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Cognitive behavioral therapy-based treatments for insomnia and nightmares in adults with trauma symptoms: a systematic review

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Introduction

Post-Traumatic Stress Disorder (PTSD) is one of the most frequently reported psychopathological conditions following trauma. PTSD occurs in people who experience and/or witness, either directly or vicariously traumatic events such as accidents, natural disasters and personal assaults (APA, 2013). Depending on the country of residence and social background, the lifetime prevalence of PTSD ranges from 1.3 to 12.2%, (Karam et al., 2014). PTSD leads to several negative physical, psychological and social sequelae. These include but are not limited to physical pain, gastrointestinal and cardio-respiratory issues, anxiety, depression, premature death, onset of Type 2 diabetes, drug and alcohol use, reduced occupational capacity and loss of important personal relationships (Pacella et al., 2013; Pietrzak et al., 2011; Schlenger et al., 2015; Shalev et al., 2017; Vogt et al., 2016).

Insomnia and nightmares are the most prevalent sleep disturbances reported by people with PTSD (Buysse et al., 2006; Pruiksma et al., 2016). Studies show that 70% to 91% of people with PTSD have difficulty initiating sleep, staying asleep, and may experience chronic nightmares (Neylan et al., 1998; Ohayon & Shapiro, 2000). Notably, insomnia and nightmares are the most frequently reported residual health problems following a successful resolution of PTSD treatment with psychological interventions (Pruiksma et al., 2016).

In a sample of 108 US military veterans receiving psychological treatment for PTSD, insomnia and nightmares were highly prevalent at baseline (92% and 69%, respectively), and remained high following psychological treatment (77% and 52%, respectively) (Pruiksma et al., 2016). A recent clinical trial by Taylor and colleagues (Taylor et al., 2020) showed that both insomnia and nightmares remained in the clinically significant range following a prolonged exposure therapy treatment for PTSD even among those who achieved remission of PTSD.

Theoretical framework

Youngren and colleagues (Youngren et al., 2020) proposed a Nightmare Cognitive Arousal Processing (Night-CAP) model that explains how the presence of sleep difficulties predict the development of PTSD. More specifically, pre-sleep cognitive arousal, worry and rumination, and sleep latency predict the occurrence of post-traumatic nightmares. When levels of sleep latency and pre-sleep cognitive arousal are high, an individual is at an increased risk of developing/experiencing post-traumatic nightmares (Youngren et al., 2020). The Night-CAP model suggests that rumination provides the right opportunity for longer period of rehearsing of negative cognitions about the actual trauma priming the content of nightmares that replay during sleep.

Similarly, the longer an individual spends in waking-state wanting to fall asleep the more pressure to fall asleep leading to rapid eye movement (REM-sleep stage) rebound and more prompt entry into REM sleep. Dreams are more likely to take place during REM; providing a rationale as to why sleep latency leads to more post-trauma nightmares (Youngren et al., 2020). The presence of trauma related nightmares, pre-sleep cognitive hyperarousal and sleep latency will increase vulnerability to the development of PTSD (Agorastos, et al., 2014; Youngren et al., 2020).

Even though the Night-CAP model provides a framework of how an individual is at increased risk of

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developing trauma related nightmares following trauma, the model can be utilised to describe how insomnia can also emerge as a result of both sleep latency and pre-sleep cognitive arousal. Insomnia is known as a hyperarousal disorder; external as well as internal factors such as alterations in neurobiological brain process can, in turn, lead to neurophysiological hyperarousal, variations in behavioural and psychological processes and behavioural conditioning learning which, in turn, increases vulnerability to the development of insomnia and associated health risks (Levenson et al., 2015). The Night-CAP model lends support to the premise that treating sleep disturbances in those exposed to trauma will lead to better outcomes for both sleep and post trauma symptoms (Agorastos, et al., 2014; Levenson et al., 2015).

Studies suggest that treating sleep disturbances in those with PTSD leads to better outcomes in terms of both improved sleep and also reduced trauma symptoms (Colvonen et al., 2018). Some of the sleep-focused psychological treatments include: (1) cognitive behavioural therapy for insomnia (CBT-I) which encompasses sleep restriction, stimulus control, cognitive component, and sleep hygiene (Morin & Espie, 2007); (2) exposure, relaxation, and rescripting therapy for nightmares (ERRT) which consists of psychoeducation about nightmares, sleep hygiene, muscle relaxation, exposure and rescripting of chronic nightmares (Davis & Wright, 2007); (3) imagery rehearsal therapy (IRT) consists of education about sleep, nightmares, homework of personalized pleasant imagery scenes, rescripting of the nightmare, problem solving and relapse prevention (Krakow & Zadra, 2010).

Multiple systematic reviews and meta-analyses have explored the effectiveness of sleep focused therapy on sleep disorders as well as PTSD symptoms. For example, a meta-analysis of 11 randomized controlled trials (RCTs) assessed the effectiveness of CBT-I, IRT and ERRT on sleep and found that these treatments significantly improved sleep quality and also reduced PTSD symptoms, with a moderate effect size of $ES = 0.6$, for the treatment group. In addition, the overall effect size as measured by sleep-diaries for sleep efficiency (SE), sleep onset latency, wake after sleep onset, Insomnia Severity Index (ISI), and the Pittsburgh Sleep Quality Index (PSQI) were large ($ES = 0.83–1.15$) in comparison to waitlist groups (Ho et al., 2016).

Similarly, Casement and Swanson (2012) identified 13 studies in their review and found that sleep-specific psychological treatments (IRT or IRT + CBT-I, or ERRT, or EERT + CBT-I) significantly reduced nightmare frequency ($ES = 0.59$), significantly improved sleep quality ($ES = 0.69$) and significantly reduced PTSD symptoms with a large effect size ($ES = 0.67$) for the treatment groups in comparison to the control groups. Other reviews reported comparable results (Taylor & Pruiksma, 2014; Wu et al., 2015).

Gaps in the literature

The presentation of sleep disorders in people with PTSD symptoms is different to those who suffer from insomnia unrelated to traumatic events. Whilst those who suffer from insomnia without trauma may look forward to sleep, individuals suffering from insomnia related to trauma view sleep as "a necessary evil" (Ulmer et al., 2011, p. 58).

Individuals presenting with sleep and PTSD symptoms tend to overestimate their sleep latency, how long it takes them to sleep, are more likely to experience hypervigilance at night, and worry more relative to those that present with sleep difficulties only (Perlis et al., 2001; Semler & Harvey, 2007).

Literature reporting on the effectiveness of psychological treatments for insomnia and nightmares in individuals exposed to trauma use self-report measures such as sleep diaries. There are issues with self-report measures being prone to bias and issues with validity checks/ whether they were completed at the time indicated (Buysse et al., 2006; Dietch et al., 2019).

Objective measures such as polysomnography (PSG) and actigraphy are recommended for utilization in assessing sleep-specific interventions in conjunction with self-report measures to gain more confidence in treatment outcomes (Buysse et al., 2006; Dietch et al., 2019). PSG, the gold standard in the diagnosis of sleep disorder, provides heart rate, activity of brain waves, oxygen levels in the blood, breathing, and eye and leg movements during sleep; it is also used to objectively measure sleep and the various sleep stages (Buysse et al., 2006).

Actigraphy is an objective measure of sleep that provides data about sleepiness and wakefulness states, it also generates estimates of sleep parameters that are usually collected from sleep diaries and PSG (Smith et al., 2018). To date, no reviews have exclusively assessed the effectiveness of objective measures of sleep and how they align with self-report measures in providing a general overview of sleep-specific treatment outcomes in those with trauma symptoms. Therefore, a better understanding of available psychological interventions through selecting high quality RCTs that assess sleep disorders both objectively and subjectively is likely to underscore a better understanding of available effective treatments.

Better understanding of the alignment between self-report and objective measures will further strengthen sleep diagnosis, not only for researchers but also for clinicians and primary care of their patients. This in turn will inform treatment and referral processes (Gieselmann et al., 2018). A major limitation in the aforementioned systematic reviews was the exclusion of objective measures in assessing the effectiveness of sleep-specific psychological

treatment outcomes. More specifically, some reviews used trials without control groups (Casement & Swanson, 2012), and others included non-peer reviewed studies (Ho et al., 2016).

As such, this review tries to address the above gaps.

Aims of this review

In this review, we aimed to extend the work that has been carried out by other reviews. Firstly, we aimed to synthesize the available literature from RCTs that used both self-report and objective measures of sleep. Secondly, we examined the effectiveness of sleep-specific psychological treatment in those diagnosed with insomnia and/or nightmares comorbid with post-traumatic stress symptoms. Finally, we explored the effectiveness of sleep-specific psychological treatment on post-traumatic stress symptoms.

Method

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (PRISMA) (Moher et al., 2009), searchers were conducted between January of 2021, and January of 2022. We performed a literature search using EBSCO, MEDLINE, PsychINFO, CINAHL, EMBASE, PubMed, Cochrane Library and Taylor & Francis databases by entering the following terminologies: (insomnia OR parasomnia OR hypersomnia OR insomniac OR night terror* OR nightmare*) AND (post-traumatic stress disorder* OR PTSD OR depression OR major depressive disorder* OR trauma OR complex trauma) AND (Psychological intervention* OR Psychotherapy* OR Psychological treatment* OR Cognitive behavioural therapy* OR cognitive behavioral Therapy* OR CBT OR multi-model CBT OR EMDR OR multicomponent psychotherapy* OR Imagery Rehearsal Therapy* OR IRT, Exposure, Relaxation, and Re-scripting Therapy* OR ERRT OR CBT-I) NOT (Pharmacotherapy*) AND (actigraph* OR actimetry OR polysomnograph OR PSG OR objective measures OR objective sleep OR sleep parameters). The following terminologies were entered into Scopus as the pre-determined terminologies yielded no results: (insomnia OR nightmares AND post-traumatic AND stress AND trauma AND objective AND measures AND psychological AND intervention AND randomised AND trials). An additional search checking reference lists and Google Scholar was carried out. Figure 1 provides a map of our literature search. Table 1 provides details of the selected studies, and Table 2 provides assessment of risk of bias.

Study inclusion criteria

Inclusion criteria for this review considered peer reviewed RCTs; studies published in English between January 1990 and January 2022; adult population 18 + ; RCTs taking a diagnostic approach /being assessed by a health professional using structured clinical interview for insomnia and/or nightmares comorbid with post traumatic symptoms; RCTs primarily using and assessing the effectiveness of sleep-specific psychological interventions for insomnia and/or nightmares using both self-report and objective measures in assessing sleep.

Exclusion criteria

The following studies were excluded from this review: animal studies, study protocols, symposiums, oral presentations and posters, studies with minors, qualitative studies, studies published prior to 1990, non-RCTs, studies excluding objective measures, overlapping RCTs, correlational studies, studies excluding diagnosis of sleep disorders and/or trauma related symptoms, theses, and RCTs treating PTSD rather than sleep disorders (refer to Fig. 1).

Selection of studies

The eligibility, suitability and risk of bias of selected RCTs were verified by two researchers (FI and GK). There were some concerns about data overlap for four studies. Email correspondence with one author confirmed data overlap in two papers (Davis et al., 2011) and another paper was deleted because data overlap could not be ascertained (Kanady et al., 2018).

Study sample characteristics

A total of 290 participants were included in the selected studies. There were 92 females and 198 males, with a mean age ranging between 33–41 years.

Outcome parameters

Sleep efficiency (SE), derived from sleep diaries, was chosen as the primary measure of insomnia for this review. SE encompasses a number of sleep variables collected through sleep diaries. SE = total sleep time/time in bed multiplied by 100; and total sleep time (TST) = time in bed—sleep onset latency—waking time after sleep onset—morning waking time (Taylor & Pruiksma, 2014).

ISI scores (Bastien et al., 2001), were also reported where appropriate. The Pittsburgh Sleep Quality Index-Addendum (PSQI-A) was the selected measure for nightmares. PSQI-A is a self-report measure used to examine the frequency of

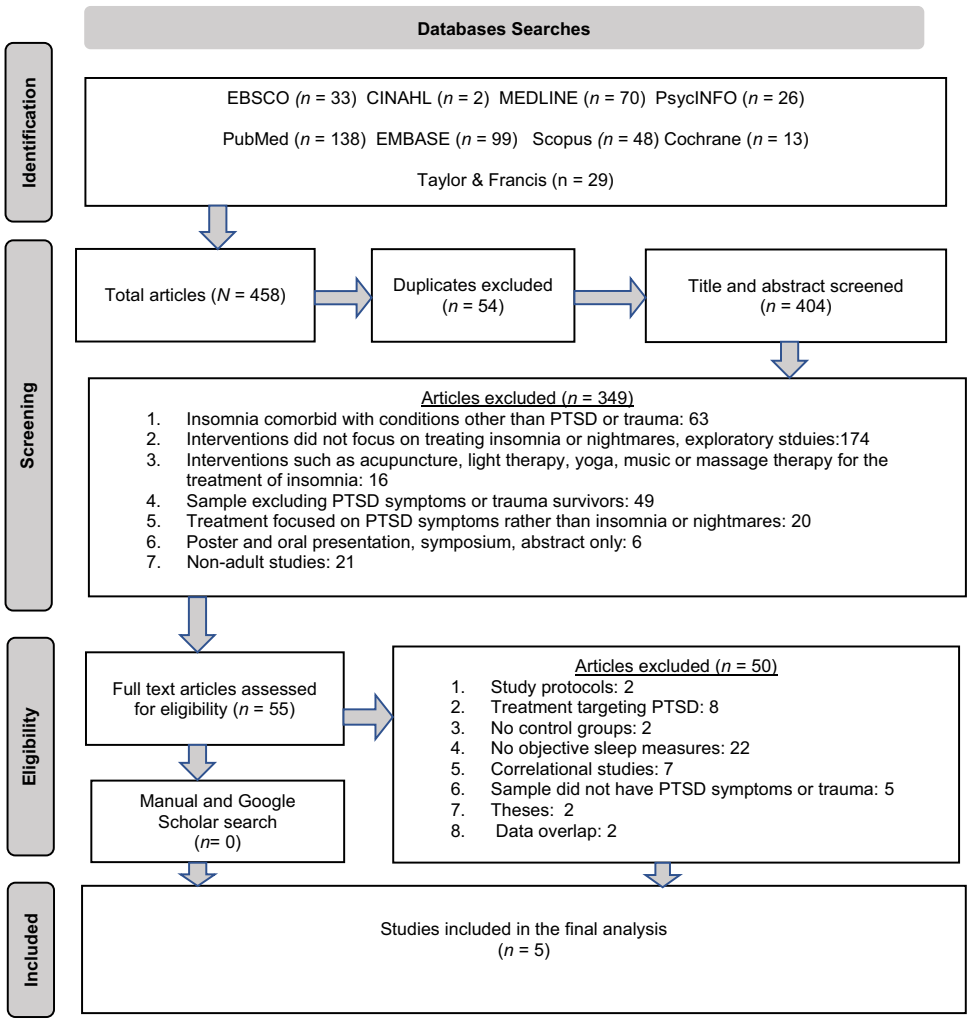

Fig. 1 PRISMA flow diagram of database searches and final studies selection

disruptive sleep behaviour and nightmares that are present in adults with PTSD (Germain et al., 2005). PSG, actigraphy and other physiological parameters were the selected objective measures of sleep in this review.

Statistical data reporting

The data presented in the results section, where available, reports on the interaction effect of time (pre-intervention against post-intervention) by group (intervention against control group). Where interaction effect is not provided, main effects alone were reported.

Results

Our search yielded four hundred and fifty-eight studies. Fifty-four duplicate studies were excluded. A total of 404 articles were screened by abstract. Of these, 349 were excluded because they did not meet the inclusion criteria (see Fig. 1). The remaining 55 studies were assessed by full text. Of these, 50 studies were excluded for reasons provided in Fig. 1. Five RCTs met the inclusion criteria and were selected for the final analysis of this review.

Findings from selected studies

The effect of CBT-I and ERRT therapy on nightmares

Four RCTs assessed the effectiveness of psychological treatment on nightmares in those presenting with post-traumatic stress symptoms in this review. Germain et al. (2012) examined the efficacy of eight sessions of Behavioral Sleep Intervention (BSI) for sleep disturbances in veterans. BSI consisted of IRT, psychoeducation about insomnia and nightmares, stimulus control, sleep restrictions, and adherence to treatment. BSI resulted in main effects of time on the PSQI-A ($p < 0.01$) for both the treatment and the placebo group. No significant treatment by time interaction was detected. Researchers of this study attributed their findings

Table 1 Summary of randomized control trials examining the effectiveness of psychological intervention on insomnia and/or nightmares comorbid with PTSD

Author/Country	Sample size N	Group-Allocations	Therapies Implemented	Objective/Subjective Measures	Treatment Focus & Post-Trauma Symptoms	Results
Germain et al., 2012 USA	50 MV	BSI ($n=17$) Prazosin ($n=18$) control placebo ($n=15$)	8 weeks of BSI 8 weeks of Prazosin or placebo	Sleep diary, ISI, PSQI, PSQI-A, PSG	Insomnia & Nightmares PTSD diagnosis using clinical structured interview	BSI significantly reduced nightmare frequency
Rhudy et al., 2010 USA	40 adults	ERRT ($n=19$) control ($n=21$)	3 weeks of ERRT two-hour duration waitlist control	PSQI, global sleep quality score, PSQI-A, SAM, electrodes to measure corrugator electromyogram EMG, heart rate HR, and skin conductance SC	Nightmares PTSD diagnosis using clinical structured interview	ERRT led to significantly lower physiological reactivity to nightmare imagery through the reduction of subjective emotions such as displeasure, sadness, fear and arousal at post treatment, three and six months follow up
Talbot et al., 2014 USA	45 adults	CBT-I ($n=29$) waitlist group ($n=16$)	8 weekly individualised CBT-I sessions	Sleep diary, ISI, PSQI, ESS, PSQI-A, Actigraphy & PSG	Insomnia PTSD diagnosis using clinical structured interview	CBT-I significantly reduced nightmares and significantly improved all measures on sleep dairy and insomnia scores
Taylor et al., 2017 USA	100 MV	FTF CBT-I (n = 34) Online CBT-I (n = 33) Control group (n = 33)	6 weeks, 60-min sessions of either FTF CBT-I or Online CBT-I Control group received a check in call every second week for 6 weeks	Sleep diary, ISI, ESS, DBAS Actigraphy	Insomnia PTSD using PTSD Checklist-Military Version	Both FTF and online CBT-I significantly improved SE and reduced insomnia scores compared to control group FTF CBT-I outperformed online CBT-I and control group on quality of sleep
Walters et al., 2020 USA	55 MV	All participants received 12 sessions of PE then randomised to CBT-I + IRT ($n=12$) or SCT ($n=11$)	5 weekly, 60-min session of IRT + 7 weekly, 60 min sessions of CBT-I control group received 12, weekly 60-min sessions of SCT	Sleep diary, ISI, PSQI, PSQI-A Actigraphy	Insomnia Nightmares PTSD diagnosis using clinical structured interview	Participants who received CBT-I were no longer in the clinical range for sleep efficiency in comparison to SCT group The addition of CBT-I to IRT led to significantly improved sleep efficiency in comparison to control groups

PTSD = post-traumatic stress disorder; DBAS = The Dysfunctional Beliefs and Attitudes about Sleep; BSI = behavioral sleep intervention; CBT-I = cognitive behavioral therapy for insomnia; MV = military veterans; ERRT = exposure, relaxation, and rescripting therapy for nightmares; IRT = imagery rehearsal therapy; SCT = supportive care therapy; PE = prolonged exposure; ISI = Insomnia Severity Index; ESS = The Epworth Sleepiness Scale; PSQI-I = The Pittsburgh Sleep Quality Index; PSG = polysomnography; PSQI-A = The Pittsburgh Sleep Quality Index Addendum; SAM = A computer version of the Self-Assessment Manikin

Table 2 Assessment of risk of bias utilizing the revised cochrane risk-of-bias tool for randomized trials (RoB 2, Higgins et al., 2019) of the selected studies

Scale	Studies				
RoB 2 Bias Domains	Germain et al., 2012	Rhudy et al., 2010	Talbot et al., 2014	Taylor et al., 2017	Walters et al., 2020
Bias due to randomization	Low risk	Low risk	Low risk	Low risk	Some concerns
Bias due to departure from intended interventions (assignment to intervention)	Low risk	Low risk	Low risk	Low risk	Low risk
Bias due to departure from intended interventions (adhering to intervention)	Low risk	Low risk	Low risk	Low risk	Some concerns
Bias due to missing outcome data	Low risk	Low risk	Low risk	Low risk	High risk
Bias in measurement of outcomes	Low risk	Low risk	Low risk	Low risk	Low risk
Bias in selection of reported results	Low risk	Low risk	Low risk	Low risk	Low risk
Overall RoB 2 judgement	Low risk	Low risk	Low risk	Low risk	High risk

to the small sample which included veterans with low nightmare frequency and low severity of post-traumatic stress symptoms (42% of the sample) (Germain et al., 2012).

Likewise, Rhudy et al. (2010) applied three sessions of ERRT and found that ERRT led to a significant interaction of treatment by time effect ($p < 0.04$) with lower scores on subjective measures of emotions such as displeasure ($d = 1.24$), sadness ($d = 0.90$), fear ($d = 1.20$), and arousal ($d = 0.68$) (all $p < 0.001$) from baseline to posttreatment for the treatment group compared to the waitlist control group (Rhudy et al., 2010).

Furthermore, Talbot et al. (2014) assessed the effectiveness of eight sessions of CBT-I for the treatment of insomnia. CBT-I resulted in a significant group by time effect ($p < 0.001$), with participants receiving CBT-I experiencing a significant reduction on PSQI-A scores from pre-treatment to six months follow-up ($p < 0.001$, $d = 1.07$) compared to the waitlist group (Talbot et al., 2014). Similarly, 12 sessions of CBT-I and IRT, led to a non-significant yet large decrease main time effect on nightmare frequency ($p = 0.11$, $d = 0.90$) compared to a control supportive care therapy from pre-to post-treatment (Walters et al., 2020) (see Table 1 for group comparisons).

Taken together, the findings of studies outlined above suggest that both CBT-I treatment alone or combined with IRT or ERRT (average of 3–12 sessions) led to a reduction in nightmares frequency with medium to large effect sizes for individuals presenting with post-traumatic stress symptoms (Germain et al., 2012; Rhudy et al., 2010; Talbot et al., 2014 Walters et al., 2020).

CBT-I effectiveness on diary measures

SE as indexed by sleep diaries was further explored by examining the effectiveness of CBT-I for insomnia in three studies in this review. Germain et al. (2012) found that eight sessions of BSI, resulted in no significant group by time interaction effect for BSI and prazosin/sleep medication for insomnia as measured by the ISI (Bastien et al., 2001) compared to the placebo group. However, at four months follow up, results showed a group by time interaction (post-treatment $p < 0.04$, and follow-up $p < 0.009$) on ISI with noticeable improvement for the BSI group compared to the prazosin group.

Similarly, Talbot and colleagues (Talbot et al., 2014) found a significant group by time interaction for SE with participants receiving eight sessions of CBT-I experiencing significantly more improvements from pre-to-post-intervention ($p < 0.001$, $d = 1.06$) and at six months follow up ($p < 0.001$, $d = -1.48$) compared to the waitlist group. Six sessions of both face to face (FTF), and online CBT-I both led to significant group by time interaction on SE ($p = 0.002$) in comparison to the control group; with the FTF treatment showing larger effect size than online CBT-I ($d = 0.89$, and $d = 0.53$ respectively) (Taylor et al., 2017). The improvements were maintained at six month follow up (Taylor et al., 2017).

Walters et al. (2020) found that seven sessions of CBT-I significantly increased SE for the treatment group compared to supportive care therapy ($p = 0.04$, $d = 1.25$). At the completion of all treatments, participants who received CBT-I no longer fell in the clinical range of insomnia (SE > 85%), whereas those receiving supportive care therapy remained in the clinical range (SE = 75%) (Walters et al., 2020).

The four RCTs suggest that CBT-I, average of six-eight sessions, is effective in improving SE and reducing insomnia severity, at both post treatment, and six-month follow up (effect sizes ranging between small to large with trends towards large effect sizes) (Germain et al., 2012; Talbot et al., 2014; Taylor et al., 2017; Walters et al., 2020).

Objective/actigraphy assessment of insomnia

Three studies in this review used actigraphy as an objective measure of sleep. Talbot and colleagues (Talbot et al., 2014) found no significant group by time interaction nor main effects of condition or time. Walters et al.'s (2020) sample size did not allow for a meaningful statistical analysis on the actigraphy measure. Total sleep time TST was significantly reduced from pre-to-post-treatment for both FTF CBT-I ($p = 0.004$) and online CBT- ($p = 0.011$) in comparison to the control group (Taylor et al., 2017). Findings from the three RCTs suggest that actigraphy maybe robust in providing data for TST parameter only (Talbot et al., 2014; Walters et al., 2020).

Objective/physiological assessment of nightmares following ERRT

One study provided objective/physiological assessment of CBT treatment and its effectiveness on nightmares. A significant group by time interaction was found following three sessions of ERRT with the intervention group experiencing significantly reduced physiological reaction to nightmares imagery from baseline to post-treatment ($p < 0.013$) compared to the waitlist group ($p > 0.40$). Large effect sizes for corrugator electromyogram ($d = 1.13$), lateralis frontalis electromyogram ($d = 0.89$), heart rate ($d = 0.93$), and skin conductance ($d = 0.99$) were found for the treatment group (Rhudy et al., 2010). This reduction remained significant at six months follow up ($p < 0.03$) for the treatment group (Rhudy et al., 2010).

Whilst results from this research is promising, it is important to highlight that this is one RCT, and more research in needed to confirm these findings. Furthermore, the study by Rhudy and colleagues (2010) measured physiological assessments of reactions to nightmare content during wakefulness rather than sleep.

Objective/polysomnography PSG assessment of insomnia

Two studies reported PSG data. Germain and colleagues (Germain et al., 2012) found no significant treatment by time interaction for PSG on any of the sleep parameters including SE. The researchers attributed the absence of effect on the PSG from this study to the inclusion of a military veterans with mild psychiatric symptoms which may have indicated the lack of response or improvement following psychological treatment for insomnia.

Talbot and colleagues (Talbot et al., 2014) found that an analysis of covariance revealed a significant increase of TST for the CBT-I group (i.e., 30 min more) at posttreatment ($p = 0.008$) compared to the control group, measured by PSG. The two studies provide inconsistent findings, however findings reported by Talbot and colleagues (Talbot et al., 2014) are promising in relation to the effectiveness of PSG for assessing sleep outcome parameters following a psychological treatment for sleep difficulties.

CBT for insomnia and nightmares and its impact on PTSD

The effect of the impact of psychological sleep treatments on post-traumatic stress symptomology was considered in four RCTs. Germain et al. (2012) assessed participants symptoms using a self-report measure of PTSD Checklist (PCL, Blanchard et al., 1996) and found no significant treatment by time interaction for PTSD ($p = 0.18$). Germain and colleagues suggested that despite the absence of significant reduction in PTSD symptoms, mild improvements for PTSD symptoms were obtained because of adherence to sleep diaries, medication consumption, and telephone or personal checking with participants throughout the study.

Similarly, Talbot et al. (2014) found no significant group by time interception, however the main effect of treatment for participants receiving CBT-I showed a reduction in scores on the Clinician Administered PTSD Scale (CAPS, Blake et al., 1995) from baseline to six months follow up ($p < 0.001$, $d = 1.23$), and a significant reduction on the self-report PCL scores from baseline to six month follow up ($p = 0.001$, $d = 0.83$). Utilizing CAPS, Walters et al. (2020) found no significant group by time interaction. However, following 12 sessions of IRT and CBT-I, the CAPS scores were reduced ($p = 0.54$. $d = 0.31$) for the treatment group compared to supportive care therapy. The findings from the three RCTs lend support to the notion that post-traumatic stress symptoms improve with small to large effect sizes following psychological treatments for insomnia and nightmares (Germain et al., 2012; Talbot et al., 2014; Walters et al., 2020).

Discussion

The aim of this preliminary review was to summarize RCTs that assessed the effectiveness of psychological interventions, using both subjective and objective measures, for treating diagnosed insomnia and/or nightmares in patients presenting with post-traumatic stress symptoms.

Our findings from the four selected RCTs showed that CBT-I treatment alone or combined with either IRT and ERRT, led to a reduction in nightmare frequency in individuals presenting with nightmares and post-traumatic stress symptoms with medium to large effect sizes (Germain et al., 2012; Rhudy et al., 2010; Talbot et al., 2014; Walters et al., 2020). The findings of this review are in line with previous research that has shown that CBT-I and ERRT alone or combined are effective in reducing nightmares in people

with post-traumatic stress symptoms (Casement & Swanson, 2012; Taylor & Pruiksma, 2014).

Furthermore, our preliminary review showed that an average of six to eight sessions of CBT-I is effective in reducing insomnia severity and improving SE at posttreatment and follow up with small to large effect sizes (Germain et al., 2012; Talbot et al., 2014; Taylor et al., 2017; Walters et al., 2020). The findings of our review are consistent with those of Taylor and Pruiksma (2014) who reviewed studies targeting insomnia comorbid with psychiatric conditions and found that CBT-I improves SE.

Actigraphy data derived from this review did not detect changes on any sleep parameter except TST due to sleep restriction therapy component of CBT-I (Talbot et al., 2014; Taylor et al., 2017; Walters et al., 2020). Actigraphy may not be a sensitive or specific enough measure to capture sleep–wake patterns in people with insomnia, as it cannot distinguish between quiet wakefulness and the sleep state (Buysse et al., 2006). The lack of alignment between self-report and objective measures has been reported by other studies (Arditte Hall et al., 2020; Stout et al., 2017).

Possibly the inconsistency between objective and subjective measures is related to subtle sleep and/or post-traumatic stress variables such as sleep quality, anger, anxiety and hypervigilance rather than a function of instruments per se. Stout and colleagues (Stout et al., 2017) found that military personnel with PTSD showed higher levels of emotional arousal, reported significantly more nightmares, flashbacks, significantly higher levels of anxiety and anger in comparison to those without PTSD. Otherwise stated, someone who is completing a sleep diary is likely to engage his emotions when answering questions/filling out questionnaires, a phenomenon that is missed by objective measures such as PSG and actigraphy, explaining the discrepancy between subjective and objective measures of sleep.

Despite the findings in relation to actigraphy, physiological assessments and findings related to PSG in measuring the effectiveness of psychological treatment for insomnia and nightmares are promising. Our findings from this review showed that reaction to nightmares imagery from baseline to post-treatment was reduced, with large effect sizes, when measured using electromyogram, heart rate and skin conductance. Furthermore, a significant increase in TST (more than 30 min for the treatment group) was found for participants receiving CBT-I for insomnia at post-treatment as assessed by PSG (Rhudy et al., 2010; Talbot et al., 2014). The inclusion of physiological and PSG data in sleep research is essential to increase the validity of the findings and further research in needed to confirm the above findings. More research is needed to close the gap between subjective and objective measures.

Interestingly, sleep-specific psychological treatments from this review supports the premise that post-traumatic stress symptoms are reduced, with small to large effect sizes, following a successful treatment of insomnia and/or nightmares in those with trauma symptoms (Germain et al., 2012; Talbot et al., 2014; Walters et al., 2020). Our findings lend further support to previous research which indicated that an application of psychological treatments for insomnia and nightmares leads to improvements in post-traumatic symptoms (Ho et al., 2016; Taylor & Pruiksma, 2014).

Limitations

In light of the above findings, the small number of the selected studies limited our ability to reach a strong conclusion in relation to the effectiveness of objective measures and their robustness in assessing the efficacy of sleep-specific psychological treatments in those with post-traumatic stress symptoms. All studies were conducted in the USA and thus, the generalisability of the findings across-cultures remain to be demonstrated.

Furthermore, whilst the PSQI-A was used as a primary outcome for nightmares, the PSQI-A does not differentiate between memories or nightmares of a traumatic experience which may not be specific to nightmares during sleep. Nevertheless, this review is the first in the field of sleep and trauma to assess the effectiveness of psychological treatments using both self-report and objective measures. Further research in needed to understand and close the gap between self-report and objective measures of sleep in those with post-traumatic symptoms.

Implications

All the studies examined in our review did not take into account variables other than insomnia, nightmares and post-traumatic stress. Observational and empirical studies should screen for the presence of other variables when measuring sleep in those with post-traumatic stress symptoms to better understand the discrepancy between the objective and subjective measures of sleep. One method in achieving this would be using qualitative designs to explore how insomnia develops and under what conditions it is maintained and exacerbated. Understanding sleep disruption following trauma, heterogeneity of symptoms and risk of co-morbid conditions, will guide prevention and treatment of sleep disorders (Agorastos et al., 2014; Levenson et al., 2015).

Researchers are utilising methods such as Online Photovoice (OPV, Tanhan & Strack, 2020), a reliable and effective method that uses live experiences and narratives to guide understanding of experiences such as trauma and sleep difficulties. This will provide insight into sleep disorders, trauma symptoms, and potential feasible effective interventions on what would help an individual in overcoming and coping with their mental health conditions.

All the clinical trials selected in our systematic reviews utilised interventions that have not undergone feasibility check for targeted population. To advance in this area, more research is needed using usability qualitative methods as a starting point using OPV, focus groups and structured interviews. Following the implementation of usability studies, clinical trials can be conducted to gain more confidence in sleep interventions used in adults presenting with sleep difficulties and trauma symptoms.

Furthermore, given the challenges posed by COVID-19, online interventions need to come to the forefront of research and clinical practice as more demand for psychological help is needed (Isaac et al., 2022). Possibly this active approach with understanding sleep disorders and trauma symptoms will provide the opportunity for diligent and effective interventions which can potentially close the gap between objective and subjective measures of sleep.

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Declarations

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