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Obesity in Children and Adolescents

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Abstract

Obesity in children and adolescents is a global public health concern, with significant implications for physical, mental, and social well-being. The weight children carry in early childhood determines their trajectory toward obesity, with their body mass index (BMI) during childhood continuing to influence them as they move through adolescence and into adulthood. The causes of childhood and teenage obesity are intricate and varied, making prevention and treatment challenging for doctors and researchers. The increasing incidence of childhood obesity has also led to the early emergence of obesity-associated diseases, including type 2 diabetes, hypertension, dyslipidemia, non-alcoholic fatty liver disease, and psychological issues such as depression and low self-esteem. By assessing BMI annually and providing families with age-appropriate anticipatory advice, pediatricians and family medicine doctors can contribute significantly to the fight against obesity. This comprehensive review discusses prevalence, causes, health consequences, and evidence-based interventions to address this critical issue. It explores the complex interplay of genetic, environmental, and behavioral factors contributing to the rise in childhood and adolescent obesity, underscoring the need for a multifaceted approach to prevention and treatment. Strategies must involve actions at the community and environmental levels, in addition to individual and parental efforts.

Keywords: Childhood Obesity, Adolescent Obesity, Public Health Concern, Health Consequences, Prevention and Treatment.

INTRODUCTION

Childhood obesity presents a significant public health concern, with rates having increased over the past three decades [1]. According to the CDC, childhood obesity is characterized by a body mass index (BMI) that is at or above the 95th percentile for their age and sex (hIps://www.cdc.gov/obesity/php/data-research/childhood-obesity-facts.html). Based on data from the National Health and Nutrition Examination Survey (NHANES) conducted in 2017–2020 among children and adolescents aged 2-19, the prevalence of obesity among children and adolescents in the US was 19.7% [2]. According to WHO guidelines, obesity in children under 5 years is defined as weight-for-height more than 3 standard deviations above the WHO Child Growth Standards median. For children aged 5–19 years, obesity is defined as measurements more than 2 standard deviations above the WHO Growth Reference median (https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight).

Overweight and obese children are at a higher risk of developing non-communicable diseases such as diabetes and cardiovascular diseases at a younger age [3]. Additionally, obese children and adolescents are more likely to develop metabolic disturbances such as hypertension, dyslipidemia, and insulin resistance, which can persist into adulthood [4]. Obesity not only affects physical health but also impacts the psychosocial well-being of children and adolescents. Furthermore, obesity has been associated with mental health issues such as depression and anxiety among young people [5]. Childhood obesity extends beyond health outcomes to affect education as well. Research suggests a correlation between obesity and school absenteeism due to illness or

injury among adolescents, highlighting the societal impact of this health issue [6]. Moreover, loss-of-control eating, a common disordered eating behavior in overweight and obese youth, further emphasizes the complexity of addressing obesity in children and adolescents [7].

Given the multifaceted challenges posed by childhood obesity, it is crucial to address this issue comprehensively. Screening for obesity, which includes BMI assessment, waist circumference measurements, lipid panel testing, and specialized screening tools, enables the identification of obesity, mitigation of associated health risks, and promotion of early intervention strategies. Strategies focusing on early intervention, promoting healthy dietary patterns, increasing physical activity, and raising awareness of the long-term consequences of obesity are essential to combat this public health crisis [8]. By understanding the various factors contributing to and resulting from childhood obesity, interventions can be tailored to effectively support the health and well-being of both children and adolescents. This review provides a comprehensive overview of current evidence on the prevalence, underlying causes, screening, health consequences, and strategies for the prevention and management of obesity in children and adolescents.

Epidemiology of Childhood and Adolescent Obesity

The prevalence and trends of obesity in children and adolescents have become a pressing global public health issue. In 2022, the global prevalence of overweight and obesity among children and adolescents aged 5-19 years has risen dramatically from 8% in 1990 to 20% in 2022 [9]. This trend is alarming, as childhood obesity is associated with various health risks, including cardiovascular disease, type 2 diabetes, hypertension, and dyslipidemia [10]. An increase in childhood obesity rates has been observed not only in developed countries but also in developing nations, indicating a growing burden on public health systems [11]. Furthermore, disparities in obesity prevalence exist among different racial and ethnic groups. African American children have higher rates of high blood pressure and obesity, Hispanic children show higher rates of abnormal glucose levels and obesity, and Caucasian children exhibit higher rates of adverse lipid levels [12].

Etiology and Risk Factors

Childhood obesity is a complex condition influenced by multiple factors, including the environment, nutrition, pollution, and genetics. Genetic factors play a significant role in its development, with studies indicating a strong genetic component from early childhood through adulthood [13]. Understanding the interaction between genetic predisposition and environmental factors is crucial. Gene-environment interactions, such as perinatal exposures, dietary patterns, and physical activity environments, and individual markers like microbiome and epigenetic backgrounds, collectively contribute to childhood obesity [14]. Variations in genes related to satiety and appetite control are associated with increased obesity risk in preschool-aged children, highlighting the role of genetic factors in regulating energy balance [15]. In conclusion, childhood obesity results from a combination of genetic factors, environmental influences, dietary behaviors, and gene-environment interactions. Understanding these genetic underpinnings is essential for developing effective prevention and intervention strategies to address this global public health issue.

Environmental influences, such as diet and nutrition, physical activity, sedentary behavior, and family and home environment, are crucial factors in the development of childhood obesity. Research has emphasized the significant impact of the home environment on children's dietary habits and physical activity levels. Factors such as parental influence, screen time, sedentary activity, food security, and sleep duration within the home have been associated with childhood obesity, particularly in low-income households [16]. Moreover, the home food environment, including the availability of healthy foods and family meal practices, influences children's weight status and dietary intake [17]. Additionally, lifestyle habits such as limited physical activity and increased energy intake also contribute to the rise in childhood obesity [18].

Racial and demographic dispraises are significant factors associated with childhood and adolescent obesity. Research has highlighted notable differences in obesity prevalence among various racial and ethnic groups, highlighting dispraises in early life risk factors for childhood obesity [19]. Factors such as age, race (specifically Black or African American), body mass index, weight perception, and weight perception accuracy have been linked to attempts to lose weight among female adolescents in the United States [20]. Additionally, differences in rapid infant weight gain have been identified as significant contributors to racial and ethnic dispraises in obesity during early childhood [21]. Cultural factors and specific beliefs or practices within different ethnic groups may influence perceptions and decisions related to childhood obesity, potentially exacerbating the issue [22]. Understanding how demographic factors, such as parental history of obesity, influence the onset of adult obesity can offer valuable insights into addressing obesity across generations [23].

Nutritional factors are key contributors to childhood obesity, emphasizing the importance of promoting healthy diets to prevent obesity and related non-communicable diseases in children [24]. Interventions targeting the home setting, incorporating parenting strategies, and addressing environmental influences are essential for preventing childhood obesity

[25]. The Family Food Environment Model of Childhood Obesity suggests that familial determinants of obesity are influenced by various domains, including political and economic environments, sociocultural environments, and built and natural environments [26]. Additionally, parental involvement in childhood obesity interventions has been shown to influence child and adolescent weight status, highlighting the role of family dynamics in addressing childhood obesity [27].

Screening of Obesity

Screening for obesity in children and adolescents is an essential aspect of public health due to the increasing prevalence of obesity among youth. Various studies emphasize the importance of early identification and assessment of obesity in pediatric populations to address associated health risks. Barlow and Committee [28] highlight the significance of universal obesity risk assessment by primary care providers to enhance the early detection of elevated BMI, medical risks, and unhealthy lifestyle habits in children. Ma *et al*., [29], discuss the use of obesity indices for screening elevated blood pressure in children and adolescents, highlighting the interconnection between obesity and other health parameters. Various studies have highlighted the significance of different indices in assessing obesity among children. BMI, which categorizes children into underweight, healthy weight, overweight, and obese based on percentiles, is commonly used [30]. Additionally, waist circumference has been suggested as a valuable measure alongside BMI for identifying overweight and obese children who may benefit from early interventions [31].

Studies have demonstrated that BMI percentiles are essential in classifying children's weight status, with specific thresholds indicating underweight, overweight, and obesity [32]. Additionally, research has identified a curvilinear relationship between BMI and body fat percentage in children, highlighting the importance of age and sex-specific BMI percentiles [33]. Furthermore, the relationship between parents' and children's screen time on BMI has been studied, emphasizing the importance of considering lifestyle factors in assessing obesity in children [34].

Primary care providers play a crucial role in universally assessing children for obesity risk to enhance the early detection of elevated BMI, medical risks, and unhealthy lifestyle habits [28]. The study by Higgins *et al*., [35], reveals the association between visceral fat and arterial stiffness in youth with obesity, highlighting the need for comprehensive screening approaches beyond traditional measures like BMI. Furthermore, screening for obesity-related complications among obese children and adolescents involves lipid panel testing, fasting glucose measurement, and liver enzyme level assessment, particularly for those with a BMI ≥85th percentile but <95th percentile [36]. Additionally, the development and implementation of pediatric networks for obesity screening programs are justified to address the growing concern of metabolic syndrome and related health issues in obese children [37].

Health Outcomes

Childhood and adolescent obesity have significant implications on health outcomes. Research indicates that obesity during childhood and adolescence is associated with wide range of adverse health consequences, including metabolic, cardiovascular, orthopedic, neurological, hepatic, pulmonary, and menstrual disorders [9]. Furthermore, childhood obesity is linked to an increased risk of obesity in adulthood, leading to negative outcomes such as cardiovascular disease, sleep apnea, diabetes, certain forms of cancer, hypertension, and premature mortality [38]. The implications of childhood obesity extend beyond physical health, impacting psychosocial well-being and educational outcomes. Obese children often experience lower health-related quality of life, mental health issues such as depression and anxiety, and increased school absenteeism. Studies have shown that childhood obesity not only compromises current health but also predicts health-compromising outcomes later in life, with serious public health implications [39]. Adverse childhood experiences contribute to poor overall health among obese children. Additionally, childhood obesity negatively influences quality of life and educational attainment and significantly increases the risk of becoming an obese adult [40].

Primary and Secondary Management of Pediatric Obesity

The cornerstones of primary and secondary prevention and treatment of pediatric obesity are lifestyle modification therapies, including behavioral treatment, nutrition modification, and physical activity. Interventions targeting obesity in children and adolescents have shown varying degrees of success, with behavioral family-based interventions demonstrating more persistent weight loss effects [41]. Lifestyle interventions focusing on nutrition education, behavioral treatment, and exercise are recommended for managing overweight children and adolescents. Comprehensive lifestyle modifications have been shown to improve diet quality and nutrient adequacy in children with abdominal obesity. Effective childhood obesity management interventions have been identified, emphasizing the significance of psychological factors in optimizing child nutrition and obesity prevention. National interventions can play a crucial role in addressing the rising prevalence of childhood obesity. Evidence-based interventions, including school-based programs promoting nutrition education and physical activity, have shown promise in reducing childhood obesity rates [42]. Although eating more fruits, vegetables, and water is beneficial, changing health-related behaviors alone will not significantly reduce obesity over the long term. One approach to

address this issue is through partnerships between community-based programs and schools that include parents. The MOVE/me Muevo Project was a randomized community trial conducted in San Diego County to prevent and control childhood obesity [43]. The study enrolled 541 families with children aged 5-8 years old and randomized 30 recreation centers into intervention and control groups. The intervention, implemented over two years, aimed to promote healthy eating and physical activity through various strategies at recreation centers and participants' homes. Mixed effects models were used to analyze outcomes, showing significant reductions in high-fat and sugary beverage consumption in the intervention group compared to the control. However, no significant differences were found in BMI or waist circumference post-intervention. Girls in the intervention group showed a trend towards reducing BMI, while boys trended towards more weight gain, neutralizing the overall effect [43].

Pharmacotherapy of Adolescent Obesity

While lifestyle modifications such as dietary management and increased physical activity are fundamental components of treatment, pharmacotherapy can play a role in certain cases, particularly for individuals with severe obesity or comorbidities (Wolf, 2024; Lazarus & Hersh, 2019; Apperley *et al.*, 2021; Czepiel *et al.*, 2020). Recommendations from an expert committee for the treatment of childhood obesity emphasize a personalized, phased approach [20], with medication included only after extensive nonpharmacologic interdisciplinary lifestyle modification therapies have failed [44].

The U.S. Food and Drug Administration (FDA) has approved several medications for treating obesity in adolescents. Among these, glucagon-like peptide 1 (GLP-1) agonists, such as Semaglutide and Liraglutide, are the most effective [45]. Liraglutide's use is limited due to frequent gastrointestinal side effects and the need for daily subcutaneous injections; it is approved for weight loss in adolescents aged 12 years and older [46].

Phentermine, a norepinephrine reuptake inhibitor, is approved for short-term use in adolescents aged 17 years and older [47]. It is often prescribed in combination with Topiramate, a gamma-aminobutyric acid (GABA) receptor agonist that suppresses appetite, with recommended daily dosages of 15 mg, 30 mg, or 37.5 mg [48].

Setmelanotide, a melanocortin 4 receptor agonist, is an effective treatment approved for individuals aged six years and older with severe obesity due to genetic disorders, including deficiencies in proopiomelanocortin (POMC), proprotein convertase subtilisin/kexin type 1 (PCSK1), or leptin receptor (LEPR) [49].

Orlistat is also approved in the United States for weight loss in adolescents, but it has low efficacy [45]. Its mechanism of action involves inhibiting pancreatic lipases to alter fat digestion, which can lead to gastrointestinal side effects [50].

For adolescents with obesity but without diabetes, randomized trials of metformin have shown very modest effects on weight loss, with follow-up periods ranging from 2 to 24 months. Given these limited benefits, its use in adolescents without type 2 diabetes is questionable and considered off-label [51].

Recently FDA approved Tirzepatide for the long-term management of weight in adults who are obese and have at least one weight-related condition (e.g., high blood pressure, type 2 diabetes, or high cholesterol), in addition to following a diet low in calories and increasing physical activity [52]. Naltrexone/Bupropion has also been investigated for weight loss, with reports of improvement [53].

Future Directions and Research Needs

Childhood and adolescent obesity present complex challenges that require a multifaceted approach, involving public health policies, lifestyle modifications, and environmental considerations. By addressing the various factors contributing to obesity in the young population, it is possible to mitigate the long- term health consequences associated with this epidemic. Preventive strategies, such as population- based interventions, have been recommended to tackle this issue effectively rather than targeting only high-risk individuals [54].

Addressing childhood obesity requires a multifaceted approach, including early intervention, promoting healthy dietary patterns, increasing physical activity, and raising awareness about the long-term consequences of obesity. Research suggests that strategies targeting behaviors such as reducing television viewing, sweet beverage consumption, and fast food intake, as well as modifying parental feeding practices, can be effective in preventing childhood overweight (55). Community-based interventions like the EPODE program have demonstrated success in addressing childhood obesity through multifactorial approaches at various community levels [56]. Studies emphasize the importance of involving community health workers in childhood obesity interventions to reduce disparities and promote health equity. Additionally, there is evidence of the significance of primary prevention approaches for childhood obesity, including intervention strategies based on ecological frameworks and evidence from experimental and epidemiological research [57]. Sustainable, multidimensional approaches at individual, community, and systems levels are crucial for effectively addressing childhood obesity. Thus, combating childhood obesity requires a comprehensive and integrated approach involving various interventions

targeting behavior, community, and policy levels. By utilizing evidence-based strategies, involving multiple stakeholders, and addressing the multifaceted nature of the issue, significant strides can be made in preventing and managing childhood obesity.

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Author Contribution

Dr Alia Al Sakkal: Conducted the primary literature research, drafted the manuscript and coordinated contributions from all the co-authors.

Dr Maitha Al Haj: Assisted with manuscript editing, managed reference citation and contributed to the development of the manuscript structure.

Dr Heba Mohamed, Dr Amal Elsetouhi, Dr Jawad Khan, Dr Gulfraz Khan, Dr Imad Dabbous and Dr Mostafa Sharaby: Critically revised the manuscript for important intellectual content, and provided editorial support throughout the writing process.

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