



Research article

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Beyond Diet and Exercise: Why Sleep is the Missing Piece in Childhood Obesity Intervention

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Abstract

Childhood obesity is a pressing global health concern, yet existing interventions often neglect a crucial factor: sleep. Insufficient and poor-quality sleep contribute to obesity by disrupting hormonal regulation, increasing appetite, and promoting unhealthy behaviours such as excessive screen time, irregular eating patterns, and physical inactivity. Research highlights that these behaviours act as shared determinants of both poor sleep and obesity. Despite this, sleep remains an underutilised component in obesity prevention strategies. This paper argues for integrating sleep into multi-component obesity interventions, focusing on modifying evening routines, regulating screen time, promoting chrononutrition, and addressing socioeconomic and psychological barriers. Future research should explore the long-term impact of sleep-focused interventions, while public health policies must prioritise sleep education in schools and community settings. A holistic approach, targeting sleep, diet, physical activity, and mental wellbeing, is essential to reducing obesity rates and improving the overall health outcomes of children and adolescents.

Keywords: Sleep; Obesity; Shared determinants; Intervention; Health-promoting; Public health; Adolescents; Behaviours; BMI; Wellbeing

Introduction

Obesity is a major global public health concern and economic crisis, with prevalence doubling since 1990 [1]. In 2022, 43% of adults and 25% of children aged 5–19 years were overweight, with 16% of adults and 12% of children classified as obese [2]. The economic burden is equally significant, with obesity accounting for 3% of global GDP annually, projected to rise to 3.5% (£3.4 trillion) by 2035 [2]. A 5% reduction in obesity rates could save £337.5 billion per year by 2060 [3]. Despite extensive public health efforts focusing on diet, physical activity, and behavioural change, obesity prevalence continues to rise [4,5]. This suggests existing approaches fail to address all key contributors. Increasing evidence

highlights sleep as a modifiable determinant of obesity [6-8], yet it remains overlooked in prevention strategies.

Insufficient sleep is associated with poor metabolic regulation [9], and key obesity-related behaviours, including unhealthy dietary habits [10], excessive screen exposure [11,12], and reduced physical activity [13]. These behaviours often co-occur, reinforcing each other and complicating intervention efforts. A comprehensive, multi-pronged approach integrating sleep into obesity prevention strategies may be more effective than current models. This paper argues that sleep must be embedded into childhood obesity interventions and presents a framework for addressing it within

public health strategies. This paper explores why sleep must be embedded into childhood obesity interventions and presents an evidence-based framework for addressing it within multi-component public health strategies.

The Role of Sleep in Obesity Development During Puberty

A growing body of evidence suggests that insufficient sleep is associated with increased adiposity and obesity in children and adolescents [14-20]. Puberty is a key period for metabolic development, where hormonal and behavioural changes shape long-term weight outcomes [21,22]. As obesity often persists into adulthood [23], ensuring adequate sleep during these stages is crucial for preventing excessive weight gain and promoting lifelong health [21]. During puberty, activation of the hypothalamic-pituitary-gonadal axis triggers hormonal changes that impact both sleep and weight regulation [24]. Gonadotropin-releasing hormone stimulates the secretion of luteinising hormone and follicle-stimulating hormone, driving the production of sex hormones such as oestrogen, progesterone, and testosterone [24-26]. These fluctuations contribute to a delayed sleep phase, leading to later bedtimes, reduced sleep duration, and increased night-time awakenings [25]. Insufficient sleep disrupts appetite-regulating hormones, increasing ghrelin (hunger hormone) while suppressing leptin (satiety hormone), fostering overeating and weight gain [10,27].

Elevated cortisol levels, further exacerbated by sleep deprivation [28], contribute to increased adiposity [29,30]. Circadian misalignment—worsened by early school start times—is associated with higher body mass index (BMI) and metabolic dysregulation [31,32]. Adolescents accumulate sleep debt during the week and attempt to compensate by oversleeping on weekends, reinforcing metabolic instability [31,32]. The bidirectional relationship between sleep and obesity necessitates sleep-focused interventions [33]. Poor sleep contributes to weight gain, while excess adiposity disrupts sleep through increased fragmentation [34], obstructive sleep apnoea [35], and chronic fatigue [36]. Psychosocial factors, including low self-confidence, body image concerns, and obesity-related anxiety, further impair sleep [37].

Given these interconnections, sleep must be a core component of obesity interventions. Diet and exercise alone fail to address the physiological and behavioural factors linking sleep to weight gain. Incorporating structured sleep schedules, improved sleep hygiene, and circadian rhythm alignment can help prevent obesogenic pathways from becoming entrenched [37]. Prioritising high-quality sleep during childhood and puberty is crucial for both immediate metabolic health and long-term obesity prevention.

Shared Behavioural Determinants of Poor Sleep and Obesity in Adolescents

Many behavioural determinants of poor sleep and obesity overlap, creating key intervention opportunities, including excessive screentime, irregular meal timings and poor diet choices,

reduced or late-night physical activity, poor mental wellbeing and weekday/weekend variation in behaviours [38].

Excessive screentime: Blue light suppresses melatonin, delaying sleep onset and reducing duration [39,40]. Screen-based activities before bed heighten cognitive stimulation, delaying sleep onset [41], and promotes sedentary behaviour, increasing the risk of weight gain through reduced physical activity and increased snacking [42,43].

Irregular meals and late-night eating: Eating late disrupts circadian rhythms, misaligning metabolic processes, which leads to poorer glucose regulation, increased fat storage, and a higher BMI [44, 45]. Irregular mealtimes can delay sleep by shifting melatonin onset, contributing to shorter sleep and further metabolic dysregulation [46].

Physical activity: Moderate physical activity reduces sleep latency and enhances sleep efficiency [47,48], but some research has found that late-night exercise may delay melatonin secretion, disrupting sleep onset [49,50]. Physical activity declines during adolescence, particularly in girls, increasing adiposity and worsening sleep [51].

Weekday-weekend variation in behaviours: Late-night socialising, increased screen use, delayed meals and no school on weekends delay sleep onset, extend sleep duration, disrupting weekday-weekend sleep patterns (social jetlag) and encouraging metabolic instability, poor dietary and activity behaviours [43,52-55].

Mental wellbeing (including stress, anxiety, and depression): Psychological distress impairs sleep and contributes to hormonal dysregulation and emotional eating, reinforcing the need for mental wellbeing support in obesity interventions [56].

These behavioural determinants perpetuate poor sleep and weight gain, making interventions that improve sleep schedules, regulate screen use, meal timing and physical activity, and mental wellbeing more effective than those focusing solely on diet and exercise.

Designing an Ideal Multi-component Intervention

To be effective, a multi-component intervention must integrate sleep, mental wellbeing, and consistent weekday-weekend behaviours into existing obesity prevention strategies.

School-Based Programmes: Schools should incorporate sleep education, teaching students about its role in metabolism and obesity risk. Strategies such as structured bedtimes, reducing pre-bed screen exposure, and optimising meal timing should be emphasised. Mindfulness techniques, including breathing exercises, can further support sleep quality.

Family and Caregiver Engagement: Caregiver-focused interventions should equip families with strategies to support structured sleep routines at home. Community workshops can educate caregivers on the importance of sleep for weight management and provide tools for enforcing technology curfews

structuring bedtime routines and maintaining consistent behaviours throughout the week.

Community and Public Health Initiatives: Public health campaigns should position sleep as a key pillar of obesity prevention, alongside diet and physical activity. Collaborations with healthcare providers, local councils, and youth organisations can ensure that these messages reach families and communities effectively [57].

Technology and Digital Health Tools: Wearable technology and sleep-tracking apps can facilitate self-monitoring and encourage behavioural changes [58]. Schools and families can use these tools to track sleep patterns, reinforce bedtime routines, and integrate mindfulness practices.

Policy-Level Changes: Policymakers should adjust school start times to better align with adolescent circadian rhythms, reducing weekday sleep debt [57]. Further regulations could address late-night advertising of unhealthy snacks and digital content to support healthier lifestyle patterns.

Clinical and Primary Care Integration: Healthcare professionals should assess sleep patterns during paediatric obesity interventions, offering tailored recommendations alongside dietary and physical activity counselling. Routine check-ups should include structured sleep plans, stress management strategies, and guidance on maintaining regular sleep schedules.

A multi-component intervention embedding sleep, mental wellbeing, and consistent daily behaviours into existing obesity prevention frameworks will enhance effectiveness. Addressing sleep as a core component will help break the cycle of obesity and foster long-term health improvements in children and adolescents.

Future Research and Clinical Implications

Obesity interventions often overlook sleep, despite its crucial role in metabolic regulation. Future research should explore how structured sleep interventions affect weight regulation long-term. Longitudinal studies are needed to assess whether improved sleep hygiene, extended sleep duration, and reduced evening screen use and food intake lead to sustained reductions in obesity rates.

Investigating how chronotype influences intervention effectiveness is also essential, as adolescents with a later chronotype may require tailored strategies such as morning bright light exposure. Socioeconomic disparities must be considered, as low-income families face barriers like parental shift work and limited access to structured sleep environments. Without addressing these factors, interventions risk being ineffective in high-risk populations. Clinical trials should evaluate the feasibility of incorporating sleep into public health strategies, including whether integrating sleep education into school-based obesity programmes enhances outcomes. Research must also determine whether targeting shared determinants—such as reducing screen time and improving meal timing—improves success rates compared to traditional single-focus interventions.

Conclusion

The current landscape of childhood obesity interventions

overlooks a critical factor: sleep. Given the robust evidence linking poor sleep to obesity and its shared behavioural determinants, sleep must be integrated into multi-component obesity prevention and intervention strategies. Future research should explore the long-term impact of sleep-focused interventions, while policymakers and healthcare professionals must advocate for sleep education as a standard component of obesity prevention. Addressing sleep alongside diet, physical activity, and wellbeing will enable more effective, holistic approaches to tackling childhood obesity and improving lifelong health outcomes.

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Conflicts of Interest

None.

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