Research Note

Free Drinking Water Provision at School Canteen and Sugar Sweetened Beverages Consumption among Junior High School Students in Tomohon City, Indonesia: A Cross-sectional Study

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ABSTRACT *Background:* Globally, concerns are raised about sugar-sweetened beverages (SSBs) as a risk factor for child obesity. In Indonesia, SSBs are commonly sold at schools while drinking water is hardly available for free. We investigated whether students in schools with free drinking water consume less SSBs at schools than their counterparts. *Methods:* We conducted a questionnaire survey, incorporating food frequency questionnaire, among 813 students in seven junior high schools with and without free drinking water at school canteen in the city of Tomohon, North Sulawesi Province. We compared their SSB consumption at schools with and without drinking water, using Mann Whitney U test or chi square test. The availability and sale of SBBs were also compared between schools with and without drinking water. *Results:* The proportion of students who reportedly drink SSBs at school at least once a day was not lower in schools with drinking water than in schools without drinking water, and so was the daily frequency of SSB consumption among daily SSB consumers. The number of SSB brands and varieties sold at school appeared to be higher in schools with drinking water than their counterparts. *Conclusions:* There was no difference in SSBs consumption among students between schools with and without free drinking water. To reduce their SSB consumption at schools, it may be necessary to provide alternative drinks or to restrict the sale of SSBs at schools.

Keywords: Drinking water; Sugar-sweetened beverages; Junior high school; Adolescent; Obesity

INTRODUCTION

Globally, there have been growing concerns about sugar-sweetened beverages (SSBs) as a risk factor for child obesity (1-3). While overall sugar intake is epidemiologically and clinically proven to trigger obesity and other metabolic adverse events such as high blood pressure and insulin resistance, the influence of sugars from SSBs is greater than those from solid foods because SSBs contain higher concentration of fructose than solid foods (4). SSBs promotes energy intake efficiently because it is available in liquid form and easy to consume. Despite such characteristics and potential health effects of SSB consumption, SSBs are widely available and accessible to children in any countries or regions irrespective of their income levels.

In Indonesia where the prevalence of obesity (BMI > +2 standard deviation above the median) among adolescents has largely increased in the recent past (by eight-fold from 0.6% in 1996 to 4.9% in 2016), the government has addressed the risk of excessive sugar intake among children through their SSB consumption at school (5-7). In schools, SSBs and bottled water are available at an affordable price for students. On the other hand, tap water available in schools is only for washing hands, since it is not safe to drink unless properly boiled (8). This situation prompts students to drink SSBs. Yet, there is noregulation to restrict the sale of SSBs at schools to date. According to the Global school-based student health survey in 2015, 28% of Indonesian students consume soft drink once or more daily (9).

Studies in the Western countries reported that the provision of drinking water at schools was effective to increase water consumption and to reduce overweight among students (10-12). In Indonesia, a few schools or food vendors in the schools voluntarily provide free drinking water for students. If students in such schools consume less SSBs at schools than those in the schools without drinking water, the provision of free drinking water at schools would be a sound approach to fight against child obesity in Indonesia as well. In the present study, we therefore tested this hypothesis among junior high school students in the city of Tomohon in North Sulawesi Province, Indonesia.

METHODS

Study Setting and Participants

This study was conducted in Tomohon City, North Sulawesi Province, Indonesia. The city has 105,000 residents in 2018, with 23% aged below 15 years (13). The majority of the population in the city is Protestant (73%), while the most of Indonesian population is Moslem (87%) (14-15). In 2017 academic year, there were 22 junior high schools with 5822 enrolled students in the city. Notably, the prevalence of obesity among junior high school students in the city is much higher than that of the whole country (10.4% vs. 2.5% in 2013) (16-17).

In Tomohon City, junior high schools start at 7 AM and finish around 1 PM with two recess time around 9 AM and 11 AM. In the schools, school

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breakfast or lunch program is uncommon, and most of schools provide foods and beverages through food vendors, where students can purchase foods and beverages freely during school recess time or after school.

The study was designed to describe school food environments in all 22 junior high schools in the city, and to investigate dietary intake and body mass index (BMI) among students (18). The sample size was calculated to estimate the proportion of students consuming SSBs once per day or more in Tomohon City to be 32.3%, following the School-based oral health survey guideline (19-20). Given 80% response rate and design effect of two, the required sample size turned to be 840. To achieve this sample size, we selected eight schools, using systematic sampling by urban/rural classification, district of the city, and the size of school, and recruited all 9th graders in the selected schools. The study was approved by the institutional review board of Sam Ratulangi University in Indonesia and the University of Tsukuba in Japan.

In the present study, we used the cross-sectional data from 813 participants in seven of eight selected schools to investigate whether students in the schools providing drinking water for free at canteen consumed less SSBs at schools than those in the schools without free drinking water. One school was excluded because SSBs were not sold in the school.

Data Collection

Data collection was conducted by the first author between July and October 2017 on typical school days among students with a written informed consent of both students and their parents. We asked students to fill out self-administered questionnaires in the classroom to provide information about their characteristics and dietary intake. At the same time, we measured their body weight and height. To obtain information about schools and the food vendors, we interviewed school principal (or designated teacher/staff) and vendors who sell foods regularly at school. We also observed the vendors to identify what were sold. For data collection, we visited schools twice, and students and vendors who were absent during our visits were excluded from the study.

Measurements

(1) School characteristics

School characteristics include type of school (public/private), number of students, availability of water server in the classroom, provision of free drinking water at canteen, and the number of beverage brands and varieties sold in school. Beverages were classified into SSBs and water. Some schools had water servers in the classrooms, but they were not free, and the installation of water servers depended on each class. Users have to pay for the water-refill fees to use.

(2) Student characteristics and SBB consumption

Student characteristics include sex, age, body height, body weight, socioeconomic status, frequency of and daily allowance for food purchase at school, and physical activity. Socioeconomic status was measured with the Family Affluence Score III, which has been validated in a previous study in Indonesia (21). The total score ranges from 1 to 13, where the higher score indicates higher socioeconomic status. Regarding physical activity, we asked the number of days per week students were engaged in moderate to vigorous-intensity physical activity for at least 60 minutes.

Body weight and height were measured using a body weight scale and a stadiometer with graduation of 0.1 kg and 0.1 cm, respectively. Students were wearing school uniform during weight measurement, so the approximate weight of school uniform was deducted from the measured weight. We calculated body mass index (BMI) by dividing the square of body weight (kg) by body height (m). Obesity, overweight, and thin are defined as z-score > 2 standard deviation (SD), 1SD < z-score ≤ 2SD, and z-score < -2SD from median, respectively, according to the WHO child growth standard for boys and girls (WHO, 2007) (22-23).

SSB consumption was evaluated using a food frequency questionnaire (FFQ) separately for consumption at school and outside school. FFQ assesses the consumption of beverages during previous 30 days with 9 levels of frequencies: (1) almost never; (2) one to three times per month; (3) once per week; (4) two to four times per week; (5) five to six times per week; (6) once per day; (7) two to three times per day; (8) four to six times per day; (9) more than six times per day, which was converted to the frequency of daily consumption (i.e., 0, 0.07, 0.1, 0.4, 0.8, 1.0, 2.5, 5.0, and 6.0, respectively) (24). For the present study, we developed the FFQ among 43 junior high schoolers in Tomohon City through three-day inconsecutive food records (two school days and a weekend day).

Analyses

First, we compared school and student characteristics between schools with and without free drinking water at canteen (as shown in Table 1 and Table 2, respectively). Then, we compared SSB consumption among students in schools with and without free drinking water at canteen (as shown in Table 3). Specifically, we compared the proportion of students who consumed SSBs at least once a day at school and outside school and among those who consume SSBs every day, we compared the daily frequency of SSB consumption at school and outside school.

For the comparisons between students in the school with and without drinking water, we performed Mann Whitney U test, t test, or chi square test, depending on the type of the variables to be compared. We showed effect size of Spearman's rho (ρ), Pearson's *r*, and phi (φ) or Cramer's V for these tests, respectively. Effect size of 0.2 for ρ, r, φ, and Cramer's V indicates a practically significant effect (25).

RESULTS

1. School characteristics

Table 1 compares the school characteristics between two schools with free drinking water at canteen and five schools without it. One of the two schools and one of the five schools were public schools. The median number of students in schools with and without free drinking water was 376 and 229, respectively. The number of SSB brands and varieties sold was much higher in schools with free drinking water than in schools without it. Such clear difference between the schools with and without free drinking water at canteen was not seen in the brands and varieties of water.

2. Student characteristics

In the schools with and without free drinking water at canteen, 251 and 562 students in the 9th grade completed the questionnaire survey and anthropometric measurements. Table 2 compares their characteristics. The proportion of male students was

higher in the schools with free drinking water (58%) than in the schools without it (45%). Mean body weight, height and BMI of the students were similar between the schools, though the proportion of overweight and obese students was higher in the schools without free drinking water (29%) than in the other schools (23%). Based on the effect size, there was no difference between the schools in students' characteristics including their family affluence, daily food allowance, food purchase at school, and physical activity.

Table 1. Characteristics of schools with and without free drinking water at canteen

	Free drinking water at canteen			
	Available (2 schools)		Not available (5 schools)	
Number of public schools	1		1	
Number of students per school (median [range [b]])	376	[374, 377]	229	[134, 1188]
Total number of students across schools	751		2011	
Number of schools providing water server in some classrooms	1		2	
Number of beverage brands/varieties sold in school (median [range [b]])				
SSBs	22	[19, 25]	2	[1, 8]
Water	1	[1, 1]	1	[1, 2]
Number of beverages sold per day per 100 students (median [range [b]])				
SSBs	61	[55, 67]	15	[6, 57]
Water	22	[18, 26]	19	[4, 47]
Daily sale of beverages per student (USD [a]) (median [range [b]])				
SSBs	0.21	[0.18, 0.24]	0.04	[0.02, 0.04]
Water	0.01	[0.01, 0.01]	0.01	[0.00, 0.11]

[a] USD 1 = IDR 13,574.00 (as of October 1st, 2017)
[b] Range shows minimum and maximum value of a variable

Table 2. Student characteristics of schools with and without free drinking water at canteen

	Free drinking water at canteen				
	Available (251 students)		Not available (562 students)		Effect size [a]
	n	%	n	%	Φ
Male	146	58.2%	254	45.2%	-0.120
Female	105	41.8%	308	54.8%	
Child growth standard [b]					Cramer's V
Normal	187	74.5%	392	69.8%	0.068
Overweight	31	12.4%	98	17.4%	
Obese	26	10.4%	60	11.7%	
Thin	7	2.8%	12	2.1%	
	Mean	(SD [c])	Mean	(SD [c])	R
Height (cm)	156.9	(7.1)	156.3	(7.2)	0.038
Weight (kg)	50.9	(11.1)	51.2	(12.6)	-0.012
BMI [c] (kg/m^2)	20.6	(4.0)	20.9	(4.3)	0.026
	Median	[IQR [c]]	Median	[IQR [c]]	P
Family affluence score [d]	5.0	[4.0, 7.0]	6.0	[4.0, 8.0]	-0.149
Daily food allowance (USD [e])	0.88	[0.74, 0.88]	0.88	[0.74, 1.47]	0.040
Food purchase at school (days/5 school days)	4	[3, 5]	4	[3, 5]	-0.019
60 mins or more PA (days/week)	3	[2, 5]	3	[2, 5]	-0.034

[a] Effect size of 0.2 indicates a practically significant effect; [b] Based on the WHO child growth standard, thin, normal, overweight, and obese are defined as z-score < -2SD, -2SD ≤ z-score ≤ 1SD, 1SD < z-score ≤ 2SD, z-score > 2SD from median, respectively; [c] SD: standard deviation, IQR: interquartile rage, BMI: body mass index
[d] Family affluence score ranges from 1 to 13; [e] USD 1 = IDR 13,574.00 (as of October 1st, 2017)

3. SSB consumption

Table 3 compares students' SSB consumption between the schools with and without free drinking water at canteen. The proportion of the students who reported to drink SSBs at least once a day in the school was higher in the schools with free drinking water (40%) than in the other schools (34%), while this proportion outside school was similar between the school with and without drinking water (57% and 55%, respectively). Among those who drink SSBs every day, the daily frequency of SSB consumption at school and outside school was also similar between the schools with and without drinking water. Based on the effect size, there was no difference between the schools in students' SBB consumption.

Table 3. SSB consumption among students in schools with and without drinking water at canteen

	Drinking water at canteen				
	Available (251 students)		Not available (562 students)		Effect size [a]
	n	%	n	%	φ
Once or more daily SSB consumption	184	73.3%	390	69.4%	0.040
At school	100	39.8%	193	34.3%	0.053
Outside school	142	56.6%	308	54.8%	0.016
	Median	[IQR]	Median	[IQR]	ρ
Frequency of daily SSB consumption of those who consume SSBs every day	2.5	[2.5, 5.0]	2.5	[2.5, 2.5]	0.033
At school	1.0	[1.0, 2.5]	1.0	[1.0, 1.0]	0.141
Outside school	1.0	[1.0, 2.5]	1.0	[1.0, 2.5]	0.094

[a] Effect size of 0.2 indicates a practically significant effect.

DISCUSSION

We found no discernable difference in SSB consumption among students regardless of free drinking water provision at their schools. This is somewhat contradictory to the findings in the Western countries that the provision of drinking water at schools would increase water consumption among students (10-12). In our study setting, it is possible that SSB consumption was not replaced by free drinking water because the sale of SSBs at schools was not restricted. In fact, previous studies reported that when SSBs and drinking water are both available, students tend to choose visually colorful SSBs because it is thought to be more thirst quenching than plain drinking water (26-27).

The impact of free drinking water provision on SSB consumption, if any, might have been cancelled due to the variety of SSBs sold. In fact, SSBs sold in the schools with free drinking water were more various than their counterparts. Previous studies show that having more varieties of SSBs in vending machine results in a higher number of SSBs sold (28-29). However, our study did not find such a relationship that more various SSBs sold in schools, more SSB consumption among students. This finding implies that students would consume SSBs irrespective of the variety of SBBs sold as long as SBBs are sold at schools.

To reduce sugar consumption from SSBs among students, it may be necessary to offer a healthier drinks at schools or totally ban the SBB sale. One option is to provide school feeding with low-fat milk or drinking water. Reportedly, school feeding can reduce students' purchase of snacks and SSBs (30). Besides, low-fat milk without added sugar has the same thirst-quenching effect as SSBs, and it will be a good calcium source (31). Another option is to allow SSBs with less sugar content to be sold at school. It might not reduce the consumption of SSBs, but it might potentially reduce sugar intake from SSBs while having the same thirst-quenching effect as regular SSBs (27). Ultimately, the ban of selling SSBs at school will prevent students to consume SSBs at school, but further investigation of its impact toward SSB consumption outside school should be kept in mind.

We acknowledge several limitations of this study. First, there is a lack of information on the amount and calorie content of SSBs students consume at school. We asked students to report only the frequency of SSB consumption based on a food frequency questionnaire. With this information, however, we could estimate the proportion of students who daily consume SSBs at school. Moreover, SSBs are sold in PET bottles (350 to 500 ml) or sealed cups (200 to 500 ml) at school, so this range of the amount is roughly consumed for one purchase. Second, we could not validate FFQ developed in this study. Still, self-report dietary survey tool like FFQ is useful to rank the tendency of predefined food (or food group) consumptions (32-33). In this study, FFQ was used to measure the consumption frequency of SSBs, which then categorized into more frequent and less frequent SSB consumption by cut-off of once per day consumption. Also, we chose this self-reporting method over food observation or other methods because it was the most feasible to obtain data of a long-term SSB consumption from a large sample (34).

The findings of this study may not be generalizable to other regions of Indonesia, and in this cross-sectional study, we are uncertain whether the provision of free drinking water at schools has any impact on SSB consumption among students. Yet, the lessons learned from this study should be still relevant to other regions or even beyond the country, because SSB consumption among children is highly prevalent globally.

In conclusion, there was no difference in SSB consumption among junior high school students between schools with and without free drinking water available at school canteen. To reduce their sugar intake through SSB consumption at schools, it is necessary to investigate the impact of providing alternative drinks or restricting the sale of SSBs at schools.

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