



SLEEP QUALITY AND SEDENTARY LIFESTYLE AS IMPORTANT FACTORS OF OBESITY IN ADOLESCENTS: A LITERATURE REVIEW

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ABSTRACT

Obesity in adolescents continues to increase globally and is one of the most pressing public health challenges. Evidence suggests that sleep quality, sleep duration, and a sedentary lifestyle play a significant role in influencing obesity risk in this age group. This literature review aims to summarize and analyze recent research findings on the relationship between sleep quality, social jet lag, screen time, and sedentary behavior on obesity in adolescents. The research method was conducted through a systematic search of international journals relevant to the topics of sleep, 24-hour movement behavior, and adolescent obesity. The review results show that poor sleep quality, sleep duration <7 hours, and irregular sleep rhythms are consistently associated with increased body mass index (BMI), waist circumference, and body fat percentage. Social jet lag is known to affect circadian regulation and energy metabolism, thereby increasing the risk of adiposity. Conversely, high screen time and a sedentary lifestyle significantly increase the likelihood of decreased physical activity, sleep disturbances, and increased daily calorie intake. These findings confirm that obesity in adolescents is not influenced by a single factor, but rather by a complex interaction between sleep, physical activity, and sedentary behavior as part of a 24-hour behavioral pattern. This review recommends the need for integrated school- and family-based interventions to improve sleep habits and reduce sedentary behavior as an effort to prevent obesity in adolescents.

Keywords: Adolescent obesity; Sedentary lifestyle; Screen time; Sleep duration; Physical activity; Obesity risk factors; Adolescent health; Sedentary lifestyle; Adolescent nutritional status; Obesity prevention

1. INTRODUCTION

Obesity in adolescents is a public health problem that is increasingly affecting various countries, including developing ones. The increase in obesity prevalence in the 10–19 age group has occurred consistently over the past two decades and poses a threat to the quality of life of future generations. Obesity in adolescence not only increases the risk of obesity in adulthood but is also associated with the emergence of non-communicable diseases such as type 2 diabetes mellitus, hypertension, dyslipidemia, cardiovascular disease, psychosocial disorders, and a reduced quality of life. This condition shows that obesity is not merely an aesthetic issue, but a

multifactorial problem influenced by behavioral determinants, the environment, and the daily lifestyle of adolescents (Amodu, 2024).

Low physical activity and unhealthy diets have long been considered the dominant factors causing obesity in adolescents. However, growing scientific evidence suggests that poor sleep quality and a sedentary lifestyle including increased screen time due to device use play an equally important role. Adolescents are an age group with frequently irregular sleep patterns due to academic demands, late-night stays, and exposure to blue light from electronic devices. Sleep disturbances in adolescents have been linked to changes in the regulation of the hormone leptin and ghrelin, increased hunger, decreased insulin sensitivity, increased physiological stress, and changes in circadian rhythms, all of which ultimately contribute to the accumulation of body fat.

Furthermore, sleep quality and duration have been shown to be important determinants closely related to obesity risk in adolescents. A systematic review of sleep and obesity showed that short sleep duration, poor sleep quality, and social jet lag contribute to increased body mass index and adiposity. These factors are often influenced by high screen time habits, thus worsening sleep patterns and increasing sedentary behavior (Yildiz et al., 2024).

In addition to declining sleep quality, a sedentary lifestyle is also becoming increasingly entrenched in adolescents' lives. The increased use of smartphones, computers, digital games, and social media leads adolescents to spend more time sitting and reduce physical activity. A sedentary lifestyle directly reduces daily energy expenditure, inhibits metabolism, and increases the risk of unhealthy food consumption due to snacking during screen time. Several studies in recent years have consistently shown that screen time exceeding 2–3 hours per day is associated with increased BMI, waist circumference, and visceral fat in adolescents. Furthermore, a sedentary lifestyle has been shown to disrupt sleep quality, creating a double-edged sword of poor sleep and low physical activity.

The interaction between sleep quality and a sedentary lifestyle is a significant concern because both not only impact the physical body but also influence adolescents' behavior and emotions. For example, adolescents who lack sleep tend to experience fatigue during the day, leading them to resort to passive activities like watching television or using their phones. Conversely, high screen time, especially at night, increases brain stimulation and decreases melatonin production, ultimately making it difficult for adolescents to sleep. This cycle lack of sleep leads to a sedentary lifestyle, and a sedentary lifestyle worsens sleep represents one of the important dynamics accelerating the development of obesity in adolescents.

Despite growing scientific evidence linking sleep quality, sleep duration, sedentary behavior, and obesity in adolescents, a comprehensive understanding of how these three factors interact remains suboptimal for prevention practice. Many obesity prevention programs in schools and communities still focus on increasing physical activity or managing nutrition, while sleep and screen time management components remain a key component of interventions. However, recent studies have shown that approaches that incorporate sleep and a reduced sedentary lifestyle are more effective in reducing obesity risk and improving metabolic health in adolescents.

Therefore, this literature review was conducted to analyze in-depth the findings of various studies related to sleep quality, sedentary lifestyle, and their impact on obesity in adolescents. This review aims not only to provide a comprehensive overview of the relationship between these three factors but also to strengthen the argument that obesity prevention requires a multidimensional approach that encompasses sleep, physical activity, and sedentary behavior simultaneously. By understanding the available scientific evidence, it is hoped that this article can

provide a foundation for the development of more targeted interventions and more holistic public health policies to address obesity in adolescents.

2. METHODS

This study used a literature review approach aimed to summarize, compare, and integrate empirical findings regarding the relationship between sleep quality, sedentary lifestyle, and obesity risk in adolescents. The literature review was conducted systematically to ensure the completeness, relevance, and accuracy of the scientific information analyzed. The initial stage of the study began with determining the focus of the study, namely behavioral factors related to adolescent obesity, specifically sleep duration, sleep quality, screen time, low physical activity, and other sedentary patterns. This focus was chosen because various previous studies have shown that modern lifestyle changes including increased exposure to devices, sleep disturbances, and decreased daily activity are important factors influencing the rise in obesity prevalence in the 10–19 age group.

The article search process was conducted in several scientific databases such as PubMed, ScienceDirect, Scopus, Google Scholar, and Wiley Online Library, covering publications spanning the past 10–15 years, to capture the latest developments on the topic. The keywords used included a combination of the following terms: "sleep quality," "sleep duration," "social jet lag," "sedentary lifestyle," "screen time," "physical inactivity," "childhood obesity," "adolescent obesity," "risk factors," "LCA in adolescents," "school-based intervention," and "24-hour movement guidelines." The Boolean operator (AND/OR) technique was used to broaden or narrow the search for articles to identify publications most relevant to the study's objectives.

The articles then underwent a multistep selection process, which included examining the title and abstract, as well as checking the topic's relevance to the research scope. Inclusion criteria included: (1) studies focusing on children and adolescents aged 5–19 years; (2) studies measuring sleep quality, sleep duration, screen time, sedentary lifestyle, physical activity, or a combination of behavioral factors; (3) studies assessing the association of these factors with obesity or components of adiposity; and (4) articles that were quantitative research, systematic reviews, scoping reviews, multilevel analyses, latent class analysis (LCA), or school-based intervention studies. Meanwhile, articles were excluded if: (1) they did not focus on adolescents; (2) they did not include sleep or sedentary variables; (3) they were opinion pieces or editorials; or (4) they were not available in full text. Through this screening process, a number of core articles were identified that served as the basis for the analysis in this literature review.

The next stage was data extraction, in which each article was identified based on its methodological characteristics, such as research design, study location, sample size, measurement instruments (e.g., Pittsburgh Sleep Quality Index, objective sleep duration, physical activity questionnaire, screen time measurement, and body mass index or Z-score), as well as key quantitative findings. Specifically, for studies using the latent class analysis approach, data were collected on the classification of lifestyle patterns and how the combination of sleep, nutrition, physical activity, and sedentary behaviors predicts obesity status. For school intervention articles, information on the strategies used, their effectiveness, and the duration of the intervention were also analyzed as complementary findings.

Data analysis used a narrative synthesis approach, a method that integrates findings from various types of studies without conducting statistical meta-analysis. Narrative synthesis was chosen because the articles used had diverse research designs, differing measurement instruments, and significant variation in sample characteristics. The synthesis was conducted by

grouping findings based on key themes: (1) the relationship between sleep quality and duration and obesity; (2) the role of screen time and a sedentary lifestyle in increasing the risk of obesity; (3) the interaction between sleep behavior, physical activity, and other lifestyle components; and (4) evidence of interventions that can modify these risk factors. This process enabled researchers to identify consistent patterns, discrepancies in findings, and underexplored research gaps.

To enhance reliability, each article was critically appraised using simple parameters such as clarity of design, accuracy of variable measurement, analytical methods, and generalizability of results. This evaluation was conducted to ensure that the synthesized findings came from quality sources and were scientifically sound. The results of this critical analysis not only strengthened the literature review's arguments but also helped formulate recommendations for further research. Overall, this literature review method was designed to generate a comprehensive understanding of how sleep quality and a sedentary lifestyle play a role in predicting obesity.

This research method uses a scoping review approach to comprehensively map scientific evidence regarding the prevalence, risk factors, and behaviors related to obesity in school children and adolescents, including physical activity, sedentary behavior, screen time, and sleep quality and duration. A literature search was conducted through the PubMed, Scopus, Web of Science, and Google Scholar databases using relevant keywords. Article selection followed the PRISMA-ScR guidelines, with inclusion criteria including a population aged 5–19 years and observational studies, systematic reviews, scoping reviews, school interventions, and latent class analysis-based studies. Selected data were extracted and analyzed descriptively to identify key themes related to adolescent obesity.

3. RESULTS AND DISCUSSION

The Relationship Between Sleep Quality and Adolescent Obesity. In addition to the basic associations found in various studies, a literature review also shows that poor sleep quality not only increases the risk of obesity but is also associated with increased inflammatory biomarkers and changes in eating behavior. Several studies report that adolescents with restless sleep (frequent awakenings, restless sleep, or difficulty initiating sleep) tend to consume foods high in sugar and fat in the morning. Sleep disturbances also increase emotional eating behaviors in adolescents, especially in the 13–16 age group, who are experiencing a phase of increased psychosocial needs. Furthermore, the study "The Relationship Between Sleep Quality, Sleep Duration, Social Jet Lag, and Obesity in Adolescents" showed that poor sleep quality is associated with increased waist circumference even when BMI is within the normal range, suggesting that sleep quality may be a more sensitive predictor of central adiposity than BMI alone.

Other research confirms that poor sleep quality is closely linked to dysregulation of stress hormones such as cortisol. Adolescents who frequently have irregular sleep or stay up late show increased morning and evening cortisol levels. Persistently high cortisol levels are associated with increased fat storage in the abdominal region and an increased desire for high-energy foods. This explains why some adolescents with poor sleep patterns still experience increased body fat even though their eating habits have not changed significantly. Overall, these findings confirm that sleep quality is an important factor that cannot be ignored in understanding the mechanisms of obesity in adolescents.

The Effect of Short Sleep Duration and Social Jet Lag. In addition to causing an imbalance in appetite hormones, short sleep duration also impacts decreased insulin sensitivity. Several studies examining metabolic indicators have found that adolescents who sleep less than 6–7 hours have higher fasting insulin levels, decreased insulin sensitivity, and increased blood glucose

levels. These conditions are early risk factors for metabolic syndrome in adulthood. The study "Shared Determinants of Poor Sleep, Obesity, and Adiposity" even showed that short sleep duration for 3–4 consecutive days is enough to alter glucose metabolism in adolescents.

In addition to short sleep duration, social jet lag has also shown a significant effect on obesity. Literature shows that adolescents with social jet lag of more than one hour experience a two-fold increased risk of obesity, while those with social jet lag of more than two hours increase the risk by three-fold. This mismatched sleep pattern not only affects sleep quality but also leads to excessive fatigue on school days, which then reduces physical activity and increases screen time to compensate for low energy. Several studies also show that social jet lag can impair decision-making, making adolescents more impulsive in their food choices, particularly fast food, sugary drinks, and high-calorie snacks.

Furthermore, there is strong evidence that device use before bed plays a significant role in triggering social jet lag. Adolescents who use their phones more than two hours before bed experience a 45–60 minute delay in sleep onset due to decreased melatonin production. This prolongs wakefulness and shifts sleep patterns to later hours. In the long term, this pattern exacerbates social jet lag and significantly increases the risk of obesity.

Sedentary Lifestyle and Screen Time as Risk Factors for Obesity. A literature review indicates that a sedentary lifestyle is a significant factor in the development of obesity in adolescents. Several studies have shown that adolescents can sit for up to 7–9 hours per day at school, plus 3–5 hours of screen time at home. This total sedentary time, which can reach more than 10 hours per day, causes a drastic decrease in daily energy expenditure and increases the tendency to snack during screen time. The study "The Influence of Screen Time and Sleep Duration on Obesity" showed that 65% of adolescents with screen time >4 hours per day experienced an increase in BMI from normal to overweight within one year.

Furthermore, the results of the study using latent class analysis showed that adolescents can be categorized into several lifestyle classes, such as "high sedentary-low sleep quality," "high screen time-low physical activity," and "irregular sleep-high sedentary group." The group with the combined characteristics of these poor behaviors showed the highest risk of obesity. This study confirms that

Interaction Between Sleep, Sedentary Lifestyle, and Daily Activity Patterns. The 24-Hour Movement Guidelines study and several school-based intervention articles indicate that adequate sleep, adequate physical activity, and low screen time should be viewed as a complementary combination of behaviors. Several studies have shown that adolescents who are sleep-deprived tend to have low levels of physical activity, while adolescents with high screen time are more likely to sleep late and wake up late. The combination of these behaviors demonstrates a much stronger negative synergy on obesity than either factor alone. Therefore, 24-hour behaviors, including sleep, activity, and sedentary behavior, must be understood holistically to assess obesity risk in adolescents.

Findings from various literatures indicate that sleep quality and sedentary lifestyle are interconnected behavioral determinants and play a key role in the development of obesity in adolescents. While nutritional factors and physical activity remain important, recent evidence confirms that adequate sleep and low sedentary behavior significantly contribute to daily energy balance.

Sleep Quality as a Fundamental Factor in Metabolic Regulation in Adolescents. Sleep quality plays a fundamental role in regulating physiological, hormonal, and metabolic functions in adolescents. Adolescence is a developmental transition period with rapid hormonal changes,

resulting in increased sleep requirements to support mental and physical growth and maturation. The reviewed literature shows that sleep disturbances, including difficulty falling asleep, restless sleep, insomnia, and sleep fragmentation, are closely associated with an increased risk of obesity (Gale et al., 2025). Poor sleep quality leads to activation of the stress system (HPA-axis), increased cortisol, and changes in insulin sensitization. Prolonged increases in cortisol can trigger fat accumulation, especially in the abdominal area. Furthermore, hormonal appetite regulators such as ghrelin increase when sleep is disturbed, while leptin a hormone that suppresses hunger decreases. This combination of hormonal changes leads adolescents to overeat, particularly consuming high-calorie and high-sugar foods as a form of energy compensation (Paulo et al., 2021).

Short Sleep Duration and Social Jet Lag as Predictors of Obesity. Short sleep duration has consistently been found to be one of the strongest predictors of adolescent obesity. Many teenagers experience shifts in sleep patterns due to academic pressure, excessive use of devices, and social activities at night. When teenagers sleep late, sleep duration is shorter and the next day's activities tend to be disrupted. Social jet lag, which is the difference in sleep times between school days and weekends, has a similar effect to jet lag during international travel. This imbalance in circadian rhythms has a significant impact on metabolic regulation. The reviewed studies indicate that social jet lag increases the risk of obesity through mechanisms such as disrupted eating rhythms, impaired glucose metabolism, and decreased energy expenditure. Teenagers experiencing social jet lag also tend to have irregular eating habits, such as skipping breakfast, eating late at night, and consuming fast food more frequently (Manuel et al., 2022).

Screen Time and a Sedentary Lifestyle Increase the Risk of Obesity. A sedentary lifestyle is not simply a lack of movement; it encompasses a variety of passive activities that require little energy, such as watching television, playing games, scrolling through social media, and sitting for long periods while studying. Studies from Ghana, Bangladesh, and other countries show that the time adolescents spend in front of screens has increased sharply in the past 10 years (Rodrigo-sanjoaquin et al., 2020). High screen time is often associated with two things: (1) increased calorie intake through snacking while watching TV, and (2) decreased physical activity, resulting in very low daily energy expenditure. Equally important, screen time is closely related to sleep quality. Blue light from screens inhibits melatonin production, disrupting sleep. When adolescents go to bed later due to screen time exposure, their sleep cycles are disrupted and indirectly increase the risk of obesity. The combination of sleep deprivation and sedentary activities is a dangerous pattern that is increasingly common among today's digital youth (Malik & Rahmadi, 2020).

Adolescents' Daily Activity Patterns as a 24-Hour Behavioral Unit. Recent research in adolescent health emphasizes that daily activity patterns must be viewed holistically within the concept of "24-Hour Movement Behavior." This concept states that sleep, physical activity, and sedentary behavior are three interconnected components. Findings from various journals indicate that adolescents who lack sleep tend to be less physically active because their bodies feel tired, lack energy, and prefer sedentary activities. Conversely, adolescents with high screen time tend to go to bed later, resulting in less energy in the morning and a reluctance to engage in activities. This three-way relationship confirms that obesity is not the result of a single behavior, but rather a complex interaction involving daily activity choices, sleep habits, and digital media use (Anam et al., 2022).

Evidence from Latent Class Analysis on Combination Patterns of Risk. Studies using Latent Class Analysis (LCA) provide a clearer picture of how sleep behavior, sedentary patterns, physical activity, and eating habits are shaped in specific groups. LCA shows that adolescents do not have a single risk factor, but rather a combination of certain behaviors that occur together. For example,

groups with high screen time often also have poor sleep quality and low physical activity. Groups with unhealthy dietary patterns are also often found to have short sleep duration. These results confirm that obesity in adolescents cannot be understood through a single variable, but through more complex lifestyle patterns.

The Role of Environmental, Family, and School Factors. Research results show that family and school environments have a strong influence on shaping adolescent sleep quality and physical activity. Parents with long work hours, irregular sleep patterns, or excessive screen time are more likely to have adolescents with similar sleep patterns. Schools lacking physical activity programs, busy schedules, or high academic pressure can encourage excessive sedentary behavior and sleep disturbances. Studies of school-based interventions show that programs that teach healthy sleep habits, limit screen time at night, and increase physical activity have a significant impact on reducing the risk of obesity (Porri et al., 2024).

Long-Term Health Implications. The combination of poor sleep behavior and a sedentary lifestyle not only increases the risk of obesity during adolescence but also has long-term impacts into adulthood. Obesity in adolescents is associated with the risk of hypertension, type 2 diabetes, metabolic syndrome, sleep apnea, and mental disorders such as depression and anxiety. Poor sleep quality during adolescence can also affect academic performance, concentration, memory, and mental health. Therefore, understanding these risk factors through a literature review is crucial as a basis for designing more effective interventions.

The Role of Emotional Regulation, Mental Health, and Psychosocial Stress in Sleep Disturbances and Obesity. Recent literature suggests that psychological dimensions such as stress, anxiety, and poor emotional regulation play a significant role in linking poor sleep quality to an increased risk of obesity in adolescents. Adolescence is a critical period characterized by intense emotional changes, high academic demands, and social pressures from peer groups and social media. These conditions can trigger chronic stress that disrupts sleep rhythms and slows down the quality of nighttime rest. Prolonged stress activates physiological mechanisms such as increased cortisol, which contributes to visceral fat density. Emotional distress also triggers emotional eating, the tendency to eat as a way to cope with emotional distress, typically involving the consumption of foods high in sugar or fat. Research across countries shows that adolescents with high levels of stress not only experience poor sleep quality but also exhibit a greater tendency towards obesity and unhealthy eating patterns. Therefore, psychosocial aspects need to be an integral part of understanding the complex relationship between sleep, a sedentary lifestyle, and obesity.

The Impact of Social Change, Urbanization, and Technological Development on Adolescent Sleep Patterns. Social and environmental changes in the past decade, particularly as a result of urbanization and the penetration of digital technology, have also impacted adolescent sleep patterns. In urban areas, exposure to artificial light at night, late-night activities, and unlimited access to digital devices make it more difficult for adolescents to maintain a healthy sleep routine. Urbanization also brings a fast-paced lifestyle that often increases academic pressure and educational competition, forcing them to reduce sleep time. Adolescents living in densely populated areas with high noise pollution are also more susceptible to sleep disorders. Research shows that exposure to nighttime disturbances and ambient light increases the risk of insomnia and decreases sleep duration. Therefore, the role of macro-environmental factors such as urban planning and the digital ecosystem is important in understanding the current dynamics of adolescent obesity.

Changes in Diet and Consumption Habits as an Indirect Impact of Sleep Deprivation. Sleep deprivation not only affects metabolism but also impacts adolescents' eating patterns and food preferences. Neurobiological studies reveal that sleep deprivation increases activity in brain areas that respond to high-sugar, high-salt, and high-fat foods. Teenagers who sleep less than 7 hours per night are more likely to skip breakfast and consume fast food during the day. Furthermore, they are more likely to eat late at night, which metabolically increases the storage of energy as fat. These irregular eating habits are exacerbated by excessive screen time, which encourages mindless eating, such as while watching videos or playing games. Research shows that snacking during screen time can increase daily calorie intake by 300–500 calories, which in the long term significantly increases BMI. This eating pattern is an important mediating factor in the relationship between sleep deprivation, a sedentary lifestyle, and obesity.

Genetic and Environmental Interactions in Shaping Obesity Risk in Adolescents. Several pieces of literature emphasize that the relationship between sleep and obesity is influenced not only by behavior but also by genetic predisposition. Adolescents with a family history of obesity are more sensitive to the negative effects of short sleep duration and screen time. Genes that regulate energy metabolism, such as the FTO (fat mass and obesity-associated gene), can increase a person's susceptibility to fat accumulation when sleep duration is suboptimal. However, genetic factors are not the sole determinants—environment and behavior still play a central role. Adolescents with a strong genetic predisposition who receive adequate sleep, controlled screen time, and adequate physical activity can still avoid obesity. Thus, gene-environment interactions need to be viewed from a broader perspective, especially in understanding the differences in adolescent responses to unhealthy sleep patterns and lifestyles.

Effectiveness of School-Based Interventions and the Social Environment in Preventing Obesity. Review results indicate that school-based interventions have significant potential to improve sleep patterns and reduce the risk of obesity in adolescents. Programs that include sleep education, limiting screen time before bed, stress management, and scheduling structured physical activity have been shown to have significant impact. Schools that implement shorter school hours, provide adequate sports facilities, and implement policies that reduce screen time during learning activities show significant improvements in students' sleep quality and physical activity levels. School-based interventions are more effective when supported by a conducive social environment, particularly the family. Parents who enforce screen time limits, provide a comfortable sleep environment, and encourage regular physical activity have been shown to reduce the risk of obesity in their adolescents. Therefore, a multilevel approach school, family, and community is needed to more comprehensively intervene on obesity risk factors.

4. CONCLUSION

Based on a review of various literature related to sleep quality, sedentary lifestyle, and obesity in adolescents, it can be concluded that these two behavioral factors contribute significantly and consistently to the increased risk of obesity in the 10–19 age group. The majority of studies indicate that short sleep duration, poor sleep quality, and irregular sleep patterns such as social jet lag play a role in affecting the regulation of metabolic hormones that control hunger, appetite, and energy balance. Sleep disturbances have been shown to increase ghrelin levels and decrease leptin, thus encouraging overeating, especially the consumption of high-calorie foods. Furthermore, irregular sleep rhythms also cause imbalances in glucose metabolism and insulin sensitivity, ultimately contributing to increased adiposity and the risk of obesity in adolescents.

Furthermore, a sedentary lifestyle has also emerged as a strong determinant of adolescent obesity. Findings from various journals indicate that high screen time, particularly with gadgets and television, is associated with low physical activity and increased food intake during passive sitting. High screen time is also closely linked to sleep quality, as exposure to blue light from digital devices can inhibit melatonin production, disrupting sleep. As a result, adolescents with high screen time not only spend more time sitting and reduce daily energy expenditure, but also experience poor sleep patterns, increasing the risk of obesity through multiple mechanisms.

Studies using latent class analysis show that combinations of behavioral risks such as insufficient sleep, excessive screen time, low physical activity, and unhealthy eating patterns tend to occur within a cluster of mutually reinforcing behaviors. This confirms that obesity is not caused by a single factor, but rather the result of a complex interaction between various aspects of adolescent lifestyle. Meanwhile, school-based research interventions highlight that programs to increase physical activity, healthy sleep education, and screen time interventions can help reduce these risk factors.

Overall, the reviewed literature indicates that sleep quality and a sedentary lifestyle are two interrelated behavioral factors that strongly contribute to obesity in adolescents. Obesity prevention and control efforts need to consider both factors together, rather than separately. A holistic, 24-hour, behavior-based approach integrating sleep, physical activity, and sedentary reduction should be a priority in future adolescent health policies.

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