Article

A Comprehensive Analysis: The Multidimensional Impact of Excessive Sugar Consumption Among Children and Adolescents and the Formulation of Innovative Solutions for Sustainable Public Health

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A Comprehensive Analysis: The Multidimensional Impact of Excessive Sugar Consumption among Children and Adolescents and the Formulation of Innovative Solutions for Sustainable Public Health

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Abstract

The phenomenon of excessive sugar consumption in children and adolescents has become a global public health crisis with serious multidimensional implications. This essay aims to comprehensively analyze the root causes, impacts, and formulate innovative recommendations for interventions in Indonesia. Through a descriptive-analytical approach utilizing a literature review method, information is synthesized from various credible sources (Google Scholar, PubMed, Indonesian Ministry of Health, WHO) based on relevant keywords. The study findings identify that excessive sugar consumption patterns stem from a complex interaction between children's natural biological preference for sweetness, the massive availability of high-sugar products (especially Minuman Berpemanis Dalam Kemasan (MBDK) / Packaged Sweetened Beverages), and socio-psychological dynamics such as peer pressure, body image issues, and gender norms. The resulting impacts are broad: in terms of health, it significantly contributes to obesity (through fructose metabolic dysregulation and intra-hepatic fat accumulation), type 2 diabetes mellitus, dental caries, and even indications for heart disease and cancer. Socially, it affects interactions and an unwillingness to bring healthy packed lunches; while economically, it imposes direct financial burdens on individuals/families and long-term healthcare costs. Therefore, this essay recommends integrated innovative solutions, including strengthening government policies (expanding MBDK excise taxes and allocating funds for health, advertising regulation, traffic light labels), enhancing creative and behavior-based education and health campaigns (gamification, nutritional literacy, practical skills), and empowering the roles of parents, schools, and the social environment (healthy canteen programs, peer pressure education, inclusive physical activities). This study is expected to serve as a foundation for critical thinking and inspiration for concrete action by various stakeholders to create an environment that supports healthy eating patterns for a more productive future generation.

Keywords: excessive sugar consumption; children; adolescents; multidimensional impact; innovative solutions; public health

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CHAPTER I

INTRODUCTION

1.1. Background

Children and adolescents represent a crucial age group that determines the future of a nation, marked by rapid growth and development potential. However, this potential is increasingly threatened by various health challenges, one of which is the pattern of excessive sugar consumption. This phenomenon has become an urgent global public health issue, considering the high prevalence of non-communicable diseases (NCDs) closely associated with uncontrolled added sugar intake. In

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Indonesia, data indicate a significant upward trend in health problems such as obesity and type 2 diabetes mellitus, even among young age groups, potentially creating a substantial health and economic burden in the future (Kemenkes RI, 2018, as cited in Tarmizi & Siregar, 2024; Alodokter, 2025).

Excessive sugar consumption among children and adolescents is not merely a nutritional issue, but rather a multidimensional problem rooted in the complex interaction between biological preferences, product availability, and social and psychological influences. Children naturally tend to prefer sweet tastes, which is exacerbated by the abundant availability of high-sugar products—particularly Minuman Berpemanis Dalam Kemasan (MBDK) [sugar-sweetened packaged beverages]—in their surroundings, including school environments (Alodokter, 2025; Bailey et al., 2018; Islam et al., 2019). Furthermore, factors such as peer pressure, body image issues, and gender norms contribute to unhealthy eating patterns and limited physical activity, encouraging the consumption of nutrient-poor, sugar-dense foods (Arna et al., 2024; Islam et al., 2019).

The impact of this excessive sugar consumption pattern extends to multiple aspects of life. From a health perspective, the risks of obesity, type 2 diabetes mellitus, and dental caries pose real threats that can permanently affect the quality of life of children and adolescents (Stanhope, 2016; WHO, 2017; Efrianty, 2020). The social implications are reflected in altered eating behaviors influenced by peer environments and pressures, as well as impacts on mental health (Arna et al., 2024; Islam et al., 2019). Meanwhile, the economic impact includes the financial burden on individuals and families for purchasing unhealthy foods, along with potential long-term healthcare costs borne by the state due to the treatment of chronic sugar-related illnesses (Arna et al., 2024; Islam et al., 2019).

Various efforts have been made to address this issue, ranging from government policies such as the imposition of excise tax on MBDK (Kementerian Kesehatan, 2024), educational programs and health campaigns (Fakultas Kedokteran Ubaya, 2022; Halodoc, 2020), to initiatives in educational and family settings (Departemen Gizi Kesehatan UGM, 2025; Islam et al., 2019). However, the complexity of the issue and the continuously rising prevalence of sugar-related diseases suggest that existing interventions have not yet been fully effective or need further optimization.

Therefore, through a literature-based approach, this article aims to comprehensively identify the root causes of excessive sugar consumption, analyze its multidimensional impacts, and formulate innovative, integrated, and sustainable recommendations and solutions. Accordingly, this study is expected to provide a foundation for critical reflection and inspire concrete actions by various stakeholders—ranging from the government, academics, health practitioners, and parents, to the general public—to collaboratively create an environment that supports healthy eating patterns for children and adolescents, in pursuit of a healthier and more productive future generation.

1.2. Problem Formulation

Based on the background described above, the problems addressed in this article are as follows:

1.2.1 How can patterns of excessive sugar consumption among children and adolescents be identified based on natural preferences, product availability, and social-psychological dynamics?

1.2.2 How do multidimensional impacts (health, social, and economic) of excessive sugar consumption affect children and adolescents?

1.2.3 How can innovative and practical solutions be formulated to address excessive sugar consumption among children and adolescents in Indonesia?

1.3. Research Objectives

The objectives of this study are as follows:

1.3.1 To identify patterns of excessive sugar consumption among children and adolescents based on literature review, including natural preferences, product availability, and socio-psychological dynamics.

1.3.2 To analyze the multidimensional impacts (health, social, and economic) of excessive sugar consumption among children and adolescents.

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1.3.3 To formulate problem-solving strategies and innovative recommendations to address excessive sugar consumption among children and adolescents in Indonesia.

1.4. Research Benefits

This study is expected to provide the following benefits:

1.4.1 Theoretical Benefits

- Contribute to the development of scientific literature on the issue of excessive sugar consumption among children and adolescents by presenting a comprehensive analysis from multiple perspectives (health, social, economic).
- Serve as a foundation for further research, both empirical studies and intervention-based research, in addressing sugar-related problems.

1.4.2 Practical Benefits

- **For the Government and Policymakers:** Provide evidence-based input and recommendations for more effective policy formulation, including excise regulations, product marketing, and nutritional labeling standards.
- **For Educational Institutions and Health Practitioners:** Offer practical guidance for developing more innovative, creative, and behavior-based nutritional education programs in schools and healthcare facilities.
- For Parents and Families: Increase nutritional literacy and awareness, and provide practical strategies to limit sugar intake and encourage healthy eating habits at home.
- For the General Public: Inspire behavioral change toward healthier sugar consumption patterns and raise collective awareness about the multidimensional impact of excessive sugar consumption.

CHAPTER II

LITERATURE REVIEW

2.1. Fundamental Concepts and Key Definitions

2.1.1. Sugar and Types of Consumption

Sugar is a type of simple carbohydrate composed of glucose, sucrose, and fructose (Ridhani et al., 2021). Glucose is the most basic form of sugar, while sucrose is commonly found in table sugar, and fructose occurs naturally in fruits, vegetables, and honey. A key distinction lies between intrinsic sugars (natural sugars) and added sugars. Added sugars refer to sugars incorporated during food processing and are commonly found in sweetened beverages, sweetened cereals, and processed foods (Bailey et al., 2018).

The phenomenon of overconsumption refers to a consumption pattern that exceeds the body's actual needs and is often associated with the pursuit of social status and superficial pleasure (Soares & Moniz, 2023). In the context of sugar, this behavior is frequently driven by psychological and social factors such as environmental pressure, food advertisements, and a lack of nutrition education. Understanding the types of sugars and the nature of this consumptive behavior serves as a conceptual foundation for analyzing the impacts of excessive sugar intake on children and adolescents.

2.1.2. Characteristics of Children and Adolescents

Children and adolescents are age groups undergoing rapid physiological and psychosocial development. According to Bailey et al. (2018), the highest intake of added sugar among children aged 2–8 comes from sweetened cereals and sweet breads, while adolescents aged 9–18 obtain more than 50% of their added sugar intake from sugary drinks such as soft drinks.

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Despite their high metabolism, excessive sugar intake during this developmental stage still poses health risks. Alodokter (2025) notes that 8 out of every 100 children in Indonesia are obese. Other risks include type 2 diabetes, dental damage, and metabolic disorders. Given these long-term consequences, it is essential to establish healthy eating habits early on, with active involvement from both families and educational institutions.

2.2. The Health Impacts of Excessive Sugar Consumption

2.2.1. Obesity and Metabolic Risks

Excessive sugar intake is a major contributor to increased obesity risk through two primary mechanisms. First, indirectly, overconsumption of sugar promotes weight gain. Simple carbohydrates in sugar rapidly elevate blood glucose levels, triggering fat accumulation and leading to overweight or obesity (Syauqy et al., 2022, as cited in Tarmizi & Siregar, 2024). Excess body weight itself becomes a significant factor in raising blood glucose levels. In Indonesia, evidence shows an increase in the prevalence of overweight individuals aged 18 and older, from 14.8% to 21.8% in 2018 (Kemenkes RI, 2018, as cited in Tarmizi & Siregar, 2024), contributing to the rise of non-communicable diseases (NCDs). A study in Bali also found that the higher one's Body Mass Index (BMI ≥25 kg/m²) and waist circumference (men >90 cm; women >80 cm), the higher the person's blood glucose level—indicating excessive fat storage linked to insulin resistance and hyperglycemia (Dewi & Dwipayana, 2022; Bano, 2013, both cited in Tarmizi & Siregar, 2024.

Second, beyond weight gain, a diet high in added sugar directly contributes to the development of metabolic diseases (Stanhope, 2016). Fructose, found in abundance in added sugars such as sucrose and high-fructose corn syrup, is uniquely processed by the liver. Unlike glucose, the liver processes fructose without regulatory limits, leading to excessive de novo lipogenesis (new fat production). This results in intrahepatic fat accumulation, impaired fat oxidation, and increased release of very low-density lipoprotein (VLDL1) into the bloodstream, contributing to dyslipidemia (high cholesterol and triglyceride levels). This hepatic fat accumulation also causes liver insulin resistance, which disrupts blood glucose regulation. Additionally, fructose metabolism elevates uric acid production and inflammation, further impairing insulin function. Human studies support that high added sugar intake significantly increases the risk of metabolic disorders, regardless of weight gain (Stanhope, 2016).

2.2.2. Type 2 Diabetes Mellitus (T2DM)

Excessive sugar consumption is a key contributor to hyperglycemia (elevated blood sugar levels), a hallmark of type 2 diabetes mellitus (T2DM). T2DM is a chronic metabolic disorder marked by insulin resistance and/or insufficient insulin production by the pancreas (Buysschaert et al., 2016, as cited in Melytania, 2023). Its two main pathophysiological mechanisms are insulin resistance and pancreatic beta-cell dysfunction (Decroli, 2019). Genetic and environmental factors—such as obesity, overeating, and physical inactivity—also play roles in the onset of T2DM (Ozougwu et al., 2013, as cited in Lestari, Zulkarnain & Sijid). Diets high in sugary foods and beverages, rich in simple carbohydrates and high-glycemic glucose, rapidly raise blood glucose levels after consumption.

Stanhope (2016) specifically outlines how added sugar directly contributes to T2DM development, particularly through hepatic mechanisms. Excess fructose overwhelms the liver, triggering de novo lipogenesis and intrahepatic fat accumulation. This buildup reduces the liver's ability to oxidize fat and increases VLDL1 release, leading to dyslipidemia. Fat accumulation in the liver also desensitizes it to insulin, disrupting glucose regulation and creating a vicious cycle of insulin resistance. Moreover, fructose metabolism raises uric acid and triggers inflammation, further impairing insulin function. Clinically, Alodokter (2025) emphasizes that chronically elevated blood sugar levels can damage the eyes, kidneys, nerves, heart, and blood vessels—causing severe and permanent complications. This underscores the urgency of mitigating excessive sugar consumption.

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2.2.3. Oral and Dental Health

Excessive sugar consumption significantly affects oral health, particularly in children. A strong correlation exists between the frequency of sugary food consumption and the severity of tooth decay (Efrianty, 2020). Sweet foods such as candy, chocolate, donuts, and sugary snacks promote rapid growth of oral bacteria that metabolize sucrose into acid. The longer these sugary foods stay on the teeth, the more acid is produced, increasing the risk of damage. The timing of consumption is also critical—saliva takes about 20 minutes to neutralize sugary foods, so frequent snacking accelerates tooth decay. Therefore, consuming sweet foods during main meals, when saliva production is higher, is recommended. Children's primary teeth are more vulnerable to caries because their enamel has lower mineral content and is less dense than permanent teeth (Wong et al., 2008, as cited in Efrianty, 2020). Data from Riskesdas 2017 showed a rise in active caries prevalence in Indonesia from 43.4% (2007) to 53.2% (2013) (as cited in Efrianty, 2020). Besides carbohydrate intake, factors such as lifestyle behaviors, saliva flow, fluoride exposure, oral hygiene, and environmental influences also contribute to dental caries (Worotitjan et al., 2013, as cited in Efrianty, 2020).

2.2.4. Other Health Impacts

Beyond obesity, type 2 diabetes, and dental caries, excessive sugar intake and unbalanced diets have significant implications for other health conditions:

- Non-Type 2 Diabetes Mellitus (particularly sugar-related types)

Research by Gani et al. (2023) found a strong correlation between excessive sugar intake and general diabetes incidence, indicating that consuming more than 50 grams (four tablespoons) of sugar per day triples the risk of diabetes. This habit promotes fat accumulation and insulin resistance, disrupting blood glucose regulation (Ardiani et al., 2021; Nurrahmawati & Fatmaningrum, 2018, as cited in Gani et al., 2023). Adequate fiber intake (28–37 grams/day for men, 27–32 grams/day for women) is critical in preventing diabetes, as those with low fiber intake are three times more likely to develop the disease. Fiber helps by increasing satiety, slowing nutrient absorption, and stimulating digestive hormones that regulate blood sugar (Nurohmi, 2017, as cited in Gani et al., 2023). Thus, a high-sugar and low-fiber diet is a major risk factor for diabetes.

- Cardiovascular Disease (CVD)

Excessive sugar intake has been linked to a higher risk of cardiovascular disease through its association with elevated blood pressure and cholesterol—both major risk factors (Malik et al., 2010; Lustig et al., 2012, as cited in Sinaga et al., 2024). Fructose in sugary drinks is often implicated. It is important to note that this relationship remains an active area of research, requiring further studies to establish a comprehensive understanding, as findings from some studies vary (Yang et al., 2014, as cited in Sinaga et al., 2024).

- Cancer

Excessive sugar consumption has also been associated with increased risk of several types of cancer, including breast, colorectal, and pancreatic cancer. Possible mechanisms include heightened obesity risk (a known cancer risk factor) and increased insulin levels that may stimulate cancer cell growth (Giovannucci et al., 2010; Lustig et al., 2012; Malik et al., 2010, as cited in Sinaga et al., 2024). Nevertheless, further research is necessary to fully clarify the causal relationship between sugar consumption and cancer risk.

2.3. Social and Economic Implications of a High-Sugar Diet

2.3.1. Impact on Social Behavior

Regular consumption of sugary foods and beverages significantly influences adolescents' social interactions and is often shaped by peer pressure. A qualitative study in rural Bangladesh revealed that street foods—including sweet items—are integral to moments of togetherness and friendship

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among teenagers. They share and enjoy them to enhance social satisfaction (Islam et al., 2019). Similarly, Arna et al. (2024) note that peer pressure substantially influences adolescents who prioritize social bonds, prompting them to adopt unhealthy eating habits such as consuming junk food or overeating during social gatherings.

This social pressure also manifests in a reluctance to bring homemade meals. Islam et al. (2019) highlighted parents' concern that their children, embarrassed to bring lunch from home, opt to purchase food from vendors instead. Additionally, psychological factors like body image play a role: adolescents with negative self-perceptions may experience emotional eating or reduced motivation for physical activity due to body-shame (Arna et al., 2024).

Furthermore, gender norms significantly shape social behavior regarding diet and physical activity (Islam et al., 2019). The study identified gender-based consumption patterns: boys tend to prefer energy drinks and sweet foods associated with masculinity, strength, and virility; girls tend to prefer spicy and sour foods. Body image ideals also differ: boys aspire to a muscular build, while girls aim for a "medium size—not too fat, not too thin," believing that fatness does not equate to health. Gender roles also restrict girls from engaging in physical activities like cycling or outdoor play, due to social stigma and disapproval. Indirectly, this reduces girls' physical activity levels and increases lifestyle-related health risks.

2.3.2. Economic Impact on Individuals and Families

The economic impact of a high-sugar diet is directly felt in personal and family finances, especially given the strong preference for eating and drinking out. Although street foods are often inexpensive, regular consumption can become a significant expense from adolescents' pocket money and family budgets (Islam et al., 2019). School environments dominated by low-cost, low-nutrient options also limit healthy choices, indirectly increasing long-term costs due to health consequences (Arna et al., 2024).

Moreover, access to and affordability of healthy foods are critical economic concerns. Islam et al. (2019) report that while rural families may enjoy seasonal fruits from their own gardens, off-season prices rise steeply, reducing consumption despite nutritional awareness. Mothers express concerns about inability to purchase nutritious foods like eggs, milk, meat, apples, or oranges, even when they understand their benefits. This underscores how financial constraints often impede the implementation of nutritional knowledge.

Ultimately, the continuous spending on sugary foods and beverages, combined with the high cost of healthy foods, can deplete household budgets. In the long term, elevated healthcare costs due to chronic sugar-related diseases (e.g., diabetes, heart disease, or obesity) will increasingly burden individuals and families financially. Obesity heightens the risk of complications requiring long-term treatment, imposing financial strain and potentially affecting career and income prospects in adulthood.

2.4. Previous Interventions and Solutions to Reduce Excessive Sugar Consumption

2.4.1. Government Policies and Regulations

The Indonesian government has actively addressed the rise in obesity and non-communicable diseases (NCDs) resulting from excessive intake of sugar, salt, and fat (SSF). The Ministry of Health (2024) recommends daily SSF intake limits of 50 g sugar (4 tbsp), 2,000 mg sodium/5 g salt (1 tsp), and 67 g cooking oil (5 tbsp).

A concrete government effort includes restricting consumption of sugar-sweetened packaged beverages (MBDK) through excise tax policies (Ministry of Health, 2024). The urgency of this policy stems from high MBDK consumption triggering diabetes. MBDK consumption reached 20.23 L per person in 2019—a 15-fold increase in the past 20 years (Ferretti & Mariani, 2019; Rosyada & Ardiansyah, 2017, cited in Ministry of Health, 2024). Imposing excise on MBDK has proven effective in 108 other countries as an NCD intervention. Historical data from the UK during sugar rationing—

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allowing less than 40 g/day for adults and no sugar for children under two—aligned with contemporary health guidelines (Boone, 2024), reinforcing the importance of early dietary control throughout life. This evidence supports sugar taxes and strict regulation of marketing sweet products to infants and toddlers (Boone, 2024). These policies aim to improve consumption behavior, public health, and promote reformulation of healthier industrial products (Ministry of Health, 2024).

2.4.2. Education Programs and Health Campaigns

Beyond policy, education programs and health campaigns play a crucial role in raising public awareness about the dangers of excessive sugar consumption and encouraging behavior change. Various initiatives are implemented by educational institutions, health organizations, and community groups.

For example, medical students from the Faculty of Medicine, University of Surabaya (FK Ubaya), conducted the "Stop Excessive Sugar Consumption" campaign on Tunjungan Street, Surabaya, in observance of World Diabetes Day (Faculty of Medicine, Ubaya, 2022). This activity educated the public about the risks of excessive sugar, diabetes symptoms, and the fact that diabetes affects all ages. Vera Novalita, Chair of FK Ubaya Student Executive Board, emphasized that the campaign aimed not to ban sugar entirely but to reduce its intake and replace it with healthy options (fruits, vegetables), while promoting an active lifestyle. The campaign featured free mineral water distribution and creative costume use to convey health messages engagingly (Faculty of Medicine, Ubaya, 2022). Such education efforts aim to increase awareness and preventive action against diabetes at an early stage.

Health platforms and media, such as Halodoc (2020), actively disseminate information on limiting sugar in children's diets, highlighting its negative effects, and providing recommended daily intake guidelines. These educational efforts aim to enhance public awareness and promote healthier eating habits.

2.4.3. Role of Parents and Educational Environment

Parents and educational environments are frontline agents in establishing healthy eating habits among children and adolescents. A qualitative study by Islam et al. (2019) emphasized parents'—especially mothers'—concern for their children's eating patterns and their efforts to promote homemade meals. However, challenges such as peer pressure and preference for sweet street food often present obstacles. The reluctance to bring packed lunches—due to embarrassment—reveals complex social dynamics in school settings influencing food choices (Islam et al., 2019). Halodoc (2020) directly stresses the importance of parental roles, particularly mothers, in limiting children's sugar intake and providing practical daily sugar intake guidelines by age.

Within schools, educational interventions have been implemented to enhance nutritional awareness and healthy eating practices. In April 2025, the Nutrition Department of UGM's Faculty of Medicine and Public Health (FK-KMK UGM) conducted a "Healthy Canteen" SSF limitation program for students and homeroom teachers at several primary schools (Nutrition Department UGM, 2025). This program aimed to help students understand SSF limits, read nutrition labels, and reduce excess intake to prevent dental caries. It included interactive materials via the booklet "Hidup Sehat Mulai dari Aku" ["Healthy Living Starts with Me"], practical nutrition-label exercises, and pre- and post-tests. The program's success—marked by student enthusiasm and improved lunch and snack choices—confirmed the importance of school-based nutrition education as a foundational step toward sustainable healthier consumption habits (Nutrition Department UGM, 2025).

CHAPTER III

RESEARCH METHOD

3.1. Type and Research Approach

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This study adopts a descriptive-analytical approach using a literature review method (*kajian pustaka*). This approach was chosen to systematically identify, review, and synthesize information from both primary and secondary sources related to excessive sugar consumption among children and adolescents. The focus includes identifying health impacts, social and economic implications, and evaluating previously implemented interventions. The objective is to explore ideas, concepts, and published empirical findings to construct comprehensive, critical, and solution-oriented arguments regarding the addressed issue.

3.2. Data Collection Procedure

The process of collecting data or information in this article was carried out through the following systematic steps:

3.2.1 Keyword Identification: Literature searches were conducted extensively using combinations of relevant keywords. The main keywords include: "excessive sugar consumption," "added sugar," "impact of sugar on children and adolescents," "childhood obesity," "type 2 diabetes mellitus," "dental caries," "social implications of sugar," "economic impact of sugar," "sugar restriction policy," "nutrition education," "parental role in sugar consumption," as well as other related terms and synonyms in both Bahasa Indonesia and English.

3.2.2 Determination of Databases and Credible Sources: The primary information sources utilized include highly reputable scientific databases such as Google Scholar and PubMed, as well as news portals and official reports published by trusted institutions (e.g., the Ministry of Health of the Republic of Indonesia, the World Health Organization/WHO). Additionally, relevant textbooks were used as a conceptual foundation to support in-depth understanding.

3.2.3 Literature Selection: The selection of literature was based on topic relevance, source credibility (prioritizing reputable scientific journals, official research reports, and trusted health organization websites), and publication currency. Nonetheless, seminal references fundamental to this field were also considered, even if published earlier. Articles that were irrelevant to the topic or considered less valid were excluded.

3.2.4Extraction of Key Information: Essential information was extracted from each selected source. This includes conceptual definitions, statistical data, research findings, impact mechanisms (physiological, social, economic), and descriptions of interventions or solutions that have been previously implemented.

3.3. Data Processing and Analysis Procedure

The collected data and information were then processed and analyzed through the following structured stages:

3.3.1 Classification and Categorization: The extracted information was classified according to the main themes forming the structure of the article, namely: fundamental concepts, characteristics of the target age group, health impacts, social and economic implications, and review of existing interventions and solutions.

3.3.2 Information Synthesis: Various findings from the literature were synthesized to identify common patterns, similarities, differences, and causal relationships between excessive sugar consumption and its various impacts. This process involved integrating ideas and perspectives from diverse sources to develop coherent and comprehensive arguments.

3.3.3 Critical Analysis: Each piece of information was critically analyzed to evaluate the strength of the evidence, its relevance to the Indonesian context, and to identify potential research gaps or existing controversies in the reviewed literature (for example, regarding the impact of sugar on heart disease or cancer risk).

3.3.4 Argument and Solution Development: Based on the synthesis and critical analysis of the literature, the main arguments of the article were developed to support a deeper understanding of the issue and formulate innovative and relevant solution proposals.

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3.4. Conclusion and Recommendation Formulation

The final stage of this methodology is the formulation of conclusions and recommendations, based on the in-depth analysis of the reviewed literature:

3.4.1 Conclusion Formulation: Conclusions were systematically drawn, directly addressing the research questions and objectives stated in Chapter I. These conclusions represent a synthesis of the main findings obtained from the literature review.

3.4.2 Recommendations: Based on the conclusions drawn and the results of a comprehensive analysis, recommendations were formulated with practical and/or theoretical significance. These may be directed to various stakeholders (such as the government, parents, educational institutions, the general public), as well as future research directions to fill identified knowledge gaps throughout the review process.

CHAPTER IV

FINDINGS AND DISCUSSION

4.1. Excessive Sugar Consumption Patterns as the Root of the Problem among Children and Adolescents

The findings from the literature review indicate that excessive sugar consumption among children and adolescents is not a single-faceted issue but rather a complex phenomenon rooted in several fundamental factors. First, there is a natural tendency (biological preference) among children to favor sweet tastes, which historically aided in identifying energy sources. However, this tendency is exacerbated by the widespread availability and accessibility of high-sugar products in everyday environments, including areas around schools (Alodokter, 2025; Islam et al., 2019). Further analysis, supported by empirical data from NHANES (Bailey et al., 2018), clearly demonstrates that sugar-sweetened beverages (SSBs) are the dominant contributor, accounting for more than half of adolescents' total added sugar intake. This reality underscores the urgent need for targeted interventions focused specifically on SSB consumption.

Second, beyond taste preferences and availability, social and psychological dynamics play a critical role in shaping sugar consumption patterns. Peer pressure often compels adolescents to adopt unhealthy eating habits, including consuming cheap and easily accessible sugary foods, even at the cost of rejecting healthy home-prepared meals (Arna et al., 2024; Islam et al., 2019). This phenomenon is reinforced by issues related to body image and gender norms, which indirectly influence food choices and levels of physical activity (Islam et al., 2019; Arna et al., 2024). For instance, gender norms that restrict certain physical activities for girls can contribute to sedentary lifestyles, thereby worsening the health risks associated with excessive sugar intake. Consequently, the issue of excessive sugar consumption is demonstrably multidimensional, involving complex interactions between biological, environmental, social, and psychological factors during a crucial stage of child and adolescent development.

4.2. Multidimensional Impact Analysis: Health, Social, and Economic

The pattern of excessive sugar consumption manifests in a series of significant multidimensional impacts on the health, social life, and economy of children, adolescents, and society at large. From a health perspective, excessive sugar consumption is a major driver of obesity and metabolic risk. Sugar, particularly fructose, contributes to weight gain not only through excess calories but also by disrupting liver metabolism, leading to fat accumulation and insulin resistance (Stanhope, 2016). This condition is aggravated by the increasing trend of overweight prevalence in Indonesia (Ministry of Health RI, 2018, in Tarmizi & Siregar, 2024). Furthermore, added sugars directly exacerbate the risk of Type 2 Diabetes Mellitus through similar liver mechanisms, even in the absence of severe obesity (Stanhope, 2016). The long-term complications of uncontrolled hyperglycemia pose serious risks to vital organs (Alodokter, 2025). Additionally, dental caries is a pressing health concern, with free sugar

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as the main trigger for tooth decay, especially among vulnerable children and adolescents (WHO, 2017; Efrianty, 2020). Studies also suggest correlations between high sugar intake and increased risk of heart disease (through blood pressure and cholesterol) and certain types of cancer (via obesity and insulin), although further research is needed to establish full causal links (Sinaga et al., 2024).

Socially, the implications of excessive sugar intake are evident in how social environments shape dietary choices. Peer pressure often deters adolescents from making healthy choices, such as reluctance to bring home-cooked meals to school due to embarrassment (Islam et al., 2019; Arna et al., 2024). Moreover, issues related to body image and gender norms indirectly influence dietary habits and physical activity, creating psychological and social barriers to a healthy lifestyle (Islam et al., 2019; Arna et al., 2024).

The economic impact is also significant and long-term. At the individual and household levels, routine spending on sugary foods and beverages—although seemingly inexpensive yet essentially unhealthy—can become a substantial financial burden (Islam et al., 2019; Arna et al., 2024). Limited access to and the high cost of healthy foods further constrain choices for low-income families, exacerbating nutritional inequality (Islam et al., 2019). In the long run, the high healthcare costs associated with chronic diseases (diabetes, obesity, cardiovascular diseases) triggered by excessive sugar consumption will strain individuals, families, and the national health system (Arna et al., 2024). This analysis highlights that excessive sugar consumption is a multidimensional public issue, requiring a holistic approach involving multiple sectors.

4.3. Problem-Solving and Innovative Recommendations for Intervention

Based on the identification of problems rooted in biological, environmental, social, and psychological factors, along with an in-depth analysis of the multidimensional impacts (health, social, economic), this article formulates integrated and potentially inspiring solutions and recommendations. The proposed solutions are as follows:

4.3.1. Strengthening Progressive Government Policies and Regulations

Government interventions such as the implementation of excise taxes on sugar-sweetened beverages (SSBs) have proven effective in various countries and are highly relevant for Indonesia, considering the high consumption of SSBs (Ministry of Health, 2024). To increase its effectiveness, an innovative recommendation is to expand the excise tax coverage to include other high-sugar food products commonly consumed by children and adolescents (e.g., sweet biscuits, sugary cereals). Furthermore, the revenue from these taxes should be specifically allocated to fund Non-Communicable Disease (NCD) prevention programs or subsidies for healthy food for low-income families, thereby creating a dual impact (disincentivizing unhealthy consumption and incentivizing healthy choices). Stricter regulations on advertising and marketing high-sugar products targeting children are also crucial, accompanied by standardized and easily understandable nutrition labels (e.g., a national traffic light label system) to enable consumers to make informed and quick decisions (Boone, 2024).

4.3.2. Enhancing Creative and Behavior-Based Health Education and Campaigns

Comprehensive nutrition education programs, such as those conducted by FK Ubaya (2022) and the Department of Public Health Nutrition at UGM (2025), need to be scaled up and integrated into the formal education curriculum from an early age. A creative idea is to design more interactive and immersive programs using digital media, gamification, or storytelling relevant to the world of children and adolescents (e.g., a nutrition education series on popular digital platforms). Campaigns should not only focus on the dangers of sugar but also on nutrition literacy (reading labels, understanding nutrients) and practical skill development (choosing healthy snacks, preparing appealing lunchboxes). The importance of behavior-based campaigns is emphasized, such as recommending the replacement of sugary drinks with mineral water or fruit, and promoting

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inclusive active lifestyles for all genders, addressing identified social barriers (Faculty of Medicine Ubaya, 2022).

4.3.3. Empowering the Role of Communities: Parents, Schools, and Social Environments

Empowerment should target parents as the primary decision-makers in the household. Nutrition education programs for parents must be accessible, practical, and inclusive, helping them understand daily sugar limits and strategies to provide healthy meals amid financial constraints and social pressure (Halodoc, 2020). In educational settings, the "Healthy Canteen" initiative by UGM (2025) should be replicated nationwide, supported by local government regulations. Schools must be encouraged to actively educate students about how social behaviors affect food choices and the importance of bringing lunch from home, while also creating an atmosphere where healthy choices are seen as "normal" and cool. Additionally, considering the role of gender norms in limiting physical activity (Islam et al., 2019), communities and schools must innovate in offering various inclusive and engaging forms of physical activity for both girls and boys, thus promoting an active lifestyle comprehensively.

By implementing these innovative, integrated, and multi-stakeholder solutions synergistically, it is expected that significant improvements in sugar consumption patterns among Indonesian children and adolescents can be achieved. Ultimately, this will yield sustainable positive impacts on public health, social resilience, and national economic growth.

CHAPTER V

CONCLUSION

5.1. Conclusion

Based on a comprehensive analysis of various literature sources, this essay concludes that excessive sugar consumption among children and adolescents constitutes a multidimensional public health issue with wide-ranging and complex impacts. This phenomenon is not only triggered by a natural preference for sweet tastes in early age but is further exacerbated by the widespread availability of added sugars in foods and beverages, as well as social and psychological influences.

Physiologically, excessive sugar consumption has been directly shown to contribute to the risk of obesity through intrahepatic fat accumulation and insulin resistance triggered by fructose. This condition serves as a precursor to Type 2 Diabetes Mellitus, as added sugar directly induces liver dysfunction and disrupts blood sugar regulation, even in the absence of severe obesity. Dental caries also remain an urgent issue, due to the metabolism of sugar by bacteria. In addition, strong correlations have been found between high sugar intake and increased risks of heart disease and certain types of cancer, although further causal research is still required.

Socially, sugar consumption behavior among adolescents is significantly influenced by peer pressure and social norms, which can inhibit healthy choices and lead to body image issues. Economically, the impact is felt directly by individuals and families through routine spending on unhealthy food, compounded by limited access to affordable healthy food, as well as the long-term healthcare costs associated with chronic diseases linked to excessive sugar intake.

Addressing this challenge requires an integrated and multisectoral approach. Government policy interventions, such as the implementation of excise taxes on sugar-sweetened beverages (Minuman Berpemanis dalam Kemasan, MBDK), have proven effective. Creative and sustainable health education programs and campaigns are essential for raising public awareness. Equally critical is the central role of parents and educational environments in shaping healthy eating habits from an early age, supported by healthy school canteens and adaptive nutrition curricula.

In conclusion, tackling the issue of excessive sugar consumption among children and adolescents demands strong synergy between government regulations, innovative public education

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initiatives, and the active involvement of families and educational institutions to create environments that inherently support healthier and more sustainable lifestyle choices for future generations.

5.2. Recommendations

Based on the findings and conclusions of this essay, several recommendations are proposed as concrete efforts to realize "Research to Impact" for better public health outcomes:

5.2.1. For Government and Policymakers (Firm Regulations and Strategic Budget Allocation):

- Expansion and Optimization of Excise Taxes: It is urgent to expand the scope of excise taxes to include other high-sugar food products commonly consumed by children and adolescents (e.g., sugary cereals, sweet biscuits), beyond just MBDK (Minuman Berpemanis dalam Kemasan). Revenues from these taxes must be transparently and specifically allocated for NCD (Non-Communicable Disease) prevention programs, health promotion, or subsidies for healthy food for low-income families—creating a positive cycle between disincentivizing unhealthy consumption and incentivizing healthy choices.
- Marketing Regulation and Nutrition Labeling: Enforce stricter regulations on the advertisement and promotion of high-sugar products targeting children and adolescents. These should be accompanied by the national implementation of easy-to-understand nutrition labels, such as the "Traffic Light Labeling" system, enabling consumers—especially parents—to make fast and informed nutritional decisions.

5.2.2 For Educational Institutions and Health Practitioners (Innovative Education and Supportive Environments):

- Interactive Nutrition Curriculum and Gamification: Integrate interactive and behavior-based nutrition curricula into formal education from an early age, using gamification, storytelling, or popular digital media relevant to children and adolescents. Education should include practical nutrition literacy (e.g., how to read labels, choose healthy snacks) and skills for preparing attractive packed meals.
- National Replication of "Healthy Canteens": The "Healthy Canteen" program should be widely replicated across all educational institutions, supported by local government regulations ensuring the availability of nutritious food and limiting the sale of high-sugar and ultra-processed products.
- Inclusive Physical Activities: Develop and promote various inclusive and engaging forms of physical activities for all genders, addressing social norms that hinder participation, to complement efforts in reducing sugar intake.

5.2.3. For Parents and Families (Empowerment and Role Modeling):

- Adaptive Nutrition Education: Organize accessible and practical nutrition education programs for parents, focusing on understanding daily sugar limits, the impact of peer pressure, and effective strategies for providing healthy food amid financial constraints—for example, through simple meal prepping or utilizing affordable local ingredients.
- Creating a Healthy Home Environment: Encourage parents to proactively create a home environment that supports healthy eating patterns by prioritizing home-cooked meals, limiting the availability of sweet drinks and snacks, and involving children in food preparation to cultivate positive habits and independence.
- Role Modeling and Open Communication: Parents should act as role models in healthy eating and engage in open conversations with their children about social pressures related to food choices, helping them develop resilience and make wiser decisions.

5.2.4. For Further Research (Evidence Development and Innovation):

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- Conduct long-term intervention studies to evaluate the combined effectiveness of policy, education, and community programs in changing sugar consumption behaviors and improving measurable health outcomes.
- Develop qualitative research to explore psychosocial and cultural factors influencing adherence to low-sugar diets in different regions of Indonesia.
- Perform cost-effectiveness analyses of various proposed interventions to identify the most efficient and sustainable strategies within the context of national resources.

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