SRIWIJAYA JOURNAL OF MEDICINE

# The Relationship Between The Weekly Soft Drinks Consumption and Body Mass Index Among Adolescents

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## Abstract

Soft drink consumption rate among adolescents was the highest and it is accompanied by an increase in the incidence of obesity. This study aimed to analyze the relationship between the frequency and volume of weekly soft drink consumption and body mass index among adolescents. This cross-sectional study involved 78 senior high school students in Palembang. The frequency of soft and energy drink consumption is assessed every week. The body mass index (BMI) was measured by standardized anthropometry. Data was then analyzed computerized with a level of significance of P <0.05. Spearman test results show that there was a significant positive correlation between the frequency and volume of weekly consumption of soft drinks and BMI among adolescents ($p < 0.001$, $r = 0.517$; $p < 0.001$, $r = 0.568$, respectively). Increased consumption of soft drinks among adolescents will be associated with increased body mass index which leads to overweight and obesity.

**Keywords: a**dolescents, BMI, soft drinks

## 1. Introduction

The soft drinks consumption has been increasing in the past decades and is associated with weight gain.[1] The consumption of soft drinks, particularly sugar-sweetened beverages, is associated with elevated risks of obesity, type 2 diabetes, and cardiovascular disease.[2] Meanwhile, the obesity prevalence in adolescents is also increasing. The incidence of obesity in adolescents has been linked to soft drink consumption because they are the target of the soft drink industry and the marketing and promotion of soft drinks have been increasing in developing countries.[1]

In Indonesia, the rate of adolescent obesity continues to increase drastically from year to year. The prevalence of adolescent obesity, which was initially 2.5% in 2010, increased to 10.8% in 2013.[3,4] One of the risk factors for obesity in adolescents is the high consumption of soft drinks, which may lead to unbalanced nutritional intake.[5]

Soft drinks are carbonated drinks with added sweeteners or flavorings. Apart from that, several substances often added to soft drinks include caffeine, saccharin, fructose, benzoic acid, sorbic acid, aspartame, and phosphoric acid. Caffeine is an ingredient in soft drinks that has been identified as a risk factor for obesity.[6] Adolescents who consume high amounts of soft drinks have a 1.4 times risk of obesity.[5] The average total intake of soft drinks in adolescents is higher than in infants/toddlers and elderly adults.[7]

Information regarding the relationship between soft drinks consumption and the prevalence of obesity in adolescents is essential to encourage policymakers in prioritizing actions aimed at reducing obesity rates in adolescents. One of the simple measurements for obesity is body mass index (BMI). BMI was reported to correlate significantly with the occurrence of metabolic syndrome.[8]

Research related to association of soft drinks consumption and adolescent obesity

incidence is also still limited. A previous study about soft drink consumption was conducted on a daily basis.[9] Therefore, this study aims to analyze the relationship between weekly consumption (frequency and volume) of soft drinks and body mass index in adolescents.

## 2. Methods

This study was analytically observational with a cross-sectional design. The study was conducted among 78 adolescents of senior high school students. Ethical clearance is from the Research and Ethical Committee of Muhammadiyah Medical Faculty, Palembang, Indonesia (No. 085/EC/KBHKI/FK-UMP/XI/2022). We interviewed respondents regarding the average frequency and volume of soft drink consumption in one week (during the past week). The frequency was categorized into never, 1-2 times, 3–4 times, and ≥ 5 times per week[9]. The volume was assessed by asking: 'How much soft drink do you usually drink (1 cup=250 ml)?'. Students who consumed four or more cups (≥1 liter) per week were classified as 'high soft drink consumers'.[10] A digital weighing scale (Omron, Japan) and wall-mounted tape measure (GEA, Indonesia) were used for measuring body weight and height, respectively. The body weight of subjects was measured to the nearest 0.1 kg. Body height was measured to the nearest 0.1 cm while the subjects stood erect, barefoot, and head in the Frankfurt plane[11]. The BMI is calculated by dividing body weight in kilograms by height squared in meter. BMI-for-age (5-19 years) chart from WHO was used to classify the subjects into obese (>+2SD), overweight (>+1SD), normal (-2SD until +1SD), thinness (<-2SD) and very thinness (<-3SD)[12]. The data were analyzed computerized. Spearman correlations of frequency and volume of soft drink consumption and BMI were calculated, with a significance value of $p < 0.05$.

## 3. Results

Data on the Characteristics of respondents are given in Table 1. Most respondents are female (87.2%) and 16 years old (41%). About 38.5% reported consuming soft drinks at least 3-4 times per week and 56.4% reported consuming ≥ 1 liter ( ≥ 4 cups) of soft drinks per week. Most students are normal (73.1%), while 9% and 6.4% are overweight and obese, respectively. Data in Table 2 showed a positive and moderate correlation between the frequency and volume of soft drink consumption and BMI ($p < 0.001$, $r = 0.517$; $p < 0.001$, $r = 0.568$, respectively).

**Table1. Characteristics of respondents (n = 78)**

| Variables | n (%) |
|---|---|
| Gender | |
| Male | 10 (12.8) |
| Female | 68 (87.2) |
| Age (Years) | |
| 14 | 4 (5.1) |
| 15 | 20 (25.6) |
| 16 | 32 (41) |
| 17 | 19 (24.4) |
| 18 | 3 (3.8) |
| Frequency of soft drink consumption (times per week) | |
| Never | 0 |
| 1-2 | 20 (25.6) |
| 3-4 | 30 (38.5) |
| ≥ 5 | 28 (35.9) |
| The volume of soft drink consumption (liters per week) | |
| < 1 | 34 (43.6) |
| ≥ 1 | 44 (56.4) |
| Body Mass Index (BMI) | |
| Obese | 5 (6.4) |
| Overweight | 7 (9) |
| Normal | 57 (73.1) |
| Thinness | 9 (11.5) |
| Very Thinness | 0 |

**Table 2. The results of Spearman correlation test analysis**

| | Body Mass Index |
|---|---|
| **Frequency of soft drink consumption** | r = 0.517<br>p < 0.001 |
| **The volume of soft drink consumption** | r = 0.568<br>p < 0.001 |

## 4. Discussion

This study measures the average weekly frequency and volume of soft drink intake. Using consumption frequency, as an index of the amount of consumption is actually an easier and relatively reliable tool for assessing the amount of consumption adopted in many other studies.[9,13,14] This study reported that all respondents consumed soft drinks at least once a week. Most respondents consumed soft drinks one liter or more per week and were classified as 'high soft drink consumers'. It is consistent with previous studies in Australia. It was also stated that high consumption of soft drinks is grouped with other unhealthy lifestyle behaviors among teenagers.[10]

This study found that the more frequent the consumption frequency and the greater the volume of soft drinks consumed per week, the higher the body mass index among adolescents. This finding is consistent with previous studies.[1,15,16] The soft drink contains large amounts of sugar.[17] The sugar in soft drinks is thought to have the potential to cause weight gain and BMI. Soft drinks have a high glycemic index, causing chronic hyperglycemia and hyperinsulinemia, which have the potential to increase body fat and body weight.[18,19]

Soft drink consumption may contribute to fat accumulation in visceral adipose tissue (VAT), thus increasing body mass index.[20] Excess fructose inside soft drinks may accumulate fat in VAT.[21] It is converted to triglycerides inside the liver cell.[22] When overproduced, triglycerides may be more likely to be stored in VAT because of an excess soft drink intake.[19] Fructose also directly increases fat deposition in VAT by activating intracellular glucocorticoids.[23]

Given the inherent limitations of this research design, hindering the formation of causal conclusions, it is recommended to evaluate dietary patterns before assessing the nutritional status of adolescents in prospective studies.

## 5. Conclusion

The frequency and volume of weekly consumption of soft drinks are moderately and positively related to body mass index among adolescents.

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