

Sleep problems in children and adolescents following traumatic life events

George Giannakopoulos, Gerasimos Kolaitis

ORCID number: George Giannakopoulos 0000-0001-7427-1776; Gerasimos Kolaitis 0000-0002-2426-150X.

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George Giannakopoulos, Gerasimos Kolaitis, Department of Child Psychiatry, School of Medicine, National and Kapodistrian University of Athens, Aghia Sophia Children's Hospital, Athens 11527, Greece

Corresponding author: George Giannakopoulos, MD, PhD, Assistant Professor, Department of Child Psychiatry, School of Medicine, National and Kapodistrian University of Athens, Aghia Sophia Children's Hospital, Thivon & Papadiamantopoulou, Athens 11527, Greece. ggiannak@med.uoa.gr

Abstract

Rates of childhood trauma exposure are extremely high, with approximately 70% of children and adolescents experiencing at least one traumatic event. Among the most common non-specific consequences of stress and trauma are disruptions of sleep. Sleep problems, such as shorter sleep duration, difficulty falling asleep, frequent awakenings, nightmares, sleepless nights, and early-morning wakefulness appear to have a higher prevalence among children and adolescents following traumatic events. This review will illustrate the role of sleep problems in traumatized children and adolescents, and emphasize the need to consider a wide range of etiological mechanisms for these symptoms. However, the relationship of trauma exposure to sleep problems among children and adolescents needs further investigation in future research. Moreover, in view of the adverse consequences of long-term disrupted sleep on mental health outcomes following trauma, the need to effectively address sleep disturbances in traumatized children and adolescents is crucial.

Key Words: Child abuse; Natural disasters; Nightmares; Posttraumatic stress disorder; Sleep; Trauma and stressor related disorders

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Core Tip: Prevalence rates of child and adolescent posttraumatic stress disorder (PTSD) range from 0.5%-5%, while subthreshold PTSD and other trauma-related difficulties are relatively common among trauma-exposed children. Prevalence rates of sleep disturbances among trauma-exposed child samples vary considerably. Adverse effects of childhood trauma on sleep have been found immediately as well as years after

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trauma and can still be demonstrated in adulthood. Several hypotheses have been proposed to explain the mechanisms by which traumatic exposure may affect sleep. We discuss here the role of sleep problems in traumatized children and adolescents, and a broad range of etiological mechanisms for these symptoms.

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INTRODUCTION

Rates of childhood trauma exposure are extremely high, with approximately 70% of children and adolescents experiencing at least one traumatic event^[1,2]. Moreover, exposure to trauma during childhood leads to a number of negative physical and mental health outcomes^[3-6]. Prevalence rates of posttraumatic stress disorder (PTSD) range from 0.5%-5%^[1,7], while subclinical PTSD and trauma-related depression and behavioral problems are relatively frequent among trauma-exposed children^[1,8-10].

Amidst the most prevalent general repercussions of stress and trauma are sleep disturbances. Sleep problems, such as shorter sleep duration, difficulty falling asleep, frequent awakenings, nightmares, sleepless nights, and early-morning wakefulness, appear to have a higher prevalence among children and adolescents following traumatic events^[11-16].

Sleep occurs in every animal species and is essential for survival. It is comprised of dynamic patterns and gradual stages that take place during the night. Cohesion, timing, and ordering of these crucial stages are vital for adequate sleep^[17]. Adequate sleep is linked to physical growth and psychological maturation, and is important for the optimal performance of vigilance systems^[18-20]. Insufficient sleep has been associated with impaired daytime functioning, excessive tiredness, fatigue, pain, elevated blood pressure later in life, lesser regulation of affective reactions, elevated emotional dysregulation, aggression, anger, irritability, uneasiness, little frustration tolerance, high risk for developing substance use disorders, suicidal behaviors, problems sustaining attention, decreased performance on abstract reasoning tasks, and reduced academic performance in children and adolescents^[21-32].

TRAUMA EXPOSURE AND SLEEP DISTURBANCES

In general population samples, approximately 16%-40% of children exhibit sleep disturbances^[33-35]. Prevalence rates of sleep disturbances among trauma-exposed child samples vary considerably, from 3% to 77.1%^[36-41]. Adverse effects of childhood trauma on sleep have been found immediately^[42,43] as well as years after trauma^[44], and can still be demonstrated in adulthood^[45].

Nightmares are reported most commonly, although rates vary widely (20.3%-80.8%) depending on methodological discrepancies in sampling, measures, and informants about the child's symptoms. In fact, nightmares are a prototypic symptom of PTSD^[46-52]. Nightmares have been included in the PTSD diagnostic formulation since its introduction in the Diagnostic Statistical Manual (DSM)-III^[53] and have recently been expanded in DSM-5^[54] to encompass sleep difficulties (as opposed to only nightmares). Recurrent distressing dreams and sleep disruptions (*e.g.*, difficulty falling or staying asleep, or restless sleep) are listed among the intrusion symptoms and the marked alterations in arousal and reactivity, respectively^[54].

Sleep disturbances seem to be critically involved in PTSD development and maintenance^[13,46]. Further, sleep difficulties seem to prevent recovery from traumatic events and to accelerate negative mental health outcomes^[14,55,56]. Hence, trauma-related sleep problems in children and adolescents seem to be an important area of study. However, limited research has been conducted to date.

Characteristics of the traumatic event and associated risk factors may participate in understanding different types of sleep problems; still, these relationships are not well-known among children exposed to trauma.

Wamser-Nanney *et al*^[57], in their study of 276 treatment-seeking children, showed that although sleep disturbances were common among trauma-exposed children, the type of traumatic event (*e.g.*, sexual abuse, physical abuse, domestic violence, emotional abuse, neglect, etc.) and the nature of trauma (*i.e.*, interpersonal *vs* non-interpersonal) or complex trauma were largely unrelated to sleep problems.

A study in 6132 adolescent survivors 3 years after a disastrous earthquake documented that older adolescents were at a significantly greater risk of sleep problems than younger children, and they had significantly higher risks of anxiety, depression, and PTSD. Other risk factors for sleep difficulties were characteristics of exposure to the earthquake, such as injury, injury of a parent, and witnessing death or feeling extremely scared in the earthquake^[58]. Similarly, another cohort study^[11] of 1573 adolescent survivors following a deadly earthquake found that the risk of sleep issues was significantly increased in older adolescents and in those who witnessed the tragic events directly. Depression, anxiety, poor social support, and negative life events were also associated with increased risk and persistence of sleep problems.

In a prospective study^[17] of 78 females who had been sexually abused in childhood, it was found that sleep disturbances correlated significantly with both depression and PTSD 10 years after disclosure of the abuse. However, these traumatized youths showed significantly higher rates of sleep difficulties than the comparison group, in addition to depression and PTSD. Moreover, sleep difficulties were associated with revictimization rates independent of sexual abuse, depression, and PTSD.

A study on sleep quality across the developmental spectrum among avalanche survivors at 16 years after exposure showed that those who were children when the disaster occurred were more likely to report PTSD-related acting out dreams in adulthood than their non-exposed peers, while those who were adults at time of the disaster had elevated risk of trauma-related nightmares^[59].

In a study of 33 children treated for injuries after road traffic accidents, it was shown that children experiencing posttraumatic stress had a prolonged subjective sleep latency^[60]. Moreover, the severity of difficulties in sleep onset and maintenance was associated with female gender and the severity of child's and mothers' PTSD.

ETIOLOGICAL MECHANISMS

Caldwell and Redeker^[18] have claimed that more extensive research is needed in order to improve our understanding of the elevated sleep problems among children and adolescents following trauma. Several hypotheses have been proposed to explain the mechanisms by which traumatic exposure may affect sleep (Table 1).

According to a biological perspective, traumatic stress may be related to increased levels of physiological arousal, that hinders conditions crucial for sleep onset. In fact, sleep onset problems may be more prominent compared to sleep maintenance problems among traumatized children^[44,60]. It has been claimed that increased activity of the amygdala and decreased activity of the medial prefrontal cortex sustain or enhance activity in arousal-promoting brain centers and diminish activity in sleep-promoting centers^[61]. The emerging pattern of enduring arousal could directly conduce to insomnia problems.

Sleep is naturally restricted to times and places that feel safe. If arousal is increased by cause of imminent threat, sleep will possibly deteriorate^[25]. Safety is a notably pertinent concern for children and adolescents exposed to trauma. Moore^[62], for example, concluded that interpersonal trauma hinders development of a safe attachment style, leading to the feeling that one needs to be continuously alert and on guard instead of sleeping.

Levin *et al*^[63] proposed a conceptual framework for understanding disturbed dreaming following traumatic stress that accommodate data on emotional memory structures and the brain correlates of emotion. A fundamental assumption in this model is that alterations in nightmare rates, severity, and comorbidity reflect the influence of both affect load, a consequence of daily alterations in emotional pressure, and affect distress, an inclination to distressing, highly reactive emotional experiences.

The threat simulation theory of dreaming^[64] states that threat simulation in the course of dreaming reenacts the cognitive mechanisms needed for adequate threat perception and threat avoidance. An assumption drawn from this theory is that real threatening events experienced throughout wakefulness may result in a heightened activation of the threat simulation system, and thus, to an elevated recurrence and severity of threatening experiences in dreams. Therefore, children living in conditions in which their physical and psychological well-being is continually jeopardized may

Table 1 Hypothetical mechanisms by which traumatic exposure may affect sleep

Hypothesis	Mechanism
Biological perspective	Physiological arousal (increased activity of the amygdala, and decreased activity of the medial prefrontal cortex) hinders sleep onset
Safety and attachment	Feeling that one needs to be continuously alert and on guard instead of sleeping
Emotional memory and affect	Alterations in nightmare rates, severity, and comorbidity reflect the influence of both affect load and distress
Threat simulation theory	Threat simulation in the course of dreaming reenacts the cognitive mechanisms needed for adequate threat perception and threat avoidance
Emotional regulation model	Individuals exposed to trauma continue to be hyper-alert to defend themselves against real or imagined hazards, such as through distressing dreaming that replays the traumatic experience during sleep
Hyperarousal-based theory	Under a hyper-arousal state, trauma survivors show an increased level of awareness and a sensitized response to the external world
Anxiety buffer disruption assumption	Fear can increase the likelihood of gathering traumatic cues in the cognitive world, resulting in intrusive thoughts
Depressive-like pathophysiology	Elevated plasma cortisol levels near sleep onset, increased sleep latency, and significant dysregulation in REM sleep patterns
Cognitive hyperactivation	Excessive worry, rumination, and negative attributions contribute to the hyperarousal interfering with sleep

REM: Rapid eyes movement.

have an extremely triggered dream production and threat simulation system. Valli *et al*^[65] examined this assumption by analyzing the content of dream reports from markedly traumatized and less traumatized Kurdish children and non-traumatized Finnish children. The researchers found that the markedly traumatized children expressed a significantly higher number of dreams and their dreams involved a greater number of threatening dream experiences. Also, the nature of dream threats of traumatized children was more serious than the threats of less traumatized or non-traumatized children.

An analogous model, the emotional regulation model of trauma^[66] proposes that there is a fear network that connects fear-related information in a traumatized individual's memory^[67]. This information can be triggered by real or imagined trauma-related cues, and a fear response will then be evoked. Hence, individuals exposed to trauma may continue to be hyper-alert to defend themselves against real or imagined hazards, such as through distressing dreaming that replays the traumatic experience during sleep^[68]. This is also supported by the finding that traumatized individuals show elevated arousal activity during sleep, which in turn leads to a lighter or more fragmented sleep^[12]. Thus, fear could be a risk factor for the onset of sleep difficulties following a traumatic event.

The hyperarousal-based theory of sleep problems^[69] proposes that PTSD leads to a hyper-arousal state, under which traumatized individuals will experience an increased level of awareness and a sensitized response to the external world. Hyper-arousal breaks the necessary prerequisite for optimal sleep quality and makes sleep problems more noticeable^[70]. Furthermore, PTSD can also cause trauma survivors to re-experience the trauma-related cues in their cognitive world, therefore eliciting the physiological arousal and undesirable emotions that will in turn disturb their sleep^[71].

Moreover, the anxiety buffer disruption assumption^[72] suggests a close association between fear and PTSD. This assumption highlights that fear can increase the likelihood of gathering traumatic cues in the cognitive world, resulting in intrusive thoughts related to hyper-arousal states^[67]. It is also suggested that the fear can exacerbate the severity of PTSD through hampering the constructive examination of traumatic experiences and the consolidation of traumatic memories^[73,74].

In support of the emotional regulation model of trauma and the hyperarousal-based theory, Zhou *et al*^[75] showed that fear and PTSD among adolescents 1 year after an earthquake mediated the relationship between trauma exposure at 1 year following the earthquake, and sleep difficulties at both 1 year and 1.5 years following the earthquake, respectively. Moreover, Zhou *et al*^[76] found that intrusive, avoidance and hyperarousal symptom clusters of PTSD could be significant predictors for the emergence and persistence of sleep difficulties from 1 year to 1.5 years after the earthquake. The intrusive symptoms of PTSD may increase the frequency of cognitive

activities^[77], and hyperarousal symptoms can elevate the physiological or psychological hyperarousal state^[12,78]; adolescents with symptoms of avoidance may seek to avoid being dominated by traumatic cues during dreaming by avoiding falling asleep^[67]. However, in the study by Zhou *et al*^[76], from 1.5 years to 2 years following the earthquake, only the avoidance symptom clusters of PTSD were risk factors for sleep difficulties and the relationship between PTSD and sleep problems weakened with time change.

Last, it has been suggested that mechanisms for sleep disturbances, such as elevated plasma cortisol levels near sleep onset, increased sleep latency, and significant dysregulation in rapid eyes movement, sleep patterns, parallel aspects of underlying pathophysiology of severe adolescent depression^[79]. Moreover, the depressive cognitive hyperactivation (*i.e.*, excessive worry, rumination, and negative attributions) may contribute to the hyperarousal interfering with sleep.

CONCLUSION

The present review illustrates the role of sleep difficulties in children and adolescents exposed to trauma and emphasizes the need to examine a wide range of etiological mechanisms for these symptoms. However, the relationship of trauma exposure to sleep problems among children and adolescents needs further investigation in future research. For example, work is needed to understand the mechanisms by which sleep difficulties emerge and persist in the context of childhood trauma, and if sleep problems exacerbate other trauma-related symptoms. Additionally, the long-term course of sleep problems in children exposed to trauma have not been thoroughly reported.

Moreover, in view of the negative consequences of long-term disrupted sleep on mental health outcomes following trauma, the need to effectively address sleep disturbances in traumatized children and adolescents is crucial. Thus, clinicians should be aware of sleep problems in childhood trauma victims. Trauma-focused interventions for children and adolescents may be beneficial not only for relieving child and adolescent traumatic stress but also for ameliorating adolescents' sleep problems, and could be complemented by tailored psychotherapeutic and pharmacological interventions targeting sleep disturbances.

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