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Racial/Ethnic Disparities in the Relationship Between Traumatic Childhood Experiences and Suboptimal Sleep Dimensions among Adult Women: Findings from the Sister Study

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Abstract

Introduction: Traumatic childhood experiences (TCEs) are associated with poor adulthood sleep, but racial/ethnic disparities have not been well-studied. We investigated the TCEs-adulthood sleep relationship among non-Hispanic (NH)-White, NH-Black, and Hispanic/Latina women.

Methods: Women enrolled in the Sister Study from 2003-2009 reported the following TCEs in a follow-up interview (2008-2012): natural disasters, major accidents, household dysfunction,

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and sexual, physical, and psychological/emotional abuse. Sleep characteristics included short sleep duration (<7 hours vs. 7-9 hours), long sleep onset latency (SOL) (>30 vs. 30 minutes), frequent night awakenings (3 times/night vs. 3 times/week [yes vs. no]), and frequent napping (3 vs. <3 times/week). Using log-binomial regression to estimate prevalence ratios (PRs) and 95% confidence intervals (CIs) for sleep characteristics among women with vs. without TCEs, we investigated racial/ethnic-specific associations and race/ethnicity as a moderator.

Results: Among 40,082 participants (mean age= 55±8.8 years), 55% reported 1 TCE (NH-White: 54%, NH-Black: 62%, Hispanic/Latina: 57%). NH-White, NH-Black, and Hispanic/Latina women reporting any TCE had a higher prevalence of short sleep compared to their within-race/ethnicity counterparts without TCEs. Associations were strongest among NH-Whites. Compared to NH-Whites with no TCEs, racial/ethnic minorities who reported any TCEs had a higher prevalence of short sleep ($PR_{Blacks}=2.13$ [95% CI: 2.02-2.24], $PR_{Hispanics/Latinas}=1.47$ [1.35-1.60]) and long SOL. When comparing racial/ethnic minorities with TCEs to NH-Whites with TCEs, PRs for short sleep ($PR_{Blacks}=1.98$ [1.88-2.08] and $PR_{Hispanics/Latinas}=1.36$ [1.25-1.48]) and long SOL were weaker.

Conclusions: TCEs were positively associated with poor sleep characteristics among women, and TCEs appear to contribute to short sleep duration and long SOL disparities.

Keywords

Adverse Childhood Experiences; Trauma; Sleep; Race; Ethnicity; Women

INTRODUCTION

Of great public health importance, traumatic childhood experiences (TCEs) prior to 18 years of age include events such as physical, sexual or emotional abuse, household dysfunction; being a victim of other forms of physical, psychological, or emotional trauma; and experiencing a natural disaster or major accident (1-3). A growing body of research suggests that TCEs like childhood abuse and family dysfunction, for instance, may contribute to sleep disruption, substance abuse, depression, suicide, and various chronic diseases, such as type 2 diabetes, heart disease, and stroke (1, 4-11). In a study of U.S. adults, the prevalence of having at least one adverse childhood experience was 60%, and it is estimated that one in four adolescent girls in the United States (U.S.) have a history of sexual abuse or assault (10, 12). Such traumatic events likely have enduring effects into adulthood, particularly among women. Prior evidence suggests that women are more likely than men to experience negative outcomes such as poor sleep after experiencing childhood trauma (1).

Both TCEs and poor sleep have been shown to be more prevalent among racial/ethnic minorities in the U.S. Based on parent/guardian report in the nationally-representative U.S. National Survey of Children's Health (N=84,837), non-Hispanic (NH)-Black and Hispanic children were exposed to more adversities (e.g., parental death; victim of/witness to neighborhood violence) than NH-White children (13). Among adults, NH-Blacks and non-Mexican Hispanics/Latinos consistently have higher prevalence of objective and subjective poor sleep compared to NH-Whites (14). Disparities in victimization rates and poor sleep by race/ethnicity may be due to overrepresentation of racial/ethnic minorities in

socioeconomically-disadvantaged environments (13, 15, 16). Because racial/ethnic minority groups are particularly susceptible to social disadvantage, it is imperative to explicitly conduct minority health research to better understand how to improve health among these groups (17).

Several potential biological mechanisms link childhood adversity to poor sleep in adulthood. For instance, early-life exposure to TCEs are thought to disrupt sleep in adulthood, in part, through neurobiological dysregulation, such as permanent or reversible alterations in corticotropin-releasing factor neurotransmission and other neurotransmitter systems involved in the hypothalamic-pituitary-adrenal axis stress response system (7, 8, 18, 19). The disruption of biologic pathways may vary by life stage of occurrence or timing of childhood trauma(1). Adversities experienced in childhood may also lead to a lower likelihood of establishing a healthy sleep schedule/routine, which may contribute to poor sleep in adulthood.

The prevalence (and many of the enduring effects) of childhood trauma in the general U.S. population are well established (10, 12, 20, 21). Also well-established, racial/ethnic minorities in the U.S. are more likely to have poor sleep compared to NH-Whites (15). However, few epidemiologic studies of childhood trauma and sleep have investigated TCEs (e.g., natural disaster, major accidents) beyond commonly studied adverse childhood experiences (e.g., sexual or physical abuse), recent studies have lacked racial/ethnic minority representation (9), and few have investigated potential racial/ethnic disparities in these relationships (13, 22). In a recent study among a racially/ethnically diverse cohort of women, we found associations between TCEs and multiple adulthood sleep dimensions in the overall cohort (23); however, we did not investigate racial/ethnic disparities in these associations. To extend our previous findings and address important gaps in the literature, we investigated the relationship between multiple TCEs and various dimensions of poor sleep by race/ethnicity in a large national cohort of women. We hypothesized that women who reported TCEs would have a higher prevalence of poor sleep characteristics compared to their racial/ethnic counterparts with no history of TCEs, and relationships would vary by race/ethnicity. Our secondary hypothesis was that racial/ethnic disparities in poor sleep would be larger when comparing racial/ethnic minority women with TCEs to NH-White women without TCEs (versus when racial/ethnic minority women with TCEs are compared to NH-White women with TCEs).

METHODS

The Sister Study

We used data from the Sister Study (Data Release 6.0), a longitudinal prospective cohort of 50,884 U.S. women. Detailed study methods have been described elsewhere (24). Briefly, women were enrolled from 2003-2009 and were eligible if they were between the ages of 35-74 years, resided in a U.S. state or Puerto Rico, did not have a history of breast cancer, and had a full or half-sister who had been diagnosed with breast cancer. The study was approved by the National Institute of Environmental Health Sciences Institutional Review Board and the Copernicus Group Independent Review Board, and written informed consent was provided by each participant. Sleep characteristics in adulthood were obtained

at enrollment, while data on childhood trauma were obtained at a first follow-up interview (2008-2012) with a response rate of 95% (24).

Participants were excluded from analyses if they did not complete the self-administered assessment of TCEs in the follow-up questionnaire (n=4,108 (8%)). Among participants with TCE data, we excluded women who self-identified as a race/ethnicity other than NH-White, NH-Black, or Hispanic/Latina due to the small sample size of other racial/ethnic groups (e.g., Asian/Pacific Islander) and within-group racial/ethnic heterogeneity (e.g., multiracial) (n=1,197); those who were currently pregnant or missing pregnancy status data (n=24); those who answered 'do not know', refused or with missing data for all TCEs (n=4,852), race/ethnicity (n=12), childhood socioeconomic characteristics (family's income growing up [n=70], highest level of household education at 13 years of age [n=387], and times when family did not have enough to eat [n=12]), sleep characteristics (n=136); or with extreme values for night awakenings, defined as >20 times per night/day (n=4). Our final analytic sample included 40,082 participants (Table 1). Compared to participants in the final analytic sample, excluded participants were more likely to self-identify as a racial/ethnic minority and have slightly lower socioeconomic status (SES); however, sleep characteristics were generally similar (Supplemental Table 1).

Assessment of exposure to traumatic childhood experiences

In a self-administered questionnaire during the first follow-up, participants were asked if they had ever personally experienced various potentially traumatic events using a modified version of the Brief Betrayal Trauma Survey (BBTS) in which additional questions were added. The BBTS has been shown to have 83% agreement for the reporting of childhood traumatic events over three years apart (25). For each trauma question, participants were asked to respond with a 'yes' or 'no.' For each affirmative response, respondents were then asked to report the age(s) at which the trauma occurred (i.e., 12 years, 13-17 years, 18 years and in the past year). To capture a robust set of TCEs, we used data from 15 questions characterizing trauma occurring at <18 years of age, which are described elsewhere (23) and in Table 2. Questions assessed the following traumas including novel TCEs rarely collected in epidemiologic studies (e.g., having a mother or sister diagnosed with breast cancer): natural disasters; major accidents; witnessing a family attack; serious family issues with drugs, alcohol, or mental health; unwanted sexual contact; physical attack; major illness; emotional or psychological mistreatment; witnessing a suicide or physical attack; death of a sibling, parent, or close friend; having a mother or sister diagnosed with breast cancer; and other major illness of someone close. As described in Table 2, 13 of the individual trauma types were also grouped into 1 of 4 domains: 1) household dysfunction or 2) sexual, 3) physical, or 4) psychological/emotional trauma, and then coded as 'ever' versus 'never' experience of the trauma type at age <18 years (4). Since trauma categories were not mutually exclusive, participants could be represented in more than one category. The various traumas assessed were further combined into a group classified as 'any trauma.'

Assessment of multiple sleep dimensions

Definitions for sleep dimensions are described in Table 1. Briefly, to determine sleep duration, participants were asked, 'About how many hours and/or minutes of sleep do you

get on average?’ (categorized as short [<7 hours], recommended [7 to 9 hours], and long [>9 hours] (26); however, long sleep was not assessed due to small sample size [$n=397$ (NH-White, $n=358$; NH-Black, $n=22$; Hispanic/Latina, $n=17$)]). Long sleep onset latency (SOL) was determined by asking participants, ‘About how long does it take you to fall asleep on average?’ and was dichotomized as >30 or ≤ 30 minutes (27). The number of night awakenings, an indicator of potential sleep disruption, was determined by asking participants two questions, ‘When you are asleep, how often do you wake for any reason?’, followed by, ‘On those nights/days you awaken when you are asleep, about how many times do you usually wake-up each night?’. Frequent night awakenings were dichotomized as ‘yes’ or ‘no’ to ≥ 3 awakenings in the same sleep period ≥ 3 times per week (27). Napping frequency was measured by asking participants, ‘How often do you take naps per week?’ and, frequent napping was dichotomized as ≥ 3 or <3 times per week (27).

Potential confounders

All potential confounders were reported at baseline. Age was measured continuously in years. Self-reported income in childhood was based on reports of spending most of their time growing up either ‘well off’, ‘middle income’, ‘low income’, or ‘poor’. Childhood food insecurity was measured by asking participants ‘Were there times when your family didn't have enough to eat?’ Childhood household educational attainment was determined by the highest educational attainment reported in response to the following question: ‘What was the highest level of education for each household member legally responsible for the participant at age 13?’ For this analysis, the ten response categories were combined into four groups (i.e. $<$ high school, high school or graduate equivalent degree, some college [including vocational/technical training or associate’s degree], or bachelor’s degree). Adverse childhood socioeconomic characteristics were dichotomized (yes vs. no) and included ‘low/poor’ self-reported income growing up, maximum household educational attainment $<$ high school at age 13 years, and food insecurity. Childhood region of residence categories included inside the US, the District of Columbia, and Puerto Rico; outside the US, the District of Columbia, and Puerto Rico; and missing/unknown.

Potential mediators

Adulthood sociodemographic characteristics, health behaviors, psychosocial stress, and clinical characteristics were measured at baseline and were considered potential mediators of the relationship between TCEs and adulthood sleep. Sociodemographic characteristics included marital status (married/living as married- yes vs. no), educational attainment ($<$ high school, high school/general education diploma, some college, Bachelor’s degree), and annual household income of $< \$50,000$ (yes vs. no). Health behaviors were alcohol consumption status (current, past, never), smoking status (current, past, never), and physical activity (metabolic equivalent hours per week) (28). Psychosocial stress was assessed by Perceived Stress Scale-4 score (29). Clinical characteristics included body mass index, calculated as weight (kilograms)/height (meters-squared) and chronic disease status (yes [at least one] vs. no [none] of the following: clinical depression, hypertension, diabetes, cardiovascular disease, and cancer).

Potential modifiers

We considered race/ethnicity as a potential modifier of the TCE-adulthood sleep relationship. Participants self-identified their race/ethnicity after being asked ‘What race do you consider yourself to be? You may choose one or more of the following: [American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or other Pacific Islander, White]’ and ‘Do you consider yourself to be Hispanic or Latina? [yes, no].’ The categories were based on the Office of Management and Budget according to Standards for the Classification of Federal Data on Race and Ethnicity (30). NH-White (White hereafter), NH-Black/African-American (Black hereafter), and Hispanic/Latina participants were included in these analyses.

Statistical analysis

Confounders were determined *a priori* based prior literature (1, 10, 11, 21, 31). Models were adjusted for age at enrollment in 5-year increments and adverse childhood SES characteristics. We used log-binomial regression models to estimate prevalence ratios (PR) and 95% confidence intervals (CI) to compare the prevalence of short sleep duration, long SOL, frequent night awakenings and frequent napping, separately, among White, Black, and Hispanic/Latina participants who reported experiencing any or a specific type of trauma to their within-race counterparts who reported never experiencing TCEs. We additionally adjusted for childhood region of residence to determine whether it confounded the race/ethnicity stratified results.

We investigated the associations between any or a specific trauma type and each sleep characteristic, separately, by race/ethnicity, with White women reporting no trauma as the reference group. Therefore, the following four TCE and race/ethnicity combinations were used: Whites reporting a TCE (n=19,238), Blacks reporting a TCE (n=1,829), Hispanics/Latinas reporting a TCE (n=1,000), and Whites reporting no TCE (n=16,140; reference group). We also compared poor sleep characteristics among Black and Hispanic/Latina women who reported TCEs to White women who also reported TCEs. By comparing Black and Hispanic/Latina women with childhood trauma to White women with and without trauma- a group representing the least amount of disadvantage, we disentangled how much racial/ethnic disparities in sleep characteristics were driven by the social construction of race/ethnicity- a marker of relative disadvantage- alone (trauma held constant in comparisons to White women with trauma) vs. the combination of or cumulative disadvantage related to both race/ethnicity and childhood trauma.

We performed two sensitivity analyses. After stratification by race/ethnicity, we determined whether timing of trauma affected results by estimating associations with poor sleep characteristics when childhood trauma occurred during childhood, adolescence, or both life stages. We explored timing of childhood trauma because prior studies suggest that childhood trauma may negatively affect brain development during critical periods, which may manifest as a psychiatric disorder with sleep disorders as either symptoms or comorbidities or an inability to fully develop adulthood life skills (e.g., sleep hygiene) (1). Brain development varies across several critical periods and differences in timing of childhood trauma as well as high cumulative childhood trauma may differentially affect sleep. Secondly, we determined

whether associations remained after adjusting for potential adulthood mediators, which included educational attainment, alcohol consumption, smoking status, physical activity, perceived stress, and chronic disease status. All statistical analyses were conducted in SAS® software version 9.4 (SAS Institute, Cary NC), and a two-sided p-value of 0.05 was used to determine statistical significance.

RESULTS

Study population characteristics

Among 40,082 participants, 88% were White, 7% were Black, and 4% were Hispanic/Latina (Table 1). Mean age $\pm$ standard deviation (SD) was 55.4 $\pm$ 8.8 years (White 55.7 $\pm$ 8.8; Black 53.4 $\pm$ 8.2; Hispanic/Latina 52.6 $\pm$ 8.9); 76% were married or living as married (White 78%, Black 53%, Hispanic/Latina 70%); and 33% reported low income while growing up (White 30%, Black 55%, Hispanic/Latina 54%).

Twenty-eight percent of participants reported short sleep (<7 hours) (White 26%, Black 54%, Hispanic/Latina 37%), 17% reported long SOL (White 16%, Black 27%, Hispanic/Latina 29%), 14% reported frequent night awakenings (White 14%, Black 12%, Hispanic/Latina 14%), and 10% reported frequent napping 3 times/week (White 10%, Black 13%, Hispanic/Latina 14%; Table 1). Over half (55%) of all participants reported experiencing any TCE (White 54%, Black 62%, Hispanic/Latina 57%; Table 2). The prevalence of experiencing a natural disaster among Black (14%) and Hispanic/Latina (13%) participants was approximately two times higher than the prevalence among White participants (7%). The prevalence of household dysfunction was highest among Black participants. Sexual, physical, and psychosocial/emotional trauma were higher among Black followed by Hispanic/Latina participants compared to White participants.

Racial/Ethnic-specific associations between TCEs and sleep characteristics

Compared to White participants without any TCEs, Whites who reported any TCE had a higher prevalence of every sleep characteristic (Table 3). Among Whites, physical trauma in childhood was consistently associated with each poor sleep characteristic (short sleep (PR=1.19, 95% CI: 1.12-1.27), long SOL (PR=1.62, 95% CI: 1.49-1.75), frequent night awakenings (PR=1.31, 95% CI: 1.19-1.43), and frequent napping (PR=1.36, 95% CI: 1.22-1.52). Compared to Black participants without TCEs, Blacks who reported any TCEs (PR=1.08, 95% CI: 1.01-1.16), natural disasters (PR=1.16, 95% CI: 1.02-1.33), household dysfunction (PR=1.11, 95% CI: 1.01-1.22), and sexual trauma (PR=1.11, 95% CI: 1.01-1.21) had a higher prevalence of short sleep. Among Black participants, history of sexual trauma in childhood (PR=1.27, 95% CI: 1.00-1.63) was marginally associated with a higher prevalence of frequent night awakenings. Hispanics/Latinas who reported psychological/emotional trauma in childhood had a higher prevalence of short sleep (PR=1.17, 95% CI: 1.02-1.34) compared to Hispanic/Latina participants who reported no psychological/emotional trauma in childhood. Additional adjustment for childhood region of residence did not affect the results of race/ethnicity-stratified models (data not shown).

Within-race/ethnicity associations between most TCEs and long SOL were stronger among Whites compared to racial/ethnic minorities, (p-value for interaction <0.05 for all trauma types except natural disasters, Supplemental Table 2). Both sexual and physical trauma in childhood were associated with a higher prevalence of frequent awakenings among White and Black participants but not among Hispanic/Latina participants ($p_{\text{sexual trauma} \times \text{race/ethnicity}}=0.02$, $p_{\text{physical trauma} \times \text{race/ethnicity}}=0.03$). Across within-race/ethnicity comparisons, associations between both any trauma and sexual trauma in childhood and frequent napping were strongest among White participants.

Sleep characteristics among Black participants with TCEs compared to White participants with and without TCEs

Black participants who reported any trauma in childhood had an approximately two-fold higher prevalence of short sleep compared to White participants who also reported any childhood trauma (PR=1.98, 95% CI:1.88-2.08), and the association was stronger when Black participants with any trauma were compared to White participants without TCEs (PR=2.13, 95% CI: 2.02-2.24; Figure 1a, Supplemental Tables 3 and 4). Similarly, associations with short sleep were stronger when Black participants who reported experiencing natural disaster in childhood were compared to White participants without TCEs (PR=2.20, 95% CI: 1.94-2.49 vs. PR=1.75, 95% CI: 1.50-2.04 for comparisons between Black and White participants who reported natural disaster in childhood).

Disparities in long SOL were larger when Black participants who reported any TCEs were compared to White participants without TCEs (PR=1.78, 95% CI: 1.63-1.94 vs. PR=1.44, 95%: 1.33-1.57 for comparisons between Black and White participants who reported TCEs). This pattern of Black-White disparities in long SOL was also observed for the following TCEs: household dysfunction and sexual, physical, and psychological/emotional trauma.

Sleep characteristics among Hispanic/Latina participants with TCEs compared to White participants with and without TCEs

When Hispanic/Latina participants with TCEs were compared to White women who also reported TCEs, the PRs of long SOL were generally attenuated compared to the PRs observed when Hispanic/Latina participants with trauma were compared to White participants without trauma (Figure 1b, Supplemental Tables 3 and 4). For instance, compared to White women who reported any TCEs, Hispanic/Latina participants who reported any TCEs had a 46% higher prevalence of long SOL (PR=1.46, 95% CI: 1.31-1.62). Hispanic/Latina participants who reported any trauma had an 80% higher prevalence of long SOL (PR=1.80, 95% CI: 1.61-2.01) compared to White women without TCEs.

Sensitivity analyses

Results of sensitivity analyses that included timing of trauma and adjustment for potential adulthood mediators are provided in Supplemental Material. Generally, associations between TCEs and sleep characteristics were strongest when participants reported that trauma occurred during both childhood and adolescence versus either life stage, alone (Supplemental Table 5). This observation was most consistent among White participants

who comprised the largest sample size. Race/ethnicity-specific associations between TCEs and sleep characteristics were attenuated after adjustment for adulthood characteristics (Supplemental Table 6).

DISCUSSION

Among a large and diverse cohort of women, we identified differential relationships between TCEs and multiple sleep characteristics across racial/ethnic groups. Whereas White women with any history of TCEs had a higher prevalence of every poor sleep characteristic ranging from 8-62% compared to White women who reported no trauma, associations were less consistent for within-race comparisons among Black and Hispanics/Latina women. Nonetheless, among Black women, any history of TCEs and specifically, natural disaster and household dysfunction experiences during childhood, were associated with higher prevalence of short sleep in adulthood. Further, sexual trauma was associated with a higher prevalence of both short sleep and frequent night awakenings among Black women. Psychosocial/emotional trauma was associated with short sleep among Hispanic/Latina women. We also found that compared with White women who reported no TCEs, both Black and Hispanic/Latina women who reported TCEs were more likely to report short sleep and long SOL. Disparities in both short sleep and long SOL were generally attenuated when comparing racial/ethnic minorities and White women who all reported childhood trauma.

Black and Hispanic/Latina participants in our study reported a higher proportion of TCEs compared to White participants, including any TCEs, natural disaster, and more commonly studied TCEs like sexual, physical, and psychological/emotional trauma. These results are consistent with a previous study reporting that the prevalence of childhood traumas differ by race/ethnicity, with Black and Hispanic/Latino children experiencing more adversities compared to Whites (13, 32). Furthermore, although the prior studies did not examine potential racial/ethnic disparities, results were consistent with our current findings: greater likelihood of poor sleep characteristics was observed among victims who experienced traumas before the age of 18 years (10, 23).

Racial/ethnic minority women with trauma had higher prevalence of poor sleep compared to White women without trauma. Furthermore, racial/ethnic disparities in short sleep (for Black vs. White women) and long SOL were smaller when Black and Hispanic/Latina women with TCEs were compared to White women with TCEs. Therefore, our results suggest that TCEs likely contribute to racial/ethnic disparities in poor sleep. These findings have been observed among other racial/ethnic minority women compared to Whites. One study among Native/Aboriginal Canadian and White women found higher sleep disturbances among Native/Aboriginal Canadian women compared to White Canadian women following sexual abuse (33). Greater sleep disturbances observed among racial/ethnic minorities may be related to environments. For instance, sleep can be disrupted by sleeping in physically or psychologically unsafe environments, and victimization due to sexual abuse, which often takes place at night and in the bedroom, may be particularly potent (34). People of color (particularly Black people) in the U.S. have historically grown up and continue to live in

disadvantaged (e.g., impoverished) physical and social environments where safety is lower, which can negatively affect sleep and may partially explain our current results (16, 35).

Associations between almost all trauma types and higher prevalence of long SOL were stronger among White women compared to the racial/ethnic-specific associations observed among Blacks and Hispanics/Latinas. A similar, but less consistent pattern that varied by type of specific trauma was also observed for frequent napping. These results may be partially explained by a previous study that suggested White women more frequently report trouble falling asleep and staying asleep than Blacks and Hispanics (11). Black adults have also been shown to be less likely to self-report sleep complaints (36) even though objective sleep measures (e.g. wrist actigraphy) suggest that sleep among Black adults is consistently worse than sleep among White adults (37). Racial/ethnic differences in self-reporting of sleep complaints may partially explain the lack of statistical interactions for other sleep characteristics. A prior study also emphasized that a lack of statistical interactions does not imply the lack of a racial/ethnic disparity (38). As evidenced by our results that showed greater disparities in poor sleep when racial/ethnic minorities with trauma were compared to White women with trauma versus the disparities in poor sleep when racial/ethnic minorities with trauma were compared to White women without trauma, it is also important to consider the prevalence of exposure (TCEs) and outcome (sleep) as well as relative associations in the assessment of health disparities (38). Furthermore, the generally higher prevalence of sleep characteristics like short sleep duration among Black and Hispanic/Latina women affects the comparability of relative race/ethnicity-specific associations because relative associations are very sensitive to the absolute prevalence observed, particularly when outcomes (e.g., short sleep) are common.

Racial/ethnic differences in the TCE-sleep relationship may be influenced by differences in resilience, defined as well-being in physical and mental health, interpersonal relationships, adherence to community standards, and economic security despite adversity (39). The impact of childhood trauma on sleep outcomes like night awakenings may be mitigated by resilience or advantageous psychobiological adaptive responses among racial/ethnic minorities due to higher cumulative adversity, which is proposed in the 'allostatic load' theory (7). For example, Baynard et al. found that a high proportion of Black female survivors of sexual abuse scored high on a resilience scale, with some displaying 'excellent resilience', as indicated by a competent level of functioning in nearly all areas of their lives (40). The TCE-sleep relationship may appear weaker among groups exposed to greater cumulative adversity. Further examination of the TCE-sleep association is warranted to determine the impact of other psychosocial factors, the specific contributions of each TCE type, developmental stage at which abuse occurred, and timing and duration of trauma (7, 8, 23, 41-43).

This study has several limitations. First, data on childhood trauma and sleep dimensions were self-reported, resulting in potential recall bias or likely non-differential reporting errors. Jackson et al. found that White, Black, Hispanic/Latino, and Asian groups overestimated their sleep duration in a non-differential manner when comparing self-reported to objective sleep measures (44). Further, dichotomizing sleep characteristics may result in the loss of information about severity of poor sleep characteristics, but use

of categories of self-reported sleep may result in a lower likelihood of misclassification/measurement error and are more translational or clinically relevant. Second, although adult participants had to recall TCEs, test-retest reliability of retrospective responses to trauma and other household dysfunction during childhood appear generally consistent over time (45). Nonetheless, there is potential for recall bias because a recent systematic review and meta-analysis showed relatively poor agreement between retrospectively-reported and prospectively-reported childhood trauma (46). Participants in the current study may have underreported childhood trauma or may be characteristically different (e.g., use different coping mechanisms such as avoidance, have differences in memory and recall) from participants who may have reported childhood trauma during childhood but not reported such trauma as an adult (46). Third, although our study measured trauma occurrences at different life stages (i.e., childhood, adolescence) and whether they were experienced during two important life stages of development, experiences were measured at single points in time rather than by frequency (or number of separate occurrences), duration, and severity. Fourth, the generalizability of the results from our study may be limited because the participants included in this study had to have a sister diagnosed with breast cancer, were of higher SES than women in the general U.S. population, and a majority self-identified as White. Because both TCEs and poor sleep are more prevalent among racial/ethnic minorities and low socioeconomic status populations in the U.S. (13, 15, 36) and our participants were higher SES and mainly self-identified as non-Hispanic white, our results may underestimate true associations between TCEs and sleep in the general population. Relatedly, our analytic sample comprised a larger proportion of white participants and participants with higher SES than those excluded from analyses; however, included and excluded participants had similar prevalence of poor sleep characteristics. Fifth, although other racial/ethnic minorities have been found to have higher odds of certain sleep disorders compared to Whites (47, 48), they were not included in this analysis due to small sample sizes.

Despite these limitations, our study has several important strengths. To our knowledge, this is one of the first studies to (1) have considered a broader set of novel TCEs and additional sleep dimensions beyond sleep duration, such as frequency of night awakenings and napping, and (2) investigate racial/ethnic variations in the TCE-sleep relationship using a large national sample of U.S. women. With nearly 14% ethnic minority representation, sample sizes of Black and Hispanic/Latina participants were sufficient for comparative analyses. Further, our study extends the literature in the field of behavioral medicine by providing race-specific estimates for a broad set of early-life traumas as well as suggesting that early life trauma may contribute to poor sleep health, differentially by race/ethnicity. Our results suggest that screening for or otherwise considering the influence of early-life traumas on sleep health could inform targeted later-life sleep health interventions among women. Further, preventing TCEs may help prevent sleep problems in adulthood. Lastly, adverse childhood experiences have been long recognized as contributors to a host of poor health outcomes that are also affected by sleep. Addressing poor sleep health among women with TCEs could help mitigate risk of disease in later life.

CONCLUSIONS

Childhood traumas were associated with a higher prevalence of multiple poor sleep characteristics in adulthood among a large multiethnic cohort of women. Furthermore, childhood trauma appears to contribute to racial/ethnic disparities in sleep duration and disturbances among adult women. Not only do racial/ethnic groups appear differentially affected in ways that may contribute to sleep-related disparities, but these differences may also depend on the type of childhood trauma. Findings from our study contribute to the scarce literature examining racial/ethnic disparities in childhood traumas influencing later-life health. Our findings also suggest that addressing early-life traumas may be important in the evaluation and treatment of poor sleep and sleep disorders and can provide scientific evidence that helps inform public health strategies to prevent or reduce disparities in poor sleep.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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(a)

Short Sleep

Long Sleep
Onset
Latency Frequent
Night
Awakenings Frequent
Napping

Figure 1.

Prevalence Ratios (95% Confidence Intervals) for Poor Sleep Characteristics Among (a) Non-Hispanic Black Women and (b) Hispanic/Latina Women Compared to White Women, Stratified by Whether Non-Hispanic White Women Reported Childhood Trauma, The Sister Study, N=40,082

Models were adjusted for participant age (years) and childhood adverse socioeconomic status characteristics (low/poor self-reported income growing up, high school household educational attainment of adult(s) who lived in the household and were legally responsible when the participant was 13 years old, and food insecurity).

Table 1.

Sociodemographic, Childhood, Health Behavior, and Clinical Characteristics by Race/Ethnicity among 40,082 Adult Women in the Sister Study

n (%)	All 40,082(100)	White 35,378 (88)	Black 2,962 (7)	Hispanic/Latina 1,742 (4)
Sociodemographic characteristics				
Age, years	55.4 ± 8.8	55.7 ± 8.8	53.4 ± 8.2	52.6 ± 8.9
Married/Living as married (yes)	76	78	53	70
Educational attainment				
<High school	1	1	1	7
High school/general education diploma	13	14	8	14
Some college	33	33	33	33
Bachelor's	53	53	58	46
Annual Household Income				
< \$50,000	23	22	28	46
Childhood characteristics				
Low income while growing up (yes)	33	30	55	54
<High school was highest educational attainment of household at age 13 years (yes)	17	14	35	54
Food insecurity (yes)	9	7	17	24
Region of residence				
Inside US, DC, and Puerto Rico	98	99	98	80
Outside US, DC, and Puerto Rico	2	1	2	19
Missing/Unknown	0	0	0	1
Sleep characteristics				
Sleep duration ^a				
Short sleep (< 7 hours)	28	26	54	37
Recommended sleep (7-9 hours)	72	74	46	63
Long sleep onset latency (> 30 minutes) ^b				
Yes	17	16	27	29
No	83	84	73	71
Frequent awakenings (Awakened 3 times once asleep 3 times/week) ^c				
Yes	14	14	12	14
No	86	86	88	86
Frequent napping (3 times per week) ^d				
Yes	10	10	13	14
No	90	90	87	86
Health behaviors				
Alcohol consumption status				
Current	82	84	71	72
Former	14	13	24	17

	All	White	Black	Hispanic/Latina
n (%)	40,082(100)	35,378 (88)	2,962 (7)	1,742 (4)
Never	3	3	5	11
Smoking status				
Current	8	8	10	6
Former	36	37	26	25
Never	57	55	64	69
METs-hours/week	50.8 ± 31.3	51.3 ± 31.4	45.5 ± 29.2	50.1 ± 30.6
Psychosocial stress				
Perceived Stress Scale-4	2.7 ± 2.7	2.6 ± 2.7	3.2 ± 3.1	3.4 ± 3.1
Clinical characteristics				
BMI (kg/m ²)	27.7 ± 6.2	27.4 ± 6.0	31.3 ± 7.1	28.2 ± 5.9
Chronic Disease (yes) ^e	46	45	58	49
Clinical depression	21	22	18	25
Hypertension	28	26	48	30
Diabetes	6	5	12	11
Cardiovascular disease	3	3	5	4
Cancer	5	6	3	4

Data are presented as percentages or mean ± standard deviation.

METs= Metabolic equivalents of physical activity

^aSleep duration was assessed by asking participants, "About how many hours and/or minutes of sleep per (night or 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. Long sleep (n=397) was not analyzed.

^b"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'.

^cFrequency 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'. They also responded to "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.

^dNapping 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', or 'never'.

^eChronic disease includes clinical depression, hypertension, diabetes, cardiovascular disease, or cancer.

Missing values include: annual income, n=1,396 (3%); all other variables 1%.

Table 2.

Definition and Prevalence of Categories of Each Traumatic Childhood Experience among 40,082 Adult Women Stratified by Race/Ethnicity in the Sister Study

n (%)	All 40,082 (100)	White 35,378 (88)	Black 2,962 (7)	Hispanic/Latina 1,742 (4)
Any traumatic childhood experience ^a	55	54	62	57
Natural disasters ^b	7	7	14	13
Major accidents ^c	7	7	8	9
Household dysfunction ^d	29	29	34	27
Witness family attack?	9	8	13	9
Serious family drug/alcohol/mental issues?	13	14	11	10
Sexual trauma ^e	28	28	37	30
Physical trauma ^f	16	16	21	18
Hit/attacked?	6	6	8	8
Major illness?	3	3	2	2
Psychological / Emotional trauma ^g	45	44	51	47
Emotionally/Psychologically mistreated?	20	21	18	18
Witness suicide/attack?	4	4	9	7
Death of sibling?	4	3	5	5
Death of parent?	8	8	10	9
Death of close friend?	4	4	5	5
Sister breast cancer diagnosis?	1	1	1	2
Mother breast cancer diagnosis?	3	3	3	2
Major illness (not breast cancer) in someone close?	5	5	5	5

^aAll traumatic childhood experiences include non-mutually exclusive events that occurred at <18 years of age. 'Any traumatic childhood experience' included any traumatic events.

^bParticipants were asked "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?"

^cParticipants were 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?"

^dHousehold 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?" and "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)?"

^eSexual trauma was assessed by asking participants: "Have you ever been made to have unwanted sexual contact, such as touching or penetration?"

^fPhysical 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?" An additional physical trauma question included, "Have you personally experienced a major illness (life threatening or severely disabling to you)?"

^gPsychological/Emotional trauma was assessed 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?”. The remaining psychological/emotional traumas were determined by asking participants, “Have you ever experienced the death of a parent?”; “Have you ever experienced the death of a sibling?”; “Have you ever experienced the death of a close personal friend?”; “Have you ever experienced your mother getting breast cancer?”; “Have you ever experienced your sister getting breast cancer?”; and “Have you ever experienced a major illness, other than breast cancer (life threatening or severely disabling) in someone close to you?”.

Percentages for each trauma type for each race/ethnicity represent those who reported ever experiencing any childhood trauma or trauma type as a proportion of the total for that trauma.

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Table 3.

Prevalence Ratios (95% CIs) for Poor Sleep Characteristics Among Women Who Reported Experiencing a Childhood Trauma Compared to Women Who Reported No Childhood Trauma, Stratified by Race/Ethnicity, The Sister Study, N=40,082

	Short Sleep (< 7 hours)						Long SOL (Takes > 30 minutes to fall asleep)					
	White			Black			Hispanic/Latina			Black		
	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI
No trauma (reference)												
Any traumatic experience ^{LSOL}	1.08	1.04-1.12	1.08	1.01-1.16	1.11	0.98-1.26	1.23	1.17-1.29	1.00	0.89-1.13	1.05	0.90-1.21
Natural disasters	1.25	1.15-1.37	1.16	1.02-1.33	1.11	0.86-1.44	1.33	1.18-1.51	1.09	0.86-1.39	1.02	0.75-1.40
Major accidents ^{LSOL}	1.09	0.99-1.20	1.11	0.94-1.33	1.03	0.74-1.42	1.42	1.26-1.59	0.96	0.69-1.34	1.09	0.75-1.59
Household dysfunction ^{LSOL}	1.07	1.02-1.13	1.11	1.01-1.22	1.09	0.91-1.30	1.32	1.24-1.41	1.05	0.90-1.24	1.07	0.86-1.34
Sexual trauma ^{LSOL}	1.13	1.08-1.19	1.11	1.01-1.21	1.09	0.92-1.29	1.31	1.23-1.40	1.06	0.91-1.24	1.05	0.85-1.28
Physical trauma ^{LSOL}	1.19	1.12-1.27	1.06	0.94-1.2	1.12	0.91-1.38	1.62	1.49-1.75	1.01	0.82-1.24	0.93	0.71-1.24
Psychological / Emotional trauma ^{LSOL}	1.09	1.05-1.14	1.08	1.00-1.16	1.17	1.02-1.34	1.29	1.22-1.36	1.02	0.89-1.16	1.08	0.92-1.27
Frequent Night Awakenings												
(Awakened 3 times once asleep 3 times/week)												
	White			Black			Hispanic/Latina			Black		
	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI
	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI
No trauma (reference)												
Any traumatic experience ^{FN}	1.10	1.04-1.16	1.12	0.91-1.37	0.97	0.77-1.23	1.17	1.10-1.25	0.90	0.74-1.08	1.03	0.81-1.30
Natural disasters	1.22	1.06-1.41	0.92	0.59-1.42	0.95	0.61-1.49	1.28	1.08-1.51	1.03	0.71-1.49	0.97	0.59-1.62
Major accidents	1.20	1.05-1.37	1.26	0.78-2.02	0.68	0.33-1.38	1.22	1.03-1.44	0.64	0.35-1.18	1.15	0.65-2.04
Household dysfunction	1.13	1.05-1.22	1.21	0.93-1.57	0.99	0.71-1.38	1.24	1.14-1.36	0.88	0.68-1.15	1.01	0.71-1.43
Sexual trauma ^{FNA, FN}	1.24	1.16-1.33	1.27	1.00-1.63	0.74	0.52-1.05	1.22	1.11-1.33	0.84	0.65-1.09	1.08	0.79-1.49
Physical trauma ^{FNA}	1.31	1.19-1.43	1.26	0.92-1.73	0.68	0.42-1.08	1.36	1.22-1.52	0.96	0.69-1.33	0.97	0.63-1.49
Psychological / Emotional trauma	1.12	1.05-1.19	1.17	0.94-1.46	0.95	0.74-1.23	1.19	1.11-1.28	0.94	0.76-1.15	1.04	0.80-1.34

CI: confidence interval; SOL: Sleep onset latency; PR: prevalence ratio; SES, socioeconomic status

All models were adjusted for age and three adverse childhood SES variables: low/poor self-reported income growing up, high school household educational attainment of adult(s) who lived in the household and were legally responsible when the participant was 13 years old, and food insecurity.

All models are compared with the reference group (within-race counterparts who reported no trauma).

All traumatic childhood experiences include non-mutually exclusive events that occurred at <18 years. 'Any trauma' included any traumatic events.

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Bolded values indicate statistical significance at two-sided $p=0.05$.
LSOL p -value for *TCE**race/ethnicity interaction term was statistically significant for long SOL
FNA p -value for *TCE**race/ethnicity interaction term was statistically significant for frequent night awakenings
FN p -value for *TCE**race/ethnicity interaction term was statistically significant for frequent napping