Original Article

Traumatic childhood experiences and multiple dimensions of poor sleep among adult women

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Abstract

Study Objectives: Exposure to traumatic childhood experiences (TCEs) may contribute to poor sleep in adulthood. Previous studies have been limited to mainly investigating physical and sexual abuse and did not consider betrayal trauma, or whether the victim regarded the perpetrator as someone socially close to them, the age group at occurrence, and trauma-related distress/anxiety.

Methods: We used a large cohort of US women, 35–74 years old, enrolled in the Sister Study from 2003 to 2009. Self-reports of specific TCEs occurring before the age of 18 years included sexual, physical, and psychological/emotional trauma; natural disasters; major accidents; and household dysfunction. Participants self-reported average sleep duration (short: <7 hours vs recommended: 7–9 hours), sleep onset latency (SOL) at least 30 vs less than 30 minutes, at least 3 night awakenings once asleep at least 3 times/week (Night awakenings [NA], yes vs no), and napping at least 3 vs less than 3 times/week.

Results: Among 40 082 women, 55% reported a TCE, with 82% reporting betrayal trauma. Compared to women reporting no TCE, women with any TCE were more likely to report short sleep (prevalence ratio [PR] = 1.08, [95% confidence interval (CI) = 1.04 to 1.11]), longer SOL (1.11, [1.06 to 1.16]), frequent NAs (1.06, [1.00 to 1.11]), and frequent napping (1.05, [0.99 to 1.12]). The relationship between experiencing any TCE and short sleep was stronger for TCEs by a perpetrator considered socially close vs not close (1.12, [1.09 to 1.16]), SOL (1.27, [1.22 to 1.33]), NA (1.20, [1.14 to 1.27]), and napping (1.24, [1.17 to 1.32]).

Conclusions: TCEs were associated with poor sleep in women with greater impact when the perpetrator was regarded as close. More research is warranted to better understand pathways between childhood trauma and sleep health in adulthood to develop effective interventions.

Statement of Significance

Childhood trauma is a pervasive public health concern that may affect sleep health even in adulthood. Most prior studies have been limited to studying the impact of physical and sexual abuse on sleep, and some have considered emotional neglect. This study extends the current literature by examining, multiple traumas (including some understudied forms such as natural disasters and major accidents) and their independent as well as cumulative impact on multiple sleep dimensions (beyond sleep duration). Social proximity of the perpetrator to the victim, age-group at occurrence, and trauma-related distress/anxiety were also investigated. We found important associations between traumatic childhood experiences and various sleep dimensions in adulthood, especially when the perpetrator was close to the victim.

Introduction

Experiencing trauma during the first 18 years of life is a substantial public health problem. In 2008, it was estimated that approximately 61% children experienced or witnessed at least one direct physical, sexual, emotional, or property victimization [1]. Traumatic childhood experiences (TCEs) have been defined as any significantly stressful event occurring during childhood/adolescence with an accompanying emotional, psychological, or social impact [2]. Although examples of traumas include physical or sexual abuse, emotional or psychological neglect, accidents, death of someone close, household dysfunction, natural disasters, intentional catastrophe (including war and terrorism), and major illnesses [3], most epidemiological studies evaluating traumatic events occurring during childhood have been limited to emotional, physical, or sexual abuse. To date, these studies have reported strong associations between TCEs and poor sleep in adulthood [4–7]. For instance, a previous review reported a 70% increased risk of self-reported sleep disturbances among individuals with a history of physical abuse during childhood [7]. Although boys are more likely than girls to report witnessing violent events, including those involving a weapon. The National Survey of Adolescents also found that among the approximate 8% of all adolescents endorsing experiencing at least one lifetime sexual assault, girls (13%) were more likely than boys (3%) to report this trauma [8].

Poor sleep is also widespread among adults in the United States. Approximately 50–70 million Americans have chronic sleep deprivation or a sleep/wake disorder [9]. In particular, a National Sleep Foundation poll among US adults found that women are more likely than men to report having difficulty falling and staying asleep and to report more excessive daytime sleepiness [10]. Individuals with habitual short sleep duration are at increased risk for obesity, diabetes, cardiovascular disease, and even mood disorders like depression [9, 11, 12]. Many previous studies have focused on sleep duration and insomnia symptoms (e.g. trouble falling or staying asleep), with few including sleep dimensions such as frequency of nighttime awakenings and napping frequency [6, 13–15]. Although previous studies have found strong associations between childhood sexual abuse and poor sleep, particularly among women [16–20], more studies are needed to explore the impact of other forms of trauma (such as the death of a sibling or close friend, natural disasters, and major accidents) on multiple sleep dimensions.

Adverse outcomes associated with childhood trauma have also been shown to differ depending on whether the event took place during early childhood (≤12 years) or adolescence (13–17 years) [21, 22]. For instance, Gal et al. [21] found that first occurrence of physical and sexual abuse during childhood was more strongly associated with later psychopathology than trauma in adolescence. Furthermore, TCEs have been shown to have a dose–response relationship with poor health outcomes in adulthood [23]. For example, Felitti et al. [24] found increased exposure to childhood abuse and household dysfunction led to a greater number of risk factors for mortality. Few studies, however, have examined increased susceptibility to poor sleep in adulthood based on different ages at trauma occurrence, despite growing evidence of differential risks of health outcomes [21, 25]. Moreover, TCEs are thought to occur across two independent dimensions: noninterpersonal (including life-threatening) in nature and social-betrayal in nature wherein a violation of trust occurs, such as sexual, physical, and psychological abuse by a caregiver [26, 27]. We extend beyond investigating the cognitive effects (e.g. anxiety, dissociation, and depression) pioneered by Freyd et al. [27] by evaluating the impact of betrayal trauma on sleep disruption in adulthood.

We sought to investigate the relationship between exposure to childhood trauma and sleep characteristics in adulthood by (1) determining the association between several types of TCEs and various measures of sleep in adulthood: we hypothesized that experiencing any type of childhood trauma will be positively associated with an increased prevalence of unfavorable sleep characteristics and there will be a dose–response relationship; (2) examining age group at occurrence (early childhood vs adolescence) of the TCE as a moderator in this relationship: we hypothesized that women who experienced trauma during early childhood will have a higher prevalence of poor sleep characteristics compared to women who experienced trauma during adolescence; and (3) determining the impact of betrayal trauma, where the victim suffered trauma perpetrated by someone regarded as socially close vs not close to them: we hypothesized that women who reported trauma perpetrated by someone socially close to them will have a higher prevalence of sleep disruption than women who reported trauma perpetrated by someone not socially close.

Methods

The Sister Study cohort

We used data from the Sister Study (Data Release 6.0), a prospective cohort of 50 884 women, designed to examine the environmental and genetic determinants of breast cancer. Study methods have been described in detail elsewhere [28]. Briefly, women were enrolled from 2003 to 2009, with eligibility criteria including being between the ages of 35 and 74 years, residing in the continental United States and Puerto Rico, being free of or without a history of breast cancer, and having a full or half-sister who has been diagnosed with breast cancer. At enrollment, participants completed a computer-assisted telephone interview administered by trained interviewers. Each subsequent year, participants were contacted for either an abbreviated annual update questionnaire or a detailed follow-up questionnaire (approximately every 2–3 years). Lifestyle-related behaviors, including sleep habits, were collected at baseline. Questions on early-life traumatic experiences were obtained at a first follow-up interview approximately 2 years after enrollment, which was completed by 46 776 participants (91.6%). The study was approved by the institutional review board of the National Institute of Environmental Health Sciences, and written informed consent was provided by each participant.

Of Sister Study participants who completed the first follow-up, our study sample excluded: women who did not complete the Stress and Coping questionnaire (4108; 8%), those with a self-identified race/ethnicity that qualified as "Other" (1197; 3%), or those pregnant at baseline (24; <1%). We also excluded those who answered "do not know," refused or had missing data for experiencing "any trauma" (4852; 10%), race/ethnicity (12; <1%), family income growing up (70; <1%), highest level of household education during childhood (387; 1%), food security during childhood (12; <1%), average sleep duration (45; <1%), time to fall asleep (50; <1%), weekly nighttime awakenings (36;

<1%), and napping frequency (5; <1%). Participants reporting implausible values for frequency of nighttime awakenings (defined as >20 times per night/day, 4; <1%) were also excluded. The final analytic sample consisted of 40 082 participants.

Assessment of exposure to traumatic childhood experiences

Participants were asked if they had ever personally experienced various potentially traumatic events. For each trauma question, participants were asked to respond with a "yes" or "no." For each positive response, respondents were then asked to report the ages of occurrence (age 12 or younger, ages 13–17, ages 18 to the present, and in the past year). Study questionnaires are available at https://sisterstudy.niehs.nih.gov/English/researchers.htm.

Childhood trauma questions were combined into one of five groups/domains: (1) natural disasters/major accidents, (2) household dysfunction, (3) sexual, (4) physical or (5) psychological/emotional trauma, and then coded as a binary variable, having "ever" or "never" experienced the trauma. The various traumas assessed were further combined into a group classified as "any trauma" and also coded as "ever" or "never." Because trauma categories were not mutually exclusive, participants could be represented in more than one trauma category. For each reported trauma, participants were asked, "Regardless of when the trauma happened, how much distress or anxiety has the trauma caused in the past 4 weeks?". Distress or anxiety was dichotomized as "yes" ("A little," "A moderate amount," or "A lot") or "no" ("None").

Natural disasters

Participants were asked to respond "yes" or "no" to the following questions: "Have you ever been in a major fire, flood or other natural disaster that resulted in serious injury to yourself or fear of your own death, or serious injury or death of someone with whom you were very close, or serious damage to your home?".

Major accidents

Participants were also asked, "Have you ever been in a major accident involving a car or other vehicle, or work site accident that resulted in serious injury or death of someone with whom you were very close, or serious damage to your home?".

Household dysfunction

Household dysfunction was measured by asking participants, "Have you ever personally witnessed someone with whom you were very close deliberately attack another family member so severely as to result in marks, bruises, burns, blood, broken bones or teeth?"; "Have you ever experienced serious family problems related to alcohol, drug, or other substance abuse, or mental illness (either you or another family member whose troubles would directly affect you)?".

Sexual and physical trauma

Sexual trauma and being physically attacked (included in physical trauma) were considered betrayal traumas. Sexual trauma was assessed by asking participants: "Have you ever been made to have unwanted sexual contact, such as touching or penetration?". Physical trauma was assessed by asking participants: "Have you ever been deliberately hit or attacked so severely as

to result in marks, bruised, burns, blood or broken bones?". Two separate questions (for sexual and physical categories) were asked to determine whether or not each trauma was perpetrated by someone regarded as close or by someone not close. The remaining non-betrayal physical trauma was determined by asking participants, "Have you personally experienced a major illness (life threatening or severely disabling to you)?".

Psychological/emotional trauma

Psychological/emotional mistreatment was determined by asking participants, "Have you ever been emotionally or psychologically mistreated (such as being yelled or screamed at, insulted or belittled) over a significant period of time?"; "Have you ever personally witnessed someone committing suicide, or being attacked so severely as to result in marks, bruises, burns, blood, broken bones or teeth, or death?". Two separate questions were also asked for psychological/emotional traumas to determine whether or not the following traumas were perpetrated by someone regarded as close or by someone not close. The remaining non-betrayal psychological/emotional traumas were determined by asking participants, "Have you ever experienced the death of a sibling?"; "Have you ever experienced the death of a parent?"; "Have you ever experienced the death of a close personal friend?"; "Have you ever experienced your sister getting breast cancer?"; "Have you ever experienced your mother getting breast cancer?"; "Have you ever experienced a major illness, other than breast cancer (life threatening or severely disabling) in someone close to you?".

Participants were also asked an open-ended question about any traumatic events not already covered in the categories listed. These traumas were included in the overall category "Any trauma."

Assessment of sleep outcomes

Sleep duration

Sleep duration was determined by asking participants, "About how many hours and/or minutes of sleep per (night/day) do you get on average?". Participants were instructed to report (in hours and minutes) how much sleep they get in a 24-hour period. Sleep duration was categorized as short (<7 hours), recommended (7 to ≤9 hours), and long (>9 hours) [29]. Long sleep was not included in the analysis due to a small sample size.

Sleep onset latency

Average time taken to fall asleep was determined from the following question: "About how long does it take you to fall asleep on average?". Study participants were asked to exclude time spent in bed reading, watching TV, etc. before falling asleep. Participants could report the number of minutes in the following manner: "less than 15 minutes," "15 minutes to half an hour," "more than half an hour but less than one hour," and "one hour or more." Time to fall asleep was dichotomized as more than or less than or equal to 30 minutes [30].

Number of awakenings

Frequency of awakenings was measured using the following question, "When you are asleep, how often do you wake up for any reason?". Participants could respond with: "every night/day or most nights/days," "3–4 nights/days a week," "1–2 nights/

days a week," "1–3 nights/days per month," "< once a month," or "never." "On those nights/days (that you awaken when you are asleep), how many times do you usually wake-up each night/day?". Participants could report the number of times (continuously) they awakened once asleep. Number of awakenings (NAs) indicating potential sleep disruption were defined as at least 3 awakenings in the same sleep period occurring at least 3 times per week and were dichotomized as "yes" or "no" [30].

Napping frequency

Napping frequency was determined by asking participants: "How often do you take naps?". Participants could respond with: "every day or most days," "three or four days a week," "one or two days a week," "one to three days per month," "less than once a month," "never." Napping frequency was coded as a binary variable, at least 3 or less than 3 times per week [30].

Potential confounders

Participants' age at enrollment was measured in years and was used as a continuous variable in analyses. Participants self-identified their race/ethnicity as either non-Hispanic white, non-Hispanic black/African American, or Hispanic/Latino. Childhood adverse socioeconomic status (SES) measures included childhood household educational attainment self-reported income most of the time growing up (well off, middle income, low income, or poor), and food insecurity ("Were there times when your family didn't have enough to eat?"). Childhood household educational attainment was determined by calculating the highest level of education among each household member legally responsible for the participant at age 13 years. For this analysis, 10 response categories were grouped into four levels for (i.e. less than high school, high school or graduate equivalent degree, some college [including vocational/technical training or associate's degree], or completed bachelor's degree and above). Childhood adverse SES score was a summary variable of yes answers ranging from 0 to 3 of the following questions: low/poor self-reported income growing up, household educational attainment at age 13 years less than high school, and food insecurity. Higher scores indicated lower childhood adverse SES. Other sociodemographic characteristics and health behaviors considered potential confounders included marital status, defined as "single/never married", "married/living as married," or "widowed/separated/divorced"; highest educational attainment was defined as "<high school (HS)," "HS/Graduate Equivalency Diploma," "some college," or "≥ bachelor's degree"; alcohol consumption and smoking status were both defined as "never," "former," or "current." We defined body mass index (BMI) as the participant's body weight (in kilograms) divided by their height (in meters [2]). Clinical depression at baseline was based on self-report of a physician's diagnosis and dichotomized as "yes" or "no."

Potential modifiers

Recent sleep medication use was measured by asking participants "Have you taken prescription or over the counter medication in the past six weeks to help you fall asleep or stay asleep [not including herbal teas, milk, liquor, or acupuncture]?". Participants could respond with "yes" or "no" as assessed in analyses. Sleep medication use in the analysis was categorically coded as "yes" or "no." We considered distress or anxiety experienced in the past 4 weeks caused by a specific trauma, regardless of timing of the trauma,

as a potential modifier of the relationship between childhood trauma and all sleep dimensions. We also considered age group at occurrence (≤12 years old vs 13–17 years old), and betrayal trauma exposure (characterized by four questions) as potential modifiers of the relationship between TCEs and sleep in adulthood.

Statistical analysis

Descriptive statistics for study participants were compared for all sleep dimensions, using means ± standard deviations (SD) for continuous variables and counts and proportions for categorical variables. Potential confounders were considered a priori based on the prior literature [4–6, 31]. Multivariable models included age measured continuously (in 5-year increments), self-identified race/ethnicity and childhood adverse SES score. We did not adjust for adulthood characteristics including marital status, annual income, educational attainment, or BMI to avoid overadjustment by factors potentially resulting from or modified by TCE exposure in childhood. Normality testing for distribution of average hours of sleep per day/night was determined using Kolmogorov–Smirnov tests. We used log-binomial regression models to estimate prevalence ratios (PR) and 95% confidence intervals (CIs) to compare the prevalence of short sleep duration among participants who reported experiencing any or a specific type of trauma to those who reported never experiencing trauma. PRs comparing ever experiencing trauma to never experiencing trauma were also estimated for taking more than 30 minutes to fall asleep, at least 3 awakenings once asleep at least 3 times per week, and napping at least 3 times per week.

In a sensitivity analysis, we stratified participants by recent use of sleep medication (yes/no) and by self-reported physician's diagnosis for clinical depression at baseline (yes/no). We also evaluated correlation among sleep dimensions using Pearson's coefficient for categorical variables and Spearman's coefficient for continuous variables. All tests for significance were two-sided and a *p* value of less than 0.05 was considered statistically significant. Statistical analyses were completed using SAS software, version 9.4 (SAS Institute, Cary NC).

Results

Study population characteristics

Table 1 shows sociodemographic, health behavior, and clinical characteristics by TCE among the 40 082 eligible Sister Study participants. Mean ± SD age was 55.4 ± 8.8 years, 88% were non-Hispanic white, 8% were non-Hispanic black, and 4% were Hispanic/Latino. Thirteen percent had a high school diploma/graduate equivalent degree, and 23% had an annual household income of less than $50 000 per year. Demographic characteristics were similar for those who reported any TCE (Supplementary Table 1). Compared with those who reported no TCE, women with TCEs were more likely to report at least two adverse early-life SES factors (12% vs 19%) and were more likely to self-report being diagnosed with clinical depression (15% vs 26%).

Among all trauma categories, similar prevalence was observed between natural disasters and major accidents (4%), household dysfunction, and sexual trauma (18%), whereas psychological/emotional trauma had the highest prevalence (36%)

Table 1. Sociodemographic and childhood characteristics, health behaviors, and clinical characteristics by ever experiencing any traumatic childhood experience among 40 082 women in the Sister Study

	All	Any traumatic experience	
		Ever n (%)	Never n (%)
	40 082	22 067 (55)	18 015 (45)
Sociodemographic characteristics			
Age, years ± SD	55.4 ± 8.8	54.9 ± 8.7	55.9 ± 8.9
Race/ethnicity			
White	35 378 (88)	19 238 (87)	16 140 (90)
Black	2962 (8)	1829 (8)	1133 (6)
Hispanic	1742 (4)	1000 (5)	742 (4)
Married/living as married, yes	30 464 (76)	16 449 (75)	14 015 (78)
Educational attainment			
<HS	362 (1)	238 (1)	124 (1)
HS/GED	5275 (13)	2803 (13)	2472 (14)
Some college	13 110 (33)	7542 (34)	5568 (31)
≥Bachelor's	21 335 (53)	11 484 (52)	9851 (55)
Annual household income <$50 000	9106 (23)	5367 (24)	3739 (21)
Childhood characteristics			
Number of adverse early life SES factors[a]			
0	23 883 (60)	12 022 (54)	11 861 (66)
1	10 034 (25)	5902 (27)	4132 (23)
2	5035 (13)	3312 (15)	1723 (10)
3	1130 (3)	831 (4)	299 (2)
Sleep characteristics			
Sleep category[b]			
Short sleep (<7 hours)	11 226 (28)	6501 (29)	4725 (26)
Recommended sleep (7–9 hours)	28 459 (71)	15 315 (69)	13 144 (73)
How long to fall asleep			
>30 minutes	6919 (17)	4175 (19)	2744 (15)
≤30 minutes	33 163 (83)	17 982 (81)	15 271 (85)
Awakened ≥3 times once asleep ≥3 times/week			
Yes	5437 (14)	3144 (14)	2293 (13)
No	34 645 (86)	18 293 (83)	15 722 (87)
Frequency of naps			
≥3 times per week	4131 (10)	2415 (11)	1741 (10)
<3 times per week	35 951 (90)	19 834 (89)	16 274 (90)
Recent use of sleep aids			
Yes	9655 (24)	5689 (26)	4006 (22)
Health behaviors			
Alcohol consumption status			
Current	32 947 (82)	17 924 (81)	15 023 (83)
Past	5726 (14)	3428 (16)	2298 (13)
Never	1361 (3)	684 (3)	677 (4)
Smoking status			
Current	3050 (8)	1902 (9)	1148 (6)
Past	14 325 (36)	8273 (37)	6052 (34)
Never	22 704 (57)	11 889 (54)	10 815 (60)
Clinical characteristics			
Mean BMI (kg/m^2) ± SD	27.7 ± 6.2	28.0 ± 6.4	27.3 ± 5.9
Waist circumference (cm) over NHLBI guidelines (yes)	15 985 (40)	9231 (42)	6754 (37)
Clinical depression, yes	8434 (21)	5798 (26)	2636 (15)

Missing values include: annual income, $n = 1396$ (3%); all other variables <1%. Waist circumference measurements >88 cm for females was defined as exceeding guidelines per the National Heart, Lung and Blood Institute. GED: general education diploma.
[a]Summary score: one or more adverse early-life socioeconomic factors (low/poor self-reported income growing up, <high school household educational attainment, food insecurity [yes]). Childhood household educational attainment was determined by adult(s) who lived in the household and were legally responsible for participant at age 13 years.
[b]Long sleep ($n = 397$) was not analyzed.

(Supplementary Table 2). Forty-four percent of participants reporting a TCE also reported trauma-related distress/anxiety. Participants with a history of TCEs were more likely than participants without a history of trauma to report short sleep (29% vs 26%, $p <0.05$) longer sleep onset latency (SOL; 19% vs 15%, $p < 0.05$), frequent NAs (14% vs 13%, $p < 0.05$), and frequent napping (11% vs 10%, $p < 0.05$; Table 1). This pattern was similar across all trauma types.

Associations between traumatic childhood experiences and sleep characteristics

The prevalence of short sleep, longer SOL, and frequent NAs was higher among those reporting any TCE compared to having no TCE, in fully adjusted models that accounted for BMI and clinical depression (Table 2). Experiencing a natural disaster was most strongly associated with short sleep prevalence (PR = 1.18, [95% CI = 1.10 to 1.27]). Reporting a physical trauma was most strongly associated with longer SOL (PR = 1.29, [95% CI = 1.20 to 1.39]) and frequent NAs (1.18, [1.08 to 1.29]), with a suggestive positive association with frequent napping (1.11, [1.00 to 1.23]).

Trauma in childhood vs adolescence and sleep characteristics

When compared to women reporting no trauma, there was no general pattern of higher prevalence of each poor sleep characteristic for women who reported traumas occurring during childhood vs adolescence (Table 3). The exception to this pattern was women endorsing experiencing a natural disaster during adolescence having a higher prevalence of short sleep, frequent NAs, and frequent napping than women reporting these traumas during childhood. On the contrary, the prevalence was higher for these same sleep characteristics among women reporting household dysfunction during childhood vs adolescence. There were strong associations for most traumas reported during both time periods with each poor sleep characteristic, particularly

between experiencing a major accident (PR = 1.82, [95% CI = 1.09 to 3.03]) or physical trauma (PR = 1.74, [95% CI = 1.56 to 1.95]) with reporting longer SOL.

Recent distress or anxiety caused by trauma

Compared to women who reported no trauma, associations between trauma and short sleep (1.12, [1.08 to 1.17]), longer SOL (1.38, [1.31 to 1.45]), frequent NAs (1.22, [1.15 to 1.29]), and frequent napping (1.25, [1.17 to 1.34]) were stronger among those who reported accompanying distress/anxiety than among those who reported trauma with no distress/anxiety (Table 4).

Betrayal trauma and sleep characteristics

There were 13 732 women who reported "yes" to each of the four questions that defined betrayal trauma, or experiencing trauma by someone either close or not close to the participant (e.g. witnessing an attack, unwanted sexual contact, being physically hit, or psychologically/emotionally mistreated). Among the four betrayal trauma types, 82% women reported trauma by someone close, 37% by someone not close, and 19% by both (Supplementary Table 3). Compared to women reporting no trauma, women reporting trauma by someone regarded as close had a higher prevalence of short sleep (1.12, [1.09 to 1.16]), longer SOL (1.27, [1.22 to 1.33]), frequent NAs (1.20, [1.14 to 1.27]), and frequent napping (1.24, [1.17 to 1.32]) than women with trauma by someone not

Table 2. Prevalence ratios and 95% confidence intervals for poor sleep among 40 082 women who reported experiencing a traumatic childhood experience (TCE) compared to those who reported no TCE (The Sister Study)

	Short sleep (<7 hours)			Takes > 30 minutes to fall asleep		
	Model I	Model II	Model III	Model I	Model II	Model III
	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
No reported trauma	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Any traumatic experience	**1.08 (1.05 to 1.12)**	**1.08 (1.04 to 1.11)**	**1.08 (1.04 to 1.11)**	**1.18 (1.13 to 1.24)**	**1.17 (1.12 to 1.22)**	**1.11 (1.06 to 1.16)**
Natural disasters	**1.21 (1.13 to 1.30)**	**1.17 (1.09 to 1.26)**	**1.18 (1.10 to 1.27)**	**1.24 (1.12 to 1.38)**	**1.19 (1.07 to 1.33)**	**1.14 (1.02 to 1.26)**
Major accidents	**1.10 (1.01 to 1.19)**	**1.09 (1.01 to 1.19)**	**1.09 (1.00 to 1.18)**	**1.33 (1.19 to 1.47)**	**1.29 (1.16 to 1.43)**	**1.21 (1.09 to 1.35)**
Household dysfunction	**1.09 (1.04 to 1.14)**	**1.09 (1.04 to 1.13)**	**1.09 (1.04 to 1.14)**	**1.27 (1.20 to 1.34)**	**1.25 (1.18 to 1.32)**	**1.16 (1.09 to 1.23)**
Sexual trauma	**1.13 (1.08 to 1.18)**	**1.11 (1.07 to 1.16)**	**1.11 (1.06 to 1.16)**	**1.26 (1.19 to 1.33)**	**1.23 (1.16 to 1.30)**	**1.15 (1.08 to 1.22)**
Physical trauma	**1.17 (1.11 to 1.23)**	**1.13 (1.07 to 1.19)**	**1.13 (1.07 to 1.19)**	**1.47 (1.37 to 1.58)**	**1.41 (1.32 to 1.52)**	**1.29 (1.20 to 1.39)**
Psychological/emotional	**1.10 (1.06 to 1.14)**	**1.09 (1.05 to 1.13)**	**1.09 (1.05 to 1.13)**	**1.24 (1.18 to 1.30)**	**1.22 (1.16 to 1.28)**	**1.15 (1.10 to 1.21)**

	Awakened ≥ 3 times once asleep ≥3 times/week			Napping ≥3 times per week		
	Model I	Model II	Model III	Model I	Model II	Model III[a]
	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
No reported trauma	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Any traumatic experience	**1.10 (1.05 to 1.16)**	**1.09 (1.04 to 1.15)**	**1.06 (1.00 to 1.11)**	**1.13 (1.07 to 1.20)**	**1.11 (1.05 to 1.18)**	1.05 (0.99 to 1.12)
Natural disasters	**1.18 (1.04 to 1.34)**	**1.15 (1.01 to 1.31)**	1.12 (0.98 to 1.27)	**1.18 (1.02 to 1.37)**	1.13 (0.98 to 1.31)	1.08 (0.93 to 1.26)
Major accidents	**1.18 (1.04 to 1.35)**	**1.17 (1.03 to 1.34)**	1.13 (0.99 to 1.29)	1.15 (0.98 to 1.34)	1.12 (0.95 to 1.31)	1.05 (0.90 to 1.23)
Household dysfunction	**1.15 (1.07 to 1.23)**	**1.14 (1.06 to 1.22)**	**1.09 (1.01 to 1.17)**	**1.18 (1.09 to 1.28)**	**1.16 (1.07 to 1.26)**	1.09 (1.00 to 1.18)
Sexual trauma	**1.23 (1.15 to 1.32)**	**1.22 (1.13 to 1.30)**	**1.16 (1.08 to 1.24)**	**1.16 (1.07 to 1.26)**	**1.11 (1.02 to 1.21)**	1.04 (0.95 to 1.13)
Physical trauma	**1.29 (1.18 to 1.40)**	**1.25 (1.15 to 1.37)**	**1.18 (1.08 to 1.29)**	**1.28 (1.16 to 1.41)**	**1.23 (1.11 to 1.36)**	1.11 (1.00 to 1.23)
Psychological/emotional	**1.12 (1.06 to 1.19)**	**1.11 (1.05 to 1.17)**	**1.07 (1.01 to 1.13)**	**1.15 (1.08 to 1.23)**	**1.13 (1.05 to 1.20)**	1.06 (0.99 to 1.13)

Childhood household educational attainment was determined by adult(s) who lived in the household and were legally responsible for participant at age 13 years. All traumatic childhood experiences include non-mutually exclusive events that occurred at <18 years. Model I adjusted for age (at the time of questionnaire completion), childhood adverse SES score (summary variable of yes answers ranging from 0 to 3 of the following questions: low/poor self-reported income growing up, household educational attainment at age 13 <high school, and food insecurity) and race/ethnicity. Model II further adjusted for the following variables measured at baseline: marital status, educational attainment, alcohol consumption, and smoking status. Model III further adjusted for the following variables measured at baseline: body mass index and clinical depression. Bolded values indicate statistical significance.
[a]Where log-binomial models did not converge due to sparseness of data, Poisson regression with robust variance estimator was used.

Table 3. Prevalence ratios and 95% confidence intervals for poor sleep among 40 082 women who reported experiencing a traumatic childhood experience (TCE) compared to those who reported no TCE (The Sister Study)

	Short sleep (<7 hours)	Takes > 30 minutes to fall asleep	Awakened ≥ 3 times once asleep ≥3 times/week	Napping ≥3 times per week
	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
No reported trauma	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Any traumatic experience				
Childhood (0–12 years)	1.03 (0.99 to 1.08)	1.02 (0.96 to 1.09)	1.00 (0.92 to 1.07)	1.02 (0.94 to 1.11)
Adolescence (13–17 years)	1.04 (0.99 to 1.10)	1.03 (0.96 to 1.11)	0.99 (0.91 to 1.08)	1.06 (0.96 to 1.16)
Both	**1.13 (1.08 to 1.17)**	**1.29 (1.23 to 1.36)**	**1.23 (1.16 to 1.30)**	**1.15 (1.08 to 1.24)**
Natural disasters				
Childhood (0–12 years)	**1.11 (1.03 to 1.19)**[a]	1.13 (1.00 to 1.27)	1.06 (0.91 to 1.24)	1.07 (0.90 to 1.28)
Adolescence (13–17 years)	**1.15 (1.03 to 1.28)**[a]	1.11 (0.92 to 1.33)	**1.26 (1.02 to 1.55)**	1.26 (0.99 to 1.60)
Both	**1.54 (1.23 to 1.93)**[a]	**1.56 (1.05 to 2.34)**	1.28 (0.65 to 2.50)	1.46 (0.75 to 2.83)
Major accidents				
Childhood (0–12 years)	1.06 (0.94 to 1.19)	1.14 (0.97 to 1.33)	1.14 (0.94 to 1.37)	1.01 (0.80 to 1.28)
Adolescence (13–17 years)	1.04 (0.94 to 1.16)	**1.24 (1.09 to 1.42)**	1.12 (0.95 to 1.33)	1.13 (0.93 to 1.38)
Both	1.30 (0.87 to 1.94)	**1.82 (1.09 to 3.03)**	0.84 (0.29 to 2.44)	1.15 (0.40 to 3.31)
Household dysfunction				
Childhood (0–12 years)	1.01 (0.95 to 1.08)	**1.12 (1.02 to 1.22)**	1.04 (0.93 to 1.15)	**1.16 (1.04 to 1.31)**
Adolescence (13–17 years)	1.00 (0.93 to 1.07)	**1.12 (1.01 to 1.23)**	0.98 (0.87 to 1.11)	1.05 (0.91 to 1.21)
Both	**1.11 (1.05 to 1.17)**	**1.25 (1.17 to 1.34)**	**1.25 (1.15 to 1.35)**	**1.14 (1.03 to1.27)**
Sexual trauma				
Childhood (0–12 years)	**1.07 (1.02 to 1.12)**	**1.15 (1.08 to 1.23)**	**1.18 (1.10 to 1.28)**	**1.12 (1.02 to 1.23)**
Adolescence (13–17 years)	**1.10 (1.03 to 1.16)**	**1.18 (1.09 to 1.29)**	**1.15 (1.03 to 1.27)**	1.03 (0.91 to 1.17)
Both	**1.25 (1.15 to 1.36)**	**1.35 (1.19 to 1.53)**	**1.53 (1.33 to 1.76)**	**1.30 (1.08 to 1.56)**
Physical trauma				
Childhood (0–12 years)	**1.14 (1.07 to 1.22)**	**1.31 (1.20 to 1.44)**	**1.20 (1.07 to 1.34)**	1.10 (0.96 to 1.25)
Adolescence (13–17 years)	1.08 (0.99 to 1.18)	**1.25 (1.11 to 1.40)**	**1.21 (1.05 to 1.40)**	**1.37 (1.17 to 1.60)**
Both	**1.19 (1.07 to 1.32)**	**1.74 (1.56 to 1.95)**	**1.40 (1.20 to 1.64)**	**1.37 (1.13 to 1.65)**
Psychological/emotional				
Childhood (0–12 years)	1.05 (1.00 to 1.10)	1.03 (0.96 to 1.10)	1.00 (0.92 to 1.09)	1.08 (0.98 to 1.19)
Adolescence (13–17 years)	1.03 (0.98 to 1.09)	**1.11 (1.03 to 1.19)**	1.05 (0.96 to 1.14)	1.06 (0.96 to 1.17)
Both	**1.13 (1.09 to 1.18)**	**1.36 (1.29 to 1.44)**	**1.23 (1.15 to 1.32)**	**1.16 (1.07 to 1.26)**

All models were adjusted for age (at the time of questionnaire completion), childhood adverse SES score (summary variable of yes answers ranging from 0 to 3 of the following questions: low/poor self-reported income growing up, household educational attainment at age 13 <high school, and food insecurity) and race/ethnicity. Childhood household educational attainment was determined by adult(s) who lived in the household and were legally responsible for participant at age 13 years. All traumatic childhood experiences include non-mutually exclusive events that occurred at <18 years. Bolded values indicate statistical significance.
[a]The validity of the model fit is questionable due to the convergence criterion exceeding the limit of 0.0001 due to the small sample size of participants who reported this trauma at both ≤12 years old and 13–17 years old. Results should be interpreted with caution.

close (Table 5). The remaining trauma types followed a similar pattern of higher prevalence of each poor sleep characteristic among women reporting close vs not close trauma.

Sleep medications and clinical depression

Twenty-four percent of women reported ever taking sleep medication in the past 6 weeks to aid in falling and staying asleep (Table 1). After stratifying participants by sleep medication status, sensitivity analysis indicated positive associations between experiencing most traumas and prevalence of frequent NAs only after participants who reported taking sleep medications were removed (Supplementary Table 4). Furthermore, 21% of women reported a physician's diagnosis of clinical depression at baseline (Table 1). The association between history of TCEs and most poor sleep characteristics remained after examining women who did not report a clinical depression diagnosis (Supplementary Table 5). However, across all TCEs, the strength of the relationship between experiencing a trauma and napping frequency was attenuated or, in part, explained by clinical depression.

There was a positive dose–response relationship in the prevalence of each poor sleep characteristic with increasing exposure

to the 6 overall trauma categories (Supplementary Table 6) and 14 trauma subtypes (Supplementary Tables 2 and 7).

Discussion

Traumatic experiences that occur in early life appear to resonate throughout the life-course, affecting sleep in adulthood. With a large sample of adult women across the United States, we found evidence that experiencing any or a specific type of TCE was associated with an increased prevalence of poor sleep characteristics, even after adjusting for BMI and clinical depression. TCE–sleep associations were stronger if accompanied by recent distress or anxiety related to that event. Interestingly, we observed a moderate and consistent pattern of higher prevalence of most poor sleep characteristics among those experiencing a natural disaster during adolescence and household dysfunction during childhood, whereas those who reported traumas during both age groups reported the highest prevalence of longer SOL among all poor sleep dimensions. For most traumas, the combined impact of betrayal traumas was greater than that of traumas perpetrated by someone not close. However, physical

Table 4. Prevalence ratios and 95% confidence intervals for poor sleep among 40 082 women who reported a traumatic childhood experience (TCE) by whether the trauma caused the victim distress or anxiety within the last 4 weeks (The Sister Study)

	Short sleep (<7 hours)	Takes > 30 minutes to fall asleep	Awakened ≥ 3 times once asleep ≥3 times/week	Napping ≥3 times per week
	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
No reported trauma	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Any trauma				
No Distress	**1.06 (1.02 to 1.10)**	1.02 (0.97 to 1.08)	1.01 (0.95 to 1.07)	1.03 (0.96 to 1.11)
Distress	**1.12 (1.08 to 1.17)**	**1.38 (1.31 to 1.45)**	**1.22 (1.15 to 1.29)**	**1.25 (1.17 to 1.34)**
Natural disasters				
No distress	**1.21 (1.11 to 1.31)**	1.11 (0.98 to 1.26)	**1.18 (1.03 to 1.36)**	1.10 (0.93 to 1.30)
Distress	**1.21 (1.05 to 1.41)**	**1.70 (1.42 to 2.03)**	1.14 (0.84 to 1.55)	**1.41 (1.04 to 1.91)**
Major accidents				
No distress	1.08 (0.99 to 1.18)	**1.24 (1.10 to 1.39)**	1.13 (0.98 to 1.31)	1.00 (0.84 to 1.20)
Distress	**1.25 (1.04 to 1.50)**	**1.76 (1.43 to 2.16)**	**1.46 (1.10 to 1.94)**	**1.80 (1.34 to 2.41)**
Household dysfunction				
No distress	**1.06 (1.00 to 1.12)**	**1.15 (1.07 to 1.25)**	1.08 (0.99 to 1.19)	1.08 (0.97 to 1.20)
Distress	**1.13 (1.06 to 1.19)**	**1.39 (1.29 to 1.49)**	**1.22 (1.12 to 1.34)**	**1.30 (1.18 to 1.44)**
Sexual trauma				
No distress	**1.11 (1.06 to 1.17)**	**1.13 (1.05 to 1.21)**	**1.16 (1.07 to 1.25)**	1.07 (0.98 to 1.18)
Distress	**1.16 (1.09 to 1.24)**	**1.58 (1.46 to 1.71)**	**1.41 (1.28 to 1.56)**	**1.38 (1.23 to 1.56)**
Physical trauma				
No distress	**1.13 (1.06 to 1.20)**	**1.34 (1.23 to 1.46)**	**1.14 (1.02 to 1.26)**	**1.19 (1.05 to 1.35)**
Distress	**1.25 (1.16 to 1.36)**	**1.78 (1.61 to 1.96)**	**1.63 (1.44 to 1.84)**	**1.46 (1.25 to 1.70)**
Psychological/emotional				
No distress	**1.09 (1.04 to 1.13)**	**1.07 (1.01 to 1.14)**	1.03 (0.96 to 1.10)	1.08 (0.99 to 1.17)
Distress	**1.12 (1.08 to 1.17)**	**1.41 (1.33 to 1.49)**	**1.22 (1.15 to 1.31)**	**1.23 (1.14 to 1.34)**

All models were adjusted for age (at the time of questionnaire completion), childhood adverse SES score (summary variable of yes answers ranging from 0 to 3 of the following questions: low/poor self-reported income growing up, household educational attainment at age 13 < high school, and food insecurity) and race/ethnicity. Childhood household educational attainment was determined by adult(s) who lived in the household and were legally responsible for participant at age 13 years. All TCEs include events that occurred at <18 years. Bolded values indicate statistical significance.

Table 5. Prevalence ratios and 95% confidence intervals for poor sleep among 40 082 women who reported a traumatic childhood experience (TCE) by a perpetrator regarded as close to the victim compared to those who reported trauma by a perpetrator regarded as not close to the victim (The Sister Study)

	Short sleep (<7 hours)	Takes > 30 minutes to fall asleep	Awakened ≥ 3 times once asleep ≥3 times/week	Napping ≥3 times per week
	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
No reported trauma	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Any trauma				
Close	**1.12 (1.09 to 1.16)**	**1.27 (1.22 to 1.33)**	**1.20 (1.14 to 1.27)**	**1.24 (1.17 to 1.32)**
Not close	1.03 (0.97 to 1.10)	1.09 (1.00 to 1.19)	**1.12 (1.02 to 1.24)**	1.03 (0.92 to 1.17)
Witness suicide/attack				
Close	**1.18 (1.10 to 1.26)**	**1.23 (1.12 to 1.35)**	**1.30 (1.16 to 1.45)**	**1.16 (1.00 to 1.33)**
Not close	**1.16 (1.01 to 1.34)**	1.18 (0.95 to 1.46)	1.27 (0.98 to 1.65)	1.16 (0.85 to 1.59)
Unwanted sexual contact				
Close	**1.13 (1.08 to 1.18)**	**1.22 (1.14 to 1.29)**	**1.26 (1.17 to 1.35)**	**1.21 (1.11 to 1.32)**
Not close	1.04 (0.98 to 1.10)	**1.13 (1.04 to 1.22)**	1.14 (1.04 to 1.25)	0.96 (0.86 to 1.08)
Physically hit/attacked				
Close	**1.16 (1.09 to 1.23)**	**1.48 (1.38 to 1.59)**	**1.25 (1.14 to 1.38)**	**1.26 (1.12 to 1.41)**
Not close	1.12 (0.98 to 1.28)	**1.25 (1.04 to 1.51)**	**1.38 (1.11 to 1.72)**	**1.58 (1.24 to 2.01)**
Emotionally/psychologically mistreated				
Close	**1.09 (1.05 to 1.13)**	**1.29 (1.22 to 1.35)**	**1.20 (1.13 to 1.27)**	**1.21 (1.13 to 1.30)**
Not close	1.13 (0.99 to 1.28)	1.17 (0.98 to 1.41)	**1.25 (1.02 to 1.54)**	1.13 (0.88 to 1.46)

All models were adjusted for age (at the time of questionnaire completion), childhood adverse SES score (summary variable of yes answers ranging from 0 to 3 of the following questions: low/poor self-reported income growing up, household educational attainment at age 13 < high school, and food insecurity) and race/ethnicity. All TCEs include events that occurred at <18 years. Bolded values indicate statistical significance.

and emotional/psychological trauma did not strictly conform to this pattern, particularly for frequent awakenings throughout the night. These findings were present following adjustments for potential confounders.

A previous study of adverse childhood experiences (ACE) and sleep disturbances in adults found a 70% increased likelihood of having trouble falling/staying asleep among those who reported experiencing physical abuse and a 30% increased likelihood

among those who reported sexual abuse [15]. Our study found physical and sexual trauma consistently associated with poor sleep measures. However, our results differed from Chapman et al. likely due to our separate analysis of time to fall asleep and having trouble staying asleep. Prior studies suggest that younger children who experience physical and sexual trauma are more likely to internalize symptoms (e.g. depression, withdrawal, anxiety, and loneliness) and experience limbic–hypothalamic–pituitary–adrenal (HPA) axis dysregulation [3, 32], over time, leading to fragmented sleep. Interestingly, PRs for the overall association were consistently higher than PRs during either age group at occurrence. These results suggest neither age group at occurrence explains the overall association; rather, women who report experiencing trauma during both periods appear to be the main driver of the overall association. Although our study did not include severity of abuse or duration, higher prevalence of each poor sleep characteristic among women reporting multiple abuses in early childhood and throughout adolescence supports previous studies that have found a dose–response relationship with poor health outcomes in adulthood [23]. Certain types of abuse typically have an earlier age onset, particularly sexual abuse [25]. In our sample, women were more likely to report sexual abuse during childhood than during adolescence. Our results of stronger associations with short sleep prevalence and longer SOL with physical trauma are consistent with prior literature suggesting higher risk of sleep pathology later in life among victims who report physical and sexual abuse [21]. Women who reported sexual trauma during childhood vs adolescence had a higher prevalence of NAs and napping, whereas women reporting sexual trauma during adolescence vs childhood had slightly higher prevalence of short sleep. These findings are inconsistent with those in an Israeli-based study by Gal et al. that examined associations between sleep disturbances (including difficulty falling asleep, staying asleep, or early awakening) and sexual abuse reported during childhood. The authors found significant associations between sexual abuse reported during childhood and sleep disturbance compared to those not reporting sexual abuse. A nonsignificant association was found for sexual abuse during adolescence. These divergent findings are perhaps due to their inclusion of men, who are less likely to report certain types of abuse and that women in their study reported a history of sexual abuse with equal frequency during childhood and adolescence.

Non-interpersonal trauma includes exposure to intentional disasters, such as destruction from terrorism, or other natural disasters resulting in significant loss of personal property, personal injury, injury to a significant other, or some terror-inducing event [33]. Interpersonal trauma, or social betrayal, is characterized by physical, emotional, or sexual abuse [33]. Trauma perpetrated by someone close, particularly a trusted caregiver, introduces an added burden to the victim that can result in greater mental health problems in later life [34, 35]. We hypothesized that betrayal trauma in childhood could be particularly disruptive to adult sleep. Previous studies have found that women are more likely than men to report traumas that are considered high in betrayal, such as sexual and emotional abuse, and these traumas are most predictive in appraising trauma-specific symptoms than non-betrayal trauma [34, 36, 37]. Consistent with previous studies on interpersonal trauma, women in our sample were more likely to report betrayal trauma than non-betrayal trauma. Although many who experience trauma in early childhood experience complete memory loss, particularly with physical and sexual assault [38] and when the trauma is perpetrated by a caregiver, or someone close [38, 39], we found that women in our sample more frequently recalled sexual and physical trauma by someone close than by someone not close. For most outcomes we examined, broadly experiencing any betrayal trauma results in increased prevalence of poor sleep outcomes.

Our results are supported by a recent nationally representative study of US adults with exposure to childhood sexual abuse by an abuser regarded as someone close vs not close reporting higher risk of adverse health outcomes [34]. Although the authors examined mental health outcomes including anxiety, problems with anger, and suicide attempts, this study holds applicability to our study as these outcomes have been associated with sleep disorders. Permeating distress or anxiety into adulthood because of early-life stress can contribute to poor sleep health in adulthood. In our study, current distress or anxiety often accompanied past trauma, particularly for those reporting household dysfunction, physical and psychological/emotional traumas.

Not only are TCEs perpetrated by a trusted caregiver that takes place in early childhood predictors of a higher prevalence of poor sleep in adulthood but studies have also shown a graded relationship with ACE scores and poor sleep health, suggesting a cumulative negative effect [5]. Our results showed increasing cumulative trauma exposure reflecting an upward trend in strength of association between childhood trauma and sleep disruption in adulthood (regardless of sleep parameter), with no apparent threshold of trauma exposure. Cicchetti et al. [40] showed that children who experience multiple types of maltreatment, physical and sexual abuse are often combined with neglect, are more likely to experience diurnal cortisol dysregulation, an indication of HPA axis dysregulation that can lead to sleep disruption.

This study has several limitations. All data collected on childhood trauma and sleep dimensions were based on self-report and are subject to recall bias. Childhood traumas were reported retrospectively and sometimes many years in the past. Although participants may be more likely to retrospectively underreport abuse that occurred years in the past, responses to questions about trauma and other household dysfunction during childhood are generally stable over time [41]. Trauma-related distress or anxiety was measured nearly 2 years after baseline, where sleep measures were assessed, which is a limitation. Furthermore, our decision to recode trauma into dichotomous variables in this study limited our ability to examine broader aspects of trauma, such as trauma severity. However, by examining trauma occurring in both early childhood and adolescence, we were able to examine the implications of other aspects of trauma, including prolonged duration of abuse. Our study also included a sample of women who were predominantly white, educated, and belonging to a higher SES, which may limit generalizability of results. However, the percentage of racial/ethnic minorities in this study is comparable [5] or higher [31] than nationally representative samples.

Despite these limitations, our study has several notable strengths. We had a large sample of more than 45 000 women across the United States, which also included a diverse sample of racial/ethnic minorities. We were also able to investigate relationships between multiple trauma and sleep dimensions that

have been understudied. To the best of our knowledge, this is the first study to examine the impact of experiencing a natural disaster during childhood on sleep as an adult. Further, our analyses uniquely assessed the relevance of the timing of exposure to trauma during specific age groups at occurrence (i.e. childhood vs adolescence), recent trauma-related distress and whether the trauma was perpetrated by someone close to the victim. In addition, a child's household characteristics, such as SES, social support and cultural background, have been shown to predict increased exposure to multiple forms of violence [42, 43]. Forty-one percent of women in our sample reported at least one adverse cumulative childhood adverse SES score.

Conclusions

Overall, trauma experienced during childhood was associated with an increased prevalence of poor sleep across multiple sleep dimensions, particularly when the trauma occurred during childhood vs adolescence, when accompanied with recent distress or anxiety, and when the trauma event was perpetrated by a caregiver or someone the victim regarded as socially close. These findings, which are based on a large national cohort of adult women, extend the field by providing information on the relationship between exposure to diverse trauma types and various sleep dimensions among women. Findings from our study also contribute to the scant literature examining the differential later-life health outcomes, particularly sleep health, associated with trauma varying by social proximity of the perpetrator to the victim. Disturbed sleep may be an indicator for a more serious health issue and should prompt clinicians to assess for history of childhood abuse in children and adults. Promoting early detection, prevention and/or reducing the prevalence of childhood trauma in early life may improve quality of life at all stages and a reduction in burden of dollars maintaining sleep health while reducing risk of later-life sleep-related chronic conditions.

Supplementary material

Supplementary material is available at *SLEEP* online.

Authors' Contribution

Authors: KL McWhorter, CG Parks, AA D'Aloisio, DM Rojo-Wissar, DP Sandler, CL Jackson.
Study concept and design: CL Jackson, KL McWhorter.
Acquisition of data: DP Sandler.
Statistical analysis: KL McWhorter.
Interpretation of data: KL McWhorter, CG Parks, AA D'Aloisio, DM Rojo-Wissar, DP Sandler, CL Jackson.
Drafting of the manuscript: KL McWhorter, CL Jackson.
Critical revision of the manuscript for important intellectual content: KL McWhorter, CG Parks, AA D' Aloisio, DM Rojo-Wissar, DP Sandler, CL Jackson.
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Obtaining funding and study supervision: CL Jackson.
Final approval: KL McWhorter, CG Parks, AA D'Aloisio, DM Rojo-Wissar, CL Jackson.

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