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REVIEW

Risk Factors of Overweight and Obesity Among School Children Aged 6 to 18 Years: A Scoping Review

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Aim: Obesity is currently one of the main health problems and represents a challenge for health education programs. Experts point out that obesity is becoming a global epidemic as the number of children suffering from obesity has increased at alarming rates in developing and developed countries. The main objective of this scoping review was identifying the risk factors for overweight and obesity in school children aged 6 to 18 years.

Methods: Included articles were published between January 1993 and June 2022, written in English, and focused on school children aged 6 to 18 years. The search was performed using PubMed, CINAHL, and Embase databases. In total, 153 articles were included in the final qualitative analysis of the study findings.

Results: The findings of this scoping review showed that the risk factors for overweight and obesity are mainly categorized into socioeconomic and household factors, environmental factors, behavioral factors, and biological factors. In addition, the interaction between these factors was found to be a significant risk factor for overweight and obesity among school children aged 6 to 18 years.

Conclusion: The study underscores the need for targeted, school-based interventions to address the risk factors contributing to overweight and obesity among school children aged 6 to 18 years. These interventions should include curriculum-embedded education about healthy eating and physical activity, fostering an environment that promotes healthy food choices and regular exercise, and incorporating behavioral modification strategies.

Keywords: overweight, obesity, risk factors, school children, scoping review

Introduction

Disease patterns are undergoing significant changes worldwide, capturing the interest of different healthcare professionals and policymakers.[1] This is especially noticeable in low- and middle-income nations, which comprise a large portion of the global population.[2] Within these regions, obesity has become a widespread epidemic, affecting more than 1 billion individuals who are categorized as overweight, and at least 30% of them are classified as obese.[3] Excess weight and obesity pose major public health challenges, significantly contributing to a range of long-term illnesses, disabilities, and premature death.[4]

In the last ten years, there has been a significant rise in the occurrence and severity of obesity in children globally, although the extent of the issue varies widely across and within nations.[5,6] Therefore, the emerging obesity epidemic and its related health problems impose a considerable public health challenge, with significant economic and societal implications.[7,8]

The global epidemic of obesity has impacted individuals of all age groups. There are approximately 22 million children under the age of five who are overweight or obese worldwide, indicating that around 10% of school children globally are affected.[9] While overweight and obesity among children initially emerged in developed countries during the late 1980s, it has more recently become a problem in the developing world as well. The prevalence of overweight and obesity in children is

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increasing globally, although the rate of change varies significantly among different countries.[10,11] The International Obesity Task Force (IOTF) recently reported a decade-long increase in obesity rates among children worldwide.[12] According to data from the IOTF, the highest rates of childhood obesity are found in developed regions such as North America and Western Europe, but the rates are rapidly rising in many middle- and low-income countries.[13] Additionally, a 2013 report by the World Health Organization (WHO) indicated that in 2011, over 40 million children under the age of five were overweight, with approximately 35 million of them residing in developing countries.[14,15] Consequently, obesity is no longer limited to high-income countries but is also spreading at a much faster pace in low- and middle-income countries.[13,16]

The World Health Organization (WHO) has drawn significant attention to investigating the global health issues that arise in nations that are undergoing a dramatic shift in their economies and nutritional patterns, especially in developing countries that have seen economic growth and an increase in people's living standards, which has led to a switch from undernutrition to overnutrition issues.[17]

Overweight and obesity among school-aged children (6 to 18 years) presents unique challenges and potential repercussions for individual health, academic success, and societal implications. The dynamic environment that school-going children inhabit - encompassing not only the home but also the school and wider community - creates a complex array of factors that contribute to their weight status.[18,19] The situation is particularly alarming, considering that unhealthy weight gain during this stage is associated with a higher risk of remaining overweight or obese in adulthood, resulting in elevated lifelong risk of non-communicable diseases, such as cardiovascular diseases, type 2 diabetes, and certain types of cancer.[20,21] Moreover, childhood overweight and obesity can also impact mental health, academic performance, and social relations, further affecting the child's overall quality of life.[22]

In addition to the health implications, the rise in childhood overweight and obesity rates presents a burden to health systems and economies globally.[23] The cost implications include both direct costs related to healthcare needs and indirect costs linked to lost productivity in later life. This increasing burden is particularly concerning for low- and middle-income countries, where resources are already scarce, and healthcare systems are often under considerable strain.[24] Meanwhile, the rapidly changing food environments, marked by increased availability and promotion of energy-dense and nutrient-poor foods, and shifting activity patterns due to urbanization, technology, and changes in transportation, have been particularly influential on the weight status of school-aged children.[25,26] Therefore, understanding the risk factors of overweight and obesity specific to this age group is essential for planning effective interventions and public health strategies. These points underscore the need for this scoping review, focused on the risk factors of overweight and obesity among school children aged 6 to 18 years.

To date, there is a paucity of studies exploring the risk factors of overweight and obesity among school children aged 6 to 18 years. Therefore, the overwhelming concern of the present scoping review is to identify the risk factors of overweight and obesity among school children aged 6 to 18 years and to generate a conceptual model illustrating the categories of risk factors of overweight and obesity among school children aged 6 to 18 years.

Methods

Identifying Research Question

This scoping review sought to answer the following research question:

What are the Risk Factors of Overweight and Obesity Among School Children Aged 6 to 18 Years?

Throughout this scoping review, we aimed to identify the risk factors of overweight and obesity among school children aged 6 to 18 years in order to generate a conceptual model illustrating the categories of risk factors of overweight and obesity among school children aged 6 to 18 years.

Search Strategies and Information Sources

Articles published in May 2022 were searched using PubMed, CINAHL, and Embase databases. These databases were comprehensively searched to identify relevant studies. The keywords used in the search process were: "Risk factors", "Obesity", "Overweight", "Dietary behaviors", "School", "Children." There were no limitations to the publication date. However, only articles published in English were included in this search. In addition, the inclusion criteria included all studies addressing the risk factors for dietary behavior change among school children aged 6 to 18 years. The following search equation was used: (("Risk factors" [Title/Abstract] OR "Obesity" [Title/Abstract] OR "Overweight" [Title/Abstract] OR "Dietary behaviors" [Title/Abstract]) AND ("School" [Title/Abstract] AND "Children" [Title/Abstract])) AND "English" [Language].

Inclusion Criteria

We included studies exploring the risk factors for overweight and/or obesity among school children aged 6 to 18 years, irrespective of the research design. In addition, editorials, commentary articles, online sources, and letters to editors discussing the risk factors of overweight and obesity among school children aged 6 to 18 years were included in this scoping review. Moreover, we considered only articles published in English.

For this scoping review, we employed certain exclusion criteria to maintain focus and quality of research. Studies not pertaining to the specific age group of 6 to 18 years were omitted. Research not directly exploring risk factors for overweight and/or obesity was also excluded. Additionally, articles published in languages other than English were not considered due to potential translation limitations. We disregarded any unpublished material or gray literature, including dissertations, conference proceedings, and reports, due to their less rigorous peer-review processes. Lastly, editorials, commentary articles, online sources, and letters to the editor were included only if they provided significant insight into the risk factors of overweight and obesity among school children aged 6 to 18 years; otherwise, they were excluded. These exclusion criteria ensured the precision and relevance of our review findings.

Study Screening, Study Selection, and Data Extraction

A total of 2.351 articles were retrieved through database searches, and 11 studies were identified through other sources. A total of 2.173 records were retrieved after duplicates were removed using Mendeley software. In total, 318 full-text articles were assessed for eligibility. Of the 318 articles, 165 were excluded (115 records had a population of preschool children, 21 were not risk factors for overweight and/or obesity, 18 were published in languages other than English, and 11 were published in non-peer-reviewed journals). Finally, 153 articles were included in the qualitative analysis (Figure 1).

To ensure a systematic and robust review of the literature, we adhered to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines for our scoping review. The PRISMA approach provided a detailed 27-item checklist and four-phase flow diagram that guided our selection process, from the initial literature search to the final selection of articles for inclusion. This ensured the transparency, completeness, and reliability of our review process. We commenced with an extensive literature search, followed by the elimination of duplicates, initial screening based on titles and abstracts, and finally, a thorough full-text review for eligibility (Figure 1).

Furthermore, the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist was employed to ensure the quality of the studies included in our review. STROBE provides critical guidelines for reporting observational studies, enhancing the accuracy and comprehensiveness of our data extraction and analysis. Each study selected for our review was evaluated using the STROBE checklist, which covered aspects like study design, setting, participants, variables, data sources, bias, study size, statistical methods, and results. Studies not meeting the criteria were excluded to ensure the high quality and validity of our findings. Through the application of the STROBE checklist, we were able to maintain the rigorous standards necessary for this review.

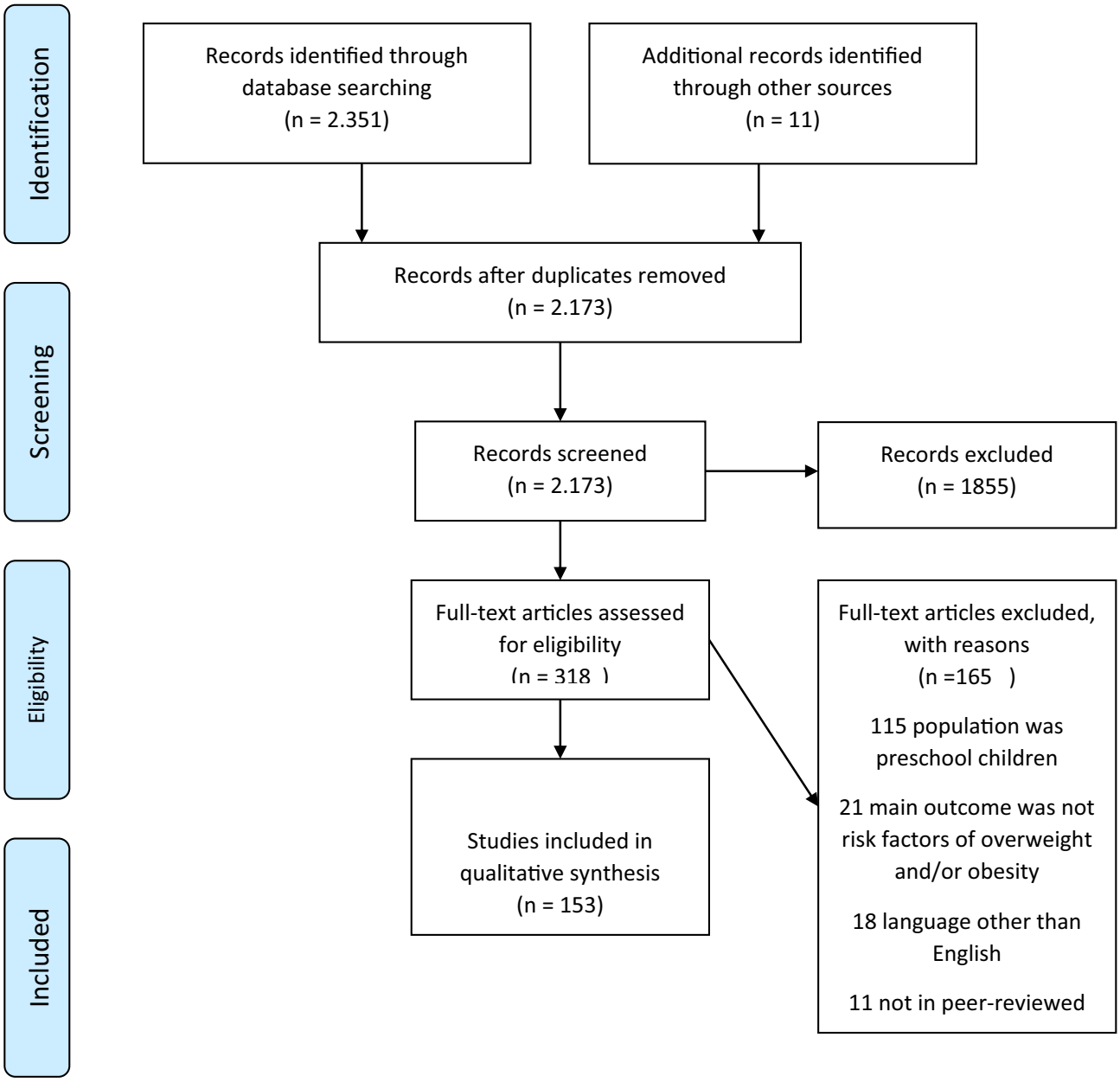

Figure 1 A flow chart of the search process.

Results

Description of the Studies

Among the 153 studies included in the data synthesis process, 52.3% (n=80) were conducted in Asia, 20.9% (n=32) in Europe, 8.5% (n=13) in Africa, 5.9% (n=9) in North America, 4.6% (n=7) in South America, 1.3% (n=2) in Australia, and 6.5% (n=10) remained undetermined.

With regard to the design of the studies, it was found that 117 studies were cross-sectional studies, 9 were case-controlled studies, 9 were narrative reviews, 5 were systematic reviews, 4 were longitudinal studies, three were cohort studies, two were prospective studies, one quasi-experimental study, one descriptive transversal study, one scoping review, and one qualitative study. Exploring the year of publication of the included studies revealed that 54 studies were published before 2011 and 99 studies were published between 2011 and 2021. In addition, the minimum and maximum ages in the included studies were one and 19 years, respectively (Table 1).

Table 1 Description of the Included Studies (n=153)

Parameter	F (%)
Year of publication	
1. **Before 2000**[18–24]	7 (4.6)
2. **2001 –2010**[25–71]	47 (30.7)
3. **After 2010**[5,11,72–165]	99 (64.7)
Geographical Area	
1. Europe	32 (20.9)
2. Asia	80 (52.3)
3. Africa	13 (8.5)
4. North America	9 (5.9)
5. South America	7 (4.6)
6. Australia	2 (1.3)
7. Undetermined	10 (6.5)
Research Design	
1. Cross-sectional	114
2. Case-control	10
3. Systematic Review	5
4. Narrative Review	8
5. Other	16

Abbreviations: F, Frequency; %, Percentage.

Risk Factors of Overweight and Obesity Among School Children Aged 6 to 18 Years

The emergence of childhood obesity and overweight is caused by several factors. Genetic, behavioral, environmental, cultural, and socioeconomic factors interact to influence weight gain. Age, sex, developmental status, and ethnicity were the other variables that affected the amount of body fat. Although inherited contributing factors to inter-individual variability in BMI, the majority of people experience overweight and obesity as a result of excessive calorie consumption and/or insufficient regular exercise. A review of the included studies revealed a number of risk factors that contribute to overweight and obesity among schoolchildren. In this scoping review, we identified four main themes of risk factors influencing overweight and obesity among schoolchildren as follows:

Socioeconomic and Household Factors

A total of 85 out of 153 extracted studies reported research-based evidence that socioeconomic and household factors are risk factors for overweight and obesity among school children aged 6 to 18 years. For instance, Rachmi et al[5] reported that the living area, income, and educational level of both parents are risk factors for overweight and obesity among school children with obesity. In addition, Wang et al[138] explored the risk factors of overweight and obesity in a sample of 1544 Chinese children aged 6–17 years. They reported that sex was a risk factor for overweight and obesity among Chinese school children. In another cross-sectional study carried out by Hadhood et al[125] in Egypt, a sample of 711 school children aged 6–14 years was recruited. The study found that living in urban regions, a low level of mother's education, formula feeding, and a lack of both vegetables and fruits in diets. Moreover, Paduano et al[156] conducted a cross-sectional study of a sample of 588 school children aged 6 to 7 years and found that the presence of a family history of overweight and obesity, low level of parental education, skipping breakfast meal, and parental beliefs about dietary behaviors are significant risk factors for overweight and obesity among school children. In addition, Karki et al[148] conducted a cross-sectional study on a sample of 575 Nepali school children aged 6 to 13 years. The study found that gender, educational level of both parents, mother's work, and sedentary lifestyle were risk factors for overweight and obesity among school children. Furthermore, Johnson et al[147] provided research-based evidence by conducting a systematic literature review on the risk factors of overweight and obesity among school children and found that

screening of 24 studies, living in a poor region, and limited access to food stores were significant risk factors for overweight and obesity among school children.

Environmental Factors

Among the 153 studies reviewed, 22 studies reported environmental factors as risk factors for overweight and obesity among school children. For example, Jia et al[124] conducted a secondary data analysis of 1648 school children aged 7 to 18 years in China and identified the school environment and policies as risk factors for overweight and obesity. Similarly, Lafta and Kadhim[36] conducted a study in Iraq with 8300 school children aged 7 to 13 years, and their findings indicated that birth rank and certain dietary and lifestyle practices were risk factors for overweight and obesity among Iraqi school children. Another study by Wang et al[11] examined 894 school children aged 9 to 12 years in China and found that paternal overweight, maternal overweight, and shorter sleep duration were significant risk factors for overweight and obesity in Chinese school children. Several studies have identified various environmental risk factors for overweight and obesity among school children aged 6 to 18 years. For instance, Jia et al[124] found that the school environment and policies were risk factors for overweight and obesity among school children in China. Lafta and Kadhim[36] reported that birth rank and certain dietary and lifestyle practices contributed to overweight and obesity among Iraqi school children. Wang et al[11] discovered that paternal and maternal overweight, as well as shorter sleep duration, were significant risk factors for overweight and obesity among Chinese school children. Murer et al[118] revealed that parental activities, including dietary behavior-related activities, parents' nationality, and media consumption, were risk factors for overweight and obesity among school-aged children in Switzerland. Additionally, Shi et al[92] found that maternal smoking during pregnancy and birth weight were significant risk factors for overweight and obesity among Canadian school-aged children. Furthermore, Bingham et al[96] identified maternal smoking during pregnancy, TV watching, and playing video games as risk factors for overweight and obesity among Portuguese school-aged children in a cross-sectional study.

Biological and Developmental Factors

A total of 43 of 153 studies reported that biological and developmental factors are risk factors for overweight and obesity among school children aged 6 to 18 years. For instance, Chi et al[123] conducted a scoping review study and found that non-modifiable risk factors for obesity among school children included both biological and developmental factors such as genes, developmental conditions, and puberty. In addition, Corica et al[139] conducted a cross-sectional study of 260 Italian school children aged 2.4–17.2 years and found that a family history of obesity and cardiometabolic diseases was a risk factor for overweight and obesity. Moreover, Teixeira et al[127] found that metabolic risk factors, such as hypertriglyceridemia and hyperglycemia, are among the biological risk factors of overweight and obesity among school-aged children. Furthermore, Ahrens et al[128] conducted a population-based cohort study on a sample of 16,228 school students aged 2–9 years and found that bone stiffness, genetic susceptibility, and specific metabolic biomarkers were significant risk factors for overweight and obesity among European school children. In a study by Blair et al, it was found that among school children aged 1 to 7 years, birth weight and rapid weight gain in infancy were risk factors for overweight and obesity. Also, Stettler et al[25] found that among school children aged 4.5 to 17.4 years in Seychelles, weight gain during the 1st year of life and increased maternal BMI were significant risk factors of overweight and obesity among school children aged 4.5 to 17.4 years.

Interaction Between Socioeconomic and Household, Psychosocial, Biological and Behavioral Factors

A total of 65 out of 153 studies reported that the interaction between two or more socioeconomic factors and household, psychosocial, biological, and behavioral factors are risk factors for overweight and/or obesity among school children. For example, Agustina et al[164] study in Indonesia reported that sedentary lifestyle, male sex, lower educational level, married, younger age, and residence in urban areas were all risk factors that interacted to increase the risk of overweight and obesity among school children. In another study by Aljassim & Jradi,[162] it was reported that the interaction between socioeconomic and household, environmental and behavioral factors, specifically; unemployed father, overweight/obese father, inappropriate father's perceptions, mode of delivery, lack of physical activity, watching TV, and frequent

snacking, were significant risk factors that increase the likelihood of overweight and obesity among school children. Moreover, Danquah et al[158] reported that the interaction between parents' economic status, sex, consumption of highly refined foods, age, parents' educational level, lack of physical activity, type of school, time spent watching TV, size of household, vitamin D deficiency, and having a diabetic parent were all risk factors associated with overweight and obesity among school-aged children.

Discussion

The present scoping review delineated the risk factors contributing to overweight and obesity among school children aged 6 to 18 years, through an analysis of 153 global studies. The risk factors were found to be encompassed in four major themes: socioeconomic, household, environmental, and biological factors. It was observed that these themes often interact, culminating in a heightened risk for obesity among children.

The influence of environmental factors on obesity is substantial, as it relates to the behavioral or lifestyle characteristics that determine energy expenditure. The prevalence of obesity and overweight is not solely a byproduct of hereditary factors; the disparities seen across different demographics and ethnicities are multifaceted.[53,120,137,166] Despite the fact that genetics and family history contribute significantly to obesity, contemporary advancements in technology have also exacerbated the issue. A noteworthy increase in obesity rates among a genetically consistent population points to the substantial role played by environmental elements. This is further supported by research evidence suggesting that lifestyle modifications are responsible for half of the overweight and obesity cases.[166,167] As a result, environmental conditions and lifestyle choices are crucial elements influencing the progression and severity of obesity, particularly in genetically predisposed individuals.[168]

Children today find themselves in an "obesogenic" environment, where an imbalance between calorie intake and expenditure, spurred by various factors, reigns. This setting promotes overconsumption of energy-dense foods while discouraging regular physical activity.[169] A sedentary lifestyle, coupled with larger food portions and high-fat, sugar-rich diets, poses a significant risk.[170] Evidence from cross-sectional studies highlight how decreased energy expenditure and insufficient physical activity among children are linked to a higher risk of obesity.[13,106,122,135]

Concurrently, eating habits have also emerged as critical environmental risk factors. Children's diets have shifted significantly over time, with more emphasis on snacking than balanced meals.[41,55,69,94,129] This tendency towards high-calorie snack foods, especially when consumed outside the home, increases the risk of obesity. Moreover, binge eating episodes further exacerbate this situation by promoting consumption of even more energy-dense meals or overall increased food intake.

Socioeconomic and cultural factors serve as significant influences, especially in industrialized nations. Lower education and socioeconomic status correlate with higher obesity rates, as they limit an individual's ability to navigate an obesity-promoting environment.[171,172] Children from lower-income families face issues of food security, limited access to healthy food options, and inadequate spaces for physical activity, thus becoming more vulnerable to excessive weight gain.[173]

Household factors, especially sociocultural practices impacting energy expenditure, are influential in the prevalence of obesity. Culturally specific food preferences, family encouragement of physical activity, or the absence thereof, can significantly affect a child's weight.[174]

Biological factors also play a crucial role in the development of childhood obesity.[175] Rapid weight gain during the first two years of life or during infancy, periods marked by increased fat cell accumulation and growth rate alterations, are strongly correlated with a subsequent risk of obesity.[176,177]

Over the last decade, the relationship between breastfeeding and childhood obesity has garnered substantial interest. Research has pointed towards an inverse correlation between breastfeeding and weight gain, further emphasizing the biological aspects of obesity development.[178,179]

Other significant environmental factors include screen time and sleep duration. Numerous studies highlight a positive correlation between prolonged screen time and body fat, marking media consumption as a marker of sedentary behavior.[180,181] Inadequate sleep, a variable with substantial influence over neuroendocrine function and glucose metabolism, also contributes to an increased risk of obesity.[151,152]

Despite the significant findings of this study, there are several limitations. One limitation is that the included studies were not subjected to the assessment of risk of bias, which might have led to the inclusion of misleading findings from studies that included methodological flaws, especially systematic literature reviews. Another limitation is that the present study focused on previous studies published in English, which by default excluded previous studies published in other languages and resulted in region-specific conclusions more than global conclusions.

Conclusion and Recommendations

The scoping review study underscores the intricate network of risk factors – including socioeconomic, household, environmental, and biological elements – that significantly contribute to the growing prevalence of obesity and overweight in school children aged 6 to 18 years. Each of these elements does not operate in isolation but interacts in a complex and dynamic manner, thereby leading to the exacerbation of the obesity epidemic among children in this age group.

However, within these identified factors, a higher-level abstraction unfolds. The increasing technological advancements and subsequent lifestyle changes in today's global society have led to an environment marked by "obesogenic" factors. This milieu has set in motion a vicious cycle of unhealthy dietary habits, sedentary behaviors, and disrupted sleep patterns which, combined with underlying socioeconomic disadvantages and genetic predispositions, form the core of the obesity problem. Ultimately, the interaction of these domains presents a more robust understanding of the risk for obesity, implicating the environment and society we create and the choices we make within them. Acknowledging this multidimensional and interconnected framework is the first step towards formulating comprehensive and effective strategies to curb the escalating trend of childhood obesity.

Given our study's findings, we recommend a concentrated focus on school-based health interventions to tackle obesity among children aged 6–18. Schools should integrate educational sessions on balanced nutrition and physical activity into their curriculum, alongside offering healthier food options and regular exercise sessions. Collaboration with healthcare providers for routine health screenings can help identify at-risk students early, allowing for prompt intervention. Future research should evaluate the efficacy of these school-based initiatives, aiding in tailoring interventions to diverse school settings and shaping long-term healthy habits to curb obesity trends among students.

Research Implications

The research implications of this study are substantial and multifaceted. It emphasizes the importance of an integrated, multi-dimensional approach to obesity prevention that takes into account the complex interplay of socioeconomic, household, environmental, behavioral, and biological factors. The findings underscore the need for targeted interventions, particularly within the school setting, to reduce obesity risk among children aged 6–18 years. These interventions need to be supported by policy changes that promote healthy food choices and regular physical activity. Furthermore, the study highlights gaps in our understanding of the specific mechanisms linking these risk factors to childhood obesity, necessitating further research. Lastly, it suggests that prevention strategies should be proactive and start early in life, opening a pathway for researchers to delve into the effects of early-life interventions on long-term obesity outcomes.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors declare no conflicts of interest.

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