



## Sleep impairments in refugees diagnosed with post-traumatic stress disorder: a polysomnographic and self-report study

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### ABSTRACT

**Background:** Post-traumatic stress disorder (PTSD) is the clinical manifestation of traumatic events and is associated with sleep disturbances. Sleep disturbances, if left untreated, may perpetuate or even worsen symptoms of PTSD. Previous studies of other PTSD populations show a higher incidence of sleep impairments and sleep disorders compared to healthy controls (HCs); however, this has never been investigated in trauma-affected refugees diagnosed with PTSD.

**Objectives:** To examine subjective sleep quality, measure sleep architecture, and identify latent sleep disorders in refugees diagnosed with PTSD compared to HCs.

**Method:** This comparative study included 20 trauma-affected refugees diagnosed with PTSD and 20 HC matched on age, sex, and body mass index. All participants completed self-report questionnaires assessing sleep quality, insomnia severity, and disturbing nocturnal behaviour, and all took part in a one-night polysomnography (PSG) assessment.

**Results:** Patients reported significantly poorer subjective sleep quality, sleep latency, sleep duration, and sleep efficiency compared to HCs. Subjective reports on hours spent in bed were not significantly different between patients and HCs. Patients reported significantly higher nightmare frequency and severity compared to HCs. PSG measures showed that patients had significantly reduced sleep efficiency, more awakenings, and longer REM sleep latency, and spent more time awake, whereas there was no significant differences regarding total time in bed, total sleep time, or sleep latency. The prevalence of sleep disorders was equal between groups.

**Conclusions:** The study identified significant impairments in several sleep domains, with a preponderance of disturbed regulation of sleep resulting in awakenings. These results indicate a need for more focus on hyperarousal and nightmares as key elements of disturbed sleep in PTSD. Furthermore, the study identified a discrepancy between subjective and objective measures concerning total sleep time, raising questions regarding the causes of 'sleep state misperception'.

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### Deterioro del sueño en refugiados con diagnóstico del trastorno de estrés postraumático: Un estudio polisomnográfico y de autorreporte

**Antecedentes:** El trastorno de estrés postraumático (TEPT) es la manifestación clínica de los eventos traumáticos y está asociado a deterioro del sueño. El deterioro del sueño, si no es tratado, puede perpetuar o, incluso, empeorar los síntomas del TEPT. Estudios previos realizados en otras poblaciones con TEPT muestran una incidencia más alta de deterioro del sueño y de trastornos del sueño en comparación con controles sanos. Sin embargo, esto no ha sido investigado en refugiados con diagnóstico del TEPT.

**Objetivo:** Evaluar la calidad subjetiva del sueño, determinar la arquitectura del sueño e identificar los trastornos latentes del sueño en refugiados con diagnóstico del TEPT y compararlos con controles sanos.

**Métodos:** Este estudio comparativo incluyó a veinte refugiados afectados con trauma y con diagnóstico del TEPT y a veinte controles sanos pareados por edad, sexo e índice de masa corporal (IMC). Todos los participantes respondieron preguntas de autorreporte para evaluar la calidad del sueño, severidad del insomnio y conductas perturbadoras durante el sueño; a todos los participantes se les realizó una evaluación mediante polisomnografía (PSG) durante una noche.

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### 关键词

多导睡眠图; 创伤后应激障碍; 难民; 创伤; 睡眠障碍; 睡眠质量

### HIGHLIGHTS

- This is the first study assessing sleep impairments and sleep disorders in refugees diagnosed with post-traumatic stress disorder (PTSD) compared to healthy controls.
- The main finding is that both subjectively and objectively measured sleep is disrupted in refugees diagnosed with PTSD compared to healthy controls.
- The results suggest that these disturbances of sleep are significant targets in treatment of PTSD and stress the importance of focusing on treatment of sleep disturbances in PTSD.

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**Resultados:** Los pacientes reportaron de forma significativa una pobre calidad subjetiva de sueño, latencia del sueño, duración del sueño y eficiencia del sueño comparados con los controles sanos. Los reportes subjetivos en relación con las horas en cama no fueron significativamente distintos entre pacientes y controles sanos. Los pacientes reportaron una frecuencia y severidad más altas de pesadillas en comparación con los controles sanos. Las mediciones mediante PSG mostraron que los pacientes presentaban significativamente una menor eficiencia del sueño, más despertares nocturnos, mayor latencia del sueño REM y mayor tiempo despiertos, mientras que no se encontraron diferencias significativas en el tiempo total en cama, duración total del sueño o latencia del sueño. La prevalencia de los trastornos del sueño fue igual en ambos grupos.

**Conclusiones:** El estudio identificó un deterioro significativo en distintos dominios del sueño con una tendencia hacia el compromiso de la regulación del sueño, llevando a despertares nocturnos. Estos resultados muestran la necesidad de mejorar el abordaje de la hipervigilancia y las pesadillas como elementos clave en el deterioro del sueño en personas con el TEPT. Además, el estudio identificó una discrepancia entre las medidas subjetivas y objetivas del sueño en relación con el tiempo de sueño total, generando interrogantes sobre la causa de esta “percepción errónea de las etapas del sueño”.

## 被诊断患有创伤后应激障碍的难民的睡眠障碍：一项多导睡眠图和自我报告研究

**背景:** 创伤后应激障碍 (PTSD) 是创伤事件的临床表现, 与睡眠障碍相关。如果不及治疗, 睡眠障碍可能会持续存在, 甚至会加重 PTSD 的症状。先前对其他 PTSD 人群的研究表明, 与健康对照组 (HC) 相比, 睡眠受损和睡眠障碍的发生率更高, 但从未在被诊断患有 PTSD 的受创伤影响的难民中进行过调查。

**目的:** 在被诊断患有 PTSD 的难民中, 对比健康对照组, 考查其主观睡眠质量、测量睡眠结构并识别潜在的睡眠障碍。

**方法:** 这项比较研究包括 20 名被诊断患有 PTSD 的受创伤影响的难民和 20 名年龄、性别和 BMI 匹配的 HC。所有参与者都完成了评估睡眠质量、失眠严重程度和困扰的夜间行为的自我报告问卷, 并且都参加了一晚多导睡眠图 (PSG) 评估。

**结果:** 与 HC 相比, 患者报告的主观睡眠质量、睡眠潜伏期、睡眠持续时间和睡眠效率显著较差。关于卧床时间的主观报告在患者和 HC 之间没有显著差异。与 HC 相比, 患者报告的噩梦频率和严重程度显著更高。PSG 测量显示, 患者的睡眠效率显著降低、觉醒次数增多、REM 睡眠潜伏期延长以及清醒时间增加, 而在床上的总时间、总睡眠时间或睡眠潜伏期方面没有显著差异。睡眠障碍的流行率在各组之间是相等的。

**结论:** 该研究确定了几个睡眠领域的显著受损, 其中主要是睡眠调节紊乱导致觉醒。这些结果表明需要更多地关注高唤起和噩梦作为 PTSD 中睡眠障碍的关键因素。此外, 该研究发现了引发“睡眠阶段误解”的关于总睡眠时间的客观和主观测量之间的差异。

## 1. Introduction

### 1.1. Post-traumatic stress disorder in trauma-affected refugees

The clinical manifestations of post-traumatic stress disorder (PTSD) include flashbacks of traumatic events, avoidance behaviour, change in reactivity, and sleep disturbances, the last of these being highly prevalent (APA, 2013; Colvonen et al., 2020; Ohayon & Shapiro, 2000; Pruiksma et al., 2016; World Health Organization, 1993). The presence of sleep disturbances results in reduced quality of life and may cause difficulties for patients in their everyday life (Carlsson et al., 2005; Giosan et al., 2015). According to the United Nations Refugee Agency, 89.3 million people are forcibly displaced worldwide as of 2021 (UNHCR, 2022). Of these, 27.1 million are refugees as a result of persecution, conflict, or generalized violence (UNHCR, 2022). These numbers are the highest known total to date and include an increase of 5.8 million refugees since only 2015 (UNHCR, 2016, 2022). Most research on PTSD is related to victims of a single or few traumatic events, such as traffic

accidents or sexual assault, or in soldiers returning from war (Brownlow et al., 2015; Maher et al., 2006; Schoenfeld et al., 2012; Spoomaker & Montgomery, 2008). However, refugees differ from populations with single or few traumatic events by having been exposed to traumas during pre-migration, migration, and post-migration. Refugees have often experienced multiple and repeated traumas for months or even years, such as war or periods of daily exposure to torture during a long imprisonment (Crumlish & O'Rourke, 2010; Steel et al., 2009). Refugees experience being forcibly displaced from their country of origin and cannot return to safe and familiar conditions to recover from their traumatic experiences (Sonne et al., 2017).

### 1.2. Sleep quality, sleep architecture, and sleep disorders

Trauma-affected patients with PTSD consistently report subjective impaired sleep quality compared to healthy controls (HCs) (Brownlow et al., 2015; Germain, 2013; Maher et al., 2006; Nappi et al., 2012;

Richter et al., 2020; Schoenfeld et al., 2012; Spoor-maker & Montgomery, 2008). Difficulties initiating sleep and maintaining sleep are pronounced and affect sleep quality (Brownlow et al., 2015; Germain, 2013; Maher et al., 2006; Richter et al., 2020; Schoenfeld et al., 2012; Spoor-maker & Montgomery, 2008). Fragmented sleep due to awakenings and/or sleep stage shifts may result in subjective complaints of daytime sleepiness even when an apparently objective normal total sleep time is present (Pace-Schott et al., 2015).

Several studies using polysomnography (PSG) to measure sleep architecture, specifically looking at the cyclical pattern of sleep and sleep stage shifts in patients suffering from PTSD, have found abnormal sleep architecture, but the findings are inconsistent (Germain, 2013; Kobayashi et al., 2007; Lee et al., 2021; Maher et al., 2006; Mellman et al., 2014; Mohsenin & Mohsenin, 2014). A meta-analysis on findings from PSG showed decreased total sleep time and sleep efficiency, increased number of awakenings after sleep onset, and decreased amount of slow-wave sleep (Zhang et al., 2019). In addition, a previous meta-analysis found that PTSD patients had more stage 1 sleep compared to people without PTSD (Kobayashi et al., 2007). The background and mechanism for these findings are not known.

Previous studies have investigated the occurrence of sleep disorders in populations with PTSD, indicating an increased incidence of rapid eye movement (REM) sleep behaviour disorder (RBD) (Elliott et al., 2020). RBD is a sleep disorder characterised by a history of excessive nocturnal motor activity and absence of muscle atonia during REM sleep [REM sleep without atonia (RSWA)] (McCarter et al., 2012). Patients report recurrent nightmares causing disrupted sleep and varying lengths of awakening (Mohsenin & Mohsenin, 2014). In addition, sleep disorders such as sleep apnoea and periodic limb movement disorder (PLMD), causing frequent arousals leading to numerous sleep stage shifts and abnormal cycling of sleep, are frequently reported and observed in PTSD patients (Brown & Boudewyns, 1996; Hoge et al., 2008; Krakow et al., 2004; Mohsenin & Mohsenin, 2014; Mysliwiec et al., 2013). However, the findings were not compared to controls and may not be specific to or consistent for PTSD.

The above-mentioned inconsistencies in findings regarding sleep quality, sleep architecture, and sleep disorders may be caused by differences between studies concerning adequate controls, demographics, and clinical factors such as gender, age, trauma type, and PTSD severity. No previous studies have compared sleep quality, sleep architecture, and sleep disorders in trauma-affected refugees to HCs (Lee et al., 2021). Owing to the above-mentioned potential differences between trauma-affected refugees and other trauma-affected populations, a thorough understanding

of these aspects in this specific refugee population may contribute knowledge of importance for enhancing the outcomes of PTSD treatment.

### 1.3. Aims of the study

The aim of the study was to investigate the occurrence of sleep pathologies in refugees diagnosed with PTSD compared with HCs using PSG and self-report questionnaires, specifically focusing on (1) subjective sleep quality; (2) sleep architecture; and (3) frequency of sleep disorders, including parasomnias (RBD and nightmares), sleep movement disorders (PLMD), and sleep breathing disorders (sleep apnoea).

## 2. Method

### 2.1. Participants

This comparative study was conducted at the Competence Centre for Transcultural Psychiatry (CTP) in collaboration with the Danish Centre for Sleep Medicine. CTP is a public mental health outpatient clinic situated in the Capital Region of Denmark, specializing in mental health in migrant populations, particularly refugees with traumatic experiences related to war, torture, or persecution.

Between May 2018 and January 2019, 20 patients who were enrolled in a treatment programme at CTP and 20 HCs were included in the study. The inclusion criteria for the patient group were being a refugee or family reunited with a refugee, being at least 18 years of age, fulfilling the criteria for the PTSD diagnosis according to the World Health Organization International Classification of Diseases, 10th edition (ICD-10) (World Health Organization, 1993), and being legally competent to provide informed consent.

Exclusion criteria were any history of severe psychotic disorders (ICD-10 diagnoses F2x or F30.1–F30.9) and/or history of substance abuse or alcohol abuse (ICD-10 F1x.24–F1x.26). Pregnancy and obesity with a body mass index (BMI) > 35 kg/m<sup>2</sup> were exclusion criteria because of the increased risk of sleep-disordered breathing such as obstructive sleep apnoea. Daily use of antipsychotic medicine, opioids, benzodiazepine, antihistamine, or central nervous system-stimulating drugs, which are known to alter sleep architecture in PSG studies, were also exclusion criteria.

Twenty healthy non-refugee controls were matched on sex, age ( $\pm 1$  year), and BMI ( $\pm 5$  kg/m<sup>2</sup>). Exclusion criteria for HCs were daily use of any kind of medication, history of substance or alcohol abuse (ICD-10 F1x.24–F1x.26), pregnancy, and current mental health diagnoses according to the ICD-10. The HCs were recruited among staff at CTP.

## 2.2. Study procedures

All patients had an initial consultation with a psychiatrist as part of regular pretreatment assessment. During this consultation, the patients answered four CTP routine self-report questionnaires, assessing symptoms of PTSD, depression, anxiety, functional impairment, and overall well-being.

Patients who met the inclusion criteria were invited to participate in the study. All patients were thoroughly introduced to the study by the first author (MA). Patients giving informed consent participated in one semi-structured interview and one structured interview, and filled out five self-report questionnaires

**Table 1.** Participant characteristics and demographics.

	Patients (n = 20)		Controls (n = 20)	
	Mean	(SD)	Mean	(SD)
Age (years)	42.21	(10.82)	42.67	(10.96)
Years since arrival in Denmark	12.05	(10.34)	42.61	(11.01)
Body mass index (kg/m <sup>2</sup> )	26.06	(4.22)	25.97	(3.31)
	n (%)		n (%)	
Gender				
Female	5	(25)	5	(25)
Male	15	(75)	15	(75)
Country of origin				
Denmark	–	(40)	19	(95)
Iran	8	(15)	–	(5)
Iraq	3	(10)	–	
Afghanistan	2	(10)	–	
Lebanon	2	(10)	–	
Syria	2	(15)	–	
Other	3		1	
Immigration status				
Refugee	17	(85)	–	
Family reunified	3	(15)	–	
Psychosocial status				
Needing translator during medical doctor session	8	(40)	–	
Affiliation to the labour market/ studying	5	(25)	19	(95)
Income from labour <sup>a</sup>	5	(25)	19	(95)
Education > 10 years from home country	11	(55)	19	(95)
Diagnosis (ICD-10)				
PTSD F.43.1	20	(100)	–	
Depression, episodic F.32.x	11	(55)	–	
Depression, recurrent F.33.x	1	(5)	–	
Symptom onset ≥ 10 years	8	(40)	–	
Previous treatment				
Admitted to a psychiatric hospital (n = 19)	2	(10)	–	
Psychopharmacological treatment	14	(70)	1	(5)
Psychotherapy	5	(25)	1	(5)
Current psychopharmacological treatment				
Mianserin	12	(60)	–	
Sertraline	12	(60)	–	
	Mean	(SD)	Mean	(SD)
CAPS-5				
Cluster B score	11.45	(3.43)	0	(0)
Cluster C score	3.45	(1.61)	0	(0)
Cluster D score	11.0	(3.15)	1.13	(1.46)
Cluster E score	11.4	(2.84)	1.88	(1.13)
Total CAPS score	37.05	(6.72)	3.00	(1.96)

Note: <sup>a</sup>Including students receiving the Danish State Educational Grant (Statens Uddannelsesstøtte, SU).

ICD-10, International Classification of Diseases, 10th edition; PTSD, post-traumatic stress disorder; CAPS-5, Clinician-Administered PTSD Scale for DSM-5.

assessing sleep quality, nightmares, nocturnal behaviour, and traumatic life events. Finally, all patients had PSG performed during one night in their own homes and filled out a sleep satisfaction questionnaire on the following morning assessing the overall sleep quality during the PSG night. Data not relevant to answer the aim of the study are not reported.

All HCs were also thoroughly introduced to the study by the first author (MA), and filled out the same self-report questionnaires, participated in interviews, and had PSG performed in their own homes.

## 2.3. Background variables

All background information (Table 1) was collected by the first author (MA) or collected from patient medical records. Information included age, sex, country of origin, traumas, years in Denmark, diagnoses, and treatments.

## 2.4. Observer rating

The most distressing, potentially traumatic event (the index event) was initially identified by a self-report questionnaire, the Life Events Checklist (LEC-5) (Gray et al., 2004) for the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) (APA, 2013). The LEC-5 was additionally used to identify the quantity of traumas and severity. The index event was further assessed at the beginning of the Clinician-Administered PTSD Scale for DSM-5 (CAPS-5) (Weathers et al., 2001, 2015) interview to determine whether it met the diagnostic criteria for a traumatic event (Criterion A).

To confirm PTSD diagnosis and severity, the CAPS-5 was used. CAPS-5 is a 30-item structured interview used to confirm PTSD diagnosis and symptom severity according to the diagnostic criteria for PTSD of the DSM-5 (APA, 2013).

The WHO Schedules for Clinical Assessment in Neuropsychiatry (SCAN) (Wing et al., 1990) is a 25-chapter semi-structured interview assessing and classifying psychopathology and behaviour associated with the major psychiatric disorders. Chapters 1, 10, 14, 16, 17, 18, and 19 (bipolar, schizophrenia spectrum, and other psychotic disorders) were administered to rule out psychotic or bipolar disorders. Certified medical doctors at CTP conducted all SCAN interviews.

The Hamilton Anxiety and Depression Rating Scale (HAM A + D) is a multiple-item semi-structured observer rating scale assessing depression and anxiety severity. Only patients participated in the Hamilton interviews, which were conducted by the principal investigator (Eysenck, 1994; Hamilton, 1960; Kiresuk & Sherman, 1968).

## 2.5. Self-report questionnaires

Mental illness was additionally assessed by self-report questionnaires. The rating scales applied have been validated in several languages as well as cultural settings.

The Harvard Trauma Questionnaire (HTQ) (Hollifield et al., 2002; Kleijn et al., 2001) is a thoroughly validated 16-item self-report checklist developed to assess trauma symptoms and PTSD symptoms according to the ICD-10.

The Hopkins Symptom Checklist 25 (HSCL-25) (Kleijn et al., 2001; Mollica et al., 1987) is a 25-item self-report screening instrument assessing anxiety and depression.

To assess subjective sleep quality and frequency of parasomnias (RBD and nightmares), the following self-report questionnaires were applied. Only measurements used in the current paper are presented.

The Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989; Insana et al., 2013) is an internationally applied and thoroughly validated 19-item self-report questionnaire assessing sleep quality and sleep disturbances for the past month.

The Disturbing Dream and Nightmare Severity Index (DDNSI) (Krakow, 2006) is a self-report questionnaire assessing disturbing dreams and nightmare frequency on a Likert-type scale ranging from not intense at all to extremely intense.

The REM Sleep Behaviour Disorder Screening Questionnaire (RBDSQ) (Stiasny-Kolster et al., 2007) is a 10-item self-report questionnaire assessing the most prominent features of RBD using yes or no questions. An RBDSQ score of 5 points was considered a positive test result.

All self-report questionnaires were available in Danish, English, Arabic, and Farsi, and all patients had free access to a translator if necessary. If no translated questionnaire was available in the patient's language, an interpreter translated the Danish version.

## 2.6. Polysomnography

PSG is considered the gold standard for assessing sleep disorders. To assess sleep architecture and sleep disorders, including PLMD, sleep apnoea, and RSWA, participants completed one PSG assessment overnight in their own homes and were instructed to continue normal sleeping routines and nocturnal behaviour in order to measure their habitual sleep patterns. Patients were instructed not to use mianserin (a tetracyclic antidepressant) on the night of the PSG assessment. Sleep architecture was recorded using the SOMNOmedics SOMNOtouch™RESP system. The PSG montage included three electroencephalographic channels (electrode placement at C3/A2, F3/A2, O1/A2), left

and right electrooculography, submental electromyography, nasal cannula flow measurements and pulse oximetry, electrocardiography, right and left anterior tibialis electromyography, and body position measurements. The data were evaluated according to the American Academy of Sleep Medicine (AASM) standards. Scoring was blinded to participants' identity and performed by registered PSG technicians who followed the AASM diagnostic standards.

## 2.7. Statistical analyses

The statistical analyses were performed in Stata (version 16). Results were considered significant at an alpha level of .05. Descriptive data regarding the demographics and clinical characteristics of the participants were analysed with chi-squared tests and independent *t*-tests for possible differences between the patients and the HCs.

Self-report measures were analysed for differences between the patient group with PTSD and HCs by independent *t*-tests.

PSG measures were analysed with independent *t*-tests and Fisher's exact test for categorical values when  $n < 5$ .

Cohen's *d* was used to calculate the effect size of the data.

## 2.8. Ethical considerations

The study was approved by the Danish Data Protection Agency (2012-58-0004) and was carried out in accordance with the ethical principles and guidelines for medical research as stated in the Declaration of Helsinki. Approval from the Ethical Committee of the Capital Region of Copenhagen was not necessary, according to the Committee (H-17039106).

Research participation was voluntary, required written informed consent, and was not a prerequisite for receiving treatment at CTP.

## 3. Results

### 3.1. Sociodemographics and trauma

Participants' demographics and clinical characteristics are summarized in Table 1.

A total of 40 individuals (20 patients and 20 HCs), ranging between 24 and 61 years of age with a mean age of 42.21 years, completed the study. The patients were all suffering from PTSD and 60% were additionally diagnosed with depression. In the patient group, 60% were prescribed selective serotonin reuptake inhibitors (SSRIs).

Scores on the LEC-5 self-report questionnaire showed that patients had an average of 10.0 lifetime traumas ( $SD = 5.87$ ), compared to HCs with an average

of 4.15 traumas ( $SD = 3.70$ ). Patients more often reported traumas based on experiences with imprisonment (65%), war (95%), and violence with weapons (25%), whereas HCs more often reported traffic accidents (55%) and life-threatening illnesses (50%).

### 3.2. Subjective sleep quality

Information on self-report sleep quality (PSQI) can be found in Table 2. The patients had a significantly higher PSQI score (mean = 15.67,  $SD = 2.92$ ) compared to HCs (mean = 3.79,  $SD = 1.50$ ), reporting a subjectively reduced sleep quality compared to HCs ( $p < .001$ ). The patients reported lying in bed for a significantly longer time (mean = 59.38 min,  $SD = 10.61$ ) compared to HCs (mean = 45.02 min,  $SD = 6.60$ ) before being able to fall asleep ( $p < .001$ ). Assessment of the participants' subjective report of hours of sleep duration per night showed a significant difference ( $p < .001$ ) between patients (mean = 277.8 min,  $SD = 96$ ) and HCs (mean = 420 min,  $SD = 46.8$ ). Time spent in bed, based on time going to bed and time waking up, showed no significant difference between the groups ( $p = .462$ ). However, sleep efficiency was significantly lower ( $p < .001$ ) in the patient group (mean = 67.1%,  $SD = 19.61$ ) compared to the HCs (mean = 91.67%,  $SD = 6.51$ ).

### 3.3. Sleep architecture

Analysis of the PSG measures is shown in Table 3. There was no significant difference between the two groups in terms of the overall time spent in bed ( $p = .521$ ) or total sleep time ( $p = .178$ ). Although not significant, the sleep latency in patients (mean = 32.6 min,  $SD = 38.5$ ) was twice as long as in HCs (mean = 15.45 min,  $SD = 12.66$ ) ( $p = .066$ ). The patients were awake after sleep onset (mean = 105.55 min,  $SD = 88.88$ ) significantly longer than HCs (mean = 53.45 min,  $SD = 42.80$ ) ( $p = .023$ ) and had significantly more awakenings throughout the night ( $p = .023$ ), having a sleep efficiency of 79.6% compared to 89.9% in HCs ( $p = .028$ ). The sleep architecture was fragmented in 35.0% of patients compared

to 10.0% of HCs ( $p = .127$ ). The time spent in different sleep stages, N1–N3 and REM sleep, did not differ between patients and HCs. Patients had significantly longer REM sleep latency (mean = 148.5 min,  $SD = 117.27$ ) than HCs (mean = 87.1 min,  $SD = 35.52$ ) ( $p = .031$ ).

### 3.4. Sleep disorders

Analysis of the PSG measures, reported in Table 3, showed no significant difference between the two groups regarding PLMD ( $p = .225$ ) or sleep-disordered breathing ( $p = 1.0$ ). Only one patient showed sign of RSWA during PSG assessment. Owing to technical errors in four PSG assessments (two in the patient group and two in HCs), it was not possible to collect data regarding RSWA.

RBD assessment on the RBDSQ self-report questionnaire (Table 4) showed that patients had a significantly higher RBDSQ score, indicating a higher risk of RBD compared to HCs ( $p < .001$ ). The one patient showing signs of RSWA also had a high score on the RBDSQ, therefore fulfilling the criteria for RBD.

Nightmare assessment on the self-report questionnaire DDNSI, as seen in Table 4, showed a significant difference in disturbing dreams and nightmare severity measured on DDNSI ( $p < .001$ ). Looking specifically at the frequency of nightmares, 75% of the patients reported weekly nightmares compared to 1% of HCs ( $p < .001$ ). Furthermore, 70% of the patients reported that their nightmares were of a severe intensity compared to 0% of HCs ( $p < .001$ ).

Statistically significant variables that differed between groups showed a large effect size, indicating that the observed differences were of clinical importance.

## 4. Discussion

The aim of the study was to investigate sleep impairments in refugees diagnosed with PTSD compared to HCs, using PSG and self-report questionnaires, specifically focusing on subjective sleep quality, sleep architecture, and frequency of sleep disorders.

The overall results revealed that patients, compared to HCs, reported significantly reduced sleep quality and clinically showed signs of disrupted sleep architecture. No differences were found in sleep apnoea, periodic limb movements, or RSWA, while a significantly higher nightmare frequency and severity was identified in patients compared to HCs.

The overall results revealed several interesting findings in terms of subjective sleep perception and objective sleep measures. The immediate difference between the patients and the HCs in terms of perceived subjective sleep quality is evident and is consistent with observations in the literature (Kobayashi

**Table 2.** Subjective sleep quality (PSQI).

	Patients		Controls		<i>p</i>	Effect size
	Mean	( <i>SD</i> )	Mean	( <i>SD</i> )		
PSQI total score	15.67	(2.92)	3.79	(1.50)	.000*	5.39
Time in bed (min)	436.2	(129.6)	459	(48.6)	.462	−0.26
Sleep duration (min)	277.8	(96.0)	420	(46.8)	.000*	−1.99
Sleep latency (min)	59.38	(10.61)	45.02	(6.60)	.000*	1.67
Sleep efficiency (%)	67.10	(19.61)	91.67	(6.51)	.000*	−1.88

Note: PSQI, Pittsburgh Sleep Quality Index.

\*Significant group difference,  $p < .05$ .

**Table 3.** Polysomnographic data.

	Patients Mean (SD)		Controls Mean (SD)		p-value	Effect size
Time in bed (minutes)	497.8	(114.09)	476.0	(61.65)	.521	0.25
Awake	105.55	(88.88)	53.45	(42.80)	.023*	0.79
N1	49.1	(35.31)	41.7	(31.97)	.492	0.22
N2	193.0	(62.62)	206.05	(30.02)	.406	0.28
N3	65.2	(46.34)	73.85	(32.10)	.497	0.22
REM	82.15	(46.98)	101.1	(22.10)	.111	0.55
Total time asleep	389.29	(94.05)	422.63	(54.14)	.178	0.45
Latency (minutes)						
Sleep latency	32.6	(38.5)	15.45	(12.66)	.066	0.67
REM sleep latency	148.5	(117.27)	87.1	(35.52)	.031*	0.80
Arousals	98.9	(65.18)	94.2	(87.21)	.850	0.06
Awakenings	27.4	(17.28)	17.55	(6.65)	.023*	0.82
Total sleep efficiency (%)	79.61	(13.97)	89.20	(7.88)	.028*	0.88
	n (%)		n (%)		p-value	
Daytime sleep	2	(10)	2	(10)	1.000	
Sleep pattern						
Normal	13	(65)	18	(80)	.127	
Fragmented	7	(35)	2	(10)		
AHI-index						
Normal	10	(50)	11	(55)	1.000	
Mild sleep apnoea	6	(30)	5	(25)		
Moderate sleep apnoea	2	(10)	1	(5)		
Severe sleep apnoea	2	(10)	3	(15)		
PLMs						
Normal	17	(85)	15	(75)	.225	
Mild PLMs	0	(0)	2	(10)		
Moderate PLMs	1	(5)	3	(15)		
Severe PLMs	2	(10)	0	(0)		
RSWA	1	(5)	0	(0)	.487	
RBD	1	(5)	0	(0)		

Note: \* Group difference significant,  $p < .05$ .

SD = Standard Deviation; REM = Rapid Eye Movement; n = number of study participants; AHI = Apnoea/hypapnoea index; PLMs = Periodic limb movements; RSWA = REM sleep without atonia; RBD = REM sleep behavior disorder.

et al., 2012; Lewis et al., 2020; Werner et al., 2016). In the literature, a consistently high prevalence of subjective sleep disorders is reported, while sleep studies using PSG have shown conflicting results (Maher et al., 2006; Mellman et al., 2014; Zhang et al., 2017). In the current study, self-report sleep questionnaires revealed that patients experience a shorter sleep duration, with more awakenings and a prolonged duration of time trying to fall asleep. PSG confirmed significantly more awakenings, more time awake after sleep onset, and borderline longer sleep latency, resulting in a significantly reduced sleep efficiency. However, PSG did not identify a significantly reduced total sleep time. The discrepancy between the self-report sleep duration of 277.8 min and the PSG recorded total sleep time of 389.29 min is striking.

**Table 4.** Sleep disorders measured on self-report questionnaires.

	Patients		Controls		p	Effect size
	Mean	(SD)	Mean	(SD)		
RBDSQ	6.85	(2.00)	2.25	(2.00)	.000*	2.3
DDNSI	18.45	(8.09)	0.35	(1.57)	.000*	3.75
	n	(%)	n	(%)		
Weekly nightmares	15	(75)	1	(16)	.000*	
Severe intensity of nightmares	14	(70)	0	(0)	.000*	

Note: RBDSQ, REM Sleep Behaviour Disorder Screening Questionnaire; DDNSI, Disturbing Dream and Nightmare Severity Index: participants experiencing nightmares or disturbing dreams weekly or monthly.

\*Significant group difference,  $p < .05$ .

The results indicate what has previously been termed ‘sleep state misperception’ (Lewis et al., 2020). Based on the current results, it is likely that the high number of awakenings, long awake time after sleep onset, and long sleep latency cause severe distress and contribute to a self-perception of markedly reduced sleep duration. Studies assessing sleep disturbances in other PTSD populations have shown that sleep disturbances, if left untreated, may perpetuate or even worsen symptoms of PTSD despite a multidisciplinary treatment effort, constituting a risk for poor outcome of PTSD treatment (Cox et al., 2017; Lamarche & De Koninck, 2007; Maher et al., 2006; Spoormaker & Montgomery, 2008). It has been argued that effective treatment of sleep disturbances may accelerate recovery in PTSD (Colvonen et al., 2019; Germain, 2013; Germain et al., 2017; Pace-Schott et al., 2015; Spoormaker & Montgomery, 2008), and the results of the current study suggest that focusing on improving sleep efficiency and decreasing the number of awakenings may be significant targets in the treatment of PTSD; however, more research on the content of such treatment is needed. Several treatment outcome studies point to the fact that trauma-affected refugees as a group are more difficult to treat than other trauma-affected populations owing to their often extensive and repeated trauma history (Nosè et al., 2017; ter Heide & Smid, 2015). Questionnaires on sleep

behaviour and subjective sleep quality have shown that PTSD patients in particular are strongly affected in terms of perceived mental health, which may correlate with the severity of PTSD symptoms (Belleville et al., 2009) and may influence the perception of sleep (Werner et al., 2016).

An increased REM sleep latency was found in the patient group. With 60% in the patient group having been prescribed SSRIs, this finding may reflect the well-documented effect of SSRIs suppressing REM sleep and thus increasing REM sleep latency (Haberland et al., 2019; Hutka et al., 2021). However, no statistical significance was found when adjusting for SSRI treatment in the patient group ( $p = .124$ ).

The decreased sleep efficiency, impaired sleep maintenance, increased awakenings, and fragmented sleep found in this study are in line with findings in meta-analyses of studies using PSG in PTSD patients (Baglioni et al., 2016; Kobayashi et al., 2007; Zhang et al., 2019). However, in contradiction to the findings in this study, meta-analyses have also found decreased total sleep time (Zhang et al., 2019), reduced slow-wave sleep (N3 sleep) (Baglioni et al., 2016; Kobayashi et al., 2007; Zhang et al., 2019), and more stage 1 sleep (N1 sleep) (Kobayashi et al., 2007).

None of the above-mentioned PSG findings reported in the PTSD sleep literature have been consistently found across all studies. Therefore, it is not surprising that not all findings are present in this study.

Furthermore, the study revealed a significant difference between the total mean score for disturbing dreams and nightmares among the patients compared to the HCs ( $p < .001$ ). Nightmares may cause interruption of sleep and varying lengths of awakenings (Mohsenin & Mohsenin, 2014), and may be an important explanation for the above-described PSG findings concerning awakenings and longer awake time after sleep onset, in turn contributing to the poor self-reported sleep quality.

On subjective self-report sleep measures, the patients showed increased symptoms of RBD, with increased movements during sleep, talking in their sleep, and being able to recall dreams after awakening. However, in contradiction with previous studies, only one patient fulfilled the criteria for RBD (Elliott et al., 2020). Whether hyperarousability could explain this finding, rather than symptoms being idiopathic RBD, is not known and needs further investigation. Furthermore, a high prevalence of sleep apnoea and periodic limb movements has been found in PTSD, which may contribute to awakening and reduced sleep length (Harvey et al., 2003; Maher et al., 2006; Mohsenin & Mohsenin, 2014). However, the present study found no differences in the occurrence of sleep apnoea.

#### 4.1. Strengths and limitations

This study has some important limitations.

First, it must be mentioned that the small sample size is a limitation, and the results are therefore exploring certain tendencies and cannot be generalized to the whole refugee population.

Secondly, only one PSG assessment was carried out per participant and therefore night-to-night variability was not assessed.

Thirdly, for the purpose of comparison with other populations, it would have been valuable to add a group of trauma-exposed refugees without PTSD.

Fourthly, the patients participating in this study were able to cope with a quite extensive examination battery and thus may have had a higher level of functioning than other patients at CTP, and therefore may not be representative of the broad refugee population.

Finally, statistics were not adjusted for multiple comparisons because of the exploratory nature of the study. Owing to limited data about the participants' living conditions, it is not known whether these would affect their sleep quality.

Some strengths of the study should also be highlighted. The sleep assessment was conducted while the participants slept at home to simulate their normal sleep routines and habits, giving a realistic insight into sleep architecture in this population. The inclusion of trauma-affected refugees with PTSD and the thorough assessment process add important information to the field of psychophysiology for a psychiatric population to which little scientific attention has been paid, despite large technical advances in this area.

## 5. Conclusion

The study identified several significant differences in sleep quality, sleep architecture, and sleep disorders between trauma-affected refugees and HCs. The reduced subjective sleep quality, decreased subjective and objective sleep efficiency, awakenings, and increased sleep latency found in trauma-affected refugees compared with HCs suggest that these aspects may serve as significant targets in the treatment of PTSD. Moreover, the study identified a high frequency of nightmares, also delineating nightmares as an important target in treatment. Further research is needed on treatments such as cognitive behavioural therapy for insomnia and imagery rehearsal therapy targeting these aspects.

Greater knowledge of the nature of sleep disorders in PTSD will provide increased insight into the pathophysiology of this complex disorder and could lead to better treatment options.

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## Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available owing to privacy and ethical restrictions.

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