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IMPACT OF ADDED SUGARS ON CHILDHOOD OBESITY: A NARRATIVE REVIEW

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ABSTRACT

The rising rates of obesity in children worldwide have become a major health issue, posing a problem for both high-income and low-income countries. Added sugar consumption, particularly from sugar-sweetened beverages, has been largely identified as a significant contributor to pediatric obesity. This scoping review aims to study the effects of additional sugar consumption on childhood obesity by synthesizing existing literature and identifying effective intervention strategies. Articles published from 1980 to January 2024 were searched in PubMed, Google Scholar, and the World Health Organization website. The review highlights a significant association between increased consumption of additional sugar, especially from drinks that have added sugar, and higher childhood obesity rates. Studies have shown that children who consume ≥10% of their daily calorie intake from sugar-added foods have a markedly higher chance of developing obesity in comparison to children consuming <10%. Additionally, sweets, processed grains, cereals, and sugar-added beverages were found to be the primary sources of additional sugar intake in kids. High added sugar intake, particularly from drinks sweetened with sugar, contributes to the growing epidemic of weight gain in pediatric age groups. While interventions targeting added sugar reduction show promise, addressing childhood obesity requires multifaceted approaches that encompass education, environmental modifications, and policy changes. Efforts to combat childhood obesity must prioritize the reduction of added sugar intake and promote healthier dietary habits among children and adolescents.

KEYWORDS: Childhood obesity; Added sugars; Sugar-sweetened beverages; Intervention programs; Nutrition Education; Public health.

INTRODUCTION

Excessive weight gain in the pediatric age groups has become a growing worldwide concern, as the rates of obesity in this age group continue to rise in both wealthy and developing nations.[1,2] Extreme body fat builds up is characteristic of being obese, which has adverse effects on health. It significantly impacts the well-being of children during their developmental years and continues to affect their health into adulthood. The National Health and Nutrition Examination Survey (NHANES) statistics showed that in 2007-2008, 16.9% of youths from ages 2 to 19 had been classified as obese in the United States, marking a significant increase over the years.[3] Similarly, the United Kingdom has witnessed a surge in childhood obesity rates, with prevalence reaching 14% in those aged 2 to 10 years and 15% in 11 to 15 years in 2004.[4] In developing countries, obesity is escalating alongside existing challenges of undernutrition, presenting a double burden of malnutrition.[5] This rise in childhood obesity poses substantial health and economic costs, as it is linked to diseases like cardiovascular diseases, type 2 diabetes, and malignancies, leading to premature deaths and long-term morbidities.[6] This review aims to highlight effective interventions for childhood obesity, including lifestyle changes, pharmacotherapy, and surgical options. Lifestyle adjustments focus on diet and activity, while medications and surgery are considered for severe cases. Each intervention should be carefully tailored to individual needs and circumstances (a). Preventive programs, including education on healthy nutritional practices and physical activity promotion, are essential to curb this epidemic and mitigate its societal and economic consequences.[7,8]

Population, Intervention, Control, Outcome

This review aims to highlight effective interventions for childhood obesity, including lifestyle changes, pharmacotherapy, and surgical options. Lifestyle adjustments focus on diet and activity, while medications and surgery are considered for severe cases.[9] Each intervention should be carefully tailored to individual needs and circumstances.[10,11] Childhood obesity has emerged as a vital global concern, influencing both developed and developing nations worldwide.[1] In the US, 16.9% of kids and teenagers between the ages of 2 and 19 were considered obese in 2007-2008. In the United Kingdom, childhood obesity rates were 14% and 15% in the age groups 2 to 10 years and 11 to 15 years respectively, in 2004. An estimated increase of 23% in the number of overweight <5 children was reported in Africa since 2000. In 2022, the number of overweight children under the age of 5 reached approximately 37 million worldwide, out of which almost half lived in Asia.[12] In 2022, 390 million children of ages 5-19 were overweight.[13-16] The overweight and obesity prevalence rate in this age group was 8% in 1990 which increased to 20% in 2022. In 1990, only 2% of children between the ages of 5 to 19 were obese; this percentage reached 8% in 2022. In 2022, 19% of girls and 21% of boys were classified as overweight.[17-19] While certain sectors of Latin America and the Caribbean have shown lower rates of overweight and obesity among <5 children, more populous countries like Chile, Brazil, and Argentina have exhibited prevalence rates of ≥7%. The prevalence of overweight is predicted to increase to 11% worldwide by 2025 should these increasing trends continue.[10,12] Developing countries also face rising obesity rates, alongside existing challenges of undernutrition, presenting a double burden of malnutrition.[20] Preventive programs are essential to curb the childhood obesity epidemic and mitigate its societal and economic consequences. These programs include education on healthy nutritional practices and the promotion of physical activity. The review aims to examine the burden and risk factors associated with childhood obesity, explore its implications for non-communicable diseases, discuss challenges in medical care and economic sustainability, and emphasize the importance of preventive programs.

METHODS (BACKGROUND)

Literature search and study selection

This narrative review was conducted following the PRISMA Extension for Narrative Reviews (PRISMA-ScR) guidelines. Since this is a narrative review, it was not registered with the International Prospective Register of Systematic Reviews (PROSPERO). A comprehensive search strategy was employed to identify relevant studies. Electronic databases, including PubMed, Cochrane, and Embase, were searched for articles published up until March 1, 2024. A combination of relevant keywords and medical subject headings (MeSH terms) was used to optimize search results.

Inclusion and exclusion criteria

Inclusion criteria included: 1) Inclusion criteria were studies including children and adolescents aged 0-19 years, 2) studies published in a peer-reviewed journal, study designs as cross-sectional, case reports, case series, and cohort were included, and 3) studies available in English-language only.

Exclusion criteria included: 1) non-peer-reviewed articles, reviews, editorials, letters to the editor, conference abstracts, and conference posters; 2) Articles that did not primarily focus on obesity in children due to added sugars or lack relevant information about its clinical characteristics, epidemiology pathogenesis, treatment options, and outcomes; 3) Articles in languages other than English due to potential limitations in translation and understanding.

Data extraction

All the potentially relevant articles were screened in two stages. Initially, articles were screened based on their titles and abstracts by two independent reviewers (J.I. and M.A.) to determine potentially relevant articles meeting predefined eligibility criteria. The full-texts of articles were screened by two reviewers and they extracted data from the source publications onto a standard Microsoft Excel data extraction form. Following this, they individually applied predefined inclusion and exclusion criteria to identify potentially eligible studies. Any discrepancies arising between reviewers were subjected to resolution by a third independent reviewer (M.N.) through collaborative discussion.

DISCUSSION

Causes of obesity

Obesity arises when there's a discrepancy between the intake of energy and its use, with more energy being consumed than what is expended.[9] This causes the body to store more fat than can be used.[12,21] This, however, is not the only reason for developing obesity.[13-20] Obesity results from an interplay of various factors such as lifestyle, dietary preferences[22], level of physical activity, sleep habits, and environmental factors like school, workplace, and neighborhood.[21] According to a study by Davidson et al, a child’s dietary preferences, degree of physical activity, and sedentary behavior are the factors that have a bearing on their risk of developing obesity.[22] BMI is found to be 25-40% heritable according to studies, suggesting the role of genetics in causing obesity. While genetics play a role in various health conditions, they contribute to less than 5% of cases of pediatric obesity.[22] The role of dietary factors, specifically added sugars, as a cause of childhood obesity will be the primary topic of this analysis.

Role of added sugar in obesity

Obesity rates have continued to increase over the past three decades despite recommendations promoting eating habits with minimal fats for weight control, along with decreased dietary fat consumption. Recent studies have demonstrated a

connection between the onset of obesity and consumption of diets rich in excess sugar, although the precise mechanisms remain debated. This review intends to clarify the connection between additional sugar consumption and the prevalence of obesity. Analysis indicates a decline in sugar consumption coinciding with a slowdown in obesity rate increases, yet the population still exceeds the recommended daily added sugar intake by over 300%. Furthermore, while added sugars have been linked to various long-term conditions like obesity, cardiovascular disease, and diabetes, recent evidence questions whether blaming added sugars alone for metabolic diseases is consistent or helpful. A model incorporating annual U.S. sugar consumption data suggests that the delayed rise in adult obesity reflects the cumulative effects of increased sugar intake among children in previous decades. This review underscores the complex interplay between added sugars and obesity, emphasizing the need for continued research and evidence-based strategies for addressing this public health challenge. (Table 1) Summarizes the key factors associated with childhood obesity.

Table 1.

Factor	Description
Causes of Obesity	Energy imbalance (calories consumed > calories burned)
	Genetics
	Dietary factors (added sugars)
Role of Added Sugar in Obesity	Increased obesity rates despite decreased dietary fat intake
	Connection between high sugar diets and obesity
	Added sugars displace nutrients and alter satiety
	WHO recommends <10% daily calories from added sugar
	SSBs, baked goods, candies, cereals major sources of added sugar for children
	Studies link excess SSB intake to childhood obesity
	Frequent snacking on highcalorie, lownutrient foods linked to obesity
	Fast food consumption linked to poor dietary quality and increased obesity risk
Consequences of Obesity	Increased risk of chronic diseases (type 2 diabetes, cardiovascular diseases)
	Psychosocial consequences (discrimination, bullying)
	Higher risk of obesity in adulthood
	Various health complications in obese children (e.g., heart issues, bone problems)
Physiological Mechanisms	Obesity linked to inflammation, oxidative stress, and mitochondrial dysfunction
	Increased susceptibility to bone fractures in obese children
Intervention Strategies	Early intervention crucial
	Policy changes to reduce SSB consumption
	Reduction of added sugar intake through:
	Public health campaigns
	Policy changes
	Educational initiatives
	Food reformulation (lower sugar content)
	Improved food labeling
	Nutrition education to promote healthy eating habits
	School meal programs to provide nutritious meals
	Long-term evaluation of intervention programs for effectiveness

Generally speaking, the sugar we consume can be broadly classified into total sugar and added sugar. Total sugars include both naturally present sugars in food and drinks, such as sugar in fruits and milk, and sugars added in the product. Added sugars or free sugars refers to any sugars added to food or drinks before consumption. These include sugars like sucrose or dextrose incorporated during the manufacturing process of food and drinks, table sugar, sugar in syrup, honey, and concentrated fruit and vegetable juices.[23] They provide calories but no nutritional benefits. In fact, they may deplete nutrients from the body and other foods consumed to enable their metabolism. Added sugars damage the mitochondria which leads to energy depletion. These sugars also displace nutritious food and alter satiety by

causing insulin and leptin resistance. Added sugars also cause a rise in insulin levels which leads to further craving for more carbohydrates. All of this may lead to obesity.[24]

The WHO advises that free sugar (ie sugars that exist naturally in fruit juices and concentrates as well as artificially added sugars) intake should not be more than 10% of the total daily energy requirement for people of all ages.[25] The Dietary Guidelines for Americans also recommends artificial sugar added to foods make up less than 10% of one's everyday calorie consumption.[23]

Sugar-sweetened beverages, bakery items, candies, ready-to-eat cereals, and other desserts are the major sources of added sugar for children.[25,26]

Various studies suggest a connection between excess intake of artificially sweetened food products and obesity in children. One study followed up with 548 schoolchildren (with 11.7 years as the mean age) for 19 months to look into the link between drinking beverages containing additional sugar and obesity. It concluded that for each SS drink added to the daily intake, the likelihood of the children developing obesity rose by 1.6 times.[27]

A study conducted in Greece collected statistics from 1165 children (2 to 11 years) and adolescents (12 to 18 years) between the ages of 2 and 18 years. The study showed that 18.7% of children and 24.5% of adolescents consumed more added sugar than the suggested maximum of 10% of overall calories consumed. In both age groups, sweets (29.8%) and refined cereals and grain products (19.1%) emerged as the leading contributors to additional sugar intake, while in adolescents, sugar-sweetened beverages (20.6%) were also a main contributor. This study reported the odds of overweight or obesity in kids and teens eating sugary foods more than the permissible 10% of daily energy requirement, taking into account the food categories and macronutrients. Children who consumed more than 10% of their daily calories from sugar-laden foods were significantly more inclined to weigh more as opposed to those consuming <10%, with odds ratios of 2.57 ($p=0.002$) and 1.77 ($p=0.047$) when adjusting for food groups and macronutrients, respectively.[28]

Research carried out in 1996 in America by Berkey et al. examined 16,771 children aged 9-14 to explore the impact of various types of sugar-added beverages on their BMI. They discovered a positive association between boys who added one serving of Sugar-Sweetened Beverages (SSB) to their daily intake over the course of a year and weight gain. While girls who upped their daily SSB consumption by a single serving also showed an increase in weight compared to non-drinkers, the effect was less pronounced than in boys. Both girls and boys who added 2 or more servings of SSB to their daily intake compared to the previous year had a more significant weight gain. However, their estimates decreased after correcting for overall energy consumption. Hence they hypothesized that this link between SSBs and weight gain was explained by calories. This study also suggested that children who reduce consumption of SSB in addition to behavioral modifications may prevent excessive weight gain.[29] Another study concluded that children consuming sugar-sweetened beverages as infants were more likely to be obese at age six when compared to children who didn't consume SSBs.[30] Various other studies have also reported on the relationship between the intake of SSB and the likelihood of obesity.[31]

Another risk factor for obesity could be snacking.[32] Frequent snacking is commonly linked to a higher intake of calorie-dense foods[33], which lack essential nutrients but are high in added sugars, salt, and saturated fat. Most common

snacks include foods like bakery items (cakes and cookies) chips, and sugar-sweetened beverages.[34] Although snacks can be beneficial, they can also lead to health problems. A case-control study done in Japan showed a remarkable correlation between irregular snacking patterns and obesity in kids at age 3.[35]

The rate at which fast food is consumed by children has risen significantly in recent years. A study showed that children who ate fast food consumed a higher amount of overall energy, fat, carbohydrates, additional sugars, sweetened beverages, and a smaller amount of fiber, fruits, milk, and non-starchy vegetables.[35] This study inferred that fast food consumption in children could have negative consequences on their dietary quality, thus increasing the likelihood of obesity.[36,37] A longitudinal study over 10 years done in girls aged 8-12 at baseline, showed a strong association between consumption of soda and BMI.[38, 39,40] However, it found no significant link between BMI and intake of energy-dense snacks.[40,41] Additional studies have found a connection between added sugar consumption and weight gain as well[42,43], while some haven't.[44,45]

Consequences of obesity

Obesity can significantly impact the health of children and adolescents. It is linked to a greater possibility of chronic illnesses like type 2 DM and cardiovascular diseases. It also has psychosocial consequences in the form of discrimination and bullying which in turn affects a child's school performance and well-being. Obese children also have a greater probability of being obese in adulthood as well, with a higher chance of developing long-term diseases.[10] Various studies have shown greater dimensions of the left atrium and left ventricle in obese children when compared to children without obesity. Investigations have also shown greater left ventricular mass in children with obesity being detected in children as young as 2 years. Studies have also reported diastolic and systolic dysfunction in children with obesity along with changes in vascular structures.[37]

Childhood obesity has also been linked to a host of psychological problems like mood, behavior, and emotional disorders, poor self-worth, and poor quality of life.[38] The chance of developing impaired glucose tolerance and metabolic syndrome, and consequently T2D, is also high in severely obese children.[39][40] Obesity also leads to various immunological and endocrine disorders, musculoskeletal problems, asthma, sleep apnea, etc.[41] [Figure: 1]

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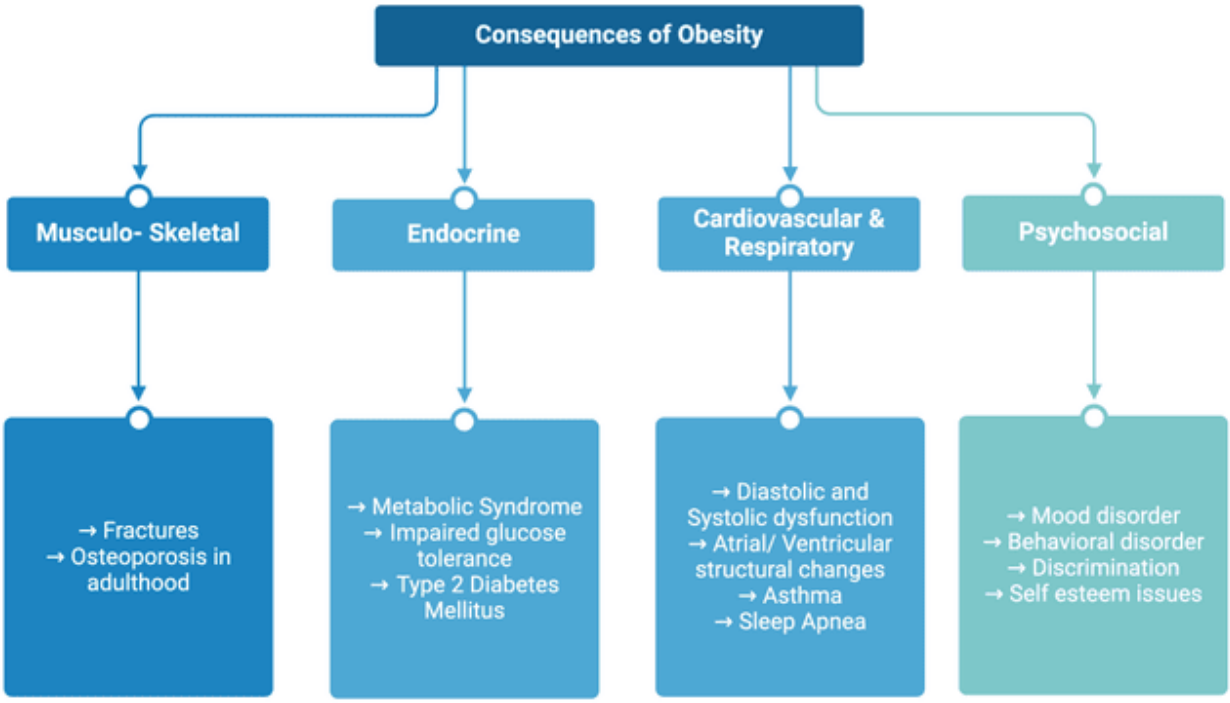

Figure 1: Consequences of obesity.

Physiological Mechanisms

An estimated 17% of youngsters are obese in America alone, posing risks for future health and life expectancy.[3,4] The accumulation of excess adipose tissue in obesity triggers inflammation, oxidative stress, apoptosis, and mitochondrial dysfunction, which in turn leads to the onset of diabetes, liver steatosis, cardiovascular disorders, and neurodegenerative conditions[5] [figure: 2]. Additionally, obesity in children has been linked to an increased susceptibility to skeletal fractures, suggesting an influence on bone metabolism and potentially compromising bone mass acquisition during childhood and adolescence, leading to osteoporotic risks in adulthood. The intricate relationship between obesity and bone remodeling, leading to osteoporosis and fracture risks, involves various cellular mechanisms, including the fate of mesenchymal stem cells and alterations in bone turnover. Obesity influences bone metabolism by promoting adipocyte differentiation over osteoblast differentiation, thereby increasing marrow adipose tissue and reducing bone mineral density (BMD). Cytokines promoting inflammation such as Tumor Necrosis Factor-alpha and Interleukin-6, elevated in obesity, further exacerbate bone resorption by promoting osteoclast formation and activity.[37,38] Moreover, obesity-associated factors like adiponectin and leptin dysregulation contribute to altered bone remodeling processes.[39,40] Various studies in humans and murine models have corroborated the deleterious effects of obesity on bone health, with bone fragility and increased fracture risks observed across different age groups. Furthermore, the inflammation induced by obesity, which is marked by an increased level of pro-inflammatory cytokines like TNF-alpha, impairs bone metabolism and exacerbates osteoclastogenesis, contributing to bone loss and fracture risks [Figure: 3]. The dysregulation of factors such as MCP1, TRAIL, LIGHT, OPG, and RANKL further underscores the intricate interplay between obesity, inflammation, and bone turnover, with implications for osteoporosis development and fracture risks. Overall, understanding the cellular mechanisms underlying obesity-induced alterations in bone remodeling is crucial for developing effective interventions to mitigate osteoporotic risks in obese individuals, especially in childhood and adolescence.[6]

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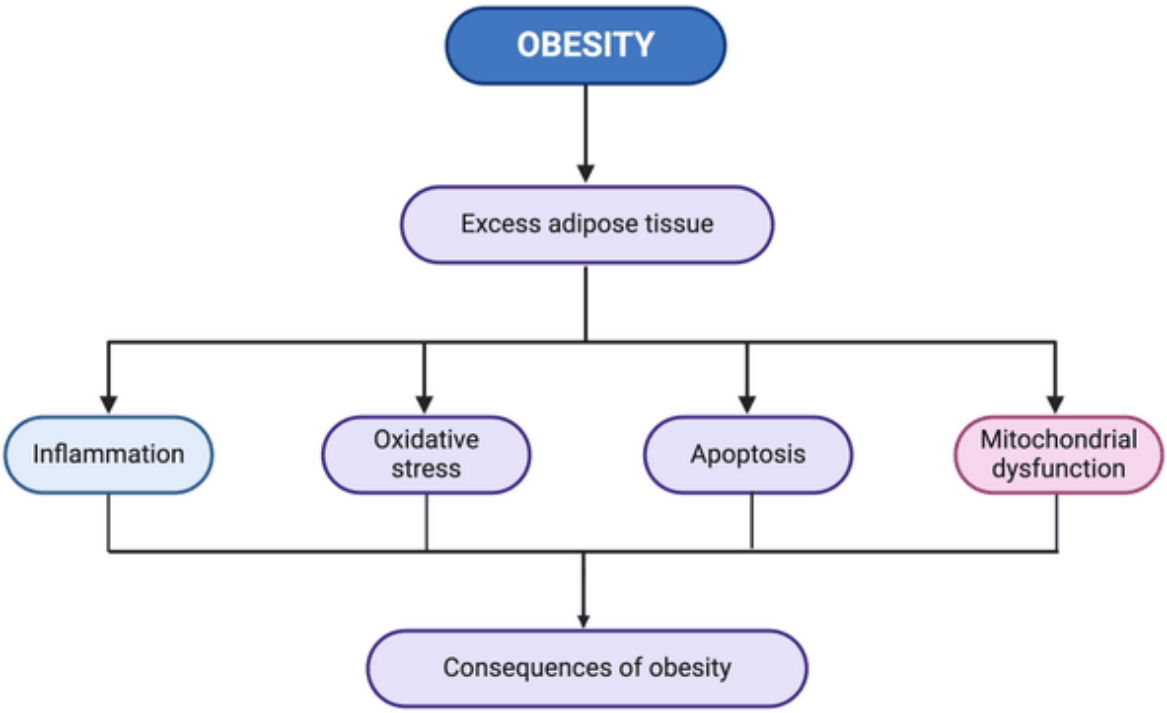

Figure 2: Pathophysiology of Obesity.

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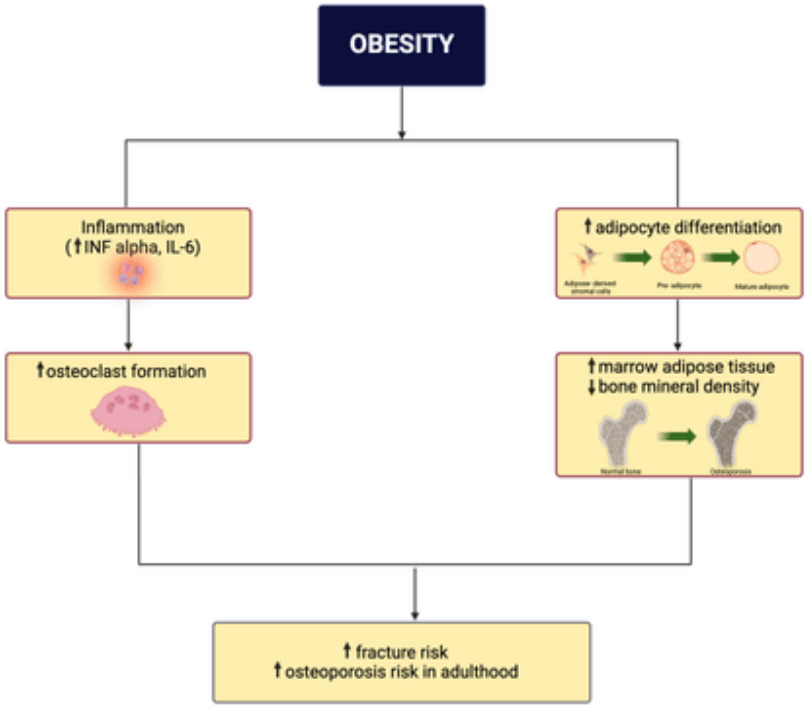

Figure 3: Pathophysiology of bone remodeling in obesity.

Interventions Strategies

Addressing childhood obesity requires early intervention, as diet patterns established in childhood often carry on into adulthood. Despite efforts focused on education and behavior modification, the effectiveness of traditional approaches remains limited.[6]

A substantial portion of additional sugars in our diet comes from drinks that are sweetened with sugar, which are extensively connected to various negative health consequences, like increased body weight, type 2 diabetes mellitus, cardiovascular disorders, and even some cancers. These findings underscore the urgent need for policy interventions targeting SSB consumption to alleviate the worldwide burden of obesity and the complications associated with it. Overweight and obesity have risen significantly in prevalence over the recent years, posing substantial health and economic burdens worldwide. The risk of T2DM, CVD, and other chronic conditions increases substantially with excessive weight gain, with obesity-related costs reaching staggering figures.[7] Addressing obesity requires multifaceted approaches, with lifestyle choices profoundly influenced by the food environment. SSBs, in particular, have emerged as a key factor contributing to positive energy balance, with their high sugar content and caloric load. Given their ubiquitous presence and significant contribution to added sugars in the diet, reducing SSB consumption has become a focal point for public health interventions. Various policies have been implemented globally to curtail SSB intake, reflecting the growing recognition of their detrimental health effects and the need for population-level strategies to promote healthier beverage choices.

Reduction of Added Sugar Intake

A significant focus of intervention strategies aimed at combating childhood obesity involves reducing added sugar intake. Added sugars contribute excess calories to the diet without providing essential nutrients, increasing the risk of weight gain and related health issues. Strategies to reduce added sugar intake may include public health campaigns, policy changes, and educational initiatives aimed at raising awareness about the detrimental effects on health linked with unrestrained sugar intake. Additionally, efforts to reformulate food products to lower sugar content and improve labeling to increase consumer awareness can help support individuals in making healthier dietary choices.

Nutrition-Based Education Initiatives

Nutrition-based education initiatives play a quintessential role in educating individuals on healthy eating habits, allowing them to make conscious decisions regarding their dietary intake. These initiatives may include nutrition education programs in schools, community-based workshops, and online resources that provide evidence-based information on balanced diets, management of portions, and reading food labels.[12] By increasing nutritional literacy and fostering a deeper understanding of the importance of healthy eating, these initiatives can empower individuals to adopt healthier dietary behaviors and lower childhood obesity risk and its related complications.

Governmental Programs and School Meal Initiatives

Governmental programs and school meal initiatives have a key role in influencing dietary behaviors and promoting positive feeding practices among youngsters. The National School Lunch Program (NSLP) and the School Breakfast Program (SBP) are two such initiatives in America, which serve millions of meals to students each school day. These programs aim to provide nutritious meals that meet specific dietary guidelines and aim to improve the student's general health and wellness.[12]

The NSLP and SBP are vital components of the federal nutrition assistance programs run by the United States Department of Agriculture (USDA).[13] The NSLP offers free or reduced-price lunches to eligible students, while the SBP provides breakfasts to students in participating schools. Both programs adhere to nutrition standards set by the USDA, which emphasize the importance of produce like fruits and vegetables, nutritious grains, and protein-rich foods in school meals.[12]

Research has shown that participation in school meal programs can positively impact dietary behaviors in pediatric age groups. Studies have revealed that students who participate in the NSLP and SBP consume more fruits, vegetables, and milk compared to non-participants. These programs also help reduce food insecurity among low-income families and ensure that students have access to nutritious meals throughout the school day.

Moreover, school meal programs have been positively linked to the betterment in academic performance, attendance, and behavior among students.[14] By providing healthy meals, these programs support overall student well-being and contribute to a positive learning environment.[15]

However, challenges remain in ensuring equitable access to nutritious meals for all students, addressing food waste, and promoting healthier food choices within school cafeterias.[15] Continued efforts to strengthen and expand school meal programs are crucial for encouraging healthy feeding practices and decreasing the rates of pediatric obesity and related health issues.[16]

Long-Term Efficacy of Intervention Programs

Evaluating the long-lasting impact of interventional programs is essential for understanding their impact on childhood obesity prevention and management. Longitudinal research and randomized controlled trials (RCTs) can assess the effectiveness of intervention strategies over extended periods and determine their sustainability and scalability. Factors such as program adherence, participant retention, and changes in health outcomes over time provide valuable insights into the long-term effectiveness of intervention programs. Additionally, cost-effectiveness analyses can help inform decision-making and resource allocation to ensure that interventions yield meaningful and sustainable improvements in population health.[17]

The widespread issue of childhood obesity in the United States demands urgent attention along with concerted efforts from various interest groups. By addressing the role of added sugars in driving obesity rates among children and adolescents, policymakers, educators, and healthcare professionals can devise targeted strategies to promote healthier dietary habits and mitigate the long-term health consequences of obesity. Moving forward, comprehensive intervention programs that combine nutrition education, environmental modifications, and behavioral changes hold promise in combating this multifaceted public health challenge.[18]

Strengths

A key strength of this analysis was its longitudinal design, which enabled the researchers to track changes in beverage consumption and BMI over time while considering children's growth and development. Although the study cannot definitively establish causality, its findings were more robust than those from cross-sectional studies. The differences between children included and excluded from the analysis were minimal, though excluding some children with higher sugar-added beverage intakes might slightly bias the results. By considering all beverages together, the study reduced

the risk of confounding from other drink types, but some unmeasured factors might still have influenced the findings despite extensive efforts to control for them.[29]

An analysis found that increased consumption of all liquids except milk is linked to weight gain. From 1965 to 2002, U.S. beverage consumption rose from 11.8% to 21.0% of total calorie intake, adding 222 daily calories per person. Sugar-sweetened drinks and alcohol accounted for 60% and 32% of this increase, respectively.[8]

Another finding revealed that overall, people are drinking fewer sugar-sweetened beverages (SSBs), but it's crucial to address disparities in SSB consumption across different racial and ethnic groups. This study offers the most recent national insights into what children and adults in the U.S. are drinking. It breaks down beverage consumption trends from 2003 to 2014 by various demographic factors.[9]

One of the strengths of the study is its large sample size, which provides a solid foundation for its conclusions. By incorporating food groups and categories defined by the WWEIA (What We Eat in America) database, the study accurately reflects the dietary habits of people across the nation. Additionally, the use of the National Cancer Institute (NCI) method helps to understand typical dietary patterns. The study also uses two days of 24-hour dietary recall data, allowing it to accurately capture the usual intake of added sugars among US children and adolescents, accounting for individual differences.[25,26]

In the study, data was collected from adolescents over several years, allowing them to examine how each person's measurements compared to the average for their age group. This approach also helped them understand how measurements taken multiple times from the same individuals related to each other. It was found that the FFQ (Food Frequency Questionnaire) provided accurate estimates of how much energy-dense snacks participants consumed, while the BIA (Bioelectrical Impedance Analysis) also reliably measured the percentage of body fat.[35]

Limitations

Some reviews of school-based interventions aimed at preventing obesity have produced varied results. In a recent review, 17 out of 25 studies successfully lowered BMI, particularly those that integrated physical education with nutritional education or focused on increasing physical activity while reducing TV time. However, another review proposed that BMI might not accurately reflect success in school children.[1]

While individual data support the connection between sugar and diabetes, current analyses struggle to identify the primary factors influencing diabetes rates amid economic and social shifts. Our approach lacks specific details such as age, sex, and race, highlighting the importance of exploring environmental factors like sugar consumption, considering that South Asians may develop diabetes at lower obesity levels compared to other groups.[4]

Certain studies depended on self-reported dietary recalls, which might result in underreporting. Changes in sugar-sweetened beverage consumption over time weren't taken into account, meaning that the findings only represent intake on a specific day rather than overall habits. As NHANES is cross-sectional, causality cannot be assumed. Additionally, factors like smoking or physical activity weren't factored in, which could influence sugar-sweetened beverage consumption. Moreover, caregivers may not consistently provide accurate reports of children's food and drink intake at daycare or school.[9,25,26]

Lifestyle behaviors were assessed with some degree of inaccuracy, potentially leading to an underestimation of their actual association with weight change. These behaviors were self-selected, and there may be other lifestyle factors not accounted for that could influence the results.[8]

Some participants dropped out of the study, but while they were a part of it, their changes in weight and body fat looked similar to those who completed it.[42]

Future Direction

The study highlights the significance of understanding the varying levels of soft drink consumption across different populations. Discovering strategies that maintain lower soft drink consumption in wealthier nations could help in addressing the increasing rates of obesity and diabetes in less affluent countries. Future research should investigate whether disparities in health risks related to sugar-sweetened beverage consumption exist among low-income and racial/ethnic minority subgroups. Moving forward, it is important for research to incorporate panel data analysis to validate results and explore the time lag between soda consumption and its effects on health.[5,36] Creating a biomarker to measure sugar intake would be helpful for more accurately estimating how much sugar people consume. Fortunately, there is ongoing research focused on this.[25]

Additional longitudinal studies involving children from various age groups, covering the full range of weight status, are necessary to enhance our understanding of how specific foods influence changes in weight and body fat during childhood.[35]

It's important for researchers to dig deeper into how different types of sugars impact our health. Conducting high-quality studies, like randomized controlled trials, is crucial for finding effective ways to reduce the consumption of sugary drinks among individuals and communities. While cutting back on sugary drinks won't solve the obesity crisis on its own, it's a small change that can make a big difference in managing weight and preventing heart and metabolic problems.[6]

CONCLUSIONS

Our review provides compelling evidence regarding the connection between increased intake of sugar-added products and the likelihood of becoming obese in children. The rising crisis of pediatric obesity has been significantly accelerated by the increasing use of food and drinks with added sugars by children. However, it is not the only cause of childhood obesity. Obesity results from an interplay between various environmental and genetic factors. This article also offers a summary of the adverse effects of obesity on the health of children and adolescents, as well as various intervention strategies aimed at decreasing the high level of added sugar consumption in children.

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