

Development of a Food Frequency Questionnaire for Assessing Dietary Intake in Children and Adolescents in South America

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Objective: This study aimed to describe the development of a food frequency questionnaire (FFQ) to assess dietary intake in South American children and adolescents.

Methods: A total of 345 children (aged 3-10 years) and 357 adolescents (aged 11-17 years) were included for analysis. The FFQ was designed to be self-administered and to assess dietary intake over the past 3 months. It was developed in Spanish and translated into Portuguese. Multiple approaches were considered to compile the food list, and 11 food groups were included. A food photo booklet was produced as supporting material.

Results: The FFQ items maintained a common core list among centers (47 items) and country-specific foods. The FFQ for Buenos Aires and Lima had a total of 63 items; there were 55 items for the FFQ in Medellin, 60 items for Montevideo, 58 items for Santiago, 67 items for Sao Paulo, and 68 items for Teresina. Alcohol was also incorporated in the adolescents' FFQ.

Conclusions: We developed a semiquantitative, culturally adapted FFQ to assess dietary intake in children and adolescents in South America. It has an optimal size allowing its completion in a high proportion of the population; therefore, it can be used in epidemiological studies with South American children and adolescents.

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Introduction

In recent years, diseases related to lifestyle, particularly obesity and associated noncommunicable diseases (NCDs), have reached global

epidemic levels (1-3). More than 42 million children aged 0 to 5 years old had overweight in 2013, which is alarming because obesity tends to persist into adulthood (4). Some studies conducted in Latin America have shown an estimated overweight prevalence of approximately 7%

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Author contributions: ACFDeM and HBC were involved in the conducting the design and funding of the study and critically reviewed the manuscript. LS, LIGZ, TRU, JR, TSC, IB, CD, FT, and LAM developed the FFQ. LS, IB, and LAM supervised the data analysis and interpretation. LS, LIGZ, TRU, TSC, FT and EDGS performed data collection. LS and LAM were involved in writing the first draft of the paper, II contributed to critical review, and all authors contributed to the writing and finally approved the submitted and published versions.

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in children younger than 5 years; in children (6-11 years old), the overweight and obesity prevalence ranged from 15% to 36.9%, and among adolescents (12-19 years old), it ranged from 16.6% to 38% (4,5). Compared with other regions of the world (6), the Latin American process of nutrition transition has occurred at a faster rate, reinforcing the need to study the dietary intake of this population, particularly the children and adolescents (7). In the 53rd Directing Council of the Pan American Health Organization, the countries of the Americas took an important step forward in the fight against the rising epidemic of obesity when they unanimously signed a 5-year Plan of Action for the Prevention of Obesity in Children and Adolescents. Among other measures, the plan calls for the implementation of fiscal policies, such as taxes on sugar-sweetened beverages and energy-dense nutrient-poor products, regulation of food marketing and labeling, improvement of school nutrition and physical activity environments, and promotion of breastfeeding and healthy eating. The goal of the plan is to halt the rise of the epidemic so that there is no increase in the prevalence of obesity within each country (4).

There are many influencing factors that affect an individual's food choices (biological, behavioral, psychological, cultural, economic, social, geographical, political, historical, and environmental, among others) that are iteratively considered both simultaneously and sequentially in food choice decision making in different ways (8). Food intakes and eating patterns influence an individual's risk of developing obesity, cardiovascular diseases, and other NCDs (9). Most of the Latin American populations have changed their dietary and physical activity patterns to fit an industrialized model (10). Assessments of eating patterns are particularly interesting in children and adolescents who are forming lifelong dietary habits. The development of accurate instruments to assess food and nutrient intake has become important because poor dietary intake data may lead to false associations between diet and diseases (9). Associations between dietary intake and health outcomes are affected or even masked by dietary intake measurement errors (11). The most important factors that promote weight gain and obesity as well as NCDs are the high intake of energy-dense nutrient-poor products, the routine intake of sugar sweetened beverages, and insufficient physical activity (4).

In this sense, food frequency questionnaires (FFQs) are often used in epidemiological studies to evaluate long-term food consumption in not only adults, but also children and adolescents. These instruments are extremely useful in epidemiological studies because they may be used in a self-administered format, they show the usual dietary intake over long periods of time, they can be used for many participants, and they can compare the dietary intake between different populations. A qualitative FFQ refers to a questionnaire that does not collect additional information about portion size, a semiquantitative FFQ refers to a questionnaire that collects information about portion size, and a quantitative FFQ refers to a questionnaire that collects information about the usual portion size by using realistic food models or by providing pictures of various portion sizes (12). Each FFQ should be created and validated in the specific population in which it will be used. The development of this instrument requires special attention in choosing food items, in developing accurate background questions, and in formatting the frequency response section (12). Moreover, it is important to consider the number of items that will be included and the method for measuring portion sizes if the FFQ is quantitative (13). The purpose of developing an FFQ is to provide an accurate method to assess the habitual intake and eating patterns of the population with a limited number of questions. It is not designed to estimate precise individual intake but, rather, rank the intake of an individual within a population (14).

A significant number of studies validating FFQs against a reference method were found in the literature (15-19). However, the detailed FFQ development process is not always well described. To the best of our knowledge, there is no FFQ that has been evaluated for validity and reproducibility in the South American pediatric population. For this reason, the aim of this study was to carefully describe the process of developing an FFQ to assess dietary intake in children and adolescents from six countries in South America (Argentina, Brazil, Colombia, Chile, Peru, and Uruguay) and to assess its feasibility in the target population.

Methods

Development process of the FFQ

A semiquantitative FFQ was developed for use in the South American Youth/Child Cardiovascular and Environmental (SAYCARE) observational, multicenter, feasibility study to assess dietary intake among children and adolescents aged 3 to 17 years from seven cities of six South American countries.

The FFQ was designed to be self-administered and to assess dietary intake over the past 3 months. The following four sections were included: (1) food items, (2) frequency of intake, (3) portion size, and (4) specific type of food (if appropriate). A question about where all the meals during the day were consumed was asked at the beginning of the questionnaire.

General information, such as age, gender, and socioeconomic status, was not included in the FFQ because this information was asked in a set of questionnaires for the SAYCARE study, and those answers were published elsewhere (Carvalho HB, Moreno LA, Silva AM, et al. Design and objectives of the South American Youth/Child Cardiovascular and Environmental (SAYCARE) study. *Obesity (Silver Spring)* 2018; Supplement).

Ethical approval was granted by the Ethics Committee of every center involved. Written informed consent was obtained from the caregivers and the adolescents, and a signed assent form was obtained from the children and adolescents.

Several questionnaires were missing the number of the center, the sex, or the date of birth of some children and adolescents, and these questionnaires were excluded from the analysis (280 children and 75 adolescents of 940 children and 464 adolescents).

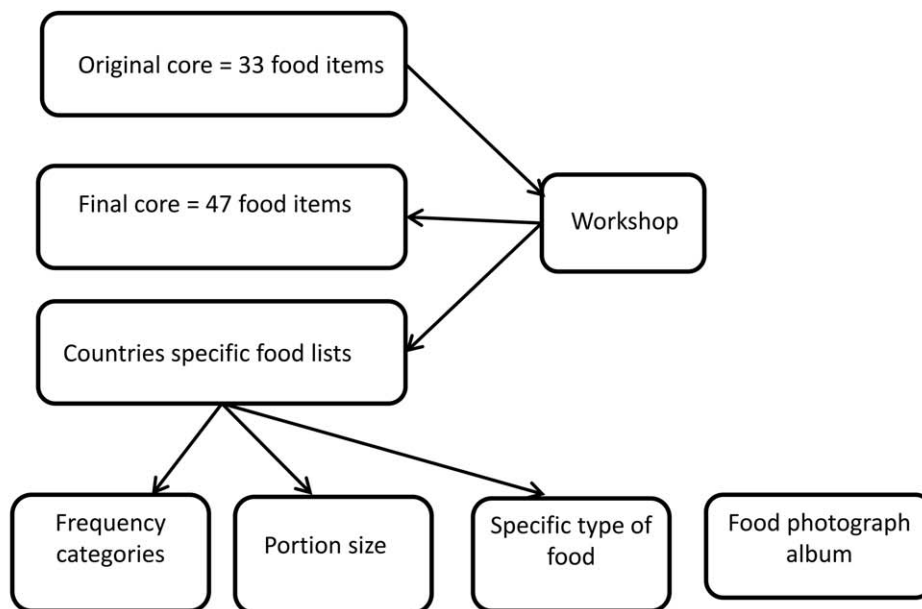
The development of the FFQ is shown in Figure 1.

Development of the food list

Given the large diversity of foods and different dietary patterns in South America, the food questionnaire development employed a multitude of approaches to compile an adequate food list, which are described in the results section. Eleven food groups were included (cereals; tubers; vegetables; fruits; oils; meats, derivatives, fish, and eggs; milk and dairy products; legumes; beverages; sugar products; and miscellaneous) (20). A common list of foods consumed in all the countries (core list) was developed (Table 1). Additional country-specific food items were included.

Frequency categories

To determine the frequency categories for the questionnaire, we adopted Willet's (21) proposal of nine response categories as follows:



Feasibility of the SAYCARE FFQ

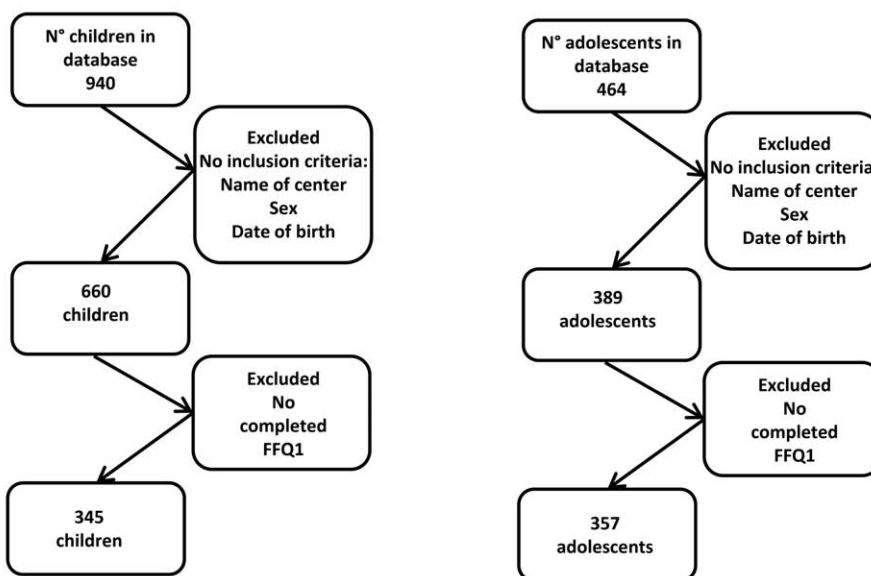


Figure 1 Development of the SAYCARE FFQ.

“never or less than one time per month,” “one to three times per month,” “one time per week,” “two to four times per week,” “five to six times per week,” “one time per day,” “two to three times per day,” “four to five times per day,” and “six or more times per day.”

Portion size estimation

For most food items, a unit was an age-specific standard portion (3-17 years old), such as an apple, a slice of bread, 50 grams of rice, or 100 grams of meat. The answer could be 1/2 portion, 1 portion, 2 portions, 3 portions, 4 portions, etc. A food photo booklet was

developed and given to the caregivers and the adolescents with the FFQ so they could identify the food portion size. Every question of the FFQ was correlated with a specific group of food photos that specified the portion size.

Specific type of food

For some food items, the type of food was specified according to the nutrient composition; for example, for bread, it was white or whole grain bread; for milk, it was whole milk, low-fat milk, or skinny milk; for fruit juices, it was fruit juice with or without added sugar.

TABLE 1 Foods (original and final core) included in the FFQ of the SAYCARE study

	Original core	Final core
1	Cooked rice	Cooked rice
2	Cooked pasta	Cooked pasta
3	Cooked pasta with tomato sauce	Bread
4	Bread	Slice bread
5	Crackers	Crackers
6	Sweet cookies	Sweet cookies
7	Fried potatoes	Filled sweet cookies
8	Potatoes	Breakfast cereal
9	Leaf vegetables	Fried potatoes
10	Vegetables	Potatoes
11	Fruits	Vegetables
12	Butter	Fruits
13	Margarine	Butter
14	Meat with less than 6% fat	Margarine
15	Meat with more than 6% fat	Oil
16	Fried meat with less than 6% fat	Beef meat
17	Fried meat with more than 6% fat	Hamburger
18	Chicken	Milanese steak
19	Milk	Chicken
20	Cheese with less than 15% of fat	Pork
21	Cheese with 15% to 25% of fat	Fish
22	Cheese with more than 25% of fat	Canned fish
23	Eggs	Sausages
24	Fried eggs	Cold meats
25	Beans	Milk
26	Soft drinks	Milk shake
27	Powdered juice	Yogurt
28	Packed juice	Cheese with less than 15% of fat
29	Sugar	Cheese with 15% to 25% of fat
30	Candies	Cheese with more than 25% of fat
31	Bakery products	Eggs
32	Chocolate	Beans
33	Chips	Lentils
34		Chickpeas
35		Water
36		Fruit juice
37		Packed juice
38		Powdered juice
39		Soft drinks
40		Coffee and tea
41		Alcoholic drinks
42		Jam
43		Ice cream
44		Candies
45		Chocolates
46		Chips
47		Pizza

Development of a food photo booklet

A food photo booklet with the basic core food items included in the final FFQ was developed by the group at the University of São Paulo, and photographs were taken under the supervision of TRU and TSC. The country-specific food photos were taken by each research group and sent to São Paulo to create a food booklet for each city, including the basic food core and the country-specific foods. For the development of the food photo booklet, the edible portion of the food, the feed conversion index of the food, the cooking methods, and the standardized procedures for the picture session (lighting, the color of the surface, household items, etc.) were considered. In the FFQ, each food item has a number that refers to the corresponding photo in the booklet.

Statistical analyses

Statistical analyses were performed by using the statistical program SPSS version 23 (IBM Corp., Armonk, New York); analyses including all countries and broken down by age group were performed. A student's *t* test (William Sealy Gosset, 1908) was used to compare the results in grams of food per day between the age groups.

Results

To develop the FFQs, the national food consumption surveys were considered for Argentina, Brazil, Colombia, and Uruguay (22-26). Additionally, some local and/or regional studies were also considered, particularly those that evaluated children (27,28). A 3-day workshop occurred in Teresina, Brazil (March 2015), during which experts from all the cities involved in the SAYCARE study completed the food lists for every country. A preliminary common core food list was developed. To be included in the core food list, food items should represent at least 30% of the children's and adolescents' total food intake and appear in at least two of the six countries involved. The basic core list was composed of 33 food items (Table 1). To harmonize the various terms according to the characteristics of the consumed foods, during the workshop, and after further discussions, the experts reached an agreement about the final list, including 47 food items that characterize the complete core food list (Table 1). The core questionnaire was developed in Spanish (adapted to the language characteristics of every country) and translated into Portuguese for use in Brazil. Two FFQ versions were developed, one to be completed by the children's caregivers and the other to be completed by the adolescents themselves. The difference between the two versions was that alcohol was only incorporated in the adolescent questionnaire.

Moreover, during the workshop, the expert group identified the country-specific foods that significantly contributed to the total daily food intake of the children and adolescents (Table 2). Some food items were common in all the countries, but their names varied from one country to another.

Finally, considering both the basic core list and the country-specific foods, the FFQ for Buenos Aires had a total of 63 items, Lima had a total of 61 items, 63 items for Medellin, 59 items for Montevideo, 57 items for Santiago, 67 items for São Paulo, and 69 items for Teresina.

Because of the children's limited recall skills, poor ability to estimate and indicate portion sizes, and low knowledge of foods that may constrain their ability to self-report their food intake without parental assistance, the FFQ was developed to be completed by the

TABLE 2 Country-specific food items

Food group	Food item	Cities where consumed
Cereals	Cooked rice	All of them
	Cooked pasta	All of them
	Bread	All of them
	Sliced bread	All of them
	Hallullah	Santiago
	Marraqueta	Santiago
	Crackers	All of them
	Sweet cookies	All of them
	Sweet filled cookies	All of them
	Cereal bars	All of them
	Bakery products	All of them
	Bocadillo	Medelin
	Breakfast cereals	All of them
	Pizza	All of them, except Teresina
	Salgadinhos	São Paulo and Teresina
	Mingau	São Paulo and Teresina
	Farofa	São Paulo and Teresina
	Polenta	Buenos Aires and Montevideo
	Salty pies and empanadas	Buenos Aires and Montevideo
	Couscous	Teresina
Tapioca	Teresina	
Wheat	Lima	
Tubers	Fried potatoes	All of them
	Potatoes	All of them
	Fried yucca	Lima, São Paulo, and Teresina
	Yuca	Lima, São Paulo, and Teresina
	Inhame	São Paulo and Teresina
	Sweet potatoes	All of them, except Santiago and São Paulo
Vegetables	Oca	Lima
	Raw vegetables	All of them
	Boiled vegetables	All of them
	Vegetable soup	São Paulo and Teresina
Fruits	Avocado	Medelin
	Fruits	All of them
Oils	Acai	São Paulo
	Fried bananas	São Paulo
	Butter	All of them
Meat and derivates and fish and eggs	Margarine	All of them
	Oil	All of them
	Chicharron	Medelin
	Beef	All of them
	Chicken	All of them
	Pork	All of them
	Milanese steak	All of them

TABLE 2. (continued).

Food group	Food item	Cities where consumed
Milk and dairy products	Hamburger	All of them
	Sausages	All of them
	Cold meat	All of them
	Fish	All of them
	Canned fish	All of them
	Visceras	Medelin and Teresina
	Eggs	All of them
	Milk	All of them
	Yogurt	All of them
	Milk shake	All of them
Legumes	Dairy desserts	All of them
	Cheese low-fat	All of them
	Cheese medium-fat	All of them
	Cheese high-fat	All of them
	Beans	All of them
	Lentils	All of them
Beverages	Chickpeas	All of them
	Water	All of them
	Fruit juices	All of them
	Packed juices	All of them
	Powdered juices	All of them
	Soft drinks	All of them
	Coffee and tea	All of them
	Cane drink	São Paulo and Teresina
	Panela	Medelin
	Honey	All of them, except Montevideo
Sugar and products	Jam	All of them
	Dulce de leche	All of them
	Dulce	All of them, except Santiago
	Ice cream	All of them
	Jelly	All of them
	Candies	All of them
	Chocolates	All of them
	Sweet popcorn	São Paulo and Teresina
	Alfajor	Buenos Aires and Montevideo
	Miscellaneous	Chips
Mayonnaise		All of them
Sauces		All of them
Soy sauce		Buenos Aires
Bienestarina		Medelin
Dehydrated fruits		Buenos Aires
Nuts		Buenos Aires

TABLE 3 English version of a fragment of the FFQ

	Food item	In the last three (3) months, how many times did your child eat his food items?	How much does he/she eat each time?	Choose the most frequent option
1.1	Rice (Food photo booklet 1-A)	Never or less than 1 time per month	1/2 portion	
		1 to 3 times per month	1 portion	
		1 time per week	2 portions	
		2 to 4 times per week	3 portions	
		5 to 6 times per week		
		1 time per day		
		2 to 3 times per day		
1.2	Pasta (pasta with sauce, lasagna, ravioli) (Food photo booklet 1-B, 1-C, 1-D)	Never or less than 1 time per month	1/4 portion	
		1 to 3 times per month	1/2 portion	
		1 time per week	1 portion	
		2 to 4 times per week	2 portions	
		5 to 6 times per week		
		1 time per day		
		2 to 3 times per day		
1.3	Bread (Food photo booklet 2-A, 2-B)	Never or less than 1 time per month	1/2 portion	White
		1 to 3 times per month	1 portion	Whole grain
		1 time per week	2 portions	
		2 to 4 times per week	3 portions	
		5 to 6 times per week		
		1 time per day		
		2 to 3 times per day		
1.4	Sliced bread (Food photo booklet 2-C, 2-D)	Never or less than 1 time per month	1/2 portion	White
		1 to 3 times per month	1 portion	Whole grain
		1 time per week	2 portions	
		2 to 4 times per week	3 portions	
		5 to 6 times per week	4 portions	
		1 time per day		
		2 to 3 times per day		
	4 to 5 times per day			
	6 or more times per day			

caregivers (3-10 years old). Adolescents (11-17 years old) completed the FFQ themselves (29).

As the food intake of children and adolescents may change several times during a short period of time (21,30), and considering adolescents' and caregivers' memory of food intake (31), the FFQ was developed to assess dietary intake over the past 3 months (32).

The food items were organized into eleven groups as follows: (1) cereals, (2) tubers, (3) vegetables, (4) fruits, (5) oils, (6) meats and

derivatives, fish, and eggs, (7) milk and dairy products, (8) legumes, (9) beverages, (10) sugar products, and (11) miscellaneous.

Some food items were discussed separately because of their special characteristics; for example, corn, sweet potatoes, and bananas have an enormous botanical diversity in Latin America. For this reason, each city used the variety and cooking forms that are usually consumed. Because cheese varieties are named differently in each city, three categories were established based on their fat content; in this way, the expert group identified the most widely consumed local

TABLE 4 Food consumption (in grams per day) of children and adolescents, SAYCARE Study

	Children												Adolescents						
	Female						Male						Female			Male			
	3-5 years		6-10 years		3-5 years		6-10 years		6-10 years		11-14 years		15-17 years		11-14 years		15-17 years		
	n = 71	n = 107	n = 107	n = 107	n = 72	n = 95	n = 98	n = 88	n = 87	n = 84	n = 88	n = 87	n = 84	n = 88	n = 87	n = 84	n = 84		
Mean	SD	Mean	SD	P	Mean	SD	P	Mean	SD	P	Mean	SD	P	Mean	SD	P	Mean	SD	P
Cooked rice	43.67	84.95	38.88	55.16	0.539	39.99	69.53	0.260	120.30	188.94	76.52	90.91	0.055	84.09	105.37	95.05	116.42	0.531	
Cooked pasta	8.41	17.01	10.79	45.16	0.553	13.60	35.18	0.059	19.45	65.22	18.06	30.78	0.861	17.56	23.84	21.83	34.04	0.367	
Bread	13.26	39.91	17.51	29.91	0.273	21.69	68.75	0.557	34.26	57.93	29.62	46.60	0.584	80.30	114.06	68.37	107.54	0.569	
Sliced bread	5.94	14.44	5.90	14.97	0.983	12.42	55.58	0.562	22.04	57.94	17.76	26.55	0.551	20.38	31.92	19.67	40.17	0.908	
Crackers	16.84	43.05	7.68	27.35	0.800	44.79	119.9	0.001	23.29	51.94	21.57	68.63	0.860	36.51	85.66	32.24	65.62	0.743	
Sweet cookies	13.61	43.29	5.43	19.33	0.023	25.86	86.42	0.007	26.73	70.28	8.03	18.57	0.028	24.27	72.05	18.44	65.83	0.616	
Filled sweet cookies	11.21	47.82	9.06	54.08	0.709	32.71	129.87	0.016	53.05	139.39	20.31	41.57	0.049	50.23	152.13	30.53	102.76	0.355	
Breakfast cereal	6.52	16.04	3.98	7.03	0.056	9.86	48.74	0.561	17.72	47.68	9.78	21.71	0.217	21.09	54.94	8.90	21.09	0.089	
Fried potatoes	21.72	29.74	25.97	111.40	0.738	15.94	28.36	0.955	39.44	87.79	15.47	19.05	0.019	45.75	127.34	19.28	27.09	0.079	
Potatoes	18.37	31.34	21.26	47.70	0.633	22.71	33.56	0.072	32.94	68.32	23.53	24.59	0.254	80.02	269.98	39.88	73.95	0.199	
Vegetables	41.16	43.71	71.29	187.30	0.179	44.49	66.12	0.891	72.69	163.97	68.42	81.91	0.846	91.03	191.92	54.39	71.02	0.144	
Fruits	196.01	231.59	200.02	302.06	0.915	262.94	459.72	0.056	273.34	447.93	200.67	333.41	0.233	304.51	541.53	185.24	348.33	0.101	
Butter	2.62	3.70	3.39	5.77	0.309	8.82	20.54	0.081	7.72	14.24	5.35	10.98	0.264	9.78	15.99	5.65	8.25	0.054	
Margarine	3.01	7.88	3.29	5.74	0.811	3.56	4.53	0.700	3.41	5.33	5.43	9.44	0.158	7.34	14.06	5.43	11.07	0.473	
Oil	5.76	10.74	4.60	6.84	0.419	4.77	6.56	0.805	6.57	10.00	4.73	5.64	0.178	10.19	26.02	4.08	5.44	0.059	
Beef meat	44.36	48.64	30.03	31.88	0.103	48.52	56.33	0.435	68.58	94.06	54.16	81.10	0.301	79.43	128.29	56.30	98.40	0.219	
Hamburger	10.47	20.65	10.78	20.58	0.924	11.24	20.66	0.818	33.03	60.99	18.59	58.47	0.132	21.52	40.77	22.93	31.56	0.818	
Milanese steak	19.93	33.55	32.17	179.32	0.574	22.20	37.58	0.871	34.85	69.01	31.65	51.85	0.761	70.83	232.97	68.67	237.43	0.957	
Chicken	46.71	48.57	58.98	163.61	0.482	41.53	49.01	0.404	65.05	103.43	56.01	109.00	0.587	91.36	183.59	60.04	107.99	0.195	
Pork	16.68	34.19	28.97	180.53	0.634	22.65	37.09	0.006	26.92	46.23	15.12	19.61	0.034	46.29	176.33	35.01	113.59	0.658	
Fish	13.51	16.95	15.91	31.57	0.534	13.53	33.15	0.758	27.63	76.65	13.09	17.89	0.128	39.21	166.54	23.33	42.80	0.445	
Canned fish	6.91	9.51	17.13	98.59	0.363	5.81	10.06	0.227	18.10	49.23	5.09	6.28	0.034	18.78	56.61	8.15	9.75	0.142	
Sausages	7.19	9.35	16.20	89.85	0.371	18.29	97.47	0.317	28.79	71.19	13.32	22.73	0.083	15.66	36.36	10.44	12.92	0.257	
Cold meat	9.82	17.85	9.53	24.91	0.928	13.59	62.13	0.616	15.66	39.89	14.45	28.76	0.829	21.49	67.71	14.05	22.38	0.378	
Milk	387.49	253.66	321.76	237.65	0.555	360.98	257.34	0.005	233.01	301.65	231.00	253.57	0.963	305.93	380.85	244.24	224.69	0.233	
Milk shake	168.96	242.34	109.37	149.18	0.277	124.12	192.39	0.356	150.49	213.17	126.06	220.15	0.484	137.74	224.28	136.52	191.11	0.973	
Yogurt	96.33	82.35	67.87	74.69	0.013	110.54	124.71	0.016	77.55	121.09	71.34	76.13	0.710	104.22	164.99	48.37	63.43	0.090	
Cheese low-fat	6.93	21.28	6.79	10.29	0.959	4.70	7.81	0.397	6.40	11.01	4.66	7.03	0.323	14.06	37.07	15.12	49.34	0.901	
Cheese medium-fat	9.18	7.90	14.24	54.17	0.423	7.39	8.28	0.051	12.09	17.51	14.92	33.03	0.501	28.39	68.19	14.64	15.98	0.104	
Cheese high-fat	8.09	19.64	11.5	56.57	0.654	4.38	4.88	0.478	9.51	24.55	8.46	22.24	0.791	17.09	53.20	8.68	10.41	0.214	
Egg	28.18	28.38	25.99	26.87	0.581	19.67	18.19	0.140	37.28	88.37	21.39	28.28	0.126	48.14	88.24	33.69	48.68	0.213	
Beans	30.96	48.12	23.92	39.19	0.255	27.57	38.91	0.089	45.95	71.38	31.44	58.43	0.170	69.65	157.28	71.26	138.63	0.949	

TABLE 4. (continued).

	Children												Adolescents																								
	Female						Male						Female			Male																					
	3-5 years		6-10 years		3-5 years		6-10 years		6-10 years		11-14 years		15-17 years		11-14 years		15-17 years																				
	n = 71	SD	Mean	SD	n = 107	SD	Mean	SD	n = 72	SD	Mean	SD	n = 95	SD	Mean	SD	n = 98	SD	Mean	SD	n = 88	SD	Mean	SD	n = 87	SD	Mean	SD	n = 84	SD	Mean	SD	P				
Lentils	13.32	26.25	17.86	68.31	0.603	10.17	9.93	11.61	14.05	0.491	18.39	26.48	11.87	20.96	0.099	32.98	136.96	14.27	20.51	0.271																	
Chickpeas	9.06	15.44	10.45	25.82	0.731	4.88	8.08	4.93	6.37	0.977	10.85	20.85	6.09	7.05	0.164	42.74	177.49	6.00	7.98	0.151																	
Water	533.15	468.85	443.95	397.92	0.133	526.85	484.41	483.2	408.19	0.487	652.69	508.38	756.59	473.73	0.173	751.16	472.71	809.17	501.01	0.462																	
Fruit juice	119.93	174.26	149.02	240.03	0.338	227.26	401.02	126.73	161.42	0.021	167.20	264.07	131.28	221.98	0.358	166.61	222.13	137.73	240.24	0.454																	
Packed juice	68.04	96.61	113.67	200.69	0.048	128.4	247.94	87.71	136.03	0.157	80.53	111.03	66.21	112.55	0.470	100.09	170.31	88.17	162.44	0.698																	
Powdered juice	53.4	112.37	86.34	182.88	0.254	194.9	430.26	126.23	226.66	0.262	98.04	146.79	118.26	221.99	0.571	155.00	300.34	112.99	233.82	0.426																	
Soft drinks	51.36	85.9	67.11	140.06	0.384	152.96	353.93	128.53	239.43	0.584	203.15	312.64	132.45	175.13	0.091	128.82	217.86	165.33	297.45	0.039																	
Alcohol drinks											20.80	56.24	41.74	101.69	0.553	161.94	390.05	18.19	22.52	0.079																	
Coffee and tea	90.19	152.7	109.00	233.64	0.645	57.04	83.45	138.48	267.81	0.097	125.47	250.32	140.52	167.71	0.671	155.99	266.15	121.39	161.72	0.373																	
Jam	6.74	20.11	10.34	28.82	0.458	5.01	7.33	5.85	7.26	0.568	8.90	18.81	7.08	21.34	0.660	7.86	12.56	16.68	41.61	0.160																	
Ice cream	15.24	50.22	12.45	26.15	0.624	12.21	14.85	29.15	139.23	0.266	37.09	66.28	22.81	70.32	0.289	21.08	27.22	35.72	161.41	0.504																	
Candies	8.57	10.89	15.52	62.69	0.334	13.23	28.49	11.18	33.23	0.658	17.40	27.34	28.77	71.88	0.189	17.63	56.83	15.39	28.18	0.773																	
Chocolates	8.00	12.33	22.48	114.73	0.260	8.95	22.27	6.5	11.38	0.340	21.33	51.66	20.60	95.91	0.953	18.19	60.19	14.25	35.06	0.636																	
Chips	8.00	9.92	6.45	13.47	0.410	20.69	75.76	8.88	16.34	0.154	14.78	59.24	11.38	21.63	0.646	6.74	12.39	15.69	65.78	0.283																	
Pizza	5.23	22.59	6.58	18.42	0.554	4.98	11.33	5.93	9.77	0.439	25.27	63.68	18.33	20.71	0.430	62.59	202.70	35.95	95.95	0.334																	

Bold font indicated P<0.05.

cheese corresponding to the three categories, and these food items were included in each local FFQ.

An English version of a fragment of the FFQ is provided in Table 3. In the food photo booklet, each photo documented the standard portion sizes, conventional household items, or common food containers for more than one food item per category. The photos also considered the various cooking methods and included prepared dishes, such as soups or cakes. The food booklet was always provided as supporting material to the FFQ.

A total of 940 children and 464 adolescents were involved in the study; 280 children (30%) and 75 adolescents (16%) were excluded for the analysis because they did not fit the inclusion criteria. In a second phase, 315 children (48%) and 32 adolescents (8%) were excluded because they did not complete the first FFQ. Therefore, 345 children and 357 adolescents were considered for analysis (Figure 1).

Food consumption (in grams per day) by the children and adolescents is shown in Table 4 and corresponds to what is expected for the difference between the sex and age groups (32). In female children, the consumption of sweet cookies and yogurt was higher, and packed juices consumption was lower, in the younger age group (3-5 years) compared with the older age group (6-10 years). In male children, the consumption of crackers, sweet cookies, filled sweet cookies, pork, milk, yogurt, and fruit juices was higher in the younger age group (3-5 years) compared with the older age group (6-10 years). In female adolescents, the consumption of cookies, filled cookies, fried potatoes, pork, and canned fish was higher in the younger age group (11-14 years) compared with the older age group (15-18 years). In male adolescents, soft drink consumption was higher in the older age group (15-18 years) compared with the younger age group (11-14 years).

Discussion

This study describes the development of a semiquantitative FFQ that was culturally adapted to assess dietary intake in children and adolescents for a multicenter study in South America. It was created to be self-administered and completed by the children's caregivers and adolescents to assess dietary intake over the past 3 months. Moreover, our FFQ considers the food availability of each city involved in the study. South America has a huge variety of dietary patterns. The following four food categories represent the main sources of energy: wheat, corn, rice, and tubers, particularly potatoes. Yucca and bananas are also part of the daily diet in most Latin American countries (33). Even a particular food item, such as corn, is not a uniform single food in this region because the botanical varieties, the local names, and the type of cooking vary greatly between and within countries.

The developed FFQ is a pragmatic approach to obtain information about dietary intake; thus, to obtain comparable data, we established a common core food list and, subsequently, a center-specific food list. The food photo booklet allowed the corresponding portion sizes to be estimated.

One of the most frequently cited limitations of an FFQ is the length of the questionnaire (34,35). Children's caregivers and adolescents

may become bored and not complete the questionnaire if it is lengthy. In our study, 52% of the caregivers completed the children's FFQ, and 92% of the adolescents completed the FFQ. The low completion rate in the children's group may be due to the fact that the FFQ was completed in the context of a larger feasibility study.

The reported food consumption in children and adolescents (Table 4), specifically the higher intake of cookies, dairy products, and fruit juices in the younger age groups, agree with what has been observed in other studies (36,37). This relationship also applies to the higher consumption of soft drinks in older male adolescents compared with younger males (36-40).

The most important strength of developing the FFQ is the systematic approach for establishing the food list considering the large variability in food availability in the region and the inclusion of children and adolescents from six countries. The FFQ is available in Portuguese and Spanish and is adapted to the different names of the foods and different spellings among Spanish speaking South American countries. This study covers a large age range from preschoolers until the end of the adolescent period. The questionnaire has an optimal size allowing a high completion rate, particularly in adolescents. Once the FFQs were developed, their reliability and validity were established for application in future epidemiological studies in this population. Future studies using these instruments will provide fundamental information to help understand the origin of NCDs related to lifestyle in children and adolescents. ○

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