

# World Journal of *Psychiatry*

*World J Psychiatr* 2021 February 19; 11(2): 27-57



**MINIREVIEWS**

- 27 Sleep problems in children and adolescents following traumatic life events  
*Giannakopoulos G, Kolaitis G*

**ORIGINAL ARTICLE****Basic Study**

- 35 Selective ablation of type 3 adenylyl cyclase in somatostatin-positive interneurons produces anxiety- and depression-like behaviors in mice  
*Yang XY, Ma ZL, Storm DR, Cao H, Zhang YQ*

**Case Control Study**

- 50 Psychic euosmia among obsessive-compulsive personality disorder patients: A case control study  
*Maraone A, Tarsitani L, Frascarelli M, Petrini F, Roselli V, Tinè M, Cavaggioni G, Brakoulas V, Biondi M, Pasquini M*

**ABOUT COVER**

Thomas Sobanski, MD, Chief Doctor, Senior Research Fellow, Department of Psychiatry, Psychotherapy, and Psychosomatic Medicine, THUERINGEN-Kliniken GmbH, Saalfeld D-07318, Germany. [tsobanski@thueringen-kliniken.de](mailto:tsobanski@thueringen-kliniken.de)

**AIMS AND SCOPE**

The primary aim of *World Journal of Psychiatry (WJP, World J Psychiatr)* is to provide scholars and readers from various fields of psychiatry with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

*WJP* mainly publishes articles reporting research results and findings obtained in the field of psychiatry and covering a wide range of topics including adolescent psychiatry, biological psychiatry, child psychiatry, community psychiatry, ethnopsychology, psychoanalysis, psychosomatic medicine, etc.

**INDEXING/ABSTRACTING**

The *WJP* is now abstracted and indexed in Science Citation Index Expanded (SCIE, also known as SciSearch®), Current Contents/Clinical Medicine, Journal Citation Reports/Science Edition, PubMed, and PubMed Central. The 2020 edition of Journal Citation Reports® cites the 2019 impact factor (IF) for *WJP* as 3.545; IF without journal self cites: 3.545; Ranking: 46 among 155 journals in psychiatry; and Quartile category: Q2.

**RESPONSIBLE EDITORS FOR THIS ISSUE**

Production Editor: *Jia-Hui Li*; Production Department Director: *Yun-Xiaojuan Wu*; Editorial Office Director: *Jia-Ping Yan*.

**NAME OF JOURNAL**

*World Journal of Psychiatry*

**ISSN**

ISSN 2220-3206 (online)

**LAUNCH DATE**

December 31, 2011

**FREQUENCY**

Monthly

**EDITORS-IN-CHIEF**

Rajesh R Tampi

**EDITORIAL BOARD MEMBERS**

<https://www.wjgnet.com/2220-3206/editorialboard.htm>

**PUBLICATION DATE**

February 19, 2021

**COPYRIGHT**

© 2021 Baishideng Publishing Group Inc

**INSTRUCTIONS TO AUTHORS**

<https://www.wjgnet.com/bpg/gerinfo/204>

**GUIDELINES FOR ETHICS DOCUMENTS**

<https://www.wjgnet.com/bpg/GerInfo/287>

**GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH**

<https://www.wjgnet.com/bpg/gerinfo/240>

**PUBLICATION ETHICS**

<https://www.wjgnet.com/bpg/GerInfo/288>

**PUBLICATION MISCONDUCT**

<https://www.wjgnet.com/bpg/gerinfo/208>

**ARTICLE PROCESSING CHARGE**

<https://www.wjgnet.com/bpg/gerinfo/242>

**STEPS FOR SUBMITTING MANUSCRIPTS**

<https://www.wjgnet.com/bpg/GerInfo/239>

**ONLINE SUBMISSION**

<https://www.f6publishing.com>

## 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.

**Author contributions:** Kolaitis G conceived the original idea; Giannakopoulos G and Kolaitis G wrote the manuscript.

**Conflict-of-interest statement:** The authors declare no conflicts of interest.

**Open-Access:** This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

**Manuscript source:** Invited manuscript

**Specialty type:** Psychiatry

**Country/Territory of origin:** Greece

**Peer-review report's scientific quality classification**

**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](mailto: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

©The Author(s) 2021. Published by Baishideng Publishing Group Inc. All rights reserved.

**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

Grade A (Excellent): A  
 Grade B (Very good): 0  
 Grade C (Good): 0  
 Grade D (Fair): 0  
 Grade E (Poor): 0

**Received:** November 30, 2020

**Peer-review started:** November 30, 2020

**First decision:** December 21, 2020

**Revised:** December 21, 2020

**Accepted:** December 28, 2020

**Article in press:** December 28, 2020

**Published online:** February 19, 2021

**P-Reviewer:** Seeman MV

**S-Editor:** Fan JR

**L-Editor:** A

**P-Editor:** Li JH



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.

**Citation:** Giannakopoulos G, Kolaitis G. Sleep problems in children and adolescents following traumatic life events. *World J Psychiatr* 2021; 11(2): 27-34

**URL:** <https://www.wjgnet.com/2220-3206/full/v11/i2/27.htm>

**DOI:** <https://dx.doi.org/10.5498/wjp.v11.i2.27>

## INTRODUCTION

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

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<sup>[11-16]</sup>.

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<sup>[17]</sup>. Adequate sleep is linked to physical growth and psychological maturation, and is important for the optimal performance of vigilance systems<sup>[18-20]</sup>. 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<sup>[21-32]</sup>.

## TRAUMA EXPOSURE AND SLEEP DISTURBANCES

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

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<sup>[46-52]</sup>. Nightmares have been included in the PTSD diagnostic formulation since its introduction in the Diagnostic Statistical Manual (DSM)-III<sup>[53]</sup> and have recently been expanded in DSM-5<sup>[54]</sup> 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<sup>[54]</sup>.

Sleep disturbances seem to be critically involved in PTSD development and maintenance<sup>[13,46]</sup>. Further, sleep difficulties seem to prevent recovery from traumatic events and to accelerate negative mental health outcomes<sup>[14,55,56]</sup>. 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*<sup>[57]</sup>, 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<sup>[58]</sup>. Similarly, another cohort study<sup>[11]</sup> 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<sup>[17]</sup> 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<sup>[59]</sup>.

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<sup>[60]</sup>. 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<sup>[18]</sup> 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<sup>[44,60]</sup>. 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<sup>[61]</sup>. 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<sup>[25]</sup>. Safety is a notably pertinent concern for children and adolescents exposed to trauma. Moore<sup>[62]</sup>, 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*<sup>[63]</sup> 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<sup>[64]</sup> 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*<sup>[65]</sup> 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<sup>[66]</sup> proposes that there is a fear network that connects fear-related information in a traumatized individual's memory<sup>[67]</sup>. 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<sup>[68]</sup>. 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<sup>[12]</sup>. Thus, fear could be a risk factor for the onset of sleep difficulties following a traumatic event.

The hyperarousal-based theory of sleep problems<sup>[69]</sup> 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<sup>[70]</sup>. 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<sup>[71]</sup>.

Moreover, the anxiety buffer disruption assumption<sup>[72]</sup> 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<sup>[67]</sup>. 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<sup>[73,74]</sup>.

In support of the emotional regulation model of trauma and the hyperarousal-based theory, Zhou *et al*<sup>[75]</sup> 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*<sup>[76]</sup> 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<sup>[77]</sup>, and hyperarousal symptoms can elevate the physiological or psychological hyperarousal state<sup>[12,78]</sup>; adolescents with symptoms of avoidance may seek to avoid being dominated by traumatic cues during dreaming by avoiding falling asleep<sup>[67]</sup>. However, in the study by Zhou *et al*<sup>[76]</sup>, 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<sup>[79]</sup>. 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.

---

## REFERENCES

- 1 **Copeland WE**, Keeler G, Angold A, Costello EJ. Traumatic events and posttraumatic stress in childhood. *Arch Gen Psychiatry* 2007; **64**: 577-584 [PMID: 17485609 DOI: 10.1001/archpsyc.64.5.577]
- 2 **Finkelhor D**, Turner HA, Shattuck A, Hamby SL. Violence, crime, and abuse exposure in a national sample of children and youth: an update. *JAMA Pediatr* 2013; **167**: 614-621 [PMID: 23700186 DOI: 10.1001/jamapediatrics.2013.42]
- 3 **Anda RF**, Felitti VJ, Bremner JD, Walker JD, Whitfield C, Perry BD, Dube SR, Giles WH. The enduring effects of abuse and related adverse experiences in childhood. A convergence of evidence from neurobiology and epidemiology. *Eur Arch Psychiatry Clin Neurosci* 2006; **256**: 174-186 [PMID: 16311898 DOI: 10.1007/s00406-005-0624-4]
- 4 **Felitti VJ**, Anda RF, Nordenberg D, Williamson DF, Spitz AM, Edwards V, Koss MP, Marks JS. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med* 1998; **14**: 245-258 [PMID: 9635069 DOI: 10.1016/s0749-3797(98)00017-8]
- 5 **Chapman DP**, Whitfield CL, Felitti VJ, Dube SR, Edwards VJ, Anda RF. Adverse childhood experiences and the risk of depressive disorders in adulthood. *J Affect Disord* 2004; **82**: 217-225 [PMID: 15488250 DOI: 10.1016/j.jad.2003.12.013]
- 6 **Heim C**, Nemeroff CB. The role of childhood trauma in the neurobiology of mood and anxiety disorders: preclinical and clinical studies. *Biol Psychiatry* 2001; **49**: 1023-1039 [PMID: 11430844 DOI: 10.1016/s0006-3223(01)01157-x]
- 7 **Merikangas KR**, He JP, Burstein M, Swanson SA, Avenevoli S, Cui L, Benjet C, Georgiades K, Swendsen J. Lifetime prevalence of mental disorders in U.S. adolescents: results from the National Comorbidity Survey Replication--Adolescent Supplement (NCS-A). *J Am Acad Child Adolesc Psychiatry* 2010; **49**: 980-989 [PMID: 20855043 DOI: 10.1016/j.jaac.2010.05.017]
- 8 **Ackerman PT**, Newton JE, McPherson WB, Jones JG, Dykman RA. Prevalence of post traumatic stress disorder and other psychiatric diagnoses in three groups of abused children (sexual, physical, and both). *Child Abuse Negl* 1998; **22**: 759-774 [PMID: 9717613 DOI: 10.1016/s0145-2134(98)00062-3]

- 9 **Kim J**, Cicchetti D. Longitudinal pathways linking child maltreatment, emotion regulation, peer relations, and psychopathology. *J Child Psychol Psychiatry* 2010; **51**: 706-716 [PMID: 20050965 DOI: 10.1111/j.1469-7610.2009.02202.x]
- 10 **Kilpatrick DG**, Ruggiero KJ, Acierno R, Saunders BE, Resnick HS, Best CL. Violence and risk of PTSD, major depression, substance abuse/dependence, and comorbidity: results from the National Survey of Adolescents. *J Consult Clin Psychol* 2003; **71**: 692-700 [PMID: 12924674 DOI: 10.1037/0022-006x.71.4.692]
- 11 **Geng F**, Fan F, Mo L, Simandl I, Liu X. Sleep problems among adolescent survivors following the 2008 Wenchuan earthquake in China: a cohort study. *J Clin Psychiatry* 2013; **74**: 67-74 [PMID: 23419228 DOI: 10.4088/JCP.12m07872]
- 12 **Pillar G**, Malhotra A, Lavie P. Post-traumatic stress disorder and sleep-what a nightmare! *Sleep Med Rev* 2000; **4**: 183-200 [PMID: 12531165 DOI: 10.1053/smr.1999.0095]
- 13 **Babson KA**, Feldner MT. Temporal relations between sleep problems and both traumatic event exposure and PTSD: a critical review of the empirical literature. *J Anxiety Disord* 2010; **24**: 1-15 [PMID: 19716676 DOI: 10.1016/j.janxdis.2009.08.002]
- 14 **Charuvastra A**, Cloitre M. Safe enough to sleep: sleep disruptions associated with trauma, posttraumatic stress, and anxiety in children and adolescents. *Child Adolesc Psychiatr Clin N Am* 2009; **18**: 877-891 [PMID: 19836694 DOI: 10.1016/j.chc.2009.04.002]
- 15 **Cohen JA**, Bukstein O, Walter H, Benson SR, Chrisman A, Farchione TR, Hamilton J, Keable H, Kinlan J, Schoettle U, Siegel M, Stock S, Medicus J; AACAP Work Group On Quality Issues. Practice parameter for the assessment and treatment of children and adolescents with posttraumatic stress disorder. *J Am Acad Child Adolesc Psychiatry* 2010; **49**: 414-430 [PMID: 20410735]
- 16 **Kliwer W**, Lepore SJ. Exposure to violence, social cognitive processing, and sleep problems in urban adolescents. *J Youth Adolesc* 2015; **44**: 507-517 [PMID: 25218396 DOI: 10.1007/s10964-014-0184-x]
- 17 **Noll JG**, Trickett PK, Susman EJ, Putnam FW. Sleep disturbances and childhood sexual abuse. *J Pediatr Psychol* 2006; **31**: 469-480 [PMID: 15958722 DOI: 10.1093/jpepsy/31.4.469]
- 18 **Caldwell BA**, Redeker N. Sleep and trauma: an overview. *Issues Ment Health Nurs* 2005; **26**: 721-738 [PMID: 16126648 DOI: 10.1080/01612840591008294]
- 19 **Dahl RE**. The regulation of sleep and arousal: Development and psychopathology. *Dev Psychopathol* 1996; **8**: 3-27 [DOI: 10.1017/S0954579400006945]
- 20 **Horne JA**. Human sleep, sleep loss and behaviour. Implications for the prefrontal cortex and psychiatric disorder. *Br J Psychiatry* 1993; **162**: 413-419 [PMID: 8453439 DOI: 10.1192/bjp.162.3.413]
- 21 **Brownlow JA**, Brown TS, Mellman TA. Relationships of posttraumatic stress symptoms and sleep measures to cognitive performance in young-adult African Americans. *J Trauma Stress* 2014; **27**: 217-223 [PMID: 24740871 DOI: 10.1002/jts.21906]
- 22 **Calhoun SL**, Fernandez-Mendoza J, Vgontzas AN, Mayes SD, Liao D, Bixler EO. Behavioral Profiles Associated with Objective Sleep Duration in Young Children with Insomnia Symptoms. *J Abnorm Child Psychol* 2017; **45**: 337-344 [PMID: 27245765 DOI: 10.1007/s10802-016-0166-4]
- 23 **Carskadon MA**. Patterns of sleep and sleepiness in adolescents. *Pediatrician* 1990; **17**: 5-12 [PMID: 2315238]
- 24 **Dahl RE**, Holttun J, Trubnick L. A clinical picture of child and adolescent narcolepsy. *J Am Acad Child Adolesc Psychiatry* 1994; **33**: 834-841 [PMID: 8083140 DOI: 10.1097/00004583-199407000-00009]
- 25 **Dahl RE**, Lewin DS. Pathways to adolescent health sleep regulation and behavior. *J Adolesc Health* 2002; **31**: 175-184 [PMID: 12470913 DOI: 10.1016/s1054-139x(02)00506-2]
- 26 **Galovski TE**, Monson C, Bruce SE, Resick PA. Does cognitive-behavioral therapy for PTSD improve perceived health and sleep impairment? *J Trauma Stress* 2009; **22**: 197-204 [PMID: 19466746 DOI: 10.1002/jts.20418]
- 27 **Giosan C**, Malta LS, Wyka K, Jayasinghe N, Evans S, Difede J, Avram E. Sleep disturbance, disability, and posttraumatic stress disorder in utility workers. *J Clin Psychol* 2015; **71**: 72-84 [PMID: 25099348 DOI: 10.1002/jclp.22116]
- 28 **Norman SB**, Stein MB, Davidson JR. Profiling posttraumatic functional impairment. *J Nerv Ment Dis* 2007; **195**: 48-53 [PMID: 17220739 DOI: 10.1097/01.nmd.0000252135.25114.02]
- 29 **Peach H**, Gaultney JF, Reeve CL. Sleep characteristics, body mass index, and risk for hypertension in young adolescents. *J Youth Adolesc* 2015; **44**: 271-284 [PMID: 25001215 DOI: 10.1007/s10964-014-0149-0]
- 30 **Short MA**, Gradisar M, Lack LC, Wright HR, Dohnt H. The sleep patterns and well-being of Australian adolescents. *J Adolesc* 2013; **36**: 103-110 [PMID: 23088812 DOI: 10.1016/j.adolescence.2012.09.008]
- 31 **Tu KM**, Erath SA, El-Sheikh M. Peer Victimization and Adolescent Adjustment: The Moderating Role of Sleep. *J Abnorm Child Psychol* 2015; **43**: 1447-1457 [PMID: 26002848 DOI: 10.1007/s10802-015-0035-6]
- 32 **Wong MM**, Brower KJ. The prospective relationship between sleep problems and suicidal behavior in the National Longitudinal Study of Adolescent Health. *J Psychiatr Res* 2012; **46**: 953-959 [PMID: 22551658 DOI: 10.1016/j.jpsychires.2012.04.008]
- 33 **Archbold KH**, Pituch KJ, Panahi P, Chervin RD. Symptoms of sleep disturbances among children at two general pediatric clinics. *J Pediatr* 2002; **140**: 97-102 [PMID: 11815771 DOI: 10.1053/j.peds.2002.01.010]

- 10.1067/mpd.2002.119990]
- 34 **Fricke-Oerkermann L**, Plücker J, Schredl M, Heinz K, Mitschke A, Wiater A, Lehmkuhl G. Prevalence and course of sleep problems in childhood. *Sleep* 2007; **30**: 1371-1377 [PMID: 17969471 DOI: 10.1093/sleep/30.10.1371]
  - 35 **Liu X**, Liu L, Owens JA, Kaplan DL. Sleep patterns and sleep problems among schoolchildren in the United States and China. *Pediatrics* 2005; **115**: 241-249 [PMID: 15866858 DOI: 10.1542/peds.2004-0815F]
  - 36 **Kovachy B**, O'Hara R, Hawkins N, Gershon A, Primeau MM, Madej J, Carrion V. Sleep disturbance in pediatric PTSD: current findings and future directions. *J Clin Sleep Med* 2013; **9**: 501-510 [PMID: 23674943 DOI: 10.5664/jcsm.2678]
  - 37 **Arnberg FK**, Rydelius PA, Lundin T. A longitudinal follow-up of posttraumatic stress: from 9 mo to 20 years after a major road traffic accident. *Child Adolesc Psychiatry Ment Health* 2011; **5**: 8 [PMID: 21396118 DOI: 10.1186/1753-2000-5-8]
  - 38 **Carrion VG**, Weems CF, Ray R, Reiss AL. Toward an empirical definition of pediatric PTSD: the phenomenology of PTSD symptoms in youth. *J Am Acad Child Adolesc Psychiatry* 2002; **41**: 166-173 [PMID: 11837406 DOI: 10.1097/00004583-200202000-00010]
  - 39 **Dollinger SJ**. The measurement of children's sleep disturbances and somatic complaints following a disaster. *Child Psychiatry Hum Dev* 1986; **16**: 148-153 [PMID: 3698730 DOI: 10.1007/bf00706172]
  - 40 **Sadeh A**, McGuire JP, Sachs H, Seifer R, Tremblay A, Civita R, Hayden RM. Sleep and psychological characteristics of children on a psychiatric inpatient unit. *J Am Acad Child Adolesc Psychiatry* 1995; **34**: 813-819 [PMID: 7608056 DOI: 10.1097/00004583-199506000-00023]
  - 41 **Wittmann L**, Zehnder D, Schredl M, Jenni OG, Landolt MA. Posttraumatic nightmares and psychopathology in children after road traffic accidents. *J Trauma Stress* 2010; **23**: 232-239 [PMID: 20419731 DOI: 10.1002/jts.20514]
  - 42 **Pynoos RS**, Frederick C, Nader K, Arroyo W, Steinberg A, Eth S, Nunez F, Fairbanks L. Life threat and posttraumatic stress in school-age children. *Arch Gen Psychiatry* 1987; **44**: 1057-1063 [PMID: 3689093 DOI: 10.1001/archpsyc.1987.01800240031005]
  - 43 **Lavie P**. Sleep disturbances in the wake of traumatic events. *N Engl J Med* 2001; **345**: 1825-1832 [PMID: 11752360 DOI: 10.1056/NEJMr012893]
  - 44 **Glod CA**, Teicher MH, Hartman CR, Harakal T. Increased nocturnal activity and impaired sleep maintenance in abused children. *J Am Acad Child Adolesc Psychiatry* 1997; **36**: 1236-1243 [PMID: 9291725 DOI: 10.1097/00004583-199709000-00016]
  - 45 **Bader K**, Schafer V. Sleep disturbances following traumatic experiences in childhood and adolescence: a review. *Somnologie* 2007; **11**: 101-110 [DOI: 10.1007/s11818-007-0299-3]
  - 46 **Spoormaker VI**, Montgomery P. Disturbed sleep in post-traumatic stress disorder: secondary symptom or core feature? *Sleep Med Rev* 2008; **12**: 169-184 [PMID: 18424196 DOI: 10.1016/j.smrv.2007.08.008]
  - 47 **Alvaro PK**, Roberts RM, Harris JK. A Systematic Review Assessing Bidirectionality between Sleep Disturbances, Anxiety, and Depression. *Sleep* 2013; **36**: 1059-1068 [PMID: 23814343 DOI: 10.5665/sleep.2810]
  - 48 **Jiang S**, Yan Z, Jing P, Li C, Zheng T, He J. Relationships between Sleep Problems and Psychiatric Comorbidities among China's Wenchuan Earthquake Survivors Remaining in Temporary Housing Camps. *Front Psychol* 2016; **7**: 1552 [PMID: 27803679 DOI: 10.3389/fpsyg.2016.01552]
  - 49 **Pigeon WR**, Campbell CE, Possemato K, Ouimette P. Longitudinal relationships of insomnia, nightmares, and PTSD severity in recent combat veterans. *J Psychosom Res* 2013; **75**: 546-550 [PMID: 24290044 DOI: 10.1016/j.jpsychores.2013.09.004]
  - 50 **Ross RJ**, Ball WA, Sullivan KA, Caroff SN. Sleep disturbance as the hallmark of posttraumatic stress disorder. *Am J Psychiatry* 1989; **146**: 697-707 [PMID: 2658624 DOI: 10.1176/ajp.146.6.697]
  - 51 **Sivertsen B**, Harvey AG, Lundervold AJ, Hysing M. Sleep problems and depression in adolescence: results from a large population-based study of Norwegian adolescents aged 16-18 years. *Eur Child Adolesc Psychiatry* 2014; **23**: 681-689 [PMID: 24292341 DOI: 10.1007/s00787-013-0502-y]
  - 52 **Harvey AG**, Jones C, Schmidt DA. Sleep and posttraumatic stress disorder: a review. *Clin Psychol Rev* 2003; **23**: 377-407 [PMID: 12729678 DOI: 10.1016/s0272-7358(03)00032-1]
  - 53 **American Psychiatric Association**. Diagnostic and statistical manual of mental disorders (DSM-III). Washington, DC: American Psychiatric Association, 1980
  - 54 **American Psychiatric Association**. Diagnostic and statistical manual of mental disorders. 5th ed. Arlington, VA: American Psychiatric Association, 2013
  - 55 **Brown TH**, Mellman TA, Alfano CA, Weems CF. Sleep fears, sleep disturbance, and PTSD symptoms in minority youth exposed to Hurricane Katrina. *J Trauma Stress* 2011; **24**: 575-580 [PMID: 21898601 DOI: 10.1002/jts.20680]
  - 56 **Bryant RA**, Creamer M, O'Donnell M, Silove D, McFarlane AC. Sleep disturbance immediately prior to trauma predicts subsequent psychiatric disorder. *Sleep* 2010; **33**: 69-74 [PMID: 20120622 DOI: 10.1093/sleep/33.1.69]
  - 57 **Wamser-Nannery R**, Chesher RE. Trauma characteristics and sleep impairment among trauma-exposed children. *Child Abuse Negl* 2018; **76**: 469-479 [PMID: 29268207 DOI: 10.1016/j.chiabu.2017.11.020]
  - 58 **Tang W**, Lu Y, Yang Y, Xu J. An epidemiologic study of self-reported sleep problems in a large sample of adolescent earthquake survivors: The effects of age, gender, exposure, and psychopathology. *J Psychosom Res* 2018; **113**: 22-29 [PMID: 30190044 DOI: 10.1016/j.jpsychores.2018.01.001]

- 10.1016/j.jpsychores.2018.07.006]
- 59 **Thordardottir EB**, Hansdottir I, Valdimarsdottir UA, Shipherd JC, Resnick H, Gudmundsdottir B. The Manifestations of Sleep Disturbances 16 Years Post-Trauma. *Sleep* 2016; **39**: 1551-1554 [PMID: 27166232 DOI: 10.5665/sleep.6018]
  - 60 **Wittmann L**, Zehnder D, Jenni OG, Landolt MA. Predictors of children's sleep onset and maintenance problems after road traffic accidents. *Eur J Psychotraumatol* 2012; **3** [PMID: 22893829 DOI: 10.3402/ejpt.v3i0.8402]
  - 61 **Germain A**, Hall M, Katherine Shear M, Nofzinger EA, Buysse DJ. Ecological study of sleep disruption in PTSD: a pilot study. *Ann N Y Acad Sci* 2006; **1071**: 438-441 [PMID: 16891594 DOI: 10.1196/annals.1364.038]
  - 62 **Moore MS**. Disturbed attachment in children: A factor in sleep disturbance, altered dream production and immune dysfunction: 1: Not safe to sleep: Chronic sleep disturbance in anxious attachment. *J Child Psychother* 1989; **15**: 99-111 [DOI: 10.1080/00754178808254836]
  - 63 **Levin R**, Nielsen TA. Disturbed dreaming, posttraumatic stress disorder, and affect distress: a review and neurocognitive model. *Psychol Bull* 2007; **133**: 482-528 [PMID: 17469988 DOI: 10.1037/0033-2909.133.3.482]
  - 64 **Revonsuo A**. The reinterpretation of dreams: an evolutionary hypothesis of the function of dreaming. *Behav Brain Sci* 2000; **23**: 877-901; discussion 904 [PMID: 11515147 DOI: 10.1017/s0140525x00004015]
  - 65 **Valli K**, Revonsuo A, Pälkäs O, Ismail KH, Ali KJ, Punamäki RL. The threat simulation theory of the evolutionary function of dreaming: Evidence from dreams of traumatized children. *Conscious Cogn* 2005; **14**: 188-218 [PMID: 15766897 DOI: 10.1016/s1053-8100(03)00019-9]
  - 66 **Foa EB**, Steketee G, Rothbaum BO. Behavioral/cognitive conceptualizations of post-traumatic stress disorder. *Behav Ther* 1989; **20**: 155-176 [DOI: 10.1016/S0005-7894(89)80067-X]
  - 67 **Zhou X**, Wu X, Yuan X, Chen J, Chen Q. The role of core beliefs challenge, subjective fear and intrusive rumination in associations between the severity of traumatic expose and posttraumatic stress disorder in adolescent survivors after Yaan earthquake. *Xinli Xuebao* 2015; **47**: 455-465 [DOI: 10.3724/SP.J.1041.2015.00455]
  - 68 **Krakow B**, Sandoval D, Schrader R, Keuhne B, McBride L, Yau CL, Tandberg D. Treatment of chronic nightmares in adjudicated adolescent girls in a residential facility. *J Adolesc Health* 2001; **29**: 94-100 [PMID: 11472867 DOI: 10.1016/s1054-139x(00)00195-6]
  - 69 **Mellman TA**. Psychobiology of sleep disturbances in posttraumatic stress disorder. *Ann N Y Acad Sci* 1997; **821**: 142-149 [PMID: 9238200 DOI: 10.1111/j.1749-6632.1997.tb48275.x]
  - 70 **Schafer JL**, Graham JW. Missing data: our view of the state of the art. *Psychol Methods* 2002; **7**: 147-177 [PMID: 12090408]
  - 71 **Berset M**, Elfering A, Lüthy S, Lüthi S, Semmer NK. Work stressors and impaired sleep: rumination as a mediator. *Stress Health* 2011; **27**: e71-e82 [PMID: 27486625 DOI: 10.1002/smi.1337]
  - 72 **Pyszczynski T**, Kesebir P. Anxiety buffer disruption theory: a terror management account of posttraumatic stress disorder. *Anxiety Stress Coping* 2011; **24**: 3-26 [PMID: 20924831 DOI: 10.1080/10615806.2010.517524]
  - 73 **Farnsworth JK**, Sewell KW. Fear of emotion as a moderator between PTSD and firefighter social interactions. *J Trauma Stress* 2011; **24**: 444-450 [PMID: 21780188 DOI: 10.1002/jts.20657]
  - 74 **Forbes D**, Parslow R, Creamer M, Allen N, McHugh T, Hopwood M. Mechanisms of anger and treatment outcome in combat veterans with posttraumatic stress disorder. *J Trauma Stress* 2008; **21**: 142-149 [PMID: 18404639 DOI: 10.1002/jts.20315]
  - 75 **Zhou X**, Wu X, Chen Q, Zhen R. Why did adolescents have sleep problems after earthquakes? *Scand J Psychol* 2017; **58**: 221-227 [PMID: 28543322 DOI: 10.1111/sjop.12366]
  - 76 **Zhou X**, Wu X, An Y, Fu F. Longitudinal relationships between posttraumatic stress symptoms and sleep problems in adolescent survivors following the Wenchuan earthquake in China. *PLoS One* 2014; **9**: e104470 [PMID: 25105288 DOI: 10.1371/journal.pone.0104470]
  - 77 **Kobayashi I**, Sledjeski EM, Spoonster E, Fallon WF Jr, Delahanty DL. Effects of early nightmares on the development of sleep disturbances in motor vehicle accident victims. *J Trauma Stress* 2008; **21**: 548-555 [PMID: 19107721 DOI: 10.1002/jts.20368]
  - 78 **Woodward SH**, Arsenaault NJ, Michel GE, Santerre CS, Groves WK, Stewart WK. Polysomnographic characteristics of trauma-related nightmares. *Sleep* 2000; **23**: A356-357
  - 79 **McCracken JT**. The search for vulnerability signatures for depression in high-risk adolescents: Mechanisms and significance. In: Carskadon MA, editor *Adolescent Sleep Patterns: Biological, Social, and Psychological Influences* New York: Cambridge University Press, 2002: 254-269



Published by **Baishideng Publishing Group Inc**  
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA  
**Telephone:** +1-925-3991568  
**E-mail:** [bpgoffice@wjgnet.com](mailto:bpgoffice@wjgnet.com)  
**Help Desk:** <https://www.f6publishing.com/helpdesk>  
<https://www.wjgnet.com>

