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Sleep Patterns and Obesity Risk in Children

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Abstract **Review Article**

All over the globe, the occurrence of obesity has become a serious public health problem. While diet and physical activity have long been acknowledged as the primary culprits of childhood obesity, there is now convincing evidence to suggest that sleep patterns are also responsible. This article looks at how sleep timings, quality or duration relate to the threat of obesity in children and adolescents. We dive into the physiological and behavioral mechanisms that sleep disruption produces obesity. It includes hormonal imbalance, appetite regulation, and physical activity changes. We also analyze the influence of modern lifestyles like screen time, irregular school schedules, and socioeconomic factors on sleep and weight status in children. As per existing evidence, encouraging beneficial sleep patterns should be recognized as an essential part of preventing and managing obesity in children.

Keywords: Sleep duration, childhood obesity, socioeconomic status, screen time, circadian rhythm.

1. INTRODUCTION

Obesity in childhood is the most important public health issue of the 21st century, affecting both present and future generations. According to WHO (2023), the prevalence of overweight and obesity among children and youth aged 5–19 years globally increased from 4% in 1975 to over 18% in 2016. This increase in obesity will put children at risk for metabolic and cardiovascular complications in childhood but also increase the probability of obesity in adulthood. Children who suffer from obesity have an increased risk of developing type 2 diabetes, hypertension, dyslipidaemia, non-alcoholic fatty liver disease and various psychosocial complications (Simmonds *et al*., 2016)

As per WHO (2023), high energy-dense and ultra-processed foods, combined with sedentary lifestyles, especially excessive screen time, have been linked to childhood obesity. This basically shows that childhood obese people consume excess energy-dense and ultra-processed foods. More recently, obesity etiology has expanded to include more behaviors and environments, one of which is sleep, a likely modifiable risk factor (Chaput *et al*., 2016).

Children need sleep for proper neurocognitive development, emotional regulation & immune function, and metabolic homeostasis. When someone sleeps, the body does important things, especially in children and teenagers such as releasing growth hormone, storing memories and repairing cells. Interestingly, childhood and adolescence are critical periods of development characterized by rapid physical, emotional, and cognitive changes, for which optimal sleep is essential. According to the American Academy of Sleep Medicine, school-aged children, aged between 6 and 12 years, should sleep for a period of 9 to 12 hours per 24-hour period, while teenagers, aged between 13 and 18 years, should sleep for 8 to 10 hours per night (Paruthi *et al*., 2016).

Even after this, people are worried that nowadays children are getting less and less sleep and at irregular times. Aspects of society and environment are making sleep duration and quality poorer. Such aspects are increased screen time, load of homework and classes, later starting school time, and poor sleep hygiene practices. This trend has caused a huge drop in average sleep duration among the youth over the last few decades (Matricciani *et al*., 2012).

Various studies are accumulating that suggest deficient sleep is not just a correlate obesity but potentially a cause of obesity. Many studies have been done on this that connect shorter hours of sleep having more body mass index, fatness and waists sized more in the case of children and teenagers. Sleeping poorly is not just about how long someone sleeps but how good that sleep is. Bad sleep which is regularly broken up or irregular sleep and bad timing of sleep have also been

shown to have a bad effect on the metabolism (Miller *et al*., 2018)

There are many different reasons sleep problems can cause obesity. This includes changes to the hormones that regulate appetite (leptin and ghrelin) along with changes to glucose metabolism and insulin sensitivity. Furthermore, sleep deprived individuals have a greater preference for high-calorie foods, greater opportunity to indulge in late-night snacking, and decreased energy expenditures due to fatigue-induced reductions in physical activity (*Spiegel et al*., 2004; Hart *et al*., 2013). Furthermore, disturbances in the natural cycle of biological processes may worsen adverse consequences.

This review article on sleep and obesity in children investigates the multifactorial association between sleep and obesity risk. Specifically, we aim to Sleep duration, quality and timing associated with weight gain and adiposity in children. We will talk about the mechanisms to find an explanation for this association. Environmental and socioeconomic factors influence both sleep and obesity risk outcomes. It is important to tackle the causative behavioral and physiological pathways through which sleep may affect obesity along with relevant environmental and socioeconomic forces.

To develop inclusive and evidence-based public health strategies for childhood obesity, it is important to understanding sleep. In working on sleep and also nutrition and physical activity, health care providers, educators, and policymakers can more effectively combat childhood obesity and enhance lifelong health and wellbeing.

2. EPIDEMIOLOGICAL EVIDENCE

Numerous epidemiological studies have been conducted on varying populations of different age groups regarding sleep duration and the risk of childhood obesity. Research indicates that children who do not sleep much are found to be fatter as there is a reverse connection between sleep and weight.

Research from 36 studies totaling more than 600,000 subject (from infancy through adolescence) data on sleep and health by Cappuccio et al. (2008) The authors found that sleeping for a short duration was associated with a nearly doubled risk of being overweight or obese (pooled odds ratio [OR]: 1.89; 95% confidence interval [CI]: 1.55 – 2.31). Recent studies have observed a similar trend as the findings. Miller and colleagues (2018) carried out a methodological review and impact process of cohort studies. They got results which show that in kids, higher sleep time were more responsive to being overweight or obese. They got OR value of 0.79 which is 21%.

Large cohort studies reinforce these observations The Growing Up Today Study (GUTS) that followed more than 15,000 adolescents in the US reported that sleeping fewer than 6 hours per night was associated with a significantly higher BMI and greater odds of obesity at 3-year follow-up as compared to sleeping 8 or more hours (Wing et al., 2009). The Longitudinal Study of Australian Children (LSAC) also monitored sleep and BMI patterns in a national cohort and found the same thing. Shorter sleep in early childhood predicted greater weight gain and increased central adiposity over a 6-year period (Hiscock *et al*., 2011).

Information from the NHANES data is also informative. An analysis of data on children aged 6–17 years (n > 6,000) examined by Liu et al. (2021) revealed that sleeping less than the recommended sleep of 9–11 hours (for ages 6–13) and 8–10 hours (for ages 14–17) was associated with higher BMI percentile and waist-to-height ratio, independent of diet and activity levels. It's important to note that the sleep-obesity link is dose-dependent, meaning as sleep gets shorter, the risk gets higher. In a study from China among more than 32000 children aged 3-18 years, for every 1-hour reduction in average sleep time, there was a linear increase noted in the setting of body mass index (BMI) z-score (Chen *et al*., 2008).

Might be relationship between cultures and ethnic things. For example, Silva et al. (2016) did a study in Brazil, which showed that short sleep was a stronger predictor of obesity in boys versus girls. Thus, there may be sex differences in the sleep-obesity link. In contrast, a Laurence et study using Millennium Cohort Study data from the UK found the sleep–obesity association was stronger for children from low-income households and an ethnic minority background, potentially due to differential exposure to stress, diet, and sleep environments (Kelly *et al*., 2013).

Studies show that not only total sleep matters but waking at the same time adds to childhood obesity. According to Anderson et al., preschoolers who go to bed early often are less likely to be obese as teens compared to other kids who sleep late or erratically. This means we must try to ensure that children get sleep at the same time – daily.

Overall, these studies suggest that short sleep is common among children and adolescents and is associated with an increased risk of overweight or obesity, independent of traditional risk factors such as excess caloric intake, physical inactivity, and low socioeconomic status. Kids' weight management programs and public health initiatives need to have sleep assessment and implementation programs as part of them.

3. Biological Mechanisms Linking Sleep and Obesity in Children

Multiple physiological and behavioral pathways are underlying the association between sleep disturbances and obesity in children and adolescents. The interactions here involve neuroendocrine regulation, circadian rhythm disruption, metabolic changes, and behavioral responses affecting energy balance and obesity. A detailed discussion of these interrelated pathways is below.

3.1 Hormonal Regulation of Appetite.

One of the most common mechanisms studied is the dysregulation of hormones that regulate appetite due to sleep loss. When [people] sleep less, they experience less leptin (a hormone released by fat cells that sends a message to the hypothalamus that you are full), and increased ghrelin (a stomach hormone that signals hunger) (Spiegel *et al*., 2004). This can drive a higher food intake, particularly of calorie-dense carbohydrate-rich foods, thus causing positive energy balance and subsequent weight gain.

These impacts seem to be particularly extreme in children because of the susceptibility of the hypothalamic-pituitary axis of a developing child. Taheri *et al*. (2004) discovered that shorter sleep duration in children resulted in notably higher fasting levels of appetite-inducing hormone ghrelin and lower amounts of appetite-suppressant hormone leptin, both of which were statistically associated with BMI z-scores. These hormone changes are thought to increase pleasure-based eating and reduce the child's ability to control how much they eat.

A lack of sleep disrupts how the body regulates blood sugar and makes it less responsive to insulin. Studies in experiments show, short-term restricted sleep, for example, can cause resistance insulin, meaning, it reduced uptake glucose peripherally, and it raised the circulating glucose (Van Cauter *et al*., 2008). Children may be particularly vulnerable to these changes Many researchers found out through various studies that sleeping low hours can be linked to increased fasting insulin levels as well as higher insulin resistance independent of adiposity. Chronic sleep deprivation can not only lead to fat gain but also increase the risk for metabolic syndrome.

3.2. Circadian Rhythm Disruption.

Circadian rhythms are natural cycles that occur in an organism's body. They are cycles of biological processes that extend up to 24 hours. Further, a central pacemaker resets those cycles regularly. Specifically, the supra-chiasmatic nucleus of the hypothalamus of every organism regulates circadian rhythms. These rhythms are crucial as they control when we sleep and eat, release hormones, and burn energy. When children do not sleep on time, eat late, or improve their sleep-wake schedule, their internal circadian rhythm can misalign with their environment. This mismatch of circadian rhythms has been shown to alter metabolic processes' timing, resulting in increased fat gain and disrupted fat metabolism (Arble and others, 2010). Moreover, melatonin is involved in sleep onset and circadian rhythm regulation. Melatonin also regulates energy metabolism and fat storage. Therefore, interference in melatonin signaling might increase the risk of obesity.

Another major way sleep connects to obesity is that it affects our activity and total energy use. When children do not get enough sleep, they tend to feel more tired, want to do less exercise and do more sedentary activities like screen time. These changes in behavior cause the body to use up lesser calories leading to less energy usage. In addition, insufficient sleep may hinder motor control, attention, and mood, leading to decreased involvement in organized physical activities like sports or outdoor play (Knutson, 2005). Over a period, this decline in energy output can start to promote weight gain. If we don't sleep as much, we remain awake longer (over 24 hours for example) and hence tend to eat food for a longer time. We tend to eat late-night snacks which comprise more and more energy-dense and nutrient-poor foods. Research indicates that children who sleep later or sleep less consume more calories, especially from fat and sugar, and are more likely to skip breakfast, a pattern associated with higher rates of obesity (Weiss *et al*., 2010).

Longer hours in front of screens ups exposure to food cues. Seeing food ads and munching on snacks while watching TV or using devices creates bad eating habits in youths that do not get enough sleep.

The lack of sleep is linked to conditions like obesity and metabolic diseases and the sleep loss leads to inflammation. Lack of sleep increases the levels of the inflammatory cytokines interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-), which play a role in insulin resistance and adipocyte dysfunction (Irwin and Opp, 2017).

In addition, dysregulated production of adipokines, which are signaling molecules released by fat tissue, can worsen this inflammation. Adiponectin is a molecule that reduces inflammation and helps increase insulin effectiveness. Lack of sleep decreases its levels (Vgontzas *et al*., 2004). This increases new fat production or adiposity and metabolic dysregulation.

4. Sleep Quality and Obesity Risk

While how much you sleep matters for obesity, better evidence suggests that how well you sleep, more specifically sleeping in pieces and waking at night are equally important for metabolic health in children. When your sleep gets interrupted over and over again, or if you're unable to go back to sleep after getting up to use the washroom or whatever. It becomes fragmented sleep when it happens often Business sleep disruptions can hinder cognitive and emotional growth in children as

well as have detrimental metabolic effects that cause obesity.

Many kids suffer from sleep fragmentation due to a sleeping disorder. These include obstructive sleep apnea (OSA), restless legs syndrome (RLS), and nocturnal asthma or behavioral insomnia. There are other environmental factors too like noise, screen time before bed, parents going to sleep at different times and co-sleeping in a crowded home. According to community surveys, 25-30% of preschool kids wake up at night regularly, with the problem found in both sexes and not always constant. Children from urban low income families do this more.

When sleep is broken, then brain hormones and metabolism change in a manner to gain weight. Waking up repeatedly lowers the amount of GH, which is highly active during deep sleep and is lowered by decreased hypothalamic-pituitary-adrenal activity to prolong elevated evening and night levels of cortisol (Spiegel *et al*., 1999). When cortisol levels in the body go high, fat deposition occurs and insulin resistance occurs in particular the abdomen.

Besides, fragmented sleep reduces the quantity and quality of slow-wave sleep (SWS), which negatively affects glucose tolerance and insulin sensitivity. Studies have shown that even short removal of sleep leads to drop in insulin action. Effects of TST do not matter (Tasali *et al*., 2008).

Waking up too often at night can affect appetite hormones Higher levels of ghrelin can occur at night and cause hunger and eating at night when we wake up. Most of the leptin rise at night is inhibited by sleep fragmentation and this is associated with an increase in next-morning appetite and preference for energy-dense foods (St-Onge *et al*., 2016).

When kids don’t sleep well, they get tired, cranky, and clumsy. Repeated daytime tiredness and sleeping activities in children cause them to complain of tiredness, crankiness or clumsiness.

Moreover, fragmented sleep interferes with self-regulation and executive function, which in turn hinders a child’s ability to control their impulses and eat healthy foods. These eating habits can further aggravate sleep and eating behaviors, which can predispose them to obesity.

Sleep-disordered breathing (SDB) due to obstructive sleep apnea (OSA) is one of the most well-documented causes of sleep fragmentation in children. A repetitive blockage of all or a portion of the upper throat airway during sleep leads to obstructive sleep apnea; this results in an arousal or awakening, the de-saturation of oxygen and an activation of the sympathetic nervous system. Parents or caregivers of sleep-disordered breathing diagnosed children seek breathing devices to aid their sleep. A registered practitioner can provide these devices, but they might involve a copayment or deductible.

In a study of 500 children with habitual snoring, Tauman *et al*. (2006) found BMI z-scores and waist circumference in children with OSA were significantly higher than in cases without OSA. Adenotonsillectomy is the most common treatment for OSA, but CPAP therapy can also be effective. These interventions can help adjust your BMI and improve insulin sensitivity. Thus, sleep-disordered breathing and adiposity are related

Kids in low-resource areas are waking up at night and sleeping poorly. Children living in overcrowded conditions have irregular routines. Sleeping is difficult due to the noise in towns and cities. Disrupted bedtimes cause children to suffer from sleeplessness. Children who live in low-income areas often don't sleep well for a variety of reasons and this makes them overweight.

5. Sleep Disorders

Obesity that leads to overweight children when young often leads to obstructive sleep apnea (OSA) that has a bidirectional relationship with overall sleep and obesity. OSA causes night-time oxygen deprivation and fragmentation of slumber that in turn promote systemic inflammation and insulin resistance that promote excessive weight gain (Beebe and Gozal, 2012).

The time kids sleep and their chronotype of morningness-eveningness directly controls their risk of obesity and overweightness. Chronotype is when kids think they are a morning type or an evening type. Chronotype indicates an individual’s intrinsic circadian rhythms that govern sleep–wake behaviour, feeding pattern, hormonal secretion and energy metabolism. When a person’s sleep and eating times fall in opposition to their chronotype or social times, circadian desynchrony occurs, which is now more frequently being implicated in the pathophysiology of pediatric obesity.

Children and adolescents with later bedtimes have been seen to have higher body mass index (BMI) and greater chances of being overweight and obese, regardless of total sleep duration. Cross-sectional and longitudinal studies support this relationship. As an illustration, Anderson *et al*. (2016) discovered that children whose bedtime was after 9:00 PM had greater odds of being obese by adolescence than children with an earlier bedtime. Interestingly, the results held true even after adjusting for sleep duration, indicating that sleep onset has independent metabolic effects.

Several mechanisms may account for this effect Late bedtimes are often associated with

- Being awake longer raises the odds of having supper, resulting in elevated blood sugar and insulin levels.
- Eating at odd times and eating more calories-dense foods more late in the night
- Reduced opportunity to be active because the days are shorter.

Additionally, bedtime delays result in meal delays too, which disturb the peripheral clocks of liver, pancreas and adipose tissue necessary for optimal glucose and lipid metabolism (Albrecht, 2012). If we eat our dinner too late it may impact negatively on our metabolism. Also, it can cause weight gain due to fat accumulation.

Chronotype is usually classed along a range of morning types (larks) to evening types (owls). Chronotype is influenced by genes, but it can change with age and surroundings. Most children have a morning chronotype early in childhood, but many shift to an evening chronotype during adolescence. This change is a development from biological puberty and also psychosocial issues.

People who have evening chronotypes are generally more obese than morning types. This is because evening types tend to eat more irregularly than morning types. They also consume more sugar and fat, as well as engage in less physical activity. The behavior and physiology can both mediate this risk.

- People who prefer evenings rather than mornings do a lot of sedentary activities in the evening. They skip breakfast and don't get enough sleep because they usually go to bed very late when school days start very early.
- Physiological factors include poorly aligned circadian clocks (internal synchronizers) with external demands. When demand exceeds capacity, clearance or efficiency becomes poor. Higher secretion of stress hormones (cortisol) is an example.

Also, children with an evening chronotype may experience social jetlag (mismatch of their biological clock with their social obligations like their school start time) which is associated with increased adiposity and cardiometabolic risk factors (Roenneberg *et al*. 2012).

The difference in bed time when a child goes to bed has been studied in the context of obesity and poor cardiometabolic profiles. Irregular sleep schedules mess with our internal body clocks and reduce sleep quality. Children with highly variable bedtimes were found to have larger waists, higher triglycerides and lower HDL cholesterols, according to Jansen *et al.,* (2013) even when their sleep duration was fine.

Not having the same timings every night can affect your overall health and obesity level as it leads to change in sleep patterns. Going to bed late usually means spending a lot of time in the presence of artificial light, especially blue light from cellphones, tablets, and TVs, that inhibits the secretion of melatonin. Melatonin helps us sleep all night long. When they don't, our health suffers through the night, like insulin becoming less effective, fat accumulating, and other problems.

A link exists between the delay of sleep and late bedtimes behaviors and exposure to light. Furthermore, light exposure at bedtime is modifiable behavior that may prevent obesity in children.

6. Social Jetlag

Social jetlag refers to the chronic misalignment between a person's internal clock and the external clock and is most commonly caused by social obligations like school. When it comes to sleep timing on weekdays and weekends, children and adolescents commonly experience misalignment, where weekdays involve an earlier rise time because of school. To compensate, they have catch-up sleep on the weekend.

As first introduced by Roenneberg *et al.,* (2003), social jetlag is the absolute difference in the midpoint of sleep on workdays (or school days) or on free days. For instance, a child with weekday sleep from 10:00 PM to 6:00 AM (sleep midpoint = 2:00 AM) and weekend sleep from 12:00 AM to 9:00 AM (sleep midpoint = 4:30 AM) would have a social jetlag of 2.5 hours. Because of this discrepancy, the inability to cope with later times has become increasingly implicated as an independent risk factor for obesity.

Social jetlag is seen in school-age children, managing at its peak in adolescence, when natural shifts towards later sleep timing (evening chronotype) coincide with first school start times. In a study where a large group of teenagers and young adults participated, more than 60% reported at least 1 hour of social jetlag. In addition, around 10–20% reported more than 2 hours' difference between their weekday and weekend sleep patterns.

This shift is exacerbated by

- Increased academic demands.
- Using electronic gadgets in the evening.
- As kids get older, parents stop telling them to go to bed.
- The body makes melatonin more slowly during puberty.

Circadian system controls key metabolic processes such as glucose metabolism, appetite control, lipid oxidation and energy expenditure. When body clocks are imperfectly synchronized with the rhythmic timing of event outcomes, a state of chromatic

misalignment develops. This, in turn, negatively affects the metabolic equilibrium.

Both adults and adolescents show social jetlag correlates with different health outcomes.

- Reduced insulin sensitivity.
- Increased glucose and triglycerides when fasting.
- More cortisol and inflammatory cytokines present in higher levels.
- The clock genes in fat tissue and liver expresses differently.

These biological disturbances enhance the storage of fat, especially in the abdomen, as well as the risk of developing insulin resistance and type 2 diabetes (Leproult *et al.,* 2014; Wong *et al.,* 2015).

A study by Parsons *et al*. (2015) involving over 3,000 adolescents found that each additional hour of social jetlag was associated with an 11% higher odds of obesity, independent of total sleep duration, socioeconomic status, and physical activity. Longitudinal studies indicate that social jetlag may have lasting health impacts beyond childhood. Chronic circadian misalignment has been associated with early onset of metabolic syndrome, dyslipidemia, hypertension, and even cardiovascular disease markers in adolescence and early adulthood (Roenneberg *et al*., 2012). Importantly, the impact of social jetlag may be amplified in socioeconomically disadvantaged populations, where consistent sleep hygiene is harder to achieve due to parental work schedules, household crowding, and reduced access to sleep education.

7. Socioeconomic and Environmental Influences

Digital media use has changed children's sleep, physical activity and diet which are risk factors related to obesity. Sleep is one of the best-known behavioural alterations of excessive screen exposure. In particular, spending too much time in front of screens is linked to going to bed later, sleeping less, sleeping poorly, and resisting sleep. Sleep disruptions contribute to the causal pathway through which exposure to digital media has been related to increased adiposity and metabolic dysfunction in youth.

The past two decades have witnessed an explosive growth in the use of screens among children and adolescents, ranging from televisions and tablets to smartphones, gaming consoles and computers. The American Academy of Pediatrics (AAP) reports children aged 8 to 18 years now average over 7 hours of screen media a day, much of which occurs in the evenings–when melatonin is produced and sleep begins (AAP, 2016). Additionally, screen use by toddlers and preschoolers is now common, often in unregulated settings at home.

Screen use can negatively affect sleep in many ways.

A. Melatonin Suppression and Circadian Phase Delay

Blue-wavelength light (450–490 nm) emissions from screens inhibit the secretion of melatonin, a hormone that initiates sleep and regulates circadian rhythms. Evening exposure to this light leads to

- Delayed sleep onset.
- Shifted circadian rhythms.
- Reduced total sleep time.

In the controlled trial of Higuchi *et al*. (2005), children who either read a printed book or played a video game on a tablet or phone under dim (not dark) light were tested. Results showed that compared to the children reading a printed book, the children using the tablet or phone showed significantly delayed melatonin onset. Using screens for a long time before sleeping might make it harder to sleep earlier at night. It will be worse for teens who usually like to sleep later at night.

B. Psychological Arousal

Using thing like games, social media, or streaming can make your brain very active. This causes us to feel alert meaning we can't sleep. Engaging content often activates the brain's reward system, making it hard to disengage and wind down before bedtime. This heightened excitement makes it harder to fall asleep, as well as sleep more deeply.

C. Displacement of Sleep Time

Using screens too much in the evenings means less time left to sleep. In many homes, screen time is deemed more important than a consistent bedtime, particularly without parent control. Kids might choose to stay up late to use media that makes them delay their sleep and restrict their sleep especially on school nights.

D. Increased Night Wakings and Sleep Fragmentation

A lot of kids sleep with their devices near and under the pillow. The notifications, exposure to light, and temptation to engage with content during the night contribute to disruptions of sleep which lower sleep efficiency and reduce the restorative function of sleep.

The relationship between screen time, sleep issues, and obesity is complex.

- When sleep is shortened or fragmented, there is an increase in ghrelin (a hormone that stimulates appetite) and a decrease in leptin (a hormone that enhances the feeling of satiety) which will in turn lead to hunger and intake of more food.
- Using screens too much involves not using your body enough. Not using your body means you don't burn energy.
- Children who do not get enough sleep are more likely to eat high-calorie and high-fat foods while using screens.

- Watching screens at night can cause your body's sleep-wake cycles to become misaligned, which causes sleep disturbances.

In a large cohort study by Falbe *et al*. (2015) children with TVs in their room had shorter sleep duration and were 1.3 times more likely to be overweight or obese (regardless of physical activity level and diet). The same way, Hart et al. (2019) found that, children with more than two hours of screen time per day had significantly shorter sleep and increased odds of central adiposity.

Sleep Disparities by SES.

Studies on a large number of people show that sleep varies with money. Children from low-income families are more likely to

- Sleep for lesser hours than their age group should get.
- They often go to bed late and wake up early.
- Have trouble falling asleep, waking up at night, feeling sleepy in the day time
- Stay in busy and noisy homes that disturb sleep continuity.

Research has shown that children from families living below the poverty line are far more likely to suffer from insufficient sleep. In a large US sample looking at children's health (the National Survey of Children's Health, 2020), it was found that children living below this dividing line had odds higher than a third of getting insufficient sleep. This was true after controlling for age, race/ethnicity, and parental education. Disparities are prevalent early in life and persist through adolescence.

Children who come from poor families do not sleep well. They don't get enough sleep and their quality is poor.

- When spaces are shared, the quality of sleep gets affected.
- The noise from sources like traffic or neighbors disrupts the rhythm of sleep.
- If household schedules are not similar to one another, including if the parents work the night shift or have two jobs, the sleep pattern of the kids won't be right.
- Not having air conditioning or heating and blackout curtains can affect your sleep.
- When the neighborhood undergoes violent incidents, the insomnia in the child worsens.

Additionally, households with lower resources have more screen time before bed because screens are cheap and can entertain or pacify children. This often leads to bedtimes happening later in the evening and circadian misalignment.

Chronic psychosocial stress in poor settings markedly affect the sleep–obesity mechanism. Experiencing financial insecurity, not having enough food, parents who fight and violence in the area can cause the body to release a chemical that makes it hard for people to sleep.

Chronic stress creates imbalance in the nervous system and body clock. This makes sleep discontinuous, disturbed and waking up at night. This leads to fatigue, dysregulation of appetite hormones (e.g., ghrelin, leptin) and excess calorie intake, particularly of energy-dense "comfort foods."

In addition, depressive and anxiety symptoms are more common among children in low-SES contexts, and they are independently related to sleep issues and weight gain.

Parents have a big impact on how their kids sleep, especially routines. Parents with higher education levels are more likely to

- Recognize the need for consistent bedtimes and sleep routines
- Enforce sleep hygiene routines.
- Make sure to avoid screens before bed.
- Model healthy sleep practices.

Low-income parents may prevent their children from going to bed on time due to.

- Working odd hours or at multiple places which reduces direct supervision.
- Having less knowledge about how sleep is good for health.
- Fatigue and stress limits energy to enforce a routine.
- No community or health systems support for enforcing behavioral sleep practices.

So, keeping a regular bedtime is not just something the parent does (might choose not to) but is affected by their socio-economic conditions.

CONCLUSION

Many studies have shown that sleep patterns are a very important factor in childhood obesity. A child's obesity risk is impacted by their sleep duration, quality, time, regularity and other factors related to sleep. In any comprehensive childhood obesity prevention strategy, addressing poor sleep should be priority number one. Moving forward, the subsequent studies must possess a longitudinal and interventional design, so as to elucidate causal relationships further and develop scalable sleep interventions in schools and the community.

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