

# Consumption of sugar sweetened beverages and correlation with body mass index and body fat percentage among college students

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**Abstract.** This study evaluated the consumption habits of sugar-sweetened beverages with body fat percent and body mass index in university students. The design of this research is a cross-sectional study. The subjects in this study were university students with a total of 111 subjects. Subject characteristics were obtained from interviews, and consumption of sugar-sweetened beverages was obtained from SQ-FFQ. BMI is obtained from anthropometric measurements and Percent body fat is obtained from measurements using the BIA. The results of this study The majority of subjects were overweight (54%), percent body fat for men in the overweight category (57.2%) and percent body fat for women in the overweight category (54.9%). The majority of the frequency of consumption of sugar-sweetened beverages is often (78.4%). There is a relationship between the consumption of sugar-sweetened beverages with nutritional status ( $p < 0.05$ ) and the consumption of sugar-sweetened beverages with percent body fat ( $p < 0.05$ ). This study concludes that there is a relationship between the consumption of sugar-sweetened beverages with BMI and body fat percent with BMI and body fat percent.

## 1 Introduction

The The prevalence of overweight and obesity among adults in Indonesia has shown a concerning increase, rising from 28.9% in 2013 to 35.4% in 2018, [1]. This trend is largely attributed to unhealthy dietary habits, including the excessive consumption of sugar-sweetened beverages (SSB). Cohort study research suggests that sugar-sweetened beverages contribute to weight gain that leads to obesity. Consumption of sugar-sweetened beverages will increase the experience of weight gain by body weight by 5% [2,3]. Sweetened beverages also contribute to body fat mass gain. A cohort study analyzing the effect of sugar-sweetened beverage consumption on increasing body fat mass showed that consumption of sugar-sweetened beverages 1-6 times per week and >1 time per day increased body fat mass by

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0.45% and 0.57% respectively. Sugar-sweetened beverage consumption can significantly increase total body fat mass [4,5] SSB consumption is particularly high among young adults, especially college students aged 18–24, who are often targeted by beverage manufacturers [6].

College students represent a vulnerable group as they face challenges in maintaining balanced diets, making them more susceptible to excessive sugar intake and its adverse effects on body composition [7]. Previous studies have extensively explored the relationship between SSB consumption and obesity; however, limited research has specifically examined the association between SSB intake and body composition metrics such as Body Mass Index (BMI) and body fat percentage among college students. Therefore, this study aims to evaluate the consumption patterns of SSBs and investigate their relationship with BMI and body fat percentage in college students.

## **2 Methods**

### **2.1 Design and subjects**

This study used a cross-sectional design. This study was conducted in Bogor, on IPB students. This study involved male and female subjects. Data on the characteristics of age, gender, pocket money, and residence were collected using a structured questionnaire Recruitment of subjects using Google Forms distribution. The minimum sample size of 100 subjects was determined using the Lemeshow study formula. The study subjects were selected based on the inclusion criteria, which were active university students, aged 18-25, not on any type of diet, and not suffering from chronic diseases. The exclusion criteria for this study were not consuming SSBs. Individuals were excluded from the study if they refused to participate or did not complete the study. The study was conducted in October-December 2023. Furthermore, all students who met the inclusion criteria were invited to participate in the study.

### **2.2 Body Mass Index and Body Fat Percentage**

The subjects' height and weight were measured by a trained researcher using a height meter (Seca 213, Germany) and a digital body scale (Omron BF 511, Japan). Height was measured with the subject barefoot, standing upright in front of the stadiometer, ensuring the heels, buttocks, shoulders, and head touched the surface, with the head in the horizontal plane of Frankfurt. Height was recorded to the nearest millimeter. Weight was taken with the subject wearing light clothing, standing in the center of the scale, and recorded to the nearest 0.1kg. This measurement was then used to calculate the body mass index (BMI) [20]. His BMI was calculated as kilogram body weight/m<sup>2</sup>. Body fat percentage was assessed using bioelectrical impedance, which consists of a bipolar handheld device (Omron HBF-375, Omron, Japan), and the results were recorded as a percentage of body weight. The subject stood with feet slightly apart, holding the device in both hands, arms stretched out at a 90-degree angle relative to the body, while the instrument recorded the impedance from hand to hand, and then calculated the percentage of body fat to the nearest 0.1%, based on age, gender, height and weight.

The BMI classification is based on the Indonesian Ministry of Health (MOH) criteria. These criteria were used as they proved to be most appropriate among adults in Indonesia [1]. Overweight was defined by a percentile >25 kg/m<sup>2</sup>. The cut-off point for normal body fat is less than 21% for males, and less than 33% for female.

## 2.3 Sugar Sweetened Beverages (SSBs)

Data were collected on sugar-sweetened beverage consumption using the SQ-FFQ SSB questionnaire for the last month with interview. It consisted of all types of packaged beverages and non-packaged beverages (viral drinks). The questionnaire looked at the frequency of consumption, energy and added sugar derived from sugar-sweetened beverages. Respondents were asked to indicate ‘how often’ they consumed the beverage in the last month. There were seven response categories, ranging from ‘never or less than 1 time per week’, to ‘more than twice per day’. However, during the analysis, we simplified the categorisation to two main categories, namely, ‘rarely less than 2 times per week’ and often more than 2 times per week”.

## 2.4 Ethical approval

All procedures in this study were approved by the Ethics Committee of University Airlangga Surabaya (No. 1284/HRECCFOOM/XI/2023).

## 2.5 Data analysis

The statistical analyses used were univariate and bivariate analyses. First of all, each variable characteristic in the study was analyzed univariately. Univariate analysis to see the results of the distribution of subject characteristics in the form of numbers and percentages, then the data normality test was carried out using the Kolmogorov-Smirnov test to determine the right type of test to be used in bivariate analysis. After obtaining the normality test results, inferential bivariate tests (correlation tests) were carried out. Univariate analysis was used to describe all variables, including mean, standard deviation, maximum value, and minimum value. Bivariate analysis was used to determine the relationship between the two variables. Test the relationship using the Pearson test or Spearman test depending on the results of the data normality test. The normality test that will be carried out is Kolmogorov-Smirnov.

# 3 Results and discussion

## 3.1 Subject characteristics

Table 1 presents the characteristics of the study participants, which consisting of university students aged 18-25 years. The mean age of the sample was 20.31 years. The gender distribution was more female and male, with the proportion of males (44.1%) and females (55.9%). In addition, 53% of the majority of pocket money Rp 750,000.00 – Rp 1,500,000.00 and majority residence of subjects living alone (86.5%).

**Table 1.** Subject characteristic

| <b>Characteristics</b> | <b>Mean</b> | <b>SD</b> |
|------------------------|-------------|-----------|
| Age                    | 20.31       | 1.34      |
|                        | <b>n</b>    | <b>%</b>  |
| Gender                 |             |           |
| Male                   | 49          | 44.1      |
| Female                 | 62          | 55.9      |

**Table 1.** Subject characteristic distribution (continue)

| Characteristics         | Mean      | SD   |
|-------------------------|-----------|------|
| Pocket money (Rp/month) |           |      |
| <500,000                | 6         | 5.4  |
| 500,000-750,000         | 17        | 15.3 |
| 750,000-1,500,000       | 53        | 53   |
| 1,500,000-2,500,000     | 30        | 30   |
| >2,500,000              | 5         | 5    |
| Residence               |           |      |
| Living alone            | 96 (86.5) | 86.5 |
| Living with family      | 15 (13.5) | 13.5 |

### 3.2 Nutritional Status

**Table 2.** Nutritional status

| Variable                                | Mean     | SD       | (Min Max)     |
|---|----------|----------|---------------|
| Body mass index (kg/m <sup>2</sup> )    | 20.31    | 1.34     | (18.71_36.82) |
| <b>Nutritional status</b>               | <b>n</b> | <b>%</b> |               |
| Normal (18.5-25kg/m <sup>2</sup> )      | 51       | 45.9     |               |
| Overweight (25.1-27 kg/m <sup>2</sup> ) | 37       | 33.3     |               |
| Obesitas (>27 kg/m <sup>2</sup> )       | 23       | 20.7     |               |
| <b>Body fat percentage</b>              |          |          |               |
| Male                                    |          |          | (11_32)       |
| Normal (11-20.9%)                       | 21       | 42.8     |               |
| High (21-25.9%)                         | 16       | 32.7     |               |
| Very high (≥26%)                        | 12       | 24.5     |               |
| Female                                  |          |          | (21_41)       |
| Normal (21-32.9%)                       | 49       | 44.1     |               |
| High (33-38.9%)                         | 38       | 34.3     |               |
| Very high (≥39%)                        | 24       | 21.6     |               |

Table 2 The mean BMI of male and female subjects was 20.31 kg/m<sup>2</sup>. Most of the subjects (54%) were overweight (33.3%) and obese (20.7%). Additionally, the nutritional status based on percent body fat of male subjects was categorized as high (57.2%) and female subjects were categorized as high (55.9%).

### 3.3 Consumption of SSBs

**Table 3.** Consumption of SSB

| SSB consumption                    | n  | (%)           | (Mean±SD)     |
|------------------------------------|----|---------------|---------------|
| <b>Added sugar in SSB (gr/day)</b> |    |               |               |
| <50 g/day                          | 50 | 45.0          |               |
| >50 g/day                          | 61 | 55.0          |               |
| SSB intake (ml/day)                |    | 534.83±304.77 | 534.83±304.77 |
| Sugar from SSB (gr/day)            |    | 43.80±20.63   | 43.80±20.63   |
| <b>Energy from SSB (kcal/day)</b>  |    | 253±149       | 253±149       |
| Low (<100 kcal)                    | 10 | 9.0           | 9.0           |
| Moderate (100-200 kcal)            | 39 | 35.1          | 35.1          |
| High (>200 kcal)                   | 62 | 55.9          | 55.9          |

**Table 3.** Consumption of SSB (continue)

|                                     |    |      |     |
|-------------------------------------|----|------|-----|
| <b>Frequency consumption of SSB</b> |    |      | 3±1 |
| Rarely (<2/week)                    | 24 | 21.7 |     |
| Often (≥2x/week)                    | 87 | 78.3 |     |
| <b>Frequency consumption of SSB</b> |    |      | 3±1 |

This According to the findings of the correlation analysis, residence and sugar from SSB correlate with BMI ( $p < 0.05$ ). Students who live alone are significantly more likely to be overweight or obese than those who live with family [8]. Overseas research on student subjects with an age range of 18-30 years stated that students who living alone consume unhealthy food or drinks at a higher rate than students who live with parents [8]. High sugar intake can trigger the process of lipogenesis in the liver and body fat tissue, which plays a role in the development of obesity [9].

### 3.4 Association between consumption of SSBs with BMI and body fat percentage

**Table 4.** Association between consumption of SSBs and BMI and body fat percentage

| Variable                     | BMI (kg/m <sup>2</sup> ) |        | Body fat percentage (%) |        |
|------------------------------|--------------------------|--------|-------------------------|--------|
|                              | p-value                  | PR / r | p-value                 | PR / r |
| Gender <sup>a</sup>          | 0.061                    | 2.233  | 0.808                   | 0.911  |
| Age <sup>b</sup>             | 0.307                    | 0.098  | 0.307                   | 0.098  |
| Pocket money <sup>a</sup>    | 0.465                    | 1.467  | 0.002*                  | 2.182  |
| Residence <sup>a</sup>       | 0.050*                   | 2.219  | 0.238                   | 1.579  |
| Sugar from SSB <sup>b</sup>  | 0.001*                   | 0.301  | 0.009*                  | 0.248  |
| Energy from SSB <sup>b</sup> | 0.199                    | 0.123  | 0.696                   | 0.038  |

Note: not adjusted with any confounding factor. significant at ( $p < 0,05$ ), analysed using <sup>a</sup>chi-square and <sup>b</sup>spearman

The findings of the correlation analysis of pocket money and sugar from SSB correlate with body fat percent ( $p < 0.05$ ). Elevated pocket money is linked to a greater intake of high-energy foods that are high in sugar and fat, resulting in elevated percentages of body fat [10] Table 3. study limitations design of this study only allows for the observation of associations and does not establish a causal relationship between SSB consumption and health outcomes. Future research a long-term study was conducted to determine the effects of SSB on health.

## 4 Conclusion

There is a correlation between sugar from SSB with BMI and percent body fat. These findings highlight the importance of reducing SSB consumption to prevent future health risks. Design of this study only allows for the observation of associations and does not establish a causal relationship between SSB consumption and health outcomes. Future research a long-term study was conducted to determine the effects of SSB on health.

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