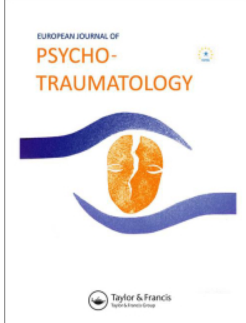

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BASIC RESEARCH ARTICLE

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Do subjective and objective baseline sleep disturbances predict post-traumatic stress disorder treatment response? A secondary analysis of a randomized controlled trial

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ABSTRACT

Background: Sleep disturbances are highly prevalent in individuals with post-traumatic stress disorder (PTSD) and might interfere with trauma-focused treatments by disrupting memory consolidation, extinction and safety learning. However, evidence on the impact of sleep deficits on PTSD treatments remains inconclusive.
Objective: This study conducted a secondary analysis of a randomized controlled trial comparing cognitive processing therapy (CPT) and dialectical behaviour therapy for PTSD (DBT-PTSD) in women with PTSD. We examined whether subjective and objective baseline sleep disturbances predicted PTSD symptom reduction after up to 15 months of outpatient treatment, whether depression moderated this relationship, and whether effects differed for CPT and DBT-PTSD.
Method: Sleep was assessed in $n = 178$ women using actigraphy, sleep diaries, and the Pittsburgh sleep quality index (PSQI), applying linear mixed models for each sleep measure.
Results: Subjective sleep disturbances as measured in the PSQI did not significantly predict overall treatment outcomes for PTSD ($p = .140$). Additionally, depressive symptoms did not moderate this relationship ($p = .469$), and the effect did not differ for CPT and DBT-PTSD ($p = .086$). The same was found for sleep diary and actigraphy assessments.
Conclusions: These findings suggest that sleep disturbances do not hinder the effectiveness of long-term trauma-focused PTSD treatment in women with complex trauma presentations, implying that sleep-specific interventions may not be a prerequisite for initiating trauma-focused treatment in this population.

¿Predicen las alteraciones del sueño basales, tanto subjetivas como objetivas, la respuesta al tratamiento del trastorno de estrés postraumático? Un análisis secundario de un ensayo controlado aleatorizado

Antecedentes: Los trastornos del sueño son muy frecuentes en personas con trastorno de estrés postraumático (TEPT) y podrían interferir con los tratamientos centrados en el trauma al alterar la consolidación de la memoria, la extinción y el aprendizaje de la seguridad. Sin embargo, la evidencia sobre el impacto de la falta de sueño en los tratamientos del TEPT sigue siendo inconclusa.
Objetivo: Este estudio realizó un análisis secundario de un ensayo controlado aleatorizado que comparó la terapia de procesamiento cognitivo (TPC) y la terapia dialéctica conductual para el TEPT (DBT-TEPT) en mujeres con TEPT. Examinamos si las alteraciones del sueño basales, tanto subjetivas como objetivas, predecían la reducción de los síntomas del TEPT luego de hasta 15 meses de tratamiento ambulatorio, si la depresión moderaba esta relación y si los efectos diferían entre la TPC y la DBT-TEPT.
Método: Se evaluó el sueño en $n = 178$ mujeres mediante actigrafía, diarios de sueño y el índice de calidad del sueño de Pittsburgh (PSQI), aplicando modelos lineales mixtos para cada medida del sueño.

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Posttraumatic-stress disorder; sleep; actigraphy; treatment; effectiveness; CPT; DBT

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Trastorno de estrés postraumático; sueño; actigrafía; tratamiento; eficacia; terapia de procesamiento cognitivo (TPC); terapia dialéctica conductual (DBT)

HIGHLIGHTS
- Sleep disturbances did not predict PTSD treatment outcomes.
- Depression did not moderate the link between sleep and PTSD treatment success.
- Findings were consistent across subjective and objective sleep assessments.

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Resultados: Las alteraciones subjetivas del sueño, medidas mediante el PSQI, no predijeron significativamente los resultados generales del tratamiento para el TEPT ($p = 0{,}140$). Además, los síntomas depresivos no moderaron esta relación ($p = 0{,}469$), y el efecto no difirió entre la TPC y la DBT para el TEPT ($p = 0{,}086$). Se observó el mismo resultado con los diarios de sueño y las evaluaciones mediante actigrafía.
Conclusiones: Estos hallazgos sugieren que los trastornos del sueño no obstaculizan la eficacia del tratamiento a largo plazo del TEPT centrado en el trauma en mujeres con presentaciones de trauma complejas, lo que implica que las intervenciones específicas para el sueño pueden no ser un requisito previo para iniciar el tratamiento centrado en el trauma en esta población.

Post-traumatic stress disorder (PTSD) places a significant burden on affected individuals. While several trauma-focused treatments effectively reduce PTSD symptoms and improve quality of life, around 40% of patients undergoing psychotherapies for PTSD still show clinically significant symptoms after treatment (Semmlinger et al., 2024). To enhance treatment outcomes, it is essential to identify factors that may hinder the treatment progress. Sleep disturbances have been proposed as one such factor (Gilbert et al., 2015).

Trauma-focused CBT approaches (e.g. prolonged exposure (PE), cognitive processing therapy (CPT)) are strongly supported by empirical evidence and considered first-line interventions for treating PTSD (APA, 2025; NICE, 2018). PTSD is characterized by a trauma-related fear network that links reminders of the event with intense emotions, bodily reactions, and threat perception (Foa & Kozak, 1986). Trauma memories are often fragmented, with vivid sensory details poorly integrated into their temporal and contextual framework (Ehlers & Clark, 2000), and are accompanied by cognitive distortions (Resick, 2016). Exposure treatment, often combined with cognitive restructuring, reactivates this network in a safe environment to allow non-threatening associations to form, fragmented memories to be organized into a coherent narrative, and maladaptive ‘stuck points’ (i.e. unhelpful beliefs about oneself, others, or the world related to the traumatic event) to be revised into more balanced appraisals (Rauch et al., 2012).

These therapeutic gains rely on memory consolidation, safety and extinction learning (Straus et al., 2018). Healthy sleep plays an important role in facilitating these processes (Bennion et al., 2013; Pace-Schott et al., 2009; Payne et al., 2012), whereas disturbed sleep was found to impair memory consolidation (Krause et al., 2017), extinction recall (Straus et al., 2017), and the neural processes underlying extinction learning (Seo et al., 2021). In an experimental study, REM sleep during a nap after exposure to a trauma film was associated with less distress from intrusions compared to participants without REM sleep or staying awake (Wilhelm et al., 2021). Given that 70–90% of individuals with PTSD report sleep disturbances (Lancel et al., 2021; Weber & Wetter, 2021), these findings raise the question of whether disturbed sleep may weaken trauma-focused treatment effects.

Evidence on whether disrupted sleep affects PTSD treatment outcomes remains inconclusive. A recent systematic review synthesized 16 primary studies examining the relationship between sleep disorder symptoms and trauma-focused psychotherapy outcomes in adults with PTSD (Bottari et al., 2023). For insomnia symptoms, studies consistently found no significant association between baseline insomnia severity and the degree of PTSD symptom reduction (Colvonen et al., 2019; Galovski et al., 2016; Hale et al., 2019; López et al., 2019; Resick et al., 2020; Sherrill et al., 2022; Taylor et al., 2020; Zalta et al., 2020). Findings on whether baseline sleep duration predicted PTSD symptom reduction were mixed. One study reported no such effect (Lommen et al., 2016), whereas another observed an effect in one intervention arm only (Taylor et al., 2020). Using polysomnography in a pilot study of 13 patients receiving NET, Weinhold et al. (2017) found that those with longer REM duration at baseline showed greater PTSD symptom reduction post-treatment, though this effect did not extend to follow-up. Greater total sleep time showed a statistical trend in the same direction. For subjective sleep quality, one study found that poorer baseline sleep quality predicted both less and slower symptom improvement (Sullan et al., 2021), whereas two studies found no predictive effect on symptom reduction post-treatment (Lommen et al., 2016; Sexton et al., 2017). However, in Lommen et al. (2016) depression moderated this relationship: among those with co-occurring depression, sleep disturbances were associated with a slower rate of symptom change, though this was not reflected in overall post-treatment symptom levels. Beyond studies captured by the systematic review, Pruiksma et al. (2023) found that baseline insomnia did not attenuate the rate of PTSD symptom reduction during CPT in active-duty soldiers, although those with insomnia maintained higher overall symptom levels throughout treatment. In

contrast, Sripada et al. (2017) found that among veteran outpatients receiving PTSD treatment, diagnosed sleep disorders were associated with a greater likelihood of belonging to a non-improving symptom trajectory.

Beyond the polysomnography study included in the systematic review (Weinhold et al., 2017), the literature on objectively measured sleep as a predictor of PTSD treatment outcomes is scarce. Hunt et al. (2023) examined actigraphy-assessed sleep between therapy sessions. Greater sleep efficiency was linked to greater fear extinction during exposure and lower PTSD symptoms in subsequent sessions. Notably, sleep efficiency predicted symptom change largely independently of its influence on extinction learning, suggesting additional mechanisms may be involved. Using polysomnography, Haynes et al. (2017) similarly found that objective sleep disorders alone did not predict clinically significant outcomes following CPT, rather, improvements depended on a combination of sleep status, depression severity, and sedating medication use.

The existing evidence base is limited in important ways. This includes a small overall number of studies, high risk of publication bias, small sample sizes leading to underpowered studies and limited ability to assess interaction effects, the frequent use of non-validated self-report instruments, and the underrepresentation of objective sleep measures (Bottari et al., 2023). The latter is a significant gap, as discrepancies between objective and subjective sleep measures are well-documented in PTSD research (Cox et al., 2017), and combining both is recommend for a comprehensive sleep assessment (Bottari et al., 2023; Lehrer et al., 2022).

To address these shortcomings, we conducted a secondary analysis of a randomized controlled trial in which both CPT and Dialectical Behavior Therapy for PTSD (DBT-PTSD), a multicomponent phase-based programme including an exposure component, significantly reduced PTSD symptoms, with DBT-PTSD demonstrating greater efficacy compared to CPT (Bohus et al., 2020). Using sleep data from the same RCT, we have previously examined changes in sleep disturbances over the course of treatment and found improvements in subjective, but not objective, sleep measures (Porten et al., 2025). In the present paper, we investigated (1) whether objective and subjective baseline sleep disturbances predict PTSD symptoms at post-treatment, (2) whether depression moderates this relationship, and (3) whether effects differ between CPT and DBT-PTSD, given that only the latter includes a dedicated exposure component. We hypothesized that greater baseline sleep disturbances would be associated with poorer PTSD treatment outcomes. Due to limited prior research, analyses on objective sleep, depression as a moderator, and treatment-specific effects were exploratory.

1. Methods

1.1. Study design and participants

This study utilized data from a multicenter randomized controlled trial (RCT) investigating the effects of CPT and DBT-PTSD on PTSD symptoms in women who had experienced childhood abuse (RELEASE; DRKS00005578). Findings from the primary RCT revealed a reduction in PTSD symptoms across both treatment groups, with DBT-PTSD demonstrating greater efficacy compared to CPT (Bohus et al., 2020). From the initial 193 participants enrolled in the RCT, 178 women, aged between 18 and 62 years, participated in the baseline sleep assessments for the present study.

The primary RCT was conducted in Germany, with participants recruited at three sites: Mannheim, Frankfurt, and Berlin. Eligibility criteria required participants to be female in both gender and sex identity and to meet the diagnostic criteria for PTSD according to the DSM-5 resulting from abuse-related trauma occurring before the age of 18. Participants also needed to show emotion regulation difficulties, including affective instability and two additional borderline personality disorder criteria. Exclusion criteria were a history of schizophrenia, bipolar I disorder, intellectual disability, or other severe psychiatric conditions necessitating immediate intervention in a different setting (e.g. BMI <16.5), current substance dependence, life-threatening suicide attempts in the two months preceding enrolment, medical conditions contraindicating exposure therapy (e.g. pregnancy), or unstable living conditions (e.g. homelessness). Ethical approval was obtained, and all participants provided informed consent.

1.2. Procedure

Participants underwent a screening process before being randomly assigned to either CPT or DBT-PTSD. CPT is a well-established, evidence-based therapy for PTSD that targets maladaptive beliefs and emotions related to the traumatic event (Resick, 2016). DBT-PTSD is a structured, phase-based treatment developed specifically for individuals with complex presentations of PTSD following childhood abuse, combining emotion regulation strategies from standard DBT with trauma-focused cognitive–behavioural techniques and elements from compassion-focused and acceptance-based approaches (Bohus et al., 2020).

Baseline assessments of sleep, PTSD, and other psychopathological measures were conducted shortly before treatment initiation (month 0). Sleep was monitored for six consecutive nights using both subjective (sleep diary) and objective (actigraphy) methods. On

the final day, participants completed the Pittsburgh Sleep Quality Index (PSQI; Buysse et al. (1989)) to assess their sleep quality over the previous week. Following baseline assessments, participants received up to 45 weekly therapy sessions (extending to month 12), followed by three monthly booster sessions (month 15). Post-treatment PTSD symptoms were assessed at month 15.

1.3. Measurements

1.3.1. Psychopathology measures

1.3.1.1. Clinician-administered PTSD scale for DSM-5 (CAPS-5). The severity of PTSD symptoms was assessed using the German adaptation of the CAPS-5 (Müller-Engelmann et al., 2020; Weathers et al., 2018). The CAPS-5 is a structured interview designed to evaluate 20 PTSD symptoms, rated on a 5-point Likert scale from 0 to 4. In this RCT sample, the instrument showed high internal consistency (Cronbach's alpha = .93) (Bohus et al., 2020).

1.3.1.2. Beck's depression inventory (BDI-II). Depressive symptoms were measured at baseline using the German version of the BDI-II Hautzinger et al. (2006). The German adaptation has demonstrated high internal consistency in prior research ($\alpha \geq 0.84$) (Kühner et al., 2007).

1.3.1.3. Structural clinical interview for DSM-IV (SCID-I). To assess co-occurring DSM-IV disorders at baseline, the SCID-I (First et al., 1997), a semi-structured interview, was administered as part of the diagnostic screening procedure.

1.3.2. Subjective sleep measures

1.3.2.1. Sleep diary. Participants provided daily sleep reports at baseline, recording data for six consecutive days via an electronic diary using the movisensXS application (movisens GmbH, Karlsruhe, Germany). Each participant received a smartphone programmed to send reminders at 9 AM to complete sleep-related questions on total sleep time (TST) ('How long was your total sleep time (in hours)?'), sleep quality ('How was your sleep last night?' rated on a scale from 1 = very bad to 4 = very good), and nightmares ('Did you experience a nightmare last night?' and if yes: 'Please enter the number of nightmares in the previous night.'). For the current study, sleep duration and sleep quality were used as the sleep diary outcomes.

1.3.2.2. Pittsburgh Sleep Quality Index (PSQI). The PSQI was adapted to assess various facets of subjective sleep across a one-week timeframe. The global PSQI score ranges from 0 to 21, with scores above 5 indicating clinically relevant sleep disturbances. Monthly PSQI assessments have demonstrated strong internal consistency (Cronbach's alpha = 0.70–0.83) and good test-retest reliability ($r = 0.81$ to $r = 0.86$) across different populations (Mollayeva et al., 2016).

1.3.3. Objective sleep measures

1.3.3.1. Actigraphy. Sleep parameters were objectively measured using an actigraphy device (move 2, movisens GmbH, Karlsruhe, Germany) worn continuously for six consecutive days and nights. Participants were instructed to wear the device on their nondominant wrist. Actigraphy data were analyzed using DataAnalyzer software (Version 1.18.3, movisens GmbH, Karlsruhe, Germany), which employs a validated algorithm. Validation details and further details can be found in Barouni et al. (2020).

Subsequent data processing was conducted using Python's NumPy package (Harris et al., 2020) to calculate key sleep parameters, including total sleep time (TST), wake after sleep onset (WASO), sleep efficiency, sleep fragmentation index, and non-wear time. Sleep onset was defined as the first continuous sleep episode lasting at least 20 min with no more than one minute of wakefulness occurring after 8 PM. Sleep offset was identified as the last 20-minute uninterrupted wakefulness episode occurring before 12 PM the next day (Fekedulegn et al., 2020). The sleep period was determined as the interval between sleep onset and sleep offset.

TST was calculated as the total minutes of sleep occurring within the sleep period. WASO referred to the total minutes of wakefulness during the sleep period. Sleep efficiency is a measure of insomnia and was defined as the percentage of the sleep period spent asleep, obtained by dividing TST by the sleep period and multiplying by 100. The sleep fragmentation index was calculated as the ratio of the number of awakenings to the total sleep period, whereas higher values indicate more fragmented sleep (Fekedulegn et al., 2020).

1.4. Statistical analysis

Analyses were performed using SPSS Version 29.0.2.0. Actigraphy and sleep diary data were averaged over the recorded days to determine the mean values of each sleep measure. Sleep-related CAPS-5 items were retained in the total score, as sleep disturbances are a core PTSD symptom and removing them would deviate from the validated scoring of the measure, limiting comparability with existing literature. To test for baseline differences between the treatment groups, independent t-tests and chi-square tests were performed for demographics, sleep measures, and psychopathology measures. Participants with a baseline sleep measurement of the corresponding assessment instrument, were included in the analysis. Pearson correlations were calculated to examine associations between subjective and objective sleep measures at

baseline and their relationship with PTSD severity. Linear mixed models (LMM) were employed for each sleep measure. Missing PTSD assessments were imputed using stochastic regression or multiple imputation (see Bohus et al. (2020)).

To examine whether baseline sleep disturbances predicted PTSD symptom severity at month 15, we conducted a series of LMMs entering PTSD symptoms at month 15 as the dependent variable, PSQI score at month 0 as a fixed factor and PTSD symptoms at month 0 as a covariate. To assess the moderating effect of depressive symptoms, we added an interaction term between PSQI (month 0) and BDI-II (month 0) to the model. To assess a differentiating effect of treatment condition, an interaction between PSQI (month 0) and treatment group (CPT vs. DBT-PTSD) was added. Separate models were fitted for sleep diary, and actigraphy and fixed factors were exchanged accordingly. All models were estimated using Restricted Maximum Likelihood.

2. Results

2.1. Baseline characteristics and missing data

A total of 178 participants completed at least one sleep assessment at baseline. The average age of women at the start of treatment was 35.9 years. On average, the onset of abuse occurred at 7.7 years of age, in 93% of cases, the perpetrator was a relative, and 90.4% of participants reported repeated abuse.

Regarding sleep, 159 participants completed the PSQI, 176 completed the sleep diary, and 129 provided actigraphy data. The lower number of actigraphy assessments was primarily due to technical issues and a transition between actigraphy device brands, participants using the older device were excluded to ensure consistency in data quality. Nearly all participants (98.7%) scored 5 or higher on the PSQI, indicating subjective clinically significant sleep disturbances at baseline. Objective actigraphy measures indicated that 38.8% of participants had a sleep efficiency below 80%, a threshold considered indicative of unhealthy sleep.

Baseline demographic and clinical characteristics are summarized in Table 1. No significant baseline differences were observed between treatment groups. Baseline correlations between subjective and objective sleep measures and their associations with PTSD severity are presented in the supplementary material.

2.2. Prediction sleep (month 0) on PTSD symptoms (month 15)

Controlling for baseline CAPS-5 scores, neither subjective nor objective sleep measures at baseline significantly predicted CAPS-5 scores at post-treatment, regardless of the sleep assessment method used (Table 2).

2.3. Moderation of depressive symptoms

Depressive Symptoms (BDI-II) did not significantly moderate the relationship between baseline sleep and PTSD symptoms after treatment while controlling for baseline symptoms. Specifically, no significant interaction was found for sleep assessed via the PSQI ($F = 0.47$, $p = .49$), sleep diary sleep quality ($F = 0.36$, $p = .55$), sleep diary TST ($F = 0.11$, $p = .74$.), actigraphy sleep efficiency ($F = 0.65$, $p = .42$), actigraphy WASO ($F = 0.93$, $p = .34$), actigraphy TST ($F = 0.01$, $p = .91$), and actigraphy fragmentation index ($F = 0.89$, $p = .35$).

2.4. Moderation of treatment group

The interaction between treatment type (CPT vs. DBT-PTSD) and baseline sleep was not statistically significant for any sleep measure in predicting post-treatment PTSD symptoms, controlling for baseline PTSD scores. This was true for sleep assessed via the PSQI ($F = 2.99$, $p = .09$), sleep diary sleep quality ($F = 2.63$, $p = .11$) sleep diary TST ($F = 1.62$, $p = .20$), actigraphy sleep efficiency ($F = 0.10$, $p = .75$), actigraphy WASO ($F = 0.06$, $p = .80$), actigraphy TST ($F = 0.13$, $p = .72$), and actigraphy fragmentation index ($F = 0.08$, $p = .78$).

3. Discussion

This study examined whether sleep disturbances at the start of treatment may hinder PTSD symptom reduction. Contrary to our hypothesis, we did not find a predictive effect of any subjective or objective baseline sleep disturbance assessments on PTSD symptom reduction. This finding was consistent across depression severity and treatment conditions. Thus, individuals experiencing sleep disturbances at baseline did not benefit less from trauma-focused treatments in terms of PTSD symptom reduction.

Our results contribute to the inconclusive literature on sleep as a predictor of PTSD treatment outcomes. The systematic review by Bottari et al. (2023) found mixed evidence across sleep domains. Our study extends this literature by finding no predictive effect across all examined subjective sleep domains, and adds a largely absent perspective by including objective actigraphy-based sleep measures. The null findings for objective sleep contrast with Weinhold et al. (2017), who found that longer REM duration predicted greater PTSD symptom reduction post-treatment in a small pilot study, though comparability is limited by a different treatment, small sample size, and use of polysomnography.

Table 1. Baseline characteristics.

	CPT		DBT-PTSD		
	n	*M (SD)*	*n*	*M (SD)*	*p*
Demographics					
Age	86	35.26 (11.22)	91	36.62 (10.58)	.32
Age start of abuse	86	7.69 (4.06)	91	7.85 (4.33)	.16
Sleep Measures[a]					
Subjective Sleep					
PSQI global score	75	11.97 (3.88)	84	11.95 (3.73)	.63
Sleep quality (sleep diary)	86	2.25 (0.55)	90	2.26 (0.53)	.97
Total sleep time (min; sleep diary)	86	5.82 (1.40)	90	5.69 (1.52)	.94
Objective Sleep					
Sleep efficiency (%)	63	82.17 (11.79)	66	81.67 (12.67)	.81
Wake after sleep onset (min)	63	101.67 (68.89)	66	99.81 (79.94)	.78
Total sleep time (min)	63	449.77 (128.45)	66	411.97 (89.62)	.11
Fragmentation Index	63	1.08 (0.51)	66	1.12 (0.52)	.81
Non-wear time during sleep period (min)	63	2.25 (4.62)	66	1.77 (3.36)	.25
Psychopathology Measures[b]					
CAPS-5 total score	80	41.36 (9.15)	89	40.09 (10.68)	.09
BDI-II	80	33.09 (10.82)	89	33.31 (10.86)	.73
Number of SCID-I diagnoses (current)	80	3.44 (1.52)	89	3.04 (1.34)	.14

Note. CPT = cognitive processing therapy; DBT-PTSD = dialectical behaviour therapy for posttraumatic stress disorder; PSQI = Pittsburgh sleep quality index; CAPS-5 = clinical administered PTSD scale for DSM-5; BDI-II = becks depression inventory; BPD = borderline personality disorder; SCID-I = structured clinical interview. [a] For sleep measures, participants with a baseline measure of the corresponding instrument are displayed in the table. [b] For psychopathology measures, participants included in the linear mixed model analyzing the primary outcome PSQI are displayed in the table.

Interestingly, our results also contrast with some findings in anxiety disorders where sleep disturbances were associated with reduced effectiveness of exposure-based therapies (Dutcher et al., 2021; Zalta et al., 2013), suggesting that the relationship between sleep and treatment response may differ for PTSD. PTSD is a complex disorder that, beyond anxiety, also encompasses a broad spectrum of symptoms including various emotions such as shame and guilt, irritability, or dissociative states. This complexity contributed to its reclassification outside the anxiety disorders section in the DSM-5 (Pai et al., 2017). The treatments in our study are believed to operate through multiple mechanisms. CPT targets posttraumatic cognitions and the applied protocol did not include a formal exposure component. Although DBT-PTSD includes exposure components, written account and imaginal exposure, it is not the sole focus of treatment. Therefore, extinction learning disruptions linked to sleep disturbances may be less central in these trauma-focused treatments.

Another important consideration is the so called sleep state misperception, where individuals subjectively perceive their sleep as more disrupted than objective measures indicate (Arditte Hall et al., 2023). While only in 38.8% of participants poor sleep efficiency (<80%) was measured objectively, 98.7% reported clinically significant subjective sleep disturbances (PSQI<5). Yet, experimental studies typically link extinction learning impairments to objective, not subjective, sleep disturbances (Schenker et al., 2021). However, as objective sleep efficiency in our sample ranged from 38% to 99% and PSQI scores from 3 to 21 with broadly normal distributions, a restricted range in either measure is unlikely to account for the null findings. Instead, these results suggest that neither subjective sleep complaints nor actigraphy-based indicators meaningfully influence trauma-focused treatment outcomes, or that more specific sleep parameters (e.g. REM-related processes) not captured here may be relevant.

An important consideration when interpreting our results is that the present study differs from most existing research in its treatment duration. While most studies in this area have examined shorter treatment formats of 10–12 sessions, the present study investigated a substantially longer treatment spanning up to 45 sessions over 15 months, which is more

Table 2. Estimates of fixed effects, sleep month 0 on CAPS-5 month 15.

Sleep measure	*n*	Estimate	SE	*p*	*d*	CI	
						LL	UL
Subjective sleep							
PSQI	159	0.46	0.31	.14	0.22	−0.15	1.08
Sleep quality (sleep diary)	176	−3.99	2.10	.06	0.27	−8.13	0.15
Total sleep time (sleep diary)	176	−0.79	0.76	.30	0.14	−2.30	0.71
Objective sleep (Actigraphy)							
Sleep efficiency (%)	129	−0.15	0.10	.14	0.23	−0.36	0.05
Wake after sleep onset	129	0.02	0.02	.27	0.12	−0.3	0.05
Total sleep time	129	−0.50	0.69	.47	0.18	−1.85	0.86
Fragmentation index	129	3.98	2.46	.11	0.25	−0.89	8.85

Note. PSQI = Pittsburgh sleep quality index.

representative of what patients receive in clinical settings in some countries (Flückiger et al., 2020). However, this also means that baseline sleep assessments and post-treatment outcomes are separated by a substantially longer interval than in previous studies, which warrants cautious interpretation of our findings. Notably, subjective sleep disturbances largely persisted in our sample despite the extended treatment period (Porten et al., 2025). To more precisely understand the mechanisms through which sleep may or may not influence treatment processes. session-by-session designs such as that employed by Hunt et al. (2023) would be needed. While such designs yield highly informative data, they are difficult to implement in longer-format treatments like ours.

3.1. Clinical implications

Our findings suggest that, for women with complex PTSD presentations, treating sleep before initiating long-term trauma-focused therapy may not be necessary. This is relevant given longstanding debates about the need for stabilization before exposure (Dyer & Corrigan, 2021). In recent years, the necessity of phase-based approaches has been discussed for individuals with complex PTSD presentations, particularly following childhood abuse, as in our sample (Maercker et al., 2022). However, emerging evidence shows that immediate trauma-focused treatment may be equally or more effective than preparatory interventions (Sele et al., 2023; van Vliet et al., 2021). These findings highlight the importance of identifying which symptoms truly need to be targeted before trauma-focused work. While dissociation may be one such candidate (Kleindienst et al., 2025), our results suggest that sleep disturbances are not.

Nevertheless, sleep remains clinically relevant. It is one of the most prevalent PTSD symptoms, linked to substantial impairments in quality of life (McCarthy et al., 2019) and often remains after trauma-focused treatments (Porten et al., 2025). Targeted interventions, such as CBT for Insomnia (Maher et al., 2021) are promising approaches that could be offered alongside or following trauma-focused therapy to improve quality of life, even if not required for PTSD symptom reduction.

3.2 . Strengths, limitations and future directions

Strengths of this study include a clinically well-diagnosed sample and a multimethod sleep assessment approach combining questionnaires, diaries, and actigraphy. Beyond these methodological contributions, our study addresses important gaps in the existing evidence base: most prior studies were conducted in U.S. military veteran populations receiving shorter treatment formats of 10–12 sessions, whereas the present study examines a female civilian sample with complex trauma presentations receiving a substantially longer treatment of up to 45 sessions.

At the same time, the all-female sample limits generalizability of findings. The absence of subjective bedtime ratings in the sleep log did not allow for cross-checking with actigraphy data. A further limitation concerns the use of wrist actigraphy as a measure of objective sleep. Although actigraphy is a valid and widely used method that places a low burden on participants for estimating sleep–wake patterns, it is less accurate than polysomnography. Specifically, because actigraphy infers sleep mainly from periods of immobility, it shows reduced specificity in distinguishing quiet wakefulness from sleep, which may lead to misclassification (Marino et al., 2013). As noted above, the temporal distance between baseline sleep assessment and post-treatment outcomes additionally limits the interpretability of our results, and it remains an open question whether the present null findings reflect a true absence of effect or are specific to longer-format treatments such as those examined here. Direct comparisons between shorter and longer treatments like ours would be valuable to determine whether treatment length moderates the relationship between baseline sleep and PTSD outcomes, and to shed light on the mechanisms through which sleep may differentially influence shorter versus longer treatment trajectories. Furthermore, future studies should track sleep and PTSD symptoms across sessions to explore how sleep may influence treatment over the treatment trajectory.

4. Conclusion

This study examined whether pre-treatment sleep disturbances predicted PTSD symptom reduction after trauma-focused treatment in women with complex PTSD presentations. Neither subjective nor objective sleep disturbances predicted treatment outcomes, and neither depressive symptoms nor treatment group moderated this relationship. These findings suggest that sleep disturbances may not need to be addressed prior to initiating long-term trauma-focused treatment in this population.

Author contributions

CRediT: **Salomé Porten:** Formal analysis, Methodology, Software, Writing – original draft, Writing – review & editing; **Franziska Friedmann:** Conceptualization, Data curation, Investigation, Project administration, Writing – review & editing; **Nikola Schoofs:** Supervision, Writing – original draft, Writing – review & editing; **Philip Santangelo:** Conceptualization, Data curation, Writing – review & editing; **Ulrich Ebner-Priemer:** Conceptualization, Methodology, Writing – review & editing; **Meike Müller-Engelmann:** Data curation, Writing – review & editing; **Regina Steil:** Data curation;

Nikolaus Kleindienst: Methodology; **Thomas Fydrich:** Data curation; **Kathlen Priebe:** Conceptualization, Data curation, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing.

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