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The Study of Risk Factors and Management of Obesity in Children : A Comprehensive Systematic Review

[1] Patrick Luckend Sahusilawane, [2] Oktavia Henny

[1,2] Gerbang Sehat Mahulu General Hospital, Mahakam Ulu, East Kalimantan, Indonesia

Corresponding Author : pluckend@gmail.com

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ABSTRACT

Background: Childhood obesity is a significant global public health issue, with a significant association between risk factors and management. Factors such as reduced physical activity and increased access to processed foods contribute to this trend. Management is crucial to prevent obesity-related health issues in adulthood, as obesity can lead to complications like type 2 diabetes, dyslipidemia, and cardiovascular diseases. Early intervention and lifestyle modifications can reduce the risk of obesity-related comorbidities, but the feasibility of implementing intensive programs may be challenging. **Methods:** This systematic review focused on full-text English literature published between 2014 and 2024, adhering to PRISMA 2020 principles. Without a DOI, editorials and review papers that were published in the same journal as the submission were not accepted. ScienceDirect, PubMed, and SagePub were among the many web resources used to compile the literature. **Result:** Utilizing dependable sources such as Science Direct, SagePub, and PubMed, the investigation scrutinized nearly 100,000 articles. After determining that ten

publications required additional investigation, a more comprehensive review of the entire corpus was carried out. **Conclusion:** Pediatric obesity is a complex issue influenced by behavioral, genetic, socioeconomic, and environmental factors. Environmental factors, such as high-calorie foods and fast-food, disrupt prefrontal executive-control responses. Genetic similarities between obese adults and children have been discovered. Treatment options include nutrition, exercise, psychological therapy, pharmacotherapy, and surgical procedures. However, treatment outcomes can vary widely, necessitating a comprehensive baseline assessment.

Keyword: Childhood, obesity, risk, management, outcomes

INTRODUCTION

Childhood obesity is a major global public health issue, with the prevalence of obesity in kids and teens between the ages of 5 and 19 increasing significantly over the past forty years. In 1975, the prevalence was at 4%, but by 2016, it had risen to over 18%.[1] In China, the prevalence of obesity in children and adolescents aged 7–18 years has also been on the rise, increasing from 0.1% in 1985 to 7.3% in 2014.[2] This trend poses a significant risk to the health of children, with 20% of kids and teenagers in the US and around the world being affected by obesity. Factors such as reduced physical activity and increased accessibility to highly processed, high-energy foods have contributed to this shift.[3,4] The complex interplay between genetics and lifestyle is at the root of the global epidemic of childhood obesity, involving a sophisticated web of biopsychosocial mechanisms that operate throughout life, influencing how genetics and the environment interact.[5]

Prevention and early intervention are the most practical and cost-effective approaches, as obesity is associated with several harmful health consequences throughout life, such as type 2 diabetes (T2D), dyslipidemia, and cardiovascular diseases.[6] In cases of severely obese children, childhood obesity has been shown to persist into adulthood with a low rate of spontaneous remission.[7] The accumulation of adiposity has a lasting impact on a person's life. Studies using large birth cohorts have found a connection between childhood obesity and increased carotid intima-media thickness in adulthood, as well as impaired glucose metabolism.[8] However, extensive longitudinal research has shown that normalizing body mass index (BMI) before adulthood can reverse the negative effects of childhood obesity on the future risk of type 2 diabetes (T2D).[9] Therefore, the practical approach to preventing obesity-related health issues in adulthood should be to actively address childhood obesity.[6]

The prevalence of childhood obesity has raised concerns due to its association with various health risks. Complications related to childhood obesity, including polycystic ovary syndrome, type 2 diabetes (T2D), dyslipidemia, hypertension, and non-alcoholic fatty liver disease, emphasize the critical need for intervention and prevention strategies.[10-12] Additionally, obesity has been linked to

premature puberty in children and adolescents, highlighting the importance of early monitoring.[13] It is crucial to monitor and address obesity in youth promptly, as obese children are more likely to remain obese into adulthood.[7] Lifestyle modifications through behavioral interventions can significantly reduce the risk of obesity-related comorbidities; however, the feasibility of implementing intensive and long-term programs may be challenging for clinicians, as well as for youth and families. The American Academy of Pediatrics (AAP) has issued clinical practice guidelines (CPG) recommending the immediate use of such interventions for adolescents aged 12 and above with obesity, regardless of the presence of comorbidities.[4,12] Furthermore, the AAP endorses the use of metabolic/bariatric surgery (MBS) as an effective treatment option to reduce cardiovascular risk factors, despite its relatively low uptake among adolescents.[14]

When developing strategies and treatments to lessen this burden, it can be helpful to understand the relationship between risk factors and management in children with obesity. This systematic literature review aimed to determine the association between childhood obesity risk factors and management that has been found in studies over the past ten years.

METHODS

Protocol

To make sure the study complied with all regulations, the author of this work carefully followed the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 guidelines. The selected methodology was carefully designed to guarantee accurate and cogent research findings.

Criteria for Eligibility

This paper offers a thorough review of studies carried out in the last ten years regarding the relationship between childhood obesity management and risk factors. The goal of this project is to clarify and improve patient care practices through in-depth data analysis. This thesis' main goal is to highlight the importance of important subjects that appear in a range of literary works.

Strict inclusion and exclusion criteria were put in place to guarantee the accuracy of the data used in this investigation. For consideration for inclusion, a piece needs to have been published in English between 2014 and 2024. Published reviews, editorials, submissions without a DOI, and duplicate journal entries are among the exclusion criteria.

Search Strategy

The study's keywords include "obesity, children, pediatric, risk factor, management, outcome, result, child, adolescent". For this research, the following Boolean MeSH keywords were entered into the databases: (((“obesity”[MeSH Terms] OR “obesity “[All Fields] AND “children”[All Fields]) OR (“obesity”[MeSH Terms] OR “obesity”[All Fields] AND “pediatric”[All Fields]) AND (“risk factor”[MeSH Terms] OR “management”[All Fields] OR “outcome”[All Fields] OR “result”[MeSH Subheading] OR “child”[All Fields] OR “adolescent”[All Fields]))).

Data retrieval

Prior to starting this in-depth analysis, the authors carefully considered the relevance of each article by carefully reading its title and abstract. Studies were only given more weight if they satisfied the inclusion criteria and matched the goals of the article. A distinct and recurrent pattern was found through a number of searches. For full-text entries, only English was accepted. Content that met all predetermined inclusion criteria and had a direct bearing on the study's subject matter was produced through the most stringent screening process. Studies that did not fit these molds were usually written off and their results were not given much weight. A vast array of data was included in the assessment, such as variables, titles, authors, publication dates, places, and study methodologies.

Quality Assessment and Data Synthesis

The authors themselves carefully read through the titles and abstracts of each article to decide which ones required more research. Subsequently, every document that was initially eligible for the review had to be carefully examined. The selection of the review papers was based on the assessment results. This criterion allowed for a quicker selection of publications for additional examination, which in turn allowed for a more comprehensive assessment of earlier studies and the conditions that called for their review.

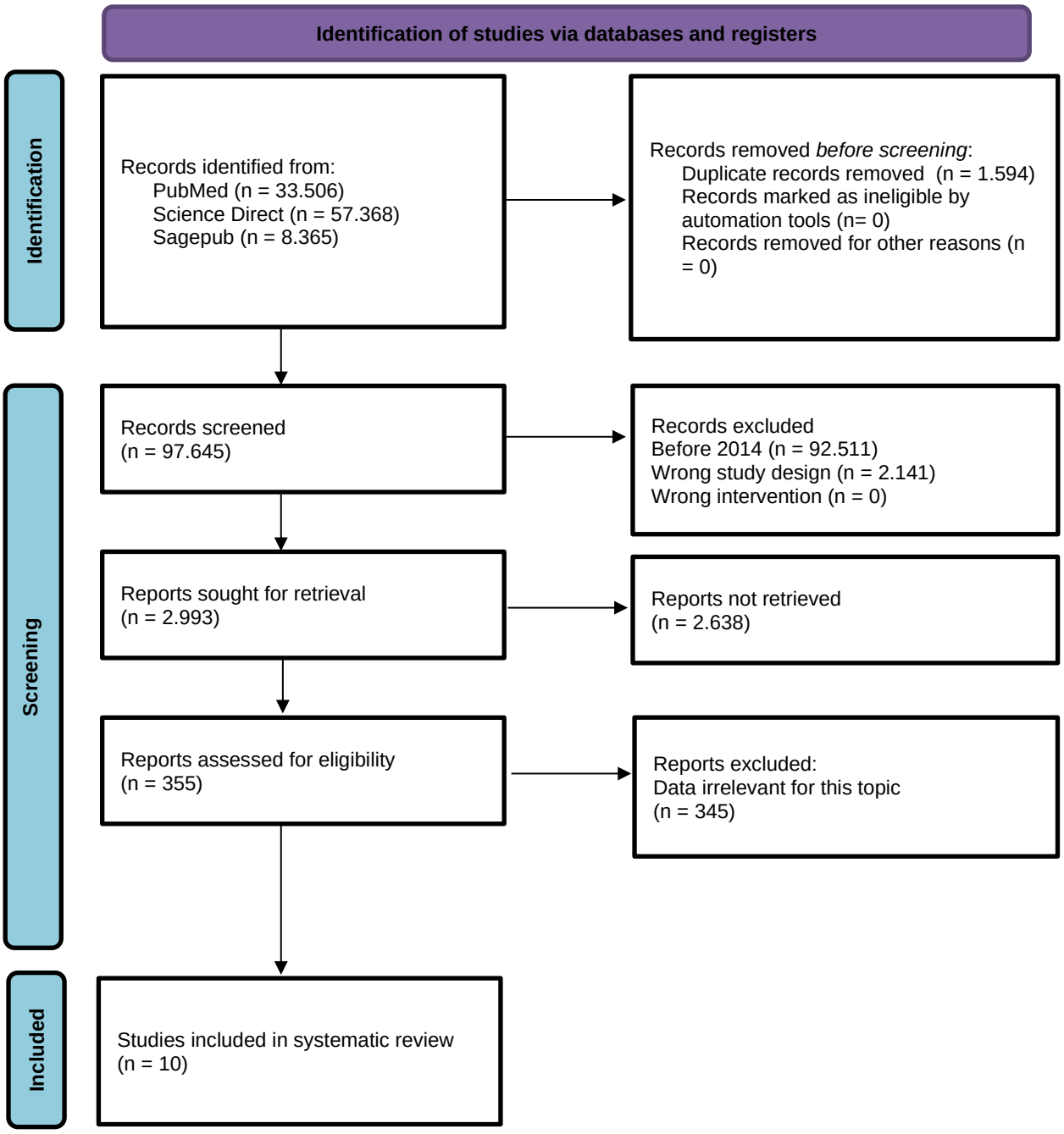

Figure 1. Article search flow chart

RESULTS

To get started on our research, our team worked hard to gather a large number of publications from reputable databases such as Science Direct, PubMed, and SagePub. Ten papers were identified as being extremely relevant to our ongoing systematic investigation following a thorough three-tier screening process. We then carried out a thorough review of every manuscript, focusing on particular areas for additional investigation. We have included a brief summary of the assessed content in Table 1 for your convenience in order to help expedite our analysis.

Table 1. The literature included in this study

Author	Origin	Method	Sample	Result
Caprio et al.[15] (2020)	Israel	Review	-	Adolescent obesity has increased tenfold over the previous forty years, making childhood obesity a global public health concern. Cardiovascular problems, fatty liver, and early type 2 diabetes are all exacerbated by this rise. The significance of insulin resistance and the possible mechanisms underlying obesity are highlighted by recent research. Adequate prevention and intervention initiatives are necessary to mitigate childhood obesity, as it will have detrimental effects on public health.
Jebeila et al.[11] (2020)	Australia	Review	-	Adolescent obesity prevalence has increased significantly, impacting children and adolescents. Treatment approaches

				include family-based behavioral interventions, intensive dietary approaches, pharmacotherapy, and metabolic surgery, but access to these therapies remains scarce.
Calcaterra et al.[16] (2023)	Italy	Review	93 studies	There is proof that certain dietary patterns cause children's sleep problems, which supports the obesity theory. This detrimental process can be halted by strategies that promote fiber, fruits, vegetables, and anti-inflammatory nutrients. This emphasizes the importance of successful public health initiatives.
Hong et al.[2] (2023)	China	Review	-	China has seen a rise in the prevalence of obesity, especially among students in primary schools. Girls' rates decline while boys' rates are slower. While obesity rates in the eastern regions have dramatically increased, they remain high in the northern areas. Nonetheless, migration has contributed to an increase in metabolic diseases linked to obesity.
Kim et al.[17] (2023)	USA	Review	-	There's a growing concern about childhood obesity, and the FDA has approved five medications for long-term weight management. The FDA approved

				the once-daily controlled-release combination of phentermine and topiramate in 2022 for children 12 years of age and older.
Maffeis et al.[18] (2023)	Italy	Review	-	Children and adolescents are looking for obesity treatment options more and more. The initial steps include medication, bariatric surgery, and lifestyle modification. Randomized control trials are being conducted in search of more effective treatment, as new medications have demonstrated efficacy and safety in teenagers.
Nogueira-de-Almeida et al.[5] (2023)	Brazil	Review	60 studies	After screening a total of 598 studies, 60 of them were included in the review because they demonstrated the key biopsychosocial factors associated with increased risks of excessive adiposity in children. Preconception, prenatal, infant, preschool, school age, and adolescence were the six time periods for which the data were presented, accounting for the incidence of risk factors and their consequences.
O'Hara et al.[19] (2023)	USA	Review	-	It is advised to begin aggressive treatment as soon as possible. This includes

				evaluating any behavioral and medical issues that may arise, using weight-promoting drugs, using anti-obesity medications (AOMs), and continuing care. Not a particular kind of treatment, but the cornerstone of it is intensive behavioral therapy. It is important to inform patients and their families about the potential consequences of each treatment option.
Tung et al.[6] (2023)	China	Review	-	Although there has been tremendous progress in managing childhood and teenage obesity, implementation still presents difficulties. Treatment entails dietary adjustments and increased physical activity, among other lifestyle and behavior modifications. Still, effectiveness is limited, particularly in cases of severe obesity. New pharmacological treatments, metabolic and bariatric surgery (MBS), and fecal microbiome transfer (FMT) are examples of future advancements; however, a deliberate strategy emphasizing long-term behavioral adjustments and weight maintenance is required.
Vajravelu	USA	Review	-	Adolescent obesity can be controlled with

et al.[4] (2023)				anti-obesity drugs like semaglutide, liraglutide, and phentermine/topiramate, as well as lifestyle changes. For uncommon cases of monogenic obesity disorders, setmelanotide is available. Although only available in specialized facilities, metabolic and bariatric surgery is effective.

According to a study by Caprio et al., the prevalence of childhood obesity among adolescents has increased tenfold over the previous forty years, posing a global public health concern. Cardiovascular problems, fatty liver, and early-onset type 2 diabetes are all influenced by this problem.[15]

According to Jebeile et al., managing obesity in underprivileged communities and low-income countries (LMICs) requires systematic, lifelong care. They also stress the need for policy changes and more research on the subject.[11]

The complicated relationship between food intake, sleep issues, and childhood and teenage obesity is highlighted by Calcaterra's research. Improved sleep quality can be facilitated by elements like fiber, fruit, vegetables, and anti-inflammatory nutrients; on the other hand, poor sleep is linked to an increased risk of obesity. Healthy eating habits require early intervention.[16]

Hong et al.'s research revealed that, although in different ways, Chinese children and adolescents continue to have a high prevalence of overweight and obesity. Even though obesity is on the rise, metabolic diseases linked to obesity are more common. The shifting prevalence is caused by a number of variables. To effectively manage and prevent the burden of obesity and its related complications, comprehensive and adaptable policies are therefore required.[2]

According to a study review by Kim et al., following a 56-week course of treatment with phentermine/ topiramate (PHEN/TPM) plus lifestyle modification, adolescents with obesity showed

a significant reduction in their BMI percentage in a double-blind trial conducted in 2022. Comparing the study group to the placebo group, triglycerides were significantly lower and HDL-C was significantly higher.[17]

According to Maffeis et al., there is a great deal of promise for treating obesity through therapy; however, there are risks involved, and long-term monitoring is required to determine whether weight loss is durable. Improving comorbidities and risk factors for chronic diseases can be accomplished through bariatric surgery, medication addition, and lifestyle modification therapy. Nonetheless, obesity is a multifactorial disorder that reacts differently to various forms of intervention. For children under the age of twelve, longitudinal studies are required to determine predictors and assess the effectiveness of pharmacotherapy.[18]

Nogueira-de-Almeida et al. discovered that the causes of childhood and teenage obesity that have been documented in the scientific literature are given.[5]

O'Hara's research on the treatment of childhood obesity found that the early and intensive application of novel AOMs significantly improves outcomes. With referrals to obesity medicine specialists for pharmacotherapy and co-morbidities related to obesity, ongoing, chronic care maximizes outcomes.[19]

According to Tung et al.'s research, managing childhood and teenage obesity is a complicated matter, especially for those who are severely obese. The efficacy of changing one's lifestyle and behavior has not increased despite advancements.[6]

According to research by Vajravelu et al., childhood obesity must be managed because obesity has long-term effects that include problems like type 2 diabetes, dyslipidemia, hypertension, and mental health problems. Although there have been advancements in weight-loss pharmacologies, there are still few approved therapies and large-scale studies to help manage childhood obesity. Physicians need to make sure patients have access to societal prevention strategies and lifestyle interventions.[4]

DISCUSSION

Adolescent obesity is a complex issue influenced by behavioral, genetic, socioeconomic, and environmental factors. The availability of affordable, high-calorie foods and the growth of the fast-food industry are just a couple of environmental changes that have led to increased consumption of added sugars.[15] Teenagers are the most likely age group to consume added sugars, putting them at risk for the central reward effects of these substances.[20] Obese adolescents show disrupted prefrontal executive-control responses to glucose and fructose intake, potentially leading to further weight gain. Sedentary behaviors such as increased media consumption reduced physical education, and the substitution of motorized bicycles for traditional bicycles also contribute to obesity.[2,15] Since the 1970s, research has suggested that obesity may be hereditary, and the discovery of the leptin gene in 1994 led to the development of medications targeting the melanocortinergic system, which has proven crucial in treating childhood obesity.[15] Studies on obesity-related traits in children have utilized genome-wide association studies (GWAS), some of which have identified genetic similarities between obese adults and children. Pediatric GWAS have also uncovered new genetic signals not found in adult populations.[21] In 2019, a polygenic risk score was developed and shown to correlate with the severity and progression of obesity over time. Exome sequencing has also been used to explore rare variations in obesity genes.[15]

The management of obesity is impeded by environmental factors, socioeconomic forces, and biological predispositions. Adipose tissue proliferates due to these factors, making efforts more difficult to achieve. An essential factor in determining body composition is the energy regulatory system, which controls hunger, fullness, and pleasure-seeking behaviors.[5,11] Maternal obesity, gestational diabetes, and weight gain during pregnancy are all linked to childhood obesity.[22] Breastfeeding, the early introduction of complementary foods, parental approaches, responsive feeding, exposure to the environment, and traumatic childhood experiences are all factors that can lead to the development of obesity in infants and young children. Obesity can be caused by endocrine disorders, central nervous system damage, and post-malignancy. Weight gain is often

associated with pharmacological agents like glucocorticoids, insulin, and atypical antipsychotics.[11] Weight stigma, a societal devaluation of individuals due to obesity, is a significant issue in children and adolescents. Weight stigma leads to discrimination and social rejection, often resulting in teasing, bullying, and weight-based victimization. Bodyweight is the most common reason for bullying in children and adolescents, with a quarter to half reporting being bullied based on their body weight.[23] Weight stigma can lead to poor mental health, impaired social development, and disordered eating behaviors. Health professionals must help reduce weight stigma by using supportive language, patient-centered behavior changes counseling, and conducting behavioral health screenings for signs of weight-based bullying.[4,11] Research indicates a strong correlation between obesity and poor sleep quality, with food choices being a contributing factor. Poor sleep quality has been related to high-fat and high-carb diets, low protein intake, sugary foods, and energy drink consumption. These food choices have an especially negative impact on school-age children. The quality of sleep may also be impacted by parenting variables, such as lax discipline techniques. To fully comprehend the connection between the timing of meals and the quality of sleep, more research is required.[5,16]

Implementing healthier eating habits, promoting physical activity, and reducing sedentary behavior are crucial components of addressing childhood obesity. Despite the overwhelming evidence supporting the use of lifestyle modifications to improve health, the most effective methods for nutritional intervention, exercise regimens, and behavioral health approaches for managing weight loss in children and adolescents remain unknown.[4] According to the latest AAP clinical practice guidelines, treatment goals should focus on improving weight status and eliminating comorbidities through "Intensive Health Behavior and Lifestyle Treatment (IHBLT)".[12] Obesity treatment in adolescents aims to reduce adiposity, improve physical and psychosocial complications, and prevent chronic diseases. The level of BMI reduction required to improve obesity-related complications is uncertain, but evidence suggests that BMI z-score reductions greater than 0-25 and 0-5 may represent clinically significant thresholds. The type and intensity of treatment depend on factors such as obesity severity, age, developmental stage, patient and family

needs, clinical competency, and healthcare system.[23] Treatment options include nutrition, exercise, psychological therapy, pharmacotherapy, and surgical procedures. However, treatment outcomes for pediatric obesity can vary widely, and a comprehensive baseline assessment is essential to guide appropriate treatment.[11] It is recommended that children follow a balanced diet tailored to their age, gender, and level of physical activity. For obese or overweight children aged 13–17 years, especially those who experience early puberty onset, medical professionals can assess the balance between weight loss and normal development, while nutritionists can help determine energy intake for these children.[2]

FDA-approved obesity pharmacotherapies are increasingly being prescribed in pediatrics to help patients manage their weight. For the treatment of obesity, PHEN/TPM, a once-daily controlled-release combination product, is accessible, safe, and effective.[17] Lower utilization rates are the result of the limited evidence that is still available. Clinical discomfort, expensive expenses, and a lack of medical training are the causes of this disparity.[24] Clinicians need to fight this by advocating for equitable and accessible implementation and educating themselves on safety, efficacy, and current FDA indications.[17] There are few FDA-approved medications for treating obesity, which makes childhood obesity a serious problem. For children 12 years of age and older, the only FDA-approved treatment for pediatric obesity is the pancreatic lipase inhibitor orlistat. It has a negligible impact on weight loss, though.[15] In a clinical trial involving obese adolescents with type 2 diabetes, ligandivolde (a GLP-1 agonist) demonstrated comparable safety, tolerability, and pharmacokinetic profiles to those of adults.[25] Although the exact mechanism by which GLP-1 promotes weight loss is unknown, it appears to be connected to a central nervous system effect. Fat people with rare variants in the MC4R, POMC, and leptin-receptor genes have significantly lost weight in recent trials employing the MC4R agonist setmelanotide. Monogenic causes of obesity are uncommon, though, and most obese children do not respond well to medications like setmelanotide. To address the metabolic effects of altered lipid partitioning in obese youth, rosiglitazone has been used in several trials.[15] To manage obesity in clinical encounters, the titration rate of medication dose adjustment is essential. Children frequently need larger doses of AOM,

which are modified based on their response to treatment. It is advised to stop taking the medication if unbearable side effects arise, even though dosage can be taken concurrently with other medications.[19]

Severe obesity in adolescents is associated with long-term morbidity and modest effects of conservative interventions.[15] According to Maffeis (2023), adolescents who are severely obese and have not responded to previous treatments may benefit greatly from bariatric surgery.[18] Previous limitations based on pubertal or skeletal maturation have been removed from the American Society for Metabolic and Bariatric Surgery Pediatric Committee and the American Academia of Pediatrics' updated recommendations for metabolic and bariatric surgery in young people. Currently, recommended BMI thresholds are greater than 35 kg/m2 or 120% of the age and sex 95th percentile, with moderate to severe concomitant conditions.[26] Bariatric procedures, which involve anatomical modification, are associated with weight loss and insulin sensitivity in morbidly obese adolescents. There are risks associated with this, though, such as micronutrient deficiencies, significant reductions in bone mineral density, and complications following surgery.[15,18] The Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS) and Adolescent Morbid Obesity Surgery (AMOS) studies have shown similar 5-year outcomes in obese adolescents, but potential comorbidities and ethical issues need to be considered. In cases of syndromic or hypothalamic obesity, bariatric procedures are less promising and should be considered only as a last resort in patients with substantial comorbidity.[15] A protective or pathogenic role is played by specific strains of the gut microbiome in the progression of obesity and type 2 diabetes.[27] Reducing abdominal adiposity and reversing metabolic syndrome in obese adolescents has been demonstrated by FMT, a technique that modifies the intestinal microbiota by introducing microbiota from a healthy donor into an already-existing microbial ecology.[28] More investigation is necessary to validate these results, though, as a recent randomized clinical trial did not show any weight loss.[6] Childhood obesity requires multidisciplinary care, including lifestyle modifications, comorbidity surveillance, and medication initiation. A comprehensive multisectoral approach targeting hospital-based programs, community-based programs, and public education can effectively combat morbid obesity

and improve public health.[6] Future research should focus on predicting treatment response to match the appropriate patient to the most likely treatment to provide benefits and minimize risks.[11]

CONCLUSION

Pediatric obesity is a complex issue influenced by behavioral, genetic, socioeconomic, and environmental factors. Environmental factors, such as the availability of high-calorie foods and the fast-food industry, have led to increased consumption of added sugars, disrupting prefrontal executive-control responses to glucose and fructose intake. Sedentary behaviors, media consumption, and motorized bicycles also contribute to obesity. Obesity may be hereditary, and the discovery of the leptin gene in 1994 led to the development of medications targeting the melanocortinergic system. Genetic similarities between obese adults and children have been discovered through genome-wide association studies (GWAS). Treatment for childhood obesity is impeded by environmental factors, socioeconomic forces, and biological predispositions. Weight gain is often associated with pharmacological agents like glucocorticoids, insulin, and atypical antipsychotics. Weight stigma, a societal devaluation of individuals due to obesity, is a significant issue in children and adolescents. Treatment options include nutrition, exercise, psychological therapy, pharmacotherapy, and surgical procedures. However, treatment outcomes for pediatric obesity can vary widely, and a comprehensive baseline assessment is essential to guide appropriate treatment.

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