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Sleep disturbances following traumatic experiences in childhood and adolescence: a review

Schlafstörungen nach traumatischen Erfahrungen in Kindheit und Jugend: ein Überblick

► **Zusammenfassung** Die vorliegende Übersichtsarbeit befasst sich mit den Langzeitfolgen von traumatischen und schwer belastenden Erfahrungen in der Kindheit – einem Forschungsbereich, der in den letzten 10 Jahren ein zunehmendes Interesse erfuhr. Die Ergebnisse mehrerer teilweise groß angelegter Langzeitstudien weisen darauf hin, dass früh einwirkende körperliche und psychosoziale Stressoren die Vulnerabilität für physische und psychische Störungen im Erwachsenenalter erhöhen können. Der Schlaf und das Traumgeschehen scheinen dabei ebenfalls betroffen zu sein. In verschiedenen Studien zeigten sich Zusammenhänge zwischen Beeinträchtigungen des Schlafs und Belastungen in der Kindheit wie körperlichem und psychischem Missbrauch, Vernachlässigung, familiärer Gewalt und

Konflikten, schweren Verletzungen, Unfällen, aber auch Krieg und Katastrophen. Zu den am häufigsten beobachteten Beschwerden solcher traumatischer Erfahrungen gehören Ein- und Durchschlafstörungen, nicht erholsamer Schlaf, das vermehrte Auftreten von Nachtschreck sowie Angst- und Alpträumen. In polysomnographischen und aktometrischen Aufzeichnungen wurden bei Betroffenen eine geringere Schlaffeizienz, häufige und längere nächtliche Wachphasen sowie vermehrte Körperbewegungen im Schlaf gefunden. Solche Beeinträchtigungen des Schlafs können eine kurzfristige Folge traumatischer Kindheitserlebnisse sein, können aber auch Jahre nach der traumatischen Erfahrung noch fortbestehen. Die Suche nach einem empirisch abgesicherten Erklärungsmodell zur Langzeitwirkung von traumatischen Erfahrungen auf den Schlaf ist noch nicht abgeschlossen. Als mögliche Faktoren werden chronisches Hyperarousal und Hypervigilanz, maladaptives Schlafverhalten, sekundäre Angstkonditionierungsprozesse sowie Störungen der Traumaverarbeitungs- und Gedächtnisfunktionen im Schlaf vermutet.

► **Schlüsselwörter** Trauma – Kindheit – Schlaf – Insomnie – Alpträume

► **Summary** The present review article discusses the long-term effects of traumatic and stressful events in childhood – a research area that has attained growing interest in the last decade. The results of several long-term studies, some of them large-scale, indicate that early physical and psychosocial stressors can lead to an increased vulnerability to physical and mental diseases in adult age. Sleep and dreaming seem to be affected as well. Several studies yield evidence that physical and emotional abuse, neglect, familial violence and conflicts, injuries, accidents, war and disasters experienced during childhood are associated with sleep disturbances. Difficulties initiating and maintaining sleep, non-restorative sleep and an elevated frequency of night terror, anxiety dreams and nightmares are among the most commonly reported problems. Polysomnographic and actigraphic recordings show reduced sleep efficiency, more frequent and prolonged night awakenings and increased body movement during sleep in individuals who report traumatic experiences. Sleep disturbances can be an immediate effect of traumatic childhood experiences, but can also persist for years after a stressful event. The search for an empirically founded theory explaining the relations between traumatic childhood experiences and sleep is not yet conclud-

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ed. Chronic hyperarousal and hypervigilance, maladaptive sleep behaviours, secondary anxiety conditioning processes as well as

disturbances of trauma processing and memory functions during sleep are hypothesized to be factors involved.

► **Key words** trauma – childhood – sleep – insomnia – nightmares

Introduction

The development of the sleep-wake system is one of the first markers of early bio-behavioural organisation and adaptation [91]. This developmental process involves complex biological, physiological and psychosocial mechanisms that commonly lead to the achievement of consolidated sleep-wake patterns. The high prevalence of sleep disturbances in early childhood reflects the vulnerability of this process to disruptive influences [58, 70, 77]. In early childhood, disturbed sleep has often been associated with difficult temperament (e.g., [79, 82, 93–95, 98]), while in older children and adolescents, abnormal sleep patterns and sleep disorders rather seem to be related to stress (e.g., [33]), psychopathology (e.g., [21, 34]), and abuse and neglect (e.g., [8, 9, 59, 78]). The present article gives an overview of the current state of research concerning short and long-term effects of traumatic experiences in childhood and adolescence on sleep. Current approaches explaining the relation between sleep and stressful events will be outlined and assimilated into an integrative model.

Effects of traumatic events in childhood and adolescence on health

In the past decade, a number of studies have been published addressing the long-term effects of traumatic events on health (e.g., [31, 40, 85]). The scope of analysed stressful events ranged from singular life-threatening events (type I trauma: e.g., severe accidents, disasters, and violent crimes) to less noticeable strains that can be traumatising due to their recurring occurrence (type II trauma: e.g., extreme neglect, experiences of violence and abuse).

In the context of a large-scale longitudinal study with more than 17,000 adult Americans, Felitti et al. [31] found a significant relation between the severity of adverse childhood experiences (ACE) and health risk behaviours (e.g., alcohol and drug abuse, smoking, promiscuity) as well as an increased incidence of specific diseases in adult age (e.g., cancer, chronic lung disease, skeletal fractures, liver diseases). There seems to be a dose-response relationship between these disorders and earlier stressful life events. Further analyses within the ACE study revealed correlations between ACE and ischemic heart disease [23], obesity [96], alcohol abuse [25], and depressive disorders [17] in adult age. In a re-

trospective survey with 205 females, Spertus et al. [85] identified emotional abuse and neglect in childhood as significant predictors for heightened anxiety, depression, post-traumatic stress symptoms and somatization symptoms. In a study by Goodwin and Stein [40], child abuse and neglect were associated with an increased risk for a wide range of physical illnesses in adult age (lung diseases, peptic ulcer, arthritic disorders, cardiac diseases, diabetes, autoimmune disorders). Similarly, a number of surveys document that adults who report stressful childhood experiences more often suffer from anxiety disorders [97], post traumatic stress symptoms such as hypervigilance or sleep disturbances [1], and show more psychopathological symptoms [32].

The effects of traumatic experiences on sleep

Traumatic events and other emotionally stressful experiences can have short and long-term negative effects on sleep. This association is especially strong after the confrontation with traumatic events in which the affected persons had to fear for their life or their physical integrity and showed intensive reactions of fear, helplessness and terror. Difficulties initiating and maintaining sleep, non-restorative sleep, increased occurrence of anxiety dreams and nightmares, somnambulism and pavor nocturnus are counted among the most frequently reported complaints (e.g., [63, 64]) and can persist for years after the occurrence of the stressful event (e.g., [57, 61, 73]). These sleep disorders are part of the diagnostic criteria for acute stress disorder and post traumatic stress disorder (PTSD). They are the most thoroughly investigated symptoms in the context of these disorders. While most studies investigating PTSD come to similar conclusions concerning subjective sleep reports, the results of sleep laboratory studies are inconsistent. Even years after the traumatic events, polysomnographic recordings of patients with PTSD showed significantly lower sleep efficiency, more and prolonged awakenings after sleep onset, more arousals and body movements, a lower amount of slow wave sleep, more REM-sleep, longer REM latency and higher REM density compared to healthy controls (cf. review articles, [4, 12, 46, 55, 66]). Other studies however did not find any significant differences between patients with PTSD and controls concerning their sleep measures. One explanation that could account for this discrepancy are the small sample sizes used in most of the latter studies; furthermore, some of them did not adequately consider medi-

cation and psychiatric comorbidity common in patients with PTSD. Moreover, most studies addressing sleep disturbances in PTSD have been conducted with combat veterans; these results are not generally applicable to other forms of traumatic experiences.

As various studies demonstrate, traumatic childhood experiences which do not necessarily lead to a full-syndrome PTSD can also have short and long-term effects on sleep (e. g., [37, 42, 80]). Among the investigated types of distress are family stress, child abuse and neglect, injuries and accidents as well as experiences of war or disasters.

■ Family stress

Several recent studies investigated the question in which way familial stressors and/or a negative child-parent-relationship have negative effects on infant sleep. Sadeh et al. [81] found that a family stress index comprised of questions regarding relocation, hospitalisations, loss, illness, and emotional turmoil was associated with poor sleep quality, assessed through actigraphy, which was characterized by increased night awakenings and reduced sleep amount in elementary school-age children.

In a study by Bates et al. [7], family stress was associated with bedtime and sleep time variability in preschoolers. In other studies a poor parent-child relationship [56] and insecure maternal attachment [10] were related to children's sleep problems. In a survey by El-Sheikh et al. [28] with healthy 8- to 9-year-olds, marital conflicts were linked to disruptions in the quantity and quality of children's actigraphically assessed sleep as well as to subjective sleepiness. In a prospective study on long-term effects of family conflicts on sleep, Gregory et al. [42] found a significant longitudinal relation between the experience of family conflicts in childhood (between age 7 and 15) and the development of insomnia at the age of 18. There was a dose-response relationship, whereby the more intense the family conflicts, the greater the young person's likelihood of developing insomnia at 18 years.

■ Child abuse and neglect

The definitions of various forms of child abuse highly depend on cultural norms. In western industrial countries, sexual abuse is broadly defined as any sexual or sex-related activity occurring between a minor and a distinctly older person. Physical abuse includes unacceptable means of inducing pain and intentional bodily harm to a child. Emotional abuse includes recurrent parental criticism, rejection, degradation, contempt, and lack of attention. The concept of neglect is more complex to define; it is usually applied when pri-

mary caregivers fail to reasonably meet minimal standards of child care such as feeding, health care, safety, and availability [76]. Child abuse, in particular sexual abuse, has often been linked to altered sleep patterns and sleep disturbances (e. g., [38, 39, 59, 71, 78]). However, most of these studies were based on parent-reported sleep measures. Sadeh et al. [80] used objective measures in order to examine the relations between child abuse and sleep patterns. The authors investigated the sleep of 39 children aged 7 to 14 which were hospitalised in a psychiatric inpatient unit. Child abuse was significantly associated with specific actigraphic sleep patterns: Physically abused children (with and without a history of sexual abuse) showed significantly lower sleep efficiency and spent proportionally less time in quiet-motionless sleep than did sexually abused and non-abused children. Glod et al. [37] came to similar conclusions. The authors analysed the actigraphic recordings of three nights in 19 physically and sexually abused children, 15 non-abused normal controls, and 10 depressed children. On average, abuse began early in life (at age 3.7 ± 2.0), with the last episode of abuse 3.3 ± 3.2 years before the study. Abused children were twice as active at night as normal and depressed children and had significantly longer sleep latency and decreased sleep efficiency. Similar to the study by Sadeh et al. [80], physically abused children had more impaired sleep efficiency than sexually abused children.

In another study by Sadeh et al. [78], parent reports of their children's sleep in the home setting revealed significantly more sleep problems in sexually abused children than in non-abused children. When these children were observed on the hospital unit however, both groups showed comparable sleep measures. The lack of significant sleep problems in the hospital setting raised the important issue of the contextual factor in sleep studies of traumatised children. The authors assumed that hospitalised children perceived the inpatient unit as relatively secure shelter where they can sleep safely, in contrast to their chronic need for hypervigilance in their natural environment. Accordingly, therapeutic efforts should aim at (re-)establishing a sense of security in the child's natural sleeping environment.

Interestingly, the sexually abused children examined by Sadeh et al. [78] were also of significantly shorter stature than the non-abused children. The fact that growth hormone is secreted mostly during deep sleep stages raised the possibility that sleep disturbances mediate growth retardation in abused children. However, this presumption could not be supported directly by the findings of this study and should be further investigated.

Chambers and Belicki [16] examined the long-term effects of abuse on sleep by letting 97 university students retrospectively assess their childhood with regard to traumatic and abusive experiences. Participants with

this kind of childhood experiences reported significantly more nightmares and sleep disturbances in adult age than other participants. Similarly, in a prospective longitudinal study, Noll et al. [62] investigated the relation of sexual child abuse and sleep problems in a sample of 147 young females. 10 years after the abuse, participants who had been sexually abused in childhood reported significantly more often that they suffered from sleep disorders than did controls. In addition, the results of other studies investigating the effects of sexual child abuse on mental health in adult age provide further evidence that the emotional strains experienced in childhood lead to an increased incidence of nightmares and sleep disorders even years after the abuse [19, 24, 36, 47].

■ Injuries and accidents

Kravitz et al. [54] assessed the long-term effects of burn injuries on sleep in 82 children and adolescents which had sustained severe burn injuries dating back 7.3 years on average with a minimum of 1 year. The affected children presented severe sleep disorders which manifested as nightmares (37%), bed-wetting (24%), and sleep-walking (18%). Ellis et al. [26] found increased nightmares and other sleep disturbances in 45 school children aged 6 to 16 who had suffered a road accident 4 to 7 months ago. Stoddard et al. [86] as well document a correspondence between severe burn injuries and an elevated frequency of nightmares in children. In an investigation on the effect of injuries on sleep, Kaufman et al. [50] assessed 19 adolescents through polysomnographic measures in the sleep laboratory and actigraphic recordings at home, who had suffered minor head injuries not less than 3 years ago. In both settings, they showed significantly lower sleep efficiency as well as more and prolonged nocturnal awakenings compared with age and gender-matched normal controls. In a similar study, Pillar et al. [65] examined the effects of minor head injuries, dating back 0.5 to 6 years on average, on self-reported sleep measures in 98 children and adolescents. Again, they presented significantly more sleep disturbances than matched normal controls. The authors claim that these disturbances can not be explained organically but are a consequence of the emotional distress caused by the injury. In order to support this presumption, they quote the findings by Farmer et al. [30], who investigated consecutive neurobehavioral symptoms in children with minor head injuries. In this survey, the prevalence of sleep disorders was not larger than in children with injuries in other body regions.

■ War and disasters

A great number of scientific articles describe the immediate effects of war experiences, natural and other disasters on sleep in children. In their review on war-related stress in children, Jensen and Shaw [49] indicated that there are inconsistent and controversial findings on children's reactions to war-related stress. The authors suggested that children's cognitive immaturity and adaptive flexibility may mitigate the anticipated stressful effects, and that the actual proximity or level of direct exposure to the disaster are further important factors in this process. Rofe and Lewin [72] report that children who lived in areas with massive terror activities slept longer and had less bad dreams compared to children who lived in less threatened war zones. The authors suggest that children who experience constant war threats develop repressive coping mechanisms that might protect them against sleep disorders. However, being directly exposed to terror attacks has a negative effect on children's sleep and wellbeing. Raviv und Klingman [69] investigated the effects of a terror attack in which 86 children had been held hostage during 16 hours. The attack ended in a release operation in which 22 children were killed and 60 injured. In a follow-up evaluation, 75 percent of the children suffered from insomnia, nightmares and other psychosomatic problems. Sleep disorders and nightmares were also found in children who had experienced a sniper attack at their school [67], a storm in which a child died through a stroke of lightning [22], and the earthquake in Armenia in 1988 [68]. In a large-scale study, Shannon et al. [84] examined 5687 school children in South Carolina after the hurricane Hugo disaster. Repetitive nightmares were reported subsequently by 5% of the girls and 3.7% of the boys. Sleep disorders were found in 20% of the children, independent of gender. The fact that the incidence of sleep disorders and nightmares decreased with advancing age leads to the assumption that younger children might have more difficulties adjusting to this kind of stressful event.

Media news of disasters as well can provoke sleep disturbances in children. 5 to 7 weeks after the explosion of the space shuttle "Challenger" in January 1986, more than half of a sample of children who had seen newscasts of the event suffered from anxiety dreams that were associated with the explosion [90]. 14 months after the event, the incidence of these dreams had decreased markedly. Terr [87, 88] conducted an extensive evaluation in the aftermath of a hijacking incident. 25 school children aged 5 to 14, who had been able to free themselves from a truck trailer after 27 hours of hostage, subsequently developed fears of the dark, of cars etc., and a pessimistic view of their future. In the immediate aftermath of the event, the children suffered from sleep-related problems such as pavor nocturnus and nightmares in which the stressful event was recurrently re-experi-

enced. Gradually, the dream contents changed and the frequency of nightmares decreased, but the high anxiety level during nightmares persisted. Even 4 to 5 years after the incident, 14 ex-hostages still had repetitive dreams of their own death [88]. In a control group of 25 children, 8 also reported dreams of dying [89], yet in 6 of these cases, Terr [89] found evidence for a very stressful event (severe accident of a parent, very severe illness, experience of an earthquake, witnessing of grandfather's death).

Own research

Within the scope of own research projects, we found significant inverse correlations between the duration and intensity of recalled stressful events in childhood and youth and self-reported sleep quality in adult age in a sample of 381 healthy subjects [2]. In another study, the effects of induced stress on sleep were assessed and linked to the amount of recalled stressful events in childhood and adolescence [5]. The sleep behaviour of 40 female university students was actigraphically assessed in four consecutive nights in the natural home environment. In the fourth night, stress induction was conducted by presenting five documentary film scenes depicting stressful experiences such as violence or abuse. In the subsequent night, the group with more reports of adverse childhood experiences (ACE) showed lower sleep efficiency and more body activity than the control group. Yet, these differences were only found during the first half of the night. In a very recent study [3], 59 patients with primary insomnia (aged 43.8 ± 8.8 years) were allocated to two groups (high-ACE group/low-ACE group) according to their answers in the Childhood Trauma Questionnaire (CTQ; [11]). According to the CTQ scores, 27 (46%) of the insomniacs had been exposed to severe stressful events in childhood and adolescence. The patients spent three nights in the sleep laboratory, including one acclimatisation night. In the two subsequent nights, they were instructed in random order to recall either especially positive or extremely negative life events before bedtime. Independent of testing conditions, the high-ACE group had significantly lower slow wave sleep, more wakefulness after sleep onset, and more movement and cortical arousals than the low-ACE group in all three nights. The actigraphic recordings as well showed lower sleep efficiency and more body movements during sleep in the high-ACE group.

Theoretical frameworks

So far, there is no empirically confirmed theory that could conclusively explain the relation between traumatic experiences and sleep. Nevertheless, the research

efforts of the past years yielded various theoretical approaches – mainly originating from the field of trauma research – which offer explanations for the development of sleep disorders and nightmares.

■ Hyperarousal and hypervigilance in traumatised persons

Morin [60] explains impaired sleep against the background of a persistent physiological hyperarousal, a constant state of excessive agitation that manifests in involuntary reactions of the autonomic nervous system, hypervigilance, increased startle responses, or elevated irritability. This form of activation can be cognitive or emotional and results in delayed sleep onset, more awakenings after sleep onset, and increased body movements during sleep. Since stress is often associated with increased anxiety, physiological and emotional arousal, increased vigilance, and activation of the sympathetic nervous system, several authors suggest that severe psychosocial stress might cause physiological changes in children which can interfere with sleep and contribute to an acute manifestation of insomnia. This assumption is supported by findings of El-Sheikh and Buckhalt [27]. In a study with healthy school children, they found that increased emotional reactivity and reduced vagal regulation during a stressful task were significant predictors for self-reported as well as objectively measured qualitative and quantitative sleep disturbances. The perception of the sleeping environment as a secure place is crucial for restorative sleep. Feelings of threat and insecurity during sleep, which can occur in the context of various sources of childhood stress and particularly in association with sexual abuse, can lead to hypervigilance incompatible with sleep. This hypervigilance, according to Dahl [20], can be seen as an important adaptation response that facilitates coping with life-threatening events and permanently perceived danger. Barlow [6] explains the state of increased vigilance as a means to avoid or cope with future potentially threatening events.

Several authors have linked sleep problems to nocturnal cognitive hyperactivation (worry and rumination), a condition that seems to play an important role in the maintenance of difficulties initiating and maintaining sleep (e.g. [29, 45]). Gregory et al. [42] assume that children who grow up in difficult home environments are particularly susceptible to developing such cognitive styles.

■ Chaotic family environment

Gregory et al. [42] assume that growing up in disorganized familial structures may be incompatible with

good sleep hygiene (e.g., lack of sleep rituals, inappropriate levels of noise), which has a negative impact on sleep and might lead to the development of inadequate sleep patterns that can persist far into adulthood. Correspondingly, Gregory et al. [43] found significant correlations between family chaos and sleep disturbances in children.

■ Maladaptive sleep patterns acquired over time

According to Morin [60] the development of insomnia is characterized by processes of classical conditioning that lead to the development of conditioned arousals. These can be triggered by signals coming from the sleeping environment and add to the chronification of the disorder. Similarly, Krakow et al. [52] assume that over time, due to maladaptive learning processes, trauma-related sleep disorders can occur independently of their original triggers.

■ Nightmares as reactions to stress

Nightmares are an immediate reaction to stress and emotional strain. A number of studies have found correlations between the intensity of experienced stress and the incidence of nightmares [18, 48, 51]. Fisher and Rinehart [33] found a significant association between children's physiological reactivity, the level of arousal (cortisol level, electrodermal activity) evoked through an experimental stressor (stroop-test), and the incidence rate of parasomnias. Some dream researchers assume that daytime experiences are incorporated into dreams in the form of so-called day residues, especially if they are emotionally significant (e.g. [13]). Also, solely emotional states can expand into the dreams appearing at night as dream feelings with emotionally congruent contents. In this sense, nightmares could be explained as nocturnal replication of diurnal states of anxiety.

■ Disturbed trauma processing and memory functions

A number of authors postulate that the processing of stressful events is attributable to modifications of the respective memory representations during sleep. On the one hand, this hypothesis is based on a presumed memory-consolidating function of sleep (e.g., [35]) and on the other hand on various assumptions concerning progressive-sequential processing of emotional experiences in REM-sleep and dreaming [14, 41, 53]. Regarding the function of dreaming, Kramer [53] distinguishes two possible patterns: (a) a progressive-sequential pattern in which unresolved daytime problems are reactivated, processed and eventually solved, and (b) a re-

petitive-traumatic pattern in which stressful events are recurrently reactivated during dreaming without any notable progress towards the solution of the problem. Changing dream contents and a decrease in intense feelings of anxiety might be an indication of successful stress management. As a matter of fact, various authors [15, 19, 90, 92] found that with increasing time, dream contents tend to gradually differentiate from the original perceptions of an event and to become less stressful. These findings support the assumption of a continuum ranging from post-traumatic replication dreams to nightmares and to anxiety dreams. Thus, persistent nightmares, particularly post-traumatic replication dreams, might be indicators that the processes of integration and network consolidation of the traumatic memory representations are impaired.

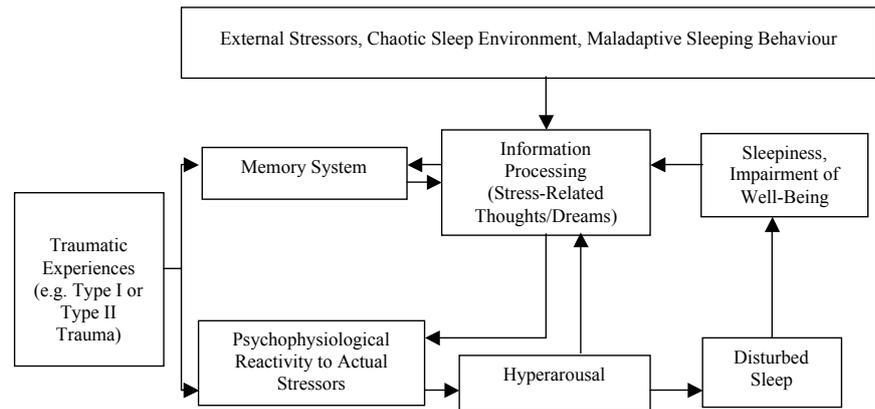
An integrative approach

On the basis of the above-quoted approaches, we suggest an integrative model of the development and maintenance of sleep disturbances in the aftermath of extremely stressful or traumatic life events (see Fig. 1). So far, this model is only of hypothetical character and needs to be further empirically verified. It assumes that multiple and prolonged experiences of extreme stress activate neuroendocrine and cognitive-emotional adaptation processes that result in a decreased psychophysiological threshold for arousals and in the development of a chronic hyperarousal. If an individual's resources for arousal reduction are insufficient, the increased vulnerability to react to stress with arousals can have negative effects on sleep. In addition, the model suggests that information processing is influenced by memory representations of extreme stress not only during wakefulness, but also during sleep. During the day, this manifests in an increased vigilance to possible anxiety and stress triggers or an anxious-fearful information processing style. During sleep, these mechanisms can facilitate the reactivation of stress-related memory contents (e.g. in the form of anxiety dreams and nightmares) which again are accompanied by physiological patterns of arousal that can cause awakenings or non-restorative sleep (e.g., [83]).

Conclusion and future directions

Traumatic experiences in childhood and adolescence seem to be a significant risk factor for the development of mental and physical disorders in adult age. Research concerning short- and long-term effects of traumatic experiences on sleep is still in the early stages. However, a number of empirical investigations provide evidence that there is a link between traumatic experiences in childhood and sleep disturbances. During traumatic

Fig. 1 Integrative approach for the explanation of the development and maintenance of sleep disorders following traumatic experiences



events as well as for years afterwards, children and adults show an elevated frequency of stress and anxiety dreams, less sleep efficiency, prolonged sleep latency and more nocturnal awakenings. The clinical relevance of these findings becomes evident considering the fact that persistent sleep disturbances can provoke a number of consecutive symptoms such as daytime sleepiness, loss of energy, elevated anxiety, states of stress and associated functional impairment [99] – symptoms that potentially add to an increased vulnerability to other mental and physiological disorders and might foster their development and maintenance. Usually, associations between traumatic experiences and sleep disorders are assumed only if they are reported by the affected patients and co-occur within a relatively short timeframe. Since the anamnesis of traumatic experiences is not part of the routine diagnostic screening for sleeping disorders, this aspect can easily be overlooked. If indeed past traumatic experiences have contributed to the development or maintenance of actual sleep disorders in an individual, conventional psychotherapeutic measures should be complemented with elements of trauma therapy, much like they are used for patients with post-traumatic stress disorder (e. g., imagery rehearsal for the treatment of nightmares; [44, 52]).

Finally, several methodical limitations of the quoted studies shall be addressed and the potential implications for future research in the field of trauma and sleep shall be considered. Most of the empirical findings in this field of research are based on self-reports by parents or by the children themselves, while objective findings are few. Since the subjective and parental knowledge about sleep and sleep patterns can be limited, subjective assessments can be distorted by the affected person's expectations and beliefs (compare Sadeh [74, 75]). The explanatory power of past findings on sleep quality is

even more restricted as even in those cases where objective measures were used, these were mainly actigraphic and not polysomnographic recordings. Moreover, children's sleep patterns seem to be very context-dependent: when examined in a relatively secure and relaxed environment (e. g. sleep laboratory or hospital unit), children may present normal sleep patterns even if their sleep has proved to be significantly impaired in stressful environments (e. g. in an abusive familial setting). This carries the risk of overlooking or underestimating existing sleep disturbances in affected children. Naturalistic studies with objective measures of sleep parameters under stressful conditions can provide significant information for future research in this field. In addition, most empirical studies do hardly bring out any specific implications for the treatment of trauma-related sleep disorders. Moreover, so far only few prospective longitudinal studies have been conducted and published. Most research work is based on (retrospective) cross-sectional studies, which does not allow for prognoses about cause-and-effect relations. Another crucial aspect that has been disregarded in many studies is the impact of inter-individual differences concerning sensitivity and reactivity to stress. Important aspects of the assessment and interpretation of traumatic experiences, coping strategies and age-dependent vulnerabilities, as described in the corresponding literature, have rarely been considered in the previous research about childhood stress and sleep. Therefore it seems vital to systematically scrutinize the constitutional characteristics, psychosocial stress factors and neurobehavioural consequences that contribute to the development of sleep disorders. Once these associations have been more profoundly investigated, it will be possible to deduce specific target-oriented treatment approaches for subgroups of sleep disordered patients.

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