

## MAIN SOURCES OF ADDED SUGAR IN ARGENTINA

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IN REPRESENTATION OF THE ELANS GROUP

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**Abstract** The high consumption of added sugars in the diet of the Argentine population and its consequent effect on health are current concerns both at the clinical and public health levels. The objective of this study was to determine the main sources of added sugars in the Argentine diet and the proportional energy contribution of each of them. The sample consisted of 1266 individuals, representative of the country's urban population from 15 to 65 years old, stratified by region, age, gender and socio-economic level. Two 24-hour dietary recalls and one socio-economic questionnaire were carried out. Among the total food and beverages consumed by Argentines, 26.9% of added sugars were provided by soft drinks and 23.8% by infusions. The third place, with 15.4%, came from baked goods (bread, cookies, etc.) and the fourth, with 12%, from ready-to-prepare juices, ahead of sweets and candies and dairy products. Men, compared to women, consumed significantly more added sugars in soft drinks (32.6 vs. 22.1%), while women consumed more added sugars in infusions (25.5 vs. 21.8%), baked goods, sugar and honey. The lower income population consumed significantly more sugar in infusions at the expense of "mate" (21.4 vs. 7 g/day), while no differences were observed in the consumption of soft drinks by socio-economic level (32.9 vs. 34.4 g/day). Urgent measures based on education could improve the consumption habits of added sugars and the health of the population.

**Key words:** added sugars, diet quality, Argentina, dietary sources of sugars, nutrition surveys

**Resumen** *Principales fuentes de azúcares de adición en Argentina.* El alto consumo de azúcares añadidos en la dieta de la población argentina y su consecuente efecto sobre la salud son preocupaciones actuales tanto a nivel clínico como de salud pública. El objetivo del presente estudio consistió en determinar las principales fuentes de azúcares añadidos de la dieta argentina y determinar el aporte proporcional de energía de cada una de ellas. La muestra consistió en 1266 individuos, representativa de la población urbana del país de 15 a 65 años y estratificada por región, edad, género y nivel socioeconómico. Se efectuaron dos recordatorios de ingesta de 24 horas y un cuestionario de nivel socioeconómico. Entre el total de alimentos y bebidas consumidos por los argentinos el 26.9% del azúcar lo aportaron las gaseosas y el 23.8% las infusiones. El tercer lugar, con 15.4%, provino de los panificados (pan, galletitas, facturas) y el cuarto, con 12%, de jugos listos para preparar, por delante de los dulces y golosinas y lácteos. Los hombres, en comparación con las mujeres consumieron significativamente más azúcares añadidos en gaseosas (32.6 vs. 22.1%) y las mujeres más en infusiones (25.5 vs. 21.8%), panificados, azúcar y miel. La población de menores recursos consumió significativamente más azúcar en infusiones a expensas del mate (21.4 vs. 7 g/día) y no se observaron diferencias en el consumo de gaseosas por nivel socioeconómico (32.9 vs. 34.4 g/día). Urgentes medidas basadas en la educación podrían mejorar los hábitos de consumo de azúcares y la salud de la población.

**Palabras clave:** azúcares añadidos, dieta, población argentina, fuentes de azúcar, encuestas nutricionales

An adequate energy balance is crucial for maintaining a healthy body weight and, consequently, for decreasing the risk associated with obesity and cardio-metabolic diseases. In this context, free sugars contribute to the increase in the total energy density of the diet, promoting a positive balance<sup>1, 2</sup>. However, a high sugar consumption is also associated with a lower diet quality and an increased risk in chronic non-communicable diseases<sup>3</sup> and dental caries<sup>4</sup>.

The World Health Organization (WHO) defines “free sugars” as those monosaccharides and disaccharides added to food by manufacturers, cooks or consumers and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates. On the other hand, intrinsic sugars are those found in fresh whole fruits and vegetables<sup>5</sup>.

Due to its health effects, the WHO recommends decreasing free sugar consumption to less than 10% of the total energy intake (strong recommendation), suggesting an additional reduction in free sugars below 5% of the total energy intake as a conditional recommendation<sup>5</sup>.

Within a single population, there are marked differences in the free sugars’ intake –derived from the different food sources– according to age and socioeconomic and educational status. These differences among distinct population segments are clearly represented in a recently published article with data from Argentina, one of the countries with the highest consumption of free sugars in the region, widely exceeding the current recommendations with a mean of 16.4% of the total energy intake<sup>6</sup>. The results showed that, in Argentina, men consume more total and free sugars in absolute terms, while women consume a higher percentage of their energy as sugars. Sugar consumption decreases with age, being adolescents the greatest consumers of free sugars and older adults the greatest consumers of intrinsic sugars. Moreover, the study informed that free sugar intake is inversely proportional to the population’s socioeconomic (SEL) and educational level and identified two regions of the country (Patagonia and Northwest) with a considerably higher sugar consumption<sup>7</sup>.

It is essential to have updated information on the main dietary sugar sources to design and implement effective measures that will reduce free sugars’ consumption at a population level. This would also allow to take specific educational actions for each population subgroup, taking the different social status into consideration. The main objective of this study was to describe the different sources of added sugars consumed by the Argentine population, according to the data from the Argentine Study on Nutrition and Health (EANS, in Spanish).

The secondary objectives of this study were: -To examine the different sugar sources in relation to age, gender, SEL and country region; -To determine the specific weight of each one of the foods/groups of foods in the total energy consumption (% TE).

## Materials and methods

The Argentine Study on Nutrition and Health (EANS) corresponds to the Argentine chapter of the Latin American Study on Nutrition and Health (ELANS, in Spanish). The ELANS has been approved by the *Western Institutional Review Board* (#20140605) and registered at *Clinical Trials* (#NCT02226627). The EANS has added the approval of the Ethic Committee of the Argentine Medical Association as a local approval of the international study. All individuals participating in the study completed an informed consent prior to their participation and a consent plus assent for cases from 15.0 to 17.9 years old.

The Argentine sample has been calculated in 1200 individuals to be representative of the population by age, gender, socioeconomic level (SEL) and country region. The general design of the study corresponds to a complex, multistage, cluster stratified (cities or cluster of cities), randomized sampling<sup>8</sup>. The used sampling frame privileges the available and official demographic information from the National Institute of Statistics and Censuses of Argentina (INDEC, in Spanish)<sup>9</sup>. The final sample was weighed based on the available information from the 2010 Population Census and from the 2015 Homes’ Permanent Survey<sup>10</sup>, and finally adjusted for a population projection for 2015. The final sample was constituted by 1266 individuals, representative of an urban population, stratified into 4 age groups (15-19, 20-34, 35-49 and 50-65 years old), by gender (female and male) and socioeconomic level (high, medium and low). For the SEL assessment, the questionnaire proposed by the AAM-SAIMO-CEIM Institutional Link Commission was used. The SEL categories thus obtained were regrouped into those used for the sample stratification according to the following equivalence: categories D1 and D2 as low, C2 and C3 as medium, and C1 and AB as high<sup>11</sup>. All the country regions were represented in the study sample: Pampa, Patagonia or South region, “Cuyo”, Northeast (NEA), Northwest (NWA) and Metropolitan Area of Buenos Aires (AMBA, in Spanish). All persons that were randomly invited to participate in the study and signed the informed consent were included. Those individuals that did not sign the consent, that were not in healthy physical or mental conditions to answer the questions for themselves or had a health condition that would acutely or chronically compromise their nutritional status or intake

were excluded. Neither pregnant nor nursing women up to 6 months after postpartum were part of this study.

For the intake determination, participants completed two 24-hour dietary recalls (R24) in non-consecutive days (3-5 days), with a standardized intake collection technique (Multiple-Pass Method)<sup>12</sup>. The intake collection interview was done at home, in person, and was carried out by an interviewer trained for that purpose. Supporting materials (e.g. visual guide of portions and measurements specifically designed for local foods and local utensils)<sup>13</sup> were used to allow the determination of the food portions with higher precision.

The intake information obtained was loaded into the *NDSR software, Nutrition Data System for Research software*, version 2013 (NDS-R, Minnesota University, MN, USA), through which the composition of energy, macro and micronutrients of the total foods and beverages was obtained, as well as the information on the total sugars added to foods and beverages, both homemade and industrialized. The complete information on the methodology of the intake evaluation and standardization of the study can be found in Kovalskys et al<sup>14</sup>. The preparations or recipes that were not included in the program's database were loaded based on their ingredients. Specifically, for Argentine foods, 638 foods and 195 local recipes were standardized.

In the NDSR, the information on added sugar was captured and analyzed through the composition of sugars and syrups added to the food during homemade preparation or industrial processing [sugar in all its forms (saccharose), honey, molasses or syrups (high-fructose corn syrup or others), fructose, glucose (dextrose), lactose, etc.], excluding mono and disaccharides constituting the natural food structure, as lactose in milk or fructose in fruits.

In order to analyze the contribution of added sugars to foods, two methods that provide complementary information were used: 1- The method proposed by Block et al.<sup>15</sup>, which emerges from the relationship between total added sugars (provided by a specific food) and the added sugars provided by the total of foods, while also considering the characteristics of the population sample. The result obtained from such methodology is the proportion of sugars provided by a food or group of foods over the total sugar consumed by the whole. The methodology proposed by Block et al. does not allow to make an individual estimate and, consequently, makes the comparative analysis according to the characteristics of the population not possible. For this reason, it was complemented by the second model of analysis.

2- The contribution of the individual mean percentage complements the population information with the proportion of sugar provided by a certain food in the individual consumption. In summary, the sugar proportion of a given food [e.g. "dulce de leche" (caramelized milk)] in relation to the total foods consumed that provide sugar, averaged between both recalls and, afterwards, for all the individuals, is the percentage of mean individual contribution. The intake information obtained was analyzed by gender (female and male), age groups (15-19, 20-34, 35-49 and 50-65 years old), SEL and country region.

ANOVA was used for comparisons among groups. It should be noted that the mean distribution in added sugar consumption did not follow a normal distribution. Thus, the analysis has been complemented with non-parametric tests (Mann-Whitney U-test). Moreover, weighing (sample weights) and adjustment by groups and strata of the complex sampling design were incorporated. Data were analyzed using the SPSS package version 20 for Windows, SPSS, Inc., Chicago, IL, USA. Results were considered significant when  $p < 0.05$ .

## Results

A description of the study population can be observed in Table 1.

Table 2 shows the groups of foods and beverages that are the main sources of added sugars in the Argentine population, as well as their energy contribution expressed as a percentage of the total energy and of the energy coming from sugars.

Soft drinks contribute the highest amount of added sugars, mainly among men, who show a mean consumption of  $42.7 \pm 51.2$  g, compared with  $22.3 \pm 35.8$  g consumed by women.

The second group of foods/beverages as source of added sugars is constituted by infusions with added sugar (coffee, tea or "mate"), in which no significant differences are observed in relation to gender:  $22.0 \pm 29.2$  g for men and  $22.6 \pm 36.7$  g for women. Within this group, "mate" constitutes the highest consumption ( $16.8 \pm 28.3$  g for men and  $18.6 \pm 35.9$  g for women), again showing no significant differences by gender.

The third group in importance as a source of added sugars is that of the whole bakery goods, (French bread, croissants, cookies, biscuits etc.) with a consumption of  $10.3 \pm 14.2$  g for men and  $9.8 \pm 12.7$  g for women. These differences in gender are not significant either. It is important to point out that cookies, biscuits and crackers account for half of the contribution of added sugars

TABLE 1.– Sample composition

Sample composition		N = 1266
Gender <sup>1</sup>	Male	573 (45.3)
	Female	693 (54.7)
Socioeconomic level <sup>1</sup>	High	65 (5.1)
	Middle	585 (46.2)
	Low	616 (48.7)
Age ranges <sup>1</sup>	15-19 years old	152 (12.1)
	20-34 years old	446 (35.2)
	35-49 years old	379 (29.9)
	50-65 years old	289 (22.8)
Region <sup>1</sup>	AMBA <sup>2</sup>	468 (37.0)
	Pampas	374 (29.5)
	Cuyo	103 (8.1)
	Northwest	138 (10.9)
	Northeast	139 (11.0)
	South	44 (3.5)

<sup>1</sup>N (%); <sup>2</sup>AMBA: Metropolitan Buenos Aires Ares

TABLE 2.– Main food and beverage sources of sugar per gender

Groups	Subgroups	% TE			% individual mean contribution			% contribution total sum		
		Total	Men	Women	Total	Men	Women	Total	Men	Women
Regular soft drink		5.3 (6.8)	6.4* (7.3)	4.2* (6.1)	26.9 (29.5)	32.6** (31.3)	22.1** (27.1)	35.1	40.9	28.7
Infusions <sup>1</sup>	Total	4.3 (6.1)	3.6* (4.9)	4.9* (7.0)	23.8 (26.0)	21.8** (24.7)	25.5** (26.9)	24.8	21.0	29.1
	"Mate"	3.4 (5.8)	2.7* (4.7)	3.9* (6.5)	18.2 (24.8)	15.9** (23.4)	20.0** (25.8)	19.8	16.1	24.0
	Coffee and tea	0.9 (2.3)	0.9 (2.0)	0.9 (2.6)	5.6 (12.7)	5.8 (11.5)	5.5 (13.1)	5.0	5.0	5.1
Bakery goods <sup>2</sup>	Total	1.8 (2.2)	1.5* (1.9)	2.1* (2.4)	15.4 (20.2)	13.0** (18.6)	17.4** (21.3)	11.1	9.8	12.6
	Cookies & biscuits	0.9 (1.1)	0.8* (1.4)	1.0* (1.6)	7.1 (13.3)	5.8** (11.6)	8.1** (14.5)	5.5	5.1	5.9
	Puddings, cakes and pastries	0.5 (1.6)	0.4* (1.3)	0.6* (1.9)	3.6 (11.4)	2.8** (9.7)	4.3** (12.6)	3.4	2.7	4.2
	Bread and cereals	0.4 (0.6)	0.4 (0.5)	0.4 (0.7)	4.7 (11.6)	4.4 (11.8)	5.0 (11.4)	2.3	2.1	2.5
Juices <sup>3</sup>		1.9 (3.4)	2.0 (3.4)	1.8 (3.5)	12.0 (19.6)	12.8 (20.7)	11.3 (18.7)	10.9	11.5	10.2
Sweets and candies <sup>4</sup>	Total	1.4 (2.1)	1.2* (1.9)	1.6* (2.3)	10.3 (15.5)	8.6** (13.7)	11.6** (16.8)	8.6	7.3	10.1
	Sugar, honey and syrup	0.5 (1.3)	0.4* (1.1)	0.6* (1.4)	3.8 (9.1)	2.9** (8.0)	4.5** (9.8)	3.2	2.5	4.0
	Chocolates and jellies	0.4 (1.0)	0.3* (0.9)	0.4* (1.1)	2.9 (8.6)	2.5 (7.8)	3.2 (9.1)	2.2	1.7	2.7
	Caramelized milk	0.3 (0.8)	0.3 (0.7)	0.3 (0.6)	2.2 (5.8)	2.0 (5.0)	2.3 (6.4)	2.1	2.1	2.1
	Candies	0.2 (0.6)	0.2 (0.5)	0.2 (0.6)	1.5 (5.4)	1.2 (4.8)	1.7 (5.9)	1.1	0.9	1.2
Milk and dairy products <sup>5</sup>		1.2 (2.2)	1.2 (2.2)	1.2 (2.2)	8.3 (15.3)	8.1 (15.2)	8.4 (15.5)	7.3	7.6	6.9

%TE: % Total Energy; % individual mean contribution: mean contribution provided by each food expressed as total grams of sugar per individual of the sample; % total sum contribution: contribution provided by each food expressed as total grams of sugar consumed by the whole population (Block et al)15; <sup>1</sup>"mate", tea and coffee; <sup>2</sup>cookies; puddings, cakes and pastries; bread and cereals; <sup>3</sup>ready-to-prepare juices; <sup>4</sup>sugar, honey and syrup, chocolates and jellies, caramelized milk and candies; <sup>5</sup>whole milk, skim milk, ice cream, whole and low-fat yogurt. \*There are significant differences within each row (for the same food) in the % TE between men and women according to one-way ANOVA statistical test with a significance of  $p < 0.05$  \*\* There are significant differences within each row (for the same food) in the % of individual mean contribution between men and women according to one-way ANOVA statistical test with a significance of  $p < 0.05$

within baked goods ( $5.3 \pm 9.9$  g for men and  $4.6 \pm 7.4$  g for women), so they are analyzed separately.

In the fourth place of foods and beverages that provide added sugars to diet are instant powdered sugary juices. In this category, as with the soft drinks, men show a significantly higher consumption than women:  $12.1 \pm 20.4$  g vs  $7.9 \pm 14.0$  g.

The fifth place in this ranking is occupied by sweets and candies, showing no significant differences in consumption by gender:  $7.6 \pm 11.9$  g for men and  $7.8 \pm 12.9$  g for women.

Finally, the sixth group as source of added sugars is constituted by dairy products, where there is again a significantly higher consumption in men, with  $7.9 \pm 15.8$  g vs.  $5.4 \pm 9.9$  g in women.

Table 3 shows the consumption of added sugars (mean g/day) coming from the different groups of foods and beverages, in relation to age, country region and SEL.

Within the “infusions with added sugar” group, the main contribution of added sugars comes from “mate”, so it is analyzed separately. The sugar added to “mate” constitutes a mean consumption of  $17.8 \pm 32.6$  g for the whole country, varying from  $50.2 \pm 92.0$  g in the Patagonian

region to  $9.2 \pm 16.6$  g in the Northeast region ( $p < 0.01$ ); the latter showing significant differences with all the other regions of the country.

There are also significant differences in “mate” consumption in relation to the socioeconomic level (SEL): at a higher SEL, less “mate” is consumed, and in turn, less sugar is added to it.

Although there are no significant differences in “mate” consumption by gender, there are indeed significant differences by age group, since adolescents (15 to 19 years old) drink less sugary “mate” than older individuals.

Figure 1 shows the mean consumption of “mate” with or without added sugar (bitter or with non-caloric sweeteners) by country region. In all country regions, more “mate” with sugar than bitter “mate” is consumed, being Patagonia where more “mate” is consumed in the whole country and, proportionally, where the sweetest “mate” is consumed (88% of sugar-sweetened “mate”).

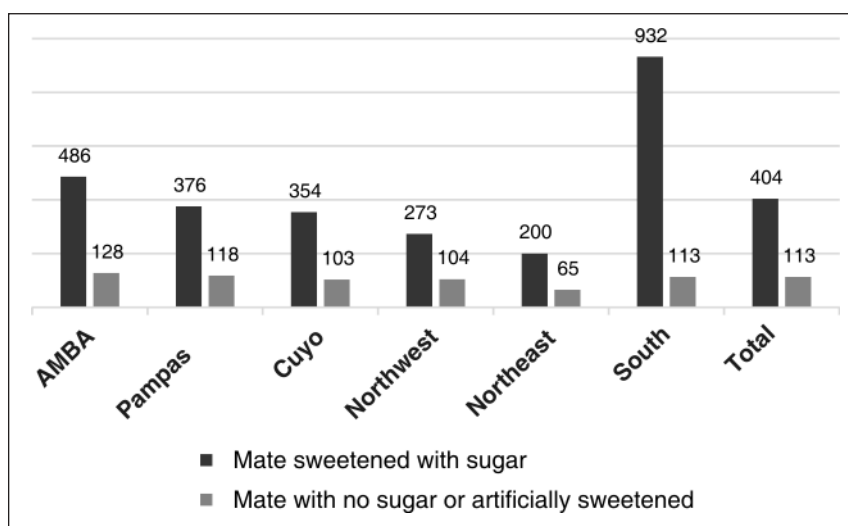
Within bakery goods, cookies, biscuits and crackers contribute as a source of added sugars with a mean consumption of  $4.9 \pm 8.6$  g for the whole country, with the AMBA (Buenos Aires) region having the highest consumption of them, with  $5.9 \pm 8.6$  g, in contrast with  $2.9 \pm 5.0$  g in the “Cuyo” (western) region.

TABLE 3.– Consumption of foods that are source of sugars by age, country region and socioeconomic level

Food (g/d) mean (SD)	Age (years)				p	Region						p	SEL			p
	15 to 19	20 to 34	35 to 49	50 to 65		AMBA	Pampas	Cuyo	Northwest	Northeast	South		High	Medium	Low	
Regular soft drink	40.9 (47.5) <sup>a</sup>	36.7 (48.2) <sup>b</sup>	30.6 (43.4) <sup>c</sup>	19.9 (35.7) <sup>abc</sup>	< 0.001	30.3 (42.1) <sup>a</sup>	30.5 (43.3) <sup>b</sup>	20.4 (30.5) <sup>c</sup>	53.9 (60.6) <sup>abcd</sup>	24.3 (36.3) <sup>d</sup>	31.5 (52.2)	< 0.001	34.4 (50.0)	29.8 (43.4)	32.9 (45.2)	0.4
Infusions <sup>1</sup>	17.3 (25.3) <sup>a</sup>	22.6 (30.1)	25.5 (41.8) <sup>a</sup>	20.3 (29.6)	0.05	24.1 (33.9) <sup>a</sup>	18.8 (24.1) <sup>b</sup>	23.5 (25.4) <sup>c</sup>	25.3 (30.3) <sup>d</sup>	11.5 (17.6) <sup>abcde</sup>	55.1 (92.0) <sup>e</sup>	< 0.001	11.2 (17.3) <sup>a</sup>	19.7 (28.3) <sup>a</sup>	25.9 (38.6) <sup>a</sup>	< 0.001
“Mate” with sugar	10.2 (22.7) <sup>ab</sup>	18.3 (29.5) <sup>a</sup>	21.3 (40.5) <sup>b</sup>	16.6 (29.3)	0.005	21.0 (34.0) <sup>a</sup>	14.9 (22.8) <sup>a</sup>	14.0 (22.6)	16.1 (26.1)	9.2 (16.6) <sup>a</sup>	50.2 (92.0)	< 0.001	7.0 (15.5) <sup>a</sup>	15.2 (26.5) <sup>a</sup>	21.4 (38.3) <sup>a</sup>	< 0.001
Bakery goods <sup>2</sup>	14.3 (19.6) <sup>ab</sup>	10.8 (13.5) <sup>c</sup>	8.8 (11.0) <sup>b</sup>	8.0 (11.4) <sup>ac</sup>	< 0.001	11.0 (14.2)	10.0 (12.5)	7.5 (10.1)	8.9 (13.3)	8.6 (11.9)	12.6 (20.7)	0.07	13.2 (15.7)	10.45 (13.9)	9.2 (12.5)	0.03
Cookies	8.4 (12.6) <sup>abc</sup>	5.5 (8.6) <sup>cd</sup>	4.3 (7.6) <sup>b</sup>	3.2 (6.5) <sup>cd</sup>	< 0.001	5.9 (8.6) <sup>a</sup>	4.9 (8.9) <sup>b</sup>	2.9 (5.0) <sup>ab</sup>	3.3 (8.2) <sup>a</sup>	5.0 (8.9)	4.8 (11.4)	0.005	6.3 (8.9)	5.3 (8.9)	4.45 (8.3)	0.12
Juices <sup>3</sup>	13.2 (15.6) <sup>ab</sup>	10.9 (17.6)	8.8 (18.4) <sup>a</sup>	7.6 (15.) <sup>b</sup>	0.003	8.3 (16.1) <sup>a</sup>	9.7 (15.7)	11.0 (16.0)	7.7 (15.9) <sup>b</sup>	14.6 (23.3) <sup>ab</sup>	14.1 (24.1)	0.001	9.1 (17.5)	9.71 (18.1)	9.9 (16.6)	0.94
Sweets and candies <sup>4</sup>	10.0 (14.3)	7.5 (11.0)	7.6 (12.7)	7.0 (13.0)	0.11	7.8 (12.4)	8.1 (13.4)	6.0 (9.1)	8.1 (13.8)	7.1 (10.7)	8.7 (11.4)	0.69	6.4 (10.2)	8.0 (11.7)	7.6 (13.4)	0.17
Milk and dairy products <sup>5</sup>	12.5 (19.5) <sup>ab</sup>	7.5 (13.8) <sup>bc</sup>	5.1 (10.8) <sup>a</sup>	4.0 (8.0) <sup>bc</sup>	< 0.001	6.3 (12.2)	6.5 (14.1)	7.1 (13.2)	6.2 (13.9)	6.9 (10.3)	7.6 (15.7)	0.97	5.7 (10.1)	7.5 (14.0)	5.7 (12.1)	0.05

SEL: Socioeconomic level; g/d: grams per day; SD: standard deviation; AMBA (Metropolitan Area of Buenos Aires) Region: Buenos Aires city and urban area; Pampas Region: Buenos Aires, Córdoba, La Pampa and Santa Fe Provinces; “Cuyo” Region: San Luis, San Juan and Mendoza Provinces; Northeast Region: Misiones, Formosa, Chaco, Entre Ríos and Corrientes Provinces; Northwest Region: Jujuy, Catamarca, Tucumán, La Rioja, Salta and Santiago del Estero Provinces; Patagonia Region: Río Negro, Neuquén, Chubut, Santa Cruz and Tierra del Fuego Provinces; <sup>1</sup>“mate”, tea and coffee; <sup>2</sup>cookies, puddings, cakes and pastries, bread and cereals; <sup>3</sup>ready-to-prepare juices; <sup>4</sup>sugar, honey and syrup, chocolates and jellies, caramelized milk, candies; <sup>5</sup>whole milk, skim milk, ice cream, whole and low-fat yogurt; abcd Within a row, in the same food, for a different age group, region and SEL followed by lower case letters, there is a significant difference between values with the same letter according to one-way ANOVA statistical test with a significance of  $p < 0.05$  and Games-Howell post hoc test for unequal variances

Fig. 1.– Mean consumption of “mate” per region (ml/day)



No significant differences in the consumption of cookies, biscuits or crackers by SEL are found, but there are indeed significant differences by age group, with the segment from 15 to 19 years old having the highest consumption. An inversely proportional relationship with age, as with soft drinks, is also found.

## Discussion

The high consumption of added sugars in the diet is a public health issue of great concern, due to its negative effect on health<sup>5</sup>. However, there are scarce publications worldwide that effectively show which foods they mostly come from.

Although the main sources of added sugars throughout the country are soft drinks, sweet infusions and bakery goods, it is interesting to mention that the amount of sugar consumed in these foods and beverages varies considerably in relation to age, country region and socioeconomic level (SEL).

In general, the highest consumption of added sugars throughout the country is seen in adolescents, with a great consumption of soft drinks (mean of 40.9 g/day). The Patagonia region shows the highest consumption of added sugars, mainly from its addition to “mate” (mean of 50.2 g/day). Lowest-SEL people consume more added sugars, from infusions in general and, particularly, from “mate” (means of 25.9 and 21.4 g/day, respectively).

If we observe consumption in relation to age in Argentina, the consumption of soft drinks, sugary juices, baked goods and dairy products shows a similar behavior, which

is inversely proportional to age. In contrast, sugary infusions tend to show a pattern directly proportional to age.

However, while for baked goods (sweet cookies, puddings, pastries, etc.) there is a statistically significant decrease for each one of the age groups' cut-offs, sugar consumption in beverages (soft drinks, infusions and juices) only shows a drop in the older adults' group. This is coincident with the results of a recently published meta-analysis of 24 longitudinal studies that examined the drop in consumption of added sugars in relation to age between 13 and 30 years old<sup>16</sup>.

The fact that added sugars present in baked goods and dairy products show the same pattern of decrease in consumption with age makes sense considering that many times these foods and beverages share the consumption occasion (breakfast and afternoon tea).

In Argentina, adolescents from 15 to 19 years old consume added sugars in a wide variety of foods and beverages, leading all food groups, except for sugary infusions. These are the categories of foods and beverages in decreasing order of consumption: soft drinks, cookies and crackers, instant powdered sugary juices, dairy products and, finally, sweets and candies.

The fact that in Argentine adolescents the main contributors of added sugars are the soft drinks is in accordance with what was published in several countries such as Canadá<sup>17</sup>, USA<sup>18</sup> and Spain<sup>19</sup>. In the latter, sugary soft drinks represent 30.2% of added sugars, which decreases to 26.0% in adults and to 9.5% in older adults<sup>20</sup>. In turn, Australian adolescents show an added sugar intake from sugary soft drinks of 19.8%<sup>21</sup>.



There are very few reports connecting consumption and SEL. In the HELENA study, which evaluated the dietary sources of sugars in European adolescents, the parents' educational level was taken as a socioeconomic indicator, finding that the parents' low educational level was positively associated with a higher free sugar intake in their children<sup>22</sup>.

In Argentina, lower-SEL individuals consume more sugar in the infusions, mainly at the expense of "mate", which is the only source of added sugars that showed significant differences according to SEL.

"Mate" is an infusion made with the leaves of the "yerba mate" (*Ilex paraguariensis*), an arboreal species typical of Argentina, Uruguay, Paraguay and south of Brazil, which is part of the cultural heritage of those countries. Due to the tannin of the "yerba mate" leaves, the infusion presents a bitter taste, so that many people prefer to sweeten the "mate" with sugar or honey.

In Argentina, a mean of 517 ml of "mate" is consumed daily per person, from which 113 ml are "mate" without sugar (bitter or with non-caloric sweeteners). Thus, 78% of "mate" is consumed in the country with added sugar.

The results showing that lower-SEL people consume more "mate" with sugar could be explained by the fact that, traditionally, sugar is considered an accessible source of energy, much more affordable than other sources such as fruits and vegetables. Considering that Patagonia is the coldest region of the country, the access to fruits and vegetables –mostly during the wintertime– is often restricted or very expensive.

It is important to remark that if we consider the WHO recommendation not to exceed 50 g of added sugars daily (10% of a standard intake of 2000 calories)<sup>5</sup>, the Patagonian region is exceeding such recommendation only by the consumption of sweet "mate" (mean of 50.2 g/day).

When analyzing consumption in relation to the country region, important regional differences are observed, particularly with sugar consumption in beverages, where the two regions that lead consumption are Patagonia and the Northwest region.

In Patagonia, 100.7 g/day are consumed only as beverages (soft drinks, infusions and juices), so that considering a basic diet of 2000 calories, the Patagonian population would be consuming twice the WHO recommendation, only in beverages<sup>5</sup>. As it was previously mentioned, half of this contribution is provided by the sugary "mate".

In the Northwest region, 86.9 g/day of added sugars are consumed as beverages, which represents 74% more than the WHO recommendation. In this case, soft drinks are predominating over sweet "mate".

The two regions' (Patagonia and Northwest) beverage consumption is almost twice that of the least consuming region ("Cuyo", with 54.9 g/day). However, it is important to point out that even being the least consuming region in the country, "Cuyo" also exceeds the WHO recommendations by 4.9%, only from the beverage intake.

The results show that, in Argentina, the main added sugar sources are beverages, in the first place, and foods, in the second place; these sugars are energetically dense, poor in nutrients, and considered as "discretionary".

One way to decrease added sugar consumption is to reformulate these foods and beverages and to stimulate the population to choose options with lower sugar content<sup>23</sup>, as well as to opt for less sweetened foods. Studies as the present one contribute by reporting the groups of foods that should be the initial focus of these reformulations, and orienting the nutritional education in relation to the population habits so that a decrease in sugar consumption is effectively reflected in health indicators.

One of the limitations that the analysis of sugar sources presents in Argentina is that the declaration of their content in foods and beverages is not mandatory in the country. To avoid this issue, the different industries of foods and beverages were contacted to obtain the information on sugar content of the industrialized foods.

On the other hand, the sugar content of the homemade foods was estimated, as it is done in international studies of this type, applying a methodology for food standardization. For Argentina, more than 195 recipes were prepared, and more than 638 foods were standardized.

Another limitation of this study lies in the difficulties found to include high-SEL individuals. Although weighing factors have been used to correct it, it would be desirable to confirm the findings obtained by increasing the sample.

Even though there is no perfect method to evaluate the information on dietary intake, 24-hour dietary recalls have less chances of altering the feeding behavior than food records, being, in this way, the elected method to quantify real intakes in extensive population studies<sup>24,25</sup>.

A strength of this study is the use of two 24-hour dietary recalls, which constitutes a precise methodology to collect the information on the main sugar sources added to foods and beverages on a representative sample at a country level.

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*The two offices of memory are collection and distribution; by one images are accumulated, and by the other produced for use. Collection is always the employment of our first years; and distribution commonly that of our advanced age.*

Dos son las funciones de la memoria, coleccionar y distribuir; por una se acumulan imágenes, y por la otra se producen para el uso. Coleccionar es siempre ocupación de nuestros primeros años, la distribución, por lo común, de nuestra edad avanzada.

Samuel Johnson (1709-1784)

*The Idler. N° 44. The use of memory considered. 17 Feb 1759.*

En: <http://www.johnsonessays.com/the-idler/use-memory-considered/>; 1-9-2019