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## Review Article

## Adverse childhood experiences are associated with adult sleep disorders: a systematic review

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## ABSTRACT

Adverse childhood experiences (ACEs) represent substantial threats to public health and affect about 58% of youth in the US. In addition to their acute effects such as injury and physical trauma, ACEs are associated with an increased risk of several negative health outcomes throughout the life course. Emerging evidence suggests that sleep disorders may be one such outcome, but existing studies have not been systematically reviewed and summarized. We conducted a systematic review to summarize the evidence concerning the relationship between ACEs and sleep disorders and disturbances, with a focus on adult women. Original publications were identified through searches of the electronic databases MEDLINE, Embase, and Web of Science using the keywords “childhood,” “adversity,” “abuse,” and “sleep” as well as searches of the reference lists of eligible studies. Studies evaluating ACEs that occurred before 18 years of age and sleep outcomes that were assessed at 18 years or older were adjudicated and included. A total of 30 publications were identified. Of the 30 studies, 28 were retrospective analyses and there was vast heterogeneity in the types of ACEs and sleep outcomes measured. The majority of retrospective studies ( $N = 25$  of 28) documented statistically significant associations between sleep disorders including sleep apnea, narcolepsy, nightmare distress, sleep paralysis, and psychiatric sleep disorders with a history of childhood adversity. In many studies, the strengths of associations increased with the number and severity of adverse experiences. These associations were corroborated by the two prospective studies published to date. Notably, investigators have documented statistically significant associations between family conflict at 7–15 years of age and insomnia at 18 years of age (odds ratio, OR = 1.4; 95% confidence interval, CI = 1.2–1.7) and between childhood sexual abuse and sleep disturbances 10 years later in adult women ( $\beta = 0.24$ ,  $p < 0.05$ ). There is a growing scientific body of knowledge suggesting an association between ACEs and multiple sleep disorders in adulthood. The available evidence indicates the need to develop treatment strategies such as trauma-informed care for survivors of abuse who suffer from sleep disorders and disturbances. Further, longitudinal studies among diverse populations are needed to improve the overall understanding of this association and to investigate potential gender and racial/ethnic disparities in the strength of the association.

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## 1. Introduction

Adverse childhood experiences (ACEs), typically defined as stressful or traumatic life events that occur during the first 18 years of

life (such as emotional, physical, or sexual abuse, emotional or physical neglect, or other forms of family dysfunction) are pervasive and significant public health problems [1–3]. A 2008 nationally representative telephone survey estimated that about 61% of children and youth in the US experience at least one ACE per year [4]. This figure slightly decreased to 57.7% in 2011 [5]. The 2011 national survey reported that 13.7% of children had experienced maltreatment, 8.0% had experienced emotional abuse, and 3.7% had experienced physical abuse in the year prior to survey [5]. With regard to sexual abuse, 5.6% of children had been sexually victimized in the last year, while 2.2% had been sexually assaulted. These estimates vary greatly by sex; among 14- to 17-year-old girls, 22.8% had experienced sexual victimization in the last year and 10.7% were sexually assaulted [5]. Additionally, the likelihood of lifetime sexual assaults was significantly higher for girls than for boys (17.4% vs. 4.2%) [5]. Because ACEs affect the majority of American

**Abbreviations:** ACEs, adverse childhood experiences; aOR, adjusted odds ratio; CI, confidence interval; CRH, corticotropin-releasing hormone; CTQ, Childhood Trauma Questionnaire; EEG, electroencephalography; HPA, hypothalamic–pituitary–adrenal; IBS, irritable bowel syndrome; OR, odds ratio; PSG, polysomnography; PSQI, Pittsburgh Sleep Quality Index; PTSD, post-traumatic stress disorder; REM, rapid eye movement; THQ, Trauma History Questionnaire; TSC, Trauma Symptom Checklist; VBS, violent behavior during sleep.

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children, it is of grave importance to understand the burdens associated with these early-life events.

In addition to their acute effects such as injury and physical trauma, ACEs are associated with an increased risk of several negative health outcomes across the life course, such as mental illness, substance abuse, heart disease, and premature mortality [1–3,6–13]. Among the few studies that have been conducted among women, investigators have identified suicide attempts and revictimization as additional outcomes of ACEs that have been exclusively identified among women [12,13]. Early detection of a history of ACEs is critical in developing trauma-informed care for subsequent health consequences and in preventing further adverse health outcomes [14]. As a result, there is a pressing need to identify the long-term effects of ACEs.

Current evidence suggests that adult sleep disorders may be one such effect of ACEs. Sleep disorders are highly prevalent health concerns and estimated to affect 50–70 million Americans, and they have cumulative effects over time [15]. Sleep disorders not only contribute to lost work-related productivity but also lead to severe health outcomes such as obesity, hypertension, diabetes, occupational injuries, depression, and premature mortality [16–20]. Identifying sleep disorders as a consequence of ACEs will inform the development of more effective therapy for survivors of abuse who suffer from sleep disorders. Additionally, an accumulating body of epidemiologic evidence has identified sleep as a common mediator of many of the associations between ACEs and the aforementioned health outcomes. Thus, identifying and treating sleep disorders in patients exposed to an ACE could prevent additional downstream health and social consequences [7,21–23]. Understanding the association between ACEs and adult sleep disorders in women is of particular interest because women are disproportionately affected by certain types of ACEs (eg, sexual abuse) and sleep problems (eg, difficulty maintaining sleep and excessive daytime sleepiness), and because women are at a risk of unique health outcomes (eg, revictimization and suicide) as a result of physical and emotional abuse [5,12,13,24]. The following is a review of the literature regarding the association between ACEs and sleep disorders in adulthood. Because of the high burden of victimization and the potential for revictimization among girls and women, we place particular emphasis on summarizing the influences of childhood adversity and sleep disorders among women. Information gleaned from this review will contribute to a research and public health agenda that addresses the needs of survivors of ACEs.

## 2. Methods

The literature search for this systematic review included original studies of human subjects with no limitation on the year of publication. The search was open to observational studies, including case series with  $\geq 10$  subjects, cross-sectional, prospective cohort, retrospective cohort, and case-control studies, as well as randomized trials. The exposure of interest, ACEs, was limited to adversity or abuse-related events that occurred before 18 years of age. ACEs could have been assessed using self-report, family member reporting, or information extracted from police records. The outcome of interest was any measure of sleep disorders and/or quality (eg, sleep deprivation, nightmare distress, or insomnia) assessed at 18 years or older. This outcome could have been assessed subjectively, objectively, or via clinical diagnosis.

Studies were identified through searches of the electronic databases MEDLINE, Embase, and Web of Science. The last search was conducted on 23 July 2014. In MEDLINE, we used the following search terms: “childhood”[All Fields] AND (“advers\*”[All Fields] OR “abuse”[All Fields]) AND (“sleep”[MeSH Terms] OR “sleep”[All Fields]). In Embase, we used the following search terms: “childhood” AND “adverse” OR “adversity” OR “abuse” AND “sleep” AND “article”/it.

Finally, in Web of Science, we used the following search terms: childhood AND (advers\* OR abuse) AND sleep. Two reviewers (SK and BG) conducted an abstract screen for all three databases separately. The reviewers then conducted a full-text screen after excluding ineligible abstracts and removing duplicate articles. An article was excluded if it was not an example of primary data collection or analysis (reviews, meeting abstracts, editorials, etc.); if it was a case series with fewer than 10 subjects; if the exposure included violence, trauma, or abuse experienced at 18 years of age or older; if the sleep-related outcome was assessed during childhood; or if the subjects were nonhuman. A search of the reference lists of eligible articles was then conducted to identify any missed articles. We considered conducting meta-analyses of the included articles; however, the heterogeneity in exposure and outcome measures did not allow for any meaningful pooled analyses.

## 3. Results

A total of 887 articles were identified through the electronic database search (87 from MEDLINE, 518 from Embase, and 282 from Web of Science). After the initial screening, based on titles and careful review of the abstracts, a total of 781 articles were excluded. After removing duplicates, 54 unique articles remained and underwent a full-text screen by the two reviewers. Overall, 24 articles were excluded during the full-text screen based on the aforementioned exclusion criteria. Fig. 1 illustrates the search and screening process. The 30 articles that met the inclusion criteria are listed in Table 1 along with their study characteristics and a brief summary of major research findings. Overall, 14 of the 30 studies were conducted in the US, and eight were conducted among women only. Childhood sexual abuse was the most common type of ACE investigated and self-reported sleep disturbances were the most common sleep-related outcomes studied. All relevant studies identified were published in the English language. The following is a summary of the literature concerning the relationship between ACEs and adult sleep disorders.

### 3.1. Early research on ACEs and adult sleep

Three studies provided initial evidence of an association between ACEs and subjective sleep in adulthood [25–27]. In their study of 97 Canadian university students, Chambers et al. [25] found that participants who had a history of ACEs had higher mean scores than participants without ACEs in all subjective sleep disorder measures. Statistically significant differences were found for nightmare frequency (0.7 vs. 0.3), sleep apnea (17.8 vs. 14.5), narcolepsy (25.8 vs. 21.1), nightmare distress (31.9 vs. 26.0), nightmare impact (25.2 vs. 18.5), and psychiatric sleep disorders (22.7 vs. 17.2). Chambers et al. [25] also identified resilience as a potential mediator of the relationship between abuse/trauma and sleep outcomes. Agargun et al. [26], in their study of 382 Turkish undergraduate students, identified a statistically significant association between ACEs and violent behavior during sleep (VBS), a disorder involving self-mutilation, sexual assault, or murder attempt during sleep. The authors reported that a greater proportion of participants with VBS reported a history of sexual abuse (10.6% vs. 5.5%), physical abuse (26.5% vs. 12.1%), parental loss (6.4% vs. 9.3%), and parental separation (11.7% vs. 7.9%) compared with controls. In a 2003 study of 292 undergraduate students, Agargun et al. [27] found that the frequency of childhood traumatic events was higher among subjects who reported having nightmares often (55%) compared with subjects who reported having nightmares sometimes (27%) and subjects who reported no nightmares (24%). In addition to nightmare frequency, physical abuse and sexual abuse were statistically significantly associated with difficulty falling asleep, fear of sleeping, and trouble sleeping compared with no abuse [27]. Collectively, these early studies

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