

Update of the acquisition parameters of the Brazilian National School Feeding Program based on the *Dietary Guidelines for the Brazilian Population*

Atualização dos parâmetros de aquisição do Programa Nacional de Alimentação Escolar com base no *Guia Alimentar para a População Brasileira*

Actualización de los parámetros de adquisición del Programa Nacional de Alimentación Escolar en base a la *Guía Alimentaria para la Población Brasileña*

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Abstract

The Dietary Guidelines for the Brazilian Population is acknowledged as a powerful inducer of public food and nutrition policies. In this perspective, this article presents the methodological path and evidence that supported the elaboration of the new parameters of food acquisition of the Brazilian National School Feeding Program (PNAE). This elaboration involved the analyses of: (1) participation of federal resources used to purchase food, grouped according to the NOVA classification, used in Dietary Guidelines for the Brazilian Population, by the set of Brazilian municipalities and according to the classification of the execution (positive or negative); (2) monthly reference menus that were prepared following Dietary Guidelines for the Brazilian Population recommendations; (3) analysis of food acquisition by the sampling of 525 municipalities, involving the relative participation of food groups (according to NOVA) in total expenditures and energy and nutritional quality of purchased foods; and (4) analysis of ultra-processed foods that should not be offered in the school environment. We proposed the adoption of the following parameters for the participation of food groups in relation to the total federal resources used in the purchase of food: $\geq 75\%$ of resources for fresh or minimally processed foods; $< 20\%$ for processed or ultra-processed foods and $< 5\%$ for processed culinary ingredients, as well as the expansion of the list of foods whose acquisition with federal resources from PNAE is prohibited. This process supported the elaboration of Resolution CD/FNDE n. 6 of May 8, 2020, which provides for the attendance of school feeding to primary education students within the PNAE.

Nutrition Programs and Policies; Food Guide; Recommended Dietary Allowances; Food Processing; School Health Promotions

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Introduction

Changes in the epidemiological and nutritional profile of the population and in the way of understanding its determinants require the adequacy and updating of public policies. In this perspective, throughout its decades of existence, the Brazilian National School Feeding Program (PNAE) has been improving its nutritional guidelines. From the publication by the Brazilian Ministry of Health of the first *Dietary Guidelines for the Brazilian Population*, in 2006 ¹, the PNAE adopted parameters so that food purchased with federal resources was aligned with its guidelines. For this, in 2009, it prohibited the acquisition of soft drinks and artificial juices, limited the acquisition of canned foods, processed meats, sweets, compound foods, semi-ready or ready-to-eat food items with high amounts of sodium or saturated fat, and also established a parameter for the minimum supply of fruits and vegetables ².

In response to the increase in obesity, chronic diseases and consumption of ultra-processed foods, a new version of the *Dietary Guidelines for the Brazilian Population* was published in 2014 ³. It adopted as a structuring approach of its guidelines the NOVA classification, which groups food according to the extent and purpose of its industrial processing ^{4,5}. In view of these new dietary guidelines of the Brazilian Ministry of Health, the Brazilian National Fund for the Development of Education (FNDE) establishes two working groups with a view to updating the nutritional parameters of the PNAE for the acquisition and supply of food. For this, they should propose parameters that would contribute to the achievement of the program's objectives related to the health and food and nutritional safety of schoolchildren and, at the same time, were auditable by their social control institutions.

The working groups were composed of representatives of the FNDE, the Brazilian Ministry of Health, the National Council for Food and Nutrition, the Collaborating Centers on School Feeding and Nutrition (CECANE) ⁶, the Federal Council of Nutritionists, the Pan American Health Organization, nutritionists responsible for the PNAE of state and municipal education departments, and specialists from different higher education institutions. The work process was supported by technicians from the Brazilian National Regulatory Agency (ANVISA), the Food Acquisition Program Management Group and the PNAE Advisory Group. The first working group operated from April to November 2017 (hereinafter Phase 1) and the second, from March to September 2018 (Phase 2).

This article aims to present the methodological path and the evidence that supported the work of these two groups regarding the elaboration of new parameters of food acquisition in the PNAE, as well as the proposal resulting from this collective effort. The record of the path, the evidence and the proposed parameters related to the supply of food goes beyond the scope of this article.

Methods

Phase 1

- **Update of PNAE parameters for food acquisition restriction**

In this phase, three groups of analyses were carried out: the first, for the total number of PNAE-executing entities (municipalities, states, and federal schools); the second, for a set of municipalities according to the level of their performance (positive execution and negative execution) and, the third, for menus prepared by CECANE, as detailed below.

For the three analysis groups, each food was allocated in the NOVA ⁵ classification groups. Such allocation was made based on the list of ingredients declared on the food label obtained through internet searches on websites of three major supermarket chains. To perform this search, the food nomenclature of the Accountability Management System (SIGPC) was used, for example, chocolate powder. Since SIGPC does not inform the brand of the purchased products, we used the list of ingredients of the food that presented the lowest price among three different brands surveyed, considering that this is the procedure practiced in the bidding processes for the acquisition of food items for schools. To make this allocation, a consensus proposal was sent through an electronic form to the members of the nine entities and bodies represented in the working group, in addition to the CECANE, totaling

24 specialists consulted. In the event of disagreement, a consensus proposal and its justification were presented to the experts, analyzed and resolved among members of the group.

a) First group of analyses

In the previous legislation ², the acquisition of canned foods, processed meats, sweets, compound foods, semi-ready or ready-made preparations and foods with a high amount of sodium or saturated fat was restricted to up to 30% of the federal resources used in the purchase of food for the Program. In order to support the updating of these legislation, an ecological study was developed with secondary data obtained from the SIGPC to identify the participation of each food group, according to the extent and purpose of its industrial processing, in the total federal resources used in the purchase of food for the program. The data refer to the annual values of acquisition of each food by the executing entities of the country between the years 2013 to 2015, the last period available at the time.

b) Second group of analyses

With the SIGPC database, an analysis of the participation of each food group was performed for a set of municipalities according to their level of performance in the program. For this, a municipality was selected by region with the highest number of the following positive implementation criteria: acquisition of foodstuffs from family farming above the minimum percentage provided for by law (30%); accountability approved without reservation by the School Feeding Council (CAE) of the municipality; absence of balance in the specific account of the PNAE beyond what is allowed by the legislation at the end of the year; registration of at least three actions of food and nutritional education in the exercise of 2014; use of own resources for school feeding in percentage equivalent to 50% or more of the amounts transferred by the FNDE; and achieving the target for the initial years of elementary school in the Basic Education Development Index. A municipality was also selected by region of the country with the highest number of the following criteria of negative execution: non-acquisition of food from family farming; accountability not approved by the CAE; complaint regarding the execution of the program from the FNDE ombudsman's office or control body, reprogramming of balance above the allowed value (30%); and registration, in the Food and Nutritional Surveillance System, of prevalence of 50% or more of excess weight in children aged 5 to 10 years. In 2015, 30 municipalities were monitored by the FNDE and characterized according to these criteria. The municipalities included in this analysis were characterized according to number of inhabitants ⁷, Brazilian Municipal Human Development Index ⁸ and number of students enrolled ⁹.

c) Third group of analyses

The relative participation of each food group in the total cost of 22 monthly menus prepared by CECANE from the five regions of the country was described according to the following *Dietary Guidelines for the Brazilian Population* ³ (p. 26) recommendation – “make fresh or minimally processed foods the basis of their food” – that were feasible from the point of view of the complexity of preparing meals in the school environment. Menus were prepared to meet 20%, 30% and 70% of the daily nutritional needs of students from daycare, preschool, elementary and high school. The relative participation of each food group was compared with the national average of its participation in the number of federal resources used in the purchase of food.

The relative participation of food groups in the total expenditure on food of the monthly menu was calculated as follows: (1) price survey carried out on the website of the supply center (CEASA) of the state referring to CECANE or the nearest state, in 2017; (2) for food items in which no price was found on the CEASA website, the lowest search price performed on the Internet was used, as explained earlier. The list of food prices has been validated by the respective CECANE.

The quality analysis of the menus prepared by CECANE was also performed, applying the Quality Index of the Coordination of Food and Nutrition Security (IQ COSAN) ¹⁰ to evaluating characteristics such as the food diversity of the menus, presence of regional foods and sociobiodiversity and absence of prohibited foods, incorporated aspects of *Dietary Guidelines for the Brazilian Population* into

its evaluation matrix, attributing positive scores to the absence of processed or ultra-processed foods in place of the positive score for the absence of restricted foods. The IQ COSAN score ranges from 0 to 95 points and classifies menus as: inadequate (0-45 points), needs improvements (46-75 points) and adequate (76-95 points).

Based on this set of analyses, a proposal was formulated to update the parameters for restriction of the acquisition of foods that establish maximum percentage values for the acquisition of processed culinary ingredients and processed and ultra-processed foods and minimum percentages for the acquisition of fresh or minimally processed foods.

- **Update of PNAE parameters for the prohibition of the purchase of certain foods**

In order to update the list of foods whose acquisition with federal resources from the PNAE was prohibited in the resolution in force at the time ², the ultra-processed foods purchased in 2015 by the executing entities (municipalities, states and federal schools) of the country, obtained from the SIGPC, were analyzed based on the guidelines of the PNAE, the precepts of *Dietary Guidelines for the Brazilian Population* and the promotion of adequate healthy food ⁸, according to which junk food, sugary drinks and others should not be part of the children's eating routine and, above all, should not be offered in the school environment.

In addition, these foods were analyzed based on the *Pan American Health Organization Nutrient Profile Model* ¹¹. Then, we identified those who had excessive sodium content (≥ 1 g per 1Kcal), free sugar ($\geq 10\%$ of the total energy value – TEV), total fats ($\geq 30\%$ of the TEV), saturated fat ($\geq 10\%$ of the TEV), trans fat ($\geq 1\%$ of the TEV) and also those that contained sweeteners. As the declaration of the number of total sugars is not mandatory on food labels in Brazil, the difference was calculated between the amount of total carbohydrates of the food analyzed with sugar and the sugar-free food available in the 4th edition of the *Brazilian Table of Food Composition (TACO)* ¹² or in the table of the Brazilian Institute of Geography and Statistics (IBGE) ¹³ of 2008-2009, if the food was not included in the former. For the other foods, which did not present a sugar-free version in TACO or in the IBGE table, the value of the free sugar of the food was used, obtained from the table of the United States Department of Agriculture (USDA) ¹⁴.

Based on this set of analyses, ultra-processed foods that should have prohibited acquisition were listed.

Phase 2

The objectives of this phase were: (a) to analyze the relative participation of the food purchased in the PNAE, according to the extent and purpose of its industrial processing, in the total federal financial resources used in its acquisition and in the total energy purchased and (b) to identify the relationship between the relative participation of food groups in these financial resources and the quality of the food purchased. For this, an ecological study was developed with secondary data from SIGPC, referring to the year 2016, the last year available when the analyses were performed. Data were used regarding the quantities of each food and the paid amounts (BRL) for 525 municipalities. For the selection of municipalities, the first draw was made for a state of each region (Acre, Alagoas, São Paulo, Santa Catarina and Goiás) and then, considering the set of municipalities of these states ($n = 1,310$), a simple random sample of 40% of the municipalities was performed.

The quantity of each food, recorded by the municipalities in different units of measure (e.g.: kg, unit, can, pack), was converted into grams ¹⁵ and the inedible fraction was excluded, according to the corresponding correction factors ¹¹. The nutritional composition of the purchased foods was calculated using TACO ¹¹ and, for foods not available in it, the official table of American nutritional composition was used ¹³.

All food items purchased were classified according to extension and purpose of industrial processing, as proposed in *Dietary Guidelines for the Brazilian Population*, according to the NOVA ^{3,4,5} classification, as described in Phase 1.

Additionally, for the evaluation of the quality of food provided by the municipalities, the following data were analyzed: the percentage distribution of energy from each macronutrient (carbohydrates,

proteins, and lipids) in the total energy acquired, the density of micronutrients (amount of micronutrient/total energy acquired by the municipality) (vitamin C, vitamin A, iron and calcium) and the number of fresh or minimally processed foods acquired. The latter variable was constructed from the counting of different types of foods, according to the concepts of diversity¹⁶ and variety³, which, to some extent, express the contribution of micronutrients from the diet.

For the analysis of the Phase 2 data, in addition to the mean values obtained for the set of municipalities analyzed, these were divided into quarters according to relative participation of energy from ultra-processed foods in the total number of foods purchased, with the first quarter (Q1) being the one with the lowest participation.

We estimated the relative mean participation (%) of energy and financial resources used for each of the four food groups for the set of municipalities analyzed, and for each quarter of the participation of ultra-processed foods. The percentage distribution of macronutrients, the density of micronutrients and the average number of fresh or minimally processed foods acquired for the set of municipalities analyzed for each quarter of the participation of ultra-processed foods were also estimated. In addition, for the set of municipalities that met the parameters of relative participation of the different food groups in the total federal resources used for the acquisition of foods proposed in Phase 1 (spending parameters), the percentage distribution of macronutrients and the average number of fresh or minimally processed foods were estimated.

Data analyses were performed using Stata version 14.2 software (<https://www.stata.com>).

Results

Phase 1

- **Update of PNAE parameters for food acquisition restriction**

In the period analyzed (2013-2015), the group of fresh or minimally processed foods had a greater participation in the federal resources used in the purchase of total food for the program (67.6%). The average participation of the sum of the groups of ultra-processed and processed foods corresponded to almost one third (29.3%) federal resources spent (Table 1).

When compared to the national average participation of each food group (Table 1), the municipalities with positive PNAE execution presented higher values for the participation of fresh or minimally processed foods and lower for processed and ultra-processed foods; the opposite is observed for municipalities with negative execution. The average participation of processed culinary ingredients in both groups of municipalities was similar to the national average (Table 2). We can also observe that, in the first group of municipalities, the average participation of fresh or minimally processed foods was higher than 75%; that the participation processed and ultra-processed, added, was less than 20%; and that that of processed culinary ingredients was less than 5%.

Table 1

Participation (%) of each food group in relation to the total federal resources used in the purchase of food. Brazilian National School Feeding Program (PNAE), 2013-2015.

Food groups	Participation (%) in total resources used in the purchase of food			
	2013	2014	2015	Mean for the period
Fresh or minimally processed foods	68.4	65.6	68.7	67.6
Processed culinary ingredients	2.9	3.3	3.0	3.1
Processed + ultra-processed foods	28.7	31.1	28.3	29.3
Processed foods	10.9	9.8	7.9	9.5
Ultra-processed foods	17.8	21.3	20.4	19.8

Table 2

Participation (%) of each food group in relation to the total federal resources used in the purchase of food in nine Brazilian municipalities with positive and negative execution. Brazilian National School Feeding Program (PNAE), 2013-2015.

Criteria for implementing the PNAE/Municipalities	Number of inhabitants	IDHM	Number of students	Participation (%) in total spending				
				Fresh or minimally processed foods	Processed culinary ingredients	Processed + ultra-processed foods	Processed foods	Ultra-processed foods
Positive								
A	10,649	0.589	20,887	86.3	1.9	11.8	10.6	1.2
B	13,955	0.710	2,767	79.3	4.0	16.7	3.4	13.3
C	46,033	0.701	15,032	66.7	1.7	31.6	2.1	29.5
D	77,653	0.793	14,664	74.5	3.9	21.6	4.8	16.8
E	15,357	0.696	3,987	82.3	3.2	14.5	8.5	6.0
Mean				77.8	2.9	19.2	5.9	13.4
Negative								
F	18,166	0.496	5,166	47.3	7.5	45.2	2.0	43.2
G	999,728	0.739	94,180	75.0	9.6	15.4	1.7	13.7
H	2,675,656	0.750	363,392	58.8	3.4	37.8	10.7	27.1
I	103,204	0.699	19,797	61.0	1.6	37.4	10.4	27.0
Mean				60.5	5.5	34.0	6.2	27.8

A and F: municipalities in the North Region; B and G: municipalities in the Southeast Region; C and H: municipalities in the Northeast Region; D and I: municipalities in the South Region; E: municipality in the Central-West Region; MHD: Brazilian Municipal Human Development Index.

* Two municipalities were selected by region, except for the Central-West Region, where one of the selected municipalities was not accountable to Brazilian National Fund for the Development of Education.

The average participation of the group of fresh or minimally processed foods in the cost of the 22 monthly menus prepared by CECANE (88%) (Table 3) was higher than the average participation of this group in the total number of federal resources used in the purchase of food for the program (Table 1). The average participation of processed culinary ingredients (6.7%) also exceeded the national average participation of this group and the sum of the average participation of processed and ultra-processed foods (5.3%) was lower than the national average participation of these groups. Despite the expressive relative participation of fresh or minimally processed foods, of the 22 monthly menus prepared by CECANE, 10 were adequate, 11 needed improvements and one was inadequate with regard to its quality according to the IQ COSAN (Table 3). All menus provided fruits and culinary preparations that could be produced in the school environment, such as rice and beans, *baião de dois*, *arroz carreteiro*, *feijão tropeiro*, *maxixada*, *canjica* and *curau* (data not shown in the table).

Based on this set of results, the working group proposed that the following parameters be adopted for the participation of food groups in relation to the total federal resources used in the purchase of food: $\geq 75\%$ of resources for fresh or minimally processed food; $< 20\%$ for processed or ultra-processed foods and $< 5\%$ for processed culinary ingredients. Starting from the average distribution obtained in the studied period, the proposed parameters sought to establish a goal of participation of different food groups that would promote an improvement in the profile of food acquisition within the scope of the PNAE.

Table 3

Participation (%) of each food group in the monthly cost and quality of the menus elaborated by the School Food and Nutrition Collaborating Centers. Brazil, 2017.

Quality IQ COSAN	Participation (%) in monthly cost					
	Fresh or minimally processed foods	Processed culinary ingredients	Processed + ultra-processed foods	Processed foods	Ultra-processed foods	
Adequate	97.3	2.7	0.0	0.0	0.0	
	98.4	1.6	0.0	0.0	0.0	
	88.3	5.4	6.3	5.3	1.0	
	88.3	5.4	6.3	5.3	1.0	
	96.7	3.3	0.0	0.0	0.0	
	97.0	3.0	0.0	0.0	0.0	
	75.7	2.9	21.4	5.8	15.6	
	68.6	28.6	2.8	2.8	0.0	
	74.3	20.0	5.7	4.6	1.1	
	95.8	3.4	0.8	0.0	0.8	
Mean	88.0	7.6	4.3	2.4	2.0	
Needs improvements	76.2	2.4	21.4	5.8	15.6	
	89.2	5.0	5.8	4.5	1.3	
	89.2	5.0	5.8	4.5	1.3	
	89.2	5.0	5.8	4.5	1.3	
	88.0	12.0	0.0	0.0	0.0	
	86.6	13.4	0.0	0.0	0.0	
	88.0	3.9	8.1	4.7	3.4	
	97.8	1.4	0.8	0.0	0.8	
	88.3	7.5	4.2	3.0	1.2	
	86.1	7.7	6.2	5.2	1.0	
Inadequate	81.3	3.6	15.1	7.1	8.0	
	96.1	2.9	1.0	0.2	0.8	
	Mean	88.0	5.8	6.2	3.3	2.9
	Total mean	88.0	6.7	5.3	2.9	2.4

IQ COSAN: Quality Index of the Coordination of Food and Nutrition Security.

• Update of PNAE parameters for the prohibition of the purchase of certain foods

From a total of 390 ultra-processed foods purchased with federal funds from the program in 2015, 160 were identified that should not be offered in the school environment, which were grouped into 13 categories (Table 4). More than half of the total of these foods are powdered or reconstituted products (52.2%), such as powdered milk drinks, powdered soups, canjica mix, cakes, puddings, risotto, and rice pudding. The second main group, which added 14% of the listed foods, refers to concentrates based on guaraná or currant syrup, sweetened fruit drinks with additives and other similar drinks, such as concentrated juice, fruit nectar and drink syrup.

We also analyzed the ban on the purchase of margarine and ultra-processed meat products, such as mechanically separated meat, mortadella, hot dogs, meatballs, ham, canned beef, salami, and sausages. Although they have high levels of critical nutrients, the ban could be difficult to implement considering that they are low-cost products that make up or accompany culinary preparations. To avoid the frequent presence of these products on the menus, parameters have been suggested to limit their offer.

Table 4

Food categories that must not be purchased in the Brazilian National School Feeding Program (PNAE) and percentage of foods with a high content of critical nutrients and the presence of sweeteners by food category, Brazil, 2015.

Categories	Number of foods grouped in the category	% of ultra-processed foods with High content					Presence of sweeteners
		Sodium $\geq 1\text{g per } 1\text{Kcal}$	Free sugar $\geq 10\%$ of the TEV of the food	Total fats $\geq 30\%$ of the TEV of the food	Saturated fat $\geq 30\%$ of the TEV of the food	Trans fat $\geq 1\%$ of the TEV of the food	
1. Concentrate based on guaraná or currant syrup, fruit drinks with additives or sweeteners and other similar drinks	22	12.5	95.8	4.2	0.0	0.0	12.5
2. Ready-made teas	1	0.0	100.0	0.0	0.0	0.0	100.0
3. Cereals with additive or sweetened	6	16.7	100.0	0.0	0.0	0.0	0.0
4. Candies and confectionery	2	0.0	100.0	0.0	0.0	0.0	0.0
5. Bonbons, chocolate bars and sprinkles	7	0.0	85.7	100.0	100.0	14.3	14.3
6. Filled cookies and similar	7	0.0	100.0	100.0	100.0	0.0	0.0
7. Cake with icing or filling and similar	7	0.0	100.0	100.0	100.0	0.0	0.0
8. Cereal bar with additives or sweeteners	8	0.0	100.0	22.2	44.4	0.0	0.0
9. Ice cream variants	2	0.0	100.0	100.0	50.0	0.0	0.0
10. Gelatin	2	100.0	50.0	0.0	0.0	0.0	100.0
11. Spices with monosodium glutamate or sodium salts	10	90.0	30.0	50.0	30.0	0.0	0.0
12. Mayonnaise	3	100.0	0.0	100.0	66.6	0.0	0.0
13. Powdered or reconstituted foods enteral	82	34.0	51.5	11.3	15.5	3.1	19.6
Total	159	25.3	62.0	25.9	27.2	2.5	6.3

TEV: total energy value.

Complementarily, based on the *Pan American Health Organization Nutrient Profile Model*, it was identified that all 160 foods had at least one critical nutrient, of which 62% contained a high content of free sugar; 27.2%, high content of saturated fat; 25.9%, high content of total fats; 25.3%, high sodium content; 2.5%, high content of trans fat; and 6.3% contained sweeteners. The details of these results by food category are shown in Table 4.

Based on these analyses, we propose that the list of foods whose acquisition would be banned with federal resources would then become: soft drinks and artificial soft drinks, already provided for in the *Resolution n. 38 of 2009*², drinks or concentrates based on guaraná or currant syrup, ready-made teas and other similar drinks, fruit drinks with additives or sweeteners, cereals with additives or sweeteners, candies in general, confectionery, bonbons, chocolates in bars or sprinkles, cookies or filled cookies, cakes with icing or filling, cereal bars with additives or sweeteners, ice creams and variants, gelatins, spices with monosodium glutamate or sodium salts, mayonnaise and powdered or reconstituted foods.

Phase 2

The group of fresh or minimally processed foods had a greater relative share of energy (52.9%) in the total of foods purchased for PNAE in the municipalities studied. The group of ultra-processed foods accounted, on average, for almost 30% of the total energy purchased, ranging from 5.1% (for the 25% of municipalities with less participation) to 64% (for the 25% of municipalities) with greater participation). In addition to processed foods, these accounted for 1/3 of the energy purchased (Table 5).

Table 5

Mean relative participation (%) of energy and financial resources executed with each of the groups of the NOVA classification, for 525 Brazilian municipalities and according to quarters of energy participation of ultra-processed foods. Brazil, 2016.

Food groups	Energy participation (%) of food groups					Participation (%) in total expenditure on food				
	Total	Quarters of energy percentage of ultra-processed foods *				Total	Quarters of energy percentage of ultra-processed foods *			
		Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
Fresh or minimally processed foods	52.8	74.2	60.5	50.1	26.4	68.2	76.3	70.1	63.2	63.2
Processed culinary ingredients	14.3	17.9	17.0	15.2	7.0	4.6	4.9	4.9	4.8	3.9
Processed foods	3.5	2.8	4.8	3.9	2.6	5.1	4.7	5.0	6.1	4.8
Ultra-processed foods	29.3	5.1	17.6	30.7	64.0	22.0	14.0	20.0	25.9	28.1
Processed + ultra-processed foods	32.9	8.0	22.5	34.6	66.6	27.1	18.8	25.0	32.0	32.9

* Minimum and maximum energy participation values for ultra-processed foods, according to quarters of participation: Q1: 0% to 10.6%, Q2: 10.6% to 24.2%, Q3: 24.3% to 40.2% and Q4: 40.4% to 99%.

The comparison of the results referring to the relative participation of ultra-processed foods in the total energy acquired with the participation of these food groups in the total resources employed indicated that the financial approach was related to the nutritional approach (Table 5). Such coherence was reiterated when the relative participation of food groups in total calories was compared with the proposal, originating from Phase 1, of adopting parameters of relative participation of food groups in total expenditures: it was observed that the municipalities located in the first quarter of energy participation of ultra-processed foods (the most desirable situation for the program) presented, on average, a distribution close to that of the proposed parameters.

The higher energy share of ultra-processed foods resulted in a higher proportion of carbohydrates (Q1: 52.1%; Q2: 56.2%; Q3: 57.1%; Q4: 62.4%) and a lower proportion of proteins (Q1: 17.7%; Q2: 15.5%; Q3: 14.3%; Q4: 12.6%) and lipids (Q1: 30.2%; Q2: 28.3%; Q3: 28.6%; Q4: 25.1%). In the municipalities allocated in the first quarter of the relative share of ultra-processed foods in the total energy purchased, the following macronutrient distribution average was observed: 52.02% for carbohydrates, 17.74% for proteins and 30.19% for lipids. For those allocated in the last quarter, this distribution was 62.36%, 12.57% and 25.07%, respectively.

Regarding micronutrients, the energy share of ultra-processed foods in the total of purchased food items did not influence the density of vitamin C, vitamin A and calcium. The density of vitamin C was lower, but not significantly, in the upper quarters of participation of ultra-processed foods, while vitamin A and calcium did not show a clear relationship with participation of these foods. As for iron, a positive gradient of its density was observed according to the share of ultra-processed foods in the total calories acquired by the municipalities.

Analyzing the number of fresh or minimally processed foods purchased according to the participation of ultra-processed foods, the average items were 31.9 (Q1), 35.5 (Q2), 34.7 (Q3) and 35.3 (Q4).

The expenditure parameters proposed in Phase 1 were already practiced by 22.5% (n = 118) of the 525 municipalities studied in this Phase. In this group, the average energy distribution from each macronutrient was as follows: 54% carbohydrates, 17.5% proteins and 28.5% lipids. These values are in accordance with the recommendations for the distribution of macronutrients (respectively 55-75% for carbohydrates, 10-15% for proteins, and 15-30% for lipids)^{17,18,19}, despite the fact that they refer to a food day and not to the acquisition of food. Considering the expenditure parameter for all food groups, the average number of types of these foods was 34.9, but no differences were found between the municipalities that reached or did not reach the parameters.

The finding that the participation of ultra-processed foods did not influence the number of micronutrients or the number of fresh or minimally processed foods purchased (proxy for variety and diversity) led to four recommendations. The first three, which are mandatory, focused on the supply of micronutrients, namely: inclusion of foods containing heme iron at least four days a week and foods containing vitamin A at least three days a week. In the case of non-heme iron source foods, these must be accompanied by facilitators of their absorption, such as food items that are sources of vitamin C. The fourth recommendation is suggestive and focuses on acquisition: that there should be at least 50 different types of fresh or minimally processed foods acquired annually by the municipalities, with a view to promoting greater variety and diversity in school meals.

Discussion

The proposed parameters for food acquisition contribute to the incorporation of the *Dietary Guidelines for the Brazilian Population* in the PNAE, since they are based on the extent and purpose of industrial food processing. In addition, the relative participation of the resources used in the acquisition of food groups in the total of executed resources was consistent with the relative participation of energy of these groups in the total of purchased energy. Consequently, the establishment of cut-off points for the participation of food groups in the total federal resources used in their purchase that provide for a majority share of fresh or minimally processed foods and limited of processed and ultra-processed foods converge with the *Dietary Guidelines for the Brazilian Population* recommendations.

We also observed consistency between the proposed parameters and the relative energy distribution of each macronutrient (carbohydrates, proteins, and fats) in the total energy acquired. The relative shares, in the total amount of energy purchased, both from food groups according to the extent and purpose of industrial processing⁵ and from macronutrients are important proxies for food quality²⁰. It is worth noting that the observed equivalence between the acquisition parameters and the nutritional parameters was due to the food prices practiced in 2016. Considering the tendency of a relative decrease in the prices of ultra-processed foods in relation to fresh or minimally processed foods²¹, the cut-off points of the proposed parameters should be periodically reviewed.

The proposed acquisition parameters proved to be feasible, since, of the 525 municipalities studied in the second phase, 22.5% practiced them. In addition, the menus developed by CECANE proved to be viable for preparing meals. Feasibility is an indispensable attribute of any proposal to improve a public policy, being just as important as its technical-scientific quality, as it will enable its applicability in different realities.

At the same time, if fully practiced, the proposed acquisition parameters will induce the improvement of the PNAE, since the average percentage of financial resources used in the acquisition of fresh or minimally processed foods will increase from 69% to at least 75%.

In addition, it is important not only to recommend minimum amounts for spending on fresh or minimally processed foods, which could be simpler operationally, but also pointing out the limits for spending on processed culinary ingredients and processed foods and ultra-processed, since these recommendations are complementary and act to favor the quality of the food offered by PNAE.

From the perspective of public policy, it is important to establish parameters that induce municipalities and states to improve the nutritional quality of the menus offered in schools, since the PNAE is one of the strategic policies for ensuring food and nutrition security²⁰. In addition, schools can be protective factors for obesity and chronic non-communicable diseases^{22,23} contributing to a school food environment that promotes healthy eating practices^{24,25}.

The proposed parameters are also auditable by the instances of social control. Municipal managers are obliged to submit detailed information on food purchase expenditures to the Schools Food Council. Based on these and with a list of the classification of foods according to NOVA (which can be made available by the FNDE), the counselors will be able to calculate the relative participation of each group of foods in the total resources. This represents an important advance for social control practices, since, until 2020, part of the nutritional parameters of the PNAE was focused on nutrients and depended on computational tools and specialized professionals to verify compliance.

The possibility of monitoring these parameters by society is a way of complying with one of the principles of the National System of Food and Nutritional Security (*Law n. 11,346/2006*), a measure of transparency also encouraged in international documents²⁶. According to Siqueira et al, in recent years, the PNAE has advanced in its legal framework towards the realization of the human right to food, but it is still necessary to advance in the active involvement of civil society organizations²⁷.

On the other hand, a low participation of ultra-processed foods in the total of purchased foods was not enough to promote a micronutrient supply or a greater diversity and variety of fresh or minimally processed foods in the list of acquired foods when compared to a greater participation of ultra-processed foods. This second finding was corroborated by the analysis of the menus prepared by CECANE: even though prepared according to the *Dietary Guidelines for the Brazilian Population*, more than half of them did not reach an “adequate” classification for diversity/variety. The results referring to the supply of micronutrients differ from those found in studies that investigated the nutritional quality of the diet according to the participation of ultra-processed foods in individual food consumption databases. In them, an inverse association was observed between consumption of ultra-processed foods and intake of micronutrients such as B12, iron, zinc, among others^{28,29,30,31}. A possible explanation for this divergence is the fact that, in our study, the estimate of the micronutrient supply was made based on data of acquisition and not of food consumption. This method may not have been sensitive enough to capture this association. On the other hand, our findings corroborate those of other studies, which show low diversity/variety of the Brazilian diet, regardless of the participation of ultra-processed foods^{32,33}. This low diversity/variety also seems to be occurring in the process of acquiring food from PNAE³⁴. In view of these findings regarding the supply of micronutrients and food diversity/variety, the criteria for food acquisition must be complemented by supply criteria that contribute to ensuring the quality of the meals offered.

It is important to comment on some limitations of the study. The SIGPC data refer only to acquisitions made with funds transferred by FNDE, disregarding the counterpart of the municipalities. Thus, acquisitions made with own resources were not counted. Although they do not reflect what was actually consumed by students, purchase estimates are accurate to determine the types of food and the amounts spent on school meals. The lack of information on the value of the counterpart from states and municipalities also did not allow estimating the financial impact of the proposed parameters, an important aspect for assessing their feasibility.

Regarding the application of the *Pan American Health Organization Nutrient Profile Model*, in view of the non-mandatory declaration of the number of total sugars on food labels in Brazil and the unavailability of product brands in the SIGPC, there was an inaccuracy in the estimates of nutritional composition and free sugars in purchased foods. However, in view of the limitation of the labeling legislation in the country and that the study was based on secondary data, a well-founded and reproducible analytical strategy was outlined.

Another relevant aspect concerns the differences in the registration of information from the municipalities with regard to the amount of food purchased. In some cases, measures such as bundle and unit were found without information regarding weight. Based on the literature, a weight standardization was adopted for these measures, but it is not possible to guarantee the precision of the values.

Furthermore, it was not possible to assess the daily per capita contribution of micronutrients, since only annual food purchase data were available, with no information on per capita quantities and number of beneficiaries, for example. However, the analysis of the number of types of food purchased can be considered a proxy for variety and diversity, which are associated with the supply of micronutrients.

It is also important to comment on the strengths of the study. The first was the adoption of the NOVA classification, the *Dietary Guidelines for the Brazilian Population* and the *Pan American Health Organization Nutrient Profile Model*, consistent theoretical references on a topic of interest to the study. The second concerns the fact that the proposed parameters are based on an empirical basis derived from the PNAE routine, which allowed working with a large volume of data and producing robust evidence for the intended objectives.

As a lesson learned, the experience of reconciling scientific aspects and methodological rigor with the knowledge accumulated in the management experience, allowed us to arrive at a proposal of

scientifically based parameters and applicable to the reality of a public policy in operation for more than sixty years.

This process supported the review of the food acquisition parameters recently published in *Resolução n. 6/2020*³⁵, which updated the rules for the execution of the PNAE from 2021. This new resolution reiterates the program's contribution to ensuring food and nutritional security for students in public basic education in alignment with the current dietary guidelines in Brazil.

Contributors

D. S. Canella and L. Bandeira contributed in the conception and planning for the study, data analysis, data interpretation, and writing of the article. M. L. Oliveira, D. H. Bandoni e I. R. R. Castro contributed in the conception and planning, and writing of the article. S. Castro e A. S. Pereira contributed in the conception and planning, interpretation of the data, and review of the article. All authors approved the final version of the article.

Additional informations

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References

1. Ministério da Saúde. Guia alimentar para a população brasileira: promovendo alimentação saudável. Brasília: Ministério da Saúde; 2008.
2. Ministério da Educação, Fundo Nacional de Desenvolvimento da Educação. Resolução nº 38, de 16 de julho de 2009, dispõe sobre o atendimento da alimentação escolar aos alunos da educação básica no Programa Nacional de Alimentação Escolar – PNAE. Diário Oficial da União 2009; 16 jul.
3. Departamento de Atenção Básica, Secretaria de Atenção à Saúde, Ministério da Saúde. Guia alimentar para a população brasileira. Brasília: Ministério da Saúde; 2014.
4. Monteiro CA, Cannon G, Levy RB, Moubarac J-C, Jaime P, Martins AP, et al. NOVA. The star shines bright. *World Nutr* 2016; 7:28-38.
5. Monteiro CA, Cannon G, Levy RB, Moubarac J-C, Louzada MLC, Rauber F, et al. Ultra-processed foods: what they are and how to identify them. *Public Health Nutr* 2019; 22:936-41.
6. Ministério da Saúde; Ministério da Educação. Portaria Interministerial nº 1.010, de 8 de maio de 2006. Institui as diretrizes para a Promoção da Alimentação Saudável nas Escolas de educação infantil, fundamental e nível médio das redes públicas e privadas, em âmbito nacional. Diário Oficial da União 2006; 9 mai.
7. Instituto Brasileiro de Geografia e Estatística. Censo demográfico 2010. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2011.
8. Programa das Nações Unidas para o Desenvolvimento. Atlas do desenvolvimento humano no Brasil. Brasília: Programa das Nações Unidas para o Desenvolvimento/Fundação João Pinheiro/Instituto de Pesquisa Econômica Aplicada; 2013.
9. Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira. Notas estatísticas. Censo Escolar 2017. Brasília: Ministério da Educação; 2018.

10. Fundo Nacional de Desenvolvimento da Educação. Índice de qualidade da coordenação de segurança alimentar nutricional – IQ COSAN. Brasília: Ministério da Educação; 2018.
11. Organização Pan-Americana da Saúde. Modelo de perfil nutricional da Organização Pan-Americana da Saúde. Washington DC: Organização Pan-Americana da Saúde; 2016.
12. Núcleo de Estudos e Pesquisas em Alimentação, Universidade Estadual de Campinas. Tabela Brasileira de Composição de Alimentos (TACO). Campinas: Universidade Estadual de Campinas; 2004.
13. Instituto Brasileiro de Geografia e Estatística. Tabela de composição de alimentos. 4ª Ed. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 1996.
14. Agricultural Research Service, United States Department of Agriculture. Composition of foods raw, processed, prepared. Beltsville: United States Department of Agriculture; 2002. (USDA National Nutrient Database for Standard Reference. Release, 15).
15. Pinheiro ABV, Lacerda EMA, Benzecry EH, Gomes MCS, Costa VM. Tabela para avaliação de consumo alimentar em medidas caseiras. 4ª Ed. São Paulo: Editora Atheneu; 2002.
16. Kennedy G, Ballard T, Dop MC. Guidelines for measuring household and individual dietary diversity. Rome: Food and Agriculture Organization of the United Nations; 2011.
17. Mann J, Cummings J, Englyst H, Key T, Liu S, Riccardi G, et al. FAO/WHO Scientific update on carbohydrates in human nutrition: conclusions. *Eur J Clin Nutr* 2007; 61 Suppl 1:S132-7.
18. World Health Organization. Protein and amino acid requirements in human nutrition: report of a joint FAO/WHO/UNU expert consultation. Geneva: World Health Organization; 2007.
19. Food and Agriculture Organization of the United Nations. Fats and fatty acids in human nutrition. Rome: Food and Agriculture Organization of the United Nations; 2008.
20. Monteiro CA, Cannon G, Lawrence M, Louzada MLC, Machado PP. Ultra-processed foods, diet quality, and health using the NOVA classification system. Rome: Food and Agriculture Organization of the United Nations; 2019.
21. Maia EG, Passos M, Levy RB, Martins APB. What to expect from the price of healthy and unhealthy foods over time? The case from Brazil. *Public Health Nutr* 2020; 23:579-88.
22. Nogueira RM, Barone B, Barros TT, Guimarães KLSLQ, Rodrigues SS, Behrens JH. Sixty years of the National Food Program in Brazil. *Rev Nutr* 2016; 29:253-67.
23. Gonçalves VS, Duarte EC, Dutra ES, Barufaldi LA, Carvalho KM. Characteristics of the school food environment associated with hypertension and obesity in Brazilian adolescents: a multilevel analysis of the Study of Cardiovascular Risks in Adolescents (ERICA). *Public Health Nutr* 2019; 22:2625-34.
24. Noll PRS, Noll M, Abreu LC, Baracat EC, Silveira EA, Sorpreso ICE. Ultra-processed food consumption by Brazilian adolescents in cafeterias and school meals. *Sci Rep* 2019; 9:7162.
25. Locatelli NT, Canella DS, Bandoni DH. Positive influence of school meals on food consumption in Brazil. *Nutrition* 2018; 53:140-4.
26. Swinburn BA, Kraak VI, Allender S, Atkins VJ, Baker PI, Bogard JR, et al. The global syndemic of obesity, undernutrition, and climate change: the Lancet Commission Report. *Lancet* 2019; 393:791-846.
27. Siqueira RL, Cotta RMM, Ribeiro RCL, Sperandio N, Priore SE. Análise da incorporação da perspectiva do direito humano à alimentação adequada no desenho institucional do programa nacional de alimentação escolar. *Ciênc Saúde Colet* 2014; 19:301-10.
28. Falcão RCTMA, Lyra CO, Morais CMM, Pinheiro LGB, Pedrosa LFC, Lima SCVC, et al. Processed and ultra-processed foods are associated with high prevalence of inadequate selenium intake and low prevalence of vitamin B1 and zinc inadequacy in adolescents from public schools in an urban area of northeastern Brazil. *PLoS One* 2019; 14:e0224984.
29. Cornwell B, Villamor E, Mora-Plazas M, Marin C. Processed and ultra-processed foods are associated with lower-quality nutrient profiles in children from Colombia. *Public Health Nutr* 2017; 21:142-7.
30. Louzada MLC, Martins APB, Canella DS, Baraldi LG, Levy RB, Claro RM, et al. Impact of ultra-processed foods on micronutrient content in the Brazilian diet. *Rev Saúde Pública* 2015; 49:45.
31. Elizabeth L, Machado P, Zinöcker M, Baker P, Lawrence M. Ultra-processed foods and health outcomes: a narrative review. *Nutrients* 2020; 12:1955.
32. Canella DS, Louzada MLC, Claro RM, Costa JC, Bandoni DH, Levy RB, et al. Consumption of vegetables and their relation with ultra-processed foods in Brazil. *Rev Saúde Pública* 2018; 52:50.
33. Oliveira N, Santin F, Paraizo TR, Sampaio JP, Moura-Nunes N, Canella DS. Baixa variedade na disponibilidade domiciliar de frutas e hortaliças no Brasil: dados das POF 2008-2009 e 2017-2018. *Ciênc Saúde Colet* 2021; 26:5805-16.
34. Amorim ANB, Rosso VV, Bandoni DH. Acquisition of family farm foods for school meals: Analysis of public procurements within rural family farming published by the cities of São Paulo state. *Rev Nutr* 2016; 29:297-306.
35. Ministério da Educação, Fundo Nacional de Desenvolvimento da Educação. Resolução nº 6, de 8 de maio de 2020, sobre o atendimento da alimentação escolar aos alunos da educação básica no âmbito do Programa Nacional de Alimentação Escolar – PNAE. *Diário Oficial da União* 2020; 8 may.

Resumo

O Guia Alimentar para a População Brasileira é reconhecido como um potente indutor de políticas públicas de alimentação e nutrição. Nessa perspectiva, este artigo apresenta o percurso metodológico e as evidências que subsidiaram a elaboração dos novos parâmetros de aquisição de alimentos do Programa Nacional de Alimentação Escolar (PNAE). Tal elaboração envolveu as análises de: (1) participação dos recursos federais utilizados para compra de alimentos, agrupados segundo a classificação NOVA, empregada no Guia Alimentar para a População Brasileira, pelo conjunto de municípios brasileiros e segundo classificação da execução (positiva ou negativa); (2) cardápios mensais de referência que foram elaborados seguindo recomendações do Guia Alimentar para a População Brasileira; (3) aquisição de alimentos por amostra de 525 municípios, envolvendo a participação relativa dos grupos de alimentos (segundo a NOVA) no total de gastos e de energia e a qualidade nutricional dos alimentos adquiridos; e (4) alimentos ultraprocessados que não devem ser ofertados no ambiente escolar. Foi proposta a adoção dos seguintes parâmetros para participação dos grupos de alimentos em relação ao total de recursos federais empregados na compra de alimentos: $\geq 75\%$ de recursos para alimentos in natura ou minimamente processados; $< 20\%$ para alimentos processados ou ultraprocessados e $< 5\%$ para ingredientes culinários processados e a ampliação da lista de alimentos cuja aquisição com recursos federais do PNAE é proibida. Esse processo subsidiou a elaboração da Resolução CD/FNDE nº 6, de 8 de maio de 2020, que dispõe sobre o atendimento da alimentação escolar aos alunos da educação básica no âmbito do PNAE.

Programas e Políticas de Nutrição e Alimentação; Guia Alimentares; Recomendações Nutricionais; Processamentos de Alimentos; Promoção da Saúde na Escolar

Resumen

La Guía Alimentaria para la Población Brasileña está reconocida como un potente inductor de políticas públicas de alimentación y nutrición. Desde esta perspectiva, este artículo presenta la trayectoria metodológica y evidencias que apoyaron la elaboración de los nuevos parámetros de adquisición de alimentos del Programa Nacional de Alimentación Escolar (PNAE). Tal elaboración implicó los análisis de: (1) participación de los recursos federales utilizados para la compra de alimentos, agrupados según la clasificación NOVA, empleada en el Guía Alimentaria para la Población Brasileña, por el conjunto de municipios brasileños, y según la clasificación de la ejecución (positiva o negativa); (2) menús mensuales de referencia que fueron elaborados siguiendo recomendaciones del Guía Alimentaria para la Población Brasileña; (3) adquisición de alimentos mediante una muestra de 525 municipios, implicando la participación relativa de los grupos de alimentos (según NOVA) en el total de gastos y de energía, así como la calidad nutricional de los alimentos adquiridos; y (4) alimentos ultraprocessados que no deben ser ofrecidos en el entorno escolar. Se propuso la adopción de los siguientes parámetros para la participación de los grupos de alimentos, en relación con el total de recursos federales empleados en la compra de alimentos: $\geq 75\%$ de recursos para alimentos in natura o minimamente procesados; $< 20\%$ para alimentos procesados o ultraprocessados, y $< 5\%$ para ingredientes culinarios procesados, así como la ampliación de la lista de alimentos, cuya adquisición con recursos federales del PNAE está prohibida. Este proceso apoyó la elaboración de la Resolución CD/FNDE nº 6, del 8 de mayo de 2020, que organiza la atención de la alimentación escolar a alumnos de educación básica en el ámbito del PNAE.

Programas y Políticas de Nutrición y Alimentación; Guías Alimentarias; Procesamiento de Alimentos; Promoción de la Salud en la Escuela

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