## Title

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SCIENTIFIC INVESTIGATIONS

# Brief behavioral treatment for insomnia decreases trauma-related nightmare frequency in veterans

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**Study Objectives:** Trauma-related nightmares are highly prevalent among veterans and are associated with higher-severity insomnia and posttraumatic stress disorder. Cognitive behavioral therapy for insomnia (typically 6–8 sessions) has been shown to reduce trauma-related nightmares. Brief behavioral treatment for insomnia (BBTI, 4 sessions) has been found to be comparable to CBT-I in decreasing insomnia severity; however, the effects of BBTI on nightmares have not been investigated. The current study tested the effects of BBTI on both trauma-related nightmares and nontrauma-related bad dreams using an active control group treated using progressive muscle relaxation therapy. In addition, we tested whether baseline trauma-related nightmare frequency and baseline nontrauma-related bad dream frequency moderated changes in insomnia severity.

**Methods:** Participants were 91 military veterans with insomnia disorder randomized to BBTI or progressive muscle relaxation therapy. Participants reported insomnia severity on the Insomnia Severity Index and reported trauma-related nightmare frequency and nontrauma-related bad dream frequency on the Pittsburgh Sleep Quality Index–PTSD Addendum.

**Results:** We found that BBTI significantly reduced trauma-related nightmares from baseline to posttreatment, whereas progressive muscle relaxation therapy did not. However, reductions in trauma-related nightmares were not maintained at the 6-month follow up. Neither BBTI nor progressive muscle relaxation therapy reduced nontrauma-related bad dreams from baseline to posttreatment. We also found that neither baseline trauma-related nightmare frequency nor baseline nontrauma-related bad dream frequency moderated changes in insomnia symptom severity.

**Conclusions:** Findings from the current study suggest that BBTI may help reduce trauma-related nightmares. Further research is needed to better understand the potential mechanisms underlying how improved sleep may reduce trauma-related nightmares.

**Clinical Trial Registration:** Registry: ClinicalTrials.gov; Name: Brief Behavioral Insomnia Treatment Study (BBTI); URL: https://clinicaltrials.gov/ct2/show/NCT02571452; Identifier: NCT02571452.

**Keywords:** nightmares, trauma, insomnia, Veterans Health Administration, behavioral therapy

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## BRIEF SUMMARY

**Current Knowledge/Study Rationale:** Nightmares are a common sleep concern among veterans, contributing to insomnia, which is associated with impairment in social, cognitive, occupational, and physical health functioning. Although brief behavioral treatment for insomnia has shown efficacy in addressing insomnia, it is unclear whether it may also lead to decreases in nightmare frequency; in addition, no prior studies have investigated the effects of any behavioral insomnia treatment on both trauma-related nightmares and nontrauma-related bad dreams.

**Study Impact:** In a sample of 91 veterans with insomnia, from baseline to posttreatment, brief behavioral treatment for insomnia reduced trauma-related nightmares (relative to progressive muscle relaxation therapy) but did not reduce nontrauma-related bad dreams, and reductions in trauma-related nightmares were not maintained at the 6-month follow up. Future research is needed to better understand how improved sleep may reduce trauma-related nightmares.

## INTRODUCTION

Insomnia is associated with impairment in social, cognitive, occupational, and physical health functioning, as well as increased health care use and health care costs.[1–3] Among U.S. military veterans, insomnia concerns are highly prevalent, affecting 27%–54% of military personnel and veterans, and 92% of military personnel with posttraumatic stress disorder (PTSD) have clinically significant insomnia.[4–6] Nightmares are a common sleep concern among veterans, contributing to overall sleep problems, with 52% of veterans with PTSD reporting nightmares "sometimes" or "frequently" (and only 5% of veterans without PTSD reporting nightmares with this frequency).[7] Veterans often rate nightmares as their chief complaint;[8] nightmares are associated with higher-severity insomnia[9] and PTSD.[10] Associations among trauma exposure, nightmares, and sleep disturbance have been well established. Nightmares related to military trauma (compared with those not related to trauma) are associated with increased awakenings throughout the night.[11] Thus, nightmares are an especially important factor to consider when treating veterans for insomnia.

Cognitive behavioral therapy for insomnia (CBT-I) is a 6- to 8-session treatment that includes stimulus control, sleep hygiene, sleep restriction, and cognitive restructuring.[12] CBT-I has shown both short- and long-term efficacy in reducing insomnia severity

across several studies.[13–15] Patients also prefer behavioral interventions for insomnia over medication.[16] Notably, patients with comorbid PTSD and insomnia have been shown to benefit from CBT-I, with treatment leading to reductions in both insomnia severity and PTSD severity.[17,18] These findings indicate that although individuals with comorbid PTSD and insomnia may experience unique sleep difficulties (including nightmares and feeling unsafe because of trauma), they can successfully engage in this treatment. Furthermore, these patients experience additional benefits from CBT-I, including decreased fear of sleep[19] and decreased nightmare frequency.[18] Talbot and colleagues[18] posited that CBT-I may decrease trauma-related nightmares by altering individuals' memory for nightmares—either through increased sleep depth or decreased number of awakenings. Further supporting this idea, a dismantling study of exposure, rescripting, and relaxation therapy indicated that the behavioral sleep intervention was the active component for treating nightmares.[20] That study compared the full exposure, rescripting, and relaxation therapy protocol (including exposure and rescripting nightmares along with stimulus control, sleep hygiene guidelines, relaxation training, and psychoeducation on nightmares and how trauma impacts sleep) with a version of exposure, rescripting, and relaxation therapy without the exposure and rescripting nightmares components; the authors found that treatment groups did not differ in outcomes on nightmares, insomnia severity, or PTSD severity.[20] This finding suggests that the active components of this therapy are not the nightmare-specific components. Furthermore, studies of veterans investigating imagery rehearsal therapy (which involves mental rehearsal of a rescripted [or altered] version of a repetitive nightmare) have shown that imagery rehearsal therapy (and imagery rehearsal therapy + CBT-I) is not more effective than CBT-I alone.[21,22]

Because of strong support for the efficacy of CBT-I, the U.S. Department of Veterans Affairs rolled out CBT-I, providing trainings for interested clinicians in mental health.[23] However, CBT-I can be difficult to access for many patients, given multiple barriers in seeking mental health care.[24] Motivated by veteran preference for insomnia treatment lasting 5 weeks or less[25] and by calls for more accessible, targeted, and time-efficient insomnia treatment,[26] a novel brief treatment for insomnia was developed: brief behavioral treatment for insomnia (BBTI). BBTI consists of 4 sessions, 2 in person (60-minute and 30-minute sessions) and 2 by telephone (20 minutes each), and it has been shown to decrease insomnia severity across several populations.[27,28] A recent study found BBTI to be noninferior to CBT-I in decreasing insomnia severity.[29] Furthermore, the benefits of BBTI seem to be long-lasting, with improvements in sleep, general health, and psychosocial functioning maintained at 6-month follow-up.[30,31]

Although BBTI has shown efficacy in addressing insomnia concerns, it is unclear whether BBTI may also lead to decreases in nightmare frequency. Previous findings that CBT-I reduces nightmare frequency[18] have suggested that nightmare frequency is responsive to treatment for insomnia. Thus, BBTI may similarly address nightmares through increasing the depth of sleep and decreasing the number of awakenings. In addition, it would be helpful to understand whether patients' nightmare frequency when entering treatment for insomnia affects their treatment response. If findings indicated that patients with a higher frequency of nightmares do not benefit from BBTI, then alternative treatment would be recommended. Unfortunately, there is a lack of research investigating the effects of baseline nightmare frequency on treatment outcomes for insomnia treatments broadly. Another research gap is understanding the effects of insomnia treatment on trauma-related nightmares vs nontrauma-related bad dreams. Previous research on the effects of insomnia treatment has focused only on trauma-related nightmares.[18,20] There is evidence suggesting that trauma-related nightmares function differently than nontrauma-related bad dreams; for instance, trauma-related nightmares are associated with increased awakenings throughout the night.[11] Trauma-related nightmares are thought to result from dysfunction in the fear-memory extinction processes in the brain (whereas nontrauma-related bad dreams are thought to facilitate fear extinction).[32]

The current study tested the effects of BBTI on both trauma-related nightmares and nontrauma-related bad dreams using an active control group, patients treated using progressive muscle relaxation therapy (PMRT), which has been previously used as an active control in insomnia trials;[33] this active control was matched for treatment duration and frequency. We hypothesized that veteran participants in the BBTI group would evidence reduced trauma-related nightmare frequency following treatment relative to the PMRT group. As an exploratory question, we investigated whether veterans in the BBTI group had reduced nontrauma-related bad dream frequency after treatment relative to the PMRT group. In addition, we investigated whether higher trauma-related nightmare and nontrauma-related bad dream frequency at baseline predicted treatment outcomes on insomnia severity.

## METHODS

### Participants

Participants were military veterans aged 18–75 years who had been diagnosed with insomnia disorder using the *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition. Local advertisements, direct mailings, referrals from U.S. Department of Veterans Affairs clinicians, and referrals from local U.S. Department of Veterans Affairs medical center research studies were used to recruit participants from January 2016–August 2018. Participants engaged in psychiatric treatment (medication or psychotherapy) were included in the study only if (1) they had been engaged in psychotherapy for 3 months and/or had been stable on psychotropic medications for at least 1 month before the screening procedures began, and (2) they had no plans to stop or start a new treatment for the duration of the study.

Exclusion criteria for all participants included (1) lifetime history of bipolar disorder or a disorder involving psychosis; (2) moderate to severe alcohol or substance use disorder over the past year; (3) working night shifts or rotating shifts; (4) pregnancy; (5) prominent suicidal or homicidal ideation; (6) unstable housing; (7) high risk for obstructive sleep apnea (OSA), determined by a positive score in all 3 categories on the Berlin Questionnaire;[34,35] (8) untreated moderate to severe OSA (treatment history determined by self-report and medical chart history and severity determined by an apnea-hypopnea index

score of > 15 events/h on home sleep apnea testing; (9) untreated medical conditions affecting sleep (eg, restless legs syndrome); (10) a subthreshold score on the Insomnia Severity Index (ISI) of 0–14;[36] and (11) not meeting the criteria for insomnia disorder using the *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition.

A total of 91 eligible participants provided informed consent to participate, were randomized to treatment, and are included in the current study.

## Procedures

The current study is a secondary data analysis from a parent clinical trial.[31] All study procedures were approved by the Committee on Human Research at the University of California, San Francisco and the San Francisco Veterans Affairs Medical Center.

### *Study design*

We conducted a randomized controlled trial comparing BBTI and PMRT (as an active control treatment). A computer-generated 6-block randomization was used to randomly assign participants, with stratification based on age (≤ 50 years vs > 50 years) and study therapist (3 therapists). Diagnostic clinical interviewers were blind to participant treatment condition, and interviewers were not involved in treatment or data collection procedures.

### *Screening*

Screening began with a brief telephone interview to assess initial eligibility for the study. Individuals who screened positive on 2 of the 3 categories on the Berlin Questionnaire were invited to complete home sleep apnea testing to rule out untreated moderate to severe OSA. To assess treatment for OSA, individuals were asked whether they were using a positive airway pressure device and how often they used this device. In the current study, OSA was considered treated if individuals reported at least 4 hours of positive airway pressure use per night. Medical records were used to confirm self-report whenever possible. In the second phase of screening, individuals completed a diagnostic clinical interview to confirm insomnia diagnosis and determine final eligibility.

### *Treatment*

Both treatment conditions included 6 appointments: 1 baseline appointment, 4 treatment sessions, and 1 posttreatment appointment. The baseline appointment consisted of (1) completing web-based self-report measures, including the Pittsburgh Sleep Quality Index (PSQI)–PTSD Addendum[37] and the ISI;[36] (2) meeting with the assigned therapist for a brief assessment of sleep difficulties and review of instructions for completing sleep diaries; and (3) being assigned to a treatment group. Participants completed a daily sleep diary for 5 weeks starting at the baseline appointment through the posttreatment appointment. Self-report measures were completed again at the midpoint of treatment, the posttreatment appointment, and at a 6-month follow up (only for those in the BBTI group). At the posttreatment appointment, participants also completed a second diagnostic clinical interview. Please refer to Maguen et al[31] for more details regarding retention and adherence monitoring.

## Treatment conditions

### *BBTI*

BBTI treatment included 2 in-person sessions (sessions 1 and 3) and two telephone sessions (2 and 4).[30] The first treatment session was 1 hour and included psychoeducation about homeostatic and circadian mechanisms related to sleep, along with sleep guidelines derived from sleep restriction and stimulus control techniques. Five key elements were introduced: (1) reducing time in bed, (2) getting up at the same time each day, (3) not going to bed unless sleepy, (4) not staying in bed unless asleep, and (5) eliminating naps. Therapists reviewed the sleep diary from the past week with patients and developed a personalized sleep plan with patients that included a target wake time and total time allowed in bed (with a minimum of 5 hours total time). The second treatment session was a 20-minute telephone session in which the sleep diary from the past week, sleep education, and sleep guidelines were reviewed and any problems with adhering to the sleep plan were discussed. The third session was a 30-minute in-person appointment and included reviewing the sleep diary from the past week, addressing problems with treatment adherence, and adjusting the sleep plan when appropriate based on sleep diary data. The fourth treatment session was a 20-minute telephone session in which the sleep diary was reviewed for the final time and the sleep plan was adjusted if appropriate. Therapists and patients discussed expectations for improvement and techniques for addressing sleep problems in the future.

### *PMRT*

PMRT has been used in many behavioral sleep treatment trials.[13,33] A manualized 4-session version of PMRT was developed that matched the BBTI treatment for session duration and type (ie, in-person vs by telephone). This treatment was based on the guidebook for PMRT by Bernstein and colleagues.[38] Therapists reviewed sleep diaries with patients to ensure that participants were completing the measure correctly, but no behavioral modifications were provided. In the first treatment session, therapists reviewed the sleep diaries and provided information about PMRT and the rationale for treatment. Therapists also introduced the fundamentals of PMRT and guided patients in a practice of PMRT involving alternating between tension and relaxation in 14 muscle groups. Patients were assigned the reviewed PMR practice twice daily for the next week. Therapists and patients collaboratively chose a time for patients to practice PMR based on individual preference, but patients were discouraged from practicing PMR when they were unable to sleep. The second treatment session included a review of the sleep diary from the past week and a discussion of any problems practicing PMR along with solutions to address these problems. The third treatment session involved another review of the sleep diary and a review of the PMR practice, along with the introduction of a more efficient tension-relaxation method that tensed 7 muscle groups. Patients were assigned this abbreviated PMR practice twice daily for the next week. The fourth treatment session included another review of the sleep diary and PMR practice, along with a discussion of problems interfering with practice and problem-solving around how to continue regular PMR practice after treatment.

## Measures

### PSQI–PTSD Addendum

The current study used the PTSD addendum from the PSQI to assess both trauma-related nightmare frequency and nontrauma-related bad dream frequency occurring in the past month.[37] We analyzed data from 2 items out of the total PSQI–PTSD Addendum: trauma-related nightmare frequency and nontrauma-related bad dream frequency. Participants were asked, "During the past month, how often have you had trouble sleeping because you … " and were provided a list, with the items "had memories or nightmares from a traumatic experience" and "had bad dreams, not related to traumatic memories." Thus, our measure of trauma-related nightmare frequency also included trauma-related memories that caused trouble sleeping. We have condensed this to "nightmare frequency" for readability throughout the article. Response options included "not during the past month," "less than once a week," "once or twice a week," and "3 or more times a week." Because nightmares and bad dreams were the focus of this study, the remaining 5 items not assessing nightmares or bad dreams on the PSQI–PTSD Addendum were not included.

### ISI

The ISI is a 7-item self-report measure of insomnia severity that asks individuals to rate their sleep difficulties over the past 2 weeks on a Likert scale from 0–4, with scores ranging from 0–28 and higher scores indicating higher insomnia severity.[36] Cutoff scores are provided, with scores < 8 indicating no insomnia, scores 8–14 indicating subthreshold insomnia, scores 15–21 indicating clinical insomnia (moderate severity), and scores 22–28 indicating severe clinical insomnia. Items assess the severity of problems with delayed sleep onset, sleep maintenance, early-morning waking, level of satisfaction with sleep pattern, interference with functioning, others noticing impairment from sleep difficulty, and worry or distress related to sleep problems. The ISI has shown excellent psychometric properties[36]; in the current study, the ISI indicated high internal consistency (Cronbach's $\alpha = 0.74$). It has been validated with both sleep diary and polysomnography.[36] In the current study, we administered the ISI as a web-based measure.

## Data analytic plan

We used generalized estimating equation models to investigate the effects of treatment on nightmares and bad dreams, which allowed us to specify our dependent variables (trauma-focused nightmares, nontrauma-focused bad dreams) as ordinal variables. We used mixed-model analysis to investigate baseline nightmare/bad dream frequency as a moderator of treatment outcome (using the ISI).

# RESULTS

## Participant characteristics

**Table 1**, **Table 2**, and **Table 3** display baseline demographics, measures, and psychiatric diagnosis by treatment group. A total of 91 veterans (male = 73, female = 17, and transgender = 1) received BBTI (n = 46) or PMRT (n = 45). In the BBTI group, the mean age for veterans was 49.5 years (standard deviation [SD] = 15.7) and the mean duration of military service was 13.5 years (SD = 9.8); in the PMRT group, the mean age for veterans was 50 years (SD = 15.3) and the mean duration of military service was 14.4 years (SD = 10.8). At baseline, 39% of participants reported having trauma-related nightmares in the past month. All participants reporting nightmares also reported Criterion A traumas (exposure to death, threatened death, actual or threatened serious injury, or actual or threatened sexual violence) during clinical interviews.

## Posttreatment trauma-related nightmare frequency

We investigated our hypothesis that veterans in the BBTI group would show lower trauma-related nightmares at posttreatment relative to veterans in the PMRT group using a generalized estimating equation. Our model predicting posttreatment trauma-related nightmare frequency included the main effects of treatment group (BBTI, PMRT) and baseline trauma-related nightmare frequency. The main effects of treatment group ($X^2$ [1, n = 91] = 6.53, $P$ = .01) and baseline trauma-related nightmare frequency ($X^2$ [3, n = 91] = 42.99, $P < .001$) were both significant. See **Figure 1** and **Table 2** for changes in trauma-related nightmare frequency (and nontrauma-related bad dreams) over time in the BBTI and PMRT groups. Of veterans reporting at least 1 trauma-related nightmare in the past month at baseline (39% of the sample), 52.38% in the BBTI group showed decreases in the frequency of their trauma-related nightmares (vs 15.38% in the PMRT group).

We also investigated whether these reductions in trauma-related nightmares would be maintained at the 6-month follow up for the BBTI group, using a generalized estimating equation. Our model showed that nightmare frequency increased from posttreatment to follow-up in the BBTI group ($X^2$ [1, n = 41] = 6.57, $P$ = .01; see **Table 2** for changes).

## Posttreatment nontrauma-related bad dream frequency

We also investigated whether patients in the BBTI group showed reduced posttreatment nontrauma-related bad dreams relative to patients in the PMRT group using a generalized estimating equation. Our model predicting posttreatment nontrauma-related bad dream frequency included the main effects of treatment group (BBTI, PMRT) and baseline nontrauma-related bad dream frequency. Baseline nontrauma-related bad dream frequency ($X^2$ [3, n = 91] = 29.80, $P < .001$) predicted posttreatment nontrauma-related bad dream frequency, but treatment group ($X^2$ [1, n = 91] = 0.90, $P$ = .34) did not predict posttreatment nontrauma-related bad dream frequency.

## Baseline trauma-related nightmare frequency moderating treatment outcome

We used a linear regression model to investigate whether baseline trauma-related nightmare frequency would moderate the effect of treatment on posttreatment ISI (controlling for baseline ISI). Our model predicting posttreatment ISI included the main effects of baseline trauma-related nightmare frequency, treatment group (BBTI, PMRT), and baseline ISI, along with

**Table 1**—Baseline demographics by treatment group.

| Variable | PMRT (n = 45) | BBTI (n = 46) |
|---|---|---|
| Sex, % | | |
| Female | 8 (18) | 9 (20) |
| Male | 36 (80) | 37 (80) |
| Transgender | 1 (2) | 0 (0) |
| Age, mean (SD) | 50.0 (15.3) | 49.5 (15.7) |
| Race/ethnicity, % | | |
| Asian | 7 (16) | 10 (22) |
| Black or African American | 4 (9) | 8 (17) |
| Caucasian/White | 23 (51) | 20 (43) |
| Hispanic or Latino | 5 (11) | 4 (9) |
| Multiracial | 3 (7) | 3 (7) |
| Native Hawaiian/Pacific Islander | 2 (4) | 1 (2) |
| Other | 1 (2) | 0 (0) |
| Education, % | | |
| High school graduate/general education degree | 3 (7) | 2 (4) |
| Some college | 8 (18) | 9 (20) |
| Associate degree | 1 (2) | 6 (13) |
| College graduate, bachelor's degree | 16 (36) | 15 (33) |
| Some graduate school | 8 (18) | 2 (4) |
| Master's level degree | 8 (18) | 8 (17) |
| Doctoral degree | 1 (2) | 4 (9) |
| Marital status, % | | |
| Never married | 10 (22) | 15 (33) |
| Married | 20 (44) | 22 (48) |
| Living with domestic partner | 5 (11) | 3 (7) |
| Divorced | 9 (20) | 6 (13) |
| Widowed | 1 (2) | 0 (0) |
| Employment status, % | | |
| Employed full time | 13 (29) | 22 (48) |
| Employed part time | 4 (9) | 5 (11) |
| Looking for work | 2 (4) | 0 (0) |
| VA service-connection disability | 3 (7) | 3 (7) |
| In school (full time) | 3 (7) | 4 (9) |
| Retired | 13 (29) | 9 (20) |
| Other | 7 (16) | 3 (7) |

BBTI = brief behavioral treatment for insomnia, PMRT = progressive muscle relaxation therapy, SD = standard deviation; VA = Veterans Affairs.

the interaction of baseline trauma-related nightmare frequency and treatment group.

The overall model was significant: $F$ (4, 83) = 15.96, $P$ < .001. Treatment group ($B$ = –4.90, standard error [SE] = 1.15, $P$ < .001) and baseline ISI ($B$ = 0.53, SE = 0.14, $P$ < .001) predicted posttreatment ISI. The BBTI group showed lower posttreatment ISI ($M$ = 8.13, SD = 5.37) than the PMRT group ($M$ = 12.57, SD = 5.28), which aligns with findings from Maguen et al.[31] In contrast, baseline trauma-related nightmare frequency ($B$ = 1.36, SE = 0.72, $P$ = .06) and the interaction of baseline trauma-related nightmare frequency and treatment ($B$ = 0.47, SE = 0.94, $P$ = .62) did not predict posttreatment ISI.

### Baseline nontrauma-related bad dream frequency moderating treatment outcome

We also used a linear regression model to investigate whether baseline nontrauma-related bad dream frequency would moderate the effect of treatment on posttreatment ISI (controlling for baseline ISI). Our model predicting posttreatment ISI included the main effects of baseline nontrauma-related bad dream frequency, treatment group (BBTI, PMRT), and baseline ISI, along with the interaction of baseline nontrauma-related bad dream frequency and treatment group.

The overall model was significant: $F$ (4, 83) = 15.12, $P$ < .001. Treatment group ($B$ = –4.69, SE = 1.22, $P$ < .001) and baseline ISI ($B$ = 0.57, SE = 0.14, $P$ < .001) predicted posttreatment ISI. In contrast, baseline nontrauma-related bad dream frequency ($B$ = 1.47, SE = 0.77, $P$ = .06) and the interaction of baseline nontrauma-related bad dream frequency and treatment ($B$ = 0.72, SE = 1.20, $P$ = .55) did not predict posttreatment ISI.

## DISCUSSION

We found that a brief behavioral treatment for insomnia reduced trauma-related nightmares, compared to a relaxation control condition, but that these reductions in trauma-related nightmares were not maintained at the 6-month follow up. Notably, reductions from baseline to posttreatment were not observed for nontrauma-related bad dreams. We also found that baseline nightmare/bad dream frequency did not moderate changes in insomnia symptom severity. This is the first known study to investigate the effects of BBTI on nightmares and the effect of a behavioral sleep treatment on both trauma-related nightmares and nontrauma-related bad dreams. In addition, this is the first study to investigate baseline nightmares/bad dreams as a moderator of insomnia treatment outcome. These findings contribute to our overall understanding of the impact of behavioral sleep interventions on nightmares.

Previous literature on trauma-related nightmares may help elucidate potential mechanisms underlying BBTI's effects on trauma-related nightmares—and why BBTI may impact trauma-related nightmares but not nontrauma-related bad dreams. Sleep architecture and physiological arousal are major recurring themes in the literature on trauma-related nightmares. Talbot and colleagues[18] posited that behavioral sleep interventions lead to more consolidated and deeper sleep, reducing the likelihood that patients awaken from and remember trauma-related nightmares. This idea is supported by findings that continuous positive airway pressure device adherence—which increases sleep depth and decreases the number of awakenings—also leads to decreases in nightmares.[39,40] It is possible that BBTI may target trauma-related nightmares specifically

**Table 2**—Baseline and posttreatment measures by treatment group.

| Variable | PMRT Baseline (n = 45) | PMRT Posttreatment (n = 45) | BBTI Baseline (n = 46) | BBTI Posttreatment (n = 46) | BBTI Follow-Up (n = 41) |
|---|---|---|---|---|---|
| Trauma-related nightmare frequency, % | | | | | |
| 0 (past mo) | 29 (67) | 27 (61) | 25 (54) | 28 (61) | 19 (46) |
| <1/wk | 5 (12) | 7 (16) | 9 (20) | 11 (24) | 13 (32) |
| 1–2/wk | 5 (12) | 5 (11) | 8 (17) | 3 (7) | 5 (12) |
| ≥3/wk | 4 (9) | 5 (11) | 4 (9) | 4 (9) | 4 (10) |
| Nontrauma-related bad dream frequency, % | | | | | |
| 0 (past mo) | 26 (61) | 28 (63) | 23 (50) | 31 (67) | 22 (54) |
| <1/wk | 10 (23) | 9 (21) | 17 (37) | 10 (22) | 16 (39) |
| 1–2/wk | 4 (9) | 6 (14) | 6 (13) | 4 (9) | 3 (7) |
| ≥3/wk | 3 (7) | 1 (2) | 0 (0) | 1 (2) | 0 (0) |
| ISI, overall mean (SD) | 17.40 (4.04) | 12.41 (5.43) | 17.09 (3.57) | 8.13 (5.37) | 7.84 (5.45) |

The scale for both trauma-related nightmare frequency and nontrauma-related bad dream frequency is 0–3 (0 = "none in the past month," 1 = "less than once per week," 2 = "1–2 times per week," 3 = "three or more times per week"). The scale for the ISI is 0–28. BBTI = brief behavioral treatment for insomnia, ISI = Insomnia Severity Index, PMRT = progressive muscle relaxation therapy, SD = standard deviation.

because trauma-related nightmares (relative to nontrauma-related nightmares) are more likely to awaken individuals.[11] Nightmares are often defined with an awakening criterion;[41,42] however, this criterion is not always included, and some believe that this criterion is not helpful in better understanding the full spectrum of nightmares (although awakening from a nightmare is important to assess, because it is associated with greater distress[41,42]). The term *nightmare* was not defined for participants in the current study as requiring awakening; thus, participants likely included trauma-related nightmares in which they did not wake up in their self-reports. Future research is needed to better understand whether BBTI reduces trauma-related nightmares through increased sleep quality reducing awakenings or through increased sleep quality reducing distress generally. It may also be that trauma-related nightmares operate through different mechanisms than nontrauma-related bad dreams (eg, limbic system activation) and that these mechanisms may be differentially impacted by improved sleep. Future research with repeated nights of sleep electroencephalogram measurement and event markers indicating trauma-related nightmares vs nontrauma-related bad dreams may help elucidate these potentially different mechanisms.

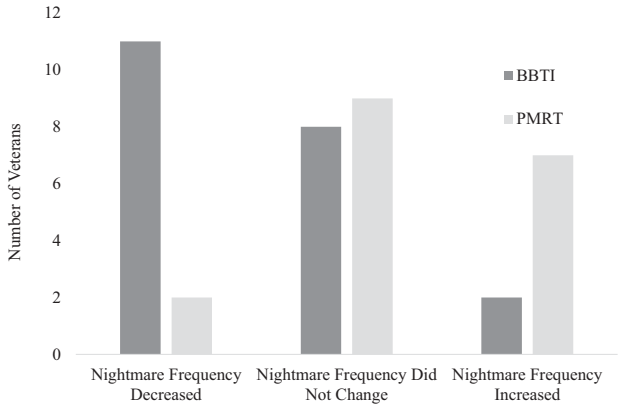
Rapid eye movement (REM) sleep may play an especially important role in trauma-related nightmares, with models of PTSD positing that REM sleep is central in fear memory and extinction processes.[43] Individuals with PTSD show greater interruptions in REM sleep relative to individuals with depression, and these interruptions are associated with self-reported

**Table 3**—Psychiatric diagnosis by treatment group.

| Variable | Level | PMRT (n = 45) | BBTI (n = 46) |
|---|---|---|---|
| PTSD diagnosis | Present | 7 (15.6%) | 9 (19.6%) |
| MDD diagnosis | Present | 5 (11.1%) | 9 (19.6%) |
| GAD diagnosis | Present | 5 (11.1%) | 5 (10.9%) |
| Panic disorder diagnosis | Present | 0 (0%) | 2 (4.4%) |
| Agoraphobia diagnosis | Present | 0 (0%) | 0 (0%) |
| Social anxiety disorder diagnosis | Present | 5 (11.1%) | 1 (2.2%) |
| Specific phobia diagnosis | Present | 2 (4.4%) | 1 (2.2%) |
| OCD diagnosis | Present | 0 (0%) | 3 (6.5%) |
| Alcohol use disorder diagnosis | Mild | 1 (2.2%) | 1 (2.2%) |
| Other substance use disorder diagnosis | Mild | 2 (4.4%) | 0 (0%) |

BBTI = brief behavioral treatment for insomnia, GAD = generalized anxiety disorder, MDD = major depressive disorder, OCD = obsessive compulsive disorder, PMRT = progressive muscle relaxation therapy, PTSD = posttraumatic stress disorder.

**Figure 1**—Changes in past-month trauma-related nightmare frequency from baseline to posttreatment among veterans endorsing nightmares.




BBTI = brief behavioral treatment for insomnia, PMRT = progressive muscle relaxation therapy.

trauma-related nightmares.[44] Furthermore, greater sleep latency—related to the rapid onset of REM sleep[45]—is associated with self-reported trauma-related nightmares.[46] BBTI has shown efficacy in reducing sleep interruptions and sleep latency;[31] these changes may impact REM sleep, which may in turn reduce nightmares (or memory of or awakening from nightmares). Future research should include laboratory studies that investigate the effect of BBTI on overall sleep architecture and specific aspects of REM sleep. Interestingly, the effects of BBTI were not maintained at the 6-month follow up. Although the reasons are not clear, it may be that the potency of active treatment (eg, ongoing sleep restriction, stimulus control, and maintenance of sleep diaries) was related to improvements in nightmares and that benefits dissipated after the end of treatment. Future research should examine a sample with a larger percentage of individuals with PTSD, more comprehensively assess the intensity of and distress caused by nightmares, and include longer follow-up intervals.

BBTI may serve as an appropriate starting point for veterans reporting sleep problems with troubling trauma-related nightmares because of its low time-investment burden for both patients and providers (with 4 sessions for BBTI vs 6–8 sessions for CBT-I). This approach is in line with a stepped-care model, which recommends beginning with the least intensive treatment that is likely to have a positive impact; this model aims to increase access to care and efficiency in the use of resources.[47] A more intensive treatment—such as evidence-based psychotherapy for PTSD—may be helpful as the next "step" in this stepped-care model if symptoms persist after a patient has completed BBTI.

BBTI can easily be offered in a primary care or integrated care setting, which may increase access and decrease mental health–related stigma.[31] Research indicates that individuals with PTSD often prefer to receive care in a primary care setting. For instance, individuals with PTSD are more likely to report symptoms to primary care providers than to mental health providers.[48] Furthermore, primary care interventions are associated with higher engagement and completion of treatment.[49] Offering BBTI through telehealth and/or other digital platforms may further increase access. Findings from a preliminary study suggest that a mobile application version of BBTI may also be efficacious.[50] More research is necessary to better understand the efficacy of BBTI in primary care and in various telehealth formats.

Notably, results from the current study indicate that BBTI is efficacious regardless of patients' frequency of trauma-related nightmares. These findings may reduce concerns from providers that BBTI may not be appropriate for patients with frequent trauma-related nightmares. However, further research is needed to investigate the effects of BBTI in a sample of veterans with comorbid insomnia and PTSD to ensure that these results will replicate in a sample with a greater prevalence of PTSD. For individuals with PTSD, BBTI may pose another benefit, functioning as a bridge to PTSD treatment for individuals who are less likely to begin PTSD treatment. Individuals with comorbid insomnia and PTSD may be less open to beginning PTSD treatment for a variety of reasons, including perceiving insomnia as the primary concern, higher stigma related to PTSD, greater skepticism about PTSD treatment, and/or higher avoidance related to PTSD treatment. However, after completing BBTI and experiencing a reduction in insomnia symptoms, patients may be more likely to engage in PTSD treatment because of increased positive impressions of evidence-based psychotherapy, improved overall functioning, or both. Patients may be able to capitalize on their momentum from successful treatment to seek additional treatment to address their remaining PTSD symptoms. More research is needed to determine whether patients with PTSD who engage in insomnia treatment are more likely to engage in evidence-based PTSD treatment.

BBTI may also serve as an early prevention intervention for the development of PTSD and/or as an adjunct treatment for evidence-based psychotherapy for PTSD. Given evidence that sleep disturbances prospectively predict PTSD,[10,51] it seems promising that early intervention for insomnia and nightmares may help change the trajectory of PTSD symptoms. BBTI may also represent a useful adjunct to evidence-based psychotherapy for PTSD, including prolonged exposure (PE) and cognitive processing therapy. After patients are treated using both PE and cognitive processing therapy, sleep problems often do not improve.[52,53] Combined CBT-I and PE treatment was developed to address this common comorbid PTSD and insomnia presentation.[53] However, this combined treatment is time-intensive, lasting 15–24 sessions. A combined BBTI and PE (or BBTI and cognitive processing therapy) treatment would reduce the time burden for patients and providers. PE has also been shortened and adapted for primary care settings to increase availability and access to evidence-based psychotherapy for PTSD.[54] BBTI may also be combined with PE adapted for a primary care setting to further increase access to effective treatments for comorbid PTSD and insomnia. Future research should test the efficacy of treatment combining BBTI and an evidence-based psychotherapy for PTSD.

The current study had several limitations. First, although 39% of veterans reported trauma-related nightmares in the past month, the

rate of PTSD diagnosis was low (18% of veterans). Future research may seek to replicate these findings in a sample of individuals with comorbid insomnia and PTSD to test the efficacy of BBTI in this population. Future research may also assess nightmare intensity as an additional outcome in this population. Second, the study sample used was a veteran sample; thus, our findings cannot be generalized to adults in the general population. Third, veterans in the current study were largely male (80%) and Caucasian (51%). Future studies should replicate findings in more diverse samples. Fourth, the current study did not use sleep laboratory parameters; future research should include these parameters (including sympathovagal tone, sleep electroencephalogram activity related to sleep stages, and timing of sleep interruptions). Fifth, we did not assess nocturia, which may reduce the efficacy of BBTI.[55] Sixth, our measure of trauma-related nightmares also included language about trauma-related memories that interfere with sleep. In future studies, language can focus more specifically on trauma-related nightmares to ensure that results do not stem from a treatment effect on trauma-related memories interfering with sleep that are not nightmares. Finally, to better understand whether nightmares were associated with functioning, we conducted exploratory analyses and found that nightmares at posttreatment were associated with lower improvement in functioning for both groups. Future longitudinal studies may investigate temporal relationships between nightmares and functioning throughout treatment.

This study represents a novel contribution to the literature in examining the effects of BBTI on nightmares. We found that BBTI reduced trauma-related nightmares in a veteran population from baseline to posttreatment but that these benefits were not maintained at a 6-month follow-up. We also found that baseline nightmare frequency did not affect the efficacy of BBTI. These results indicate that BBTI may be helpful for individuals with trauma-related nightmares, but additional studies are needed using samples of individuals with a higher frequency of trauma-related nightmares and individuals with PTSD. BBTI may serve several functions in the future—as a more accessible primary care or digital intervention, as an early intervention for the development of PTSD symptoms, as a bridge to PTSD treatment, and as an adjunct to treatment for comorbid PTSD and insomnia. Research is needed to test the efficacy of BBTI in these novel contexts. More research is also needed to investigate potential mechanisms that explain how behavioral sleep interventions lead to change in trauma-related nightmares.

## ABBREVIATIONS

BBTI, brief behavioral treatment for insomnia
CBT-I, cognitive behavioral therapy for insomnia
ISI, Insomnia Severity Index
OSA, obstructive sleep apnea
PE, prolonged exposure
PMRT, progressive muscle relaxation therapy
PSQI, Pittsburgh Sleep Quality Index
PTSD, post-traumatic stress disorder
REM, rapid eye movement
SD, standard deviation
SE, standard error

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## DISCLOSURE STATEMENT

All authors have seen and approved this manuscript. Rachel M. Ranney, VA Advanced Postdoctoral Fellow in Mental Illness Research and Treatment, Sierra Pacific (VISN 21) Mental Illness Research Education and Clinical Center, VA San Francisco Health Care System, and the Department of Psychiatry and Behavioral Sciences, University of California, San Francisco School of Medicine. This study was funded by VA Rehabilitation Research and Development grant I01 RX001539 (principal investigator: Maguen). This research is also supported by the Department of Veterans Affairs Office of Academic Affiliations Advanced Fellowship Program in Mental Illness Research and Treatment, the Medical Research Service of the Veterans Affairs San Francisco Health Care System, and the Department of Veterans Affairs Sierra Pacific Mental Illness Research, Education, and Clinical Center. The authors report no conflicts of interest.