001	11.65	0.066
PCL-5 Subscale: Items 15-20 **Changes to Arousal and Reactivity** (PTSD Criterion E) Score Range: 0-24	13.43	7.07	<0.001	7.58	<0.001

Note. p<0.10 reported as 3 digits after the decimal point, p=0.100-.99 reported as 2 digits after decimal point, and values of .000 and 1.0 reported as <0.001 and >0.99; Number of observations vary according to variable, from n=26 to n=30.