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Food sources of added sugar: Brazilian data (EBANS) from Latin American Nutrition and Health Study (ELANS)

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ABSTRACT

Introduction: Brazil has the second highest *per capita* consumption of sugar in the world and added sugar (AS) contributes to 12.6% of the total energy intake.

Objective: To investigate the main food sources of AS intake in Brazilian population, according to sex, age, nutritional status, and Brazilian macro-regions.

Methods: 2,000 individuals aged 15-65 years were included in the Brazilian Nutrition and Health Study (EBANS). EBANS is part of the Latin American Study of Nutrition and Health (ELANS), a multicenter cross-sectional study of a nationally representative sample of urban populations from eight Latin American countries (Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Peru, and Venezuela). Food and beverage intake, measured by 24-h dietary recall, were classified into 216 groups. The contribution of each group to AS incorporated sample weights and adjusted for clusters and strata of complex sample design.

Results: The top 10 food groups with the highest levels of AS were: soft drinks (36.0%); powdered juice mix (with sugar) (9.6%); milk (with sugar) (8.4%); coffee (with sugar) (7.2%); plain sugar (7.3%); natural juice (with sugar) (4.8%); chocolate candy (2.4%); milk, plain or not (without added sugar) (2.3%); cookies (2.2%); and whole grain cracker (1.9%). Independent of sex, age, nutritional status, or Brazilian macro-regions, the main contributor to AS consumption was soft drinks.

Conclusion: The results highlight the need for interventions focused on all Brazilian groups evaluated and the development of public health policies to reduce AS content, especially the major sources of AS (beverages processed and homemade).

KEYWORDS

Cross-sectional studies, Diet, Brazil, Food intake, Sugars, Beverages, Soft Drinks.

INTRODUCTION

Sugar production in Brazil has reached significant levels in the recent years; it more than doubled in 2000–2014, Brazil is the world's largest producer and exporter of sugar[1]. The consumption of sugar follows the same pattern; Brazil has the second highest added sugar intake *per capita* (600 kcal/day) in the world, which contributes to 12.6% of the total energy (TE) intak.[2,3].

The World Health Organization (WHO)[4] recommends reducing free sugars intake to prevent the increase in obesity prevalence and other chronic non-communicable diseases associated with high consumption of sugar[5,6]. Such recommendation is corroborated by the food guide for the Brazilian population which suggests sugar should be used in small quantities in culinary preparations. Nevertheless, there is no specific recommendation either for the consumption of added sugars in the world or in Brazil[7].

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Although the average intake of dietary sugar may be increasing in some specific populations, studies have indicated stable or decreasing trends in dietary sugar intake[8,9]. In this sense, it is important to constantly assess the sugar intake among distinct populations; but, beyond the total amount, it is also necessary to explore the food sources considering cultural particularities and the globalization[9].

Thus, this study aimed to investigate the main food sources of added sugar in a representative sample of Brazilian population, according to sex, age, nutritional status, and Brazilian macro-regions.

METHODS

Study and participants

This study was conducted with participants from the Brazilian Study of Nutrition and Health - *Estudo Brasileiro de Nutrição e Saúde* (EBANS), carried out from November 2014 to August 2015. EBANS is a cross-sectional population-based survey of Brazilian individuals, and is part of the Latin American Study of Nutrition and Health - *Estudio Latinoamericano de Nutrición y Salud* (ELANS), carried out in eight Latin American countries: Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Peru, and Venezuela. The overarching ELANS protocol (60953716.4.0000.5505) was approved by Federal University of São Paulo, Brazil. EBANS was approved by the Research Ethics Committee of the "Instituto Pensi - Hospital Infantil Sabará" CAAE: 31670314.8.0000.5567.

Sample design

EBANS sampling was random complex and multistage. Sample size was calculated using a confidence level of 95% and a maximum error rate of 3.49% at 5% significance level and survey design effect of 1.75. Individuals were stratified by geographical location (only urban areas), sex, age, and socioeconomic level (SEL). The total sample was composed of 2,000 individuals, aged 15–65 years, of both sexes, living in private households in the major cities of Brazil in terms of population weight, according to the Brazilian's macro-regions (North, Northeast, Midwest, Southeast, and South).

Pregnant and lactating women (in the first 6 months postpartum), individuals with major physical or mental impairments that affect food intake or physical activity (for example: recent surgery, severe asthma, dementia, and major depression), individuals outside of the age range 15–65 years, adolescents without assent or consent of a parent or legal guardian, individuals living in institutions, and those who were unable to read were excluded.

Dietary intake data

Data from the first 24-h dietary recall (24HRI) was used to identify the primary sources of added sugar. A single 24HRI for a large population yields an unbiased estimate of the population-level dietary patterns[10]. The 24HRI were conducted by trained interviewers using the multiple pass method[11] and included all types and amounts of foods and beverages consumed in the preceding 24 hours. A photographic album containing household utensils and portion sizes was used to improve accuracy in the estimation of food servings. All foods and beverages reported were converted into energy and nutrient values using the Nutrition Data System for Research software (NDS-R version 2013, University of Minnesota, Mineapolis)[12]. As the NDS-R software is based on the United States Department of Agriculture (USDA) food composition database[13], a USDA food matching standardized procedure involving nutritional equivalency of local food reported by the study participants was conducted by professional nutritionists to minimize errors and verify quantities of key nutrients. The complete procedure for standardization of the food composition database has been previously described in detail[14].

Defining food sources of added sugar

According to the NDS-R (version 2013) added sugars includes monosaccharides and disaccharides that were added as caloric sweeteners as added sugars, white sugar included in recipes (beverages or foods) were also computed[12].

In the first step, a total of 1,317 foods and beverages reported in the first 24HRI, were clustered into 216 food groups based on the frequency of consumption and similarity of added sugar content. In the next step, if the food group was consumed fewer than ten times, it was grouped with other food items according to the similarity of added sugar content (for example: whole milk with coffee (sweetened with white sugar) and skimmed milk with coffee (sweetened with white sugar). Finally, the contribution of each food group to the total added sugar intake was determined, considering the sampling design, using the method proposed by Block et al.[15], This method was used to estimate the corresponding percentage to foods or food groups consumed by the population from the total intake of a specific nutrient, which is the added sugar in the present study. Once classified, the percentage of added sugar contributed was calculated using sample weights, and the foods were sequenced in rank order of contribution.

Statistical analyses

Analyses were conducted separately for sex (female and male), age groups (the same used in the sample design) (15–19 years old, 20–34 years old, 35–49 years old, and 50–65 years old), Brazilian macro-regions (South, Southeast, Midwest, North, and Northeast), and for nutritional status (with overweight, obese or morbidly obese) or without overweight (underweight or normal weight).

All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) Complex Samples (version 22.0 for Windows, SPSS, Inc., Chicago, IL, USA) to

incorporate sample weights and adjust for clusters and strata of the complex sample design.

RESULTS

Data for the top 10 food and beverage sources of added sugar across total population, sex, age groups, nutritional status, and Brazilian macro-regions are presented in tables 1-4. Soft drinks/sodas were the major contributors of added sugar in EBANS (36%), followed by powder juice mix with sugar (9.61%); milk with white sugar (8.44%); coffee with white sugar (7.72%); plain sugar (7.26%); natural juice with white sugar (4.79%); chocolate candy (2.37%); milk (plain or not) without white sugar (2.29%); cookies (2.24%); and whole grain crackers (1.89%). These groups accounted for 82.6% from the total contribution. However, it is important to emphasize that the average consumption in grams per day (g/d) of added sugar includes only the amount of sugar taken by consumers, and it was observed that these average consumption values do not necessarily represent the percentage of the total energy (%TE).

In all groups and categories evaluated, "soft drinks/sodas" alone contributed most to the average added sugar intake in g/d and %TE. The %TE from soft drinks/sodas ranged from 9.38% (Midwest) to 12.78% (South). The consumption was very similar in both sexes, nutritional status, and various age groups (around 11%), with exception for adults aged 50–65 years (9.77%). The lowest %TE for all groups and categories was from milk without white sugar, ranging between 0.36% and 1.33%.

The second component that most contributed to the average intake of added sugar (in grams per day - g/d) was "cookies" for both sexes, nutritional status, adolescents and young adults, and those living in the Southwest, Midwest and Northeast region; "powder juice mix with sugar" for adults, middle aged adults, and those living in the South; and "natural juice with white sugar" for those living in the Northern region of Brazil.

"Coffee and milk with sugar" had higher contribution of average added sugar intake in women, in middle-aged adults (35 to 49 years old), and in individuals living in the Midwest region than other macro-regions.

Table 1 shows the top 10 dietary contributors of added sugar according to sex. Women showed a higher percentage of added sugar from milk with white sugar, coffee with white sugar, plain sugar, natural juice with white sugar, chocolate

Table 1. Top 10 food and beverage sources of added sugar by contribution (%), consumption in grams/day (g/d) and percentage of the total energy (%TE) in participants of the study, according to total population (EBANS) and sex.

	Foods /beverages	n	%	EBANS					Female (n=1058)					Male (n=942)				
				% contrib	g/d		%TE		% contrib	g/d		%TE		% contrib	g/d		%TE	
					Mean	SE	Mean	SE		Mean	SE	Mean	SE		Mean	SE	Mean	SE
1	Soft Drinks	1062	2.16	36.02	54.86	1.50	11.34	0.27	32.4	46.93	1.59	11.45	0.34	39.16	62.25	2.00	11.23	0.36
2	Powder juice mix (w/sugar)	537	1.09	9.61	28.81	1.87	6.38	0.29	9.05	26.59	3.35	6.94	0.52	10.1	30.77	1.81	5.89	0.29
3	Milk (w/sugar)	780	1.59	8.44	15.75	0.53	3.57	0.13	8.55	13.75	0.55	3.79	0.2	8.36	18.02	0.91	3.33	0.16
4	Coffee (w/sugar)	995	2.02	7.72	12.66	0.53	3.19	0.13	9.16	12.79	0.77	3.69	0.2	6.51	12.51	0.68	2.6	0.15
5	Plain sugar	692	1.41	7.26	17.73	0.70	3.50	0.15	7.54	15.63	0.97	3.82	0.25	7.03	20.2	1.30	3.12	0.21
6	Natural juice (w/sugar)	296	0.6	4.79	24.33	1.46	5.25	0.32	4.9	21.76	1.96	5.81	0.53	4.71	27.17	2.25	4.65	0.32
7	Chocolate candy	137	0.28	2.37	23.52	2.46	3.98	0.31	2.85	22.77	2.91	4.12	0.42	1.96	24.51	4.07	3.81	0.4
8	Milk, plain or not (w/o:sugar)	863	1.76	2.29	4.12	0.33	0.80	0.07	2.23	3.57	0.52	0.8	0.11	2.34	4.71	0.40	0.79	0.08
9	Cookies	87	0.18	2.24	31.4	1.81	5.44	0.29	2.34	30.35	3.16	5.24	0.39	2.16	32.43	2.70	5.64	0.49
10	Whole Grain Crackers	392	0.8	1.89	6.51	0.31	1.42	0.05	2.22	5.78	0.39	1.46	0.07	1.61	7.62	0.43	1.36	0.07

% contrib: percentual of contribution; g/d: consumption in grams per day; %TE: percentage of the total energy; w: with; w/o: without. SE: Stardard Error.

candy, cookies, and whole grain crackers than men; nevertheless, the average consumption (g/d) of these sources was higher among men, except for coffee with sugar.

Table 2 indicates that the intake of soft drinks decreases with age, excluding those in young adults. Compared with other age groups, adolescents received the highest percentage of added sugar from chocolate candy and cookies, which also contributed more to the average consumption of added sugar in this age group and received the lowest percentage of added sugar from natural juice with white sugar. Coffee and milk with sugar contributed the most for middle-aged adults compared with other age groups.

The top sources of added sugar among over and non-overweight individuals were soft drinks (36.47% vs 35.56%), powder juice mix with sugar (8.29% vs 11.23%), milk with white sugar (8.10% vs 8.87%), coffee with white sugar (8.54% vs 6.74%), and plain sugar (7.72% vs 6.71%) (Table 3).

In relation to Brazilian macro-regions (Table 4A and B), powder juice mix contributed more to the sugar consumption of individuals living in the Midwest (32.72 g/d; 16.62%) and Southern regions (37.92 g/d; 14.61%) and contributed less to those living in the Northeast (23.80 g/d; 4.27%) and Northern regions (16.46 g/d; 3.11%). On the contrary, natural juice with white sugar contributed more to the sugar consumption of individuals living in the Northeast (27.4 g/d; 11.78%) and Northern regions (27.42 g/d; 6.32%) and contributed less to those living in the Midwest (19.3 g/d; 3.63%) and Southern regions (16 g/d; 1.04%).

DISCUSSION

This study describes the top 10 added sugar sources of contribution, consumption, and percentage of the total energy among Brazilian population, and stratified by sex, age groups, nutritional status, and macro-regions. In all groups evaluated, soft drinks were the main contributor of added sugar, with the highest consumption and %TE.

Sugars can be found naturally in foods or in food products; these sugars are added during processing or preparation and include syrups and table sugars[16]. Although the 2015–2020 Dietary Guidelines for Americans[17] recommended consuming less than 10% of daily TE from added sugars (defined as

Table 2. Top 10 food and beverage sources of added sugar by contribution (%), consumption in grams/day (g/d) and percentage of the total energy (%TE) in participants of the study, according to age groups.

	Foods /beverages	15 to 19 years (n=235)					20 to 34 years (n=745)					35 to 49 years (n=608)					50 to 65 years (n=412)				
		% contrib	g/d		%TE		% contrib	g/d		%TE		% contrib	g/d		%TE		% contrib	g/d		%TE	
			Mean	SE	Mean	SE		Mean	SE	Mean	SE		Mean	SE	Mean	SE		Mean	SE	Mean	SE
1	Soft Drinks	37.91	68.90	4.4	12.16	0.8	40.15	55.57	1.8	11.24	0.4	33.74	52.87	2.2	11.80	0.4	26.31	41.03	2.9	9.77	0.5
2	Powder juice mix(w/sugar)	10.25	30.98	4.5	6.35	0.7	8.80	26.34	0.9	5.35	0.2	10.21	31.16	3.2	8.00	0.6	9.93	28.54	6.7	6.16	0.9
3	Milk (w/sugar)	8.20	20.75	1.8	3.56	0.3	7.66	16.42	1.0	3.52	0.2	8.59	14.43	0.8	3.46	0.2	10.81	13.45	0.8	3.87	0.4
4	Coffee (w/sugar)	2.66	12.47	1.2	2.44	0.3	6.06	12.52	0.7	2.91	0.2	10.50	12.83	0.8	3.26	0.2	13.40	12.63	1.2	3.63	0.3
5	Plain sugar	6.24	19.16	2.1	3.08	0.3	6.98	17.89	1.1	3.20	0.2	8.19	18.26	1.6	3.85	0.4	7.46	15.13	1.5	3.87	0.4
6	Natural juice (w/sugar)	4.02	24.35	3.6	4.92	1.0	4.60	25.51	3.1	5.01	0.6	5.10	24.43	1.8	5.39	0.5	5.73	21.77	2.3	5.80	0.6
7	Chocolate candy	4.00	35.21	9.9	4.30	0.9	1.70	17.14	1.2	3.21	0.3	2.50	25.84	3.9	4.58	0.6	1.95	20.14	4.5	4.62	1.1
8	Milk, plain/not (w/o:sugar)	1.73	3.93	0.7	0.79	0.2	3.66	7.48	0.7	1.33	0.1	1.23	2.32	0.5	0.48	0.1	1.17	1.24	0.2	0.36	0.1
9	Cookies	4.23	41.82	5.3	6.80	0.9	3.05	30.47	1.8	5.12	0.3	0.92	20.92	2.9	4.69	0.4	0.05	8.79	0.0	3.13	0.0
10	Whole Grain Crackers	1.78	10.37	1.2	1.86	0.3	1.74	7.06	0.5	1.43	0.9	2.09	5.78	0.7	1.32	0.1	2.08	4.85	0.5	1.36	0.1

% contrib: percentual of contribution; g/d: consumption in grams per day; %TE: percentage of the total energy; w: with; w/o: without; SE: Stardard Error.

Table 3. Top 10 food and beverage sources of added sugar by contribution (%), consumption in grams/day (g/d) and percentage of the total energy (%TE) in participants of the study, according to nutritional status.

	Foods/beverages	Without overweight (n=836)					With overweight (n=1164)				
		% contrib	g/d		%TE		% contrib	g/d		%TE	
			Mean	SE	Mean	SE		Mean	SE	Mean	SE
1	Soft Drinks	35.56	54.14	2.26	11.26	0.44	36.47	55.46	1.88	11.40	0.32
2	Powder juice mix (w/sugar)	11.23	32.37	3.60	6.30	0.49	8.29	25.66	1.33	6.45	0.31
3	Milk (w/sugar)	8.87	16.74	0.91	3.39	0.16	8.10	14.95	0.72	3.72	0.20
4	Coffee (w/sugar)	6.74	12.79	0.99	3.13	0.24	8.54	12.58	0.54	3.22	0.15
5	Plain sugar	6.71	18.31	1.23	3.23	0.21	7.72	17.34	0.89	3.68	0.22
6	Natural juice (w/sugar)	4.62	26.63	2.87	5.07	0.45	4.94	22.81	1.46	5.38	0.43
7	Chocolate candy	2.55	24.41	4.03	4.10	0.49	2.22	22.72	2.79	3.89	0.34
8	Milk, plain or not (w/o: sugar)	2.36	4.60	0.39	0.82	0.10	2.23	3.78	0.50	0.78	0.10
9	Cookies	3.15	35.72	2.95	6.20	0.46	1.49	25.93	1.59	4.49	0.28
10	Whole Grain Crackers	1.74	6.84	0.45	1.41	0.10	2.02	6.29	0.41	1.43	0.06

% contrib: percentual of contribution; g/d: consumption in grams per day; %TE: percentage of the total energy; w: with; w/o: without; SE: Stardard Error.

empty calories), there are no specific recommendations regarding the amount of added sugar intake in Brazil. The WHO[4] guideline focused only on the amount of free sugar intake, recommending less than 10% of TE intake and suggesting further reduction of free sugars to below 5% of TE. Despite the fact that no specific recommendations exist, evidences in recent studies indicate that excessive consumption of added sugar sources is a major risk of overweight and obesity and increases the risks of developing hypertension, dyslipidemia, and insulin resistance[18,19].

The top five contributors to intake of added sugar in EBANS were soft drinks, powder juice mix with sugar, milk with white sugar, coffee with white sugar, and plain sugar, which were similar to those reported in other countries. In Mexico, the main contributors were sugar-sweetened beverages (SSBs), unsweetened and artificially sweetened beverages, sweetened milk and milk beverages, pastries and other cereal-based desserts and sweets, sugars, and other sweeteners as main food sources[20]. In the United States, the main food sources of added sugars were SSBs, desserts, sugary fruit, and candy, determined by the "National Health and Nutrition Examination Survey" (NHANES 2005–2010)[21]. In Europe, the top sources of added sugar were sweet products and beverages such as soft drinks and dairy products[22]. In Australia, the top sources of added sugar were SSBs, sugar and sweet spreads and cakes, biscuits, pastries, and batter-based products[23].

Thus, the findings of the present study were consistent with those observed worldwide; that is, SSBs (including non-diet soft drinks, flavored juice drinks and other sweetened fruit drinks, sports drinks and energy drinks, sweetened teas and coffees, dairy beverages, lemonade, and other fruit-ades) are the main sources of added sugar consumption. Our results revealed that soft drinks (36.02%) and other SSBs (powder juice, milk, coffee, natural juice, milk plain or not), that together represented 68.87%, are the main sources of added sugars in Brazilian diet and was also observed among Mexican, American, Spanish and Australian diets[21,23-24]. High consumption of SSBs is one of the main factors responsible for higher prevalence of obesity and obesity-related diseases[25]. This finding serves as a basis for establishing policy interventions such as overcharging SSBs, with the objective of try reversing this scenario in several countries, as Denmark, Finland, Hungary, France, Norway, United States, Mexico, Australia, and Chile[26-28].

The results indicated that the percentages of TE intake from added sugars are high. A single food item soft drinks exceeding the Dietary Guidelines for Americans recommendations of 10% to TE intake for all groups evaluated. Interestingly,

Table 4A. Top 10 food and beverage sources of added sugar by contribution (%), consumption in grams/day (g/d) and percentage of the total energy (%TE) in participants of the study, according to Brazilian macro-regions.

	Foods /beverages	South (n=197)					Southeast (n=1116)					Midwest (n=168)				
		% contrib	g/d		%TE		% contrib	g/d		%TE		% contrib	g/d		%TE	
			Mean	SE	Mean	SE		Mean	SE	Mean	SE		Mean	SE	Mean	SE
1	Soft Drinks	38.13	54.06	4.86	12.78	1.16	39.15	57.83	2.08	11.81	0.35	23.76	48.83	4.37	9.38	0.65
2	Powder juice mix (w/sugar)	14.61	37.92	12.39	8.12	1.63	9.9	27.58	1.34	6.64	0.31	16.62	32.72	3.65	6.05	0.52
3	Milk (w/sugar)	7.73	12.76	1.62	3.11	0.43	6.89	14.32	0.52	3.49	0.19	10.88	23.62	2.42	4.37	0.51
4	Coffee (w/sugar)	9.35	13.9	2.28	3.47	0.5	5.88	10.45	0.52	2.85	0.15	13.1	19.09	2.32	4.45	0.56
5	Plain sugar	7.04	14.82	2.48	3.66	0.8	6.99	18.03	0.71	3.44	0.15	7.85	21.82	3.47	3.65	0.54
6	Natural juice (w/sugar)	1.04	16	1.73	3.96	0.53	3.23	22.65	1.68	5.41	0.34	3.63	19.3	1.79	3.7	0.47
7	Chocolate candy	2.59	24.69	6.29	5.3	1.45	2.81	25.31	3.05	4.28	0.37	0.57	14.78	5.04	2.09	0.58
8	Milk, plain or not (w/o:sugar)	1.94	3.77	0.94	0.89	0.22	2.55	4.27	0.32	0.81	0.08	2.31	6.19	2.04	1.2	0.36
9	Cookies	1.1	22.8	6.18	3.27	0.78	1.85	32.06	1.72	5.8	0.37	3.05	41.45	10.19	5.26	0.7
10	Whole Grain Crackers	0.98	4.4	1.11	1.09	0.17	1.76	6.11	0.42	1.42	0.07	1.79	6.88	1.22	1.45	0.18

% contrib: percentual of contribution; g/d: consumption in grams per day; %TE: percentage of the total energy; SE: Stardard Error; w: with; w/o: without.

between 1987 and 2003, Brazilians had higher consumption of soft drinks, which increased the added sugar intake from 6.1% to 18.8%[29]. A previous meta-analysis showed that higher intake of soft drinks is associated with increased energy intake and incidence of overweight or obesity, and lower intakes of milk, calcium, and other nutrients, contributing to higher risk of developing health problems[5-6].

Notably, the other SSBs that were considered as the main source of added sugar and had contributed more to the average intake of added sugar were powder juice mix, natural juice, and milk and coffee with white sugar. Similarly, the 2008–2009 Brazilian Household Budget Survey (BHBS)[30] indicated that coffee provides high amounts of TE. These results revealed that coffee is an important driver of added sugar intake as well as milk. Furthermore, it is important to highlight how much these food sources of added sugar provide empty calories; leastways the milk is a significant contributor to calcium intake[22].

The second component that contributed more to the average intake of added sugar (g/d) was "cookies" for the most categories analyzed. Sweets, cookies, snacks, soft drinks, and SSB usually provide low amounts of nutrients (minerals, vitamins, and fiber); so, The Dietary Guidelines for the Brazilian Population 2014[7] recommends that cookies and snacks should be avoided because they are not nutritionally balanced.

Differences among sexes were also observed in the "Dutch National Food Consumption Survey (DNFCS) 2007–2010"[31]. This study showed that men had higher absolute sugar intake than women, but women consumed more energy from sugar than men. While women had higher proportion of contribution, the average consumption (g/d) were higher among men, excluding coffee with sugar. The same result was demonstrated in ELANS study, while Brazilian women had highest proportion of contribution (13.1%) than men (12%), the average consumption were highest among men (61.8 g/d) than women (53.9 g/d)[3].

With regard to age groups, the Brazilian Study of Cardiovascular Risks in Adolescents (ERICA)[32] revealed that adolescents had higher consumption of juices and soft drinks, fried and baked snacks, and sweet and savory biscuits and had an excessive consumption of saturated fatty acids and free sugar. In this study, adolescents had higher proportion and average consumption of soft drinks, chocolate candy and cookies than the other age groups. Following this way, previous study with EBANS data observed that Brazilian adolescents presented the highest consumption of added sugar

Table 4B. Top 10 food and beverage sources of added sugar by contribution (%), consumption in grams/day (g/d) and percentage of the total energy (% TE) in participants of the study, according to Brazilian macro-regions.

	Foods/beverages	North (n=137)					Northeast (n=382)				
		% contrib	g/d		%TE		% contrib	g/d		%TE	
			Mean	SE	Mean	SE		Mean	SE	Mean	SE
1	Soft Drinks	37.45	58.09	3.44	10.26	0.67	31.97	47.62	3.23	10.2	0.63
2	Powder juice mix (w/sugar)	3.11	16.46	2.72	3.92	0.61	4.27	23.8	6.67	4.17	0.68
3	Milk (w/sugar)	14.64	16.16	1.66	3.5	0.36	10.18	17.29	1.5	3.73	0.28
4	Coffee (w/sugar)	6.22	13.58	1.03	3.17	0.21	9.96	13.64	1.13	3.17	0.25
5	Plain sugar	8.47	18.02	3.98	3.34	0.5	7.49	16.67	1.33	3.55	0.31
6	Natural juice (w/sugar)	6.32	27.42	5.95	5.15	1.3	11.78	27.4	3	5.61	0.69
7	Chocolate candy	1.05	13.1	1.73	2.13	0.23	2.37	21.63	7.24	3.22	0.64
8	Milk, plain or not (w/o:sugar)	2.41	3.32	1.54	0.45	0.2	1.64	3.3	1.07	0.69	0.24
9	Cookies	2.51	20.37	3.9	4.48	0.76	3.51	32.72	3.46	5.83	0.77
10	Whole Grain Crackers	3.51	7.87	0.77	1.49	0.08	2.32	7.65	0.63	1.52	0.13

% contrib: percentual of contribution; g/d: consumption in grams per day; %TE: percentage of the total energy; SE: Stardard Error; w: with; w/o: without.

(74.2 g/d) and % TE (14.5%) compared with other age groups, and this consumption decreases with age (20–34 years: 62.3 g/d and 55.5%; 35–49 years: 42.7 g/d and 13.1% and 50–65 years: 12.5 g/d and 10.7%)[3].

In the BHBS, the contribution of added sugars to household food availability in Brazil reached 16.7% of TE. In the Northern region of Brazil, added sugars corresponded to 13% of TE; in the other regions, it was between 16.3% and 18.1%[33]. The present study showed that the North had the lowest mean of consumption among top 10 added sugar food sources compare with the other macro-regions (194 g/d; 37.88% TE).

Notwithstanding, this study had several limitations. Foods considered as "unhealthy" may have been underreported during the interview. Thus, the actual values may still have been underestimated[34]. The strength of this study was that it used a representative sample of the largest country in Latin America, which can assist the development of public policies, mainly related to the control and prevention of obesity and other chronic diseases.

CONCLUSION

The *Estudo Brasileiro de Nutrição e Saúde* shows that beverages were the main contributor, among sexes, age groups, nutritional status, and Brazilian macro-regions of added sugars in Brazilian diet.

There is an overlap between the major sources of added sugar and empty calories, especially for soft drinks, coffee and cookies. However, product reformulation alone is not enough. Public health education programs should focus on reduce of added sugar content in homemade beverages (like natural juice, milk and coffee) in the overall Brazilian population.

REFERENCES

1. Frawley N. The Brazilian sugar industry. Agric Commod. 2016;6(2):63.

2. Block JM, Arisseto-Bragotto AP, Feltes MM. Current policies in Brazil for ensuring nutritional quality. Food Qual Safety. 2017;1(4):275-88.

3. Fisberg M, Kovalskys I, Gómez G, Rigotti A, Sanabria LC, García MY, et al. Total and Added Sugar Intake: Assessment in Eight Latin American Countries. Nutrients. 2018;10(4):389.

4. World Health Organization (WHO). Sugars intake for adults and children: Guideline [Internet]. Genebra: WHO; 2015. Available from: https://apps.who.int/iris/bitstream/handle/10665/149782/9789241549028_eng.pdf?sequence=1

5. Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. Am J Clin Nutr. 2006;84(2):274-88. Review.

6. Vartanian LR, Schwartz MB, Brownell KD. Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. Am J Public Health. 2007;97(4):667-75.

7. Ministério da Saúde (MS). Guia alimentar para a população brasileira [Internet]. Brasília: Ministério da Saúde; 2014.

8. Welsh JA, Sharma AJ, Grellinger L, Vos MB. Consumption of added sugars is decreasing in the United States. Am J Clin Nutr. 2011;94(3):726-34.

9. Wittekind A, Walton J. Worldwide trends in dietary sugars intake. Nutr Res Rev. 2014;27(2):330-45. Review.

10. Dodd KW, Guenther PM, Freedman LS, Subar AF, Kipnis V, Midthune D, et al. Statistical methods for estimating usual intake of nutrients and foods: a review of the theory. J Am Diet Assoc. 2006;106(10):1640-50. Review.

11. Moshfegh AJ, Rhodes DG, Baer DJ, Murayi T, Clemens JC, Rumpler WV, et al. The US Department of Agriculture Automated Multiple-Pass Method reduces bias in the collection of energy intakes. Am J Clin Nutr. 2008;88(2):324-32.

12. University of Minnesota. Nutrition Coordinating Center, Nutrition data system for research (NDSR). 2008.

13. Núcleo de Estudos e Pesquisas em Alimentação. Tabela brasileira de composição de alimentos. 4th ed. 2011.

14. Kovalskys I, Fisberg M, Gomez G, Rigotti A, Cortés LY, Yépez MC, et al. Standardization of the Food Composition Database Used in the Latin American Nutrition and Health Study (ELANS). Nutrients. 2015;7(9):7914-24.

15. Block G, Dresser CM, Hartman AM, Carroll MD. Nutrient sources in the American diet: quantitative data from the NHANES II survey. I. Vitamins and minerals. Am J Epidemiol. 1985;122(1): 13-26.

16. Erickson J, Slavin J. Total, added, and free sugars: are restrictive guidelines science-based or achievable? Nutrients. 2015;7(4): 2866-78.

17. US Department of Health and Human Services, US Department of Agriculture. Dietary guidelines for Americans 2015-2020 [Internet]. Skyhorse Publishing Inc.; 2017. Available from: https://health.gov/dietaryguidelines/2015/guidelines/

18. Johnson RK, Appel LJ, Brands M, Howard BV, Lefevre M, Lustig RH, et al. Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. Circulation. 2009;120(11):1011-20.

19. Te Morenga L, Mallard S, Mann J. Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. BMJ. 2012;346:e7492. Review.

20. Sánchez-Pimienta TG, Batis C, Lutter CK, Rivera JA. Sugar-Sweetened Beverages Are the Main Sources of Added Sugar Intake in the Mexican Population. J Nutr. 2016;146(9): 1888S-96S.

21. Ervin RB, Ogden CL. Consumption of added sugars among US adults, 2005-2010. NCHS Data Brief. 2013;122:1-8.

22. Azaïs-Braesco V, Sluik D, Maillot M, Kok F, Moreno LA. A review of total & added sugar intakes and dietary sources in Europe. Nutr J. 2017;16:6.

23. Lei L, Rangan A, Flood VM, Louie JC. Dietary intake and food sources of added sugar in the Australian population. Br J Nutr. 2016;115(5):868-77.

24. Ruiz E, Rodriguez P, Valero T, Ávila JM, Aranceta-Bartrina J, Gil A, et al. Dietary Intake of Individual (Free and Intrinsic) Sugars and Food Sources in the Spanish Population: Findings from the ANIBES Study. Nutrients. 2017;9(3):E275.

25. Hu FB. Resolved: there is sufficient scientific evidence that decreasing sugar sweetened beverage consumption will reduce the prevalence of obesity and obesity related diseases. Obes Rev. 2013;14(8):606-19. Review.

26. Eyles H, Mhurchu CN, Nghiem N, Blakely T. Food pricing strategies, population diets, and non-communicable disease: a systematic review of simulation studies. PLoS Med. 2012;9(12): e1001353.

27. World Health Organization (WHO). Using price policies to promote healthier diets [Internet]. Genebra: WHO; 2015. Available from: http://www.euro.who.int/__data/assets/pdf_file/0008/273662/Using-price-policies-to-promote-healthier-diets.pdf

28. Popkin BM, Hawkes C. The sweetening of the global diet, particularly beverages: patterns, trends, and policy responses for diabetes prevention. Lancet Diabetes Endocrinol. 2016;4(2):174-86.

29. Levy RB, Claro RM, Bandoni DH, Mondini L, Monteiro CA. Availability of added sugars in Brazil: distribution, food sources and time trends. Rev Bras Epidemiol. 2012;15(1):3-12.

30. Bezerra IN, Goldman J, Rhodes DG, Hoy MK, Souza AM, Chester DN, et al. Difference in adult food group intake by sex and age groups comparing Brazil and United States nationwide surveys. Nutr J. 2014;13(1):74.

31. Sluik D, van Lee L, Engelen AI, Feskens EJ. Total, free, and added sugar consumption and adherence to guidelines: the Dutch National Food Consumption Survey 2007–2010. Nutrients. 2016;8(2):70.

32. Souza AM, Barufaldi LA, Abreu GA, Giannini DT, Oliveira CL, Santos MM, et al. ERICA: intake of macro and micronutrients of Brazilian adolescents. Rev Saude Publica. 2016;50(suppl 1):5s.

33. Monteiro LL, Hassan BK, Rodrigues PR, Yokoo EM, Sichieri R, Pereira RA. Use of Table Sugar and Artificial Sweeteners in Brazil: National Dietary Survey 2008–2009. Nutrients. 2018;10(3):295.

34. Lafay L, Mennen L, Basdevant A, Charles MA, Borys JM, Eschwege E, et al. Does energy intake underreporting involve all kinds of food or only specific food items? Results from the Fleurbaix Laventie Ville Sante (FLVS) study. Int J Obes Relat Metab Disord. 2000;24:1500–6.