Mal J Nutr 30(3): 473-486, 2024

Sweetened beverage consumption and its association with overweight and obesity across population groups in the Philippines

Eva A. Goyena*, Josie P. Desnacido, Antoniette G. Cristobal & Apple Joy D. Ducay

Nutritional Assessment and Monitoring Division, Food and Nutrition Research Institute - Department of Science and Technology, Taguig City, Philippines

ABSTRACT

Introduction: The increasing prevalence of overweight and obesity has been a major nutritional concern. Evidence shows that habitual or excessive sweetened beverage (SB) consumption is associated with weight gain and obesity. This study assessed the SB consumption across different age groups and determined its association with overweight and obesity. **Methods:** Data of 31,003 preschool children, school-age children, adolescents, and adults from 2018-2019 Expanded National Nutrition Survey were utilised. Data on SB consumption, type, and quantity were obtained from 24-hour food recalls, and participants' nutritional status was assessed. Multivariate logistic regression was conducted to evaluate association between SB consumption and obesity using STATA 16. **Results:** Mean SB intake per day increased with age. Nearly 48% of preschool children, 33% of schoolchildren, 24% of adolescents, and 21% of adults consumed SBs amounting to >10% of total energy intake. Males, urban dwellers, and those with higher socioeconomic status were more likely to consume SBs. After controlling for sex, age, wealth, and place of residence, children and adults with higher SB intake, and all age groups with higher sugar intake from SB per day were more likely to be overweight and obese. **Conclusion:** SB consumption was higher among older age groups, males, urban dwellers, and those with higher socioeconomic status. High consumption of SBs was associated with overweight and obesity. Revisiting current nutrition policies, particularly the food-based dietary guidelines and front-of-pack labelling, and necessary regulations are needed to reduce SB consumption and control obesity in the Philippines.

Keywords: obesity, overweight, sweetened beverages

INTRODUCTION

The increasing prevalence of overweight and obesity across different population groups has been a major nutritional concern not only in high-income countries, but also in low- and middle-income countries (LMICs). In the Philippines, the prevalence of overweight and obesity has almost doubled over the span of six years among 5-10 years old children, from 8.3% in 2015 to 14% in 2021, while the prevalence among adolescents and adults was already at 13% and 40.2% in 2021, respectively (DOST-FNRI, 2022a).

The burden of overweight and obesity, especially during childhood and adolescence, increases the risk of

*Corresponding author: Eva A. Goyena, Ph.D.
Nutritional Assessment and Monitoring Division, Food and Nutrition Research Institute-Department of Science and Technology, Taguig City, Philippines
Tel: 837-2071 local 2280; Fax: (+62) 839-1843; Email: evabille2@gmail.com
doi: https://doi.org/10.31246/mjn-2024-0035

non-communicable diseases (NCDs) including diabetes, cardiovascular diseases, cancer, and dental caries in later life (Keller & Bucher Della Torre, 2015; WHO, 2015). Economic growth and urbanisation have driven the rapidly changing dietary patterns in many LMICs towards the increasing consumption of packaged and processed foods high in sugar, saturated fat, and sodium, coupled with reductions in physical activity (Popkin, 2015).

The increasing consumption of sweetened beverages (SBs) is shown to be highly related to the increasing prevalence of weight gain and obesity among children, adolescents, and adults (Gan *et al.*, 2021; Miller *et al.*, 2020). Defined as water-based, powdered, or concentrated non-alcoholic beverages with caloric or non-caloric sweeteners or both added by the manufacturers, SBs include: 1) sweetened juice drinks; 2) sweetened tea; 3) all carbonated beverages; 4) flavoured water; 5) energy and sports drinks; 6) powdered drinks not classified as milk, juice, tea or coffee; 7) cereal and grain beverages; 8) and other non-alcoholic beverages that contain added sugar (Onagan, Ho & Chua, 2019). The World Health Organization (WHO) recommends reducing the intake of free sugars to <10% of total energy intake, as they increase overall energy intake and may displace healthier foods from the diet, potentially leading to weight gain and increased NCD risk (WHO, 2015).

In the Philippines, the Republic Act (RA) 10963, known as the Tax Reform for Acceleration and Inclusion (TRAIN) law, was implemented in January 2018 to potentially reduce SB consumption and also address features of the food market associated with increased rates of obesity and diabetes (Onagan *et al.*, 2019), while encouraging industry players to develop healthier product alternatives and raising revenues for social services, among others.

Effective public health responses to excessive SB intake require an understanding of SB consumption patterns. To date, there have been limited nationwide studies on SB consumption across population groups since the enactment of the TRAIN law. In fact, sales of SBs were sustained despite the implementation of the TRAIN law because of enhanced marketing and product variants being offered in small portions (Onagan *et al.,* 2019). A previous study by Dasco *et al.* (2023) presented a declining proportion of households and individuals consuming SBs, and a decreased volume of intake of carbonated beverages, sweetened powdered drinks, and sweetened tea between 2013 and 2018-2019. However, these two studies reported inconsistencies in sustained sales against the trivial effect of SB intake attributable to the TRAIN law. Moreover, the limitations of the existing Philippine nutritional guidelines and *Pinggang Pinoy* (Healthy Food Plate) recommendations to inform consumers' dietary choices and the effects of excessive SB consumption amidst the growing prevalence of obesity are concerning. Nevertheless, looking into the correlates of SB consumption, including population groups with SB intake >10% of total caloric intake, as well as the possible association between SB consumption and overweight/obesity among various population groups, is needed in the context of strengthening evidence that SB consumption is associated with increased overweight and obesity, which may lead to other diet-related NCDs. This study assessed SB consumption across different age groups in a nationally representative population survey in the Philippines and determined its association with overweight and obesity status.

MATERIALS AND METHODS

Study design and participants

The study utilised data collected in the 2018 and 2019 Expanded National Nutrition Survey (ENNS), a cross-sectional, nationally representative household-based survey, which covered 40 and 39 provinces, respectively, and highly urbanised cities (HUCs). It employed the 2013 Master Sample Frame of the Philippine Statistics Authority (PSA), which was a replicated sampling; each replicate was composed of at least five provinces or HUCs (DOST-FNRI, 2022b).

A total of 31,003 individuals covered in the 2018-2019 ENNS were included in the study, which comprised 3,891 preschool children 6 months-5 years old, 7,478 school-age children 6-12 years old, 5,839 adolescents 13-19 years old, and 13,795 adults 20-59 years old.

Study variables

Overweight and obesity

Overweight and obesity were assessed in the ENNS using the weight-for-height index of the WHO Child Growth Standards (WHO, 2006) for preschool children 6 months-4.9 years old, body mass index (BMI)-for-age of the WHO Growth Reference (WHO, 2007) for school-age children and adolescents 5-19 years old, and the WHO BMI Classification (WHO, 2005) cut-offs for adolescents aged 19.08 years and adults 20-59 years old.

Demographic and socioeconomic data

The demographic characteristics collected in the ENNS, which were used in the study, included age, sex, place of residence, and wealth status. Wealth was assessed using proxy measures based on principal component analysis of the household's dwelling materials, water access, toilet facility, ownership of any appliances, vehicles, and electricity connection.

Dietary intake

During the ENNS, a 24-hour food recall was used to collect the food and beverages consumed by the participants aged ≥6 months, utilising measuring tools such as cups, tablespoons, wooden matchboxes, and plastic circles to estimate the amount of each food item or beverage consumed. The data were processed and analysed using the Food and Nutrition Research Institute (FNRI) Individual Dietary Evaluation System, which encompasses the updated Food Composition Table. Energy, protein, and micronutrient intakes of each participant relative to the 2015 Philippine Dietary Reference Intakes (PDRI) of particular age groups were estimated.

SB classification

SBs included were those enumerated in RA 10963: 1) sweetened juice drinks; 2) sweetened tea; 3) all carbonated beverages, including those with caloric and non-caloric sweeteners; 4) energy and sports drinks; 5) powdered chocolate drinks; 6) cereal and grain beverages with added sugars; and 7) other pre-packaged beverages with added sugar, including flavoured water, among others. Excluded beverages were: 1) plain milk and all milk drink products; 2) 100% fruit juices; 3) 100% natural vegetable juices; 4) meal replacement and medically indicated beverages; 5) ground coffee, instant soluble coffee, and pre-packed powdered coffee products; 6) unsweetened tea; and 7) beverages sweetened with coconut sap or stevia glycosides (Onagan *et al.*, 2019). Consumption of SBs was expressed in mL. Mean intakes of powdered chocolate-flavoured beverages, cereal and grain beverages, and powdered fruit-flavoured juices were converted into mL using the

standard dilution ratio indicated on the packages of their commercially available counterparts.

Statistical analysis

Sampling weights were computed for the survey periods to generate weighted results and were post-stratified based on the populations obtained from the PSA. The 2018 and 2019 data were pooled to increase the precision of the estimates. Data were organised and analysed using STATA 16 (StataCorp, Texas, USA, 2019). Percent and mean amount of intake per day in grams of SBs were estimated using descriptive statistics. The percent energy contribution of SBs of population groups was calculated by dividing the mean calories from SB intake by the total caloric intake of SBs. The difference in percentages and means was compared and assessed based on 95% confidence intervals (*CI*s). Non-overlapping *CI*s meant a significant increase or decrease in mean SB intake. Meanwhile, tertiles categorised participants into three groups based on their level of SB consumption and the amount of sugar derived from SB consumption, typically labelled as low, moderate, and high. Multivariate logistic regression was employed to determine the association between SB intake (as independent variable) and overweight and obesity (outcome variable). SB intake was measured in terms of daily consumption and categorised into tertile levels, while overweight and obesity were binary outcomes indicating whether an individual was classified as overweight or obese based on weight-for-height index or BMI. The model was adjusted for age, sex, wealth, and place of residence to control for potential confounding factors and ensure a robust analysis. Adjusted odds ratios (*AOR*) and 95% *CI*s were calculated. All statistical tests were analysed at a 5% level of significance.

Ethical considerations

The protocol was reviewed and approved by the Department of Science and Technology–FNRI Ethics Review Committee on July 31, 2017, with Protocol Code FIERC-2017-07, and technical clearance was given by the PSA. Informed consent was obtained in writing from participants before the actual ENNS data collection.

RESULTS

General characteristics of study participants

The socio-demographic and socioeconomic characteristics and nutritional status of study participants are presented in Table 1. The study participants comprised 14.3% of preschool children 6 months-5 years old, 22.1% of school-age children 6-12 years old, 17.3% of adolescents 13-19 years old, and 46.3% of adults 20-59 years old. The proportion of male (49.8%) and female (50.2%) participants was almost similar. Likewise, the proportion of rural (50.4%) and urban (49.6%) dwellers was almost equal. By wealth status, 44.1% of the study participants were from the rich quintile, 35.9% were from the middle, and 20.0% were from the poor wealth quintile. Overweight and obesity was prevalent among 4.9% of preschool children, 15.1% of schoolchildren, 11.7% of adolescents, and 38.6% of adults (Table 1).

SB intake across age groups

Table 2 shows the average consumption of SBs per day and its contribution to energy intake across age groups. Overall, mean SB intake increased with age, ranging from 191.2 g/day among preschool children to 304.5 g/day among adults.

The overall mean SB intake among preschool children was 191.2 g/day. Mean SB consumption was significantly

Table 1. Socio-demographic and socioeconomic characteristics of children, adolescents, and adults: Philippines, 2018-2019 (*N*=31,003)

Characteristics	*n*	*%*	*SE*	*95% CI*	
				Lower limit	*Upper limit*
Age group					
Preschool-age children	3891	14.3	0.4	13.5	15.1
<2 years old	393	10.9	0.8	9.4	12.7
2-5 years old	3498	89.1	0.8	87.3	90.6
School-age children	7478	22.1	0.5	21.0	23.3
6-9 years old	4406	59.9	0.8	58.2	61.5
10-12 years old	3072	40.1	0.8	38.5	41.8
Adolescents	5839	17.3	0.4	16.4	18.1
13-15 years old	2878	48.9	1.0	46.7	51.1
16-19 years old	2961	51.1	1.0	48.9	53.3
Adults	13795	46.3	0.5	45.3	47.4
20-39 years old	7707	59.7	0.7	58.2	61.1
40-59 years old	6,088	40.3	0.7	38.9	41.8
Sex					
Male	15607	49.8	0.5	48.8	50.8
Female	15396	50.2	0.5	49.2	51.2
Place of residence					
Rural	18650	50.4	5.1	39.8	61.0
Urban	12353	49.6	5.1	39.0	60.2
Wealth status					
Poor	7292	20.0	1.6	16.9	23.6
Middle	11360	35.9	1.0	33.8	38.0
Rich	12351	44.1	2.3	39.3	49.1
Nutritional status					
Preschool-age children					
Stunting	962	25.2	1.3	22.4	28.1
Wasting	205	5.8	0.7	4.4	7.6
Overweight-for-height	182	4.9	0.5	3.9	6.0
School-age children					
Stunting	1421	18.2	1.2	15.8	20.9
Wasting	731	9.1	0.6	8.0	10.4
Overweight & obesity	1035	15.1	0.9	13.2	17.2
Adolescents					
Stunting	1271	24.5	1.4	21.6	27.7
Wasting	543	10.7	0.6	9.5	12.1
Overweight & obesity	636	11.7	0.5	10.6	12.8
Adults					
Chronic energy deficient (CED)	891	6.8	0.4	6.0	7.7
Overweight & obesity	5436	38.6	0.8	36.9	40.2

Table 2. Mean sweetened beverage (SB) consumption and its contribution to energy intake in a day across age groups: Philippines, 2018-2019

Population groups	*Mean intake/day (g)*	*p-value*	*% Contribution of SB to the total energy intake*			*p-value*
			<10%	*10-19%*	*≥20%*	
Preschool-age children	191.2		52.0	35.1	12.8	
<2 years old	139.3	<0.001*	49.9	28.8	21.3	<0.001*
2-5 years old	197.5		52.3	35.9	11.8	
School-age children	237.3		67.3	27.6	5.1	
6-9 years old	226.9	<0.001*	63.6	30.1	6.3	<0.001*
10-12 years old	252.7		72.7	23.9	3.4	
Adolescents	298.0		76.1	20.3	3.6	
13-15 years old	280.9	<0.001*	76.0	20.4	3.6	0.190
16-19 years old	314.1		76.3	20.2	3.5	
Adults	304.5		79.2	18.2	2.6	
20-39 years old	307.0	<0.001*	79.4	18.1	2.5	0.792
40-59 years old	289.3		79.8	17.7	2.5	

*Significant at $p<0.05$

higher among children aged 2-5 years (197.5 g/day) than infants <2 years old (139.3 g/day) ($p<0.001$). Furthermore, 52.0%, 35.1%, and 12.8% of preschool children had SB intake contributing to <10%, 10-19%, and ≥20% of their total energy intake per day, respectively. Among school-age children, mean SB intake was 237.3 g/day. Nearly one-third (32.7%) consumed SBs contributing to ≥10% of total caloric intake per day. School-age children aged 10-12 years had significantly higher mean SB intake (252.7 g/day) than children aged 6-9 years (226.9 g/day) ($p<0.001$) (Table 2).

Among adolescents, the average consumption of SBs was 298 g/day. There were 23.9% of adolescents whose SB intake contributed to ≥10% of their total energy intake per day. Mean SB intake was significantly higher among older adolescents aged 16-19 years (314.1 g/day) than younger adolescents aged 13-15 years (280.9 g/day) ($p<0.001$). Adults had the highest SB intake, with a mean of 304.5 g/day. Furthermore, 20.8% of adults consumed SBs amounting to ≥10% of their total energy intake per day. Adults 20-39 years old had significantly higher mean SB intake (307.0 g/day) than those aged 40-59 years (289.3 g/day) ($p<0.001$) (Table 2).

SB intake by socio-demographic and socioeconomic characteristics

Table 3 presents the mean SB consumption and its contribution to energy per day among study participants as disaggregated by sex, place of residence, and wealth status. Higher SB intake was generally observed among males, urban dwellers, and those from rich households in all age groups.

Among preschool children, males (196.0 g/day) and those from urban areas (197.0 g/day) had slightly higher mean SB intake per day than their respective counterparts. Preschool children from rich households had significantly higher mean SB intake (203.5 g/day) as compared to those with lower wealth status ($p<0.001$). School-age children from urban areas (247.0 g/day) and rich households (260.1 g/day)

Table 3. Mean sweetened beverage (SB) consumption and its contribution to energy intake in a day across population groups by sex, place of residence, and wealth status: Philippines, 2018-2019

Population groups	*Mean intake/ day (g)*	*p-value*	*% Contribution of SB to the total energy intake*			*p-value*
			<10%	*10-19%*	*≥20%*	
Preschool-age children						
Sex						
Male	196.0	0.060	53.9	33.1	13.0	0.107
Female	185.6		49.8	37.5	12.7	
Place of residence						
Rural	185.6	0.099	49.0	36.2	14.7	0.011*
Urban	197.0		55.2	34.0	10.8	
Wealth status						
Poor	171.4	<0.001*	49.6	36.0	14.4	0.212
Middle	194.6		51.7	35.4	12.9	
Rich	203.5		54.4	34.1	11.5	
School-age children						
Sex						
Male	238.7	0.152	69.5	25.5	5.0	<0.001*
Female	235.7		64.9	29.9	5.3	
Place of residence						
Rural	227.9	<0.001*	66.1	28.9	5.0	0.852
Urban	247.0		68.5	26.2	5.3	
Wealth status						
Poor	195.4	<0.001*	67.1	26.8	6.0	0.907
Middle	234.6		68.1	27.3	4.5	
Rich	260.1		66.6	28.2	5.2	
Adolescents						
Sex						
Male	302.2	0.097	81.2	16.7	2.1	<0.001*
Female	294.1		71.4	23.7	4.9	
Place of residence						
Rural	279.2	<0.001*	78.2	18.7	3.1	<0.001*
Urban	318.0		73.9	22.0	4.1	
Wealth status						
Poor	276.1	<0.001*	76.0	21.3	2.7	0.002*
Middle	288.4		78.4	18.8	2.8	
Rich	315.3		74.3	21.2	4.6	
Adults						
Sex						
Male	320.6	<0.001*	84.7	13.8	1.5	<0.001*
Female	289.6		74.0	22.3	3.6	
Place of residence						
Rural	295.6	0.001*	81.2	16.5	2.3	<0.001*
Urban	313.2		77.2	19.9	2.9	
Wealth status						
Poor	285.0	<0.001*	81.8	16.4	1.7	<0.001*
Middle	299.9		80.7	17.1	2.2	
Rich	314.9		77.2	19.7	3.2	

*Significant at $p<0.05$

Table 4. Prevalence of overweight and obesity by sweetened beverage intake and energy intake from sweetened beverage: Philippines, 2018-2019

Population groups	*%*	*SE*	*95% CI*		*p-value*
			Lower limit	*Upper limit*	
Preschool-age children	4.9	0.5	3.9	6.0	
SB intake, g/day					
1st tertile	3.5	0.3	2.8	4.2	0.002*
2nd tertile	4.5	0.8	3.0	6.6	
3rd tertile	6.8	1.1	4.8	9.6	
Energy intake from SB (kcal)					
1st tertile	2.7	0.6	1.7	4.4	0.008*
2nd tertile	5.8	1.8	2.7	11.8	
3rd tertile	7.2	1.2	4.8	10.8	
School-age children	15.1	0.9	13.2	17.2	
SB intake, g/day					
1st tertile	12.1	1.1	9.9	14.8	<0.001*
2nd tertile	14.7	1.4	11.9	18.0	
3rd tertile	18.5	1.7	15.3	22.3	
Energy intake from SB (kcal)					
1st tertile	13.5	1.0	11.3	16.0	<0.001*
2nd tertile	14.2	1.2	11.6	17.3	
3rd tertile	18.0	1.8	14.1	22.7	
Adolescents	11.7	0.5	10.6	12.8	
SB intake, g/day					
1st tertile	10.0	0.9	8.3	12.0	0.025*
2nd tertile	11.6	0.9	9.9	13.6	
3rd tertile	13.6	1.4	11.0	16.8	
Energy intake from SB (kcal)					
1st tertile	9.8	1.1	7.5	12.6	0.004*
2nd tertile	11.8	1.2	9.2	15.0	
3rd tertile	16.0	1.6	12.5	20.2	
Adults	38.6	0.8	36.9	40.2	
SB intake, g/day					
1st tertile	38.5	1.7	35.0	42.2	0.134
2nd tertile	39.4	1.1	37.2	41.7	
3rd tertile	-	-	-	-	
Energy intake from SB (kcal)					
1st tertile	39.8	2.6	33.9	46.0	0.220
2nd tertile	38.1	1.0	35.7	40.5	
3rd tertile	37.8	1.1	35.5	40.1	

SB: Sweetened beverage
*Significant at $p<0.05$

had significantly higher mean SB intake than their counterpart groups ($p<0.001$). No significant difference was noted in SB intake between males (238.7 g/day) and females (235.7 g/day). On the other hand, more female schoolchildren (35.2%) had SB intake amounting to ≥10% of total energy intake per day as

compared to males (30.5%) (p<0.001) (Table 3).

The average SB intake per day among male adolescents (302.2 g/day) was slightly higher than among females (294.1 g/day). Adolescents from urban areas (318.0 g/day) and rich households (315.3 g/day) had significantly higher SB intake than their counterparts (p<0.001). The percentages of female adolescents (28.6%), urban dwellers (26.1%), and those from rich households (25.8%) with SB intake contributing to ≥10% of total energy intake per day were significantly higher than their respective counterpart groups (p<0.001, p<0.001, and p=0.002, respectively). Among adults, males (320.6 g/day), urban dwellers (313.2 g/day), and rich households (314.9 g/day) had significantly higher SB intake as compared to their counterparts (p<0.001). Likewise, the percentages of female adults (25.9%), urban dwellers (22.8%), and those belonging to rich households (22.9%) whose SB intake amounted to ≥10% of total caloric intake were significantly higher than their counterpart groups (p<0.001) (Table 3).

SB intake and overweight and obesity

Table 4 shows the prevalence of overweight and obesity among population groups by tertiles of SB intake and energy intake from SB. Notably, the prevalence of overweight and obesity was significantly higher among preschool children (6.8%), schoolchildren (18.5%), and adolescents (13.6%), whose SB intake per day was high or at the 3rd tertile (p=0.002, p<0.001, and p=0.025, respectively). Likewise, this was observed among preschool children (7.2%), schoolchildren (18.0%), and adolescents (16.0%), whose energy intake from SB was in the 3rd tertile as compared to the lower tertiles (p=0.008, p<0.001, and p=0.004, respectively). On the other hand, the prevalence of overweight and obesity among adults was not statistically different regardless of the amount of SB and energy intake from SB per day.

Association between SB intake and overweight and obesity

Table 5 presents the results of the logistic regression analysis between the amount of SB intake or sugar intake from SB as the independent variable and overweight and obesity as the outcome variable. After controlling for sex, age, wealth, and place of residence, preschool children, school-age children, and adults with the highest SB intake per day, or those in the 3rd tertile, were 1.69 times, 1.37 times, and 1.15 times more likely to become overweight and obese, respectively, than those in the lower tertiles (p=0.045, p=0.028, and p=0.049, respectively). Moreover, preschool children (*AOR*=1.83, p=0.029), school-age children (*AOR*=1.41, p=0.002), adolescents (*AOR*=1.49, p=0.015), and adults (*AOR*=1.16, p=0.032) with the highest sugar intake from SB per day or in the 3rd tertile were more likely to become overweight and obese.

DISCUSSION

The findings of this study revealed that there was an increasing consumption pattern of SB across population groups, while the percentage of individuals whose SB intake amounted to ≥10% of total energy intake per day declined with age. Higher SB intake was also noted among males, urban dwellers, and rich households. Regression analysis showed that higher consumption of SBs was associated with overweight and obesity, specifically among ppreschool-age children, school-age children, and adults.

SB intake across age groups

Throughout the years, the consumption of SBs has increased globally from 1990-2018, with a larger increase from 1990-

Table 5. Multivariate logistic regression between consumption of sweetened beverage and overweight and obesity: Philippines, 2018-2019

	Becoming overweight and obese															
	Preschool-age children				*School-age children*				*Adolescents*				*Adults*			
	AOR	*95% CI*		*p-value*	*AOR*	*95% CI*		*p-value*	*AOR*	*95% CI*		*p-value*	*AOR*	*95% CI*		*p-value*
		LL	*UL*			*LL*	*UL*			*LL*	*UL*			*LL*	*UL*	
SB intake, g/day																
1st tertile	ref				ref				ref				ref			
2nd tertile	1.18	0.68	2.04	0.533	1.13	0.81	1.56	0.457	1.19	0.86	1.65	0.266	1.08	0.93	1.26	0.275
3rd tertile	1.69	1.01	2.82	0.045*	1.37	1.04	1.81	0.028*	1.33	0.95	1.88	0.095	1.15	1.00	1.32	0.049*
Sugar intake from SB, g/day																
1st tertile	ref				ref				ref				ref			
2nd tertile	1.03	0.59	1.82	0.903	1.22	0.94	1.59	0.120	1.19	0.77	1.83	0.402	1.17	1.05	1.31	0.010
3rd tertile	1.83	1.08	3.13	0.029*	1.41	1.15	1.73	0.002*	1.49	1.09	2.03	0.015*	1.16	1.01	1.32	0.032*

AOR: Adjusted odds ratio; LL: Lower limit; UL: Upper limit; SB: Sweetened beverage
Controlled factors: sex, age, wealth, place of residence
*Significant at $p<0.05$

2005 than from 2005-2018 (Lara-Castor *et al.*, 2023). This could be the outcome of hefty marketing of SBs, particularly in developing countries, despite the recommendations of medical experts and health organisations to limit its consumption (Taylor *et al.*, 2011).

An increasing pattern in the consumption of SBs by age group was evident in this study. Contrary to this observation, studies from India and Saudi Arabia found that the younger age groups were more likely to consume SBs as compared to adults (Mathur *et al.*, 2020; Al-Hanawi *et al.*, 2022). Across 51 countries, the average SB consumption among children and adolescents was 1.3 servings of 250 mL or 8½ oz SB per day (Ooi *et al.*, 2022), while the average consumption recorded among adults in 187 countries was 0.58 servings of 8 oz SB per day (Singh *et al.*, 2015). On the other hand, <10% of the total energy intake comes from SB across population groups in the United States (Marriott *et al.*, 2019), which was likewise observed in this study.

This study also revealed that males, urban dwellers, and rich households had higher SB intakes than their counterpart groups. These findings are in harmony with studies conducted in China and India (Guo, Phung & Chu, 2021; Mathur *et al.*, 2020). The difference in SB consumption by sex could be attributed to the possibility that females are more mindful of their physique and body fitness as compared to males, hence the avoidance of energy-dense foods and beverages (Gui *et al.,* 2017; Guo *et al.,* 2021). Meanwhile, urban areas are more socially and economically advanced, which improve the purchasing power and accessibility of residents to retailers offering SBs (Guo *et al.,* 2021). However, a meta-

analysis revealed that those with higher socioeconomic status were less likely to have high SB intake as they tended to have better access to various resources and food choices as compared to those with lower socioeconomic status (Purohit *et al.*, 2023). Nonetheless, given that overweight and obesity are more prevalent in urban households and upper wealth quintiles in the Philippines (DOST-FNRI, 2022b), these results indicated that preschool children, school-age children, adolescents, and adults from urban areas and rich households should be given more attention for interventions or programmes towards healthy diets and behavioural change.

Association of SB consumption with overweight and obesity

This study provided a picture of SB consumption and its association with overweight and obesity across population groups in the Philippines. It was found that preschool children, school-age children, and adults with the highest SB consumption, and all selected population groups with the highest sugar intake from SB per day were more likely to become overweight and obese. Other reports also found a direct association between SB consumption and weight gain, overweight, and obesity in children, adolescents (Keller & Bucher Della Torre, 2015; Malik *et al.*, 2013), and adults (Malik *et al.*, 2013). Moreover, obesity indices, specifically weight, BMI, or BMI *z*-score, were positively associated with SB intake in both children and adults (Luger *et al.*, 2017). A significant positive association between the consumption of sugar-containing beverages and total adiposity and central adiposity has been observed among children <12 years old (Frantsve-Hawley *et al.*, 2017). Nguyen *et al.* (2023) noted that every single serving or 12 oz increase in the consumption of SB per day can be associated with a 0.07 kg/m^2 higher BMI among children and adolescents, and a 0.42 kg higher body weight among adults. Furthermore, the same study found a significant linear dose-response association between SB intake and BMI and weight gain among children and adults, respectively.

One meta-analysis concluded that the effects of reducing SB intake on obesity are equivocal based on available randomised evidence in 2013, as the pooled results were not statistically significant and the effect point estimates only accounted for 1.5% of the variance in BMI change among the overweight and obese (Kaiser *et al.*, 2013). However, a recent systematic review and meta-analysis found evidence that reduced SB consumption could result in a lower BMI in children and adolescents and lower body weight among adults when compared with the consumption of non-caloric beverages (Nguyen *et al.*, 2023). Further research is needed to understand the association of SB with diet and health outcomes and the heterogeneity of consumer responses.

In 2016, WHO recommended the taxation of sugar-sweetened beverages to address childhood obesity. Existing literature demonstrates that taxation is an effective measure in combating obesity and NCDs (WHO, 2022). For instance, in Vietnam, higher SB tax rates led to weight reduction and lower BMI, as well as increased reduction in obesity prevalence (Phonsuk *et al.*, 2021). In the Philippines, the TRAIN Law was enacted by virtue of RA 10963, which took effect in January 2018 to change the consumption pattern and potentially fund public health efforts that further support healthy diets through the ongoing universal health care reforms (Onagan *et al.*, 2019). During the start and early years of implementation of the TRAIN law in the Philippines in 2018-2019, the intake and percentage of households and individuals consuming SBs were significantly lower than in

2013, when SBs were not yet subjected to any specific tax (Dasco *et al.,* 2023). This implies that SB taxation may work as intended in reducing the demand through price increase. However, SB taxation may have more impact on the lower income class as they tend to opt for cheaper products and lessen their consumption as compared to those from the higher income class who tend to sustain their original intake patterns (Lobstein, Neveux & Landon, 2020).

Limitations

There were several limitations in this study. Firstly, the findings do not reflect causality as the ENNS data were cross-sectional. Secondly, possible confounders, such as dietary habits or the presence of illnesses or co-morbidities, may affect SB consumption among selected population groups that were not considered in the analysis. Thirdly, the 24-hour food recall method relied on the respondent's memory and was prone to bias, which could affect the analysis of potential factors of overweight and obesity. Fourthly, the intake of each type of SB across the two survey periods was not taken into account, which may affect the development of overweight and obesity among selected population groups. Nonetheless, the two-year survey on SB consumption among the selected population groups provided a wealth of information that could be used for future studies. Moreover, the current study offered insightful information on the prevalence of SB intake and its related factors.

CONCLUSION

This study focused on the consumption of SB and its connection with overnutrition among Filipino preschool children, school-age children, adolescents, and adults in the 2018-2019 ENNS. In all selected population groups, older age groups, males, urban dwellers, and those from rich households were more likely to have higher SB intake. Preschool children, school-age children, and adults with the highest SB intake and all selected population groups with the highest sugar intake from SB per day were more likely to become overweight and obese.

The results of this study highlighted the importance of revisiting current nutrition policies, particularly the food-based dietary guidelines and front-of-pack labelling, as well as the necessary regulations in the Philippines. For instance, added sugar should be mandatory on food labels to inform and guide consumers in making healthy food choices. Promoting water intake while reducing SB consumption through nationwide public nutrition education campaigns using various platforms (e.g., social media, television, radio, internet, online groups) could yield tangible results. Continuous monitoring of SB consumption to track changes over time, including impact assessment of the TRAIN law on nutrition and health outcomes is highly suggested.

Acknowledgement

The authors are grateful for the contribution of the field researchers, all the hardworking community nutrition and health workers, and local government units involved in the 2018-2019 ENNS.

Authors' contributions

Goyena EA, conceived, carried out the study, reviewed and edited the manuscript; Desnacido JP, assisted in the analysis, interpretation of results, and write-up of the manuscript; Ducay AJD, analysed and interpreted the data; Cristobal AG, interpreted and assisted in the write-up of the manuscript. All authors read and approved the manuscript.

Conflict of interest

The authors declare no conflict of interest in the conduct of the study or the generation of its results. There are no other sources of funding for the ENNS outside the Philippine government.

References

Al-Hanawi MK, Ahmed MU, Alshareef N, Qattan AMN & Pulok MH (2022). Determinants of sugar-sweetened beverage consumption among the Saudi Adults: findings from a nationally representative survey. *Frontiers Nutr* 9:744116.

Dasco MLP, Platon-Desnacido J, Ducay AJD, Duante CA & Vargas MB (2023). Monitoring the consumption of sugar-sweetened beverages: an input to republic act no. 10963 (TRAIN law). *Philipp J Sci* 152(5):1609-1622.

DOST-FNRI (2022a). *In: 2021 Expanded National Nutrition Survey*. Department of Science and Technology–Food and Nutrition Research Institute. From https://enutrition.fnri.dost.gov.ph/uploads/2021%20ENNS-NATIONAL%20NUTRITION%20SUMMIT_FINAL.pdf. [Retrieved April 11 2024].

DOST-FNRI (2022b). *Philippine Nutrition Facts and Figures: 2018-2019 Expanded National Nutrition Survey (ENNS)*. Department of Science and Technology–Food and Nutrition Research Institute, Taguig City.

Frantsve-Hawley J, Bader JD, Welsh JA & Wright JT (2017). A systematic review of the association between consumption of sugar-containing beverages and excess weight gain among children under age 12. *J Public Health Dent* 77(Suppl 1): S43-S66.

Gan Q, Xu P, Yang T, Cao W, Xu J, Li L, Pan H, Zhao W & Zhang Q (2021). Sugar-sweetened beverage consumption status and its association with childhood obesity among Chinese children aged 6-17 years. *Nutrients* 13(7): 2211.

Gui ZH, Zhu YN, Cai L, Sun FH, Ma YH, Jing J & Chen YJ (2017). Sugar-sweetened beverage consumption and risks of obesity and hypertension in Chinese children and adolescents: a national cross-sectional analysis. *Nutrients* 9(12):1302.

Guo H, Phung D & Chu C (2021). Sociodemographic, lifestyle, behavioral, and parental factors associated with sugar-sweetened beverage consumption in children in China. *PloS One* 16(12):e0261199.

Kaiser KA, Shikany JM, Keating KD & Allison DB (2013). Will reducing sugar-sweetened beverage consumption reduce obesity? Evidence supporting conjecture is strong, but evidence when testing effect is weak. *Obes Rev* 14(8):620-633.

Keller A & Bucher Della Torre S (2015). Sugar-sweetened beverages and obesity among children and adolescents: A review of systematic literature reviews. *Child Obes* 11(4):338-346.

Lara-Castor L, Micha R, Cudhea F, Miller V, Shi P, Zhang J, Sharib JR, Erndt-Marino J, Cash SB, Mozaffarian D & Global Dietary Database (2023). Sugar-sweetened beverage intakes among adults between 1990 and 2018 in 185 countries. *Nat Commun* 14(1):5957.

Lobstein T, Neveux M & Landon J (2020). Costs, equity and acceptability of three policies to prevent obesity: A narrative review to support policy development. *Obes Sci Pract* 6(5):562-583.

Luger M, Lafontan M, Bes-Rastrollo M, Winzer E, Yumuk V & Farpour-Lambert N (2017). Sugar-sweetened beverages and weight gain in children and adults: a systematic review from 2013 to 2015 and a comparison with previous studies. *Obes Facts* 10(6):674-693.

Malik VS, Pan A, Willett WC & Hu FB (2013). Sugar-sweetened beverages and weight gain in children and adults: A systematic review and meta-analysis. *Am J Clin Nutr* 98(4):1084-1102.

Marriott BP, Hunt KJ, Malek AM & Newman JC (2019). Trends in intake of energy and total sugar from sugar-sweetened beverages in the United States among children and adults, NHANES 2003-2016. *Nutrients* 11(9):2004.

Mathur MR, Nagrath D, Malhotra J & Mishra VK (2020). Determinants of sugar-sweetened beverage consumption among Indian adults: findings from the National Family Health Survey-4. *Indian J Community Med* 45(1):60-65.

Miller C, Ettridge K, Wakefield M, Pettigrew S, Coveney J, Roder D, Durkin S, Wittert G, Martin J & Dono J (2020). Consumption of sugar-sweetened beverages, juice, artificially-sweetened soda and bottled water: An Australian population study. *Nutrients* 12(3):817.

Nguyen M, Jarvis SE, Tinajero MG, Yu J, Chiavaroli L, Mejia SB, Khan TA, Tobias DK, Willett WC, Hu FB, Hanley AJ, Birken CS, Sievenpiper JL & Malik VS (2023). Sugar-sweetened beverage consumption and weight gain in children and adults: a systematic review and meta-analysis of prospective cohort studies and randomized controlled trials. *Am J Clin Nutr* 117(1):160-174.

Onagan FCC, Ho BLC & Chua KKT (2019). Development of a sweetened beverage tax, Philippines. *Bull World Health Organ* 97(2):154-159.

Ooi JY, Wolfenden L, Sutherland R, Nathan N, Oldmeadow C, Mclaughlin M, Barnes C, Hall A, Vanderlee L & Yoong SL (2022). A systematic review of the recent consumption levels of sugar-sweetened beverages in children and adolescents from the World Health Organization regions with high dietary-related burden of disease. *Asia Pac J Public Health* 34(1):11-24.

Phonsuk P, Vongmongkol V, Pongutta S, Suphanchaimat R, Rojroongwasinkul N & Swinburn BA (2021). Impacts of a sugar sweetened beverage tax on body mass index and obesity in Thailand: A modelling study. *PloS One* 16(4):e0250841.

Popkin BM (2015). Nutrition transition and the global diabetes epidemic. *Curr Diab Rep* 15(9):64.

Purohit BM, Dawar A, Bansal K, Nilima, Malhotra S, Mathur VP & Duggal R (2023). Sugar-sweetened beverage consumption and socioeconomic status: a systematic review and meta-analysis. *Nutr Health* 29(3):465-477.

Singh GM, Micha R, Khatibzadeh S, Shi P, Lim S, Andrews KG, Engell RE, Ezzati M, Mozaffarian D & Global Burden of Diseases Nutrition and Chronic Diseases Expert Group (NutriCoDE) (2015). Global, regional, and national consumption of sugar-sweetened beverages, fruit juices, and milk: a systematic assessment of beverage intake in 187 countries. *PloS One* 10(8):e0124845.

Taylor FC, Satija A, Khurana S, Singh G & Ebrahim S (2011). Pepsi and Coca Cola in Delhi, India: availability, price and sales. *Public Health Nutr* 14(4):653-660.

WHO (2005). *Surveillance of Chronic Disease Risk Factors: Country Level Data and Comparable* Estimates. World Health Organization, Geneva.

WHO (2006). *WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development.* World Health Organization, Geneva.

WHO (2007). *In: Growth reference data for 5-19 years.* World Health Organization. From https://www.who.int/tools/growth-reference-data-for-5to19-years/indicators. [Retrieved April 11 2024].

WHO (2015). *Guideline: Sugars Intake for Adults and Children.* World Health Organization, Geneva.

WHO (2022). *WHO Manual on Sugar-Sweetened Beverage Taxation Policies to Promote Healthy Diets.* World Health Organization, Geneva.