

# Sugar Content in Sugar-Sweetened Beverages in the Aftermath of Thailand's Sugar Tax: A Cross-Sectional Analysis

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**Background:** The high consumption of sugar-sweetened beverages (SSBs) has been linked to overweight and chronic disease. Since Thailand launched its sugar taxation policy, the sugar content of SSBs remains unknown.

**Objective:** To assess product sugar content as g/100 mL and the number of products that meet the sugar tax criteria and to compare sugar content levels across various SSB categories.

**Materials and Methods:** Between April and May 2020, a cross-sectional survey was conducted in Bangkok and five provinces in health region 2, which are Sukhothai, Phitsanulok, Phetchabun, Tak, and Uttaradit, using major supermarket retailers and local convenience stores. Data were collected from product packaging and nutrition information panels (NIP) of each SSB via photograph. Data were analyzed using descriptive statistics. The Kruskal-Wallis H test was used to compare sugar content across various SSB categories.

**Results:** From 1,316 SSBs, the products without NIPs (n=79) were excluded, along with duplicate products in different packaging sizes (n=248). The remaining 989 items were included in the authors' analyses. The median sugar content of all products was 7.5 (IQR 5.0 to 10.0) g/100 mL. The maximum sugar content was 24.0 g/100 mL in fermented milk and the minimum was 0.2 g/100 mL in herbal beverages. Flavored drinking yogurts had the highest median sugar content, at 11.7 (IQR 7.5 to 13.9) g/100 mL, while flavored water had the lowest median, at 4.5 (IQR 3.0 to 8.6) g/100 mL. There were statistically significant differences in sugar content between SSBs categories (p<0.001). Of all 989 products, 393 (39.7%) had a sugar content below 6 g/100 mL and were subjected to zero tax.

**Conclusion:** Most of SSBs have low sugar content level with respect to excise sugar tax rate. However, the sugar content in drinkable dairy products and carbonated soft drink are of concern.

**Keywords:** Sugar-sweetened beverages, Serving size, Sugar, Taxation

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The prevalence of overweight and obesity in children and adolescent has risen in recent decades; this fact has been widely documented. More than 340 million children and adolescents were overweight or obese in 2016<sup>(1)</sup>. Research has shown that increased overweight and obesity rates in high and middle-income countries are largely driven by the health-related habits and behaviors of

obesogenic environments<sup>(2)</sup>. This situation allows the population to consume high levels of sugar that lead to overweight or obesity.

Sugar-sweetened beverages (SSBs) are defined as carbonated or non-carbonated drinks with free sugars added by manufacturers, cooks, or consumers, or sugars naturally found in honey, syrup, fruit juices, and fruit juice concentrates<sup>(3)</sup>. SSBs are the major dietary sources of sugar<sup>(4)</sup>. High SSB consumption is associated with increased risk of long-term weight gain, diabetes, cardiovascular disease<sup>(5)</sup> and other non-communicable diseases (NCDs) among children, adolescents, and adults<sup>(6)</sup>.

High SSB consumption also has a potential causal relationship to obesity<sup>(2)</sup>. For instance, SSB consumption is highest among adolescents, which is consistent with the increased prevalence of overweight among adolescents in several countries<sup>(7)</sup>. This situation, however, varies according to the country. The World Health Organization (WHO)

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issued a comprehensive strategy that combine the involvement of the policy, environment, and individual as follow 1) the policy such as provide nutrition information, effective tax on SSBs, implement the set of recommendations on the marketing of foods and non-alcoholic beverages, nutrient profile, nutrient labeling, 2) the environment cover healthy food environments and access to healthy foods in disadvantaged communities, and 3) individual of interpretive front-of-pack labelling<sup>(8)</sup>. Therefore, nutrition information, nutrient labeling, and taxation are the methods of WHO strategy<sup>(8)</sup>. In alignment with this initiative, Thailand began implementing its SSB taxation policy in 2017.

This policy was not Thailand's first initiative to reduce the intake of SSBs. The 2012-2016 Strategic Framework of Food Management was issued by the National Food Committee. This framework addressed both mandatory nutritional labeling and voluntary nutrition information panels (NIP) for packaged beverages. In 2017, the SSB taxation was launched, and it stipulated an increased in taxes every two years, until 2023. The policy aimed for reduced sugar content per single serving and decreased overall sugar consumption among the Thai population. Moreover, this policy was implemented in conjunction with efforts to increase public knowledge about healthy lifestyle choices that prevent overweight, obesity, and diet related NCDs<sup>(9)</sup>. In addition, WHO guideline issued in 2015, suggested that adults and children restricted their daily free sugar intake to 24 g, to reduce their risk for NCDs<sup>(5)</sup>. According to this recommendation, each count is responsible for compiling and disseminating nutritional information for its population.

Thailand, like most countries, reports the total sugar, monosaccharides, and di-saccharides presented in food via nutritional information according to international standards (The Codex Alimentarius Guidelines)<sup>(10)</sup>. Although, it is mandatory to label carbohydrate content information on food products, labelling sugar content information is voluntary and dictated by regulations in each country<sup>(10)</sup>. In Thailand, nutritional labelling is only required for specific food groups, not including SSBs<sup>(11)</sup>. Consequently, not all local SSBs have nutritional information on their packaging. Thus, Thai consumers may overlook the sugar content of SSBs<sup>(11)</sup>.

The rollout of Thailand's SSB tax structure will take place in four phases, the first phase was between September 16, 2017 and September 30, 2019, the second phase between October 1, 2019

and September 30, 2021, the third phase between October 1, 2021 and September 30, 2023, and the final phase is projected to begin on October 1, 2023<sup>(9)</sup>. It is important to determine the sugar content of beverages as this information is essential to policy makers' tax reformulation process. To that end, it is also necessary to identify SSB types, product sizes, and numbers.

Moreover, policy makers may wish to consider socioeconomic issues that contribute to SSB consumption. A study by Ferretti and Mariani found that a 10% increase in SSB affordability was associated with an average increase of 0.4 overweight or obese adults per 100 individuals<sup>(2)</sup>. Indeed, SSB consumption is one indicator that officials may opt to consider in monitoring population weight gain.

There is growing interest in the potential use of policy intervention to reduce SSB consumption at the population level. Thus, research to determine the sugar content of SSBs sold in Thailand is urgently needed. To the best of the authors' knowledge, no such study has been published, and there is a gap in research concerning this issue. Hence, the present study aimed to examine the sugar content of SSBs as g/100 mL, to assess the number of products on the sugar tax criteria, and to compare sugar content across different SSB categories. Study findings will contribute to SSB tax reformulation and inform the use of SSB consumption as an indicator in populational weight gain prevention.

## Materials and Methods

### Study design

The authors conducted a cross-sectional survey in the Bangkok metropolitan area, home to the major market share of SSBs in the country. Health region 2 was also selected, which included the five provinces of Phitsanulok, Sukhothai, Tak, Uttaradit, and Phetchabun. Health region 2 was the part of the Naresuan university's social development program and had the highest number of overweight adolescences in Thailand<sup>(12)</sup>. Data was collected between April and May 2020. Ethical approval was granted by The Naresuan University Institutional Review Board (no. IRB P20001/63).

### Selection of supermarket chains

The authors included all supermarket chains with stores in every region of Thailand. In Bangkok, supermarkets chosen for data collection represented the eight major supermarket retailers, all of which dominated the grocery market share and own four

**Table 1.** The definitions of sugar-sweetened beverages categories

Categories	Definitions
Flavored water	Water-based beverages with added caloric sweeteners or flavoring.
Carbonated soda drinks/soft drinks	Carbonated or sparkling drinks with added sugar and without the words energy or sports drink printed on the label.
Sports drinks/energy drinks	Drinks specifically designed to help active people hydrate before, during and after exercise. Energy drinks designed to boost energy and alertness.
Carbonated fruit or herbal drinks	Carbonated or sparkling drinks that contain fruit juice or herbs, along with added caloric sweeteners or flavoring.
Coffee-based beverages	Ready-to-drink coffee, with added caloric sweeteners or flavoring.
Green tea-based beverages	Ready-to-drink green tea, with added caloric sweeteners or flavoring.
Tea-based beverages	Ready-to-drink tea (sweetened or flavored), excluding green tea.
Flavored drinking yogurts	Beverages labelled either drinking yogurt or ready to drink yogurt, with added caloric sweeteners or flavored.
100% fruit/vegetable juices	Beverages containing 100% pure fruit or vegetable juice.
50% to 99% fruit/vegetable juices	Beverages containing 50% to 99% fruit or vegetable juice.
25% to 49% fruit/vegetable juices	Beverages containing 25% to 49% fruit or vegetable juice.
Less than 25% fruit/vegetable juices	Beverages with a fruit or vegetable juice content below 25%.
Herbal beverages	Ready-to-drink herbal beverages with added caloric sweeteners or flavoring.
Nut/rice milk	Plant-based milk with added caloric sweeteners or flavored.
Flavored milk	Cows' milk with added caloric sweeteners or flavoring.
Fermented milk	Beverages labelled as fermented milk, with added caloric sweeteners or flavoring.

retail convenience stores<sup>(13)</sup>. Two local convenience stores in Bangkok and ten local convenience stores in health region 2 were selected by using convenience sampling.

### Definition of sugar-sweetened beverages

Two authors (Hongsanun W and Kitreerawutiwong N) engaged in a discussion and a consensus on the definition of SSB categories (Table 1). The study included all beverages categories that contained sugar. SSBs were classified as follows, flavored water, carbonated soda drinks or soft drinks, sports drinks or energy drinks, carbonated fruit or herbal drinks, coffee-based beverages, green tea-based beverages, tea-based beverages, flavored drinking yogurts, fermented milk, 100% fruit or vegetable juices, 50% to 99% fruit or vegetable juices, 25% to 49% fruit or vegetable juices, juices comprised of less than 25% fruit or vegetable, herbal beverages, nut or rice milk, and flavored milk.

The study excluded all alcoholic beverages, dry, concentrated coffee or tea, artificially sweetened diet beverages, infant or maternal products, and concentrated cordials defined as flavored drink concentrate. To be included in the analysis, each product had to be a ready-to-drink beverage that was specifically marketed towards, or accessible to, adolescents. Since the study focused on the sugar content of each product, products labelled

'zero sugar', 'light' or 'no calories' were excluded. Notably, there is no reported evidence of adverse effects stemming from the consumption of intrinsic sugars and naturally occurring sugars in milk. Thus, WHO guidelines for the sugar intake of adults and children focus on the effect of free sugar intake<sup>(3)</sup>. Consequently, the authors excluded 100% plain milk and natural yogurts from the present study.

### Data collection

The data were collected from the packaging and NIP of each SSB, via photograph. When duplicate products such as those already recorded at another store, appeared at subsequent locations, they were not recorded again. Moreover, once data were collected from each major supermarket, the authors confirmed it via data collected in local convenience stores, until no new data were found. Approximately 5% of products were checked for accuracy by two authors (Hongsanun W and Kitreerawutiwong N). Randomly selected products were checked against the original sources, with no errors detected. The last author (Petcharaburanin K) confirmed the accuracy by randomly selecting products and comparing their SSB categorization to the original source. The data were recorded using form, then extracted for analysis.

Product sizes: Product size referred to the volume of each SSBs. The authors collected data for various

**Table 2.** Sugar content (g/100 mL) in various SSB categories

Categories	Number of products	Sugar content(g/100 mL)		
		Median (interquartile range)	Max	Min
Flavored water	34	4.5 (3.0 to 8.6)	12.0	1.5
Carbonated soda drinks/soft drinks	50	8.6 (5.6 to 9.8)	13.5	1.9
Sports drinks/energy drinks	46	9.7 (6.0 to 9.7)	20.0	3.9
Carbonated fruit/herbal drinks	18	10.5 (7.1 to 10.5)	12.6	4.9
Coffee-based beverages	22	5.6 (5.0 to 8.6)	21.3	0.9
Green tea-based beverages	31	6.0 (5.5 to 7.9)	12.1	2.1
Tea-based beverages	19	6.1 (4.9 to 8.3)	22.9	4.6
Flavored drinking yogurts	89	11.7 (7.5 to 13.9)	20.9	2.5
Fermented milk	18	11.5 (9.3 to 15.1)	24.0	3.0
100% fruit/vegetable juices	136	9.5 (6.7 to 11.0)	16.0	2.5
50% to 99% fruit/vegetable juices	45	9.1 (5.3 to 10.6)	19.0	2.5
25% to 49% fruit/vegetable juices	100	6.7 (5.0 to 10.0)	16.7	1.0
Less than 25% fruit/vegetable juices	91	5.8 (4.8 to 9.0)	20.9	0.3
Herbal beverages	93	5.6 (4.3 to 7.6)	14.5	0.2
Nut/rice milk	93	4.8 (3.0 to 5.7)	10.0	0.5
Flavored milk	104	8.8 (6.5 to 10.0)	14.4	1.2
Total products	989	7.5 (5.0 to 10.0)	0.2	24.0

product sizes, up to 2,000 mL. When the same product was available in different product sizes with identical formulations, only one unit of the smallest size was retained because the formulation per 100 mL was the same. When data per serving were unavailable, the package size was taken as serving size. Prior to analysis, the following information were collected for each SSB, product name, product size, serving size, and amount of sugar (g) - which was used to calculate sugar content (g/100mL).

Sugar content: “Total sugar” was a combination of free sugar and naturally occurring sugar. It is currently the only type of sugar declared on NIPs in Thailand and many other countries<sup>(14)</sup>. The sugar content declared on NIPs was collected and SSBs without NIPs were excluded.

### Statistical analysis

All data analyses were performed on 100 mL of each product. Data were reported as median, IQR, and range, as indicated. When the data regarding sugar content in SSBs were not normally distributed, a non-parametric Kruskal-Wallis H test was used to determine amount of sugar content differences between SSBs categories. Statistical analyses were conducted using SPSS Statistics for Windows, version 17.0 (SPSS Inc., Chicago, IL, USA)<sup>(15)</sup>, with a significance level of p-value less than 0.05.

## Results

### Number of SSBs

One thousand three hundred sixteen SSB items were surveyed. Products without NIPs (n=79) and duplicate products in different sizes (n=248) were excluded. This left a 989 products for inclusion in the present study analysis. The number of products in each category is shown in Table 2.

### Comparing SSB servings to WHO guidelines

As previously stated, the WHO recommends a daily free sugar consumption of less than 24 g<sup>(3)</sup>. Of the 989 products analyzed, 825 (83.4%) had a sugar content (per serving) that fell below this cap.

### Total sugar content

Sugar content as g/100 mL in various SSB categories is shown in Table 2. The median sugar content of all products was 7.5 (IQR 5.0 to 10.0) g/100 mL. The maximum sugar content was 24.0 g/100 mL, which was from fermented milk, and the minimum was 0.2 g/100 mL, which was from herbal beverages. On average, flavored drinking yogurts contained the highest sugar content with a median of 11.7 g/100 mL, and flavored water contained the lowest sugar content, with a median of 4.5 g/100 mL.

There were statistically significant differences

**Table 3.** Number of SSBs in different of sugar taxation categories

Sugar content criterion	Number of products; n (%)
Sugar content below 6 g/100 mL	393 (39.7)
Sugar content above 6 to 8 g/100 mL	166 (16.8)
Sugar content above 8 to 10 g/100 mL	184 (18.6)
Sugar content above 10 to 14 g/100 mL	199 (20.1)
Sugar content above 14 to 18 g/100 mL	34 (3.4)
Sugar content above 18 g/100 mL	13 (1.3)
Total	989 (100)

in sugar content between the 16 SSBs categories ( $p < 0.001$ ).

### SSBs and sugar taxation criteria

The Thai Excise Department implemented a new sugar excise tax rate on October 1, 2019 and to be continued until September 30, 2021. Table 3 shows the number of SSBs products included in the different sugar taxation categories. Sugar content was separated into six levels to reflect taxation standards. Of the 989 products, the majority, 393 (39.7%), had sugar content below 6 g/100 mL. Only 13 items (1.3%) had sugar content above 18 g/100 mL.

### SSB categories and the number of SSBs in different sugar content categories

The list of SSB categories and number of

products in each category that meet the different sugar tax rate criteria are shown in Table 4.

Some products, including sports or energy drinks, coffee-based beverages, tea-based beverages, flavored drinking yogurts, fermented milk, 50% to 99% fruit or vegetable juices, and less than 25% fruit/vegetable juices, had products with a sugar content over 18 g/100 mL.

## Discussion

The present study found that of the 16 product categories, fruit or vegetable juices were the majority for a total of 372 items (37.6%). The sugar content of these juices ranged from below 25% to 100% (Table 2). Notably, the study of Jin et al found that juice drinks had the highest percentage of products (69.8%) in China<sup>(16)</sup>. This finding supports the notion of categorizing beverages differently in different countries. The results of the present study facilitate the future evaluation of trends in the Thai SSB market.

As previously stated, the present study found that most SSBs (83.4%) in Thailand had sugar content lower than 24 g, per serving. Not only are these results in alignment with WHO sugar intake and health recommendations<sup>(3)</sup>, they are far lower than those observed in some other countries<sup>(17)</sup>. In the U.K., for instance, 73% of carbonated SSBs exceeded the WHO's maximum daily recommendation<sup>(17)</sup>.

**Table 4.** SSB categories and numbers in different sugar content categories

Categories	Sugar content criterion (g/100 mL); n (%)						Total products; n (%)
	Less than 6	Over 6 to 8	Over 8 to 10	Over 10 to 14	Over 14 to 18	Over 18	
Flavored water	24 (70.6)	1 (2.9)	3 (8.8)	6 (17.6)	0 (0.0)	0 (0.0)	34 (100)
Carbonated soda drinks/soft drinks	14 (28.0)	10 (20.0)	18 (36.0)	8 (16.0)	0 (0.0)	0 (0.0)	50 (100)
Sports drinks/energy drinks	13 (28.3)	8 (17.4)	3 (6.5)	14 (30.4)	6 (13.0)	2 (4.3)	46 (100)
Carbonated fruit or herbal drinks	4 (22.2)	1 (5.6)	3 (16.7)	10 (55.6)	0 (0.0)	0 (0.0)	18 (100)
Coffee-based beverages	12 (54.5)	4 (18.2)	3 (13.6)	2 (9.1)	0 (0.0)	1 (4.5)	22 (100)
Green tea-based beverages	17 (54.8)	7 (22.6)	5 (16.1)	2 (6.5)	0 (0.0)	0 (0.0)	31 (100)
Tea-based beverages	9 (47.4)	5 (26.3)	2 (10.5)	1 (5.3)	0 (0.0)	2 (10.5)	19 (100)
Flavored drinking yogurts	13 (14.6)	13 (14.6)	14 (15.7)	30 (33.7)	16 (18.0)	3 (3.4)	89 (100)
Fermented milk	3 (16.7)	0 (0.0)	4 (22.2)	6 (33.3)	4 (22.2)	1 (5.6)	18 (100)
100% fruit/vegetable juices	29 (21.3)	24 (17.6)	32 (23.5)	49 (36.0)	2 (1.5)	0 (0.0)	136 (100)
50% to 99% fruit/vegetable juices	14 (31.1)	6 (13.3)	12 (26.7)	11 (24.4)	1 (2.2)	1 (2.2)	45 (100)
25% to 49% fruit/vegetable juices	47 (47.0)	17 (17.0)	12 (12.0)	23 (23.0)	1 (1.0)	0 (0.0)	100 (100)
Less than 25% fruit/vegetable juices	51 (56.0)	7 (7.7)	19 (20.9)	10 (11.0)	1 (1.1)	3 (3.3)	91 (100)
Herbal beverages	51 (54.8)	25 (26.9)	12 (12.9)	4 (4.3)	1 (1.1)	0 (0.0)	93 (100)
Nut/rice milk	73 (78.5)	12 (12.9)	8 (8.6)	0 (0.0)	0 (0.0)	0 (0.0)	93 (100)
Flavored milk	19 (18.3)	26 (25.0)	34 (32.7)	23 (22.1)	2 (1.9)	0 (0.0)	104 (100)

However, the present study is the first survey conducted since Thailand launched its sugar tax policy and the sugar content of SSBs should be progressively reviewed every two years. Thus, updated data may inform the reformulation of new sugar tax rates.

Study findings also show a statistical difference in sugar content between SSB categories ( $p < 0.001$ ). Our study also determined the median sugar content of all products to be 7.5 g/100 mL. Meanwhile the median sugar content of non-alcoholic beverages in Canada was 9.2 g/100 mL<sup>(14)</sup> and the median sugar content of non-carbonated SSBs in China was 9.6 g/100 mL<sup>(16)</sup>. The highest sugar content was found in flavored drinking yogurts (median 11.7, IQR 7.5 to 13.9 g/100 mL). Therefore, it is not conceivable to be consume as part of a 'healthy diet'. Difference of sugar content need to be considered when consuming SSB to balance sugar intake based on serving size.

Soft drinks are known to be adolescents' main source of sugar, exceeding non-carbonated SSBs<sup>(18)</sup>. The sugar content of carbonated soda drinks in New Zealand, Australia, Canada, and U.K. were 9.5, 9.7, 10.4, and 7.1 g/100 mL<sup>(19)</sup>, respectively. The present study found Thailand's carbonated sodas or soft drinks and carbonated fruit or herbal drinks to be in a similar range, at 8.6 and 10.5 g/100 mL, respectively. Non-carbonated SSBs might be healthier alternatives to other options such as fruit or vegetable juices, coffee or tea-based beverages, sports drinks or energy drinks, herbal beverages, flavored water, and drinkable dairy products. Nevertheless, the harmful effects of sugars in non-carbonated SSBs may contribute to overweight and obesity in adolescents<sup>(6)</sup>.

Although, flavored drinking yogurts with a median of 11.7 g/100 mL, fermented milk with a median of 11.5 g/100 mL, and flavored milk with a median of 8.8 g/100 mL are exempt from sugar tax, the authors found that they had the sugar content higher than carbonated soda drinks or soft drinks, with a median 8.6 g/100 mL. The sugar content of flavored milk in Australia, the U.K., and South Africa were 8.8, 9.5 and 8.9 g/100 mL, respectively, which is far lower than the sugar content of their flavored yogurts, at 11.9, 12.4, and 10.1, respectively<sup>(20)</sup>. This may be due to perceived healthiness on flavored milk, fermented milk, and flavored drinking yogurts unless, the company added sugar in these products. Therefore, SSB's nutritional facts label and label reading skill to interpret nutrient number and sugar content per serving size is essential among adolescents.

Furthermore, the present study found that most fermented milk and flavored drinking yogurts had

a sugar content over 10 to 14 g/100 mL. Thus, if drinkable dairy products were not exempt from the sugar tax<sup>(21)</sup>, manufactures would have to pay 1 Baht per liter. This situation is of concern because the sugar content in drinkable dairy products is not controlled. Consequently, adolescents who frequently consume these products may be at greater risk of exceeding their recommended sugar intake. Although flavored milk may prove beneficial by increasing milk intake, its added sugars may have a negative impact on health.

Interestingly, fruit or vegetable juices with and without added sugar have a sugar tax liability in Thailand, unlike drinkable dairy products<sup>(21)</sup>. In the U.K., fruit juice, vegetable juice, and milk are liable for taxation if sugar is added<sup>(22)</sup>. Therefore, the authors recommend that Thailand change the tax-exempt status of its drinkable dairy products. In addition, the present study found that 100% fruit or vegetable juices had the highest sugar content among all fruit or vegetable juices. In the U.K., the sugar content of 100% fruit or vegetable juices was 10.7 g/100 mL in 2014<sup>(23)</sup> and 9.3 g/100 mL in 2016<sup>(19)</sup>. Moreover, in 2016 the sugar content of 100% fruit or vegetable juices in New Zealand, Australia, and Canada were 9.8, 9.5, and 9.8 g/100 mL, respectively<sup>(19)</sup>. Fruit juice consumption is associated with a high risk of type 2 diabetes<sup>(24)</sup>. Hence, consumption of 100% fruit or vegetable juices need to be aware on sugar content.

SSBs with a sugar content above 18 g/100 mL accounted for only 1.3% of the products from various categories, including sports or energy drinks, coffee-based beverages, tea-based beverages, flavored drinking yogurts, fermented milk, 50% to 99% fruit or vegetable juices, and less than 25% fruit or vegetable juices. This suggests that the SSB taxation policy has achieved its goal of reducing the purchase and consumption of SSBs.

As previously stated, the rate of sugar taxation differs between countries. In 2016, the British government announced the Soft Drinks Industry Levy, an SSB tax intended to combat childhood obesity. This policy came into effect in April 2018. Companies producing sugar-sweetened soft drinks will have to pay 0.24 British pounds (£) per 1,000 mL when the sugar content of a drink is 8 g/100 mL or more. When the sugar content is between 5 and 8 g/100 mL, manufacturers pay £0.18/1,000 mL<sup>(25)</sup>. The meta-analysis found that the equivalent of a 10% increase in SSB tax was associated with a decline in purchases and dietary intake of 10.0% (95% CI -5.0 to -14.7), based on the pre and post intervention on taxation policy<sup>(26)</sup>. This finding is gleaned from the

initial phase of Thailand's SSB tax implementation. Thus, data relating to SSB purchase and intake should continue to be monitored forward.

The authors' results confirmed that drinkable dairy products and fruit or vegetable juices were not the best healthy alternatives because of their high sugar content. This should be communicated to adolescents and their parents. Moreover, Thai consumers are unaware of the amount of sugars in products they regularly buy<sup>(11)</sup>. Thus, the Thai government should focus on reducing the sugar content of SSBs while increasing consumers awareness. The latter may be accomplished through several approaches, for example enhancing the standards for nutrition labels and educating the adolescent to read and comprehend nutrition information. This may make the labels easier for adolescents to understand, while prompting manufactures of high sugar SSBs to make positive changes. Moreover, designing self-administrated tool for monitor sugar intake is needed.

### Limitations and recommendations

One study limitation is that data were only collected from the Bangkok metropolitan area and one region of Thailand. Another limitation is that collected data only included SSBs products with NIPs on their packaging, therefore products without NIPs were excluded. Thus, we lost the opportunity to retrieve more representative data regarding the sugar content in each SSB category. However, only 79 of 1,316 (6.0%) SSBs without NIP were excluded from the analysis. The Food and Drug Administration of Thailand should launch a new policy that requires SSBs to have NIP on every package. Information about beverage type, sugar content, and serving size may help Thai people to use data in making decision on SSB consume. The development of self-administrated tools for assessing habitual beverage intake is recommended.

### Conclusion

Since the launch of the new sugar tax rate, the sugar content of most SSBs fell below 6g/100 mL. It seems beverage manufactures have adapted to the new tax policy. The sugar content of drinkable dairy products, which are currently exempt, should be monitored forward. Furthermore, the intake of drinkable dairy products and incidence of overweight Thai adolescences should be studied further. This information will contribute towards baseline data for future sugar monitoring efforts and the reformulation of SSBs in Thailand.

### What is already known on this topic?

SSB consumption is a determinant of health for adolescences and causes of obesity and NCDs in adults. It is important to determine the sugar content of SSBs, and to investigate any changes in this regard every two years, in alignment with changing sugar tax rates.

### What this study adds?

This is the first cross-sectional survey on SSB sugar content in Thailand. It has discovered new and intriguing data for future monitoring. The finding that the median sugar content of flavored milk (g/100 mL) is similar to that of carbonated soda drinks or soft drinks is particularly significant. The finding that most 100% fruit or vegetable juices had a sugar content exceeding 10 to 14 g/100 mL is also noteworthy. Indeed, these fruit or vegetable juices may need to be viewed with concern for their health implications.

### Conflict of interest

The authors declare no conflicts of interest.

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