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Review

A Comprehensive Review of Pediatric Obesity: Causes, Consequences, and Multicomponent Treatment Approaches

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ABSTRACT

Pediatric obesity has emerged as one of the most pressing public health challenges of the 21st century, with significant implications for both physical and psychological well-being. This review synthesizes current evidence on the multifactorial causes, health consequences, and management strategies for childhood and adolescent obesity. The development of obesity in early life is shaped by complex interactions among genetic, epigenetic, environmental, behavioral, and socioeconomic factors. Key contributors include poor dietary habits, sedentary lifestyle, maternal and prenatal influences, and psychosocial determinants. The consequences of pediatric obesity extend far beyond excess adiposity, encompassing cardiometabolic disorders, orthopedic problems, respiratory dysfunction, and psychosocial impairments. Effective management requires an individualized, multidisciplinary, and family-centered approach. Evidence supports multicomponent interventions that integrate dietary modification, increased physical activity, behavioral and psychological support, and—in selected cases—pharmacological or surgical treatment. Pharmacotherapy with glucagon-like peptide-1 receptor agonists, such as liraglutide and semaglutide, has shown promising results in adolescents with severe obesity, while bariatric surgery remains a viable option for refractory cases. Emerging personalized, pathophysiology-informed strategies and novel pharmacologic agents offer new opportunities for targeted intervention. Addressing pediatric obesity necessitates long-term, comprehensive, and sustainable efforts that engage healthcare systems, families, and communities to mitigate the escalating burden of this condition.

KEYWORDS

pediatric obesity, adolescent obesity, lifestyle interventions, bariatric surgery, prevention, multicomponent treatment

INTRODUCTION

Childhood and adolescent obesity has emerged as one of the most significant public health concerns of the twenty-first century. The global prevalence of excess body weight among youth continues to rise, affecting nearly one in five children and adolescents worldwide [1]. This increasing trend is observed not only in high-income nations but also across low- and middle-income countries (LMICs), where rapid urbanisation, changes in dietary patterns, and reduced physical activity have contributed to an expanding epidemic. The World Health Organization defines overweight and obesity as abnormal or excessive fat accumulation that poses a risk to health, typically assessed through age- and sex-adjusted body mass index (BMI). Central adiposity, in particular, is closely linked to adverse cardiometabolic profiles and increased morbidity in childhood and later life [2].

The causes of paediatric obesity are multifactorial and extend beyond the simplistic notion of an imbalance between energy intake and expenditure. Rather, obesity represents the outcome of a complex interplay between genetic susceptibility, metabolic regulation, behavioural habits, and socio-environmental conditions acting across the life course. Genetic and epigenetic mechanisms influence individual predisposition, while lifestyle and environmental exposures — such as inadequate physical activity, high consumption of processed foods, poor sleep hygiene, and social disadvantage — amplify the risk. Early-life determinants, including maternal health, intrauterine environment, and infant feeding practices, further shape long-term metabolic outcomes [3].

The persistence of obesity from childhood into adulthood is a well-established phenomenon, with approximately 80% of obese adolescents remaining obese as adults and about 70% continuing beyond the age of 30 [1]. This continuity significantly increases the risk of cardiovascular, cerebrovascular, and metabolic diseases, as well as psychological and social complications [1,2]. Consequently, the prevention of childhood obesity has become a global public health priority. Evidence indicates that early preventive interventions are more cost-effective and yield better long-term outcomes than treatment in adulthood [1]. Comprehensive prevention strategies should therefore combine public education, family-centred interventions, and supportive environments that promote healthy lifestyles from early childhood [2].

This review aims to provide an evidence-based overview of the current understanding of pediatric obesity, including its prevalence, contributing factors, preventive approaches, and therapeutic interventions.

METHODOLOGY

This narrative review was conducted using a structured literature search focusing on childhood and adolescent obesity. A systematic search of the PubMed database was performed for publications released between January 2010 and October 2024. To identify relevant studies, the following keywords and their combinations were applied: *“childhood obesity,” “adolescent obesity,” “pediatric overweight,” “etiology,” “risk factors,” “epidemiology,” “COVID-19,” “prevention,” “management,” “lifestyle interventions,” “pharmacotherapy,”* and *“bariatric surgery.”*

Inclusion criteria comprised:

- peer-reviewed articles published in English or Polish,
- studies addressing epidemiology, etiological determinants, health consequences, preventive strategies, clinical assessment, or treatment of pediatric obesity,
- systematic reviews, meta-analyses, clinical practice guidelines, randomized or non-randomized clinical trials, and large observational studies.

Exclusion criteria included:

- publications not focused on individuals under 18 years of age,
- articles lacking accessible full text,
- commentaries, editorials, conference abstracts without methodological detail, and studies with insufficient relevance to the scope of this review.

To ensure completeness, reference lists of key articles and major reviews were screened manually for additional eligible sources. After removing duplicates and applying the eligibility criteria, a final set of publications consistent with these requirements was included in the synthesis presented in this manuscript.

DISCUSSION

Epidemiology of Childhood Obesity

Childhood and adolescent obesity is a growing global health concern, affecting both high-income countries and, increasingly, low- and middle-income countries (LMICs) [4]. More recent projections by the World Obesity Federation predict that by 2030, this number may reach 254 million children and adolescents aged 5 to 19 years [5].

Although obesity rates remain highest in nations such as the United States, Canada, and parts of Europe, a steep rise is now observed in LMICs, particularly in Asia, the Middle East, and Latin America [6,7]. In many of these regions, the coexistence of undernutrition and obesity presents a dual burden of malnutrition [8].

In Europe, the World Health Organization Regional Office for Europe (WHO/Europe) reported that in some countries up to 30% of children are overweight or obese [8]. The COSI (Childhood Obesity Surveillance Initiative), covering over 40 countries, found wide variation across Europe, with the highest rates in Mediterranean countries such as Greece, Italy, and Spain [9].

In Poland, national data indicate a consistent upward trend in the prevalence of excess body weight among children and adolescents. The 2018 HBSC study reported that approximately 18% of Polish adolescents aged 11–15 years were classified as overweight or obese [10].

Impact of COVID-19 on Pediatric Obesity

These rising trends set the stage for exploring how acute disruptions, such as the COVID-19 pandemic, further influenced pediatric obesity patterns. School closures and prolonged home confinement resulted in reduced physical activity and increased screen exposure, while heightened stress and disrupted daily routines contributed to irregular eating patterns [11].

Reports from multiple regions—including China, Europe, and the USA—indicated accelerated weight gain during lockdowns, driven primarily by decreased movement and changes in dietary habits [2]. The term “covibesity” has been introduced to describe this trend. Pediatric obesity has also been associated with more severe COVID-19 outcomes, although most infected children continue to experience mild disease [11].

Understanding the interplay of pandemic-related behaviors with established etiological factors provides insight into the multifactorial nature of obesity development.

Causes of Childhood and Adolescent Obesity

Childhood obesity develops through the combined influence of genetic susceptibility, prenatal and early-life exposures, lifestyle behaviors, and environmental conditions [2,3].

Dietary and Lifestyle Factors

High consumption of energy-dense foods and low levels of physical activity contribute to a positive energy balance. Sedentary behaviors, including prolonged screen use, reduce overall movement are linked with disrupted daily routines. In contrast, regular physical activity supports healthy weight regulation and cardiometabolic outcomes [2].

Early-Life and Maternal Influences

Maternal factors such as pre-pregnancy obesity, excessive gestational weight gain, and gestational diabetes increase offspring risk of obesity. Prenatal exposures—including stress, smoking, air pollution, and certain nutritional deficiencies—affect fetal metabolic programming. Early postnatal patterns, such as rapid infant weight gain, also contribute to long-term obesity risk [3].

Genetic and Epigenetic Contributions

Genetic predisposition shapes individual vulnerability to obesity, with numerous genes influencing appetite regulation, metabolism, and fat distribution. Epigenetic modifications resulting from prenatal and early-life exposures may further alter metabolic pathways and contribute to intergenerational transmission of obesity risk [3].

Family and Psychosocial Environment

Family routines, parental feeding practices, and socioeconomic constraints significantly influence children’s eating behaviours and activity patterns. Limited access to healthy foods and household stress can amplify obesity risk. Neurodevelopmental conditions, such as ADHD and ASD, are also associated with challenges in maintaining healthy lifestyle habits [3].

Medical and Pharmacological Contributors

Certain endocrine disorders and central nervous system injuries are recognized contributors to pediatric weight gain. Additionally, medications such as glucocorticoids, antiepileptics, insulin, and atypical antipsychotics may promote adiposity and should be considered during clinical evaluation [2].

Strategies for Managing Obesity in Children and Adolescents

Principles of Pediatric Obesity Management

Effective management should be grounded in a comprehensive assessment of both the child and their family, consistent with established guidelines. Multicomponent interventions integrating at least two elements—such as physical activity, nutritional counseling, psychological support, or technology-based tools—represent the foundation of care. Treatment should be individualized and developed through shared decision-making [12].

Nutritional strategies and physical activity promotion are key components, complemented by psychological interventions aimed at fostering behavioral change. Currently, evidence is insufficient to strongly recommend for or against technology-based interventions in pediatric obesity treatment [12].

In selected cases, particularly among older children, pharmacologic therapy may be considered as an adjunct. GLP-1 receptor agonists and biguanides are options for patients aged 12 years and older, while lipase inhibitors are not recommended in pediatric populations. Severe obesity unresponsive to conservative measures may warrant surgical interventions, including laparoscopic sleeve gastrectomy or Roux-en-Y gastric bypass for adolescents ≥13 years, evaluated by a specialized multidisciplinary team [12].

Lifestyle Interventions

Dietary Approaches

Short-term low-carbohydrate interventions can aid weight reduction and improve cardiometabolic outcomes, even without strict calorie restriction. However, limited trials and heterogeneity constrain firm conclusions versus traditional calorie-restricted diets [13].

Effective care integrates nutritional modification, increased physical activity, reduced sedentary time, and improved sleep. Adolescents may also benefit from structured dietary programs, pharmacotherapy, or bariatric procedures. Prevention requires coordinated, evidence-based public health strategies [14].

Structured nutrition guidance encourages local dietary patterns, fruits and vegetables, limits on energy-dense foods and sugary drinks, and regular family meals. The traffic light diet categorizes foods by energy density: “green” foods freely, “yellow” in moderation, and “red” occasionally [2].

Physical Activity

Physical activity interventions may include educational components, structured exercise programs, or both, aligned with local recommendations. The goals of exercise are to provide a safe, supportive, and enjoyable environment that encourages active play, facilitates socialization, and develops motor competence, confidence, and fundamental movement skills. Exercise programs aim to enhance physical fitness, reduce obesity-related complications, improve quality of life, and help children achieve age-appropriate activity levels. Evidence suggests that the most effective programs involve sessions of at least 60 minutes, three or more times per week, over a minimum of 12 weeks. Activities should be tailored to the child's abilities and baseline fitness, incorporating principles of frequency, intensity, duration, type, volume, and progression, while also emphasizing enjoyment and individual preferences [2].

Behavioral and Psychological Interventions

Behavioral interventions target diet, physical activity, sedentary behavior, and sleep. Strategies include parental engagement, home environment adjustments, screen time monitoring, and sleep hygiene improvements. Cognitive behavioral therapy (CBT) is widely applied to address cognitive and emotional factors influencing eating behaviors, self-esteem, and psychosocial wellbeing [2].

Pharmacotherapy

Currently approved pharmacological options for managing pediatric obesity include orlistat, phentermine, phentermine–topiramate, liraglutide, and semaglutide. Liraglutide and semaglutide, both glucagon-like peptide-1 receptor agonists (GLP-1 RAs), act by enhancing satiety, delaying gastric emptying, and reducing overall food intake. Since their regulatory approval, the use of these agents in children and adolescents has increased [15].

Liraglutide has demonstrated a safety and tolerability profile in adolescents comparable to adults, with mostly mild adverse events and no severe complications reported [16]. Semaglutide, administered once weekly alongside lifestyle interventions, has been associated with significant reductions in BMI and body weight, as well as improvements in cardiometabolic parameters. Adverse events are generally mild to moderate, most commonly gastrointestinal [15,16,17]. Among GLP-1 RAs, semaglutide shows superior efficacy, likely due to its molecular structure, prolonged half-life, and broader central nervous system penetration [15,17].

Surgical Interventions

For adolescents with severe obesity—defined as a BMI ≥120% of the 95th percentile—metabolic or bariatric procedures, such as Roux-en-Y gastric bypass or vertical sleeve gastrectomy, can result in

substantial weight loss, with average BMI reductions of approximately 30% within the first year [18].

Pathophysiology-Informed and Personalized Approaches

Obesity involves dysregulation of appetite, satiety, and reward pathways. Understanding these mechanisms has led to novel anti-obesity medications (AOMs) for monogenic/syndromic and polygenic obesity. Interventions must be sustainable, long-term, and patient-centered. Guidelines recommend early, intensive, individualized management integrating behavioral therapy, pharmacotherapy, and, when indicated, surgery [19].

Personalized pharmacologic interventions, such as setmelanotide and metreleptin, target specific genetic defects and demonstrate clinically meaningful weight reduction in selected conditions [19].

Clinical Assessment

A thorough clinical evaluation is essential to identify underlying causes, obesity-related complications, risk of future disease, and modifiable behavioral factors. Laboratory assessments may include liver function tests, lipid profile, fasting glucose, glycated hemoglobin, oral glucose tolerance testing, and additional endocrine or genetic studies when indicated.

Treatment goals include reducing adiposity, mitigating physical and psychosocial complications, and preventing chronic diseases. Interventions should be tailored to the child's preferences, family environment, and resources, and include diet, exercise, behavioral therapy, and psychological support [2].

CONCLUSIONS

Childhood and adolescent obesity is a complex and multifactorial condition with significant short- and long-term health implications. Evidence supports that prevention, early intervention, and multicomponent management strategies are most effective in achieving sustainable improvements in weight and health outcomes. Lifestyle modifications, including balanced nutrition, structured physical activity, behavioral therapy, and psychological support, remain the cornerstone of treatment. Pharmacologic interventions and bariatric surgery may be considered for selected patients with severe obesity or inadequate response to conservative approaches. Successful management relies on individualized, family-centered care, ongoing monitoring, and supportive environments that facilitate adherence to healthy behaviors. Addressing pediatric obesity requires coordinated efforts across healthcare, community, and policy domains to reduce the global burden of this condition.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Supplementary Materials

None.

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