

Too Sweet to Ignore: How SSB Intake and Physical Inactivity Affect BMI in Malang's Student Population

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ARTICLE INFO	ABSTRACT
ORCHID ID Author 1: - Author 2: - Author 3: - Author 4: - Author 5: -	The growing incidence of overweight and obesity in young adults has been closely associated with unhealthy lifestyle habits, particularly the high intake of sugar-sweetened beverages (SSBs) and low levels of physical activity. College students are especially at risk due to lifestyle changes that occur during their university experience. This research aims to investigate the SSB consumption patterns, physical activity levels, and their correlation with Body Mass Index (BMI) among university students in Malang City. A descriptive cross-sectional study was carried out with 382 active students chosen through accidental sampling. Data were obtained using an online questionnaire shared through student networks and social media platforms. The results indicated that 73.8% of participants expressed a preference for SSBs, with bottled tea being the most commonly consumed, primarily bought from minimarkets. While 63.4 percent of students reported exercising 1 until 2 times a week, 68.1 percent participated in low-intensity activities, and 43.7 percent worked out for less than 30 minutes. A strong correlation was identified between SSB consumption and BMI (p is 0.882, 2-tailed), while physical activity showed a weak and non-significant association (p is 0.128). The need for targeted health promotion programs aimed at reducing SSB intake and encouraging students to engage in more efficient physical activity routines is highlighted by these results.
Article History: Paper received: 25-06-2025 revised: 28-06-2025 accepted: 29-06-2025	
Keywords: Body mass index; college students; physical activity; sugar-sweetened beverages	

1. Introduction

The increase in the consumption of sugary drinks has become an important public health issue in recent years. Particularly in Latin America and Sub-Saharan Africa, the consumption of sugary drinks has been on the rise since 1990, affecting young people, urban dwellers, and those with higher levels of education (Cudhea et al., 2023). At the same time, global consumption of sugary drinks among adolescents and young adults has increased by 23%, with particularly high levels observed in urban areas and among those with highly educated parents (J. Zhang et al., 2024). Based on the results of the 2018 National Basic Health Survey (Riskesmas), in 2022, Indonesia ranked third in terms of sweetened beverage consumption in Southeast Asia, with an average consumption of 20.23 liters per person per year. Additionally, 61.3% of the Indonesian population consumes sugary drinks more than once a day (Karyoko et al., 2024).

Students experience significant lifestyle changes during the transition to college, which often leads to unhealthy eating habits and decreased physical activity. Research shows that

during the academic year, students tend to experience an increase in waist circumference and, in some cases, body mass index (BMI) (Blackburn et al., 2025). The level of physical activity among college students often declines, especially when they begin to lead a more sedentary lifestyle. This condition worsens during difficult times, such as during the COVID-19 pandemic, when many students also experience difficulties accessing healthy food and tend to increase their alcohol consumption (Wattick et al., 2022; T. Zhang et al., 2021).

However, a substantial proportion of students maintain unhealthy habits in both diet and physical activity, increasing their risk for future health problems (Cazzaniga et al., 2024). High consumption of sugar-sweetened beverages (SSBs) combined with low physical activity significantly increases the risk of weight gain and obesity, especially in adolescent students aged 13-17 years. Various large-scale studies on children and adolescents show that both high SSB intake and lack of moderate to vigorous physical activity independently increase the likelihood of being overweight or obese. When both behaviors occur together, the risk becomes even greater, with certain groups such as adolescent girls being more vulnerable to its effects (Othman & Hassan, 2025; Zou et al., 2023).

Students are recognized as important agents of change in promoting healthy lifestyles, making them a key target for various health promotion initiatives. The university environment can be a very effective setting for promoting healthy behaviors, as students spend most of their time there and are at a crucial stage of development in forming long-term habits. Successful health promotion activities among students can reduce chronic disease rates, improve academic performance, and support well-being by providing nutrition education and exercise programs (Fernández-Martínez et al., 2024; Na, 2024; Núñez-Rocha et al., 2020).

This study highlights three key elements related to student health: consumption of sugar-sweetened beverages (SSBs), physical activity, and Body Mass Index (BMI). SSBs are highlighted because they contain high calories but few nutrients, which can lead to increased energy intake (Yan et al., 2022). In addition, it is very important to engage in physical activity because it can regulate energy expenditure and prevent weight gain (Khusun et al., 2024; Lichthammer & Budai, 2021). Finally, Body Mass Index (BMI) is a useful measure for assessing health risks and nutritional status (Piqueras et al., 2021).

The relationship between Body Mass Index (BMI), physical activity, and sugar-sweetened beverages (SSBs) among university students in Malang City is not well understood locally. Effective health plans must be based on a knowledge of this connection. Since the population of students and the population of universities in Malang City is high, it has attracted more beverage businesses of beverages, and hence, the local data about the students should be used to run the health programs in favor of the students. As a result, local data must be collected to develop effective health interventions for students.

Students, as they transition to adulthood, develop their eating habits and physical activity independently. During this period, they are more vulnerable to making unhealthy decisions, such as consuming too many sugary drinks and not engaging in enough physical activity, which may result in future obesity and other health problems (Arroyo-Izaga & Telleria-Aramburu, 2021; Xie et al., 2021; Yasmeen et al., 2020).

Therefore, this study examines the relationships between these variables by concentrating on pupils in Malang City and examining their Body Mass Index (BMI), physical

activity, and consumption of sugar-sweetened beverages. The originality of this study is in its emphasis on a particular and understudied population—university students in Malang City—within the framework of a quickly expanding urban education hub, therefore providing insightful information to guide local health promotion and intervention plans.

2. Method

This study is a descriptive study with a cross-sectional design. Data collection was conducted from July to August 2024 through the distribution of online questionnaires using the Google Forms platform. The questionnaires were distributed through student networks and social media to reach respondents who met the criteria. Particularly, the instrument was shared via WhatsApp chat rooms with undergraduate University students.

Recruitment was conducted using a snowball sampling strategy, where students who had completed the questionnaire were encouraged to share the form with their peers through WhatsApp groups. The process of completion was tracked by using the functionality of Google Forms, where the number of received responses was recorded. To reduce the occurrence of incomplete or partial responses, all individual questions were set to be mandatory, with no questions skipped without the need to make a response to as many questions as possible.

The sample in this study consisted of 382 active students in Malang City who were selected using voluntary. The instruments used included demographic characteristics, sweetened beverage consumption habits (SSBs), physical activity, and Body Mass Index (BMI). BMI was calculated based on the weight and height data reported by the respondents.

The inclusion criteria in this study included: Active students at higher education institutions in Malang City (universities, institutes, colleges, polytechnics, or academies); Aged between 18 and 25 years; Had consumed sugary drinks at least once in the past month; and Willingness to participate in the study by completing the questionnaire and providing the required data, such as weight, height, and expenses related to beverage consumption.

Exclusion criteria include: Respondents currently on a special diet due to specific medical conditions (such as diabetes mellitus, metabolic disorders, or eating disorders); Respondents currently in an intensive weight loss or weight gain program; Incomplete or invalid respondent data (e.g., illogical weight and height measurements); and Respondents who provided inconsistent answers or demonstrated a lack of seriousness in completing the questionnaire.

Data analysis was conducted using descriptive analytics to describe frequency distributions and explore relationships between variables related to SSB consumption habits, physical activity, and Body Mass Index (BMI).

This study has undergone an ethical review process and has been deemed ethically sound based on the Ethical Exemption Certificate with number: 25.10.6/UN32.14.2.8/LT/2024, issued by the Research Ethics Committee of Universitas Negeri Malang. All research procedures were conducted under the principles of caution, data confidentiality, and informed consent from participants. There was no direct intervention posing risks to the research subjects, and all data collected were used solely for scientific purposes.

3. Result and Discussion

3.1 Respondent Characteristics

The characteristics of the respondents in this study provide an initial overview of the profile of the students who participated in the study. A total of 382 respondents were involved, coming from various universities in the city of Malang. Table 1 show about characteristics of respondents.

Table 1. Respondent Characteristics

Characteristics	Frequency (n)	Percentage (%)
Age (Year)		
18	28	7,3
19	153	40,1
20	137	35,9
21	53	13,9
22	9	2,4
23	2	0,5
Gender		
Male	75	19,6
Female	307	80,4
BMI		
Underweight	86	22,5
Normal	181	47,4
Overweight	47	12,3
Obesity 1	48	12,6
Obesity 2	20	5,2
Field of Study		
Health	127	33,2
Non-Health	255	66,8
Total	382	100

Source: Primary Data, 2024

According to the summary of the age table presented above, the majority of the 382 respondents were 19 years old, making up 40.1%, followed closely by 35.9% who were 20 years old, and the lowest demographic was those aged 23 years, accounting for just 0.5%. College students, particularly those in their first and second years, are at a crucial point for forming enduring health habits, which makes them an important focus for health promotion initiatives on campus. Studies indicate that the university setting can have a considerable impact on students' mental well-being, eating patterns, and exercise levels, as many students do not adhere to recommended guidelines and face heightened stress, anxiety, and weight gain during this transitional phase (Seppälä et al., 2020; Sharma et al., 2020).

Of the 382 respondents, 80.4% were female and 19.6% were male, indicating a much higher number of female participants. This can be attributed to the activity of women involved in health-related questions, and they are more willing to take part in online surveys. Since gender may tone down trends in SSB intakes and physical activity, the results must be affected by this demographic imbalance. Decisions about health-related choices are also partly determined by gender as it is shown in contemporary literature: women tend to become more health practice-oriented, and men are less disciplined in their health behavior and their dietary choices more value on experimental fulfillment (Puch et al., 2020). Behavioral trends result

from a mix of biological, psychological, and social factors, including norms and inequalities (Lawrence et al., 2020). Additionally, Gender also affects health behaviors, with women more likely to engage in health surveys, causing potential research biases (Bhatta, 2024; Nielsen et al., 2020).

According to the Body Mass Index (BMI) data, 47.4% of students belong to the normal weight range in terms of nutritional state. But 22.5% are underweight, which can indicate that they have poor nutrition or academic pressure, which can be reflected in nutrition. The number of those who are at level 2 of obesity constitutes only 5.2%; this is a worrying situation as it means that people are at risk. This is an indication of the importance of dealing with both underweight and overweight students when it comes to promoting health in schools.

A majority, 66.8% of the respondents, belong to non-health-related fields, whereas 33.2% of them are pursuing courses related to health. This disparity in education implies that students in the non-health sector fail to comprehend nutrition and healthy living completely. Thus, health promotion strategy ought to engage not only health programs, but also all disciplines at campus in enhancing general health awareness among students (Jorge, 2023; Wolbring et al., 2023).

3.2 SSB Consumption Habits among Students in Malang City

Table 2. Distribution of SSB Consumption Preferences Among Students in Malang City in 2024

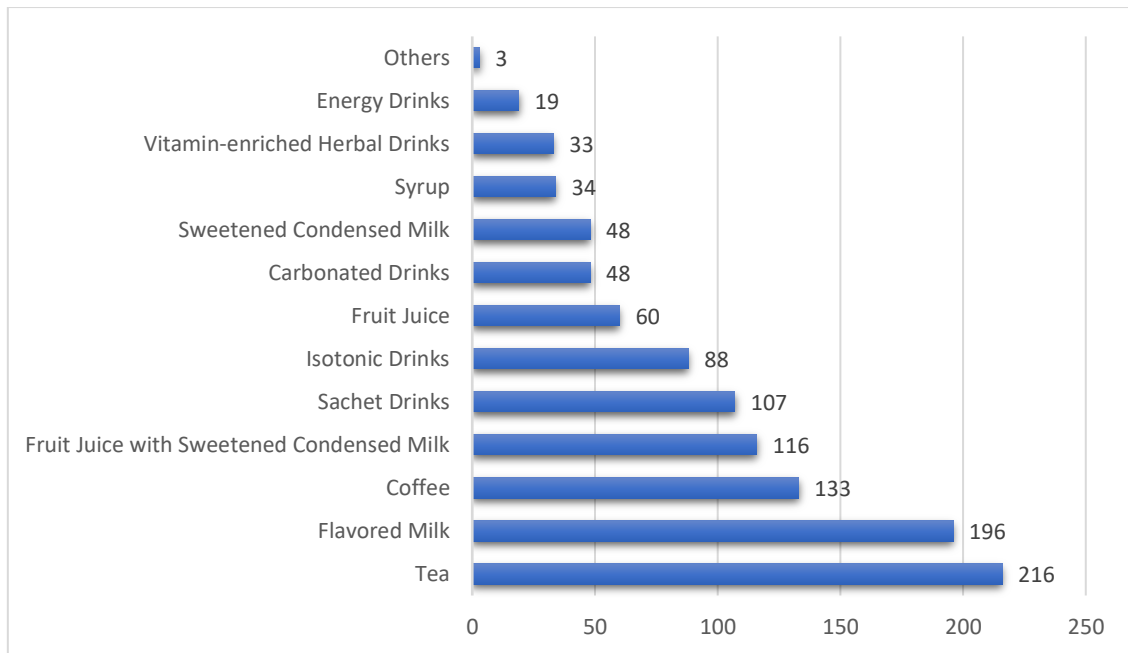
Preference for consuming SSBS	Frequency (n)	Percentage (%)
Yes	228	73,8
No	100	26,2
Total	137	35,9

Source: Primary Data, 2024

According to empirical evidence, the level of students with a preference for sugar-sweetened beverages (SSBs) in Malang City is high because 228 respondents out of the 308 (73.8 % of the sample size) indicate that they prefer the above beverages. Such drinks are conveniently available, have an appealing taste, and are commonly eaten either with meals or even during activities. The current evidence matches the one reported in experiments conducted with university and school-attending sample populations, where an increase in SSBs consumption is confirmed: the number of students who drink these beverages 23 times per week, or even daily increases, and sweetened tea or soda turns out to be the most popular (Mueller et al., 2024). A study by Zafar et al. (2025) shows that regular soda is the most consumed sugar-sweetened beverage among university students in Kuwait, with 42% drinking it 5-6 times per week and 32% consuming it daily.

In contrast, 26.2% respondents reported that they do not prefer SSBs. These evidences support the need to pay attention to the intake of SSB in college students because massive consumption of this type of food and drinks coupled with physical inactivity or unhealthy eating habits can lead to metabolic problems. In the sample, the taste is the determinant that influences SSB choice, especially in the younger generation, which is then promoted by massive advertising (Netzel et al., 2023). However, the fear of obesity, diabetes and poor oral health may make them be unwilling to consume, particularly where health messages are clear and related to daily living reality (Giombi et al., 2022; Haynes-Maslow et al., 2022). The choices are

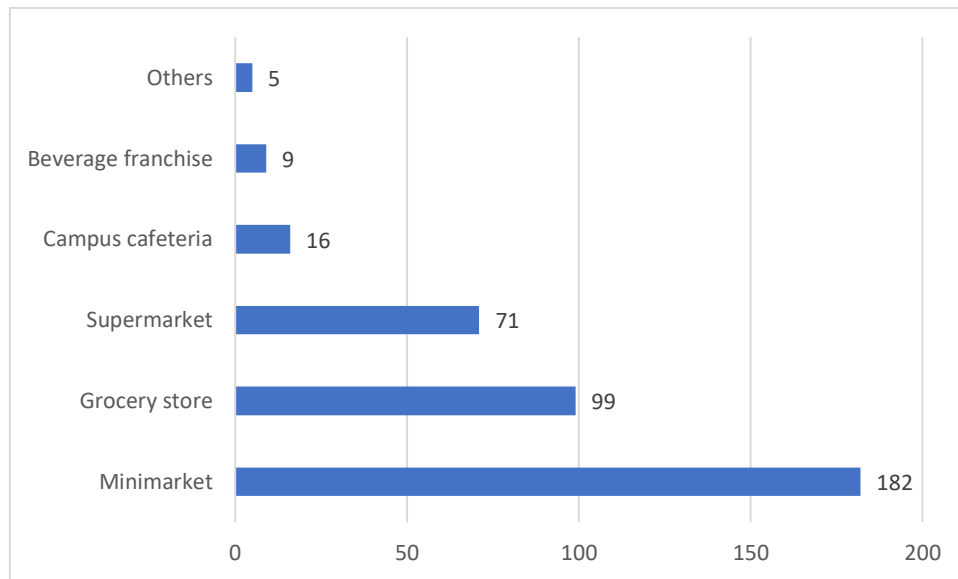
also swayed by economic factors, namely, the price of SSBs and the alternatives to merely step towards healthier products (Mattei et al., 2022; Miller et al., 2020).



Source: Primary Data, 2024

Figure 2. The Most Commonly Consumed Types of SSBs

According to the study, the types of sweetened beverages most frequently consumed by students consist of packaged tea, flavored milk, packaged coffee, and fruit juice combined with sweetened condensed milk. These findings are consistent with previous research. Normal sodas and fruit-flavored beverages also top the list of the prevalent drinks in most places. In all varieties of student groups, sweetened teas and soda turn out to be the most widely chosen preferences, and flavored milk is another habitually used beverage, followed by sweetened coffee (Abdulah et al., 2025; Hsu et al., 2013; Jalil et al., 2020).



Source: Primary Data, 2024

Figure 2. Distribution of SSB Purchasing Locations

This study reveals that students mainly buy sugar-sweetened beverages (SSBs) from minimarkets and small grocery stores. The easy access and low prices of these drinks strongly influence their consumption habits. There is a need for initiatives to promote healthier drinking choices among students, especially considering socioeconomic differences in SSB intake (Mekonnen et al., 2023).

3.3 Physical Activity Habits among Students in Malang City

The results of this study indicate that the majority of participants, namely 242 people (63.4%), engage in physical activity with a frequency of 1 to 2 times per week. Factors such as age, gender, socioeconomic status, and health status can significantly influence participation in physical activity across various community groups (Whitfield et al., 2021). Environmental factors, such as the availability of supportive indoor and outdoor spaces and the strength of social networks, also play an important role in encouraging regular physical activity (Pei et al., 2022)

Furthermore, the majority of respondents tend to prefer low-intensity exercises, with 260 people (68.06%) expressing this preference. Low-intensity physical activity can offer significant health benefits, including reduced risk of chronic diseases, improved cardiometabolic health, and increased life expectancy, particularly among individuals who were previously inactive or very sedentary (Biddle et al., 2021; Janssen et al., 2024). Studies indicate that replacing sedentary time with light-intensity activity—such as casual walking or light housework—can lead to measurable improvements in body composition, glucose metabolism, and kidney function, with the greatest benefits observed in the most sedentary individuals (Janssen et al., 2024; Thijssen et al., 2025)

The most often reported time for physical activity is under 30 minutes, according to 167 participants (43.72%). Previous research has demonstrated that the advantages of physical activity are contingent upon the length of the session, the objectives to be met, and individual

traits, with moderate duration frequently yielding the greatest benefits (Jung et al., 2025). In contrast, only 105 (27.49%) respondents follow the recommended frequency of 3 to 7 workouts per week for health. For both physical and mental well-being, regular exercise is crucial. Between three and seven times a week, several health groups advise engaging in physical activity. Frequent exercise can enhance overall mental health, encourage better eating habits, decrease smoking, and lower body mass index (BMI) (Leonov et al., 2024; Muradyan, 2024; Song et al., 2021)

The actual participation in physical activity is mostly involved, although it is not much for students can change their health or nutrition. Those activities are light, largely short, and infrequent, and do not comply with the health guidelines. In that regard, students should be encouraged to enhance the level, time, and frequency of physical activities they engage in order to see greater health benefits.

3.4 The Relationship between SSB Consumption Habits and Body Mass Index (BMI) among Students in Malang City

Based on the results of statistical analysis using Pearson's correlation test, it was found that there is a strong relationship between the habit of consuming sugar-sweetened beverages (SSBs) and the nutritional status of students in Malang City as measured by Body Mass Index (BMI). The significance value (2-tailed) obtained was 0.882, indicating that the correlation between the two variables is in the strong or close category. According to Guilford's criteria, a correlation value between 0.70 and less than 0.90 is categorized as a strong relationship (high correlation), so this result can be interpreted as evidence of a consistent and reliable association between SSB consumption levels and the nutritional status of students. This finding indicates that the higher the frequency or amount of sweetened beverage consumption, the greater the likelihood that students will have a higher BMI.

Numerous studies reliably show that a greater intake of sugar-sweetened beverages (SSBs) correlates with a higher body mass index (BMI) and an elevated risk of being overweight or obese among both children and adults. Previous research has revealed that each additional serving per day of sugar-sweetened beverages is associated with an increase of 0.07 kg/m² in children's Body Mass Index (BMI) and an increase of 0.42 kg in adults' weight (Nguyen et al., 2022). Meta-analyses and systematic reviews also show a clear and linear positive association: each additional serving of sugar-sweetened beverages (SSBs) per day is associated with a significant increase in BMI and body weight. On the other hand, efforts to reduce SSB consumption lead to lower weight gain or even weight loss compared to control groups (Neelakantan et al., 2022). Other study highlights that the timing and context in which calorie-containing beverages (SSBs) are consumed—such as during main meals at home—can influence weight outcomes, underscoring the importance of parental and environmental influences (Vinke et al., 2020).

3.5 The Relationship between Physical Activity Habits and Body Mass Index (BMI) among Students in Malang City

The Pearson correlation test showed a weak relationship between exercise frequency and students' BMI in Malang City, with a significance value of 0.128. In other words, exercise frequency does not have a significant impact on the nutritional status of students in the context

of this study, possibly due to other more dominant factors influencing BMI, such as dietary patterns, type of calorie intake, or consumption habits of sugary beverages.

Research investigating the connection between physical activity and nutritional health, especially among college students, consistently indicates that exercise, by itself, shows little to no significant link with nutritional status, including BMI or the likelihood of being overweight, when compared with other factors such as eating habits and calorie intake. For instance, a study involving adolescents in Nepal revealed that although most participants partook in moderate exercise, the extent of their physical activity did not significantly relate to being overweight; rather, factors such as the consumption of junk food and eating patterns played a more critical role in shaping nutritional health. (Baral et al., 2025). In a similar vein, a study conducted with female students at an Islamic boarding school found no notable connection between exercise habits and nutritional status; however, energy adequacy (dietary intake) was found to have a significant relationship (Sabilla, 2024). The results indicate that even though consistent physical activity is crucial for general well-being, its influence on nutritional status might be less significant when compared to more influential elements like diet quality, energy balance, and various lifestyle choices. Consequently, programs designed to enhance nutritional status among students should focus on fostering healthy eating patterns and maintaining energy balance, with exercise acting as a supportive rather than the main component.

This research has several drawbacks, including reliance on self-reported data, which might lead to information bias, and a cross-sectional methodology that does not clarify causal links between variables. Moreover, additional lifestyle factors such as sleep patterns, academic stress, or general eating behaviors have not been examined in depth. Consequently, it is suggested that future studies adopt a longitudinal approach and explore other aspects that could affect students' nutritional status more thoroughly, while also implementing direct measurements to improve data reliability.

4. Conclusion

The findings of the study suggest that students primarily consume packaged drinks, particularly throughout the day. Sweet tea is the preferred choice among beverages because of its delightful flavor, and minimarkets are the main venues for purchasing these drinks. A strong correlation exists between the consumption of sweetened beverages and the nutritional status (BMI) of students in Malang City. However, there is no significant correlation between exercise habits and nutritional status, or the effect is so minimal that it can be disregarded, likely due to other, more influential factors affecting the nutritional status of students. Universities and public health stakeholders should create nutrition education programs to reduce sugar-sweetened beverage intake. They should also limit high-sugar drinks on campus and promote healthier options.

Acknowledgments

This study is part of research activities funded by the Faculty of Sports Science Decentralization Fund, University of Malang, Fiscal Year 2024. The author would like to express gratitude to the Faculty of Sports Sciences for the financial support and facilities provided. Thanks are also extended to all student respondents who participated and provided data voluntarily, as well as to those who assisted in the data collection process.

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