

Treatment of behavioral sleep problems in children and adolescents – literature review

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Summary

Aim. To collect data on treatment of behavioural sleep disorders in children and adolescents.

Materials and methods. A literature review based on the PUBMED database.

Results. Based on the analysed materials three basic complementary procedures were identified – implementation of sleep hygiene, behavioural interventions and pharmacological treatment. The rules of sleep hygiene proven to be effective include: regular sleep schedule, adequately prepared place to sleep (a dark, quiet bedroom without multimedia), bedtime routine, avoiding caffeinated beverages. The following issues require further studies to confirm their effectiveness: falling asleep independently without parent’s assistance, bedtime reading, physical activity, reducing daytime multimedia use, tryptophan rich breakfasts. Behavioural interventions and pharmacological treatment may in some cases be temporarily implemented to complement the sleep hygiene.

Conclusions. The implementation of sleep hygiene is a primary, fully acceptable to the child and parents, way to improve the baby sleep. In case of ineffectiveness of the proposed rules, those can be complemented with behavioural methods that are highly effective but some parents do not accept them or make mistakes in their introduction. Pharmacotherapy can be used as a temporary support for families with severe behavioural problems as an aid in the implementation of sleep hygiene and behavioural methods.

Key words: sleep, children, behavioural sleep problems

Introduction

In last decades sleep disorders present an increasing and significant health issue in industrialized societies. Problem influences not only adults but also children and adolescents. It is estimated that various sleep difficulties (bedtime resistance, delayed

sleep onset, frequent waking after sleep onset, lack of sleep consolidation, early waking, daytime sleepiness) may affect 25–62% of children depending on development phase [1–3]. Those can present as a primary problem or coexist with other disorders [4]. Increasing attention is paid to multiple social and economic costs generated by sleep disorders in children, such as parental depression, children's school performance, medical consultations and diagnostic tests, work and school absence and in consequence to their treatment, especially to sleep hygiene [5].

Caregivers often lack basic knowledge about healthy sleep and sleep hygiene [6]. Despite the significance of the problem it is hardly ever referred to in Polish professional literature. There are no guidelines for pediatricians or child and adolescent psychiatrists that care for families who report such issues.

Aim

The aim of this article is to review current evidence regarding treatment of behavioral sleep disorders in pediatric population.

Methods

The authors reviewed articles in the PUBMED database regarding treatment of behavioral sleep disorders. Three main treatment modes were identified: introduction of sleep hygiene, behavioral interventions and pharmacotherapy.

Sleep hygiene

Most dyssomnias in children and adolescents are behavioral in nature [7, 8]. Due to this fact primary form of treatment proposed to their parents is introduction of sleep hygiene [9–11]. In Table 1 the authors summarized sleep hygiene principles recommended in the analyzed literature.

Table 1. Sleep hygiene principles

bedroom without intense stimuli regular bed and wake up time bedtime routine avoiding caffeine-containing beverages include reading as a bedtime routine falling asleep independently in child's own bed without parental assistance limited use of devices emitting blue light spectrum such as tablets, smartphones, computers, TV moderate daytime physical activity tryptophan and vitamin B ₆ rich breakfast and sunlight exposure in the morning hours

Bedtime routine

Mindell et al. analyzed “Sleep in America Poll” survey conducted on nearly 1,500 parents and verified presleep practices influence on length and quality of sleep. They demonstrated positive correlation between consistent bedtime routine and healthy sleep in children. Regular bedtime routine was associated with shorter sleep onset latency, less night arousals and longer total sleep time [8]. Also Sadeh et al., who studied sleep habits in American and Canadian families using Internet-based questionnaires (n = 4,505), confirmed positive effect of bedtime routine on sleep in children [12].

Furthermore, Mindall et al. conducted 3-week study with a control group of 405 children aged 0–3 investigating relation between consistent bedtime routine (bath, massage, quiet activities, within 30 minutes before sleep) and sleep. Introduction of bedtime routine resulted in shorter sleep onset latency, less night wakings and better sleep continuity. Moreover, parents in the intervention group considered sleep as a lesser problem [13]. In a further study with a control group involving more than 250 children, Mindell et al. demonstrated that internet-based interventions are beneficial in improving children’s sleep quality [14].

Regular sleep schedule

Regular bed and most importantly wake up times irrespectively of the day of the week are crucial for healthy sleep. In their epidemiological study of 20 thousand children in China, Li et al. proved that irregular sleep schedule is a risk factor for shorter total sleep time in pediatric population [15]. Likewise Blader et al., who studied sleep of primary school pupils, observed that children who did not follow fixed sleep schedule more frequently presented bedtime resistance which led to delayed bedtime and deregulation of circadian rhythm [1]. Additionally, a study conducted on a group of more than 3,000 school children in Belgium showed that nowadays there is a tendency to go to bed later with unchanged wake up times which results in chronic sleep deprivation and increased prevalence of excessive daytime somnolence. However, greater bedtime resistance and sleep latency were observed in children who went to bed earlier than their peers [3].

In a study of US population, Mindell et al. discovered that late bedtimes (after 9 p.m.) for children up to 10 years old was associated with longer sleep onset latency and shorter total sleep time (about 48–78 minutes). It applied to more than 60% of infants and pupils [8]. Similarly Nixon et al., who assessed sleep duration of 500 Australian 7-year-old children using actigraphy, observed that those with bedtimes after 9 p.m. slept on average 41.1 minute less than their peers [16].

On the other hand, Biggs et al. assessed relationship between sleep schedules and daytime behavior in a sample of 1,622 healthy children in Australia. They noted

that inconsistency in sleep schedules exceeding 60 minutes increased likelihood of behavioral difficulties, most commonly hyperactivity [17].

Quiet, dark bedroom

In everyday life, we meet with the general statement that a healthy child can fall asleep anywhere, regardless of conditions. Some authors even recommend using “white noise at the volume of the shower” to help children sleep [18]. This myth is not confirmed with scientific evidence. It has been observed that intrusive background noise and intrusive light in children’s bedrooms caused problems with falling asleep and sleep continuity, increased odds for repetitive limb movements and excessive daytime somnolence [3]. Results of the study conducted by Ising, who evaluated children exposed to a constant, intense traffic noise, showed increased cortisol level in their blood in the first half of the night which probably was responsible for sleep difficulties [19]. Similarly Linder, who assessed group of 15 children using actigraphy in a hospital setting during a course of chemotherapy, proved that factor most disrupting their sleep was hospital environment, especially the intensity of light and noise [20].

In recent study with a control group, Serra-Negra et al. analyzed relationship between environmental factors, sleep and bruxism in pupils. Children exposed to light and noise had shorter total sleep time and were predisposed to bruxism [21].

It is suggested that the combination of exposure to light at night with the lack of exposure in the morning desynchronizes circadian rhythm arising from serotonergic activity reduction [22]. Initially, when it is still quite easy to treat, it manifests with deregulation of multiple systems including endocrine, autonomic and gastro-intestinal systems. In the long-term perspective, it leads to refractory to treatment conditions such as chronic fatigue syndrome, burnout, fibromyalgia, orthostatic deregulation, depression [22].

Bedtime story

Reading or telling stories is a part of a bedtime routine in many families [8]. Studies confirmed its positive impact indicating the advantages such as reducing bedtime anxiety, promoting healthy sleep habits, decreasing bedtime resistance and increasing total sleep time [8, 23]. Importance of memory consolidation/enhancing new vocabulary during sleep is also underlined [24, 25]. Research suggest that children who regularly listen to stories at bedtime are reported to sleep longer and deeper, less often awake at night, use richer vocabulary and function better cognitively [26]. Correlation between good sleep and reading stories is not fully understood. It is suggested that it may be due to the greater parent emotional availability. Based on limited number of conducted studies, available data interpretation is difficult.

Falling asleep independently in own bed without parental assistance

In the first year of life children often cry at night demanding to meet their needs. As parents take into consideration child's and their own comfort they tend to accustom infants to various forms of sleep initiation such as nursing/feeding, rocking, cuddling at parental bed etc. [27]. Those methods appear to be inconsiderate. American study found that infants put to crib drowsy but awake have shorter sleep onset latency, less often awake at night and sleep 60 minutes longer than their peers. Likewise parental presence while child falls asleep is associated with shorter total sleep time [8]. It seems that allowing the child to fall asleep without parental presence and a response delay for child's night waking promotes self-soothing and reduces number of sleep interruptions.

Mindell et al. in their survey inquiring parents of 30 thousand children on several continents made interesting comparison [27]. Parental presence at sleep onset had significant influence on children's sleep only in predominantly-Caucasian countries (Australia, New Zealand, USA, UK). In those countries 41% of children fell asleep independently in their own bed/crib. In contrast in predominantly-Asian regions (China, India, Indonesia, Korea, Japan, Malaysia, Philippines, Singapore, Thailand, Taiwan) there was no such correlation as only 4% of children fell asleep without parental presence. It is suggested that infants' sleep quality correspond with the level of parental involvement at sleep onset not with room or bed sharing.

Falling asleep in own crib, adapted for infants, is also important from the safety point of view [28]. Nakamura et al. analyzed data collected by the US Consumer Product Safety Commission on deaths of children younger than 2 years between 1990 and 1997. They identified 515 deaths of children who were placed to sleep in adult beds. In 121 cases deaths were reported to be caused by child overlying by other person, 394 were due to entrapment in the bed structure.

Moderate daytime physical activity

The results of studies evaluating the relationship between physical activity and sleep are controversial. Williams et al., who studied group of 200 children using accelerometer, collected data suggesting negative correlation between their daytime activity and total sleep time [29]. Awad et al. analyzed association among sleep, BMI and exercises in 312 adolescents using home polysomnograph. They observed that regular, vigorous activity correlates with increased stage II sleep and decreased slow wave sleep [30]. Results of the study conducted by Dworak et al., where influence of moderate to vigorous activity on sleep was verified, lead to contrary conclusions. Examining 11 boys using polysomnograph they found that one-time vigorous activity results in decrease in sleep onset latency and stage II sleep, simultaneously increasing time of slow wave sleep and its efficiency [31]. Ekstedt et al., taking into consideration their own research and the available data suggest that generalized excessive physiologi-

cal tension can interfere with sleep architecture and cause its fragmentation. However, their underline that vigorous daytime activity can promote good sleep [32].

Limited use of devices emitting blue light spectrum such as computers, tablets, smartphones, TV

The number of media devices rise exponentially each year. Not surprisingly children and adolescents tend to enjoy them in increasing time amount, even directly before bedtime [33, 34]. Results of Eggermont's survey reveal that 1/3 of adolescents fall asleep watching television, moreover 22% use computer games as a sleep aid. Additionally, Mistry reports that 41% of American 5-year-olds have television in their bedroom [34].

In the last decade multiple studies of pediatric population in various countries (i.e. China, USA, Finland) demonstrated that media overuse in a long-term perspective shortens total sleep time [8, 15, 35, 36], interferes with circadian rhythm, correlates with bedtime resistance and parasomnia occurrence [37, 38]. It is suggested that it may be associated with inappropriate and violent content [39]. On the contrary, other hypothesis points to more biological grounds of this issue. Dworak et al. exposed 11 adolescent boys to single, one hour voluntary age-appropriate excessive television and computer game consumption. In the subsequent night polysomnograms were conducted. Watching television reduced sleep efficiency without changes in sleep patterns, playing computer game resulted in prolonged sleep onset latency, increased stage II sleep and significantly reduced slow wave sleep [40].

On the basis of these findings, in 2011 American Academy of Pediatrics recommended to discourage media use (active and passive) by children younger than 2 years. Furthermore, parents were discouraged from placing a television set in their child's bedroom [41].

Nevertheless, recent reports suggest that direction of relationship between media use and sleep might not be obvious. Australian study indicates bidirectional correlation between sleep and media use in early childhood. Not only frequent media use results in reduced total sleep time but also shorter sleep encourages increased use of various devices [42]. Tavernier reached different conclusions in a prospective study involving a group of nearly 1,000 students during the first three years at the university [43]. Data from the study indicate that correlation in young adults is unidirectional, sleep disorders predispose to future intensive television use and social networking. The interpretation of these reports requires caution, further research is necessary.

Avoiding caffeine-containing beverages

Over the past few years children and youth are the fastest growing consumer group of caffeine-containing products. In her review, Temple notes that the average

daily caffeine intake in population under the age of 18 has almost doubled over the last 30 years [44]. Sleep in America Poll revealed that almost 30% of American children aged 6–10 drink from 1 to 5 cans of caffeinated drinks daily [45]. Depending on the beverage type they may contain from 50 to 550 mg of caffeine in a can [46]. Not only American population is affected by this problem. Sitko, who evaluated adolescent group in Warsaw, noted that 50% of them reported drinking cola and 40% declared coffee consumption [47]. Multiple studies have shown the negative effects of caffeine on sleep latency, efficiency, duration and homeostatic need for sleep. Students who consume caffeine often report difficulty falling asleep on school days and excessive sleepiness the next day [35, 48]. Young people often drink energy beverages in the evening to reduce sleepiness and increase the time spent on entertainment and media use [46]. Number of countries has introduced restrictions on the advertising and sale of energy drinks to anyone under the age of 18. In November 2014 Lithuania completely banned sale of beverages containing more than 150 mg of caffeine/l to children.

Tryptophan and vitamin B₆ rich breakfast and sunlight exposure in the morning hours

Relationship between sleep and diet has raised specialists' interest in recent years. The consideration basis is the melatonin synthesis pathway, in which melatonin precursor is serotonin synthesized from tryptophan. An important coenzyme of the above reactions is vitamin B₆. It is hypothesized that sunlight may be a factor accelerating serotonin synthesis. Several studies on children, adolescents and young adults in Japan suggest that breakfast rich in tryptophan and vitamin B₆ in conjunction with the morning sun exposure (at least 10 minutes) improve sleep quality, reduce time to fall asleep and promote morningness [49, 50]. Harada et al., who analyzed habits of more than 2,000 children aged 0–15, observed a negative correlation between the amount of tryptophan consumed in breakfast and evening chronotype occurrence in children. In addition, their study results suggest that children with evening chronotype were prone to irritability and depressed mood [51].

Cubero et al., studying a group of 30 children aged 8–16 months using actigraph obtained similar results. In 5 consecutive weeks, cereals with different tryptophan amount were administered to infants as an evening meal. Administration of enriched cereals allowed children to maintain calm, restoring sleep [52].

Tryptophan supplementation was also tested as a remedy for night terrors with promising results. Bruni et al., in their study with a control group, supplemented nearly 50 children with L-5-hydroxytryptophan. Within a month it resulted in a complete relief/reduction of more than 50% of night terror episodes in 93.5% of children in the study group versus 28.6% in the control group [53].

Those studies should be interpreted with caution resulting from their small range. They require confirmation in further observations.

Behavioral interventions

Sleep hygiene is essential for healthy sleep, but sometimes due to developmental reasons or parenting issues is not sufficient to avoid bedtime resistance and acquire sleep continuity. In those cases behavioral interventions should be considered further line of treatment [54–57]. A systematic review by Bellini et al. summarizes the available data based on their effectiveness [58].

The oldest technique is extinction – the method which encourages parents to ignore their child and its behavior from the moment child is put to bed till next morning. This method introduced correctly is highly effective in no time [54]. Even though, it is unacceptable to many parents and can result in further disorder reinforcement if interrupted (instrumental conditioning) [59]. Modified extinction is associated with parental presence in child's room, however, there should be no interference. This method has comparable effectiveness to unmodified extinction. Another form of this method is gradual extinction involving short visits scheduled in the case of constant crying i.e. every 5 minutes or the gradual lengthening of the time between successive responses to a crying infant. Moore et al., in a randomized study on a small group of children tested another modification of the above methods with a positive effect. Bedtime Pass Program suggested by them involves: child getting into bed, providing them with a card exchangeable for one “free” trip out of the room or one parent visit to satisfy an acceptable request (e.g. hug or additional glass of water), surrender of the pass after its use and extinction thereafter. The method reduced bedtime resistance, time to quiet each night and was reported to be highly acceptable by the parents [55].

Behavioral intervention remarkably accepted by parents is ‘stimulus control’. It involves removing child who does not fall asleep from the crib and quiet play with a parent for a specified period of time (30 minutes). In order to minimize time necessary to fall asleep bedtime is delayed. After positive reinforcement associated with immediate sleep onset, in the following days bedtime is set 15–30 minutes earlier, until the desired bedtime is reached [56].

In case of frequent wakes after sleep onset scheduled awakenings are recommended. This technique involves waking child 15–60 minutes prior to usual spontaneous arousal time followed by standard way of putting child to sleep. After some time, when there are no spontaneous arousals, intervals between scheduled awakenings are prolonged. Method requires quite a lot of parental commitment and takes several weeks to bring the desired effect. It cannot be used in the smallest infants.

Finally the best behavioral intervention, recommended by experts because of cost and time effectiveness, is prevention of sleep problems through parental education regarding infant sleep hygiene and healthy sleep habits [54, 56]. Parents waiting for a child, as well as parents of infants should be the target population of such educational programs.

Pharmacotherapy

Currently there are no reliable data on the pharmacotherapy use in children's sleep disorders [60]. In spite of it, specialists treating sleep problems report they frequently recommend use of various medications to improve sleep. In a recent study Owens et al. asked child and adolescent psychiatrists in the US how often they had endorsed pharmacotherapy to promote sleep. In the sample of more than 1,200 doctors 96% wrote at least one prescription for sleep medicine in a typical month. Respondents admitted that at least quarter of their insomnia patients were treated pharmacologically. Alpha agonists, trazodone, antidepressants and atypical antipsychotics were most commonly used [61].

In 2003 the American Academy of Sleep Medicine assembled a multidisciplinary expert team to create sleep disorders pharmacotherapy guidelines for pediatric population. Experts recommended to begin treatment with taking detailed history, sleep hygiene introduction, treatment of concomitant disorders (i.e. obstructive sleep apnea syndrome) and use of non-pharmacological methods. The medication choice should be individualized, tailored to the clinical diagnosis and optimized from pharmacokinetic profile point of view. Pharmacotherapy should be used in the short term, its effectiveness and objectives should be reconsidered with every prescription [62].

In her review Owens lists medications used to treat children's insomnia in US. She mentions antihistamines, melatonin, herbal preparations, benzodiazepines, GABA agonists (zolpidem, zopiclone, zaleplon), ramelteon (not available in Poland), alpha-agonists (clonidine), antidepressants, mood stabilizers and atypical antipsychotics. None of the named substances has sufficiently reliable research on the effectiveness and safety of use in children. Moreover, none of them have FDA approval for treatment of pediatric dyssomnias [63]. Owens recommends caution pharmacotherapy use in the children insomnia treatment.

Recapitulation

The current research analysis on the parameters affecting children's and adolescents' sleep has confirmed the effectiveness of: regular sleep schedule, bedtime routine, appropriate conditions for sleep (quiet, dark bedroom, without media), avoiding caffeinated beverages, and properly applied behavioral interventions.

Data regarding several factors are inadequate and require further in-depth research. This applies to falling asleep independently without parental assistance, bedtime stories, physical activity, daytime media use reduction, and tryptophan enriched breakfasts.

Some methods did not prove to be effective: use of white noise and incorrectly applied behavioral techniques.

It should be emphasized that there is no data on the effectiveness and safety of pharmacotherapy for insomnia in children.

Recommendations

Applying sleep hygiene can improve children's and adolescents' quality and length of sleep, consequently their overall functioning, school performance and social skills. Healthy habits increase the likelihood that youth will avoid problems with insomnia and circadian rhythm disorders in adulthood.

In the absence of guidelines we propose to implement techniques with documented effectiveness and safety adapted to the patient's age in the following order:

1. introduction of appropriate conditions for sleep (dark, quiet bedroom without media);
2. setting a sleep schedule adapted to the actual physiological need for sleep;
3. non-stimulus bedtime routine implementation adequate to the child developmental level;
4. avoiding caffeinated products.

If these methods present with insufficient effectiveness we suggest following measures:

5. reading as a part of bedtime routine;
6. falling asleep independently without parental presence;
7. daytime media use reduction;
8. moderate daytime physical activity (finished at least one hour before bedtime);
9. introduction of tryptophan, B₆ enriched breakfasts followed by sunlight exposition in the morning hours.

However, if effects of the above techniques are found to be poor, we recommend using behavioral interventions as a method of choice taking into account their effectiveness and lack of side effects.

Pharmacological treatment should be used as a last resort, only in the short term and in conjunction with behavioral methods as an adjunctive therapy when non-pharmacological methods have failed.

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