



Intra-and interpersonal determinants of sugar sweetened beverage and daily sugar intake among adolescent girls in Tasikmalaya City: A cross-sectional study

Determinan intra-dan interpersonal kebiasaan konsumsi minuman manis dan gula pada remaja putri di Kota Tasikmalaya: Sebuah pendekatan cross-sectional

Prima Endang Susilowati¹, Rizka Fikrinnisa², Nisatami Husnul³, Lilik Hidayanti^{4*}

¹ Nutrition Program, University of Siliwangi, Tasikmalaya, Jawa Barat, Indonesia.

E-mail: primaendangs@unsil.ac.id

² Nutrition Program, University of Siliwangi, Tasikmalaya, Jawa Barat, Indonesia.

E-mail: rizka.fikrinnisa@unsil.ac.id

³ Nutrition Program, University of Siliwangi, Tasikmalaya, Jawa Barat, Indonesia.

E-mail: husnul.nisatami@unsil.ac.id

⁴ Nutrition Program, University of Siliwangi, Tasikmalaya, Jawa Barat, Indonesia.

E-mail: lilikhidayanti@unsil.ac.id

*Correspondence Author:

Nutrition Program, University of Siliwangi, JL. Siliwangi No.2 Tasikmalaya, Jawa Barat, Indonesia.

E-mail: lilikhidayanti@unsil.ac.id

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Abstract

Sugar Sweetened Beverages (SSBs) are a type of high-energy drink favored by adolescents. Determinants within the individual and interactions with others can influence SSB intake. This study aimed to understand the association between intra- and interpersonal determinants of the frequency of SSBs consumption and daily sugar intake in adolescent girls. This study used a cross-sectional design, with 342 subjects selected from 1425 junior high school students in Tasikmalaya City. Data collection on daily sugar intake used the SQ-FFQ, while the frequency of SSBs consumption was assessed using a questionnaire. Data analysis was performed using chi-square and logistic regression. The results showed that most participants frequently consumed SSBs (83%) and had excessive daily sugar intake (61.1%). Sweet taste preference ($p=0.041$; aOR 1.919 [1.028–3.585]), advertising influence ($p=0.013$; aOR 2.141 [1.176–3.898]), and access to SSBs at school ($p=0.033$; aOR 2.594 [1.082–6.214]) were associated with the frequency of consumption. The frequency of SSBs consumption ($p=0.000$; aOR 7.293 [3.681–14.452]) and maternal education ($p=0.044$; aOR 1.662 [1.013 – 2.726]) were associated with daily sugar intake. Access to SSBs at school was the most dominant determinant associated with the frequency of SSBs consumption. School-based interventions can include providing drinking water, especially during lunchtime.

Keywords: Adolescents, socio-ecological factors, sugar-sweetened beverages, sugar intake

Abstrak

Minuman berpemanis gula atau *Sugar Sweetened Beverages* (SSB) adalah jenis minuman berenergi tinggi yang digemari oleh remaja. Faktor-faktor dalam diri individu dan interaksi dengan orang lain dapat memengaruhi konsumsi SSB. Tujuan penelitian ini adalah untuk mengetahui hubungan antara faktor intra- dan interpersonal dengan frekuensi konsumsi SSB dan asupan gula harian pada remaja putri. Penelitian ini menggunakan desain cross-sectional, dengan 342 subjek yang dipilih dari 1425 siswa SMP di kota Tasikmalaya. Pengumpulan data asupan gula harian menggunakan SQ-FFQ, sedangkan frekuensi konsumsi SSB menggunakan kuesioner. Analisis data menggunakan uji Chi-square dan pemodelan regresi logistik. Hasil penelitian menunjukkan, sebagian besar subjek sering mengonsumsi SSB (83%) dengan asupan gula kategori berlebih (61,1%). Kesukaan terhadap rasa manis ($p=0,041$; aOR 1,919 [1,028–3,585]), pengaruh iklan ($p=0,013$; aOR 2,141 [1,176–3,898]) dan akses terhadap minuman manis di sekolah ($p=0,033$; aOR 2,594 [1,082–6,214]) berhubungan dengan frekuensi konsumsi minuman manis. Frekuensi konsumsi minuman manis ($p=0,000$; aOR 7,293 [3,681–14,452]) dan

pendidikan ibu ($p=0,044$; aOR 1,662 [1,013 – 2,726]) berhubungan dengan asupan gula harian. Akses minuman manis di sekolah menjadi faktor paling dominan yang berhubungan dengan frekuensi konsumsi minuman manis. Intervensi berbasis sekolah dapat dilakukan dengan menyediakan air minum terutama pada saat makan siang.

Kata Kunci: Asupan gula, minuman manis, remaja, sosioekologi

Introduction

Sugar-sweetened beverages (SSBs) are beverages containing added sugars introduced during processing or preparation, including soft drinks, fruit-flavored drinks, energy and sports drinks, sweetened tea, and sweetened coffee (Beaulieu et al., 2020). Carbonated and noncarbonated beverages and fruit juices with added sugars are classified as SSBs. These beverages are generally characterized by low nutritional value and high sugar content (Malik & Hu, 2022).

The consumption of SSBs by children and adolescents has increased substantially worldwide. Globally, the average consumption among individuals aged 3–19 years exceeds three servings per week in South Asia and more than nine servings per week in Latin America (Lara-Castor et al., 2024). In Indonesia, approximately 72% of adolescents consume SSBs, and 41% consume them more than once daily (Laksmi et al., 2018). In parallel with the increasing consumption of SSBs, total sugar intake has also increased significantly (Tran et al., 2023). Between 2007 and 2019, sugar consumption increased by approximately 40% in upper-middle-income countries (UMICs) and low- and middle-income countries (LMICs) (Russell et al., 2023). This trend represents a growing public health concern because of its potential adverse effects on health.

Currently, SSB consumption is recognized as a major contributor to the global burden of noncommunicable diseases and other public health problems (Gui et al., 2021). Regular consumption of SSBs is associated with an increased risk of overweight and obesity, type 2 diabetes mellitus, cardiovascular diseases, and dental caries (Li et al., 2022). Among adolescents, the consumption of more than one serving of SSBs per day (approximately 355 mL) is associated with a higher risk of obesity, type 2 diabetes mellitus, cardiovascular disease, dental caries, and lipid metabolism disorders (World Health Organization [WHO], 2015).

Furthermore, emerging evidence suggests that SSB consumption is associated with adverse mental health outcomes, including depression and psychological disorders (Craig et al., 2022; Venus Valencia et al., 2022).

Numerous studies have demonstrated that frequent consumption of SSBs contributes to obesity in children and adolescents (Kuklina & Park, 2020). This association is primarily attributed to the high energy density of these beverages, combined with their low satiety and limited nutritional benefits (Costa et al., 2022). Unlike solid foods, liquid calories do not effectively suppress hunger or induce satiety, often leading individuals to consume additional foods with SSBs (Rogers et al., 2020). Consequently, excessive energy intake may occur, resulting in a positive energy balance and increased fat storage (Marriott et al., 2019). Over time, excess adiposity can increase the risk of obesity-related conditions, including cardiovascular disease, diabetes mellitus, hypertension, and certain cancers (Leal et al., 2022).

Multiple factors influence the SSB consumption of adolescents. The socio-ecological framework provides a comprehensive approach to understanding the determinants of SSB consumption by considering intrapersonal, interpersonal, and environmental influences (Wang et al., 2022). Intrapersonal factors include individual characteristics, such as age, sex, physical activity, dietary habits, and health-related behaviors. Interpersonal factors encompass social interactions and family-related influences, including parental characteristics, household socioeconomic status, and peer environments (Schneider et al., 2020).

The World Health Organization (WHO) has emphasized the importance of evaluating behavioral change strategies aimed at reducing free sugar intake, particularly from SSBs, in children and adolescents (WHO, 2015). Dietary behaviors established during childhood often persist into adolescence and adulthood. Therefore, identifying the factors associated

with SSB consumption during adolescence is critical for developing effective prevention strategies (Smirk et al., 2021). A comprehensive understanding of these determinants is essential for identifying and prioritizing intervention targets with the greatest potential to reduce SSB consumption and prevent overweight and obesity among adolescents (Calcaterra et al., 2023).

Adolescent girls represent a critical population for nutritional interventions because their health and nutritional statuses can influence future generations (Sparrow et al., 2021). To maximize the benefits of Indonesia's demographic dividend, improving the nutritional and health status of adolescents is an important national priority (Salim, 2020). Recent observations indicate that many adolescents frequently spend their pocket money purchasing SSBs, a habit that may contribute to long-term health risks (Sajdakowska et al., 2024).

Tasikmalaya, a city located approximately 105 km from Bandung, the capital of West Java Province, and 255 km from Jakarta, the capital of Indonesia, provides a unique setting for investigating dietary behaviors among adolescents (Ridwana et al., 2022). Ridwana et al. The majority of the population is of Sundanese ethnicity, a cultural group traditionally recognized for its predominantly plant-based dietary pattern (Rahfiludin et al., 2021). Given this context, the present study aimed to examine the intrapersonal and interpersonal determinants associated with SSB consumption and daily sugar intake among adolescent girls living in a population whose traditional dietary practices are largely plant-based.

Methods

This observational study employed a cross-sectional design in which all study variables were measured simultaneously at a single point in time. The study was conducted in Tasikmalaya City, West Java, Indonesia, and data were collected over a four-month period from May to August 2024. The study population comprised female students enrolled in public senior high schools in Tasikmalaya City. Three of the ten public senior high schools in the city were randomly selected as the study sites. Based on the minimum sample size calculation using a

90% confidence level and an additional 10% allowance for non-response, a minimum sample size of 342 participants was determined. A final sample of 342 participants was selected from a total population of 1,425 students using proportional random sampling.

Eligible participants were female senior high school students with no medical conditions requiring medications known to affect body weight, appetite, or metabolism, including steroids, antidepressants, antidiabetic agents, antihistamines, antihypertensive drugs, and protease inhibitors. Students following a weight-loss diet during the study period were excluded. Before data collection, all participants and their parents or legal guardians received detailed information regarding the study objectives and procedures. Written informed consent was obtained from both the participants and their parents or legal guardians prior to enrollment. Ethical approval for this study was granted by the Health Research Ethics Committee of the Ministry of Health Polytechnic of Palangkaraya (approval no. 308/VII/KE.PE/2024; July 1, 2024).

The primary outcome variables were the frequency of sugar-sweetened beverage (SSB) consumption and the daily sugar intake. The frequency of SSB consumption was assessed based on participants' self-reported responses regarding the number of times they consumed SSBs in the previous week. SSBs were defined as beverages containing added sugars, including soft drinks, fruit and vegetable juices with added sugar, powdered beverages, packaged sweetened beverages, sports and energy drinks, instant tea and coffee beverages, and flavored milk (Sousa et al., 2020). Participants were categorized as frequent consumers if they consumed SSBs more than three times per week and infrequent consumers if they consumed SSBs three times per week or less.

Daily sugar intake was assessed using a semi-quantitative food frequency questionnaire (SQFFQ). The food list included in the SQ-FFQ was developed through a review of the literature on commonly consumed SSBs, a 24-hour dietary recall survey, and a local market assessment to ensure content validity and contextual relevance. Daily sugar intake was calculated in grams per day and subsequently categorized according to the recommendations of the Indonesian Ministry of Health (Kemenkes RI, 2013). Participants consuming ≥ 50 g of sugar

per day were classified as having excessive sugar intake, whereas those consuming less than 50 g per day were classified as having non-excessive sugar intake.

Independent variables were selected based on the socio-ecological framework proposed by McLeroy et al. (1988), which conceptualizes health behavior as being influenced by intrapersonal, interpersonal, and environmental factors. As all participants resided within the same geographical area and were exposed to relatively similar social and policy environments, environmental determinants were assumed to be homogeneous. Consequently, this study focused on the intrapersonal and interpersonal determinants of SSB consumption and daily sugar intake.

The intrapersonal determinants included age, school grade, Body Mass Index-for-Age Z-score (BAZ), daily pocket money, physical activity, screen time, breakfast habits and sweet taste preference. Age was calculated from the participant's date of birth to the date of data collection and was categorized as ≤ 16 and > 16 years. School grade was categorized as either Grade X or Grade XI. Nutritional status was assessed using the BAZ, an anthropometric indicator recommended for evaluating the nutritional status of individuals under 18 years of age. Height was measured three times using a Seca 213 stadiometer, and body weight was measured once using a calibrated Seca 803 digital scale. Nutritional status was classified according to the Indonesian child growth reference standards as severe thinness (< -3 SD), thinness (≥ -3 SD to < -2 SD), normal nutritional status (≥ -2 SD to $\leq +1$ SD), overweight ($> +1$ SD to $\leq +2$ SD), and obesity ($> +2$ SD) (Kemenkes RI, 2020).

Daily pocket money was assessed based on the amount of money received by the participants each day and categorized into $\leq$ IDR 20,000 and $>$ IDR 20,000 (Saraswati et al., 2024). Physical activity was measured using the Physical Activity Questionnaire for Adolescents (PAQ-A), a validated instrument commonly used to assess habitual physical activity in adolescents (Kowalski et al., 2004). Based on the study protocol, physical activity was categorized as light (< 1.5 METs), moderate (1.5–2.0 METs), or vigorous (> 2.0 METs). Screen time was defined as the average daily duration of using screen-based devices, including mobile phones, tablets, computers, and televisions. Participants

were categorized as having screen time of < 5 hours/day or ≥ 5 hours/day based on the recommendations of the U.S. Surgeon General's Advisory (2023).

Breakfast habits were assessed by determining the frequency of food or beverage consumption before leaving for school during the previous week. Participants who reported eating breakfast more than three times per week were categorized as having frequent breakfast habits, whereas those who reported breakfast consumption three times per week or less were categorized as having infrequent breakfast habits (Saraswati et al., 2024). Sweet taste preference was assessed based on participants' self-reported liking of sweet-tasting foods and beverages and was categorized as either liking or disliking sweet tastes.

The interpersonal determinants included parental education, employment status, household income, external influences, and access to SSBs at home and school. Parental education refers to the highest level of formal education completed by the participant's father and mother and was categorized as elementary school, junior high school, senior high school, or university. Parental employment status was classified as employed or unemployed, and occupations were further categorized as formal or informal. Household income was defined as the total monthly family income and categorized according to the 2024 Regional Minimum Wage of Tasikmalaya City as $\leq$ IDR 2,630,951 or $>$ IDR 2,630,951 per month (West Java Provincial Government, 2023).

External influences were assessed through participants' responses regarding whether peer groups, advertising exposure, product packaging, free product promotions, or prize-draw campaigns influenced their decisions to consume SSBs. Responses were categorized as either "yes" or "no." Access to SSBs at home and school was evaluated based on participants' perceived ease of obtaining SSBs and classified as either easy or difficult. All data collection procedures were conducted by the principal investigator with the assistance of seven trained final-year undergraduate nutrition students from Universitas Siliwangi who served as enumerators.

Data were analyzed using univariate, bivariate, and multivariate statistical methods. Univariate analyses were conducted to describe the participants' characteristics. Categorical variables were summarized using frequencies

and percentages, whereas continuous variables were described using measures of central tendency and dispersion, including the mean, standard deviation, median, minimum, and maximum values. Bivariate associations between independent variables and study outcomes were examined using chi-square tests. Prior to the analysis, variables with more than two categories were recategorized into dichotomous variables. Specifically, BAZ categories were collapsed into underweight/normal ($\leq +1$ SD) and overweight/obesity ($> +1$ SD), physical activity was categorized as light (≤ 1.5 METs) and moderate-to-vigorous (> 1.5 METs), and parental education was grouped into elementary/junior high school and senior high school/university. Crude odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated to estimate the strength of the associations. Variables with p-values below 0.25 in the bivariate analysis were subsequently included in multivariable logistic regression models to identify factors independently associated with SSB consumption and excessive daily sugar intake.

Result and Discussion

All participants (100%) successfully completed all study procedures, and complete data were available for the analysis. The participants consumed sugar-sweetened beverages (SSBs) an

average of five times per week, with consumption ranging from never to daily. The mean daily sugar intake was 66.2 g/day, ranging from 0–188.8 g/day. Most participants were classified as frequent consumers of SSBs (83.0%), and more than half (61.1%) had excessive daily sugar intake according to the recommended threshold (Table 1).

Bivariate analysis identified several intrapersonal and interpersonal factors associated with the frequency of SSB consumption. Among the intrapersonal determinants, screen time ($p = 0.017$) and sweet taste preference ($p = 0.018$) were significantly associated with frequent SSB consumption. Among the interpersonal determinants, household income ($p = 0.039$), exposure to advertising ($p = 0.018$), and access to SSBs at school ($p = 0.013$) were significantly associated with the frequency of SSB consumption.

Regarding daily sugar intake, the frequency of SSB consumption was identified as a significant intrapersonal determinant associated with excessive sugar intake ($p < 0.001$). Among the interpersonal determinants, maternal educational attainment was significantly associated with daily sugar intake ($p = 0.026$). These findings suggest that both individual behavioral factors and family related characteristics contribute to variations in SSB consumption and sugar intake among adolescent girls.

Table 1. Sugar sweetened beverages (SSBs) consumption in adolescent girls

Variable	n (%)	Median (min-max)	Mean $\pm$ SD
SSBs consumption (x/week)		7 (0-7)	5.6 $\pm$ 1.8
Often	284 (83.0)		
Rare	58 (17.0)		
Daily sugar intake (g)		59.8 (0-188.8)	66.2 $\pm$ 40.7
Excessive	209 (61.1)		
Not excessive	133 (38.9)		

Table 2. Relationship between intra- and interpersonal determinants with SSBS and daily sugar intake in adolescent girls

Intra dan inter personal factor	Frequency of SSBs consumption		p-value; cOR (95% CI)	p;cOR(95%CI)		p-value; cOR (95% CI)
	Often	Rare		Excessive	Not Excessive	
	n (%)	n (%)		n (%)	n (%)	
Intrapersonal factor						
Age (years)						
≤ 16	169 (85.8)	28 (14.2)	0.152;	127 (64.5)	70 (35.5)	0.170;
> 16	115 (79.3)	30 (20.7)	1.6 (0.9-2.8)	82 (56.6)	63 (43.4)	1.4 (0.9-2.2)

Grade						
X	163 (84.5)	30 (15.5)	0.517;	126 (65.3)	67 (34.7)	0.091;
XI	121 (81.2)	28 (18.8)	1.3 (0.7-2.2)	83 (55.7)	66 (44.3)	1.5 (1.0-2.3)
Status of BAZ						
Overweight	65 (87.8)	9 (12.2)	0.286;	50 (67.6)	24 (32.4)	0.249;
Not overweight	219 (81.7)	49 (18.3)	1.6 (0.8-3.5)	159 (59.3)	109 (40.7)	1.4 (0.8-2.5)
Pocket money (IDR per days)						
> IDR 20,000	83 (82.2)	18 (17.8)	0.907;	59 (58.4)	42 (41.6)	0.508;
≤ IDR 20,000	201(83.4)	40 (16.6)	1.1 (0.6-2.0)	150 (62.2)	91 (37.8)	1.2 (0.7-1.9)
Physical activity (MET)						
Light	232 (84.4)	43 (15.6)	0.255;	169 (61.5)	106 (38.5)	0.901;
Moderate-heavy	52 (77.6)	15 (22.4)	1.6 (0.8-3.0)	40 (59.7)	27 (40.3)	1.1 (0.6-1.9)
Screen time (hours per day)						
≥ 5 hours	237 (85.6)	40 (14.4)	0.017*;	171 (61.7)	106 (38.3)	0.730;
< 5 hours	47 (72.3)	18 (27.7)	2.3 (1.2-4.3)	38 (58.5)	27 (41.5)	1.2 (0.7-2.0)
Breakfast habits (times per week)						
Often (≤ 3 times)	97 (82.2)	21 (17.8)	0.882;	71 (60.2)	47 (39.8)	0.887;
Rare (> 3 times)	187 (83.5)	37 (16.5)	0.9 (0.5-1.7)	138 (61.6)	86 (38.4)	0.9 (0.6-1.5)
Sweet taste preferences						
Yes	221 (86.0)	36 (14.0)	0.018*;	153 (59.5)	104 (40.5)	0.361;
No	63 (74.1)	22 (25.9)	2.1 (1.2-3.9)	56 (65.9)	29 (34.1)	0.8 (0.5-1.3)
Frequency of SSBs Consumption (times per week)						
Often	NA	NA	NA	196 (69.0)	88 (31.0)	0.001*;
Rare	NA	NA	NA	13 (22.4)	45 (77.6)	7.8 (4.0-15.0)
Interpersonal Factor						
Parent's education						
Father's education						
Elementary-junior high school	115 (85.8)	19 (14.2)	0.341;	91 (67.9)	43 (32.1)	0.050;
Senior high school-university	169 (81.3)	39 (18.8)	1.4 (0.8-2.5)	118 (56.7)	90 (43.3)	1.6 (1.0-2.5)
Mother's education						
Elementary-junior high school	128 (83.7)	25 (16.3)	0.897;	104 (68.0)	49 (32.0)	0.026*;
Senior high school-university	156 (82.5)	33 (17.5)	1.0 (0.6-1.9)	105 (55.6)	84 (44.4)	1.7 (1.1-2.7)
Parents' employment						
Father's employment						
Formal	37 (77.1)	11 (22.9)	0.328;	26 (54.2)	22 (45.8)	0.366;
Informal	247 (84.0)	47 (16.0)	0.6 (0.3-1.3)	183 (62.2)	111 (37.8)	0.7 (0.4-1.3)
Mother's employment						
Not work	239 (82.7)	50 (17.3)	0.846;	17 (61.2)	112 (38.8)	1.000;
Work	45 (84.9)	8 (15.1)	0.9 (0.4-1.9)	32 (60.4)	21 (39.6)	1.0 (0.6-1.9)

Family income (IDR per month)						
> IDR 2,630,951	7391.3	78.8	0.039*;	49 (61.3)	31 (38.8)	1.000;
≤ IDR 2,630,951	21180.5	5119.5	2.2 (1.1-5.8)	160 (61.1)	102 (38.9)	1.0 (0.6-1.7)
External influence						
Peer group						
Yes	222 (85.1)	39 (14.9)	0.106;	163 (62.5)	98 (37.5)	0.434;
No	62 (76.5)	19 (23.5)	1.7 (0.9-3.3)	46 (56.8)	35 (43.2)	1.3 (0.8-2.1)
Advertising						
Yes	159 (87.8)	22 (12.2)	0.018*;	118 (65.2)	63 (34.8)	0.126;
No	125 (77.6)	36 (22.4)	2.1 (1.2-3.7)	91 (56.5)	70 (43.5)	1.4 (0.9-2.2)
Packaging						
Yes	223 (83.8)	43 (16.2)	0.577;	164 (61.7)	102 (38.3)	0.801;
No	61 (80.3)	15 (19.7)	1.3 (0.7-2.5)	45 (59.2)	31 (40.8)	1.1 (0.7-1.9)
Free product						
Yes	249 (84.7)	45 (15.3)	0.071;	182 (61.9)	112 (38.1)	0.558;
No	35 (72.9)	13 (27.1)	2.0 (1.0-4.2)	27 (56.3)	21 (38.1)	1.3 (0.7-2.1)
Prize draws						
Yes	31 (75.6)	10 (24.4)	0.259;	21 (51.2)	20 (48.8)	0.225;
No	253 (84.1)	48 (15.9)	0.6 (0.3-1.3)	188 (62.5)	113 (37.5)	0.6 (0.3-1.2)
Access SSBs						
At home						
Easy	49 (87.5)	7 (12.5)	0.437;	40 (71.4)	16 (28.6)	0.114;
Not easy	235 (82.2)	51 (17.8)	1.5 (0.7-3.6)	169 (59.1)	117 (40.9)	1.7 (0.9-3.2)
At school						
Easy	266 (84.7)	48 (15.3)	0.013*;	192 (61.1)	122 (38.9)	1.000;
			3.1 (1.3-7.1)			1.0 (0.5-2.3)
Not easy	18 (64.3)	10 (35.7)		17 (60.7)	11 (39.3)	

cOR= Crude Odds Ratios; *significant at $p < 0.05$

Logistic regression analysis was performed to identify intrapersonal and interpersonal determinants associated with the frequency of sugar sweetened beverage (SSB) consumption and daily sugar intake among adolescent girls. For the outcome variable of SSB consumption frequency, eight independent variables, comprising three intrapersonal and five interpersonal factors, were included in the multivariable logistic regression model. For the outcome variable of daily sugar intake, nine independent variables, including four intrapersonal and five interpersonal factors, were included in the final model.

Multivariate analysis revealed that one intrapersonal factor and two interpersonal factors were significantly associated with SSB consumption frequency. Among the intrapersonal factors, sweet taste preference was significantly associated with frequent SSB consumption ($p = 0.041$). Among the interpersonal factors, exposure to advertising ($p = 0.013$) and access to SSBs at school ($p = 0.033$) were significantly associated with the

frequency of SSB consumption. These findings indicate that both individual taste preferences and environmental influences contribute to adolescents' SSB consumption behavior.

Regarding daily sugar intake, the frequency of SSB consumption was the only intrapersonal factor significantly associated with excessive sugar intake ($p < 0.001$). Maternal education was the only interpersonal factor significantly associated with daily sugar intake ($P = 0.044$). These results suggest that frequent consumption of SSBs substantially contributes to higher sugar intake among adolescent girls, whereas maternal educational attainment may influence dietary behaviors related to sugar consumption.

Among all determinants included in the model for SSB consumption frequency, access to SSBs at school emerged as the strongest associated factor (adjusted odds ratio [aOR] = 2.954), indicating that adolescents with easier access to SSBs at school were nearly three times more likely to consume SSBs frequently than those with limited access. For daily sugar intake,

the frequency of SSB consumption was the most influential determinant ($aO = 7.293$), suggesting that adolescents who frequently consumed SSBs

had more than seven times higher odds of excessive daily sugar intake than those who consumed SSBs less frequently.

Table 3. Final model of intra- and interpersonal determinants of SSBs consumption and daily sugar intake in adolescent girls

Variable	p	aOR	95%CI
Frequency of SSBs consumption			
Intrapersonal			
Screen time	0.064	1.889	0.963 – 3.7016
Sweet taste preferences	0.041*	1.919	1.028 – 3.585
Interpersonal			
Family income	0.069	2.142	0.944 – 4.862
Advertising influence	0.013*	2.141	1.176 – 3.898
Access SSBs at school	0.033*	2.594	1.082 – 6.214
Daily sugar intake			
Intrapersonal			
Grade	0.214	1.366	0.835 – 2.234
BAZ	0.593	1.178	0.647 – 2.143
Frequency of consumption of SSBs	0.000*	7.293	3.681 – 14.452
Interpersonal			
Mother's education	0.044*	1.662	1.013 – 2.726
Advertising influence	0.314	1.280	0.791 – 2.071
Prize draw influence	0.237	0.643	0.309 – 1.337
Access of SSB sat home	0.183	1.577	0.807 – 3.081

aOR=adjusted Odds Ratios; *significant at $p < 0.05$

In the present study, the average daily sugar intake among participants exceeded the maximum recommended intake established by the Indonesian Ministry of Health, which is 50 g/day (Kemenkes RI 2013). One of the major contributors to excessive sugar intake is frequent consumption of sugar-sweetened beverages (SSBs) (Yu et al., 2022). Indonesia ranks among the countries with the highest consumption of SSBs in Southeast Asia (Relmbuss Biljers Fanda et al., 2020), and adolescents represent one of the population groups with the highest consumption levels (Buwana, 2023). Findings from the 2018 Indonesian Basic Health Research Survey (RISKESDAS) indicated that nearly half of individuals aged 20–24 years consumed sweetened beverages more than once daily, while more than one-third consumed sweet foods more than once per day (Kemenkes RI, 2019). Current national dietary guidelines recommend that daily sugar intake should not exceed 5–10% of the total daily energy intake, equivalent to approximately 50 g/day for adults and 27–40 g/day for children and adolescents (Sartika et al., 2022). This recommendation is particularly relevant considering that

commercially available SSBs in Indonesia contain, on average, 7.26 g sugar per 100 mL (Indonesian Food and Drug Authority [BPOM RI], 2019).

The present study demonstrated that preference for sweet taste ($p = .041$; adjusted odds ratio [aOR] = 1.919, 95% CI [1.028, 3.585]), exposure to beverage advertising ($p = .013$; aOR = 2.141, 95% CI [1.176, 3.898]), and easy access to SSBs at school ($p = .033$; aOR = 2.594, 95% CI [1.082, 6.214]) were independently associated with a higher frequency of SSB consumption among adolescent girls after adjusting for potential confounding variables. Previous studies have shown that pleasant taste, convenience, affordability, and easy accessibility are among the primary reasons for adolescent consumption of SSBs (Bragança et al., 2022). Taste is a key determinant of food choice, particularly during adolescence, which is characterized by increasing autonomy in dietary decision-making (Kourouniotis et al., 2016). Individual differences in taste preferences may contribute to variations in dietary intakes and nutritional statuses (Hayes et al., 2013). Sweet-tasting foods and beverages are generally highly

preferred by adolescents (Bawajeeh et al., 2022), and this preference may encourage the greater consumption of beverages with high sugar content (Winzer et al., 2023).

The influence of advertising on SSB consumption observed in this study is consistent with previous evidence indicating that adolescents are highly susceptible to food and beverage marketing. The food and beverage industry frequently targets adolescents because of their growing purchasing power, influence on household purchasing decisions, and potential as long-term consumers (Story & French, 2004). Marketing strategies promoting SSBs have become increasingly intensive and often transcend national boundaries through digital and social media (Brownbill et al., 2018). Several studies have reported that greater exposure to beverage advertisements is associated with higher consumption of sugar sweetened beverages among adolescents (Chaffee et al., 2021).

Easy access to SSBs at school was identified as an important determinant of frequent consumption. SSBs are widely available in school canteens, convenience stores, kiosks, and food vendors near schools (Madsen et al., 2019). Given that students typically spend approximately eight hours per day at school, the opportunities to purchase and consume food and beverages during breaks are substantial (Hidayanti et al., 2022). Previous studies have reported that many students purchase sugary drinks during lunch breaks or while travelling to and from school (Grummon et al., 2015). School canteens and nearby food vendors have been identified as major sources of SSB purchases by adolescents (Smith & Holloman, 2014). Consequently, the school food environment plays an important role in shaping beverage consumption behavior and overall dietary quality.

The findings of this study further revealed that frequent SSB consumption was strongly associated with excessive daily sugar intake ($p < .001$; aOR = 7.293, 95% CI [3.681, 14.452]). Participants who frequently consumed SSBs were more than seven times as likely to have excessive sugar intake compared with those who consumed SSBs less frequently. This finding is biologically plausible because SSBs constitute one of the largest sources of added sugars in the diets of adolescents (Keller & Bucher Della Torre, 2015). Increased consumption of SSBs

contributes substantially to the total daily energy intake and may lead to a positive energy balance, increased adiposity, and obesity (Nguyen et al., 2023). Sugar-sweetened beverages, including carbonated soft drinks, sweetened fruit beverages, and sports or energy drinks, commonly contain high levels of sucrose or high-fructose corn syrup (HFCS), which substantially increases their caloric content (Lin et al. 2018). Despite their high energy density, these beverages have limited nutritional value and contribute few essential nutrients beyond calories.

Maternal education was also identified as a significant determinant of excessive daily sugar intake among adolescent girls ($p = .044$; aOR = 1.662, 95% CI [1.013, 2.726]). Adolescence is a developmental period characterized by increasing independence and greater influence from peers and the surrounding environments. Nevertheless, family characteristics, particularly parental behaviors and educational backgrounds, continue to play an important role in shaping dietary habits (Zhang et al., 2022). Mothers often serve as the primary gatekeepers of household food choices and dietary practices, influencing children's eating behaviors from childhood to adolescence (Mahmood et al., 2021). Higher maternal educational attainment is generally associated with greater nutritional knowledge, healthier food purchasing decisions, and increased awareness of the health risks associated with the excessive consumption of energy-dense, nutrient-poor foods and beverages, including SSBs (Prasetyo et al., 2023). Consequently, maternal education may contribute to a lower sugar intake among adolescents through its influence on the home food environment and parental dietary guidance (Kumar et al., 2023).

Several limitations should be considered when interpreting the findings of this study. First, the cross-sectional design precluded causal inference between the identified determinants and study outcomes. Second, data collection relied on self-reported questionnaires, which may be subject to recall and social desirability biases. To minimize these potential limitations, face-to-face interviews were conducted, and a standardized food photograph atlas was used to assist the participants in estimating portion sizes more accurately. Despite these limitations, this study had several notable strengths. It examined both intrapersonal and interpersonal

determinants within a socio-ecological framework and included a relatively large sample of adolescent girls, thereby providing a comprehensive understanding of the factors associated with SSB consumption and excessive sugar intake in this population.

Conclusion

The present study demonstrated that sweet taste preference, exposure to advertising, and access to sugar sweetened beverages (SSBs) at school were significantly associated with the frequency of SSB consumption among adolescent girls. Among these factors, access to SSBs at school was the strongest determinant of frequent SSB consumption. Furthermore, the frequency of SSB consumption and maternal education were significantly associated with the daily sugar intake. Frequent SSB consumption was identified as the most influential factor associated with excessive daily sugar intake in adolescent girls.

These findings highlight the importance of implementing comprehensive school-based strategies to reduce SSB consumption and excessive sugar intake among adolescents in the future. Interventions aimed at improving access to safe drinking water, limiting the availability of SSBs within and around school environments, and strengthening nutrition education programs may contribute to healthier beverage choices and improved dietary behaviors among adolescent girls in the future.

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