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INSOMNIA IN CHILDREN AND ADOLESCENTS: THE ROLE OF PHYSICAL ACTIVITY AND CONTEMPORARY TREATMENT METHODS

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ABSTRACT

Insomnia is a sleep disorder and an important health problem among children and adolescents. It affects physical and mental health, cognitive and emotional development, and quality of life. This article reviews current literature on the characteristics of paediatric insomnia, the role of physical activity, and pharmacological and non-pharmacological treatments. Developmental differences, consequences of sleep disturbances, and available therapeutic approaches are discussed. Short sleep duration is associated with difficulties in emotional regulation, poorer cognitive functioning, and an increased risk of children being overweight or obese, although observational studies do not establish causality. Physical activity may improve selected sleep parameters and overall sleep quality, but evidence does not demonstrate its consistent effect on total sleep duration. Importantly, most studies have not specifically investigated children and adolescents with diagnosed insomnia, limiting conclusions about the therapeutic effectiveness of exercise interventions. Cognitive behavioural therapy for insomnia remains the first-line treatment for adolescents, whereas evidence supporting its effectiveness in younger children is limited. Melatonin may be considered in selected cases, particularly in children with neurodevelopmental disorders, when behavioural interventions have been unsuccessful. However, sufficient data on its long-term safety is still lacking. The effectiveness of other sleep medications in paediatric populations has not been adequately established. Treatment should therefore be individualised, age-appropriate, and primarily based on non-pharmacological approaches. Further studies involving children and adolescents with diagnosed insomnia are needed to clarify the therapeutic role of physical activity and assess the effectiveness and safety of available treatments.

KEYWORDS

Paediatric Insomnia, Children, Adolescents, Physical Activity, Cognitive Behavioural Therapy, Melatonin

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1. Introduction

Sleep is one of the fundamental factors necessary for the proper functioning of the human body, and its adequate duration and quality are of great importance during childhood and adolescence. It influences physical, cognitive, and emotional development, as well as the ability to concentrate, memory processes, and emotional regulation. During periods of rapid physical development, insufficient sleep can lead to adverse health consequences, including impaired cognitive function, difficulties with mood regulation, and an increased risk of overweight and obesity due to reduced physical activity (Himelfarb & Shatkin, 2024; Kahn, 2023; Kteish et al., 2026).

One of the health problems occurring in the pediatric population is insomnia, which is classified as a sleep disorder. It may manifest as difficulty falling asleep, maintaining sleep continuity, or waking up too early, accompanied by difficulty falling back asleep. Its prevalence among children and adolescents may be associated with many factors, including biological, psychological, behavioral, and environmental factors. The clinical presentation of insomnia also varies by age. In younger children, poor sleep-onset habits and the need for a caregiver's presence may be more significant, whereas in adolescents, changes associated with puberty, a shift in the circadian rhythm, stress, and academic pressure play a major role (Himelfarb & Shatkin, 2024; Kahn, 2023).

Among the factors that may affect sleep quality, physical activity is receiving increasing attention. Regular exercise is an important part of a healthy lifestyle for children and adolescents, supporting their physical and mental development. The results of studies to date indicate that physical activity may have a beneficial effect on certain sleep parameters, in particular by improving sleep quality and efficiency and reducing the amount of time spent awake at night. However, it has not been conclusively demonstrated that it leads to an increase in total sleep time. Furthermore, most of the available studies involve the general

population of children and adolescents, rather than individuals with diagnosed insomnia, which limits the ability to unequivocally assess its effectiveness as a therapeutic method (Kahn, 2023; Kubiak, 2022).

Another important issue is the selection of appropriate treatments for insomnia based on the patient's age and any comorbid conditions. Modern therapeutic management relies primarily on nonpharmacological methods, including sleep hygiene, cognitive-behavioral therapy, relaxation techniques, and modifications to daily habits. In selected cases, pharmacological treatment is also considered, particularly the use of melatonin. However, its use requires a proper assessment of indications, medical supervision, and consideration of the limited data regarding the safety of long-term use in children and adolescents (Bruni et al., 2024; Himelfarb & Shatkin, 2024; Kteish et al., 2026; Schlieber & Han, 2021). Given the multifactorial nature of insomnia and its potential consequences for the normal development of young individuals, it is essential to seek effective and safe methods for preventing and treating this disorder. Of particular importance is determining the role of regular physical activity as a factor supporting healthy sleep and evaluating available therapeutic methods. The aim of this study is to present the characteristics of insomnia in children and adolescents, discuss the importance of sleep for their healthy development and functioning, and analyze the impact of physical activity on selected sleep parameters.This paper also provides an overview of current pharmacological and nonpharmacological treatments for insomnia, with particular emphasis on their efficacy, limitations, and applicability in the pediatric population. (Bruni et al., 2024; Dhir et al., 2024; Kteish et al., 2026; Kubiak, 2022; Mei et al., 2024)

2. Methodology

Searches of two online databases (PubMed and Medline) were conducted in November 2026. Databases were searched for inclusion of following terms: insomnia; sleep disturbances; children; adolescents; physical activity; exercise; cognitive behavioural therapy for insomnia; non-pharmacological treatment; pharmacotherapy; paediatric practice. Following filters were used:
1. Human studies; 2. Language: English or Polish; 3. Age: children (6-12) and adolescents (13 -18); 4. Publication year from 2015 to 2026. Unrelated studies and works without available full text were excluded. Initial screening and data extraction was conducted independently by two reviewers.

3. Results

3.1. Characteristics of Insomnia in Children and Adolescents

Insomnia is classified as a sleep disorder and represents a significant problem among children and adolescents (Himelfarb & Shatkin, 2024; Kahn, 2023; Kteish et al., 2026). In these age groups, it may have adverse consequences for mental and physical health, negatively affect quality of life, and influence development (Himelfarb & Shatkin, 2024; Kahn, 2023). Characteristic symptoms include difficulties falling asleep, maintaining sleep, or early morning awakening with difficulty returning to sleep. Insomnia may be short-term or chronic (Kubiak, 2022). The occurrence of sleep difficulties despite adequate conditions and opportunities for sleep, as well as their negative impact on daily functioning, is also important (Himelfarb & Shatkin, 2024; Kahn, 2023; Kteish et al., 2026) Clinical assessment should also consider the presence of accompanying factors affecting sleep, such as somatic illnesses, behavioural patterns, stress, or general life circumstances (Himelfarb & Shatkin, 2024; Kahn, 2023; Kubiak).

The epidemiology and clinical presentation of insomnia in the paediatric population vary according to age (Kahn, 2023; Lunsford-Avery et al., 2021). In younger children, sleep disturbances may result from inappropriate behavioural patterns, an inability to fall asleep without a caregiver, or nocturnal awakenings (Kahn, 2023; Lunsford-Avery et al 2021). In adolescents, changes associated with puberty, a physiological shift in circadian rhythm, and increased emotional tension during the day, stress, or pressure become more prominent (Kubiak, 2022; Lunsford-Avery et al., 2021). Adolescents tend to fall asleep later, which, combined with early school start times, may contribute to insufficient sleep duration (Kubiak, 2022; Lunsford-Avery et al., 2021).

The main differences in the clinical presentation of insomnia, associated factors, and its potential consequences in children and adolescents are presented in Table 1.

Table 1. Characteristics of Insomnia in Children and Adolescents According to Developmental Stage

Area	Preschool- and School-Aged Children	Adolescents
Clinical presentation	Difficulties falling asleep independently, nocturnal awakenings, difficulties returning to sleep	Difficulties initiating or maintaining sleep; possible co-occurrence of insufficient sleep duration
Developmental factors	Dependence on caregiver presence when falling asleep, established sleep-onset associations	Physiological delay in sleep phase and changes in circadian preferences
Psychological and environmental factors	Difficulties with emotional regulation, family stress, irregular evening routines	School-related and psychosocial stress, irregular sleep schedules
Coexisting conditions	Neurodevelopmental disorders, including ADHD and ASD; other sleep disorders	Anxiety and depressive symptoms; circadian rhythm disorders
Potential daytime consequences	Difficulties with concentration, behavioural regulation and emotional regulation	Daytime sleepiness or fatigue, difficulties with concentration and school functioning
Key aspects of assessment	Information provided by parents or caregivers, assessment of sleep-onset habits	Adolescent self-report, assessment of sleep–wake schedules

Note. Authors' own compilation based on Himelfarb and Shatkin (2024), Kahn (2023), Kteish et al. (2026), Kubiak (2022), and Lunsford-Avery et al. (2021). The table presents typical developmental trends rather than separate diagnostic criteria; the characteristics listed may occur in both age groups.

The prevalence of insomnia among children and adolescents varies according to age and sex, as well as the methodology used in individual studies (Combs et al., 2016; Falch-Madsen et al., 2020). Combs et al. (2016) cited findings from previous studies indicating that the prevalence of insomnia was approximately 20% among school-aged children, while among adolescents it ranged from 4% to 23.8% . In their seven-year cohort study involving 194 participants, intermittent insomnia was identified in 27% of participants, while persistent insomnia was observed in 4% . It is important to note that these figures reflect symptoms occurring during the study period rather than prevalence at a single point in time. The study findings varied depending on the definition of insomnia adopted. The authors compared an assessment based solely on nocturnal symptoms with a more restrictive definition, based on the ICSD-2 criteria, which also took into account adequate opportunity for sleep and daytime symptoms (Combs et al., 2016).

In a Norwegian cohort study conducted by Falch-Madsen et al., involving 1,037 participants aged 4 to 14 years of age, the prevalence of insomnia was approximately 2.5% at ages 4 and 6, and ranged from 7.5% to 12.3% between the ages of 8 and 14. Throughout the follow-up period, insomnia was identified at least once in 18.7% of participants, highlighting the significance of this problem in the paediatric population (Falch-Madsen et al., 2020). The researchers applied the diagnostic criteria for insomnia included in the DSM-IV and DSM-5 classifications (Falch-Madsen et al., 2020). It should be noted that, from the age of 8 years, data were also collected through interviews with the children themselves, rather than relying solely on parental reports, which may have contributed to differences in the findings (Falch-Madsen et al., 2020). When assessing insomnia in younger children, it may also be important to consider parental assistance with falling asleep or returning to sleep following nocturnal awakenings. In the study by Falch-Madsen et al., the use of sleep medication was also included as one of the elements in the assessment of difficulties falling asleep (Falch-Madsen et al., 2020).

The aetiology of insomnia in children and adolescents is multifactorial and involves interactions between biological, psychological, behavioural and environmental factors. Potential factors associated with its occurrence include difficulties with emotional regulation, stress, irregular sleep schedules, unfavourable evening habits and coexisting health problems (Himelfarb & Shatkin, 2024; Kahn, 2023; Kteish et al., 2026). Insomnia has also been observed among children and adolescents diagnosed with attention-deficit/hyperactivity disorder (ADHD), as well as among children with autism spectrum disorder (ASD) (Lunsford-Avery et al., 2021). The assessment of insomnia should also take into account the possibility of coexisting sleep disorders, particularly circadian rhythm disorders and sleep-related breathing disorders (Kahn, 2023; Kteish et al., 2026; Lunsford-Avery et al., 2021).

Chronic sleep difficulties may be associated with impaired cognitive, emotional, behavioural and social functioning. In children and adolescents, difficulties with attention and concentration, emotional regulation, school functioning and quality of life are particularly important. The relationships between sleep disturbances and mental health are complex and may be bidirectional; therefore, the observed associations do not always allow the direction of causality to be clearly established (Himelfarb & Shatkin, 2024; Kahn, 2023; Kteish et al., 2026).

3.2. The Importance of Sleep

Sleep is an important part of human life, and its quality and duration influence overall development. It is particularly important in the paediatric population, as sleep disturbances may negatively affect children's development and functioning (Schlieber & Han, 2021). In their review, Marisa Schlieber and Jisu Han describe the influence of sleep on various areas of development. Among other findings, they highlight an association between insufficient sleep and the development of overweight in children, which may have numerous health consequences (Schlieber & Han, 2021). Similarly, Michelle A. Miller et al. observed that shorter sleep duration was associated with an increased risk of developing overweight or obesity in infancy (seven studies, 14,738 participants, risk ratio [RR]: 1.40; 95% CI: 1.19–1.65; $p < .001$), early childhood (eight studies, 31,104 participants, RR: 1.57; 95% CI: 1.40–1.76; $p < .001$), middle childhood (three studies, 3,005 participants, RR: 2.23; 95% CI: 2.18–2.27; $p < .001$), and adolescence (three studies, 26,652 participants, RR: 1.30; 95% CI: 1.11–1.53; $p < .002$) (Miller et al., 2018).

Sleep also plays an important role in children's cognitive and behavioural functioning. Research has demonstrated associations between sleep, cognitive development and memory. In younger children, daytime naps have been shown to support memory consolidation. In school-aged children, adequate nocturnal sleep duration has been associated with better retention of certain types of information (Mason et al., 2021).

Yang et al. (2022) further highlighted the importance of sleep duration for cognitive development. In their study of children aged 9–10 years, shorter sleep duration was associated with poorer performance on cognitive tests. Some of these differences remained evident at the two-year follow-up (Yang et al., 2022).

Sleep is also important for the emotional and behavioural functioning of children and adolescents. Schlieber and Han (2021) indicate that sleep problems in younger children may be associated with difficulties in emotional regulation, increased irritability and behavioural problems. A systematic review and meta-analysis by Short et al. (2020), which included studies involving adolescents, demonstrated that shorter sleep duration was associated with a greater likelihood of adverse mood outcomes, including depressive symptoms, anxiety symptoms and anger . In contrast, Gilchrist et al. (2023) observed an association between shorter sleep duration and greater difficulties in emotional regulation among adolescents; however, they did not confirm an association between these variables in subsequent years of follow-up.

The recommended duration of sleep in children and adolescents varies according to age and developmental stage. In 2016, the American Academy of Sleep Medicine (AASM) published recommendations regarding appropriate sleep duration. Infants and younger children have greater sleep requirements, and the recommended number of hours of sleep decreases with age. It is worth noting that these recommendations refer to total sleep duration over a 24-hour period, including naps in younger age groups (Paruthi et al., 2016). Detailed recommendations are presented in Table 2.

Table 2. Recommended Sleep Duration in Children and Adolescents According to the American Academy of Sleep Medicine

Age group	Recommended sleep duration per 24 hours
Infants (4–12 months)	12–16 hours, including naps
Children (1–2 years)	11–14 hours, including naps
Preschool-aged children (3–5 years)	10–13 hours, including naps
School-aged children (6–12 years)	9–12 hours
Adolescents (13–18 years)	8–10 hours

Note. Recommendations refer to total sleep duration over a 24-hour period. The AASM did not specify a recommended sleep duration for infants younger than 4 months. Authors' own compilation based on Paruthi et al. (2016).

3.3. The Importance of Physical Activity

Physical activity is one of the key components of a healthy lifestyle and also plays a role in the development of children and adolescents. The World Health Organization (WHO) defines physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure. Among children and adolescents, physical activity may take various forms, including active play, active recreation and walking. It may also involve participation in physical education classes or organised sports groups. Regular physical activity has positive effects, including improvements in cardiorespiratory fitness, muscular fitness, bone health and cardiometabolic parameters. Beneficial effects on cognitive development and functioning, as well as mental health, have also been observed (Bull et al., 2020; Chaput et al., 2020).

The WHO has developed recommendations for physical activity that take into account activity requirements, duration and intensity across different age groups, beginning in infancy. Detailed recommendations are presented in Table 3 (Bull et al., 2020; World Health Organization, 2019).

Table 3. WHO Recommendations on Physical Activity for Children and Adolescents

Age group	Recommended physical activity
Infants (under 1 year)	Physical activity several times a day, particularly through interactive floor-based play. For infants who are not yet mobile: at least 30 minutes of tummy time while awake, spread throughout the day.
Children aged 1–2 years	At least 180 minutes of a variety of physical activities at any intensity throughout the day.
Children aged 3–4 years	At least 180 minutes of physical activity throughout the day, including at least 60 minutes of moderate- to vigorous-intensity activity.
Children and adolescents aged 5–17 years	An average of at least 60 minutes per day of moderate- to vigorous-intensity physical activity, mostly aerobic, across the week. Additionally, vigorous-intensity activities and activities that strengthen muscles and bones on at least 3 days per week.

Note. Authors' own compilation based on World Health Organization (2019, 2020).

Physical activity influences sleep patterns and sleep quality in the paediatric population. Available studies suggest that regular physical activity has beneficial effects on selected sleep parameters, although the findings remain heterogeneous. In a meta-analysis conducted by Song et al., which included 27 randomised controlled trials involving children and adolescents aged 6–18 years, improvements in sleep quality and sleep efficiency, as well as a reduction in wake after sleep onset (WASO), were observed following exercise interventions. Notably, the authors did not identify a statistically significant effect on total sleep time (Song et al., 2025).

In contrast, a meta-analysis by Ma et al., which included 14 randomised controlled trials, investigated the effects of exercise interventions on several sleep-related outcomes, including sleep quality, sleep duration, sleep onset latency, wakefulness and insomnia severity. The findings indicated a beneficial overall effect of aerobic exercise on sleep outcomes (standardised mean difference [SMD] = 0.91; 95% CI: 0.40–1.43). However, the authors noted that, owing to the high heterogeneity of the included studies ($I^2 = 91.5\%$) and the variability in the sleep parameters assessed, it was not possible to draw definitive conclusions regarding the effects of exercise on each individual sleep parameter (Ma et al., 2026).

3.4. Methods of Treating Insomnia (Pharmacological and Nonpharmacological)

3.4.1 Nonpharmacological:

The primary method of treating insomnia is non-pharmacological treatment, which includes:

3.4.1.1 Sleep hygiene

The goal is to establish proper guidelines that help regulate the sleep-wake cycle. These guidelines include:

Maintaining regular bedtimes and wake-up times. We must ensure that children get an adequate amount of sleep appropriate for their age. We must ensure that adolescents do not use phones, computers, or other electronic devices at least one hour before bedtime; additionally, we should limit exposure to bright light in the evening. The bedroom should be kept at a comfortable temperature and quiet. Energy drinks and caffeine

should be avoided, especially in the late afternoon. Adolescents should engage in regular physical activity during the day and avoid strenuous exercise right before bedtime. The number and duration of daytime naps should be limited in children who subsequently have trouble sleeping at night (Kteish et al., 2026; Williams Buckley et al., 2020; Youssef & Valji, 2026).

3.4.1.2 Cognitive-Behavioral Therapy (CBT-I)

Cognitive-behavioral therapy is one of the most important modern treatments for chronic sleep disorders in children and adolescents. It involves changing negative beliefs about sleep and helps reduce anxiety about being unable to fall asleep. It enables the development of healthy sleep habits, teaches relaxation techniques, and adjusts time spent in bed to current sleep needs. For younger children, the therapy also involves parents and caregivers. With adolescents, we place greater emphasis on their independent development of healthy habits (Kteish et al., 2026; Williams Buckley et al., 2020; Youssef & Valji, 2026).

3.4.1.3 Behavioral Therapy for Younger Children

This therapy aims to establish a consistent evening routine that will teach children to fall asleep on their own and will also positively reinforce appropriate behaviors and help parents respond appropriately to nighttime awakenings in children or adolescents (Youssef & Valji, 2026).

3.4.1.4 Relaxation Techniques

These techniques include breathing exercises, muscle relaxation training, age-appropriate meditation, gentle stretching exercises, as well as visualization and calming imagery. (Dhir et al., 2024; Kteish et al., 2026)

3.4.1.5 Limiting Exposure to Blue Light

Light emitted by phone or computer screens and other electronic devices can delay melatonin secretion and make it harder to fall asleep. It is recommended to limit their use, especially during the hour before bedtime (Youssef & Valji, 2026).

3.4.1.6 Light therapy and circadian rhythm regulation

For adolescents with delayed sleep phase syndrome, carefully planned exposure to morning daylight can be used. This helps shift the circadian rhythm to earlier hours. The method should be tailored to the individual's sleep problem (Youssef & Valji, 2026).

3.4.2 Pharmacological:

Pharmacological Treatment Methods

Pharmacotherapy in children and adolescents requires great caution. It is not a routine treatment for insomnia and should be considered only after evaluating the causes of the sleep disorder and following ineffective behavioral therapy (Bruni et al., 2024; Dhir et al., 2024; Kteish et al., 2026).

3.4.2.1 Melatonin

Melatonin is a hormone produced by the pineal gland that regulates the body's circadian rhythm. It is one of the most commonly prescribed medications for treating certain sleep disorders in children and adolescents. It is used in individuals who have difficulty falling asleep, in teenagers with delayed sleep phase syndrome, and in children with ADHD and autism who experience sleep disturbances. However, it is important to remember that it may also cause side effects such as daytime drowsiness, headaches, dizziness, nausea, and vivid dreams. Melatonin should be used only after consulting a doctor, at an appropriately selected dose and at the right time. It is not a universal sleep aid. Melatonin supplementation can be started at a minimum dose of 0.5 mg, administered 30–60 minutes before the planned bedtime; if it proves ineffective, the doctor may increase the dose (Bruni et al., 2024). Parents should be informed about the potential side effects associated with melatonin use and the lack of data regarding its long-term safety (Abdelgadir et al., 2018; Bruni et al., 2024; Kteish et al., 2026).

3.4.2.2 Antihistamines

An example of a medication from this group that we use is hydroxyzine, which has a sedative effect and may cause drowsiness. However, it is not recommended for the routine treatment of insomnia, as it can cause side effects such as drowsiness the following day, impaired concentration, and paradoxical reactions—such as agitation in children—and it also has adverse effects on the nervous and cardiovascular systems (Dhir et al., 2024; Kteish et al., 2026)

3.4.2.3 Antidepressants

In exceptional cases, a doctor may consider prescribing antidepressants with sedative effects, such as mirtazapine or trazodone. These medications are primarily used in patients whose insomnia is accompanied by specific mental disorders. They are not the standard treatment for insomnia in children and adolescents (Dhir et al., 2024; Kteish et al., 2026).

3.4.2.4 Sleep medications from the benzodiazepine and Z-drug classes

Examples of such medications include benzodiazepines, zolpidem, and zopiclone. They can induce drowsiness and make it easier to fall asleep; however, their use in children and adolescents is very limited due to the risk of dependence, tolerance, memory impairment, and other adverse effects. It is important to note that they should not be used routinely to treat insomnia in minors (Kteish et al., 2026).

3.4.2.5 Treatment of Comorbid Conditions

An important part of treatment is addressing conditions that can cause sleep disturbances, including ADHD, allergies and asthma, depression and anxiety disorders, restless legs syndrome, and obstructive sleep apnea. In such cases, we treat the underlying cause of insomnia (Kteish et al., 2026; Williams Buckley et al., 2020).

4. Discussion

This literature review indicates that insomnia is a common problem in the paediatric population and that insufficient sleep is associated with adverse consequences for somatic health, cognitive development and emotional functioning in children and adolescents.

Estimates of the prevalence of insomnia in children and adolescents vary considerably. These discrepancies stem largely from methodological differences. Combs et al. showed that the prevalence of insomnia depended on the definition used: it was higher when only nocturnal symptoms were considered and lower when the ICSD-2 criteria, which also require daytime symptoms and adequate opportunity for sleep, were applied (Combs et al., 2016). In the study by Falch-Madsen et al., based on DSM criteria, prevalence increased with age. However, from the age of 8 years, interviews with the children themselves were also included, not only parental reports, which may have contributed to the higher values in older age groups (Falch-Madsen et al., 2020). This may indicate that parents do not recognise some of their children's sleep difficulties. In clinical practice, the diagnosis of insomnia should therefore be based on complete diagnostic criteria and, where the child's age allows, include the child's own report. Epidemiological studies using uniform definitions and comparable methodology are needed.

Short sleep emerged as a risk factor for, or a marker of, the development of overweight and obesity in the paediatric population. In the meta-analysis of prospective studies by Miller et al. (2018), this association was found in all age groups analysed, from infants to adolescents. The review by Schlieber and Han cites the same data (Schlieber & Han, 2021). The strength of these conclusions is limited by four factors. First, when age groups were pooled, heterogeneity was very high and publication bias was detected, although the association remained significant after correction. Second, the strongest association, in middle childhood, was based on only three studies, and in older children and adolescents no significant association with change in BMI z-score was found (Miller et al., 2018). Third, sleep was assessed almost exclusively by questionnaires, and the studies differed in their definitions of short sleep and obesity and in the range of confounders considered. Fourth, only observational studies were analysed, which do not allow a causal relationship to be established. Despite these limitations, sleep duration can be regarded as a modifiable risk factor, and sleep assessment and parental education on recommended sleep duration should be part of obesity prevention in children. Intervention studies are needed to test whether extending sleep reduces the risk of obesity, as are studies with objective sleep measurement.

Sleep duration is also associated with cognitive development. In a large longitudinal study, Yang et al. showed that children aged 9–10 years who slept less than 9 hours achieved poorer results on cognitive tests, particularly in crystallised intelligence, and differed from their peers in brain structure and function. These differences persisted after two years of follow-up (Yang et al., 2022). These findings are consistent with the review by Mason et al. (2021), which highlights the importance of sleep for cognitive development and memory. However, earlier studies on sleep and intelligence yielded inconsistent results, and the study discussed has important limitations. Sleep duration was reported by parents in response to a single question, the children were divided into only two groups, and only some of the participants underwent neuroimaging

after two years (Yang et al., 2022). Nevertheless, these studies support the recommendation of at least 9 hours of sleep at this age (Paruthi et al., 2016), and sleep duration is worth assessing in children with learning difficulties. Intervention studies with objective sleep measurement are needed, also taking into account sleep regularity and circadian rhythm.

Shorter sleep also co-occurs with poorer mood and difficulties in emotion regulation. In the meta-analysis by Short et al., which included healthy adolescents, shorter sleep was associated with a higher likelihood of mood deficits, including depressive and anxiety symptoms and anger. The association was strongest in experimental studies, in which sleep was restricted and mood was assessed immediately afterwards (Short et al., 2020). Yang et al. observed differences in depressive symptoms between children sleeping less and more than 9 hours that persisted for two years (Yang et al., 2022), and in younger children insufficient sleep is associated with irritability and difficulties in controlling emotions (Schlieber & Han, 2021). These results support an effect of sleep on mood in the short term, whereas the long-term relationship is less certain. In a large longitudinal study by Gilchrist et al., shorter sleep co-occurred with difficulties in emotion regulation at the same time point but did not predict them in the following year, nor vice versa (Gilchrist et al., 2023), and long-term studies in young children have yielded inconsistent results (Schlieber & Han, 2021). These discrepancies may have several causes. The studies addressed different phenomena – mood, emotions and emotion regulation – which, according to Short et al., are often conflated in the literature (Short et al., 2020). Sleep was assessed mainly by questionnaires. In young children, an additional difficulty is that irritability and problems with emotional control may also be symptoms of ADHD (Schlieber & Han, 2021). In clinical practice, this justifies assessing sleep in children with depressive or anxiety symptoms or irritability, and assessing mood in children who sleep too little. Regular sleep times, including at weekends, limiting the use of electronic devices before bedtime and, at the system level, later school start times and reduced academic pressure may be helpful (Short et al., 2020). Studies with daily, objective sleep measurement are needed, as are intervention studies testing whether extending sleep improves mood.

Two meta-analyses of randomised controlled trials indicate that physical activity interventions improve sleep quality in children and adolescents. Song et al. showed improvements in sleep quality and sleep efficiency and a reduction in wake after sleep onset, with no effect on total sleep time (Song et al., 2025). Ma et al. included one sleep outcome from each study and pooled them into a single composite estimate, which indicated a beneficial effect of aerobic exercise (Ma et al., 2026). The agreement between the two studies should, however, be interpreted with caution, as they are partly based on the same trials. Exercise thus improved mainly the quality and continuity of sleep rather than its duration. In the study by Song et al., sleep duration assessed mainly by questionnaires improved, whereas total sleep time, most often measured objectively, did not change(Song et al., 2025). The strength of the evidence is limited by very high heterogeneity, possible publication bias in both studies and low or very low certainty of evidence. The studies also differed in their populations (healthy children and children with obesity, autism, ADHD and chronic diseases) and in the type, frequency and duration of exercise (Ma et al., 2026; Song et al., 2025). Most importantly, neither meta-analysis included children with diagnosed insomnia (Ma et al., 2026; Song et al., 2025). The results therefore concern the improvement of sleep in the general population and in children with comorbidities, not the treatment of insomnia. Physical activity can thus be regarded as a safe component of sleep hygiene and an adjunct to non-pharmacological methods, particularly in younger children and in children with autism and ADHD, in whom the effects were most favourable (Song et al., 2025). However, the current evidence does not justify its use as a stand-alone treatment for insomnia (Ma et al., 2026). Studies involving children with diagnosed insomnia, with objective sleep measurement and assessment of exercise timing, are needed, as are studies examining whether physical activity can enhance the effect of CBT-I.

When interpreting these findings, it should be borne in mind that most of the studies discussed concerned sleep duration in the general population rather than children with diagnosed insomnia (Gilchrist et al., 2023; Ma et al., 2026; Miller et al., 2018; Short et al., 2020; Song et al., 2025; Yang et al., 2022) . Short sleep and insomnia are not equivalent: a child may sleep too little because of late bedtimes or early school start times without meeting the criteria for insomnia, and insomnia does not necessarily shorten total sleep time. Conclusions regarding the consequences of short sleep and the benefits of physical activity can therefore be applied to children with insomnia only indirectly. Studies conducted in this specific group are needed.

Cognitive behavioural therapy for insomnia (CBT-I), which includes, among other components, sleep hygiene education, stimulus control, sleep restriction and relaxation techniques, is considered the first-line treatment for insomnia in adolescents (Kteish et al., 2026; Youssef et al., 2026). Its effectiveness is supported by the meta-analysis by Mei et al., which included 8 randomised controlled trials with 599 participants. CBT-

I reduced insomnia severity and improved sleep onset latency, total sleep time and sleep efficiency, and the improvement in insomnia severity was maintained at follow-up (Mei et al., 2024). However, comparison of the results of individual studies is hampered by the use of different insomnia rating scales and by the varying components of the interventions described as CBT-I (Mei et al., 2024). Compared with pharmacotherapy, CBT-I is characterised by low risk (Mei et al., 2024), and in adults it has proved more effective than pharmacological treatment (Youssef & Valji, 2026). In practice, its use is limited by the low availability of therapists working with children and adolescents and by the small number of validated digital programmes for adolescents (Youssef & Valji, 2026). Studies of CBT-I in younger children, studies directly comparing it with pharmacological treatment in the paediatric population, and studies of forms of therapy available in practice, including digital ones, are needed.

Melatonin is the best-studied drug used for insomnia in children, but its place in the treatment of children without comorbidities remains controversial. The strongest evidence concerns children with neurodevelopmental disorders: in the meta-analysis by Abdelgadir et al., melatonin increased total sleep time by a mean of 48 minutes and shortened sleep onset latency (Abdelgadir et al., 2018), and the American Academy of Neurology guideline recommends its use in children with autism after behavioural strategies have been unsuccessful (Williams Buckley et al., 2020). Assessments of the place of melatonin in treatment differ between sources. A European expert consensus regards it as the next step after sleep hygiene and behavioural interventions (Bruni et al., 2024), whereas other authors recommend treating it only as an adjunct because of its modest effects in otherwise healthy adolescents (Youssef & Valji, 2026). It should be noted that the European consensus was developed with financial support from a manufacturer of dietary supplements and that its authors received honoraria from this company (Bruni et al., 2024). The translation of research findings into practice is further hampered by the regulatory status of melatonin, which in many European countries is available as a dietary supplement, and the content of the active substance in such products may differ from the labelled amount . Melatonin may therefore be considered after unsuccessful non-pharmacological treatment, as a pharmaceutical-grade preparation, at a low dose, under medical supervision and for a limited period (Williams Buckley et al., 2020, Bruni et al., 2024), with parents informed about the lack of long-term safety data (Williams Buckley et al., 2020). Long-term safety studies in children without comorbidities are needed, as are studies comparing melatonin with CBT-I and evaluating their combination.

The efficacy and safety of other drugs used for paediatric insomnia have not been confirmed. No hypnotic drug is approved by the FDA for use in children, and in the European Union only prolonged-release melatonin has been authorised, for children with autism spectrum disorder and Smith–Magenis syndrome (Dhir et al., 2024); other drugs are therefore used off-label. Evidence on antihistamines is limited to a few small studies with inconclusive results, and their use carries a risk of next-day sedation and paradoxical agitation (Dhir et al., 2024). Sedating antidepressants should be considered only when there is an indication for them other than insomnia (Dhir et al., 2024). In one study, adolescents taking trazodone in combination with a selective serotonin reuptake inhibitor (SSRI) more often reported thoughts of self-harm (Dhir et al., 2024). Benzodiazepines and Z-drugs additionally carry a risk of tolerance and dependence, which outweighs their limited benefits (Dhir et al., 2024). The decision to use these drugs should therefore be individualised, preceded by an assessment of benefits and risks, and accompanied by informing parents about off-label use. Randomised controlled trials of the drugs actually used in practice are needed, particularly in children without comorbidities.

4.2 Limitations of the available literature

A substantial proportion of the sources (9 out of 26) were narrative reviews, and the meta-analyses on the consequences of short sleep were based mainly on observational studies. In most studies, sleep was assessed using questionnaires completed by children or their parents, which increases the risk of bias due to subjective assessment. Objective methods, such as actigraphy and polysomnography, were rarely used. The studies differed in their definitions of insomnia, short sleep and obesity and in how mood and emotions were assessed, which hampers comparison of their results. In both primary studies and meta-analyses, data from children and adolescents were often pooled using different age cut-offs, which may have masked age-related differences. The meta-analyses were also characterised by high heterogeneity, and possible publication bias was found in some of them. The certainty of evidence regarding the effect of physical activity on sleep was rated as low or very low, and both meta-analyses were partly based on the same trials. The most important limitation, however, is that most studies concerned children from the general population rather than children with diagnosed insomnia. Knowledge on treatment is also based largely on narrative reviews, guidelines and

expert opinion, and evidence on pharmacotherapy comes mainly from studies in children with neurodevelopmental disorders. In addition, a conflict of interest among the authors of one of the consensus statements was identified.

4.3 Limitations of this review

This is a narrative review. Sources were searched in PubMed among publications in English and Polish from 2015–2026. The selection of studies was not systematic and may be subject to selection bias. The restrictions on language and publication years may have led to the omission of some relevant publications, and some of the conclusions are based on secondary sources.

4.4 Future research directions

Above all, studies are needed in children and adolescents with diagnosed insomnia, with separate analysis of children with comorbidities such as ADHD and autism. Future studies should use uniform diagnostic criteria for insomnia, objective methods of sleep measurement and separate analysis of individual sleep parameters, and should clearly distinguish between mood, emotions and emotion regulation. Experimental and intervention studies, including school-based programmes, would be of greater value than further observational studies. Data on the relationship between sleep and obesity come from a meta-analysis covering studies up to 2017 and require updating . With regard to physical activity, the optimal type, frequency and timing of exercise should be determined, its effectiveness compared with CBT-I, and its potential to enhance the effects of CBT-I assessed. In terms of treatment, studies of CBT-I in younger children, long-term safety studies of melatonin in children without comorbidities, and studies comparing non-pharmacological and pharmacological methods in the paediatric population are needed.

5. Conclusions

Cognitive behavioural therapy is the first-line treatment for insomnia in adolescents, whereas its effectiveness in younger children requires confirmation in further studies.

The diagnosis of insomnia in children should be based on uniform criteria and take into account the child's own report and the presence of comorbidities.

Regular physical activity improves sleep quality and continuity in children and adolescents and may be a component of sleep hygiene; however, the lack of studies in children with diagnosed insomnia does not allow it to be regarded as a stand-alone treatment.

Sleep deficiency may contribute to the risk of overweight and obesity, impair the development of cognitive functions and affect the regulation of mood and emotions.

Melatonin may be used as an adjunctive treatment in children with ADHD and autism with insomnia in whom non-pharmacological methods have been ineffective. There is no clear evidence for children without these disorders, and other pharmacological treatments have not been supported by evidence.

The greatest gap in current knowledge is the limited number of studies in children with diagnosed insomnia, which indicates the need for research in this group.

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