Intake of soft drinks and sugar sweetened beverages by Colombian children and adolescents

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Abstract

Objectives: to describe the consumption of sugar sweetened beverages in Colombia, South America and variables associated with this consumption.

Methods: based on the Food Frequency Questionnaire applied in the National Survey of the Nutritional Situation of Colombia (2010), the prevalence and frequency/day of the consumption of sugar sweetened beverages by 10,070 subjects between 5 and 17 years old was estimated.

Results: the prevalence of sugar sweetened beverages consumption in subjects between 5 and 17 years old was 85.3%, and the average frequency of consumption was 0.71 times/day. The relationship between age and the prevalence of consumption displayed a J form, and the association with frequency in times/day was linear. The highest consumption occurred at 16 years of age, with a prevalence of 90.4% and an average frequency of 0.83 times/day. Overweight and obesity were not associated with consumption ($p>0.05$).

Conclusions: the prevalence and average frequency of consumption were positively associated with age, wealth, and level of urbanism and conversely associated with education and household food security. Children with stunting have a reduced prevalence but increased frequency of consumption. The consumption of sweetened-beverages is an expression of the stage of nutritional and food transitions.

Key words *Soft drinks, Diet, Child, Adolescent, Colombia*

Introduction

In 2005, the National Nutrition Situation Survey (Encuesta Nacional de la Situación Nutricional, ENSIN-2005) in Colombia quantified the consumption of sugar-sweetened-beverages (SSB) through a 24-Hour Dietary Recall (r24h).[1] The prevalence of SSB consumption in the last 24 hours (PU24) was 21.8%, and the average amount consumed was 371 g. The PU24 for SSB was 11.3%, with an average amount of 31.5 g.[1] The report of this measurement was non-specific and did not differentiate whether the beverages contained sugar, or if, for example, the amount of SSB reported used powder or reconstituted liquid in their preparation.

Colombia, like Latin America, is not unfamiliar with 2 of the main phenomena associated with the development of chronic noncommunicable diseases (CND): nutrition and food transitions.[2] As a consequence of the stages of transition, excess weight and obesity have increased in all groups. In the National Food Situation Survey (ENSIN-2010), the prevalence of overweight among children and adolescents between 5 and 17 years old was 17.5%.[3] The nutrition transition continued in the period of 2005-2010, during which excess weight increased in the Colombian population by at least 5%.[4]

The habitual consumption (≥2 times/day) and excessive consumption (over 0.15 L/day) of SSB,[5-7] mainly refreshments and others such as soft drinks, tea and juices, have been associated with excess weight and are also attributed to other undesirable effects in the development of mediators of CND, such as caries, asthma, hypertension, kidney damage, metabolic syndrome, diabetes mellitus type II, osteopenia, increased visceral fat and resistance to insulin.[8,9] However, there is also contradictory evidence stating that SSB consumption does not cause excess weight.[10] The adequate measurement of consumption is complex, and many of these findings are attributed to a lack of rigor in the measurement of exposure to these beverages. A study that reviewed 32 reports evaluating SSB consumption and the risk of overweight in children and adolescents showed that only 9 studies were methodologically sound and that 5 of them positively confirmed this relationship.[11]

According to Euromonitor International, an independent market research agency, the 2009-2014 per capita consumption of SSB decreased from 48.5 L in 2009 to 47.5 L in 2014 in Colombia. However, spending in the segment of SSB increased by 40%, with a greater emphasis on the market for tea, juice and soft drinks enriched with fiber and energy drinks.[12,13] Euromonitor also states that Colombia is among the countries with the lowest SSB consumption in the region. For example, in 2013 in Mexico, the annual consumption per capita was between 142 and 373.4 L, where it was only 47.2 L in Colombia.[13,14] In addition, the Administrative Department of Statistics (Departamento Administrativo de Estadística, DANE) states that SSB consumption *per capita* in the period of 2009-2013 increased by 7% due to the country's economic growth and that the middle class reached 62% of market participation, with the lower class at 29% and the higher class at 9%.[15]

In Colombia, the Ministry of Public Health has proposed taxing the consumption of SSB, disseminating preventive messages on their consumption through mass media and other measures that aim at restricting and even prohibiting the sale and consumption of SSB in school settings.[16] Complementarily, the beverage industry announced self-regulation measures that include not selling SSB in schools.[16]

The objective of this study was to describe the consumption of SSB and some variables associated with it.

Methods

Study population. The ENSIN-2010 was performed in Colombia, South America, by the Colombian Institute of Family Welfare (Instituto Colombiano de Bienestar Familiar, ICBF), the methodology of which has previously been published.[3] In summary, participants were selected to represent 99% of the population through multi-stage stratified sampling. All municipalities of the 32 departments of the country were grouped in strata with similar sociodemographic characteristics. The strata were represented by randomly selected municipalities, maintaining the proportional probability of stratum size. Within each stratum, clusters were formed from 10 households that were randomly selected. Household members were invited to participate. In total, 50,670 households were included in the survey.

Measurement of consumption: prevalence and frequency of the consumption of SSB. The ENSIN-2010, which utilized a food frequency questionnaire (FFQ) using 10 categories of response for the last month, estimated the frequency of consumption of 30 foods or food groups and 3 related practices. The details of the construction of the FFQ have previously been published.[3] In this study, we analyzed the SSB (boxed, powdered, bottled?) item. The ENSIN-2010 does not differ by the type of refreshments or

soft drinks (i.e., light, sugared, gasified, etc.). The categories of FFQ responses were converted into a continuous variable (frequency/day), using appropriate dividers to express the frequency of consumption in units of "day" (time).[3,17] The consumption calculation, prevalence (yes/no) and frequency/day (times/day), was performed for all subjects between 5 and 17 years of age, except for pregnant women and subjects who were practicing diets prescribed by health professionals, thus incorporating the complex sample design. The FFQ was applied through a direct interview by nutritionists-dietitians; when the children were between 5 and 10 years old or the adolescents were under 12 years old, the mothers or caregivers responded. The responses were recorded directly on laptops (PDAs). The FFQ used does not have reproducibility or validity studies, but the consumer frequency section is exhaustive, and it contains mutually exclusive and complementary response options, which rationally allows for a continuous timeline for this type of analysis.

Sample. The usual consumption of SSB was studied using the FFQ in a subsample of 17,897 subjects between 5 and 64 years old. For the present analysis, we chose children between 5 and 10 years old (3,842) and adolescents between 11 and 17 years old (6,345). We excluded those who were practicing a diet prescribed by a health professional (n=38) and pregnant adolescents (n=371). To ensure plausible data on body mass index [kg/m^2] (BMI), we limited the analysis to subjects with a height >80 and <200 cm and a weight >12 and <200 kg. The subsample analyzed included 10,070 subjects.

Anthropometric measurements. Anthropometric measurements were obtained using standardized techniques and calibrated instruments. Size was measured with a stadiometer with a sensitivity of 1 millimeter (Diseños Flores SR Ltda, Lima, Peru); weight was measured using scales with a sensitivity of 100 g (SECA 872). Overweight in children and adolescents was defined according to the equivalent cut-off points for body mass index (BMI) for sex and age, ≥25, following the recommendations of the International Obesity Task Force (IOTF).[18] Stunting was established based on Z scores on the Height/Age indicator (Z<2), using the World Health Organization benchmark. Excess weight was the sum of overweight and obesity, BMI ≥25.

Socioeconomic evaluation. Food security was determined based on a modified and validated Colombian version of the "Community Childhood Hunger Identification Project".[19] Ethnicity was established through self-recognition of the subject. The wealth index was measured using the survey designed by the Demographic and Health Survey (DHS). This continuous index was categorized into quintiles and represents household wealth through various indicators, which are grouped based on the principal component analysis.[20] The level of education of the subjects was established based on the years studied and approved; the reference categories are of interest for the programs of nutrition and public health in Colombia. The level of urbanism was established by the ICBF based on population density;[3] regions are geospatial clusters that correspond to cultural identity and were pre-established by the Colombian state for all regional and national government agencies.

Statistical analysis. The main outcomes of interest were the prevalence of SSB (yes/no) and the average frequency of consumption (times/day). To quantify the associations between sociodemographic variables and outcomes, we estimated consumption prevalence ratios (PRs) and the differences between mean consumption frequencies by categories of predictors. All estimates and 95% confidence intervals (CI95%) were calculated by incorporating the complex sample design with Stata software version 14 (Stata Corporation, College Station, TX).[21] The PRs and their 95% CIs were adjusted in a binomial regression model with the consumption prevalence as the dependent variable. The mean differences and their 95% CIs were adjusted in linear regression models with frequency/day as the dependent variable. For binomial and linear models, the predictors were some of the variables included in the survey: gender, age, ethnicity, stunting, overweight, head of household education, wealth index, household food insecurity, area and geographic regions. In addition, all *p*-values were calculated using the linear trend test for nominal, ordinal, or variance (ANOVA) predictors. The technical procedures for the ENSIN-2010 were endorsed by the Research Ethics Committee of the National Institute of Health of Colombia, as recorded in Act 3 of April 8, 2010. The ICBF obtained informed consent from the participants prior to enrollment. The authors declare that the procedures performed in the development of this work met the ethical standards, revised in 2008, of the Helsinki Declaration. The Committee of Ethics in Health Research of the Industrial University of Santander is exempt from reviewing the analyses performed with public and anonymous information considered as secondary sources.

Results

The prevalence of SSB for children aged 5 to 10

years was 81.8%, and their mean frequency of consumption was 0.60 times/day (CI95%, 0.57 to 0.64). The prevalence of SSB consumption in adolescents aged between 11 and 17 years old was 87.4%, and their mean frequency of consumption was 0.77 times/day (CI95%, 0.74 to 0.80). In all the subjects studied, the prevalence was 85.3%, and the mean frequency of consumption was 0.71 times/day (CI95%, 0.69 to 0.74). The correlation between prevalence and frequency of consumption was r=0.80 (CI95%, 0.44 to 0.94).

The prevalence of overweight was 12.8%, and that of stunting was 10.6%. The highest consumption was in adolescents aged 16 years, with a prevalence of 90.4% and a mean frequency of 0.83 times/day. A direct association between consumption and frequency with age was found (p<0.0001 for both, Tables 1 and 2). Sex was not associated with consumption. Bogotá, the capital of the country, displayed the highest consumption prevalence (93.6%) and average frequency (0.73 times/day); the Pacific region displayed the lowest consumption prevalence (76.5%) and average frequency (0.57 times/day). The nutritional status based on the height/age indicator was associated with consumption: the prevalence of consumption was higher in subjects without stunting (PR=1.04 (CI95%, 1.02 to 1.05), p<0.0001), but the frequency of consumption was 0.06 (0.03 to 0.09) times/day greater in subjects with stunting (p<0.0001). Excess weight was not associated with consumption (p>0.05).

All the variables representing socioeconomic level differently were directly associated with consumption. Table 1 shows the crude prevalence of consumption and adjusted PRs for the different variables studied. Table 2 shows the mean frequency and adjusted consumption differences (times/day).

Table 1

Association between sociodemographic variables and the prevalence of sugar sweetened beverages in subjects between 5 and 17 years of age in Colombia, ENSIN-2010[a].

Characteristic	n[b]	Prevalence of consumption[c]		Adjusted prevalence ratio (CI95%)[e]	p[f]
		%	p[d]		
Sex			0.43		0.11
Male	5162	85.7		1	
Female	5025	85.0		0.97 (0.95; 0.99)	
Group of people			<0.0001		0.22
Children (5-10 years)	3842	81.8		1	
Teenagers (11-17 years old)	6345	87.4		1.01 (0.98; 1.04)	
Age (years)			<0.0001		0.03
5-8	2477	82.1		1	
9-11	1937	81.4		0.99 (0.96; 1.02)	
12-15	3900	86.9		1.01 (0.98; 1.04)	
16-17	1873	90.1		1.04 (1.00; 1.07)	
Overweight/Obesity (kg/m²) [g]			0.61		0.53
No	8900	85.2		1	
Yes (≥25)	1287	86.0		0.99 (0.96; 1.01)	
Stunting (Height /Age)			<0.0001		<0.0001
No	8866	86.2		1.04 (1.02; 1.05)	
Yes (Z <-2)	1315	77.8		1	

continue

All analyses incorporated the complex sample design. [a] National Food and Nutrition Situation Survey (ENSIN-2010); [b] n was <10,070 due to missing values; [c] based on a Food Frequency Questionnaire with 10 response categories; [d] Linear trend test; [e] Reasons for prevalence. The 95% confidence interval (CI95%) was obtained from a binomial regression model with the consumption of sugar sweetened beverages (yes/no) as a dependent variable. Estimates for education excluded the index of wealth and food security because they may be on the causal path. Estimates for the wealth index excluded food security. Food security excluded the wealth index; [f] Linear trend test in ordinal predictors. For geographic area, region and ethnicity, the value of p is derived from the Wald test; [g] based on BMI equivalents according to the IOTF.

Table 1 **conclusion**

Association between sociodemographic variables and the prevalence of sugar sweetened beverages in subjects between 5 and 17 years of age in Colombia, ENSIN-2010[a].

Characteristic	n[b]	Prevalence of consumption[c]		Adjusted prevalence ratio (CI95%)[e]	*p*[f]
		%	*p*[d]		
Ethnicity			<0.0001		0.05
Mestizo	7753	86.1		1	
Indigenous	1226	73.5		1.03 (1.00; 1.05)	
Afrocolombian	1208	84.4		1.06 (1.04; 1.08)	
Education (Years)			0.63		<0.0001
Preschool or less (<1)	170	84.3		1	
Incomplete primary (1-4)	3269	82.5		1.02 (0.95; 1.06)	
Full elementary (5)	951	83.7		1.04 (0.97; 1.08)	
Incomplete secondary school (6-10)	4048	89.4		1.06 (1.01; 1.10)	
Secondary school (11)	246	90.1		1.04 (0.95; 1.09)	
Technology/University (>11)	1503	79.6		0.99 (0.91; 1.05)	
Wealth Index			<0.0001		0.003
Q1 poorest	3575	77.5		1	
Q2	2466	83.8		1.05 (1.03; 1.06)	
Q3	1837	88.7		1.05 (1.03; 1.07)	
Q4	1321	88.5		1.03 (1.00; 1.06)	
Q5 richest	988	91.3		1.07 (1.04; 1.09)	
Household food insecurity			<0.0001		0.003
No	3023	89.0		1	
Light	3780	85.1		0.98 (0.95; 1.00)	
Moderate	1982	82.2		0.93 (0.90; 0.96)	
Severe	1390	80.5		0.91 (0.87; 0.95)	
Urbanism			<0.0001		<0.0001
Urban area of cities	6599	88.6		1	
Intermediate cities/towns	2241	79.7		0.95 (0.92; 0.98)	
Dispersed population	1347	75.2		0.89 (0.84; 0.92)	
Region of the country			<0.0001		<0.0001
Bogota	535	93.6		1.11 (1.09; 1.13)	
Central	2327	81.9		1	
Atlantic (North)	2323	88.9		1.10 (1.09; 1.11)	
National Territories (South)	2103	85.4		1.09 (1.07; 1.11)	
Oriental	1490	86.6		1.08 (1.06; 1.09)	
Pacifica (West)	1409	76.5		0.99 (0.96; 1.02)	

All analyses incorporated the complex sample design. [a] National Food and Nutrition Situation Survey (ENSIN-2010); [b] n was <10,070 due to missing values; [c] based on a Food Frequency Questionnaire with 10 response categories; [d] Linear trend test; [e] Reasons for prevalence. The 95% confidence interval (CI95%) was obtained from a binomial regression model with the consumption of sugar sweetened beverages (yes/no) as a dependent variable. Estimates for education excluded the index of wealth and food security because they may be on the causal path. Estimates for the wealth index excluded food security. Food security excluded the wealth index; [f] Linear trend test in ordinal predictors. For geographic area, region and ethnicity, the value of *p* is derived from the Wald test; [g] based on BMI equivalents according to the IOTF.

Table 2

Association between sociodemographic variables and the frequency/day of consumption of sugar sweetened beverages in subjects between 5 and 17 years of age in Colombia, ENSIN-2010[a].

Characteristic	n[b]	Frequency of consumption[c]		Adjusted difference (CI95%)[e]	*p*[f]
		Average ± EE	*p*[d]		
Sex			0.97		0.12
Male	4328	0.71 ± 0.02		1	
Female	4153	0.71 ± 0.02		-0.01 (-0.03; 0.00)	
Age group			<0.0001		0.288
Children (5-10 years)	3055	0.60 ± 0.02		1	
Teenagers (11-17 years old)	5426	0.77 ± 0.02		0.02 (-0.01; 0.05)	
Age (years)			<0.0001		0.03
5-8	1965	0.59 ± 0.02		1	
9-11	1552	0.64 ± 0.02		-0.04 (-0.07; -0.01)	
12-15	3312	0.77 ± 0.02		0.00 (-0.04; 0.04)	
16-17	1652	0.80 ± 0.03		0.04 (-0.01; 0.08)	
Overweight/Obesity (kg/m2) [g]			0.003		0.56
No	7396	0.70 ± 0.01		1	
Yes (≥25)	1085	0.81 ± 0.04		0.01 (-0.02; 0.04)	
Stunting (Height /Age)			0.80		<0.0001
No	7442	0.71 ± 0.01		1	
Yes (Z<-2)	1033	0.70 ± 0.04		0.06 (0.03; 0.09)	
Ethnicity			<0.0001		0.04
Mestizo	6448	0.72 ± 0.01		1	
Indigenous	1018	0.56 ± 0.03		-0.04 (-0.09; 0.02)	
Afrocolombian	1015	0.69 ± 0.03		0.03 (0.00; 0.07)	
Education (Years)			0.95		0.07
Preschool or less (<1)	136	0.68 ± 0.08		1	
Incomplete primary (1-4)	2629	0.64 ± 0.02		-0.01 (-0.07; 0.06)	
Full elementary (5)	791	0.76 ± 0.04		-0.00 (-0.07; 0.07)	
Incomplete secondary school (6-10)	3541	0.79 ± 0.02		0.02 (-0.04; 0.09)	
Secondary school (11)	215	0.74 ± 0.07		0.00 (-0.07; 0.08)	
Technology/University (>11)	1169	0.57 ± 0.03		-0.06 (-0.13; 0.01)	
Wealth Index			<0.0001		0.003
Q1 poorest	2848	0.61 ± 0.02		1	
Q2	2081	0.72 ± 0.03		0.04 (0.01; 0.07)	
Q3	1577	0.74 ± 0.02		0.05 (0.02; 0.09)	
Q4	1111	0.73 ± 0.03		0.04 (0.01; 0.08)	
Q5 richest	864	0.78 ± 0.03		0.07 (0.03; 0.10)	
Household food insecurity			0.01		0.003
No	2610	0.76 ± 0.02		1	
Light	3166	0.69 ± 0.02		-0.02 (-0.04; -0.00)	
Moderate	1592	0.68 ± 0.03		-0.04 (-0.07; -0.02)	
Severe	1101	0.67 ± 0.03		-0.05 (-0.08; -0.01)	

All analyses incorporated the complex sample design. [a] National Food and Nutrition Situation Survey (ENSIN-2010); [b] n was <8,481 due to missing values; [c] Based on a Food Frequency Questionnaire with 10 categories of response. The average day is estimated only for those who consume sugar sweetened beverages; [d] Linear trend test and adjusted difference.[e] The 95% confidence interval (CI95%) was obtained from a linear regression model with frequency/day as the dependent variable. Estimates for education excluded the index of wealth and food security because they may be on the causal path. Estimates for the wealth index excluded food security. Food security excluded the wealth index; [f] Linear trend test in ordinal predictors. For geographic area, region and ethnicity, the value of *p* is derived from the Wald test; [g] based on BMI equivalents according to the IOTF.

Table 2 **conclusion**

Association between sociodemographic variables and the frequency/day of consumption of sugar sweetened beverages in subjects between 5 and 17 years of age in Colombia, ENSIN-2010[a].

Characteristic	n[b]	Frequency of consumption[c]		Adjusted difference (CI95%)[e]	p[f]
		Average ± EE	p[d]		
Geographic area			<0.0001		<0.0001
Urban area of cities	5673	0.76 ± 0.01		1	
Intermediate cities/towns	1833	0.65 ± 0.03		-0.04 (-0.08; -0.00)	
Dispersed population	975	0.52 ± 0.03		-0.08 (-0.12; -0.04)	
Region of the country			<0.0001		<0.0001
Bogota	491	0.73 ± 0.04		0.08 (0.05; 0.11)	
Central	1792	0.80 ± 0.03		1	
Atlantic (North)	2025	0.67 ± 0.02		0.08 (0.06; 0.11)	
National Territories (South)	1827	0.74 ± 0.03		0.05 (0.02; 0.09)	
Oriental	1260	0.74 ± 0.03		0.05 (0.03; 0.08)	
Pacifica (West)	1086	0.57 ± 0.02		-0.05 (-0.09; -0.02)	

All analyses incorporated the complex sample design. [a] National Food and Nutrition Situation Survey (ENSIN-2010); [b] n was <8,481 due to missing values; [c] Based on a Food Frequency Questionnaire with 10 categories of response. The average day is estimated only for those who consume sugar sweetened beverages; [d] Linear trend test and adjusted difference.[e] The 95% confidence interval (CI95%) was obtained from a linear regression model with frequency/day as the dependent variable. Estimates for education excluded the index of wealth and food security because they may be on the causal path. Estimates for the wealth index excluded food security. Food security excluded the wealth index; [f] Linear trend test in ordinal predictors. For geographic area, region and ethnicity, the value of *p* is derived from the Wald test; [g] based on BMI equivalents according to the IOTF.

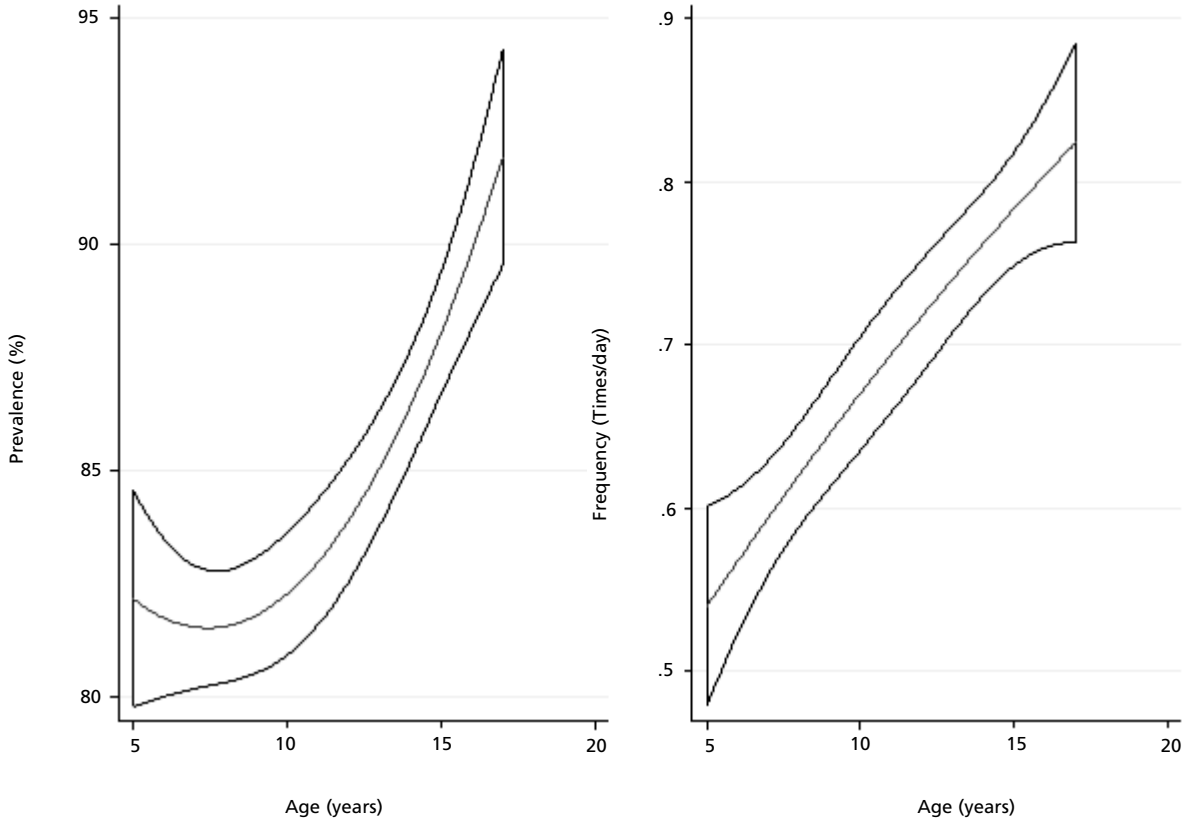
Discussion

Based on the FFQ applied in the ENSIN-2010, we managed to establish that in Colombia, 8 out of 10 children and 9 out of 10 adolescents consume SSB. The prevalence of consumption in subjects is not differentiated by sex. The relationship between age and the prevalence of consumption had a J-shaped distribution (Figure 1). In addition, the relationship between age and frequency of consumption (times/day) was linear (Figure 1), and the highest prevalence was reached in adolescents aged 16 years. For both prevalence and frequency/day, the variables studied that approximate the socioeconomic level of subjects and households, such as food security, household head education, and the wealth index, were directly related to consumption. The consumption of SSB in Colombia is predominant in urban areas, which presupposes a direct relationship with the degree of urbanism, structural and economic development and human development. Neither the prevalence nor the frequency/day of consumption was related to excess weight. The relationship with ethnic groups was clear: indigenous groups had the lowest consumption, and the Afro-Colombian population had the highest prevalence and average frequency. The above findings are another expression of the stage of nutrition and food transitions in Colombia.

According to the different theorists of the nutrition transition phenomenon,[22-24] based on the results presented here and other complementary results derived from the ENSIN, we can affirm that in the nutrition and alimentary transition that Colombia is experiencing, patterns 2 to 5 are observed: there is famine in some regions (pattern 2), whereas there is a high protein diet and accelerated migration of the traditional diet to the so-called western diet in the more developed regions and with higher levels of urbanism, with the subsequent appearance of CND (patterns 3 and 4). The transition follows the model of low- and middle-income countries; it is characterized by an accelerated nutrition transition in which the extremes of the nutritional status and the double load coexist.[25] The presence of different stages of the food and nutrition transition reflects different levels of structural, economic and all types of development in the interior of the country and results in differences in consumption reported here by the level of urbanism, region or index of wealth. As in the nutritional state, this is the result of complex

Figure 1

Prevalence and frequency (times/days) of sugar sweetened beverages in the Colombian population between 5 and 17 years old, ENSIN-2010, Colombia.



Based on a Consumer Frequency Questionnaire applied at ENSIN-2010, Colombia. Regression lines for prevalence, frequency/day and age in years (the area between the lines represents the 95% confidence interval).

interactions between the determinants.

Although it has been reported that the probability of SSB consumption in adults is higher in men than in women,[5] this relationship is not present in those under 18. In Ecuadorian children and adolescents between 10 and 19 years of age, according to the National Health and Nutrition Survey conducted in 2012, men consume more SSB than women (83 *versus* 79.9%); however, these differences are not significant.[26] A review of several studies on the determinants of SSB consumption in children and young adolescents concluded that sex is apparently not a determinant of consumption.[27] However, in Mexico, studies in adolescents have reported that men consume more energy from SSB but also from general consumption.[28] The differences that occur in consumption are particular to the stage of nutritional and food transitions and are also evident in other consumptions. For example, in Colombia, women consume more vegetables than men.[3] These differences in consumption by sex, even in children and adolescents, can be explained by hypothesis, by the differential incorporation of the concept of health or by social pressure in the ideal of Western beauty.

It has previously been reported that adolescents and young adults most frequently consume SSB.[11] However, even assuming that this consumption is exclusively at the expense of SSB, their theoretical consumption derived from the estimated amount in the ENSIN-2005 (approximately 400/day g), which corresponds to an estimated frequency of 0.80 times/day in the ENSIN-2010, still does not reach the level of exposure in which a causal association between excess weight and SSB consumption has

been reported, which is the habitual consumption of more than 0.15 L/day, with a frequency of ≥2 times/day.[5-7] Of course, here only the consumption of SSB has been evaluated with some limitations rather than the total amount of SSB consumed.

There is abundant literature concluding that malnutrition in any form, stunting (height/age), acute malnutrition (weight/height) or overweight (weight/height or weight/age) can be promoted through an adequate intake of nutrients.[29,30] The consumption of SSB, among other things, displaces the consumption of food dense in nutrients and provides "empty" energy; therefore, it is reasonable to think that there is a causal relationship between consumption and growth.[29,30] Our results adjusted by the possible confounders show that although the subjects with delayed growth have a lower prevalence of consumption, they present a more average frequency/day value; therefore, it is possible that in Colombian children and adolescents, the displacement of food dense in nutrients by the consumption of SSB is a rational explanation for stunting. The cross-sectional data do not allow us to delve into a possible causal explanation between the consumption of SSB and stunting, which would justify conducting new studies.

Several of the aspects that deserve special care in analyzing these consumption outcomes are related to exposure measurement; a) the FFQ used in the ENSIN-2010 did not specifically ask for the type of beverage consumed, nor for its type of sweetener. In Colombia, according to industry and data from Euromonitor International, the market for sugar-free or artificially sweetened has grown rapidly and reached 30% of market shares in 2014. b) The dose here is a combined representation of prevalence and frequency; in populations with a high prevalence of consumption but a low frequency, this can be translated to subjects less exposed to the components of the beverage than in subjects of populations with a low relative prevalence and greater frequency of consumption. c) The FFQ applied in the ENSIN-2010 did not measure the amount consumed or how to approach this measurement. However, using r24h, the ENSIN-2005 had complementarily established that in children between 4 and 8 years of age, the PU24 was 18.5% and the mean amount consumed was 273 g; in the group from 9 to 13 years old, the PU24 increased to 21.6% and the mean amount to 330 g; and in the group from 14 to 18 years old, the PU24 was 26.4% and the mean amount was 409 g. The PU24 of soft drinks was always smaller and varied widely with age. d) There was no difference between carbonated and non-carbonated beverages in how the consumption of SSB was measured. e) The ENSIN-2010 did not ask about the consumption of bottled water. f) FFQs are simplified methods that can lead to memory bias and dilution of the association by reverse causality. All of the above are limitations in the measurement of exposure and future challenges for ENSIN and other studies.

The interest in investigating excess weight as one of the main mediators in the development of CND and the consumption of SSB faces the challenges described above and many others. Here, we found no association between overweight and consumption, but the cross-sectional nature of the data, the limitations in measuring consumption as described above, the possible decrease in consumption in subjects with excess weight and others that we are not even aware of lead to a dilution of the association, if it existed, and do not allow any causal approach.

Finally, we could characterize the consumption of SSB in Colombian children and adolescents and can highlight some of the methodological challenges for future measurements. Studies must estimate the contribution made by SSB to the total energy intake. It is necessary to understand the consumption of SSB as an expression of the stage of nutritional and food transitions to make coherent public policies and preventive practices.

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