Familial aggregation and dietary patterns in the Brazilian population

Agregação familiar e padrões alimentares na população brasileira

Agregación familiar y patrones de alimentación en la población de Brasil

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Abstract

The aim of the study was to identify dietary patterns in Brazil and verify aggregation among members of the same family based on the Brazilian National Dietary Survey, *a nationwide dietary survey conducted in 2008-2009 in individuals over 10 years of age. Dietary intake was estimated with a food record. Dietary patterns were identified by factor analysis, and familial aggregation was verified by linear regression. Three major dietary patterns were identified: (1) a traditional snack featuring coffee, rolls, oils and fats, and cheese; (2) traditional main meal, based on rice, beans and other legumes, and meat; and (3) fast food type snacks, namely sandwiches, processed meats, soft drinks, snacks, and pizza. Pattern 2 showed the strongest association (β = 0.37-0.64). Patterns 1 and 3 showed positive associations for all pairs of family members, with β ranging from 0.27 to 0.44 and 0.32 to 0.42, respectively. The study showed familial aggregation of dietary patterns in the Brazilian population.*

Family Relations; Food Consumption; Feeding Behavior

Resumo

Identificou-se padrões alimentares consumidos no Brasil e a agregação entre pai, mãe e filhos, utilizando o Inquérito Nacional de Alimentação, *realizado em 2008/2009 em indivíduos acima de dez anos de idade. O consumo alimentar foi estimado pelo registro alimentar. Os padrões foram identificados por meio de análise fatorial e a agregação familiar dos mesmos foi verificada por regressão linear. Três principais padrões alimentares foram identificados: Lanche tradicional (1): café, pães, óleos e gorduras, e queijos; "grande refeição tradicional" (2): arroz, feijão e outras leguminosas, e carnes; e "lanches do tipo* fast food" *(3): sanduíches, carnes processadas, refrigerantes, salgados e pizzas. As maiores associações ocorreram no padrão 2 (β = 0,37 a 0,64). Nos padrões 1 e 3 também foram encontradas associações positivas envolvendo todos os pares, com β variando de 0,27 a 0,44 e de 0,32 a 0,42, respectivamente. O presente estudo evidenciou agregação familiar de padrões de consumo alimentar na população brasileira.*

Relações Familiares; Consumo de Alimentos; Comportamento Alimentar

Introduction

Unhealthy dietary practices acquired during adolescence tend to persist throughout life [1,2] and are associated with increased risk of chronic noncommunicable diseases such as obesity, cardiovascular diseases, and type 2 diabetes in adulthood [2,3].

Effective proposals for the prevention of this group of diseases and promotion of healthy eating by adolescents require understanding the formation of eating habits and their maintenance over the course of life. Multiple socioenvironmental and personal factors interact to influence individual eating patterns, featuring interpersonal relations within the family. In addition to providing food, the family influences attitudes, preferences, and values related to food intake. Equally important are the independence and autonomy acquired during adolescence and related to food choices [4].

Studies have used various methods to evaluate food intake in order to investigate familial aggregation, that is, the resemblance of eating habits among individuals from the same family. For purposes of analysis, pairs from the nuclear family are evaluated, like fathers and children, mothers and children, spouses, and siblings [5]. In the literature, the factors included in this research are calorie and micronutrient intake, food items and groups, and diet quality index [6,7,8,9,10].

Nutritional Epidemiology has used the identification of dietary patterns to overcome the limitations of studies based on computation of nutrients and foods, given the complex combination of nutrients and anti-nutritional factors in the human diet. Statistical methods are used for this purpose that allow analyzing correlations between a large number of variables (food groups in this case), defining a set of common latent dimensions that can provide a more objective basis for the elaboration of dietary recommendations and guidelines [11].

Despite much discussion in this regard, to our knowledge there are no studies aimed at verifying the association between food intake patterns among individuals from the same family. Such an approach allows identifying family influence on eating habits that are consistent with disease risk or protection. The aim of the current study is to investigate familial aggregation of dietary patterns in a representative sample of the Brazilian population.

Material and methods

Study design and population

The study was based on data from the *Brazilian National Dietary Survey* (INA) [12], included as a module of the *Brazilian Household Budget Survey* (POF) 2008-2009 conducted by the Brazilian Institute of Geography and Statistics (IBGE) [13]. This was a cross-sectional study with a population consisting of individuals of both sexes, over 10 years of age, considering all of Brazil's major geographic regions and urban and rural areas.

Data were collected in the POF from May 2008 to May 2009. Following geographic and statistical stratification of the primary sampling units, namely the census tracts from the 2000 *Population Census*, a two-stage cluster sampling plan was adopted. The first stage was the choice of census tracts, selected by proportional probability in relation to the number of households in each tract. A subsample of tracts was selected by simple random sampling in each stratum.

The secondary units sampled in the second stage were the permanent private households within each of the selected tracts, selected by simple random sampling without replacement. Tracts were evaluated over the 12 months of study, thus allowing the geographic and socioeconomic strata to be represented by the selected households during every quarter.

Individual food intake was assessed by simple random sampling of a subsample of 25% of the units from the second stage, the households in each tract. All the tracts selected in the POF 2008-2009 were surveyed, as were all residents over ten years of age in the households from the INA subsample. Of the 55,970 households selected for the POF 2008-2009, 34,003 individuals over ten years of age participated in the evaluation of individual food intake.

For analysis of familial aggregation, we selected households where at least one adolescent child lived. We thus identified each household resident based on information on the degree of kinship or nature of household subordination in relation to the reference person in the consumption unit, with the following options: (01) reference person; (02) spouse; (03) child; (04) other relative; (05) tenant; (06) pensioner; (07) domestic servant; or (08) domestic servant's relative. Further details on the sampling and data collection have been published by IBGE [13].

"Reference persons", "spouses", and "children" were grouped separately. The NODUPKEY procedure (software SAS, version 9.3; SAS Inst., Cary, USA) was used to randomly select a child from each household, and a second child was

chosen, independently of gender and also randomly, as the sibling. Through the child, the mother was identified as the female reference person and the father as the male reference person. Of the total INA sample, 5,927 families had at least one child, who added to a sibling, father, and/or mother, when they existed, totaled 17,918 individuals in the sample. Figure 1 shows the flowchart with the formation of the sample for analysis of familial aggregation.

Evaluation and analysis of food intake data

Food intake was estimated by recording all foods and beverages consumed on predetermined days, besides reporting the times, amounts consumed (in household measuring units), and preparation. Food intake records were completed by the informants themselves except when they presented some impediment, in which case the assistance of another household resident or relative was suggested. For the current article, the analyses are based on the first day of the food record due to the lack of data (for 1,103 individuals) on the second day. Missing data in studies with complex samples affect important information such as those on strata and clusters due to the study design's properties, which can skew the estimates [14].

Participants on in the INA survey cited a total of 1,120 food items on the first day, all of which were grouped into 27 groups according to nutritional similarity and frequency of consumption, in order to subsequently identify the dietary patterns by exploratory factor analysis. Table 1 lists the 27 food groups.

Identification of dietary patterns by exploratory factor analysis

Identification of food intake patterns used factor analysis, with principal components analysis as the extraction method, aimed at reducing the data (food groups) into factors (dietary patterns) based on the correlations between these variables. This procedure was employed due to the complexity of the POF sample. We began by establishing the estimated correlations matrix considering the sample's complex design, using the GLM procedure from the SAS statistical package; factor analysis was performed using as "input" the estimated correlations matrix considering the sample's complex design according to the methodology proposed by Skinner et al. [15] and employed in Nutritional Epidemiology by Kerver et al. [16].

To determine the adequacy of using factor analysis in the sample, we used Kaiser-Meyer-Olkin (KMO) values greater than 0.50 as acceptable and significant results on the Bartlett sphericity test [17]. Scree plot was used to determine the number of factors needed to represent the data, where the values situated before the curve began to flatten determined the number of factors to be retained [18,19].

Varimax was used for rotation of the factors, aimed at obtaining a structure of independence between the factors and greater interpretability. Food items with factor load greater than or equal to 0.30 were retained in the patterns [17,19,20].

The analysis generated factor scores that represent the sum of the loads of each factor weighted by the factor's eigenvalue and multiplied by each individual's standardized food group intake. The scores represent standardized variables, with mean equal to zero and standard deviation equal to one.

Familial aggregation

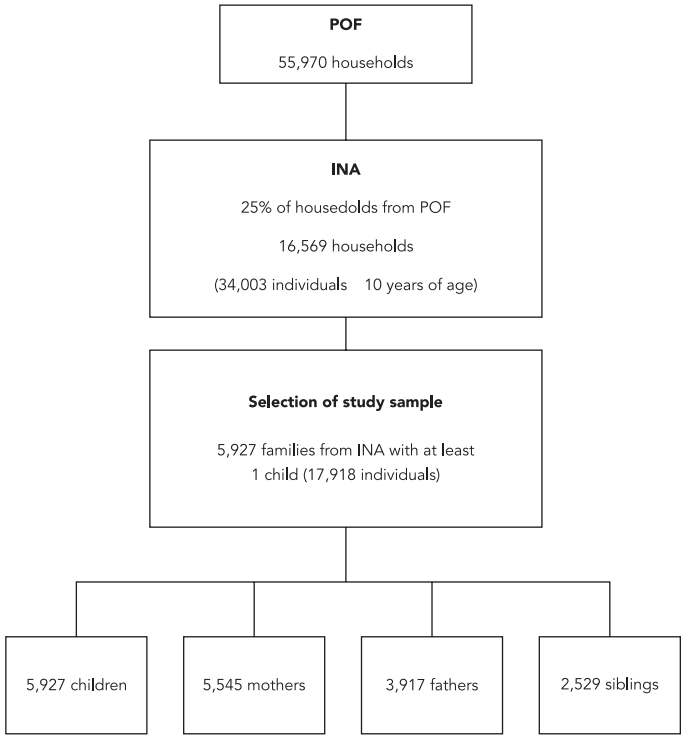
Familial aggregation of dietary patterns was verified by linear regression. The PROC SURVEYREG procedure was used, which allows analysis of data from complex samples, considering the expansion factors, by means of the SAS version 9.3 statistical package. In order to test the respective correlations between the pairs: "father and son", mother and son", "father and daughter", "mother and daughter", "siblings", and "father and mother", each linear regression model was constructed using the normalized factor scores for each pair's component, while in the linear regression analyses between mothers and children and between fathers and children, the child's factor scores were used as the dependent variable, and for the father-mother pairs the father's factor scores were used as the dependent variable. It was assumed that children are extensively influenced by the parents' eating habits [21,22,23,24,25], that the woman exerts influence on the man's eating, since she historically has greater control over and management of the family's eating as a whole [26], and that for the pairs of siblings, the adolescents were selected randomly in the household and the first one selected was used as the dependent variable. Linear regression coefficients and their respective 95% confidence intervals were estimated, which allowed comparison of the relations between family pairs for each of the three factors.

Ethical considerations

The study protocol for individual food intake in the POF 2008-2009 was approved by the Ethics Research Committee of Instituto of Social Medi-

Figure 1

Flowchart demonstrating sample selection for analysis of familial aggregation of eating patterns in the *Brazilian National Dietary Survey* (INA), Brazil, 2008-2009.



POF: *Brazilian Household Budget Survey*.

cine in the Rio de Janeiro State University (CAAE 0011.0.259.000-11).

Results

The sample consisted of 5,545 mothers, 3,917 fathers, and 8,456 children, of which 52.6% were boys and 47.4% girls. Mean age was 48 ± 12 years for fathers, 46 ± 12 for mothers, and 18 ± 8 for children. KMO (0.534) and Bartlett's sphericity test ($p < 0.01$) indicated that the correlations between the items were sufficient and adequate for factor analysis. Scree plot indicated that three factors should be retained, as shown in Figure 2.

The first pattern, characterized as the "traditional snack", included breads, cheeses, oils and fats, and coffee and did not include sweets, salted snacks, or dairy products. The second pattern, characterized as the "traditional main meal", included rice and rice dishes, beans and other legumes, and meats, and did not include soups, broths, macaroni, or pasta. The third pattern, "fast food type snacks", included sandwiches, processed meats, salted snacks, pizzas, and soft drinks and not fruit or breakfast cereals.

The three dietary patterns jointly explained 65.9% of total variance in food intake. Table 2 shows the rotated factor matrix.

The highest beta values occurred in the "traditional main meal" pattern for all the target pairs, varying from 0.37 (father-daughter) to 0.64 (father-son). Father-daughter and mother-daughter showed the lowest beta values, while father-son and mother-son showed the highest. In the "traditional snack" pattern, beta varied from 0.27 (father-daughter) to 0.44 (mother-father). In the "fast food type snacks" pattern, the lowest beta was also for father-daughter (0.32), statistically different from all the other pairs. The

Table 1

Food groups used in factor analysis of participants in the *Brazilian National Dietary Survey* (INA), 2008/2009.

Food groups	Foods
1. Rice and rice dishes	Rice, whole grain rice, rice dishes
2. Corn and corn dishes	Corn, corn dishes
3. Beans and other legumes	Beans, green/string beans, bean dishes, other legumes
4. Greens and vegetables	Lettuce, kale, cabbage, raw salads, other greens, squash, carrots, chayote, cucumber, tomatoes, other vegetables
5. Potatoes and other tubers	Potato, sweet potato, French fries, manioc, other tubers
6. Fruits and oilseeds	Pineapple, açaí, bananas, oranges, apples, papaya, mango, watermelon, tangerines, grapes, fruit salad, other fruits, oilseeds
7. Manioc flour and farofa	Manioc flour, farofa
8. Breakfast cereals	Breakfast cereals
9. Macaroni and pasta	Pasta, instant noodles, macaroni, macaroni dishes
10. Breads	Bread, rolls, whole wheat bread
11. Sweets	Cakes, cookies, cream-filled cookies, diet/light cakes and cookies, chocolates, chocolate drinks, milk-based sweets, fruit sweets, ice cream/popsicles, honey, brown sugar, refined sugar, other sweets, diet/light sweets
12. Salted snacks	Crackers, processed salted snacks (e.g. potato chips)
13. Meats	Beef, beef dishes, pork, pork dishes, poultry, poultry dishes, other types of meat, innards
14. Fish	Fresh fish and fish dishes, canned fish, other seafood
15. Salted meats	Salted fish, salted meats
16. Processed meats	Sausage, frankfurters, ham, other cold cuts
17. Eggs	Eggs
18. Dairy products	Whole milk, skim milk, powdered whole milk, dairy dishes and products, smoothies, yogurts, other dairy products, diet/light dairy products, flavored and sweetened milk drinks
19. Cheeses	Cheeses
20. Oils and fats	Oils and fats, light oils and fats
21. Alcoholic beverages	Distilled beverages, beer, wine
22. Soft drinks	Soft drinks, diet/light soft drinks
23. Coffee	Coffee
24. Juices and other beverages	Fresh juices, reconstituted juices, fruit drinks, soy beverages, teas, other non-alcoholic beverages
25. Salted snacks and pizzas	Pizzas, fried salted snacks, baked salted snacks
26. Sandwiches	Sandwiches
27. Soups and broths	Soups, broths, sauces

highest beta values were for mother-son (0.42), siblings (0.41), and mother-father (0.40), similar to each other (Table 3).

Discussion

The current study identified three dietary patterns in a representative sample of the Brazilian population, called "traditional snack", "traditional main meal", and "fast food type snacks".

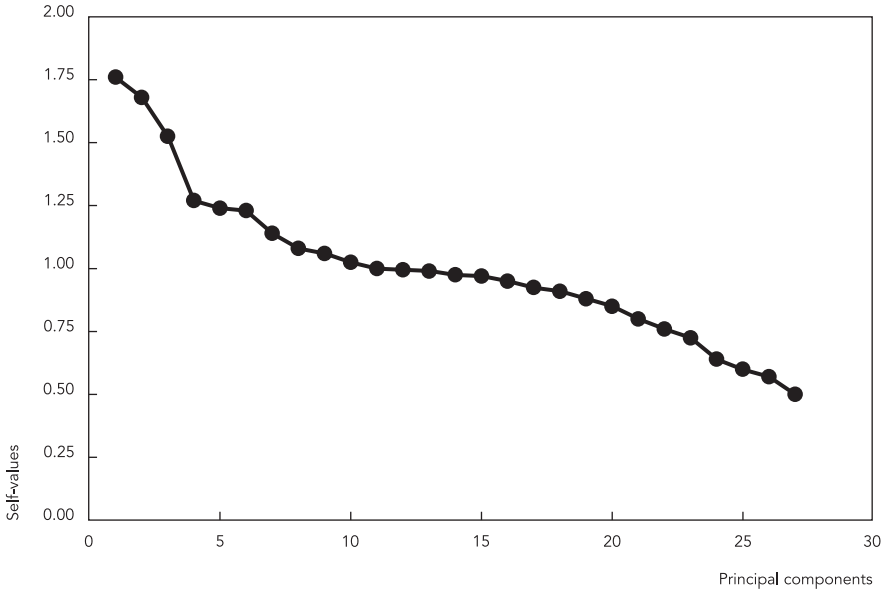
To our knowledge this study was the first attempt to evaluate familial aggregation of food intake using nationally representative data for the Brazilian population. Although previous studies tested associations between groups of foods and nutrients between family members [10,27,28,29,30], none evaluated familial aggregation in dietary patterns.

Wang et al. [31], in a recent systematic review and meta-analysis on resemblance of food intake by parents and children, observed weak to moderate associations in studies published since 1980. However, the authors highlighted that many of these studies were based on small samples, and that few had been performed in developing countries, where eating away from home by children and adolescents is not as common as in developed countries.

Studies have also indicated that family influence on adolescents' food choices is decreasing, given the increasing autonomy and opportunities for choices in this stage of life [31,32,33]. The current study showed moderate associations be-

Figure 2

Scree plot: representation of number of eating patterns obtained in the principal components analysis of food groups in the *Brazilian National Dietary Survey* (INA), Brazil, 2008-2009.



tween factor scores of dietary patterns between parents and adolescent children, indicating familial aggregation of food choices, even in this age bracket. Our values were similar to those observed by other authors that examined the correlation in food intake between parents and children [10,27,31,34].

Factors that may contribute to familial aggregation include family meals, transmission of dietary information to children, and parents' initiatives and efforts to encourage children to consume healthy foods, including through household food purchases [35,36,37,38].

The strongest associations identified in the current study were in the "traditional main meal" pattern in all the family pairs analyzed, which suggests parental influence in maintaining traditional Brazilian eating habits among children, encouraging consumption of the traditional Brazilian diet based on rice and beans [26,39]. Various studies have shown that this pattern exerts a protective effect against overweight and obesity in both adults and children and adolescents [39,40,41,42,43,44,45,46,47]. In the current study, in addition to the traditional main meal pattern, a traditional snack pattern was also observed, characterized by a traditional Brazilian light meal: bread, butter or margarine, cheese, and coffee, which showed positive and moderate associations in all the family pairs, especially mother-father. According to De Moura Souza et al. [48], in Brazil these foods are mainly consumed by women.

The "fast food snacks" pattern, including soft drinks, sweets, cakes, cookies, salted snacks, processed meats, and other high-fat products, also identified in other studies [47,49,50,51], showed positive and moderate associations in all the target pairs. This finding may indicate the Westernization of eating habits in the family, since this pattern consists of foods that are high in fat, sugar, and salt, reflecting the incorporation of unhealthy habits and customs related to the Western lifestyle [52,53,54,55], especially in Brazilian families with adolescent children, given that consumption of such foods is more prevalent in this age bracket [48]. This dietary pattern has been associated with an increase in metabolic disorders and weight gain in both adolescence [47,56,57] and adulthood [55,58,59,60,61].

Studies in various areas have shown beneficial effects of family meals, such as better quality of the foods consumed and good nutritional status, especially in children. Family meals have

Table 2

Components of the rotated matrix of eating patterns retained in the factor analysis of participants in the *Brazilian National Dietary Survey* (INA), 2008/2009.

Food group	"Traditional snack"	"Traditional main meal"	"Fast food snacks"
Breads	**0.78**	-0.17	0.22
Oils and fats	**0.65**	-0.14	0.10
Coffee	**0.54**	0.09	-0.05
Cheeses	**0.30**	-0.23	0.20
Sweets	**-0.50**	-0.10	0.07
Salted snacks	**-0.36**	-0.05	-0.09
Dairy	**-0.35**	-0.28	-0.15
Rice and rice dishes	0.16	**0.82**	-0.10
Beans and legumes	0.20	**0.80**	-0.08
Meats	-0.06	**0.61**	0.04
Soups and broths	0.02	**-0.40**	-0.21
Macaroni and pasta	-0.09	**-0.29**	0.12
Soft drinks	-0.29	-0.01	**0.76**
Salted snacks and pizzas	-0.25	-0.10	**0.48**
Sandwiches	-0.36	-0.07	**0.37**
Processed meats	0.23	-0.06	**0.31**
Fruits	-0.004	-0.15	**-0.43**
Breakfast cereals	-0.17	-0.20	**-0.30**
Corn and corn dishes	-0.07	0.06	-0.18
Greens and vegetables	0.02	0.27	-0.24
Potatoes and other tubers	-0.07	0.16	0.02
Manioc flour and farofa	0.01	0.13	-0.14
Fish	0.02	-0.15	-0.18
Salted meats	-0.02	0.02	-0.08
Eggs	0.17	0.13	-0.11
Alcoholic beverages	0.08	0.07	0.25
Juices and other beverages	-0.09	0.04	-0.18
Eigenvalues	2.72	2.12	1.72
Percent variance (%)	24.19	23.81	17.85
Percent accumulated variance (%)	24.19	48.00	65.86

Note: Kaiser-Meyer-Olkin (KMO) = 0.534; Bartlett's sphericity test (0.001).

been associated with the consumption of traditional staples and sources of fiber and inversely associated with consumption of unhealthy foods such as fried salted snacks and soft drinks [62,63,64].

Lower beta values were observed for pairs with daughters when compared to pairs with sons, which may indicate gender influence on dietary aggregation, with boys more influenced by their parents' food intake than girls.

The study's possible methodological limitations include the use of factor analysis for deriving dietary patterns, since this method involves some arbitrary decisions such as grouping of food items and retention and naming of factors. Still, the dietary patterns identified here were comparable to those of other studies.

The study identified familial aggregation of food intake patterns in the Brazilian population, suggesting family influence on individual eating habits. This context corroborates the importance of developing strategies to encourage eating meals in the family and exploring the contribution of family life to healthy dietary practices, providing evidence for elaborating dietary recommendations and public health policies.

Table 3

Association between family pairs and eating patterns in families participating in the *Brazilian National Dietary Survey* (INA), 2008/2009.

Family pairs	"Traditional snack" β (95%CI)	"Traditional main meal" β (95%CI)	"Fast food snacks" β (95%CI)
Father/Son	0.40 (0.39-0.40)a	0.64 (0.63-0.65)	0.38 (0.36-0.39)a
Mother/Son	0.38 (0.36-0.40)ab	0.59 (0.57-0.60)a	0.42 (0.40-0.45)b
Father/Daughter	0.27 (0.25-0.28)	0.37 (0.35-0.38)	0.32 (0.30-0.34)
Mother/Daughter	0.36 (0.34-0.37)b	0.46 (0.45-0.48)	0.37 (0.35-0.39)a
Siblings	0.40 (0.39-0.40)a	0.55 (0.54-0.55)a	0.41 (0.40-0.41)b
Mother/Father	0.44 (0.42-0.46)	0.56 (0.55-0.57)a	0.40 (0.38-0.41)ab

95%CI: 95% confidence interval.

Note: same letters in columns indicate statistically equal results between pairs (p > 0.05).

Resumen

Se identificaron patrones de dietas consumidas en Brasil y la agregación entre el padre, la madre y los niños, mediante la Encuesta Nacional de Alimentos, *realizada en 2008/2009, en mayores de 10 años de edad. La ingesta dietética se estimó mediante el registro de alimentos. Los patrones fueron identificados por análisis factorial y la agregación familiar de éstos se verificó mediante regresión lineal. Se identificaron tres patrones principales de dieta: merienda tradicional (1) -café, pan, quesos y aceites y grasas-; comida tradicional (2) -arroz, frijoles, otras legumbres y carne-; y fast food (3) -sándwiches, carnes procesadas, refrescos, aperitivos y pizzas. La asociación más alta se encontró en el patrón 2 (β = 0,37-0,64). En los padrones 1 y 3 también se encontraron asociaciones positivas, involucrando a todos los pares, con β variando de 0,27 a 0,44 y de 0,32 a 0,42, respectivamente. Este estudio mostró agregación familiar de los hábitos alimentarios en la población brasileña.*

Relaciones Familiares; Consumo de Alimentos; Conducta Alimentaria

Contributors

F. A. Massarani, D. B. Cunha, A. P. Muraro and B. S. N. Souza participated in the conceptualization, design, analysis, and revision of the article. R. Sichieri and E. M. Yokoo participated in the conceptualization, design, and writing of the article.

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