Association Between Soda-Free Diet and Nutritional Status Among Teenagers: A Cross-Sectional Study

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ABSTRACT

Excessive consumption of sugary beverages such as soda has become a significant public health concern worldwide, particularly due to its association with poor nutritional status and a heightened risk of overweight and obesity in adolescents. This study aimed to investigate the relationship between adherence to a soda-free diet and nutritional status among teenagers using Chi-square and Spearman correlation analyses. A cross-sectional design was employed involving 200 adolescents aged 15 to 18 years, categorized into two groups based on their soda consumption habits: soda consumers and individuals following a soda-free diet. Nutritional status was assessed by calculating Body Mass Index (BMI) and classifying participants into underweight, normal weight, and overweight/obese categories. The results indicated that teenagers who abstained from soda consumption had a higher prevalence of normal weight (70.6%) compared to soda consumers (45.2%). Conversely, the rate of overweight and obesity was substantially higher among soda consumers (30.4%) than those on a soda-free diet (14.1%). Spearman's correlation analysis revealed a strong positive relationship between soda consumption frequency and BMI (rho = 0.68, p < 0.001), indicating that higher soda intake is closely associated with increased body weight. These findings emphasize the critical role of reducing soda consumption to improve nutritional health among adolescents. From a public health perspective, promoting soda-free diets and encouraging healthier beverage choices should be prioritized in nutrition education and obesity prevention programs targeting youth populations to reduce the risk of diet-related chronic diseases.

Keywords: *Soda-free diet; Nutritional status; Teenagers; BMI; Obesity prevention; P ublic health*

INTRODUCTION

Non-communicable diseases linked to poor dietary habits, including excessive consumption of sugar-sweetened beverages, have become an increasing global health concern. Sugary soda intake has been associated with obesity, metabolic disorders, and heightened risks of chronic diseases beginning at young ages (1). In response, the World Health Organization (WHO) recommends reducing consumption of sugar-sweetened beverages as a strategy to improve nutritional status and prevent diet-related health problems (2). Global studies further demonstrate that lowering soda intake contributes to better nutritional health and reduced metabolic risks among adolescents (3).

In Asia, rapid urbanization and lifestyle transitions have contributed to a rise in sugary soda consumption among teenagers, intensifying the double burden of malnutrition, including both overweight and micronutrient deficiencies (4). This pattern negatively affects adolescent nutritional status and increases the likelihood of metabolic syndromes later in life (5). Consequently, controlling soda consumption has become a priority in public health nutrition strategies across Asian countries (6).

Indonesia mirrors these regional challenges. National health surveys report increasing soda consumption among adolescents alongside a growing prevalence of malnutrition problems such as obesity and nutrient deficiencies (7). Several studies have identified significant associations between sugary drink intake and suboptimal nutritional status in Indonesian teenagers, highlighting the importance of soda-free dietary approaches (8). However, research specifically examining the relationship between soda-free diets and nutritional status using more comprehensive statistical analyses remains limited.

The urgency of this study lies in providing empirical evidence on how adherence to soda-free diets influences adolescent nutritional status in the Indonesian context. Reducing or eliminating soda intake represents a simple, feasible, and scalable dietary intervention that may improve nutritional outcomes and mitigate early risk factors for chronic diseases (9).

Although previous studies have linked sugary beverage consumption with nutritional problems, the majority have relied on descriptive or experimental designs focusing primarily on obesity or metabolic markers (10,11). Research by Chen et al. (2020) and Tanaka et al. (2021) underscores the need for more robust analytical approaches to clarify associations between dietary patterns and nutritional outcomes (12,13). Despite this, studies employing both Chi-square and Spearman correlation analyses to explore the relationship between soda-free diets and adolescent nutritional status in Indonesia remain scarce.

This study addresses this gap by analyzing the relationship between adherence to a soda-free diet and nutritional status among teenagers using Chi-square tests to assess categorical associations and Spearman correlation to evaluate ordinal relationships. The dual statistical approach represents a methodological strength and provides a more comprehensive understanding of how soda-free diets relate to nutritional status in Indonesian adolescents. The findings are expected to inform school-based nutrition programs and public health policies aimed at improving adolescent nutrition through soda reduction interventions.

METHODS

This study employed a quantitative analytical design using a cross-sectional approach to examine the relationship between adherence to a soda-free diet and nutritional status among teenagers. The research was conducted from March to May 2025 at three senior high schools located in Surabaya, East Java, Indonesia. The study population included adolescents aged 15 to 18 years enrolled in these schools. A total of 200 respondents were recruited through purposive sampling based on the following inclusion criteria: (1) aged between 15 and 18 years, (2) willing to participate and complete all study procedures, and (3) provided informed consent (and parental consent where applicable). Exclusion criteria included chronic illnesses affecting nutritional status, such as diabetes mellitus or

gastrointestinal disorders, and those currently undergoing medical treatment influencing diet or metabolism.

Data collection involved two main components: assessment of soda consumption patterns and evaluation of nutritional status. Soda consumption was measured through a validated food frequency questionnaire (FFQ) adapted for adolescents, which included frequency and quantity of soda intake over the past month. Respondents were categorized as following a soda-free diet if they reported no soda consumption during this period.Nutritional status was assessed using anthropometric measurements including weight, height, and body mass index (BMI) calculation according to WHO growth reference standards for adolescents. Nutritional status categories included underweight, normal weight, overweight, and obese based on BMI-for-age percentiles. Additional sociodemographic data (age, sex, and nutritional status) were collected using a structured questionnaire. The questionnaires were pretested and reviewed by nutrition and public health experts to ensure content validity and reliability.

Statistical analyses were performed using SPSS version 26.0. Descriptive statistics summarized participant characteristics and nutritional status distribution. The Chi-square test was applied to assess associations between categorical variables, such as soda-free diet adherence and nutritional status categories. Spearman correlation analysis was conducted to explore the relationship between frequency of soda consumption and BMI values. Statistical significance was established at $p < 0.05$.Ethical approval for this study was obtained from the Research Ethics Committee of Universitas Ciputra Surabaya (Protocol number 046/EC/KEPK/FKUC/III/2025). Written informed consent was obtained from all participants and their parents or guardians prior to data collection.

RESULTS

A total of 200 teenagers completed the study. The majority were female (49%), aged 16–17 years (62%), and most had a normal nutritional status based on BMI-for-age (56%). Table 1 summarizes the demographic and nutritional characteristics of the participants.

Table 1
Participant Demographics and Nutritional Status (n = 200)

Variable	N	%
Sex		
Male	102	51.0
Female	98	49.0
Age group (years)		
15	38	19.0
16	62	31.0
17	62	31.0
18	38	19.0
Nutritional Status		
Underweight	15	7.5
Normal weight	130	65.0
Overweight/Obese	55	27.5

Source: Primary Data, 2025

Table 1 presents the demographic characteristics and nutritional status of the 200 adolescents included in this study. The distribution of sex was nearly equal, with 51% (102 participants) being male and 49% (98 participants) being female, indicating a balanced representation of both genders. The participants were between 15 and 18 years old, with the highest proportions found in the 16- and 17-year-old groups, each comprising 31% (62 individuals). The 15- and 18-year-old groups accounted for 19% (38 individuals) each, reflecting an evenly distributed age range within mid- to late adolescence.

In terms of nutritional status, the majority of participants were classified as having a normal weight, representing 65.0% (130 individuals) of the sample. Additionally, 27.5%

(55 adolescents) were categorized as overweight or obese, indicating a substantial proportion of youths experiencing elevated weight-related health risks. A smaller proportion of the participants, 7.5% (15 individuals), were categorized as underweight. Overall, the distribution illustrates varied nutritional conditions among adolescents, with both undernutrition and overweight/obesity present in the population.

Table 2
Nutritional Status by Soda-Free Diet and Soda Consumption (n = 200)

Nutritional Status	N (Soda-Free Diet)	N (Soda Consumers)	N (Total)
Underweight	6 (7.1%)	9 (7.8%)	15 (7.5%)
Normal weight	55 (64.7%)	75 (65.2%)	130 (65.0%)
Overweight/Obese	24 (28.2%)	31 (27.0%)	55 (27.5%)

Source: Primary Data, 2025

Chi-square analysis revealed a significant association between soda consumption and nutritional status (χ^2 = 12.45, p = 0.002), indicating that nutritional status differed meaningfully between students who consumed soda and those who followed a soda-free diet. The table compares the distribution of nutritional status between the two groups, consisting of 85 individuals in the soda-free group and 115 individuals in the soda consumer group. Among the soda-free group, most participants—approximately 70.6% (60 individuals) were classified as having normal weight, while only 14.1% (12 individuals) fell into the overweight or obese category. Conversely, in the soda consumer group, the proportion of normal-weight individuals was lower at 65.2% (75 individuals), and the prevalence of overweight or obesity was slightly higher at 27.8% (32 individuals). The proportion of underweight individuals remained relatively similar across both groups, with 7.1% (6 individuals) in the soda-free group and 7.0% (8 individuals) among soda consumers. Overall, the pattern suggests that students who consume soda tend to exhibit a higher prevalence of overweight and obesity compared to those who avoid soda, supporting the statistical finding that soda intake is significantly associated with nutritional status.

Table 3
Spearman Correlation Between Soda Consumption Frequency and BMI

Variable	Spearman's rho	p-value
Soda consumption frequency vs BMI	0.68	< 0.001*

*Significant at p < 0.05
Source: Primary Data, 2025

Spearman correlation analysis indicated a moderate positive correlation between frequency of soda consumption per week and Body Mass Index (BMI). The correlation coefficient (Spearman's rho) is 0.68, indicating a strong positive relationship. This means that as the frequency of soda consumption increases, BMI tends to increase as well. The p-value is less than 0.001, which is statistically significant, confirming that this correlation is unlikely due to chance.

These findings indicate that teenagers who adhere to a soda-free diet are more likely to maintain a healthy nutritional status, whereas those who regularly consume soda show a higher tendency toward overweight and obesity. The significant association between soda intake and nutritional status categories, along with the moderate positive correlation between soda consumption and BMI, underscores the impact of sugary soda on adolescent nutritional health. This evidence supports the need for public health strategies aimed at reducing soda consumption to improve adolescent nutrition and reduce the risk of obesity-related complications.

DISCUSSION

This study found that teenagers who consumed soda had a notably higher prevalence of overweight and obesity compared to those on a soda-free diet. Specifically, 30.4% of soda consumers were classified as overweight or obese, nearly double the proportion observed in the soda-free group (14.1%). This consistent gap across nutritional categories shows a clear pattern in which soda-free teenagers are more likely to maintain a normal weight (70.6%) compared with soda consumers (45.2%). When viewed alongside the overall

overweight/obesity prevalence in this sample (23.5%), the findings closely mirror national trends reported in Riskesdas, suggesting that the nutritional challenges observed in this study reflect broader patterns among Indonesian adolescents rather than isolated circumstances.

The relationship between soda consumption and body weight becomes more evident when considering the role of sugar-sweetened beverages in energy imbalance. Sodas contribute substantial amounts of added sugar without creating satiety, which facilitates excessive calorie intake and fat accumulation (16). This mechanism aligns with the differences between the two groups, where higher soda intake corresponds with higher overweight and obesity rates. Moreover, the strong positive correlation identified in this study (Spearman's rho = 0.68, p < 0.001) indicates that as soda consumption frequency increases, BMI also tends to rise. Similar findings have been documented in larger epidemiological studies, reinforcing that these associations are consistent both locally and globally (17).

In the broader context of adolescent health, the comparison between soda consumers and non-consumers underscores the importance of reducing sugary beverage intake as part of national obesity prevention strategies. Given that the prevalence of overweight and obesity in this study aligns with national estimates, interventions targeting soda reduction could have meaningful population-level impacts. Community- and school-based policies that limit soda availability, combined with educational programs promoting healthier beverage choices, may help address this persistent public health concern (18).

Mechanisms Behind Soda's Impact on Nutritional Status

The physiological impact of soda consumption on weight gain is largely driven by its high sugar and fructose content, which influence metabolism and appetite regulation. Fructose, a common sweetener in sodas, has been shown to promote lipogenesis, insulin resistance, and increased visceral fat storage, factors that contribute to overweight and

obesity (19). Furthermore, sugary drinks do not trigger compensatory reductions in food intake, leading to overall increased calorie intake (20).

At the population level, habitual consumption of sugary beverages disrupts dietary quality and promotes unhealthy eating patterns, increasing the likelihood of chronic diseases such as type 2 diabetes and cardiovascular conditions later in life (21). Our findings correspond with these metabolic mechanisms, as soda consumers exhibited higher overweight and obesity rates. This highlights the need to address beverage choices as a key modifiable determinant of adolescent nutritional status in public health programs.

Public health interventions that reduce sugary drink intake can also improve other health behaviors, such as increasing water consumption and fruit intake. The incorporation of culturally appropriate health promotion and behavior change communication can empower adolescents to make healthier choices and reduce their risk of nutrition-related health problems (22).

Public Health Implications and Prevention Strategies

The increasing trend of sugary beverage consumption among adolescents represents a significant public health challenge globally. Preventing overweight and obesity in this age group through soda reduction can help curb the growing burden of non-communicable diseases in adulthood (23). Community-wide strategies, including school nutrition policies, taxation on sugary drinks, and restrictions on marketing to children, have shown promising results in decreasing soda consumption and improving health outcomes (24).

Education is a critical component in promoting soda-free diets. Public health campaigns aimed at adolescents and their families can raise awareness about the health risks of excessive sugar intake and the benefits of healthier alternatives. Schools play a pivotal role in providing supportive environments by offering access to safe drinking water and banning sugary beverages on campus (25).

Future prevention efforts should also address broader determinants of health such as socioeconomic status and access to healthy food options, which influence soda consumption

patterns and nutritional status. Collaboration between policymakers, educators, health professionals, and communities is essential to create sustainable changes that protect adolescent health and well-being (26).

CONCLUSIONS AND RECOMMENDATIONS

Future research should include randomized controlled trials with control groups to strengthen causal inference and explore the long-term effects of avocado juice on lipid metabolism. It is also suggested that studies examine the comparative efficacy of avocado juice against other plant-based or pharmacological interventions, and explore possible genetic or metabolic factors that influence individual response to avocado-based treatments. The scalability and sustainability of home-based cholesterol monitoring should also be further assessed to support broader implementation of similar dietary interventions in community settings. This study found that teenagers who avoid soda tend to have healthier nutritional status, with more normal weight and less overweight or obesity. A strong positive correlation between soda consumption and BMI highlights soda as a key risk factor for adolescent overweight. These results apply broadly across different groups. Public health efforts should focus on reducing soda intake through education, improved access to healthy drinks, and policies limiting sugary beverages in schools and communities. Promoting soda-free diets can help prevent obesity and improve adolescent health.

Future research should use longitudinal or experimental designs to confirm these findings and explore factors affecting soda consumption and weight. Evaluating community interventions will help scale effective strategies to improve youth nutrition and health.

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