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Sleep Disorders and Obesity in Children and Adolescents: Interactions with Physical Activity and Diet

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ABSTRACT

Background: Childhood obesity is common and associated with a wide range of health risks. Growing evidence suggests that insufficient or poor-quality sleep in young people is linked to a higher likelihood of excess weight, in part through increased energy intake and lower levels of physical activity.

Aim of study and materials: Aim of this article is to overview studies published on PubMed in the last 5 years (2020–2025).

We analyze the interactions between sleep disorders and obesity in children and adolescents, with particular emphasis on the role of physical activity and diet as key factors influencing the proper development of young people.

Results: Evidence consistently shows that short and poor-quality sleep are associated with higher adiposity, adverse metabolic profiles and unhealthier eating patterns. Behavioural clusters combining insufficient sleep, low physical activity and poor diet confer the greatest obesity risk, while multidimensional lifestyle interventions can modestly improve both sleep and weight outcomes.

Conclusions: Childhood obesity and sleep disturbances are closely interrelated and should be addressed together. Sleep ought to be recognised as a third pillar of lifestyle management, alongside physical activity and diet, in prevention and treatment strategies. Integrated, family- and school-based programmes that combine sleep hygiene, promotion of daily movement and improvement of diet quality. appear most promising.

Keywords: sleep disorders, childhood obesity, physical activity, diet, circadian rhythm, metabolic health

Introduction

Childhood obesity is one of the most serious public health challenges today, and its prevalence continues to rise. Current estimates indicate that hundreds of millions of children and adolescents worldwide are overweight or obese (McHill i in., 2022). Excess body weight in young people is associated with numerous adverse health consequences, including metabolic dysfunction, hypertension, impaired glycaemic regulation, orthopaedic complications and reduced psychological well-being (Jones i in., 2021; Spiga, Davies, i in., 2024). Moreover, obesity that develops in childhood often tracks into adulthood and is associated with an increased risk of chronic diseases later in life (Spiga, Tomlinson, i in., 2024). Identifying modifiable factors that contribute to early, excessive weight gain therefore remains crucial for effective prevention strategies.

Sleep disorders in children and adolescents represent another growing health problem. Many young people do not meet age-appropriate sleep recommendations, and sleep quality is impaired by irregular lifestyles, excessive exposure to screens and blue light, stress and various behavioural or environmental factors (Jiang i in., 2025). Common sleep problems in this age group include insufficient sleep, poor sleep quality, insomnia and obstructive sleep apnoea. These disturbances negatively affect cognitive performance, emotion regulation and daytime functioning (Dutil i in., 2022; Gale i in., 2025).

Growing evidence suggests that insufficient sleep quantity and quality contribute to the development of overweight and obesity. Short sleep duration is associated with appetite dysregulation, increased energy intake, higher consumption of energy-dense foods and reduced physical activity due to fatigue (Cui i in., 2025; Marlow i in., 2024). Epidemiological studies consistently show that children who sleep less are at higher risk of obesity, have poorer diet quality and are more likely to engage in sedentary behaviours (Porri i in., 2024). Conversely, obesity itself can impair sleep by promoting sleep-disordered breathing and reducing overall sleep quality, creating a self-perpetuating cycle of poor sleep and weight gain (Krietsch i in., 2022).

Lifestyle behaviours—particularly physical activity and dietary patterns—appear to play an important role in the relationship between sleep and obesity. Low levels of physical activity and prolonged sedentary time are strongly associated with childhood obesity, whereas regular activity improves metabolic health and may have a beneficial effect on sleep quality (Torres-Lopez i in., 2024). Similarly, irregular mealtimes, high consumption of processed foods and poor overall diet quality are associated with both insufficient sleep and excessive weight gain in children (Saidi i in., 2021).

Despite extensive research in each of these areas, the interplay between sleep, obesity, physical activity and diet in the paediatric population remains complex and not fully understood. A comprehensive analysis of the available evidence is needed to clarify the mechanisms linking these factors and to support a more integrated approach to obesity prevention.

The aim of this review is to examine current evidence on the association between sleep disturbances and obesity in children and adolescents, and to explore the potential role of physical activity and diet. Understanding these interactions may support the development of more comprehensive and effective strategies for promoting healthy growth, preventing obesity and improving sleep health in the paediatric population.

Sleep Disorders in Children and Adolescents

Sleep disorders in children and adolescents encompass conditions that disrupt sleep duration, quality, or timing to an extent that adversely affects daily functioning and healthy development. Sleep deprivation, insomnia symptoms, and sleep-disordered breathing are currently regarded as major public health problems in this age group (Dutil i in., 2022; Gale i in., 2025; Porri i in., 2024).

Sleep deprivation is one of the most prevalent health problems in adolescence. Developmental changes in circadian regulation, combined with early school start times, increasing academic demands, and evening exposure to electronic media, prevent many adolescents from obtaining the recommended 8–10 hours of sleep per night. Even among younger school-age children, busy daily schedules, numerous extracurricular activities, and irregular bedtimes can lead to chronic sleep restriction (Gale i in., 2024; Porri i in., 2024).

Insomnia in paediatric populations is typically characterised by persistent difficulties initiating or maintaining sleep, or by non-restorative sleep, accompanied by daytime consequences such as fatigue, irritability, and impaired concentration. These problems become more frequent during adolescence, in parallel with increasing psychosocial stress and evening activities that delay bedtime (Dutil i in., 2022; Porri i in., 2024). Longitudinal studies suggest that poor subjective sleep quality and insomnia symptoms are associated with higher body mass index and greater adiposity over time (Grimaldi i in., 2023; Morrison i in., 2023).

Sleep-disordered breathing (SDB), which includes both primary snoring and obstructive sleep apnoea, represents another important category of paediatric sleep disorders. It is characterised by abnormal breathing during sleep, typically resulting from upper airway obstruction, and leads to intermittent hypoxia and sleep fragmentation. Although SDB is less prevalent in the general paediatric population than sleep deprivation or insomnia, it occurs

substantially more often in children and adolescents with overweight or obesity (Porri i in., 2024; Gale i in., 2025). Untreated SDB has been linked to cognitive deficits, behavioural problems, and adverse cardiometabolic outcomes, whereas weight management and targeted treatment can improve sleep parameters and overall health in affected children (Torres-Lopez i in., 2024; Catalán-Lambán i in., 2023).

Across these sleep disorders, the health consequences are wide-ranging and clinically significant. Insufficient or disrupted sleep impairs attention, memory, and executive functions, and is associated with poorer academic performance and learning difficulties (Dutil i in., 2022; Porri i in., 2024; Olsen i in., 2022). Children and adolescents with chronic sleep problems are more likely to exhibit irritability, impulsivity, mood swings, and symptoms resembling attention-deficit/hyperactivity disorder, and short or poor-quality sleep has been associated with heightened psychological distress, emotional problems, and an increased risk of depression (Porri i in., 2024; Olsen i in., 2022).

In addition, experimental and observational studies indicate that shorter or fragmented sleep can disrupt appetite regulation, increase preferences for energy-dense foods, and is associated with lower levels of physical activity and greater sedentary time. These changes constitute plausible behavioural mechanisms through which sleep disturbances contribute to weight gain and the development of obesity (McHill i in., 2022; Krietsch i in., 2022; Saidi i in., 2021; Dumuid i in., 2025).

Relationship Between Sleep and Obesity

Clinical evidence consistently shows that sleep is closely related to body weight in children and adolescents. Cross-sectional studies indicate that shorter sleep duration, later bedtimes, and irregular sleep patterns are associated with higher BMI and a greater likelihood of overweight or obesity in this age group. A large meta-analysis reported that children with late bedtimes had approximately 1.27-fold higher odds of obesity (Fillon i in., 2021). In a systematic review of sleep duration and health indicators, Dutil et al. reported that later sleep onset and reduced sleep duration were repeatedly linked with increased adiposity and less favourable cardiometabolic profiles in children and adolescents (Dumuid i in., 2025; Grimaldi i in., 2023). Gale et al. found that multiple dimensions of sleep—including duration, quality, and night-to-night variability—were associated with obesity risk in adolescents, suggesting that not only sleep duration, but also sleep quality and night-to-night consistency are important (Gale i in., 2024). Moreover, studies analysing 24-hour movement behaviours and diet clusters have shown that children characterised by short sleep in combination with low levels of

physical activity and unhealthy dietary patterns are more likely to present adverse obesity markers than those with healthier sleep, activity, and diet profiles (de Mello i in., 2024; Moschonis i in., 2025).

Hormonal mechanisms also help to link inadequate sleep with obesity and poor sleep quality. Studies in adults have shown that chronic circadian disruption and sleep restriction increase subjective hunger and preference for high-calorie foods, in line with changes in appetite-regulating hormones such as leptin and ghrelin (McHill i in., 2022). In a randomised crossover study in school-aged children, Morrison et al. demonstrated that even modest reductions in sleep led to higher energy intake and altered eating behaviours, supporting an association between insufficient sleep and increased caloric consumption (Morrison i in., 2023; Grimaldi i in., 2023). Taken together, these findings suggest that hormonal and neurobehavioural changes accompanying inadequate sleep may promote overeating and subsequent weight gain in children and adolescents.

Metabolic consequences of inadequate sleep may further contribute to the risk of obesity. Sleep restriction and circadian misalignment can impair insulin sensitivity and glucose regulation, creating a metabolic environment that favours fat storage. Grimaldi et al. highlighted that the interplay between sleep, anthropometric indices, and nutrition is dynamic and bidirectional: poor sleep is associated with worsening weight status and unhealthy dietary patterns, which in turn may exacerbate metabolic disturbances (McHill i in., 2022; Grimaldi i in., 2023). In addition, short or fragmented sleep may reduce spontaneous physical activity and increase sedentary time. Thus, changes in both energy intake and energy expenditure appear to mediate the relationship between sleep and obesity (Krietsch i in., 2022; (de Mello i in., 2024; Dumuid i in., 2025).

A systematic review by Porri et al. concluded that improving sleep may contribute to both the prevention and treatment of childhood obesity, although the magnitude of the observed effects varies across studiem (Porri i in., 2024). In a meta-analysis of sleep-focused lifestyle interventions in children with overweight or obesity, Liu et al. reported that programmes targeting sleep-related behaviours produced small but statistically significant improvements in BMI and body composition, together with better sleep outcomes (Liu i in., 2024). Lifestyle trials have also shown that enhancing physical activity and diet can improve sleep in young people with obesity: Torres-Lopez et al. found that a structured exercise programme led to favourable changes in objective sleep parameters in children with overweight or obesity (Torres-Lopez i in., 2024). Saidi et al. demonstrated that a balanced eucaloric diet improved actigraphy-derived sleep in adolescents with obesity (Saidi i in., 2021). Multidisciplinary

interventions, such as those evaluated by Catalán-Lambán et al., have similarly reported beneficial changes in sleep following weight-management programmes. Taken together, these findings suggest that sleep and obesity influence each other through overlapping behavioural and metabolic pathways (Catalán-Lambán i in., 2023).

Bidirectional associations between sleep and obesity are increasingly recognised. On the one hand, short and poor-quality sleep clearly predict a higher risk of obesity through hormonal, metabolic, and behavioural pathways. On the other hand, excess adiposity, particularly central and upper-body fat, increases the likelihood of sleep-disordered breathing and other sleep disturbances, which can further impair metabolic health and daytime functioning (Torres-Lopez i in., 2024; Catalán-Lambán i in., 2023). Although more longitudinal and mechanistic research in paediatric populations is needed, the current evidence suggests that sleep should be viewed both as a potential cause and as a consequence of obesity, and as a key target within comprehensive strategies for obesity prevention and treatment in children and adolescents (Fillon i in., 2021; Moschonis i in., 2025; Miller i in., 2021).

As illustrated in Figure 1, sleep disturbances and obesity share common behavioural and physiological determinants.

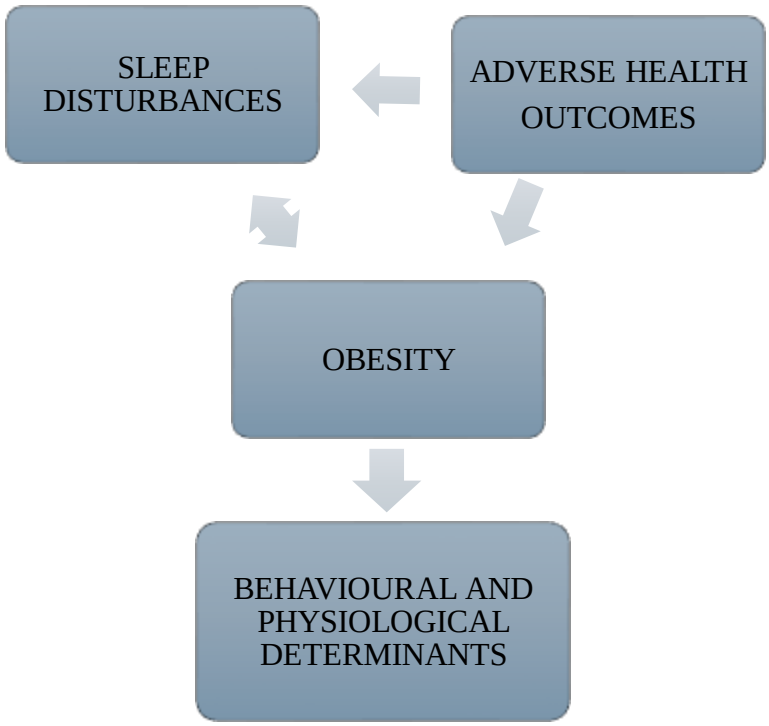

Figure 1. Conceptual model of mechanisms linking sleep disturbances, obesity, diet and physical activity in children and adolescents.

Role of Physical Activity

Physical activity is a key determinant of both sleep quality and weight status in paediatric populations. Regular exercise promotes physiological changes conducive to sleep, such as increased energy expenditure, modulation of circadian rhythms and reductions in stress and anxiety, which facilitate sleep onset and continuity. In a 20-week exercise intervention in children with overweight or obesity, Torres-Lopez et al. observed a significant reduction in wake after sleep onset, indicating improved objective sleep continuity (Torres-Lopez i in., 2024). Spending more than two hours per day on recreational screen media has been linked to disturbed sleep patterns and a higher risk of obesity in children (Jones i in., 2021)

Meeting recommended activity levels helps to prevent excessive weight gain by increasing energy expenditure, preserving lean mass and improving metabolic health, including insulin sensitivity, whereas chronically low activity levels are associated with higher adiposity and a greater likelihood of overweight or obesity (de Mello i in., 2024). School and community-based programmes that promote physical activity, often in combination with dietary education, have demonstrated modest but meaningful reductions in childhood obesity, supporting the contribution of physical activity to weight management in youth (Spiga, Davies, i in., 2024; Spiga, Tomlinson, i in., 2024).

The beneficial effects of physical activity on sleep and adiposity are interrelated. Improved sleep can enhance daytime energy and motivation for movement, while regular exercise can stabilise the sleep–wake cycle and encourage more regular bedtimes. Cluster and compositional analyses of 24-hour behaviours indicate that children who combine short sleep with low physical activity and unhealthy diet are most likely to present adverse obesity markers (de Mello i in., 2024; Dumuid i in., 2025; Moschonis i in., 2025). Recent work also highlights shared behavioural determinants, such as physical inactivity and high screen exposure, as common drivers of both poor sleep and excess weight in adolescents (Gale i in., 2024). Enforcing earlier bedtimes in adolescents, thereby increasing sleep opportunity by approximately 1.5 hours, markedly reduced daily sedentary time (by about 1.7 hours) without affecting moderate-to-vigorous physical activity (Krietsch i in., 2022; Dumuid i in., 2025; Moschonis i in., 2025).

Role of Diet

Diet quality and eating habits are closely linked to both paediatric obesity and sleep disturbances. Children with obesity often consume energy-dense, nutrient-poor foods such as sugar-sweetened beverages and sweet snacks and frequently skip breakfast, patterns that

promote excess energy intake and commonly coexist with insufficient or poor-quality sleep (Dutil i in., 2022). Consistently, Zhong et al. reported that adolescents consuming more fruits and vegetables have better sleep quality, whereas diets rich in fat, sugar, caffeine and alcohol are associated with poorer sleep (caffeine odds ratio ≈ 1.67 for sleep problems) (Zhong i in., 2024). A large meta-analysis identified high sugary drink consumption as a major behavioural determinant of childhood obesity, with an estimated population-attributable risk of about 16%, followed by insufficient sleep at roughly 15% (Gale i in., 2025). Experimental sleep restriction in school-aged children has been shown to increase daily energy intake, especially from ultraprocessed, non-core foods, and to raise emotional overeating when tired. This pattern suggests a fatigue-driven preference for sugary, high-fat foods, potentially creating a vicious cycle in which poor sleep promotes unhealthier eating, further weight gain and worsening of sleep quality (Zhong i in., 2024; Porri i in., 2024).

Prevention strategies and treatments for obesity and sleep disorders

Prevention and treatment of obesity and sleep disorders in children and adolescents require an integrated approach that simultaneously addresses sleep, physical activity and diet. Systematic reviews indicate that programmes combining dietary counselling with increased physical activity achieve meaningful reductions in BMI z-scores, particularly during the first year after implementation (Spiga, Davies, i in., 2024; Spiga, Tomlinson, i in., 2024)). Notably, one meta-analysis in preschool children found that improving sleep led to smaller increases in BMI compared with control groups, suggesting that sleep-focused strategies can curb weight gain (Hu i in., 2024). More recent data suggest that sleep should be regarded as a third pillar of lifestyle management, alongside diet and physical exercise, in strategies aimed at reducing obesity risk in young people (Dutil i in., 2022; Gale i in., 2025; Fillon i in., 2021). Regular moderate-to-vigorous physical activity is another key component of prevention: higher activity levels and shorter sedentary time are consistently associated with a lower risk of obesity (de Mello i in., 2024; Dumuid i in., 2025; Moschonis i in., 2025). Cochrane reviews show that school-based interventions, typically combining nutrition education, increased opportunities for physical activity and environmental modifications, can slow excessive weight gain over the short and medium term (Spiga, Davies, i in., 2024; Spiga, Tomlinson, i in., 2024). A recent randomised controlled trial found that a 10-hour time-restricted eating regimen combined with resistance training produced approximately 2 kg weight loss and substantial fat loss in young adults, while also improving sleep quality (Cui i in., 2025). Family-focused studies, such as Healthy Start and Baby-Act, which provide parents from early childhood with guidance on

diet, physical activity and sleep habits, demonstrate favourable changes in energy balance–related behaviours and underscore the importance of parental involvement. Digital tools, including teleconsultations, parental coaching via telehealth and mobile app–supported lifestyle programmes, are increasingly used to support these interventions, although their long-term effectiveness is still being evaluated (Olsen i in., 2022; Campos i in., 2020).

7. Conclusions

Childhood obesity and sleep disorders frequently co-occur and share a common network of behavioural and physiological determinants. The evidence summarised in this review indicates that short sleep duration and poor sleep quality are consistently associated with higher adiposity in children and adolescents. Behavioural profiles characterised by insufficient sleep, low levels of physical activity and unhealthy dietary patterns appear to confer the greatest risk of obesity. Observational findings are supported by studies showing that regular physical exercise and a balanced diet can lead to improvements in sleep parameters and BMI.

Most available studies are observational, rely on self-reported behaviours and are characterised by relatively short follow-up periods. Heterogeneity in the definitions of sleep, obesity and lifestyle-related behaviours further complicates direct comparison between studies. In practical terms, the findings highlight the need to systematically incorporate sleep hygiene, the promotion of daily physical activity and the improvement of diet quality and eating patterns into integrated obesity prevention and treatment programmes implemented in schools and primary care, and supported by mass media and online platforms.

Disclosure

The authors declare no conflict of interest.

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