Original article

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Description of energy intake by degree of food processing. National Survey on Nutrition and Health of 2018–2019

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ABSTRACT

Introduction. Worldwide, children and adolescents lead the consumption of ultra-processed foods. The objective of this study was to describe the energy intake by the degree of food processing by age group in the urban population over 2 years of age in Argentina.

Population and methods. Cross-sectional study based on data from the 2nd National Survey on Nutrition and Health of 2018–2019 conducted using a multistage probability sample from urban areas of Argentina. Data were collected from a 24-hour recall and were analized, for each age group, the daily energy intake from 1) unprocessed or minimally processed foods; 2) processed culinary ingredients; 3) processed foods; and 4) ultra-processed foods. A descriptive, statistical analysis was performed.

Results. In 15 444 individuals older than 2 years, minimally processed foods accounted for 34.5% of daily energy; ultra-processed foods, 26.0%; processed foods, 23.0%; and culinary ingredients, 16.6%. The percentage of energy from ultra-processed foods is higher in children and adolescents than in adults ($p < 0.01$), while the trend is the opposite from processed foods and culinary ingredients ($p < 0.01$). Cookies, pastries, sweetened beverage and confectionery accounted for two-thirds of the energy contributed by ultra-processed foods.

Conclusion. Children and adolescents in urban areas in Argentina showed the highest energy intake from ultra-processed. Food policies should consider the characteristics of each age group to promote a healthier diet.

Key words: *food consumption; age groups; ultra-processed foods; nutrition surveys; Argentina.*

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INTRODUCTION

Ultra-processed foods, a category of the NOVA classification system,[1] are typically ready-to-consume, hyper-palatable foods and beverages marketed in large servings, with a strong marketing strategy mostly targeted at children.[2] They are usually energy-dense, high in salt, sugar, and low quality fats.[3] Their relative prices have decreased over time, especially in higher-income countries, so that the sale and consumption of these foods have increased progressively and steadily over the past decades worldwide.[1,4] Argentina is no stranger to this trend[5] and has the highest per capita sale of ultra-processed foods in the region.[6] As their sale and consumption increase, it is observed that children and adolescents are their main consumers, accounting for more than 60% of daily energy in high-income countries and up to 35% in lower-income countries.[2]

The evidence shows that an increased consumption of ultra-processed foods is associated with a nutritionally unbalanced diet,[7-14] an increased risk for overweight, obesity, and chronic noncommunicable diseases, as well as with other risk factors for these.[15,16] Obesity affects 3.6% of children under 5 years of age; 20.4% of children aged 5–17 years; and 33.9% of adolescents aged 18 years and older.[17] For all these reasons, the assessment of consumption patterns has become a priority in the nutritional epidemiology research agenda.

A dietary pattern with a large amount of ultra-processed foods in childhood may have consequences on the development of tastes and preferences, defining lifelong consumption patterns and affecting health in the short and long term,[18] in addition to a low prevalence of exclusive breastfeeding, an early introduction of foods and beverages of poor nutritional quality, and inadequate responsive feeding practices.[19] According to the analysis of the 1st National Survey on Nutrition and Health (*Encuesta Nacional de Nutrición y Salud*, ENNyS, 2005), between a quarter and a third of the energy consumed by children, female adolescents and women of reproductive age was provided by ultra-processed foods,[20] and such higher consumption was associated with a lower consumption of healthy foods and a higher intake of nutrients related to chronic diseases.[21] Based on the availability of data from the 2nd ENNyS, which includes more age groups, the objective of this analysis is to describe the energy intake by the degree of food processing by age group in the population over 2 years of age in Argentina.

POPULATION AND METHODS

Type of study and source of data

This was an observational, descriptive, and cross-sectional study. This analysis used the data from the food and beverage consumption database for the 2nd ENNyS conducted in Argentina between 2018 and 2019 (available at http://datos.salud.gob.ar/dataset/ennys2). The survey took a multistage probability sample of urban areas in Argentina with 5000 inhabitants or more and included 5763 children aged 0–23 months, 5829 children aged 2–12 years, 2399 adolescents (13–17 years old), and 7367 adults (≥18 years), of both sexes. This analysis included data for the population aged 2 years and older. Adults were also considered for the analysis, to compare their consumption with that of children and adolescents.

Data were collected using a 24-hour recall using the 5-step method to record all foods and beverages consumed during the day before to the interview. The Argentine Food Digital Photographic Atlas (Atlas Fotográfico Digital de Alimentos Argentinos, AFDAA)[22] was used during data collection to assist participants in estimating servings and interviewers in establishing quantities. In a subset of the population, a second recall was conducted; for this analysis; the values of the first 24-hour recall were used. The details about the methodology of the ENNyS can be found in the survey document.[17]

The following variables were obtained from the sociodemographic questionnaire: age, sex, level of education of the head of household in children under 18 years of age, and of the survey respondent for adults, health coverage, family income quintile per consumer unit (CU), region, and status as indigenous individual or descendant of indigenous peoples. All these variables were categorized according to the survey database.[17]

Variables

Based on the amount of foods and beverages consumed by each individual, the energy intake was estimated for each food in the database, using values from the Analysis System and Food Registry 2 (Sistema de Análisis y Registro de Alimentos 2, SARA 2) compiled for the ENNyS of 2018–2019.[23] The 1103 recorded foods were classified according to the degree of processing, following the NOVA[1] classification,

into mutually exclusive groups and subgroups: 1) unprocessed or minimally processed foods (14 subgroups: e.g., meat, root vegetables, grains, vegetables, legumes, fruits); 2) processed culinary ingredients (4 subgroups: e.g., vegetable oils, sugar, animal fats); 3) processed foods (10 subgroups: e.g., freshly made unpackaged breads, cheeses, vegetables and fruits preserved in brine or syrup); and 4) ultra-processed foods (21 subgroups: e.g., soft drinks, candies, cookies and pastries, packaged breads, sandwiches and burgers).

Data analysis

For the total sample and for each age group, the average daily energy intake (kcal/d) and the percentage of energy were estimated for each group of the NOVA classification and the respective food subgroups. The difference in means was assessed using an ANOVA test, with a significance level of $p < 0.05$.

The descriptive analysis was done considering the weighted sample with the SPSS software, version 20.

Ethical considerations

This study was conducted based on the data obtained from the ENNyS of 2018–2019, duly authorized by the *ad-hoc* Ethics Committee of the Department of Health Research of the National Ministry of Health and Social Development. The data used in our study are publicly available and conveniently anonymized in http://datos.salud.gob.ar/dataset/ennys2. In addition, all aspects related to the development of this project have been conducted in accordance with valid national and international standards.

RESULTS

A total of 15 444 individuals aged 2 years and older were assessed; *Table 1* shows the main characteristics of each age group assessed. In the sample of children and adolescents, there was a lower percentage of women, a greater public health coverage, and a higher proportion of low-income households.

Figure 1 and *Table 2* describe the energy intake from each food subgroup in each group of the NOVA classification. Minimally processed foods account for one-third of the daily energy intake, with the lowest average value observed in adolescents ($p < 0.01$). Cereals and meats were the most important foods within this group, while milk and plain yogurt contributed 7.3% of the energy in children aged 2–12 years.

The percentage of energy from culinary ingredients ranged from 14.4% to 17.3%; oils were the main source of calories in this group (~8–9%), followed by sugar.

Processed foods accounted for 18.8% of total energy intake in children and 24% in adolescents and adults ($p < 0.01$). In this case, most energy came from fresh bread, accounting for ~9% of the total energy, followed by cheeses, which accounted for 3.7% of the daily energy.

Ultra-processed foods accounted for 32.8% of the daily energy intake in children; 29.5%, in adolescents; and 23.6% in adults ($p < 0.01$). Most calories from ultra-processed foods were related to the consumption of cookies and pastries, which accounted for 7.5% of energy intake in children; 6.8% in adolescents; and 4.5% in adults ($p < 0.01$), followed by candies (5.2%, 3.8%, and 3.3%, respectively), soft drinks (3.8%, 4.5%, and 3.3%, respectively), and crackers (1.8%, 1.8%, and 3.3%, respectively) (*Table 2* and *Figure 2*).

DISCUSSION

The findings of this study help to evidence energy intake based on the degree of processing according to the groups defined by the NOVA classification system and the energy contribution from different foods in each group, and to compare the differences among age groups. Children and adolescents consume a higher proportion of energy from ultra-processed foods, while adults consume a higher percentage from culinary ingredients and processed foods.

When considering the diet of the Argentine population, between a quarter and a third of the energy is provided by ultra-processed foods, depending on the age group. These figures are close to what has been observed in the analysis of the ENNyS 1, which showed that ultra-processed foods contributed 27% of the energy consumed by children aged 2–5 years; 31%, by female adolescents; and 26%, by women aged 20–49 years,[21,24] and the analysis of the National Survey on Household Expenditure of 2017–2018, which showed that 29% of energy intake was from ultra-processed foods.[5]

Overall, these figures are similar to those observed in Mexico (29.8% of energy)[10] and Chile (28.6%),[13] but higher than those reported in Brazil (21.5%)[25] and Colombia (15.9%).[8]

By comparison, these figures are much lower than those found in the United States (57.9%),[7] Canada (47.7%),[14] and Australia (42.0%).[11]

Table 1. Characteristics of the sample by age group in Argentina (National Survey on Nutrition and Health of 2018–2019)

	Total sample	Age group		
		2–12 years	13–17 years	≥ 18 years
	(n = 15 444)	(n = 5776)	(n = 2374)	(n = 7294)
Age, mean (95% CI)	25.1 (24.8–25.4)	6.8 (6.7–6.9)	15.0 (14.9–15.0)	42.9 (42.5–43.3)
Females, % (95% CI)	52.4 (51.7–53.1)	47.7 (45.9–49.0)	46.3 (44.1–48.6)	54.5 (53.7–55.4)
***Level of education, %** (95% CI)*[a]				
Incomplete secondary education (<12 years)	51.0 (50.3–51.7)	57.0 (55.4–58.5)	57.1 (54.9–59.3)	48.5 (47.7–49.3)
Complete secondary or higher education (≥12 years)	48.2 (47.5–48.8)	42.6 (41.0–44.1)	42.0 (39.8–44.2)	50.5 (49.7–51.3)
***Health coverage**, % (95% CI)*				
Public	42.4 (41.7–43.0)	51.5 (50.0–53.1)	46.4 (44.1–48.6)	39.3 (38.5–40.1)
Private company or labor union	57.2 (56.5–57.9)	48.1 (46.6–49.6)	52.9 (50.7–55.1)	60.3 (59.5–61.1)
***Region, %** (95% CI)*				
GBA	34.0 (33.4–34.7)	33.0 (31.5–34.4)	32.9 (30.9–35.1)	34.5 (33.7–35.3)
Pampa	32.3 (31.7–33.0)	30.6 (29.2–32.1)	30.1 (28.1–32.2)	33.1 (32.3–33.9)
NOA	11.6 (11.2–12.1)	12.8 (11.8–13.9)	13.3 (11.9–14.9)	11.1 (10.6–11.6)
NEA	8.5 (8.1–8.9)	9.6 (8.7–10.5)	10.1 (8.8–11.5)	7.9 (7.5–8.4)
Cuyo	7.1 (6.8–7.5)	7.3 (6.5–8.2)	6.8 (5.7–8.0)	7.1 (6.7–7.5)
Patagonia	6.4 (6.1–6.8)	6.7 (5.9–7.5)	6.7 (5.7–7.9)	6.3 (5.9–6.7)
***Family income quintile per CU, %** (95% CI)*				
Q1 (low)	19.7 (19.2–20.3)	29.1 (27.7–30.5)	24.9 (23.0–26.9)	16.4 (15.9–17.1)
Q2 (middle-low)	19.8 (19.2–20.3)	23.3 (22.0–24.7)	24.0 (22.1–25.9)	18.2 (17.6–18.8)
Q3 (middle)	20.1 (19.5–20.6)	18.4 (17.2–19.6)	17.8 (16.2–19.6)	20.9 (20.2–21.5)
Q4 (middle-high)	20.1 (19.6–20.7)	16.0 (14.9–17.2)	17.7 (16.0–19.4)	21.6 (21.0–22.3)
Q5 (high)	20.3 (19.7–20.8)	13.1 (12.1–14.2)	15.7 (14.1–17.4)	22.9 (22.2–23.6)
Indigenous or descendant of indigenous peoples, % (95% CI)	2.7 (2.4–3.0)	2.2 (1.8–2.7)	2.1 (1.5–2.7)	2.9 (2.6–3.2)

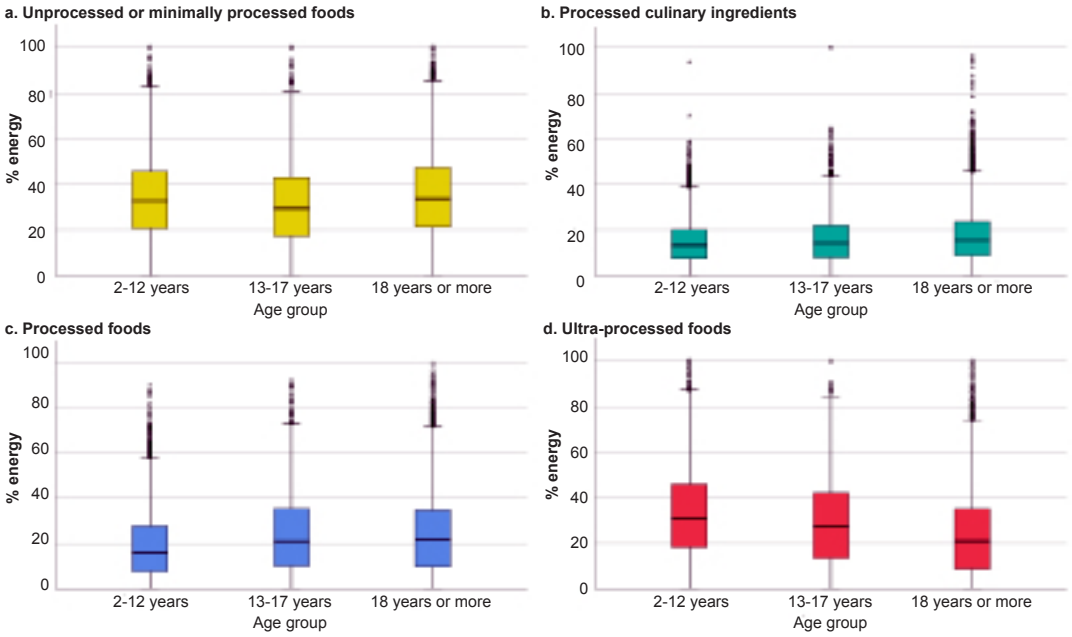
CI: confidence interval.
LL: lower limit.
UL: Upper limit.
CU: consumer unit.
Q: quintile.
[a]: For individuals younger than 18 years, it corresponds to the head of household.
GBA: Greater Buenos Aires Area.
NOA: Northwest region of Argentina.
NEA: Northeast region of Argentina.

Our results show a higher consumption of energy from ultra-processed foods in children and adolescents, as observed in middle- and low-income countries, where they account for a quarter and a third of the daily energy, while in high-income countries, more than 60% of the daily energy consumed by children and adolescents comes from ultra-processed foods, with them as the main consumers.[26]

This may have an unfavorable impact on habit development by defining lifelong consumption patterns.[18] It is a call for attention to the need for policies that protect breastfeeding and promote timely interventions to encourage appropriate practices during food introduction, in order to establish healthy food preferences from an early age, which have the potential to translate into a lifelong healthy diet.[27]

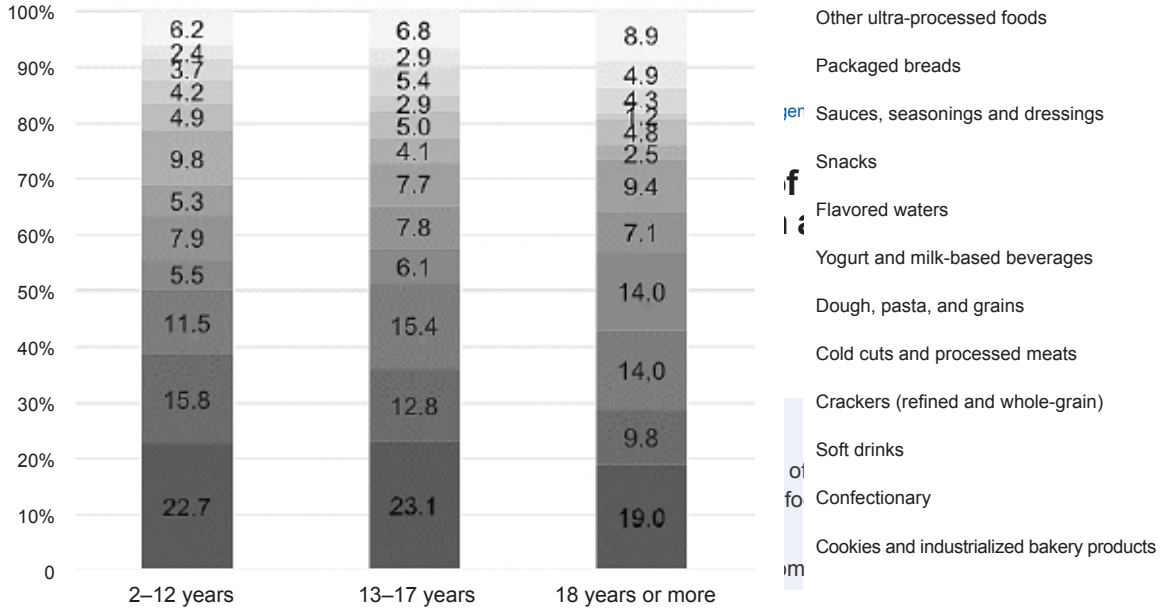
In Argentina, according to data from food sales,[6] surveys of household expenditures,[5] and the analysis of the ENNyS 1,[21] the food subgroups that contribute the most energy from ultra-processed foods are cookies and pastries, soft drinks and juices, candies and confectionery, packaged breads, and mass produced dough and pasta. This is consistent with the findings of this study and presents a pattern that is similar to that of other countries in the region.[6] Based on such

Figure 1. Average energy intake per NOVA category, by age group (% kcal)



characterization, we can state that sweet foods account for the greatest energy intake within the group of ultra-processed foods, and these findings are consistent with previous studies on the consumption of sugars.[28] These foods also have symbolic and hedonistic value, especially in childhood. The exposure to sweet taste from an early age, its impact on the development of food preferences, and its physiological consequences are relevant areas for research,[29] especially

Figure 2. Percentage of energy from ultra-processed foods by age group (%)



Note*: other ultra-processed foods include breakfast cereals and cereal bars, cream cheese and processed cheese, pre-prepared meat, vegetables or legumes, pre-fried frozen vegetables, alcoholic beverages, instant soups, milk-based desserts, margarine and fats, sandwiches and burgers, other soft drinks, instant coffee and cappuccino, liquid and powdered artificial sweetener, and peanut butter.*

Table 2. Average energy distribution by NOVA category and food groups in Argentina, total sample and by age group (National Survey on Nutrition and Health of 2018–2019)

Food groups by NOVA category	Total sample		2–12 years		13–17 years		≥ 18 years		
	Absolute (kcal/d)	% energy	Absolute (kcal/d)	% energy	Absolute (kcal/d)	% energy	Absolute (kcal/d)	% energy	*p*
Total	**1859**	**100**	**1745**	**100**	**2095**	**100**	**1860**	**100**	
1: Unprocessed or minimally processed foods	**606**	**34.5**	**570**	**33.9**	**617**	**31.0**	**615**	**35.1**	0.00
Vegetables	21.6	1.4	13.0	0.8	16.4	0.9	24.7	1.6	0.00
Fruits	39.6	2.5	36.0	2.3	23.4	1.3	42.7	2.7	0.00
Fruit juice (natural)	2.8	0.2	1.6	0.1	1.5	0.1	3.3	0.2	0.02
Root vegetables	46.3	2.6	44.1	2.6	48.5	2.4	46.6	2.6	0.43
Cereals	176.0	9.8	185.0	10.8	216.5	11.0	168.2	9.4	0.00
Nuts and seeds	3.7	0.2	1.6	0.1	3.1	0.1	4.4	0.2	0.00
Legumes	2.9	0.2	2.0	0.1	2.2	0.1	3.3	0.2	0.00
Milk and plain yogurt	55.5	3.3	118.5	7.3	55.3	2.8	37.9	2.3	0.00
Meat	152.9	8.1	94.8	5.5	155.8	7.5	168.8	8.9	0.00
Poultry	64.8	3.8	50.8	3.0	58.2	3.0	69.6	4.2	0.00
Fish and seafood	4.2	0.2	1.4	0.1	3.3	0.1	5.1	0.3	0.00
Other meats	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.10
Egg	27.3	1.5	20.2	1.2	29.1	1.4	29.0	1.7	0.00
Other unprocessed or minimally processed foods	8.1	0.6	0.6	0.0	3.4	0.2	10.9	0.7	0.00
2: Processed culinary ingredients	**306**	**16.6**	**249**	**14.4**	**324**	**15.7**	**319**	**17.3**	0.00
Plant oils	167.4	9.2	140.5	8.0	188.9	9.0	172.1	9.5	0.00
Animal fats	27.3	1.3	24.8	1.3	33.2	1.4	27.3	1.3	0.04
Table sugar	108.6	6.0	82.3	5.0	101.0	5.3	117.0	6.4	0.00
Other ingredients	2.4	0.1	1.5	0.1	0.8	0.0	2.8	0.1	0.00
3: Processed foods	**452**	**23.0**	**341**	**18.8**	**515**	**23.8**	**474**	**24.0**	0.00
Breads (fresh, unpackaged)	167.6	9.0	144.1	8.3	214.4	10.4	168.0	9.0	0.00
Pasta and grains	11.7	0.7	8.9	0.5	11.5	0.6	12.5	0.7	0.63
Bakery and pastry products	54.0	2.5	47.1	2.4	66.1	2.8	54.4	2.5	0.00
Cheese	73.1	3.7	52.2	2.8	86.1	3.8	77.2	4.0	0.00
Vegetables, fruits, other plant-based foods preserved in brine or syrup	10.0	0.6	8.9	0.5	10.7	0.6	10.2	0.6	0.00
Ham, other salted, cured or canned meats or fish	31.1	1.5	20.3	1.1	32.9	1.5	33.8	1.6	0.00
Meat preelaborated	54.4	2.8	50.1	2.7	73.5	3.5	53.1	2.7	0.00
Jelly and jam	14.2	0.7	8.3	0.4	11.8	0.4	16.2	0.8	0.00
Wine and beer	33.1	1.4	0.1	0.0	5.7	0.2	46.0	2.0	0.00
Other processed foods	2.4	0.1	0.8	0.0	2.1	0.1	2.9	0.1	0.01
4: Ultra-processed foods	**496**	**26.0**	**585**	**32.8**	**639**	**29.5**	**452**	**23.6**	0.00
Breads packaged	18.1	1.1	13.9	0.8	18.9	0.9	19.2	1.2	0.00
Crackers (refined and whole-grain)	47.5	2.9	30.8	1.8	36.3	1.8	53.7	3.3	0.00
Cookies. pastry and cakes (industrial)	106.2	5.3	135.7	7.5	151.2	6.8	91.9	4.5	0.00
Breakfast cereals and cereal bars	7.5	0.4	13.6	0.8	12.7	0.6	5.1	0.3	0.00
Flavored waters	22.4	1.3	26.7	1.6	30.3	1.5	20.2	1.1	0.00
Soft drinks	72.5	3.5	71.4	3.8	97.7	4.5	69.5	3.3	0.00
Other non-alcoholic beverages	0.7	0.1	1.2	0.1	1.1	0.0	0.5	0.1	0.00
Yogurt and milk-based beverages	18.6	1.2	50.0	3.2	23.0	1.2	9.3	0.6	0.00
Milk-based desserts	1.5	0.1	3.1	0.2	0.7	0.0	1.2	0.1	0.00
Cream cheese and processed cheese	11.4	0.7	7.6	0.5	9.6	0.5	12.8	0.7	0.00
Confectionary	59.4	3.0	93.9	5.2	82.1	3.8	46.8	2.3	0.00
Doughs, pasta and cereals (industrial)	41.5	2.1	31.5	1.7	46.8	2.3	43.6	2.2	0.03
Cold cuts and processed meats	36.6	1.9	46.1	2.6	49.3	2.3	32.2	1.7	0.00
Margarines and fats	0.8	0.0	0.6	0.0	1.4	0.1	0.8	0.0	0.79
Sauces, seasonings and dressings	22.8	1.1	22.8	1.2	34.9	1.6	21.2	1.0	0.00
Salty snacks	11.8	0.6	28.0	1.4	19.7	0.9	6.3	0.3	0.00
Sandwiches and burgers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.18
Pre-prepared (meat, vegetables or legumes)	5.3	0.3	6.8	0.4	5.7	0.3	4.8	0.3	0.00
Instant soup	1.2	0.1	1.0	0.1	0.8	0.1	1.2	0.1	0.12
Alcoholic beverages	5.4	0.2	0.0	0.0	13.6	0.3	5.8	0.2	0.00
Other ultra-processed foods	4.6	0.3	0.8	0.0	3.0	0.1	5.9	0.4	0.00

Note: *other unprocessed or minimally processed foods include tea, yerba mate, coffee, cocoa husk and water; other processed culinary ingredients include corn starch, honey, salt, syrups, cocoa, yeast, and vinegar; other processed foods include textured soy, tofu, non-alcoholic beer, packaged lemon juice, milk with sugar, milk with protein, and coconut milk; other ultra-processed foods include instant coffee and cappuccino, liquid and powdered artificial sweeteners, frozen pre-fried vegetables, and peanut butter.*

because of the increase in the sweet taste threshold due to repeated exposure and the resulting associations.

Such pattern may be associated with marketing strategies of ultra-processed foods targeted particularly at this age group.[30] In Argentina, several studies have demonstrated that advertised foods and beverages are high in energy, added sugars, and total fats,[31,32] and that they may be one of the factors associated with the increase in overweight and obesity. The most commonly used marketing strategies in food and beverage advertising, both on TV and in brand websites of foods and beverages, were those targeted at children.[33,34] Marketing and advertising play a great role on preferences and consumption, and these have an impact on the nutritional status of children and adolescents, which calls to reflect and act on ways to protect children against their effects.

An important step forward is the recent enactment of Law no. 27642 on the Promotion of Healthy Eating, which established the display of a warning on the excessive content of energy, sugars, fats, and salt on food labels, and prohibits advertising, promotion, and/or sponsorship of products that have at least a warning label directly targeted at children and adolescents, in order to protect the right to health and a healthy diet. However, it is worth noting that no single policy is the solution to the problem and that it is necessary to implement multiple strategies to address a problem that has many aspects.

This is a concerning scenario for several reasons; on the one hand, because of the high prevalence of overweight and obesity in children and adolescents and, on the other hand, because children and adolescents have a less healthy eating pattern than adults, consuming 40% more sugary beverages, twice as many pastries or snacks, and three times as many confectionary as adults.[17] There are major quantitative and qualitative differences between the diet of the Argentine population and dietary guidelines;[35] a low proportion of the population reports having consumed recommended foods on a daily basis, such as fresh fruits and vegetables, meat, milk, yogurt, or cheese, while a high proportion of the population reports daily or frequent consumption of non-recommended foods, such as sugary beverages, pastries, snacks, and confectionary.[17]

This study gives data based on age groups, and this provides opportunities to identify the main dietary problems in each age group, and thus establish priorities and plan targeted actions. Bearing in mind that we are talking about children, changes in nutrition environments are a priority to improve the quality of their diet because they are both the cause and the effect of the deterioration of food systems, which directly affects the food security, malnutrition, health status, and well-being of the population.

In relation to the potential limitations of this study, it is necessary to consider that analyzed data correspond to the population from an urban setting and that findings may be different in rural areas or small towns. Although a second 24-hour recall interview was available for a subsample of participants, we used only the first one because it is considered adequate to estimate the average energy intake in these groups. Based on information availability, in the future, it will be necessary to analyze this subject in greater depth using statistical analyses that allow to study the association between the consumption of ultra-processed foods and the characteristics of the population. ■

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