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ORIGINAL

Evolution of food intake estimates in Brazil: the 2008-2009 and 2017-2018 National Dietary Surveys

Evolução das estimativas da quantidade dos alimentos consumidos no Brasil: Inquérito Nacional de Alimentação 2008-2009 e 2017-2018

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ABSTRACT

Objective

To present changes in the estimated amount of food intake in Brazil between the 2008-2009 and 2017-2018 National Dietary Surveys.

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Methods

Food intake data from the 2008-2009 and 2017-2018 surveys were used to highlight the differences in the frequencies of foods mentioned, the number of the measurement units mentioned, and the frequency of measurements that were incompatible with the reported food and were exchanged by the most mentioned measurement (standard measurement), as well as to describe the updates performed in the database between edits.

Results

The elaboration of the 2017-2018 referenced measurement table was based on the 2008-2009 table, which was revised and updated. In the 2008-2009 survey, 9980 household measurements were mentioned for 1970 types of food and preparations, while in 2017-2018 there were 11050 and 2534, respectively. While in 2008-2009, 2.8% of citations were replaced by the standard measurement, in 2017-2018, only 0.7% of food items needed to be replaced.

Conclusion

The procedures used to estimate the amount of food intake between the surveys allowed updating the table of household measurements and minimizing errors in the estimate of this amount, with a reduction in measurement units that were inconsistent or incompatible with the aforementioned foods.

Keywords: Data collection. Diet records. Food intake.

RESUMO

Objetivo

Apresentar a evolução na estimativa da quantidade dos alimentos consumidos no Brasil entre os Inquéritos Nacionais de Alimentação de 2008-2009 e de 2017-2018.

Métodos

Foram utilizados dados de consumo alimentar de 2008-2009 e de 2017-2018 para evidenciar as diferenças nas frequências de citações, nos números de unidades de medidas citadas e na frequência de medidas incompatíveis com o alimento que foram substituídas pela medida citada com maior frequência (medida padrão), bem como descrever as atualizações realizadas no banco de dados entre as edições.

Resultados

A construção da tabela de medidas referidas de 2017-2018 foi baseada na tabela de 2008-2009, a qual foi revisada e atualizada. No inquérito de 2008-2009 foram citadas 9980 medidas caseiras para 1970 alimentos e preparações, enquanto em 2017-2018 foram 11050 para 2534, respectivamente. Enquanto em 2008-2009 2,8% das citaçoes foram substituídas pela medida padrao, em 2017-2018, somente 0,7% dos alimentos precisaram ser substituídos.

Conclusão

Os procedimentos utilizados na estimativa de quantidade de alimentos consumidos entre os inquéritos permitiram atualizar a tabela de medidas caseiras e minimizar erros na estimativa dessa quantidade, com redução de unidades de medidas incoerentes ou incompatíveis com os alimentos citados.

Palavras-chave: *Coleta de dados. Consumo de alimentos. Registros de dieta.*

INTRODUCTION

Food serving size is characterized as the amount of food on the plate, based on criteria chosen by the customer, restaurant, and/or producer [1]. It is also related to the amount of drink or food that was ingested at a given time.

The process of estimating the amount of food intake represents a relevant source of bias in its assessment, which may underestimate or overestimate it. Accuracy improvement in the quantification of food intake in national surveys contributes both to a reliable assessment of the population's food intake, as well as to the elaboration of recommendations and dietary guidelines and assessment of the size of servings ingested over the years [2].

The first *Inquérito Nacional de Alimentação* (INA, National Dietary Survey), conducted in Brazil together with the 2008-2009 *Pesquisa de Orçamentos Familiares* (POF, Household Budget Survey) released a table of household measurements that gathered information from different data sources, serving as a basis for the analysis of the food intake [3-6]. This first experience allowed us to verify mistakes when recording their incompatibility, referring to the mass and weight of the food measurements, as well as the difficulty of dimensioning, relating to the size of the food [4]. In the second INA conducted with the 2017-2018 POF, modifications were incorporated to improve the estimate accuracy of quantities ingested by the Brazilian population [5] and update the 2008-2009 database [6]. Accurately knowing the serving size allows the development of strategies that are effective in reducing the total energy intake [7].

This article presents the changes made to the 2008-2009 database, the impact of these changes on the 2017-2018 INA, highlighting the procedures for collecting measurements and the evolution in the estimate of the amount of food intake in Brazil in the 10 years between the two surveys.

METHODS

The data in this article refer to the food intake modules of the INA, conducted in 2008-2009 and 2017-2018, by the *Instituto Brasileiro de Geografia e Estatística* (IBGE, Brazilian Institute of Geography and Statistics), with the POF.

Both surveys were conducted on representative samples of the Brazilian population, generating estimates for the five major regions, urban and rural areas, and different socioeconomic levels. In summary, the 2008-2009 POF was conducted in 55,970 households, with food intake data collected in approximately 25% of these households. In the 2017-2018 POF, interviews were conducted in 57,920 households and 35% of these participated in the food intake module. Only residents above 10 years of age participated in the INA, in a total of 34,003 individuals in 2008-2009 and 46,164 individuals in 2017-2018 [3,5].

Food intake data were collected on two non-consecutive days using food records in the 2008-2009 survey and 24-hour dietary recalls in 2017-2018 [3,5].

The individuals who answered the 2008-2009 food intake module received a booklet that contained instructions for filling out food records with photos of kitchen utensils and containers most used to serve food, in order to help estimate intake quantities [3].

For a detailed record of the food intake, the booklet captured information on the time, place, amount, type of food, and types of preparation [3]. In the 2017-2018 food intake module, the data collection was conducted through a personal interview, with a professionally trained agent, and based on the Multi-Step Method [8]. Residents reported all food and drink (including water) ingested the day before each visit. Food intake was recorded in a software specially designed for this assessment, which requested detailed information on the amount ingested, when and where they ingested it, and occasion of meals [5].

In the 2017-2018 version, questions about "addition items" were included, with 12 items that are commonly eaten together with bread, pasta, cookies, among others, which are: olive oil, butter/margarine, sugar, sweetener, honey, molasses, mayonnaise, ketchup, mustard, soy sauce, grated cheese, and milk cream [5].

In both surveys, after completing the system with the information collected, the agent reviewed the report and confirmed the intake of food with the respondent, investigating the reports with no record of intake in a period of three hours or more and, in the 24-hour dietary recall, when less than five foods had been ingested.

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To estimate the amount ingested, the table of measurements of dietary intake from the 2017-2018 POF, with their respective amounts in grams or milliliters, was elaborated by extensively reviewing and updating the table of measurements from the 2008-2009 POF.

The previous methodology was maintained, with the compilation of tables of household measurements and other sources of information, such as: publications containing information on the volume capacity of household measurements; food labels; scientific articles with the unit weight of some Brazilian fruits; and directly weighing some foods and preparations conducted in research centers at Brazilian universities. The review and update of the previous table was conducted in 5 steps (Figure 1).

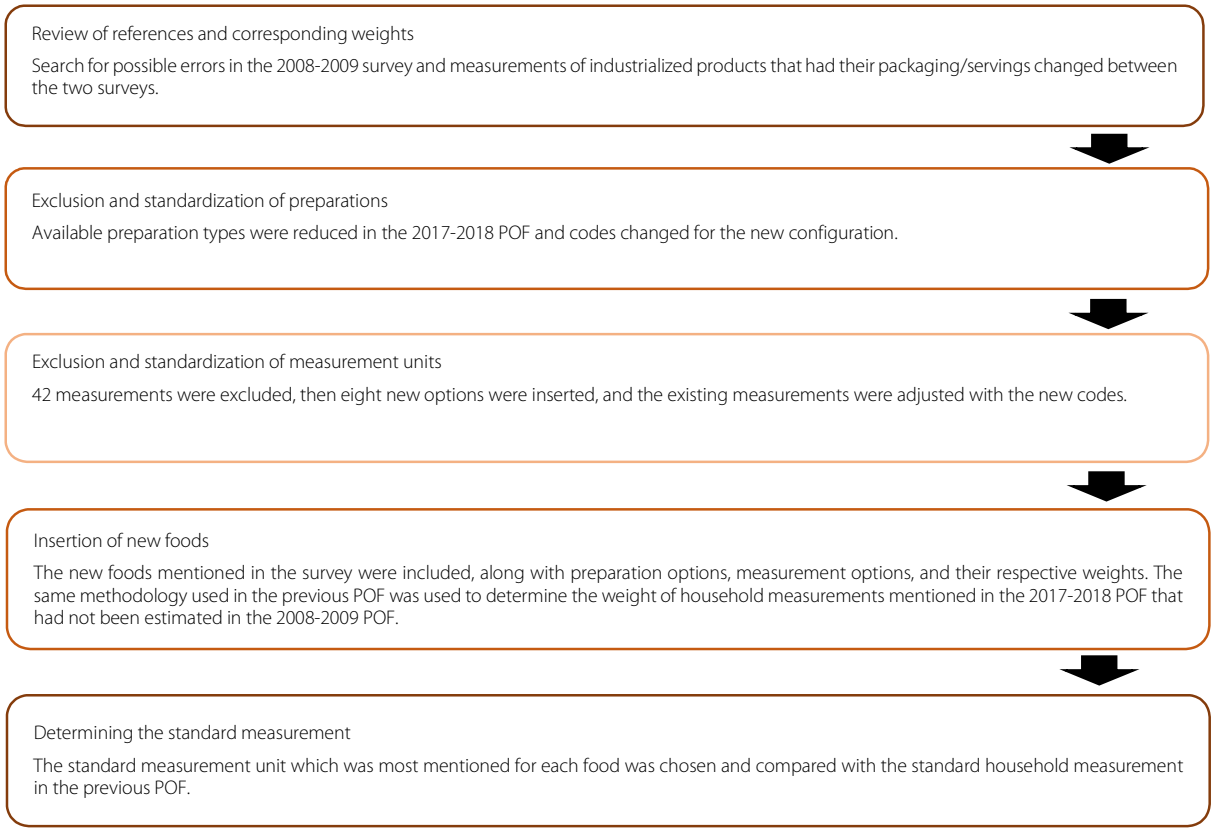

Figure 1 – Procedures used in the steps of updating the Table of Measurements referred to for food intake in Brazil between 2008-2009 to estimate the quantity consumed according to the 2017-2018 POF-INA. Brazil, 2017-2018.
Note: POF: *Pesquisa de Orçamentos Familiares*.

The first step consisted of reviewing the references and weights used in the 2008-2009 table. Then, there was the exclusion and standardization of preparations, where the types of preparation available for some foods were reduced from 16 in the 2008-2009 POF to 10 options in the 2017-2018 POF. In the third stage, the number of measurement options per food was reduced from 106 in the 2008-2009 POF to 64 units in the 2017-2018 POF. Table 1 presents all the measurements used in each survey.

In the fourth stage, the new foods mentioned in the survey were included, along with preparation options, measurement options and their respective weights. Finally, in the fifth step, for each food, a standard measurement unit was defined to be considered in situations in which the food records contained unusual

household measurement units. To define the standard measurement, the most mentioned measurement for each food was identified and compared with the household measurement considered standard in the previous POF.

To illustrate the changes resulting from the review and update of the household measurements database used in the analysis of individual food intake data from the 2017-2018 dietary survey, the ten most mentioned items in the 2017-2018 INA were identified, based on the estimate frequency of all foods mentioned in the two days of food record. Then, the raw frequencies of the measurement units referred to these items were described and compared to the 2008-2009 INA. Water was not considered in the list of most consumed items, as it was not collected in 2008-2009. Addition items were also not considered, since the amount ingested was made from a standard estimate, without specifying the household measurement used.

The frequency of measurements that migrated to the standard measurement was estimated in the two surveys for the most mentioned foods. This estimate was calculated according to sex, age, and Brazilian region in the 2017-2018 INA, considering the sample weight and complexity.

To assess the impact of imputing standard quantities when mentioning inappropriate measurements for the most mentioned foods, it was estimated the total mean energy intake in the population, considering the standard measurements and excluding records that were imputed. To estimate the energy ingested, the nutritional composition table generated for the 2017-2018 survey was used [5].

All analyses were performed using the Statistical Analysis System software, version 9.4.

RESULTS

In the 2008-2009 POF, 1970 types of food and preparations were mentioned, while in 2017-2018, this number rose to 2534. Including the different household measurements mentioned for each food and preparation (Chart 1), 9980 were mentioned in 2008-2009 and 11050 were mentioned in 2017-2018.

Table 1 – Number of times mentioned, number of measurement units mentioned, and frequency of measurement that migrated to the standard measurement, according to *Inquérito Nacional de Alimentação* year. Brazil, 2008-2009 and 2017-2018.

Foods	2008-2009 POF				2017-2018 POF			
	nº of times mentioned	% (95% CI)	nº of measurement units mentioned	% migratory for standard measurement	nº of times mentioned	% (IC 95%)	nº of measurement units mentioned	% migratory for standard measurement
Rice	80,033	90.9 (89.8-91.5)	28	0.1	96,579	83.3 (82.3-84.4)	24	0.2
Banana	11,030	22.6 (21.4-23.8)	25	0.3	11,758	18.8 (18.1-19.6)	16	0.2
Coffee	86,498	83.8 (82.9-84.7)	38	0.2	105,285	82.6 (81.8-83.4)	19	0.5
Beans	62,662	81.4 (80.3-82.5)	27	0.1	69,956	68.1 (66.9-69.4)	20	0.2
Pasta	15,186	51.7 (50.4-53.1)	23	0.3	14,641	19.5 (18.7-19.6)	12	1.4
Bread	39,152	61.6 (60.2-63.0)	20	1.6	28,503	37.9 (36.8-39.0)	8	0.4
Beef	31,867	31.8 (30.6-33.1)	31	1.7	22,917	25.9 (25.0-26.8)	15	0.7
Chicken	10,978	23.7 (22.7-24.7)	27	3.9	18,777	22.7 (21.8-23.6)	13	0.5

Note: POF: *Pesquisa de Orçamentos Familiares*.

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Chart 1 – Home measurement options available at each *Inquérito Nacional de Alimentação*. Brazil, 2008-2009 and 2017-2018.

2008-2009		2017-2018	
Wing	31 bottle options (ranging from 200ml to 2.5l)	Steak	Saucer
Kernel	Segment	Bread roll	Knife tip
Half slice	Gram	Ball	Serving portion
Bar	7 can options (ranging from 250ml to 473ml)	Bunch	Handful
Steak	Liter	200 ml carton	Dessert plate
Bread roll	Pack	Mug	Soup plate
Ball	A half	Rice spoon/serving	Flat plate
Bunch	Milliliter	Coffee spoon	Slice
Mug	Package	Teaspoon	Sachet
Pint	Chunk	Dessert spoon	Bag
Cone	Tongs	Soup spoon	Tablet
Rice/serving spoon	Chest	Ladle	Cup
Coffee spoon	Neck	American cup	Bowl
Teaspoon	Saucer	Coffee cup	Unit
Dessert spoon	Knife tip	*Requeijão* glass	Small unit
Soup spoon	Serving portion	200 ml cup	Coffee cup
Ladle	Handful	300ml cup	Tea cup
American cup	Chop	Big cup	
Coffee cup	Bowl	Medium cup	
Requeijão glass	Dessert plate	Tulip cup	
Big cup	Soup plate	Bowl	
Medium cup	Flat plate	Dose	
Tulip cup	Kilo	Skimmer	
Rib	Branch	Skewer/spit	
Thigh	Slice	Corncob	
Bowl	Sachet	Loaf	
Dose	Bag	Sheet	
Skimmer	Over thigh	8 bottle options (ranging from 200 ml to 600 ml)	
Skewer	Tablet	Drops	
Spit	Cup	6 can options (ranging from 250 ml to 500 ml)	
Ear	Bowl	Half	
Slice	Unit	Package	
Filet	Small unit	Small package	
Sheet	Coffee cup	Chunk	
Forkful	Tea cup	Tongs	

Considering the two days of food intake, excluding water and addition items (sugar, olive oil, and margarine/butter), the most mentioned items in Brazil in 2017-2018 were: coffee and coffee with milk (grouped together as "coffee"), rice and white rice (grouped together as "rice"), beans, bread, pasta, bananas, chicken, and beef. A total of 44 different measurement units were used to record the intake of these foods, which were mentioned 368,416 times. In 2008-2009, these same items were mentioned 337,406 times, with 64 different measurement units (Chart 1).

There is a decrease in the percentage of food and in the number of measurements mentioned, comparing the two surveys (Table 1). In those items where the measurement units registered inconsistent or incompatible results with the related foods, it was decided to replace the mistaken measurement with the

measurement considered to be standard. Considering the completeness of the items mentioned, foods that underwent a change to the standard measurement represent 0.7% of all items mentioned in 2017-2018, while in 2008-2009 it was 2.8%. Comparing the change in each item, it is observed that the percentage reduced for most of the most mentioned items, except for rice and beans, which practically remained with the same percentage of change, and pasta and coffee, which went from 0.3% to 1.4% and from 0.2% to 0.5%, respectively (Table 1).

The need to change the mentioned measurement to the standard measurement was observed in 9.8% of the dietary recalls in the 2017-2018 INA, but there was no difference in the frequency of changes according to sex, age, or region (Table 2). The mean total energy also did not change significantly when inappropriate measurements were excluded, that is, those that had their quantities estimated from the standard measurement (1589 kcal; 95%CI 1575-1603 kcal vs. 1587 kcal; 95%CI 1573-1601 kcal, respectively).

Table 2 – Frequency of measurements that migrated to the standard measurement, according to sex, age, and region in the 2017-2018 *Inquérito Nacional de Alimentação*. Brazil, 2017-2018.

Variables	% (95% IC)
Sex	
Male	9.2 (8.6-9.9)
Female	10.4 (9.7-11.1)
Age	
Teenagers	10.0 (8.9-11.2)
Adults	9.6 (9.0-10.2)
Older adults	10.5 (9.4-11.5)
Region of Brazil	
Northern	10.9 (8.8-13.1)
Northeastern	8.9 (8.2-9.7)
Southern	9.4 (8.5-10.3)
Southeastern	11.4 (10.1-12.8)
Midwestern	11.2 (9.3 -13.0)

In 2017-2018, the rice spoon/serving was the most mentioned measurement for rice, while the piece stood out in the chicken and beef records. Beans were reported more frequently in ladles and bread and bananas, in units. For pasta, the most mentioned measurement was the serving portion and for coffee, the coffee cup (Figure 2).

DISCUSSION

This article presents the procedures used in the steps of updating the table of measurements referred to food intake in Brazil in 2008-2009 to estimate the amount of food intake in the 2017-2018 POF-INA. The update was conducted in five steps for more accurate estimates. Comparing the two surveys, there is a reduction in measurement units that are inconsistent or incompatible with the foods mentioned, decreasing the percentage of measurements that were replaced by the measurement considered to be standard.

The first step was essential to identify previous errors and volumes of industrialized products that suffered changes to their packaging/servings in the interval between the two surveys. Once the application

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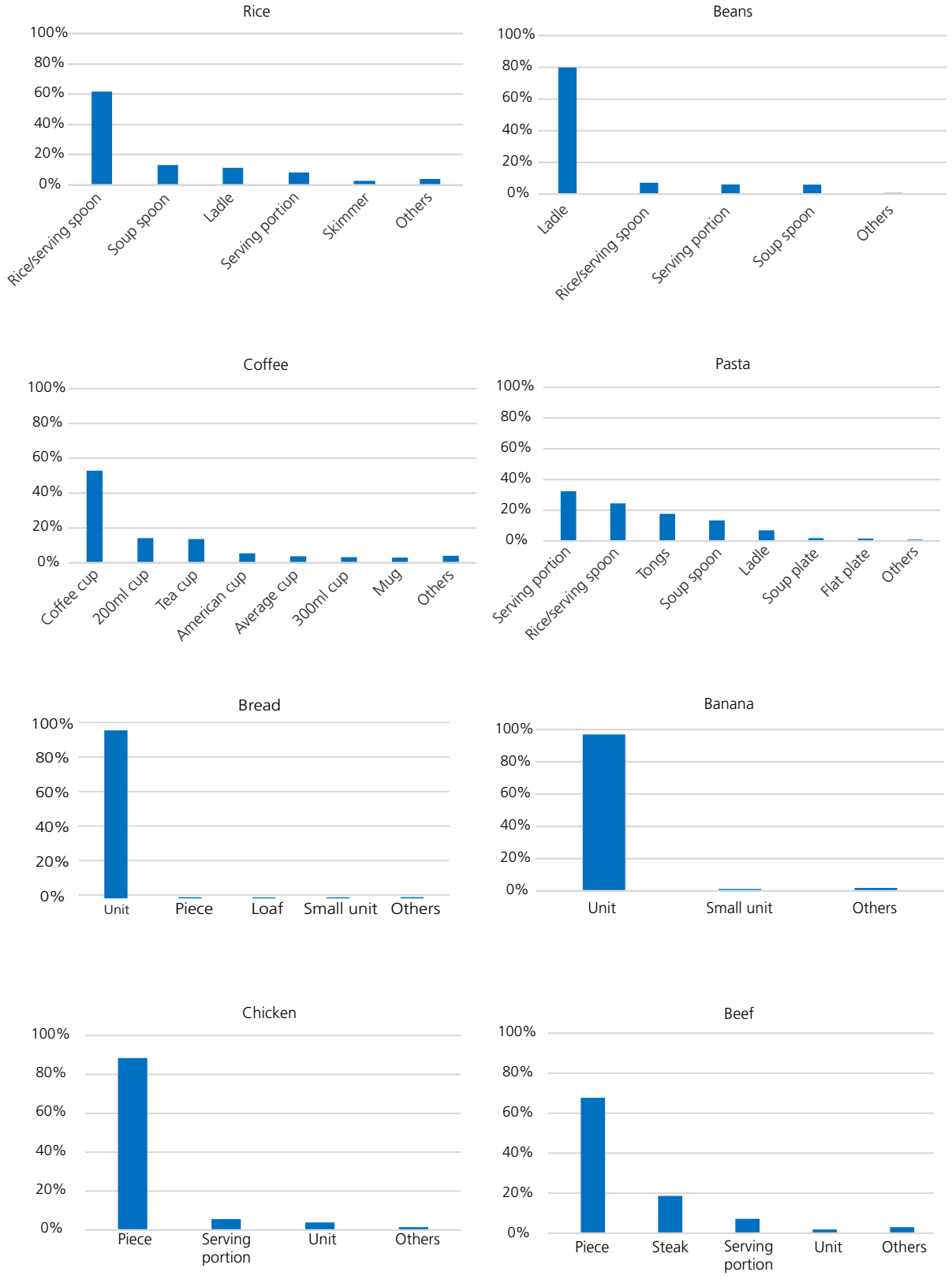

Figure 2 – Measurement units mentioned for the most consumed items in the 2017-2018 *Inquérito Nacional de Alimentação*. Brazil, 2017-2018.

of the procedures used to estimate the amount of food in the 2017-2018 INA was completed and compared to the previous edition (2008-2009 INA), it is possible to observe an evolution in the table, which now has a reduced number of preparations, offering one smaller quantity of household measurements, it has new foods, having all weights revised and updated according to the new sizes of servings/packaging.

In both surveys, all household measurements were available to be chosen from the intake records in the software used to include the data, however, this can result in registration bias, as it increases the possibility of using measurements that are incompatible with the food. In the 2008-2009 survey, there was a report of inappropriate measurement units for certain foods, thus indicating difficulty in estimating quantities or typing errors when entering data [4].

The reduction in the available quantity of measurements from 106 in 2008-2009 to 64 in 2017-2018 favored the reduction of biases associated with incompatible or inconsistent measurements regarding the type of food mentioned. This was reflected both in the reduction in the percentage of measurements that migrated to the standard measurement, and in the reduction in the number of measurement units mentioned.

The decrease in the percentage from 2.8% in 2008-2009 to 0.7% in 2017-2018 regarding the migration to the standard measurement demonstrates a greater concentration in household measurements consistent with food intake. The standard measurement is estimated in situations where it is not possible to adopt any procedure to estimate the weight of the household measurement mentioned, thus being a process of critique and quality control of data from large surveys [9]. These reductions demonstrate that the measurements mentioned by the participants are consistent with their food intake, especially for bananas, bread, beef, and chicken, thus signaling more accurate reports.

Several types of foods are reported with distinct levels of accuracy, amorphous foods that do not have a defined shape (for example, pasta, salad, and mashed potatoes) can be estimated with less precision when compared to solid and countable foods (for example, bread, fruit) [10,11]. In 2008-2009, the serving spoon was the most mentioned measurement for rice, ladle for beans, steak for the beef, coffee cup for coffee, and bread unit for the bread [4]. In 2017-2018, the measurements that were mentioned for rice, beans, coffee, and bread remained the same as in the previous survey, however, we observed a change in relation to beef, which now has the piece measurement as the most mentioned measurement.

The final version of the table of household measurements from the foods mentioned in the second INA included all the possible measurements that could be mentioned for each food, thus having 51 thousand lines, while the table for 2008-2009 was limited to cited household measurements only. It was decided to include all possible measurements for each food because, despite being a representative sample of the Brazilian population, some measurements used may not have been reported by the selected participants. These measurements were included with the aim of minimizing possible errors in future surveys and to strengthen the table developed so that it can be used by other researchers in different studies and surveys around Brazil. The updated table used to analyze food intake data for the 2017-2018 INA is available on the IBGE website, together with the research documentation, available in the 2017-2018 POF microdata option <https://www.ibge.gov.br/estatisticas/sociais/populacao/24786-pesquisa-de-orcamentos-familiares-2.html?=&t=microdados>.

The possible limitations of this study refer to the characteristics of the methods used to assess food intake, which differed between one survey and another, being food records in 2008-2009 and 24-hour dietary recalls in 2017-2018. However, in both surveys, procedures were adopted to ensure data quality, such as using the multiple-step method, reviewing the report with respondents, and asking about the intake of items commonly omitted in surveys. Even though the recall is subject to memory bias, the results of this

study showed that the modifications made to the table of household measurements allowed reports that were more consistent with the foods and with less estimation error.

Another limitation refers to the reporting of inappropriate measurement units for certain foods, however, we believe that the imputation of standard quantities for these measurements did not generate significant changes in the mean total intake of the population. Furthermore, there was no difference in the percentage of mentioned items that migrated to the standard measurement according to sex, age group, and region.

The fact that there is no differentiation for the size of some measurements, for example a small, medium, or large serving was also a limiting factor, however in the databases used to estimate the weight of this measurement there is no information for this option for most food types.

The highlight of this article is the detailed description of the procedures used in the largest food intake survey in Brazil. The demonstration of the extensive revision and updating of the table of measurements mentioned related to food intake in Brazil in the 2008-2009 POF and the maintenance of the methodology of the previous survey, with the compilation of tables of household measurements and other sources of information, makes it possible to clarify the methods and strategies needed in conducting food surveys for researchers investigating food intake. It is important to highlight that knowing accurately the amount of food that individuals consume can favor the development of strategies that reduce the serving size of the meal, reducing energy intake [7].

CONCLUSION

The procedures used to estimate the amount of food intake between the surveys allowed updating the table of household measurements and minimizing quantity estimation errors, with a reduction in measurement units that were inconsistent or incompatible with the foods mentioned.

CONTRIBUTORS

IN BEZERRA contributed to data analysis and interpretation, writing, and the final revision of the manuscript. JB CAVALCANTE and TM VASCONCELOS contributed to data analysis and interpretation and writing the manuscript. RA PEREIRA, EM YOKOO, and R SICHIERI coordinated the research and contributed to writing and the final revision of the manuscript.

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