Jurnal Gizi dan Dietetik Indonesia
(Indonesian Journal of Nutrition and Dietetics)
Vol 14, Issue 4, 2026: 314-323

Available online at: https://ejournal.almaata.ac.id/index.php/IJND
p-ISSN 2303-3045 e-ISSN 2503-183X
DOI: https://dx.doi.org/10.21927/ijnd.2026.14(4).314-323

A too sweet environment? An analysis of the energy and sugar content of beverages in urban schools setting in Surabaya

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ABSTRAK

Latar Belakang: *Prevalensi intoleransi glukosa oral pada remaja Indonesia yang mencapai 16,8%, memunculkan kekhawatiran terkait lingkungan yang membentuk pilihan minuman harian remaja, khususnya di lingkungan sekolah. Kantin sekolah sering menyediakan minuman dengan kandungan gula tambahan dan energi yang tinggi, namun rendah zat gizi esensial.*
Tujuan: *Penelitian ini bertujuan untuk mengidentifikasi jenis minuman yang dijual di kantin sekolah di wilayah perkotaan dan menilai kandungan gizinya.*
Metode: *Penelitian ini merupakan studi deskriptif potong lintang yang dilakukan di dua sekolah menengah atas negeri di Surabaya, Jawa Timur. Sebanyak 478 sampel minuman dianalisis. Data diperoleh melalui wawancara dengan penjual kantin untuk mengumpulkan informasi mengenai resep minuman dan melalui informasi label nilai gizi produk kemasan. Kandungan gula dan energi dihitung per porsi penyajian.*
Hasil: *Terdapat sepuluh jenis minuman yang dijual di kantin, meliputi teh, minuman berbasis susu, minuman tradisional Indonesia, minuman cokelat, dan minuman bersoda. Minuman berbasis susu dan minuman tradisional memiliki rata-rata kandungan energi tertinggi (141,39±33,87 kkal dan 138,28±51,15 kkal), sedangkan minuman dengan perisa buatan memiliki energi terendah (44,26±13,96 kkal). Minuman tradisional juga memiliki kadar gula tertinggi (24,17±8,78 g/porsi), melebihi rekomendasi WHO.*
Kesimpulan: *Kantin sekolah di wilayah perkotaan Indonesia didominasi oleh minuman manis tinggi kalori, menciptakan lingkungan yang "terlalu manis" bagi siswa. Diperlukan upaya pengaturan penjualan, pelatihan penjual, dan promosi pilihan minuman sehat untuk mendukung kebiasaan makan yang lebih baik serta menurunkan risiko kesehatan jangka panjang.*

KATA KUNCI*: gizi, lingkungan makanan sekolah, minuman berpemanis, obesitas, perkotaan Indonesia, remaja.*

ABSTRACT

Background: *The prevalence of oral glucose intolerance among Indonesian adolescents, reaching 16.8%, has raised concerns about the environmental factors shaping adolescents' daily beverage choices, particularly within school settings. School canteens often offer beverages that are high in added sugars and energy but low in essential nutrients.*

Objectives*: This study investigates the types of beverages sold in school canteens in urban area and examines their nutritional content, focusing on sugar and energy levels.*

Methods: *We conducted a cross-sectional descriptive study in two public high schools in Surabaya, East Java. A total of 478 beverage samples were analysed. Data were collected by interviewing canteen vendors to collect information on drink recipes and packaged product labels. We then calculated the sugar and energy content per serving.*

Results: *Our result identifies ten types of beverages, including tea, milk-based drinks, traditional Indonesian beverages, chocolate drinks, and soft drinks. Among these, milk-based and traditional drinks had the highest average energy content (141.39±33.87 kcal and 138.28±51.15 kcal, respectively), while artificially flavoured beverages had the lowest (44.26±13.96 kcal). Traditional drinks also contained the highest levels of sugar (24.17±8.78 g per serving), exceeding WHO recommendations.*

Conclusions: *The results suggest that school canteens in urban Indonesia are filled with sugary, high-calorie drinks, creating what could be described as a "too sweet" environment for students. Efforts to regulate canteen offerings, train vendors, and promote healthier beverage choices are urgently needed to help students make better dietary decisions and reduce their risk of long-term health issues.*

KEYWORDS***:*** *adolescents, nutrition, obesity, school food environment, sugary drinks, urban Indonesia*

Article info: Received May 23, 2025; 1st revision July 08, 2025; 2nd revision July 28, 2025; 3rd revision August 19, 2025; 4th October 22, 2025; 5th December 04, 2025; accepted December 27, 2025; available online July 31, 2026; published July 31, 2026.

INTRODUCTION

Indonesia remains facing a double burden of malnutrition. This condition is characterized by the coexistence of undernutrition and overnutrition. The prevalence of thinness among adolescents aged 16–18 years is nearly 6.6%, while the total prevalence of overweight and obese adolescents is about 12.1% (1). The increasing trend of overweight and obesity among adolescents contributes to an elevated risk of non-communicable diseases such as Type 2 Diabetes Mellitus. Recently, the Indonesia National Health Survey shows a meaningful increase in the prevalence of disturbed oral glucose tolerance test among adolescents aged 15-24 years, which was about 16.3% (1). These findings suggest that unhealthy eating behaviors established during adolescence may predispose individuals to metabolic diseases later in life.

One of the main factors contributing to the increasing rates of overnutrition among adolescents is the high intake of sugar, especially from sugar-sweetened beverages (SSBs). Adolescents spend 7 to 10 hours of their day at school, thus, increasing the likelihood to purchase many drinks and food from the school's canteen during the day (2). In many Indonesian schools, canteens serve a wide variety of sweetened beverages such as sugary teas and artificially flavoured beverages. These items are typically inexpensive, widely available, making them an attractive option during school breaks. However, the excessive availability and consumption of sugary beverages high in calories but low in other essential nutrients, can lead to an imbalance between energy intake and expenditure, leading to obesity. It has been reported that an intake of 1 teaspoon added sugar can increase body weight by 0.11 kg (3). Sugar-sweetened beverages (SSBs) are also widely recognized as a major contributor to excessive caloric intake and poor dietary quality, particularly among children and adolescents (4). Regular consumption of SSBs has been consistently linked with an increased risk of several chronic health conditions, including obesity, type 2 diabetes mellitus, cardiovascular disease, non-alcoholic fatty liver disease

(NAFLD), and dental caries (5,6). The World Health Organization has recommended limiting added sugar intake to less than 10% of total daily energy, with a conditional recommendation to reduce it further to below 5% to minimize chronic disease risk (7). Currently, the analysis of SSBs availability in Indonesia school canteen is still limited. This article aims to explore the current state of food environments in Indonesian school canteens, with a particular focus on the availability and consumption of high-sugar products. By highlighting the need for better regulation and nutrition education in school settings, this study seeks to support efforts to create a healthier school food environment for Indonesian children.

MATERIALS AND METHODS

Design and Study Population

This study is part of a trial that investigated the implementation of traffic light labelling in school canteens, which is described in detail elsewhere (8). The data collection was carried out in August-November 2023. The study population in this research consisted of canteens that sold beverages at two public senior high schools in Surabaya, the capital city of East Java Province, Indonesia. This study used a convenience sampling method to select two public senior high schools in Surabaya. The selection of the schools was based on the location that nearby the city centre to represent the typical urban characteristics. The school canteens operated using a booth-based system, where each booth was independently managed by individual vendors who rented space from the school and operated under school supervision.

Data Collection and Analysis

Data were collected through interviews with canteen vendors to obtain information on the price and the type of beverages sold per serving size. For homemade beverages, recipes per serving size were collected to estimate the energy and sugar content and analysed using Nutrisurvey software (SEAMEO-TROPMED RCCN, University of Indonesia, Jakarta, Indonesia). Information about the beverage serving size was collected through direct interviews with the vendors. Whenever possible, the vendors were asked to show the actual cup or container used to estimate the standard serving size more accurately. For the packaged beverages, the nutrition value information was documented from the product label and the vendors were unsure whether any additional ingredients were added during preparation. The sugar and energy content of each beverage was calculated and analyzed descriptively. Results are presented as mean and standard deviation (SD), with measurements expressed in grams (for sugar) and kilocalories (kcal) for energy. The analyses were conducted using Microsoft Excel 2019 (Microsoft Corporation, Redmond, WA, USA).

RESULTS AND DISCUSSIONS

The study identified a wide variety of beverages sold in school canteens with a total of 478 samples of beverages, encompassing both homemade and packaged drinks. From the data collected at two urban public schools in Surabaya, a total of ten beverage categories were found, including tea (both sweetened or bottled), milk (e.g. milkshake, flavoured and unflavoured milk), artificially fruit-flavoured beverages, ice cream, Indonesian traditional drink (e.g. es kopyor, es cao or black-grass jelly ice), coffee, carbonated soft drink, energy drink, herbal drink (e.g. milk ginger), and chocolate-based drink.

By the type, artificially flavoured beverages were the most common (n= 215, 45%), followed by coffee (n=64; 13%), milkshake (n= 54; 11%), and tea (n= 36; 8%). Meanwhile, milk-based beverages accounted for 23 products (5%) and the least represented was traditional drinks (n= 5; 1%), energy drinks (n= 6; 1%), and herbal drinks (n = 3; 1%). Ice cream (n= 16, 3%) and carbonated soft drinks (n= 15; 3%) were also found in smaller proportions (**Table 1**). When grouped by its processing method, approximately 59% of the beverages were homemade (n= 281), while 41% were packaged (n = 197). Both homemade and packaged drink products were available in the canteen. The price of the beverages ranged from Rp 2,000.00-5,000.00 per serving size with the average serving size was approximately 225 ml. Overall, the type of the beverages can be summarized in **Table 1**. As depicted from **Figure 1**, milk contains the highest energy followed by traditional drinks which contribute to 141.39±33.87 kcal and 138.28±51.15 kcal respectively.

Table 1. Categories and examples of beverages sold in school canteens

Beverage Category	n (%)	Examples
By type		
Tea	36 (8)	Sweetened iced tea, bottled tea, Thai tea, and milk tea
Milk	23 (5)	Packaged UHT milk including unflavoured and flavoured milk (e.g. strawberry, taro), milk-based drink prepared from powder milk, condensed milk drink.
Milk-shake	54 (11)	Pop-ice
Artificially flavoured drink	215 (45)	Bottled orange flavoured drink, flavoured milk shake, and artificially-flavoured tea.
Ice cream	16 (3)	Commercial ice cream
Traditional drink	5 (1)	*Es kopyor, sinom, es doger, es cao* (black grass-jelly)
Coffee	64 (13)	Coffee (both bottled and prepared coffee), coffee milk
Carbonated soft-drink	15 (3)	Soda and cola
Energy drink	6 (1)	Commercial energy drink
Chocolate drink	41 (9)	Iced and hot chocolate
Herbal drink	3 (1)	Milk ginger (*susu jahe*)
By processing		
Homemade beverages	296 (62)	Sweetened iced tea, artificially-flavoured tea, Thai tea, and milk tea, milk-based drink prepared from powder milk, flavoured milk shake, commercial ice cream, coffee, Iced and hot chocolate, and milk ginger (*susu jahe*), and *Es kopyor, sinom, es doger, es cao* (black grass-jelly).
Packaged beverages	182 (38)	Bottled tea, UHT milk including unflavoured and flavoured milk (e.g. strawberry, taro), bottled orange flavoured drink, bottled coffee, soda and cola, bottled tea, and commercial energy drink.

Milkshake, herbal drink, and ice cream contain similar energy, ranging about 100 kcal. There are three types of beverages that contain energy below 80 kcal/ serving size such as artificially-flavoured drink (44.26±13.96), carbonated soft drink (75.33±25.45), and tea (82.99±64.78), representing the group with the lowest energy content.

Meanwhile, energy drinks and chocolate drinks contain each 89.88±25.99 kcal and 107.68±30.22 kcal. Among other types of beverages, ice cream, tea, milk, and traditional drink show the widest standard deviation bars, representing the higher variation of energy content in the group. Milkshakes and milk-based beverages were analyzed separately in this study, as they differ in composition and preparation methods. Milkshakes often include added ingredients such as ice cream, flavoured syrups, or sweetened toppings, which contribute to higher energy and sugar content compared to standard milk drinks.

Analysis the mean sugar content of each beverage type which is depicted in **Figure 2**. Traditional drinks such as es kopyor, es cao, and es doger had the highest sugar content, reaching 24.17±8.78 grams. Coffee, herbal drink, carbonated soft drink, milk, tea, and chocolate drink are the beverage groups that contain sugar closely, ranging from 19.50 to 13.49 grams. Other three beverage groups, such as artificially flavoured drink, energy drink, and ice cream contain sugar less than 10 grams per serving size. Traditional drink, coffee, tea, chocolate, and energy drink have the widest standard deviations compared to others

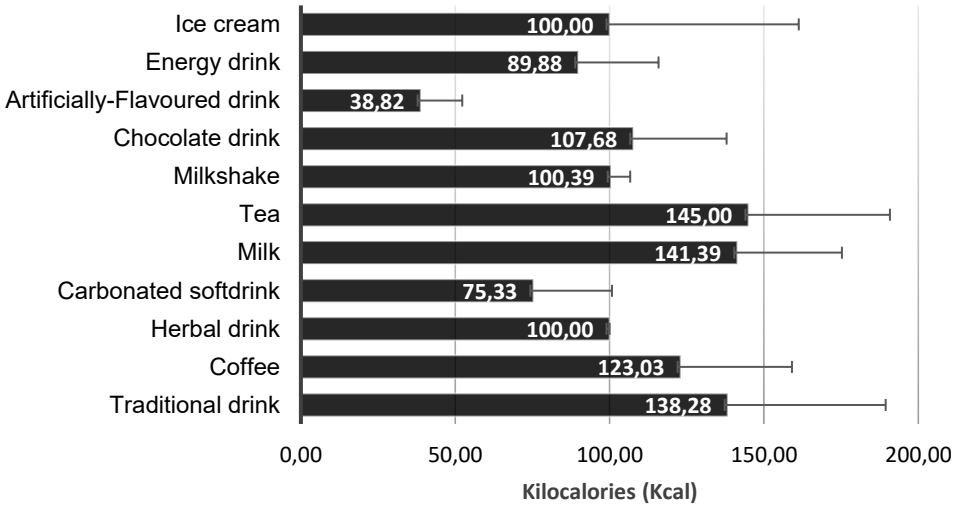

Figure 1. Mean energy content of beverage (n=478) per serving size based on the type. Unit is measured in kilocalories (kcal). Error bars represent Standard Deviation (SD)

The energy and sugar content of beverages also differed according to their source. As depicted in **Figure 3**, homemade beverages contained a higher mean energy content (93.84 ± 49.27 kcal/serving) compared to packaged drinks (86.08± 39.15 kcal/serving). Similarly, sugar content was also higher in homemade beverages (15.07 ± 4.09 g/serving) than in packaged beverages (12.45 ± 7.08 g/serving).

This consistent difference suggests that homemade drinks may contribute more substantially to students' total energy and sugar intake. This present study provides information of the variety in the types and the content of energy and sugar from beverages sold in school canteens in urban Indonesia. Our findings reveal that school canteens offer a wide variety of both homemade and packaged drinks, which can be categorized into ten groups. This various type of beverages reflects the high availability and accessibility of sweetened products within school environments which may raise concerns about the dietary habits formed during adolescence. Duran et al. suggest that the more variety in SSBs brand, type, and flavour, the more consumption of SSBs (9).

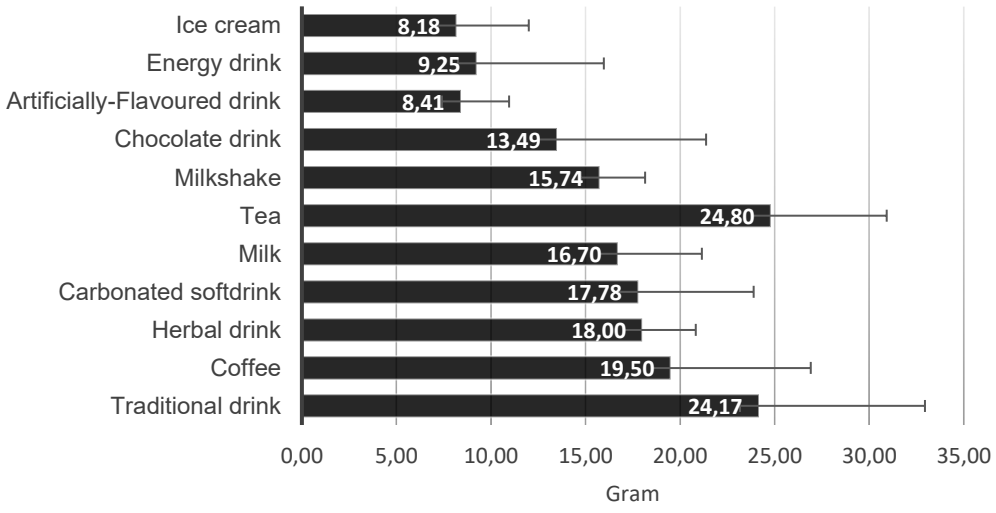

Figure 2. Mean sugar content of beverage per serving size based on its type

One of the important findings is the high energy content of milk-based drinks, which had the highest mean energy per serving (141.39±33.87 kcal), followed by traditional Indonesian beverages such as es kopyor, es cao, and es doger (138.28±51.15 kcal). Approximately, these beverages contributed to 14–17% of the daily energy requirement based on the Indonesian Recommended Dietary Allowance (RDA) for adolescents aged 13–18 years (2,100–2,500 kcal/day). This indicates that a single serving of these beverages already represents a substantial portion of students' daily energy needs from drinks alone, potentially increasing the risk of excessive calorie intake when consumed regularly during school hours. The increase of energy levels in these types of drinks can be attributed to the use of sweetened condensed milk, added sugar, coconut milk, and syrup which are commonly found in both milk-based and traditional beverages. Our findings suggest that although traditional drinks are often considered healthy (10), they actually contain a high amount of energy. The consumption of beverages containing high-energy can contribute to an excessive energy intake and lead to overnutrition (3). Moreover, liquid energy (energy coming from beverages) induces lower satiety (a fullness feeling following drinking) and later they can compensate for more energy from the diet. Altogether, these mechanisms can lead into an increase in body weight among adolescents (11,12).

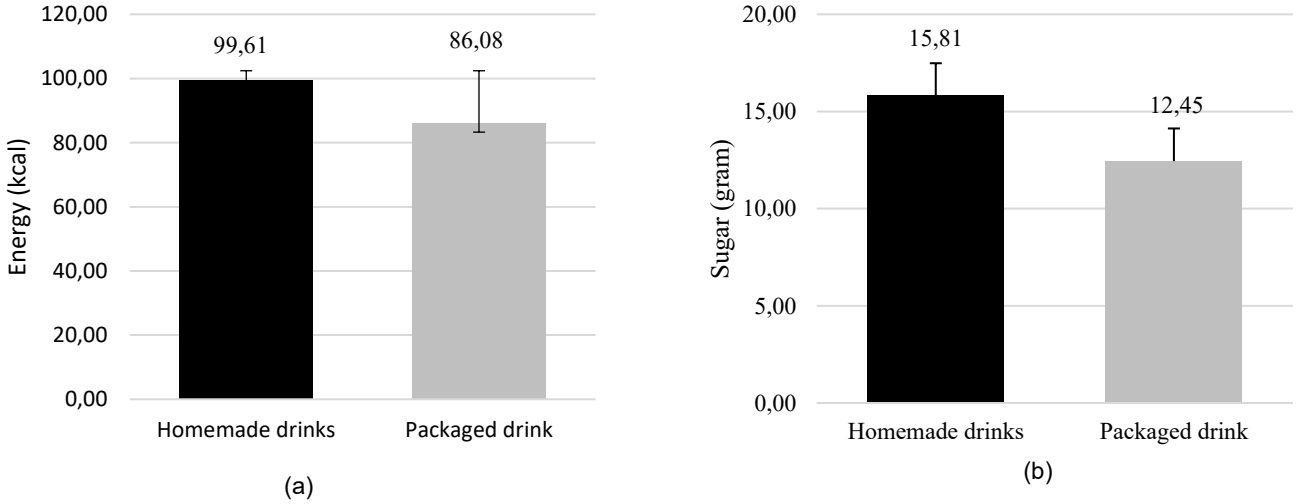

Figure 3. Mean energy content in kcal (a) and sugar content in gram (b) of homemade drinks (black bars) and packaged drinks (grey bars) sold in high school cafeterias per serving size

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Meanwhile, the chocolate-based drinks and coffee also contain high energy, exceeding 100 kcal per serving size. The elevated energy content in these drinks is due to the addition of sweetened condensed milk or sucrose. This condition can increase the obesity risks among school-aged students when consumed frequently, especially without compensation by adequate physical activity and exercise (11,13).Interestingly, three beverage types, namely artificially flavoured drinks (38.82±13.45 kcal), carbonated soft drinks (75.33±25.45 kcal), and energy drinks (89.88±25.99 kcal), were found to have the lowest average energy content. However, these types of beverages remain concerning due to their high sugar content and low nutritional value. Despite their relatively low energy contribution, frequent consumption of these drinks may increase the risk of excessive sugar intake and displace healthier beverage choices among adolescents.

When examining sugar content, traditional drinks, positioned the highest (24.17±8.78 g), likely due to multiple sweet ingredients including syrup and sweet-condensed milk which were added into the beverages. Coffee, milk, tea, chocolate drinks, and herbal beverages also contributed significantly to daily sugar intake, with average contents ranging from 19.50 g to 13.49 g per serving. These values are concerning when reciting WHO recommendations suggesting that added sugar intake should not exceed 5% of total energy per day for children and adults to reduce the risk of overweight and dental caries (5). The 5% of sugar limit recommendation is equivalent to 25 grams/ day for adults (14). The consumption of SSBs more or equal than three times per week is associated with a 60% odds of weight gain (15). A daily intake of 100 grams of sugary beverages was linked with increased body mass index (BMI) and adiposity in children and adolescents (16).

Artificially flavoured drink, ice cream, and energy drink becomes the beverage type with the sugar content less than 10 grams/ serving size. However, these drinks are not nutritionally advantageous, as they still contain high levels of added sugar and offer little to no essential nutrients. The lower sugar content of ice cream may reflect the smaller portion sizes or a perception of these products as “treats” rather than regular beverages. Energy drink can be defined as a typically glucose-based energy drink, with functional or stimulation claiming a particular energy boost from caffeine, guarana, taurine, ginseng or other herbs (17). The sugar content of this energy drink is lower when compared to others because most of the energy drinks have sugar-free or low-sugar versions which use artificial sweeteners (e.g. aspartame and saccharine) as the replacement (17,18). Additionally, the artificial-flavoured drink (e.g. orange flavoured drink) also demonstrates lower sugar content, potentially due to the use of artificial non-caloric sweetener. The amount of sugar in these fruit-flavoured drinks is similar to a survey conducted in the United of Kingdom (UK) which demonstrated 64% of juice in that country contains approximately 9.5 grams of sugar (19). Although the sugar content in this drink type is considered to be low, the consumption of artificial non-caloric sweetener and artificial flavour might need attention. Artificial flavour has a significant effect on hyperactivity behaviour in children population while non-caloric artificial sweetener is associated with depression and cardiovascular diseases (20). Moreover, the consumption of artificial-flavoured drinks has been linked with the risk of obesity-related cancers (21).

With regard to the type of beverages (packaged vs. homemade), our finding reported that homemade drinks or the drink prepared on-site, often exceed recommended sugar thresholds compared to industrially packaged ones. This condition may be explained by the lack of standardized recipes and portions in homemade beverage preparation which can lead to higher variability in sugar content and serving size. Moreover, vendors frequently add sugar or sweetened condensed milk to enhance palatability which subsequently contributes additional energy beyond the natural content of the ingredients used. Milk and milk products, including condensed milk, are not classified as SSBs. However, they contain an important source of sugar and their consumption should be limited (22). In this study, we found that milk and milk products were widely available in the school canteen. Pure milk, flavoured-milks, and milk products provide various essential nutrients (protein, calcium, potassium,

phosphorus, and vitamins) to fulfil the nutrient requirement in adolescents (23). The average sugar content of milks in our study is approximately 16.70±4.45 grams. To achieve the minimum sugar intake, plain milk is more preferred to those with added sugar.

Our study also shows that the price of the SSBs is noticeably cheap. The lower the price of SSBs, the more likely the students to buy these unhealthy beverages (12). It has been known that price affordability has become one of key contributing factors for SSBs purchasing among school-aged children (24). Growing evidence suggests that an increase in SSBs price could lead to an increase of plain water demand (25) and less SSBs purchase (26). Moreover, the school sites we studied had no tap-water for their students. A provision of free drinking water might be an effective suggestion to reduce SSBs consumption among school students as mentioned by a previous study (15,27). Overall, this study reveals that school canteens, particularly in urban areas of Indonesia, foster a "too sweet" environment, characterized by the high availability of the energy-dense and sugary drinks. This present study highlights the urgency for school-based nutrition intervention, including policy regulation to limit the sale of sugar-sweetened beverages (SSB), the introduction of nutritional guidelines for school vendors, and the promotion of healthier drink alternatives such as unsweetened herbal infusions. Currently, Indonesia still has no specific policy addressing nutritional content and the quality of foods being sold in school canteens (28). Our study supports evidence to encourage the Indonesian government to study and launch specific SSBs regulation in school environments. This regulation has been implemented in several countries such as Australia and other South-East Asia countries including Cambodia, Malaysia, and Philippines, where the sales of SSBs in the public schools have been removed (29,30).

LIMITATION

This study has several strengths. First, this study provides detailed data on both energy and sugar content of beverages sold in school canteens in Indonesia. This information offers important insight regarding the nutritional environment which school-aged children are routinely exposed to. Second, this study uses real-world data from vendor interviews and product labels enhances the practical relevance of the findings for policy and intervention development.

We also acknowledge several limitations in this study. The data were collected from only two public high schools in one urban city, which may limit the generalizability of the findings to other regions, including rural areas or private schools. In addition, the analysis focused exclusively on beverages and did not include foods, which also contribute substantially to students' overall dietary intake

CONCLUSION AND RECOMMENDATION

This study demonstrates that school canteens in urban Indonesia are dominated by higher variety sugar-rich and energy-dense beverages, contributing to the "too sweet" environment that might increase the risk of developing chronic diseases. Comprehensive strategies by the government to endorse nutritional labelling, regulation of sugary beverage sales, and health promotion efforts targeting both vendors and students might be beneficial to improve school food environments to become healthier. At the school level, a provision of free-drinking water can be implemented to reduce energy and sugar consumption from the beverages. Addressing this issue is a crucial step in combating the double burden of malnutrition, especially among school-aged adolescents.

ACKNOWLEDGEMENT

This research was funded by The SEAMEO Regional Centre for Food and Nutrition (RECFON) 2023.

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