

Trauma-Associated Sleep Disturbances among Women: A Nationwide Study

Anna Unnarsdottir

abu@hi.is

University of Iceland <https://orcid.org/0000-0002-6421-445X>

Arna Hauksdóttir

University of Iceland

Thor Aspelund

Icelandic Heart Association <https://orcid.org/0000-0002-7998-5433>

Erla Bjornsdottir

Reykjavik University

Svava Jonsdottir

University of Iceland

Gunnar Tomasson

University of Iceland

Vincent Mysliwicz

University of Texas Health Sciences Center San Antonio

Unnur Valdimarsdóttir

University of Iceland <https://orcid.org/0000-0001-5382-946X>

Edda Thordardottir

University of Iceland

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Abstract

Trauma-associated sleep disorder (TASD) is a proposed REM-sleep parasomnia that arises after exposure to traumatic events. In a nationally representative sample of 29,653 Icelandic women aged 18–69, we found a TASD prevalence of 6.5%. Younger age (18–29 years), lower educational attainment, and exposure to a higher cumulative count of life stressors, especially physical or sexual violence and stillbirth, were each associated with increased TASD risk. Experiencing the worst life stressor more than once and close temporal proximity to worst life stressor were associated with a higher TASD prevalence, particularly in the youngest age group. TASD also co-occurred frequently with other mental disorders, most notably probable post traumatic sleep disorder (PTSD) and severe depressive symptoms. This study identifies violence exposure and stillbirth as notable risk factors for TASD, alongside repeated traumatic occurrences and closeness to the worst life stressor among young women. These findings underscore the interconnected nature of life stressors, TASD and psychopathologies in women with implications for developing targeted interventions for trauma recovery.

Introduction

In 2014, trauma-associated sleep disorder was proposed as a distinct REM-sleep parasomnia, characterized by symptoms of trauma-related nightmares, hyperactivity, and disruptive nocturnal behaviors, including gross body movements or abnormal vocalizations.¹ Sleep disturbances such as nightmares and insomnia are symptoms of post-traumatic stress disorder (PTSD), and have drawn particular attention for their pervasive and detrimental impact on traumatized individuals.²⁻⁵ While much research has been devoted to understanding factors contributing to these sleep disturbances, why certain trauma survivors continue to experience them after successful treatment of other PTSD symptoms remains unclear.⁶

Prior research of the proposed trauma-associated sleep disorder has predominantly focused on males in high-stress occupations, particularly military service, finding trauma severity and pre-existing mental health conditions to be risk factors for the disorder.^{1,7-13} Studies show that combat veterans with PTSD have more sleep-related symptoms than those without PTSD, including nocturnal screaming,¹⁵ dream enactment,^{10,15} insomnia,^{10,14} startle awakenings,¹⁰ and fewer arousals from non-REM sleep.¹⁶ However, gaps remain in our understanding of how different types of trauma affect sleep, particularly among women and non-military populations. The current study therefore aims to investigate the prevalence of trauma associated sleep disturbances (TASD) and its associated factors, within a large, nationally representative cohort of women in Iceland.

Methods

Study population

Participants were women who took part in the baseline assessment of the population-based Stress-And-Gene-Analysis (SAGA) cohort study in 2018-2019. All Icelandic speaking women, aged 18–69 residing in Iceland ($n=104,197$ women) were invited. A total of 30,403 women (29.2% of eligible women) participated in the study. The study population is representative of the Icelandic female population in terms of age, education, income, and region.¹⁷

Analyses included 29,653 participants, after excluding those with cognitive brain diseases ($n=32$) and those with missing TASP data ($n=718$). Only participants reporting exposure to at least one life stressor were included (see Fig. S1).

Procedure

Women were invited to participate in the study through a phone text message, e-mail, or paper mail. Participation included answering an extensive internet-based questionnaire about trauma history and health, including sleep disturbances. Data was collected from March 2018 to July 2019.

Measures

Life stressors. A modified version of the Life Events Checklist (LEC-5)¹⁸ was utilized to assess direct and indirect exposure to life stressors. In addition, other life stressors were assessed (see Table S1 for the complete list). The worst life stressor was defined as the event or experience that currently bothers the individual the most. Furthermore, single questions were used to determine both the frequency of occurrence of the worst life stressor (once; more than once) and the temporal proximity to the event (0–1; 2–4; 5–9; 10–19; ≥ 20 years). Age at first occurrence of the worst life stressor was divided into the subsequent stages, based on the Erik Erikson's psychosocial stages in human development: infancy/toddlerhood (age 0–3); childhood (age 4–12); adolescence (age 13–19); young adulthood (age 20–39); adulthood (age ≥ 40).¹⁹

Traumatic sleep disturbances. In the current study, two measurement tools were used to assess the criteria for TASP. The Pittsburgh Sleep Quality Index Addendum for PTSD (PSQI-A), a seven-item self-report scale, was used to evaluate trauma-related sleep problems,²⁰ and the PCL-5, a 20 item self-report scale, which assesses the DSM-5 symptoms of probable PTSD in the past month, based on individual's worst life stressor.²¹ Past month TASP were assessed with the following criteria¹: 1) lifetime exposure to a significant life event that meets DSM-5 Criterion A for PTSD²; 2) a total score exceeding three on PSQI-A²⁰; 3) presence of trauma-related nightmares (PCL-5 item 2 and PSQI-A item 3 rated ≥ 1)^{20,21}; and 4) abnormal sleep behaviors, such as episodes of terror or vocalizations (PSQI-A item 6 rated ≥ 1) or abnormal motor behaviors, including kicking, punching, running, or screaming (PSQI-A item 7 rated ≥ 1).²⁰ Miscarriage and abortion were excluded due to insufficient information regarding their classification as Criterion A trauma.

Background information. Demographic information included age, relationship status (married or in relationship; single or widowed), education level (primary; secondary; tertiary level A; tertiary level B), personal monthly income (<1200 Euro (EUR); 1201–2400 EUR; 2401–4000 EUR; 4001–5600 EUR; ≥ 5601 EUR, conversion rates according to the Central Bank of Iceland, February 1, 2018),²² and employment

status (employed/studying; unemployed, staying at home/maternity leave; on disability; sick leave; retired). Smoking (never; previous smoker; non-daily; daily) and binge drinking in past year (never; less than once a month; monthly; once or more a week) were also assessed.

Sleep problems. The Pittsburgh Sleep Quality Index (PSQI),²³ a 19-item self-report scale, was used to assess general sleep problems in the past month. The PSQI global score >10 was used as a cut-off for general sleep problems, in line with previous studies.^{24,25}

Comorbid mental disorders. The Patient Health Questionnaire (PHQ-9),²⁶ a nine-item self-report scale, was used to assess depression symptoms in the past two weeks. The PHQ-9 total scores of <10, 10–19, and 20–27 represented mild/moderate, moderately severe, and severe depression, respectively. The World Health Organization World Mental Health Composite International Diagnostic Interview (WHO WMH-CIDI) was used to assess the presence or absence of self-harm, suicidal ideation, and suicidal attempts over the past five years.²⁷ The General Anxiety Disorder scale (GAD-7), a seven-item self-report scale, was used to assess anxiety symptoms in the past two weeks. The GAD-7 total scores of <10, 10–14, and 15–21 represented minimal/mild, moderate, and severe anxiety, respectively.²⁸

Statistical analysis

We followed the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines as a framework when designing the cross-sectional study.²⁹ RStudio (V.2024.04.1 'Chocolate Cosmos') was used to conduct the analysis. Descriptive statistics were used to summarize the data and the package 'ggplot'³⁰ for data visualization.

Participants with more than 75% missing items on the PSQI-A, PCL-5, PHQ-9, and GAD-7 scales were excluded. For participants who responded to more than 75% of each scale, row imputation was used to handle missing data before calculating the total score. Multivariate imputation was performed using the "mice"³¹ package to address missing data using predictive mean matching with m=20 rounds of imputations and 20 iterations.³²

Modified Poisson regression models, with the sandwich variance estimator, were used to estimate prevalence ratios (PRs) with 95% confidence intervals (CIs)^{33,34} between TASD and various background factors, psychiatric symptoms, and trauma-related factors, both in age adjusted and multivariable-adjusted models. The latter incorporated adjustments for age, relationship status, education, personal income, employment status, number of LEC-5 life stressors, and temporal proximity to the worst life stressor, when relevant. The Poisson regression models with generalized estimating equations were fitted using the 'geeglm'³⁵ function and the 'forestplot'³⁶ package was used to generating a standard forest plot for the aforementioned analysis. Table S2 shows a comparison of logistic regression models in the context of complete case analysis, analysis with missing values, and pooled data analysis after multiple imputation.

We conducted a stratified analysis by age groups to explore variations in observed patterns (Table S3). Effect modification was assessed using a Poisson GEE model with an interaction term, and age-stratified relative risks were estimated via contrast matrices and generalized linear hypothesis testing.

Results

Sample Characteristics

Among the 29 653 women in the study (mean age 43.6 [SD 13.6] years), TASD prevalence was 6.5%. Most participants were married or in a relationship (75.8%), held university degrees (54.6%), reported medium-or-high personal income (69.0%), were employed (81.2%), and had experienced 2–3 LEC-5 life stressors (40.0%; Table 1). The most prevalent symptoms reported on the PSQI-A were general nervousness and hot flashes, while disruptive nocturnal behaviors were the most infrequent (Figure S2).

Background information and associations with TASD

After adjusting for covariates, we observed the highest prevalence of TASD among women in the youngest age group (adjusted PR [aPR], 2.59; 95% CI, 2.14–3.14), compared to those in the highest age group (60–69 years old; Figure 1). A stratified analysis by age groups (Table S3) revealed significant interactions between age and education, employment status, worst LEC-5 life stressors, and occurrence of worst life stressor ($p < .05$). Additionally, being single or widowed was associated with a higher prevalence of TASD (aPR, 1.25; 95% CI, 1.14–1.37) compared to being married or in a relationship. Furthermore, having secondary and primary education was associated with a 45–66% higher prevalence of TASD when compared to tertiary-level B education. Being unemployed (aPR, 1.31; 95% CI, 1.03–1.69), on disability (aPR, 1.93; 95% CI, 1.69–2.21), or on sick leave (aPR, 1.75; 95% CI, 1.46–2.09) was associated with a higher prevalence of TASD, compared to being employed or studying. Daily smoking (aPR, 1.54; 95% CI, 1.21–1.95), as well as monthly (aPRs, 1.28; 95% CI, 1.21–1.95) and weekly (aPRs, 1.43; 95% CI, 1.12–1.81) binge drinking, were associated with a higher prevalence of TASD compared to non-smoking and non-binge drinking. No association was found between TASD and personal income.

Life Stressors and TASD

We observed a notable increase in TASD prevalence with the number of LEC-5 life stressors encountered (Figure 2 and S3). Notably, certain life stressors exhibited particularly strong associations with TASD. With exposure to natural disasters as reference, we observed highest prevalence of TASD when the worst life stressor was exposure to physical violence (aPR, 1.86; 95% CI, 1.41–2.45), sexual violence (aPR, 2.46; 95% CI, 1.91–3.16), combat/war-zone (aPR, 3.28; 95% CI, 1.22–8.77), captivity (aPR, 2.03; 95% CI, 1.24–3.32), life-threatening illness or injury (aPR, 1.49; 95% CI, 1.13–1.96), sudden violent death (aPR, 1.69; 95% CI, 1.25–2.29), accidental sudden death (aPR, 1.58; 95% CI, 1.16–2.15), and stillbirth (aPR, 2.42; 95% CI, 1.54–3.82). However, adultery/rejection and other difficult birth experiences were found to be associated with a lower prevalence of TASD. Other life stressors such as bullying, discrimination, and divorce were non-significant. Women who encountered their worst life stressor more than once reported a 49% higher prevalence of TASD compared to those who experienced it once (Figure 2). Years since worst life stressor showed a graded association with TASD, with women exposed within a year displaying the highest prevalence and women exposed more than 20 years ago the lowest (Figure 3). Stratification for age at study entry revealed that this graded association was somewhat evident in all

age groups; however, the prevalence was highest among women aged 18–29 years (Figure S4). No association was found between the prevalence of TASD and age at the first occurrence of the worst life stressor.

Psychiatric Comorbidity

After adjusting for all covariates, TASD was found to be strongly associated with probable PTSD (aPR, 11.07; 95% CI, 9.94–12.32; Figure 4). Further analysis revealed 74% (n=1424/1926) of individuals with TASD also had probable PTSD. Additionally, individuals with general sleep problems had a higher prevalence of TASD (aPR, 3.71; 95% CI, 3.37–4.08), compared to those without general sleep problems. Examining the overlapping prevalence of TASD, probable PTSD, and general sleep problems, we found that 3.5% of the total sample exhibited all three conditions, while only 1.1% had TASD without the other two (Figure S5). Moderately severe (aPR, 4.00; 95% CI, 3.40–4.71) or severe (aPR, 6.70; 95% CI, 5.30–8.46) depressive symptoms were associated with a higher prevalence of TASD compared to mild or moderate depressive symptoms. Suicidal ideation (aPR, 2.42; 95% CI, 2.05–2.86), suicidal attempts (aPR, 1.84; 95% CI, 1.32–2.58), and self-harm (aPR, 2.25; 95% CI, 1.82–2.77) in the past five years were also linked with TASD. Additionally, moderate (aPR, 3.19; 95% CI, 2.73–3.72) and severe (aPR, 4.61; 95% CI, 3.77–5.64) anxiety symptoms were associated with TASD compared to minimal or mild symptoms.

Discussion

In this nationwide-representative cohort of adult women, we established a population prevalence of TASD of 6.5% which was considerably higher among young women. Exposure to physical and sexual violence, combat, and stillbirth, was associated with markedly higher prevalence of TASD than other life stressors. Close temporal proximity to the worst life stressor and repeated events were also associated with higher prevalence of TASD, particularly among young women. Finally, TASD was strongly associated with current symptoms of PTSD, depressive, and anxiety.

Our investigation revealed that 6.5% of women met criteria for TASD in the past month, marking the inaugural examination of TASD prevalence in a general population sample since its introduction in 2014.¹ This is however lower than found in a study of 3618 veterans which reported a TASD prevalence of 12.1%, with similar rates among men and women.³⁷ Among women in our study exposed to war (N = 24), we observed a 12.5% prevalence. Previous studies have found combat exposure to be associated with more frequent nightmares, nocturnal behaviors, sleep disturbances, and altered REM sleep.^{10,14–16,38} In our study, general nervousness was the most frequently reported TASD symptom, whereas trauma-related memories or nightmares were predominant in a study of 375 veterans.³⁹ Terror or screaming during sleep and dream enactment were relatively infrequent in our study, (11.7% and 8.8%, respectively) but higher than the 5% prevalence of dream enactment found in a general Norwegian sample, involving both genders.⁴⁰

Our study revealed a strong link between TASD and the number of life stressors, with prevalence increasing progressively with each additional stressor experienced. Previous research suggests that

higher cumulative count of traumatic experiences is associated with TASD and an increased risk of PTSD, nightmares, and insomnia.^{37,41,42} Interpersonal trauma, especially exposure to sexual violence, was strongly associated with higher TASD in our study. Such trauma profoundly impacts physical and mental well-being, particularly if the assault occurs during sleeping hours, undermining a sense of safety and leading to sleep avoidance due to fear of nightmares or loss of control.^{43,44}

Our study also identified a high TASD prevalence among women who had experienced stillbirth, aligning with research indicating significant emotional, psychological, and physiological impacts of stillbirth, including depression, anxiety, and PTSD.⁴⁵ Life-threatening illness, injury, and sudden death were also found to be associated with higher prevalence of TASD. In female U.S. veterans with TASD, the most common traumatic events associated with TASD were combat (41.4%), illness (11.1%), and attacks (10.1%).³⁷ While research on TASD among survivors of life-threatening illnesses is limited, PTSD has been reported in 12–25% of individuals after acute medical events like heart attacks, strokes, and cancer.⁴⁶ These findings highlight the nuanced connection between distinct trauma types and TASD development, suggesting that TASD onset is linked to more severe and personal traumatic experiences.⁴⁷

Our results also revealed that repeated exposure to the worst life stressor was associated with a higher TASD prevalence, consistent with PTSD studies.⁴⁸ In line with previous research on 823 US female veterans,³⁷ we found close temporal proximity to the worst life stressor to be associated with higher TASD prevalence, particularly among women younger than 30. Sexual abuse, which is prevalent as the index traumatic event in this cohort, likely contribute to this trend, as they occur most frequently during teenage years and young adulthood.⁴⁹ The severity of nightmares and disruptive nocturnal behaviors tends to be most pronounced in the wake of the trauma, occurring frequently in the weeks and months immediately following the event.^{1,7} While these symptoms may persist over time, their frequency and intensity typically diminish.^{9,16}

TASD prevalence was strongly associated with comorbid psychiatric symptoms, particularly probable PTSD, with a 74% prevalence among TASD women, aligning with other studies' 50–76% range.^{1,37} The association between TASD and PTSD is well-documented in the literature as these are both conditions triggered by exposure to traumatic events and often co-occur.^{1,13,50,51} The overlapping symptoms, particularly those related to re-experiences such as recurrent distressing dreams and flashbacks, underscore the interconnected nature of these conditions.¹ Despite the well-documented correlation, further research is crucial to understand the mechanisms underlying this comorbidity and to develop effective interventions aimed at addressing the symptoms of both PTSD and TASD. Furthermore, our study found that women with depressive and anxiety symptoms, suicidal ideation and attempts, and self-harm had higher prevalence of TASD. This is in line with the findings of a study of post-9/11 veterans where TASD had a higher comorbid prevalence of PTSD, major depressive disorder, and suicide ideation than those without TASD.³⁷ Women with general sleep problems, as measured by the PSQI, had a higher

prevalence of TASD, highlighting the interconnectedness of broad sleep symptoms and trauma.³⁸ It's unclear whether these general sleep problems preceded trauma, but pre-existing sleep problems may influence trauma outcomes, as seen in veterans with pre-war nightmares having higher PTSD risk post-war.⁵² The current study marks the first exploration of comorbidity of TASD, probable PTSD, and general sleep problems, with 3.5% of the sample exhibiting all three conditions.

There are two notable strengths in this study. Firstly, the utilization of the large nationwide SAGA cohort study of approximately 30,000 nationally representative women to investigate the prevalence of TASD and its associated factors in a population-based setting.¹⁷ Secondly, this study represents the largest cohort to date to assess TASD and associated risk factors among women in the general population. To our knowledge, no other large cohort studies have explored TASD in this demographic. Despite these notable strengths, it is important to acknowledge certain limitations in our study. The cross-sectional nature of the study prevents us from drawing any conclusion on the directionality between TASD and the assessed comorbidities. Moreover, this study exclusively depended on self-reported TASD symptoms and trauma exposures. The study is also limited to general population of women in a Nordic welfare state, thus large longitudinal studies are needed to expand our understanding of TASD across diverse populations, including men, adolescents, and children.

In conclusion, this study provides critical insights into factors influencing the prevalence of TASD and its psychiatric comorbidities in a nationally representative population of women. These findings highlight exposure to violence and stillbirth as strong risk factors of TASD, with repeated trauma exposure and temporal proximity to the worst life stressor entailing additional risk of TASD. These findings underscore the interconnected nature of life stressors, TASD and psychopathologies in women with implications for developing targeted interventions for trauma recovery.

Declarations

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Author Contributions:

A.B.U. contributed to the concept and design; data acquisition, analysis, and interpretation; drafting of the manuscript; statistical analysis; and takes responsibility for the integrity of the data and accuracy of the analysis.

E.B.T. contributed to the concept and design; data acquisition, analysis, and interpretation; drafting and critical review of the manuscript; statistical analysis; funding acquisition; and supervision.

U.A.V. contributed to the concept and design; data acquisition and interpretation; drafting and critical review of the manuscript; funding acquisition; and supervision.

T.A. contributed to data analysis and interpretation; statistical analysis; and critical review of the

manuscript.

S.D.J. contributed to data analysis and interpretation; and statistical analysis.

V.M. contributed to data interpretation and critical review of the manuscript.

A.H. contributed to data interpretation and critical review of the manuscript.

G.T. contributed to data interpretation and critical review of the manuscript.

E.B. contributed to data interpretation and critical review of the manuscript.

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Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author [A.B.U.]. The data are not publicly available due to data protection laws in Iceland and because they contain information that could compromise research participant privacy and consent.

Ethics Approval and Consent to Participate: All SAGA cohort participants provided informed consent.

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Table

Table 1. Demographic characteristics of participants.

	Overall n=27 333
Age in Years, M(SD)	43.7 (13.6)
Age Categories, n(%)	
18–29	5273 (19.3%)
30–39	5628 (20.6%)
40–49	6126 (22.4%)
50–59	6204 (22.7%)
60–69	4102 (15.0%)
Marital Status, n(%)	
Married or in a relationship	20 612 (75.8%)
Single or widowed	6573 (24.2%)
Unknown	148
Education, n(%)	
Tertiary level B	6198 (22.8%)
Tertiary level A	8670 (31.8%)
Secondary	8418 (30.9%)
Primary	3944 (14.5%)
Unknown	103
Personal Income, n(%)	
≥5601 EUR	3679 (14.0%)
4001–5600 EUR	6263 (23.8%)
2401–4000 EUR	8201 (31.2%)
1201–2400 EUR	6254 (23.8%)
<1200 EUR	1869 (7.1%)
Unknown	1067
Employment Status, n(%)	
Employed/studying	22 037 (81.2%)

Unemployed	475 (1.7%)
Staying at home/maternity leave	979 (3.6%)
On disability	2154 (7.9%)
Sick leave	694 (2.6%)
Retired	813 (3.0%)
Unknown	181
No. of LEC-5 Life Stressors^a, n(%)	
0	3924 (14.4%)
1	6097 (22.3%)
2–3	10 920 (40.0%)
4–5	4966 (18.2%)
≥6	1426 (5.2%)
Temporal Proximity to Worst Life Stressor, n(%)	
≥20 years	7631 (29.2%)
10–19 years	5614 (21.4%)
5–9 years	4194 (16.0%)
2–4 years	4169 (15.9%)
0–1 year	4570 (17.5%)
Unknown	1155

^a According to the Life Events Checklist for DSM-5 (LEC-5) – response option ‘happened to me’.

Figures

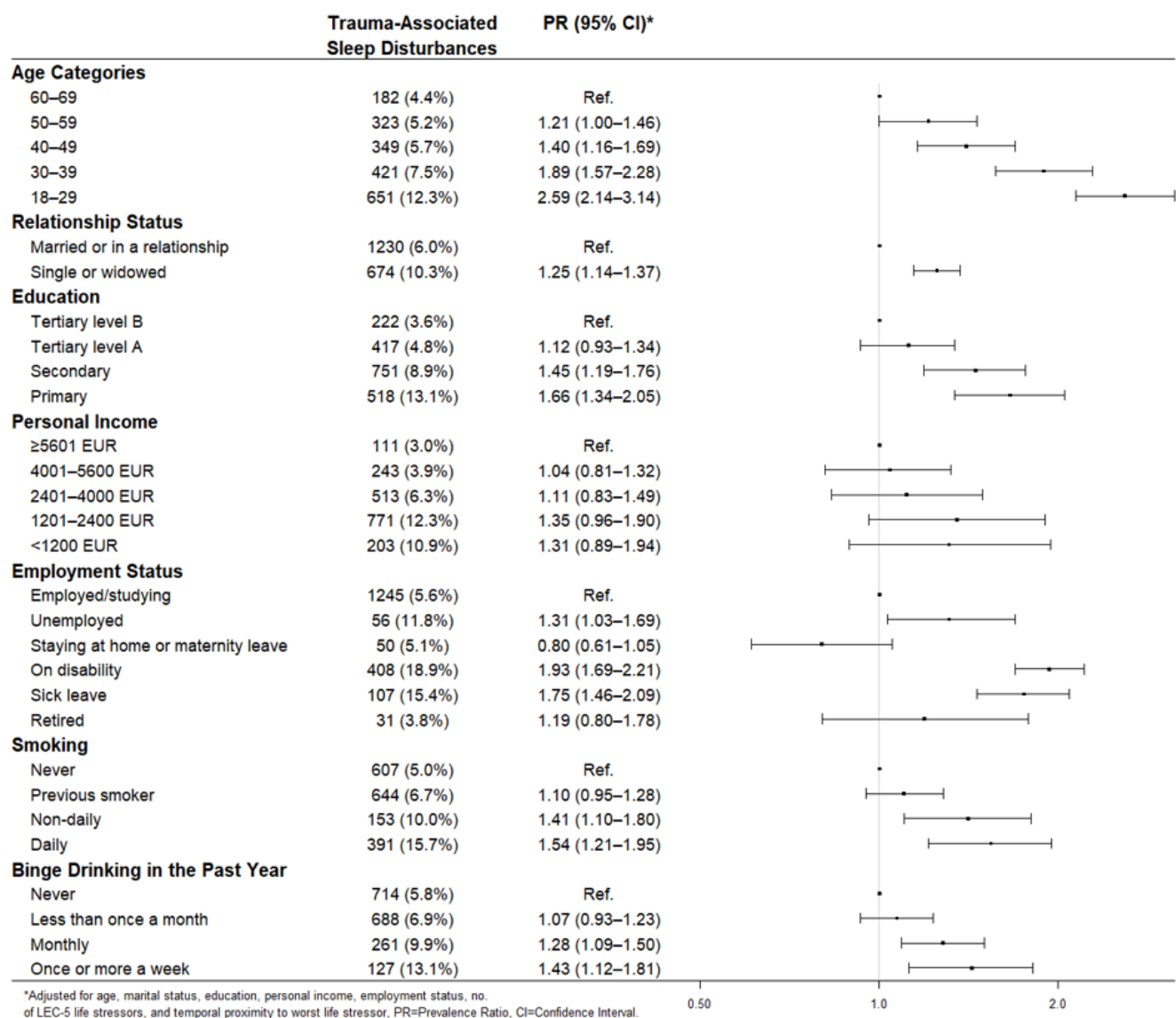


Figure 1

Association of trauma-associated sleep disturbances (TASD) with sociodemographic characteristics and health-related behavior, presented on a logarithmic scale. PR = Prevalence Ratio, CI = Confidence Interval.

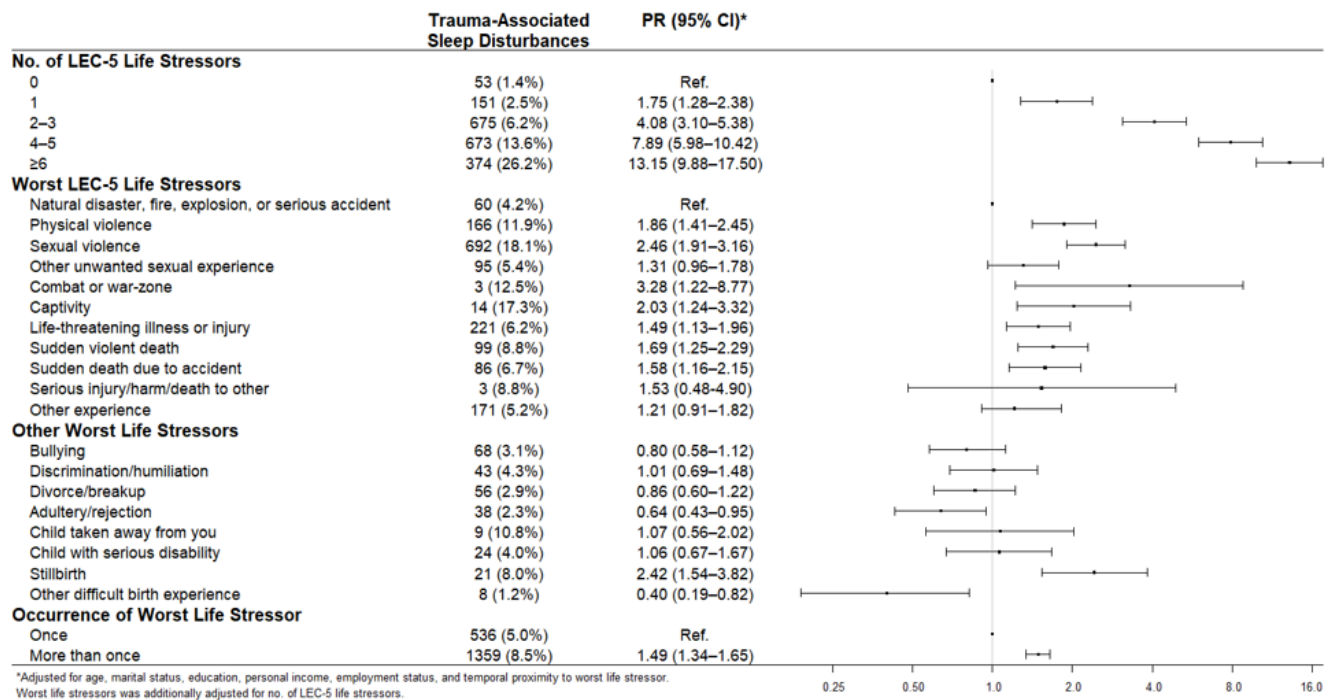


Figure 2

Association of TASC with life stressors and the occurrence of worst life stressor, presented on a logarithmic scale.

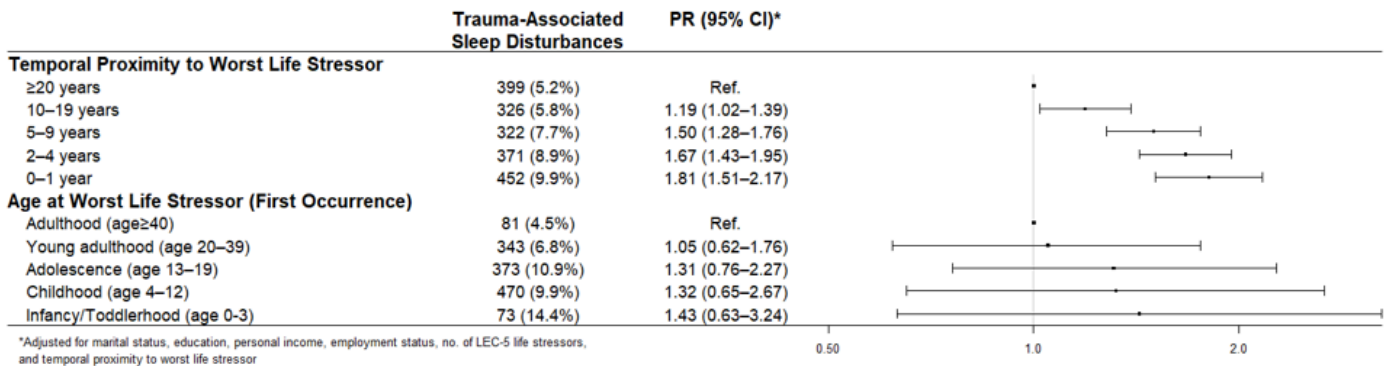


Figure 3

Association of TASC and mental well-being.

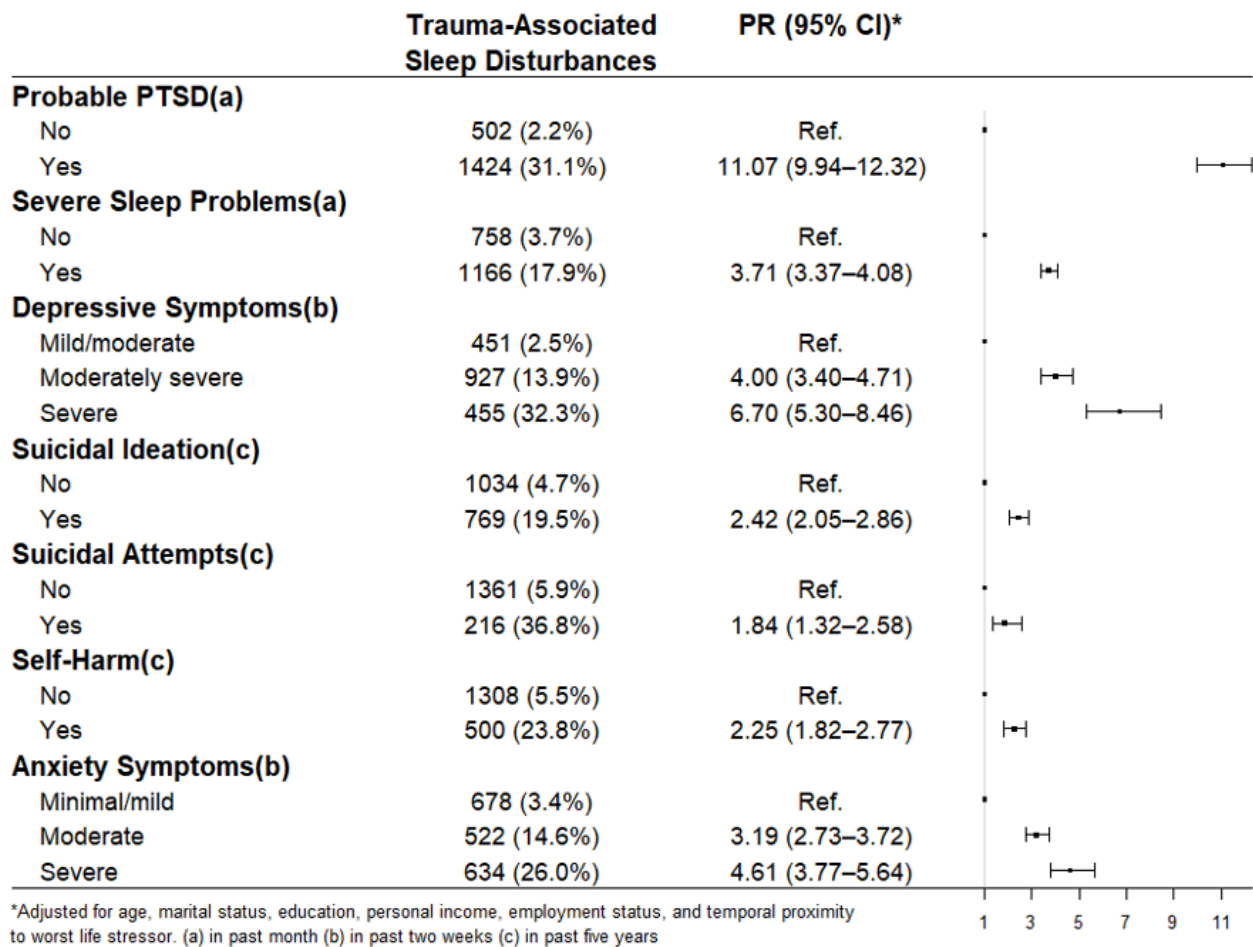


Figure 4

Association of TASD and mental well-being.

Supplementary Files

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- [Supplement.pdf](#)