



From screens to snacks: emerging risks fueling global adolescent obesity: A literature review

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ABSTRAK

Latar Belakang: Obesitas pada anak merupakan epidemi global dan masalah gizi utama di kalangan anak-anak. Hal ini ditandai dengan penumpukan lemak yang berlebihan atau abnormal yang dapat membahayakan kesehatan.

Tujuan: Studi ini bertujuan untuk menganalisis artikel-artikel yang berkaitan dengan faktor risiko obesitas pada anak dan remaja.

Metode: Metode yang digunakan dalam penulisan artikel ini adalah tinjauan pustaka dengan mencari artikel dari tiga basis data yaitu Scopus, Sage, dan PubMed Journals menggunakan model strategi PCC. Sebanyak 281 artikel diperoleh, penyaringan berdasarkan rentang artikel duplikasi tahun 2018-2023 menyisakan 52 artikel dan penyaringan kriteria kelayakan menyisakan 15 artikel. Artikel-artikel tersebut dinilai kualitasnya melalui penilaian kritis JBI, 3 artikel dikeluarkan dan 12 artikel relevan yang tersisa kemudian dianalisis dan disintesis.

Hasil: Faktor risiko yang diidentifikasi meliputi karakteristik sosial ekonomi dan demografis, riwayat medis sebelumnya, pola tidur, kebiasaan makan, kurangnya aktivitas fisik, dan waktu penggunaan layar yang berkepanjangan. Berbagai faktor yang dapat dimodifikasi dan tidak dapat dimodifikasi berkontribusi terhadap obesitas pada anak.

Kesimpulan: Pencegahan yang efektif memerlukan kolaborasi multi-sektoral antara sekolah, keluarga, penyedia layanan kesehatan, dan pembuat kebijakan untuk mempromosikan gaya hidup sehat dan meminimalkan faktor risiko ini pada anak-anak dan remaja.

KATA KUNCI: anak; faktor risiko obesitas; obesitas; remaja

ABSTRACT

Background: Childhood obesity is a global epidemic and a major nutritional problem among children. It is characterized by excessive or abnormal fat accumulation that may impair health.

Objectives: This study aimed to analyze articles related to risk factors for obesity in children and adolescents.

Methods: The method used in writing this article is a literature review by searching articles from three databases, namely Scopus, Sage, and PubMed Journals, using the PCC strategy model. A total of 281 articles were obtained; screening based on the range of 2018-2023, duplicate articles left 52 articles, and screening eligibility criteria left 15 articles. The articles were assessed for quality through JBI critical appraisal; 3 articles were excluded, and the remaining 12 relevant articles were then analyzed and synthesized.

Results: Identified risk factors included socioeconomic and demographic characteristics, previous medical history, sleep patterns, dietary habits, physical inactivity, and prolonged screen time. Various modifiable and non-modifiable factors contribute to childhood obesity.

Conclusions: Effective prevention requires multi-sectoral collaboration among schools, families, healthcare providers, and policymakers to promote healthy lifestyles and minimize these risk factors in children and adolescents.

KEYWORDS: adolescent; child; obesity; obesity risk factors

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INTRODUCTION

Childhood obesity has become an increasingly concerning global public health issue (1). The World Health Organization (WHO) in 2018 defines obesity as an excessive or abnormal accumulation of fat that can interfere with health (2). Obesity is a disorder that arises from a disturbance in the balance of energy regulation in the body. Obesity occurs when energy intake far exceeds energy use (3). This energy imbalance can result from a combination of factors and varies from one person to another (4). Obesity has become a worldwide epidemic, not only in adults but also in children (5).

The prevalence of overweight and obesity among children and adolescents aged 5-19 years has radically increased from just 4% in 1975 to more than 18% in 2016. The increase was similar among boys and girls, with 18% of girls and 19% of boys overweight in 2016 (6). About 55% of obese children will become obese in adolescence, about 80% of obese adolescents will remain obese in adulthood, and about 70% will become obese over the age of 30 (7). The percentage of obese toddlers (BB / TB) in the age group 0-59 months was 4.31%; in 2018, it increased to 4.60%, and in 2018 it was 8% (8). Childhood obesity is known to have a negative impact on physical and mental health. Being overweight or obese affects children's self-esteem and impairs social

development (9). Obese children are usually more likely to remain obese into adulthood and have chronic diseases such as diabetes, hypertension, cardiovascular disease, musculoskeletal disorders, and certain types of cancer (endometrial, breast, and colon) (6). Obesity has been associated with increased premature mortality and high incidence of degenerative diseases such as Type II diabetes mellitus, cardiovascular disease, hypertension, hyperlipidemia, and some cancers (10,11).

Several studies have found that among the risk factors for childhood obesity, eating patterns and habits are important predictors of overweight and obesity. Not only frequency or excessive portions of food, but also the habit of consuming junk food, high-calorie snacks, and foods and drinks high in sugar are related to the incidence of obesity (14,15). High sugar intake has been widely associated with an increased prevalence of childhood overweight/obesity. The risk of obesity is more than twofold greater in children and adolescents who have an added sugar intake of 10% or more of total energy intake per day (16). Although various risk factors have been identified, comprehensive reviews that synthesize these factors across different populations and settings remain limited. Therefore, this review aims to

systematically examine the risk factors associated with childhood and adolescent obesity.

MATERIALS AND METHODS

The references for this literature review came from three databases: Scopus, Sage, and PubMed Journals published between 2018 and 2023. The process of extracting this review article used specific clinical questions, abbreviated as PCC [Population (P), Concept (C), and Context (C)]. Population (P) is Children (age <18 years) adolescents and Concept (C) is related to obesity risk factors and Context (C) is a community setting. We used several keywords with a Boolean search: Children OR Child OR Adolescent AND Risk Factors of Obesity. The selection of articles in this study followed a method called Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), as shown in **Figure 1**.

The inclusion criteria in this study were articles: (1) articles describing risk factors for

obesity in children and adolescents; (2) research articles within the last 5 years (2018-2023); (3) open-access, full-text articles; (4) articles in English; (5) original articles or research articles. The exclusion criteria in this study were articles including children with certain conditions and articles that were protocol studies. All authors conducted the first screening and content analysis of the articles.

RESULTS AND DISCUSSIONS

This systematic review was conducted using a structured selection process, identifying 281 records from three databases. After excluding 229 articles during the automation and duplication screening process, the remaining articles were re-screened using the JBI criteria, resulting in 15 initial studies. Finally, following a critical appraisal, three articles were excluded as they did not meet the inclusion criteria, leaving a total of 12 studies included in the final review.

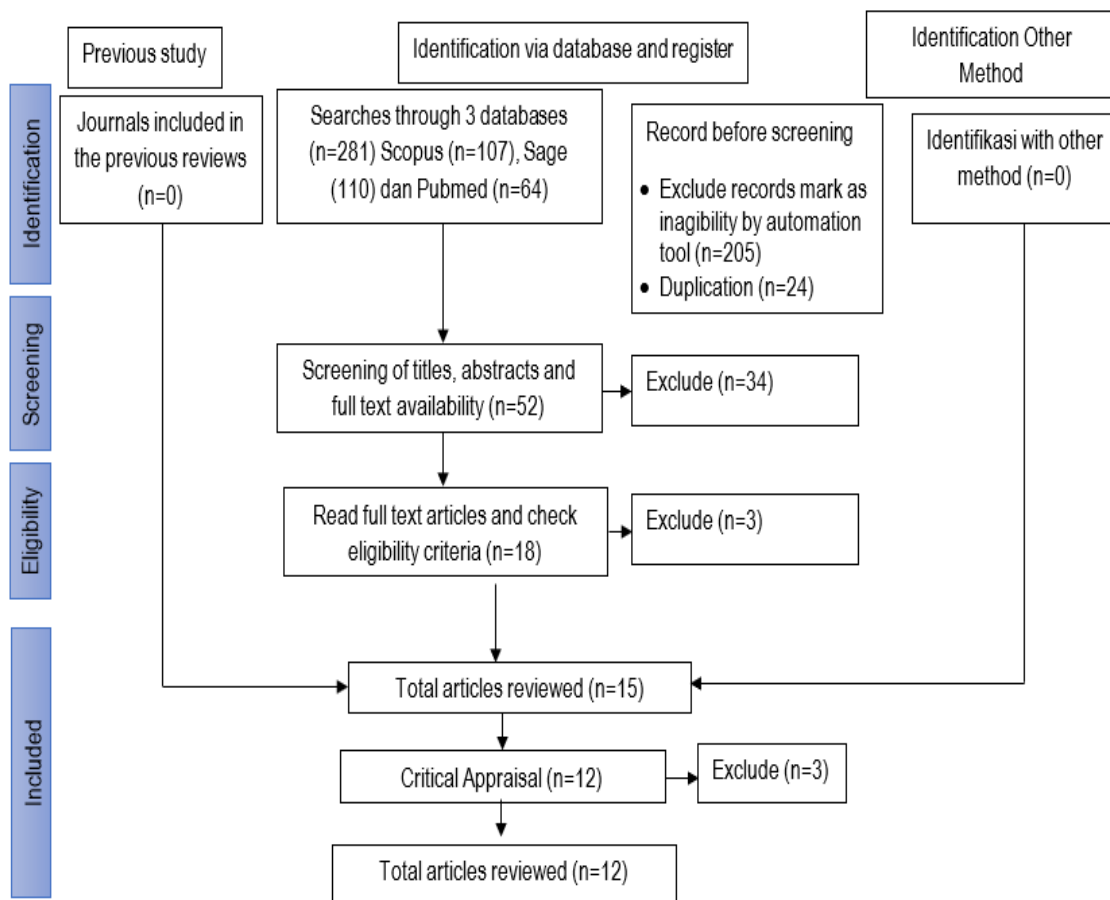


Figure 1. PRISMA Flow diagram of the study identification and selection process

Table 1. Comparative overview of outcomes across included articles

Authors, Years	Research Objective	Research method	n	Setting	Populations Research
Litsfeldt <i>et al.</i> , 2020	To investigate the relationship between sleep duration, overweight/obesity, and academic failure in school in adolescents.	Quantitatif (<i>Cross-sectional</i>)	1363 child	Junior high schools in four districts in Sweden.	Grade 7 and 8 children aged 13-15 years old. m
Lee <i>et al.</i> , 2019	To identify intergenerational risk factors contributing to obesity in children aged 24 to 80 months using national cohort data in South Korea.	Quantitative (<i>Cohort</i>)	1.001.775 Child	South Korea	The population was drawn from the Korean National Health Insurance (KNHI) database. The National Infants and Children Health Checkup (NICHHC) data is targeted at children aged 4 to 80 months, and their parents' health checkup records are obtained from the
Li <i>et al.</i> , 2018	To identify factors that commonly contribute to dental caries and obesity, and determine how dental caries affects excess body fat.	Quantitatif (<i>Cross-sectional</i>)	383 Child	45 secondary schools from 380 randomly selected schools in Hong Kong	Children aged 12-18 years.
Alqaoud <i>et al.</i> , 2021	To examine trends in the correlation between overweight or obesity correlation between skipping breakfast, sugary and sweetened drinks, and screen time in Kuwait.	Quantitatif (<i>Cross-sectional</i>)	4400 Child	8 health centers in six regions of Kuwait	Children aged 24-60 months recruited from 8 health centers in six regions of Kuwait at the time of vaccination from January 2015 to December 2018

Authors, Years	Research Objective	Research method	n	Setting	Populations Resarch
Choi <i>et al.</i> , 2022	To determine the influence of behavioral factors of 3-year-olds and 5-year-olds as well as child and family characteristics on the risk of obesity at age 5.	Quantitative (<i>Cohort</i>)	26,047 children from the 2017 national health screening program who had their sixth screening	Hospitals or health institutions designated as infant and child health screening centers	Mothers and children who are examined at hospitals or health institutions designated as infant and child health screening institutions.
Huang <i>et al.</i> (2021)	To examine the association between cesarean section (SC) birth and the risk of overweight/obesity in children before 4 years of age.	Quantitatif (<i>Cohort</i>)	10,150 mother-child	Cummunity	Mothers and children whose data were contained in the Medical Birth Registry of Xiamen (MBRX) from January 2011 to December 2012.
Purnama <i>et al.</i> , 2022	To determine the factors associated with the incidence of obesity in adolescents during the COVID-19 Pandemic in North Sumatra Province.	Quantitatif (<i>Cross-sectional</i>)	127 Teenagers	Schools (SMP, SMA, SMK, and University) of North Sumatra Province	The population of this study is all adolescents aged 15-23 years who are in junior high school, high school, vocational high school, and university.
Grace <i>et al.</i> , 2022	To assess the risk factors for obesity in adolescent school children	Quantitatif (<i>Case-control</i>)	220 Teenagers	School sampling method from the list of Senior Secondary Schools in the study area (Chrompet, an area in Chennai, India)	Adolescents (students) aged 10-17 studying in Chrompet, an area in Chennai, India
Skjåkødegård <i>et al.</i> , 2021	To analyze how children's sleep duration, sleep timing (including social jetlag) and sleep problems are related to obesity and behavioral factors known to cause childhood obesity.	Quantitative (<i>Cross-sectional</i>)	170 children consisting of 85 children with severe obesity and 85 children with normal weight	Children with severe obesity were recruited from the Obesity Outpatient Clinic, Haukeland University Hospital, Bergen, Norway, by referral. The normal weight group (BMI≤IOTF 25) was recruited from randomly selected schools in Bergen city.	Children (mean age 12.4 years, range 5.8-17.1 years)

Authors, Years	Research Objective	Research method	n	Setting	Populations Research
Chen <i>et al.</i> , 2022	To analyze a comprehensive set of potential risk factors of obesity and overweight among Chinese children of different ages and with wide geographical coverage.	Quantitative (<i>Cross-sectional</i>)	193,997 healthy children and adolescents consisted of 102,178 boys and 91,819 girls	11 provinces, autonomous regions, and municipalities that geographically represent western, southern, eastern, northern, and central China (Community).	Healthy children and teenagers
Grace <i>et al.</i> , 2021	To assess nutritional factors associated with obesity in case and control group adolescents.	Quantitative (<i>Case-Control</i>)	110 obese adolescents (intervention group) and 110 non-obese adolescents (control group).	16 in Kancheepuram Urban Area Senior Secondary School.	The research population included school children between the ages of 10 and 17, studying in standard V to standard XII.
Jijin Hu <i>et al.</i> , 2019	To evaluate the association between early childhood overweight/obesity status and TV viewing time, and further investigate age differences in the association, a community-based paired case-control study was conducted in China.	Quantitatif (<i>Case-control retrospektif</i>)	The study included 933 children aged 1-5 years who were individually matched in a 1:2 (case: control) ratio by age and community, involving 311 overweight and obese children and 622 normal weight control subjects.	Community: a community healthcare center in Shenyang, Liaoning Province.	The study was conducted at 72 community healthcare centers in Shenyang, Liaoning Province.

Table 2. Synthesis of key results and major conclusions from selected studies.

Authors, Years	Research Sample	Result
Litsfeldt <i>et al.</i> , 2020	1363 Students in grades 7-8 aged 13-15 in four counties in southern Sweden	The results showed that short sleep duration (<7 hours) was associated with overweight/obesity ($p = 0.001$), academic failure at school ($p = 0.007$), and poorer economic conditions ($p = 0.004$).
Lee <i>et al.</i> , 2019	1,001,775 data points taken from the Korean National Health Insurance (KNHI) database on children aged 24 to 80 months	The results showed that the prevalence of obesity was 6.57%, while the prevalence of overweight was 11.31% among the entire study population. There were 17 groups with a higher prevalence of childhood obesity than the average prevalence, which were classified as high-risk groups for childhood obesity. 6 groups had a prevalence of childhood obesity that was twice as high as the average prevalence from this study. The best predictors were as follows: mothers who were obese before conception, fathers who were obese, not receiving medical assistance, and mothers with hypertension during pregnancy.
Li <i>et al.</i> , 2018	383 secondary school students from 45 schools in Hong Kong	The results obtained show that the mean (standard deviation, SD) of BMI, WC, WHR, WHtR, TRSKF, and DMFT are 21.26 (3.72), 69.11 (9.25), 0.77 (0.06), 0.42 (0.05), 15.72 (6.33), and 2.06 (2.43), respectively. Men were more likely to be overweight/obese than women. Various factors, including gender, parental employment status, mouthwashing habits, frequency and amount of meat consumption, frequency of oil consumption, use of fluoride toothpaste, and DMFT, were found to be significant ($p < 0.05$) in different final models for adiposity status.
Alqaoud <i>et al.</i> , 2021	4400 children	The results showed that there was no significant decrease (p values ≥ 0.12) found for overweight and obesity. Conversely, skipping breakfast, consuming sugary drinks and those containing sweeteners, and screen use were found to have a significant decrease ($p < 0.0001$). Skipping breakfast was found to have a 31% lower risk of overweight. Watching TV daily for 2–3 hours increased the likelihood of obesity by up to 5.6 times.
Choi <i>et al.</i> , 2022	26,047 children from the 2017 national health screening program who underwent the sixth screening (at the age of 5)	Female children, birth weight over 4 kg, a 'caution/referral' statement during developmental screening at ages 3 and 5, maternal obesity, and middle-income status are risk factors for obesity in the subjects of this study. Good appetite, high milk consumption, high intake of sweet foods at age 3, eating quickly, irregular meal and

Authors, Years	Research Sample	Result
		snack times, large portion sizes, high intake of fatty and salty foods, and lack of physical activity at age 5 are also considered significant risk factors.
Huang <i>et al.</i> , 2021	10,150 mother and child	The results showed that children aged 1 to 4 years old, BMI Z-scores, and the risk of overweight/obesity in children born via C-section were higher than those born vaginally. Longitudinal analysis of anthropometric measurements assessed during study visits in children aged 1 to 4 years born via CS showed that after adjusting for various effect factors, there was a change in BMI Z-scores of 0.04 (95% CI: 0.01–0.09, $p = 0.003$), significantly higher than children born vaginally, and the risk of overweight/obesity incidence increased by 8% in children born via CS; OR = 1.08 (1.01–1.21, $p < 0.05$).
Purnama <i>et al.</i> , 2022	127 teenagers residing in North Sumatra Province	There is a significant association between fast food consumption patterns and the incidence of obesity among adolescents during the COVID-19 pandemic ($p = 0.018$; PR = 1.575)
Grace G <i>et al.</i> , 2022	220 teenagers	Having obese parents. The statistical test results obtained (OR: 2.62, p -value: 0.003) Increased waist-to-hip ratio. In this study, the case group had a significantly abnormal waist-to-hip ratio compared to the control group (OR: 5.24, p -value < 0.0001) Lack of exclusive breastfeeding. Statistical test results obtained (OR: 3.43, p -value < 0.0001)
Skjåkødegård <i>et al.</i> , 2021	170 children consisting of 85 children with severe obesity and 85 children with normal weight	The group of children with obesity and children with normal weight was balanced in terms of age, gender, and ethnicity. Children with severe obesity had significantly later bedtimes (on average 36 minutes later, $P < .001$) as well as on the night before school (36 minutes later, $P < .001$) and on weekend nights (39 minutes later, $P = .002$). Children with obesity more frequently experienced sleep problems (28.0% vs. 20.9% in children with normal weight, $P = .03$).
Chen <i>et al.</i> , 2022	193,997 healthy children and adolescents, consisting of 102,178 boys and 91,819 girls	Parents with overweight (Children with normal weight = Father (4.4%) and Mother (1.6%) vs Children with obesity = Father (9.3%) and Mother (3.6%), premature birth (Children with normal weight = 5.0% vs Children with obesity = 5.4%), and longer breastfeeding (> 10 months) (Children with normal weight = 31.0% vs Children with

Authors, Years	Research Sample	Result
		obesity = 36.3%), macrosomia (Children with normal weight = 8.4% vs Children with obesity = 12.9%)
Grace <i>et al.</i> , 2021	The required sample size was calculated as 110 obese adolescents (cases) and 110 non-obese adolescents (controls).	The risk factors statistically associated with adolescent obesity were increased fast food intake, consumption of sweet foods, inadequate fruit intake, and parental freedom in purchasing snacks.
Jijin Hu <i>et al.</i> , 2019	This study involved 933 children with the following ratio: 311 overweight and obese children and 622 normal weight control subjects.	Watching TV for more than 1 hour is positively associated with the prevalence of unhealthy behaviors related to TV viewing ($P < 0.05$). After controlling for this behavior, the association between TV viewing and overweight/obesity status in childhood was significant among children aged 4 to 5 years (odds ratio, OR = 1.72, 95% confidence interval, CI: 1.16–2.54), but not significant among children aged 1 to 3 years.

Table 1 shows that childhood obesity is a multifactorial issue driven by lifestyle habits such as poor diet, high screen time, and sleep disturbances alongside critical familial and developmental factors, including parental obesity, socioeconomic status, birth weight, and early feeding practices. In **Table 2**, included studies collectively identify childhood obesity as a multifactorial condition influenced by diverse determinants. Key risk factors include familial and genetic backgrounds, such as parental obesity, socioeconomic status, and maternal health during pregnancy. Dietary and lifestyle habits are also significant, with studies highlighting the impacts of fast food, sugary drinks, irregular meals, screen time, and sleep disturbances on obesity prevalence. Finally, early-life and developmental markers, including birth weight, mode of delivery, and breastfeeding duration, further contribute to a child's long-term metabolic health and obesity risk.

Six of the twelve included studies highlight the multifactorial nature of childhood obesity, identifying significant socioeconomic, demographic, and early-life determinants. Key risk factors include unstable family structures, parental obesity, and varying parental educational and employment backgrounds, as well as higher household income, which may increase exposure to energy-dense foods. These conditions contribute to psychosocial stress, emotional eating, and unhealthy lifestyle habits. Furthermore, early-life factors such as cesarean delivery, birth weight, prematurity, and breastfeeding practices are associated with increased obesity risk, potentially influencing long-term metabolic programming (21, 22). Other noted factors include female sex and a history of developmental screening (23), though the mechanisms behind the latter require further investigation.

Sleep plays an important role in maintaining metabolic homeostasis. Insufficient sleep disrupts appetite-regulating hormones by increasing ghrelin levels while reducing leptin secretion, resulting in increased hunger and caloric intake. Sleep deprivation is also associated with fatigue, reduced physical activity, and greater screen exposure during evening hours, further reinforcing unhealthy behavioral patterns (13,24,25). These findings highlight adequate sleep duration as an important target for obesity prevention. Dietary behaviors emerged as the most consistently reported risk factor, with seven of the twelve studies identifying unhealthy eating patterns as major contributors to childhood obesity. Frequent consumption of organ meats, fast food, sugary foods, and inadequate fruit intake were positively associated with obesity. Skipping breakfast and permissive parental attitudes toward snack purchasing also increased obesity risk, whereas higher whole-grain consumption appeared to be protective.

These findings reinforce existing evidence that excessive consumption of energy-dense, nutrient-poor foods leads to positive energy balance and weight gain. Breakfast skipping has repeatedly been associated with increased caloric intake later in the day and poorer dietary quality (26–28). Similarly, inadequate fruit and vegetable intake reduces dietary fiber consumption, resulting in decreased satiety (29). High consumption of sugary snacks not only contributes to obesity but is also associated with adverse oral health outcomes (30). Collectively, these findings suggest that improving dietary quality should remain a primary focus of childhood obesity prevention strategies. Insufficient physical activity was consistently identified as an important behavioral risk factor. Children and adolescents who engaged in limited physical activity or lacked regular exercise demonstrated a higher likelihood of obesity. Regular physical activity contributes to maintaining energy balance through increased energy expenditure while supporting cardiovascular fitness and metabolic health. Adolescents participating in moderate-to-vigorous physical activity exhibit significantly lower obesity prevalence compared with those performing only light-intensity activities (31). Nevertheless, one

population-based study conducted in China reported no significant association, potentially reflecting differences in study methodology, measurement approaches, or regional characteristics (19). Despite these variations, the overall evidence supports physical activity as a protective factor against childhood obesity.

Extended screen time was associated with sedentary behavior, unhealthy eating patterns, and increased body weight. Digital media exposure may influence obesity through several pathways. Prolonged sedentary behavior reduces daily energy expenditure, while exposure to digital food marketing increases children's preference for energy-dense foods. Screen use during meals often encourages mindless eating and greater consumption of high-calorie snacks (19,27,32,33). Furthermore, excessive screen time may delay bedtime and shorten sleep duration, thereby indirectly increasing obesity risk (34–37).

CONCLUSION AND RECOMMENDATION

This literature review highlights the complex nature of childhood obesity, emphasizing the need for comprehensive prevention strategies. To effectively address these risk factors, it is essential to foster collaboration among parents, schools, healthcare providers, and policymakers in promoting healthy lifestyles through education, structured physical activities, balanced nutrition, and screen time management. Strengthening public health initiatives and conducting further longitudinal research will be crucial to develop evidence-based interventions and reduce the prevalence of obesity in children and adolescents.

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