Factors associated with feeding practices among Brazilian children aged 12 to 23 months old

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Abstract

Objectives: a quantitative analytical cross-sectional study aimed to identify demographic characteristics to access health services and housing conditions in relation to inadequate feeding practices among Brazilian children from 12 to 23 months of age.

Methods: the analysis of the feeding practices (consumption of recommended food groups) of 2541 Brazilian children (aged 12-23 months old) was performed using data from the Pesquisa Nacional de Saúde 2013 (National Health Survey). Descriptive and multivariate statistics used the Decision Tree Analysis based on CHAID (Chi-squared Automatic Interaction Detector) algorithm, as well as hierarchically adjusted Poisson regression analyses were performed. The variables were entered in a hierarchical model at distal (demographic), intermediate (access to health) and proximal (housing conditions) levels.

Results: the results showed a high prevalence of sugar consumption (85.5%; CI95%=83.7-87.2) and highlighted inadequate feeding practices among non-white children (p=0.001), resident in the North (p<0.001) and Northeast (p=0.010) of Brazil and in towns in the countryside (p<0.001) presented feeding practices that were not recommended for consumption in the food groups.

Conclusions: non-white children, who lived in the North and Northeast regions of Brazil and in the countryside, which are known to be more socioeconomically vulnerable, were more likely to experience inadequate feeding practices.

Key words Complementary feeding, Inequality in Health, Child health, Brazil

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Introduction

Food introduction (FI) period begins in the sixth month of a baby’s life, with the end of exclusive breastfeeding, which from this point onwards is complemented by a choice of food from different food groups (avoiding those with added sugar) to meet all the child’s nutritional needs.\(^1\)\(^,\)\(^2\) Performed slowly and gradually, FI allows children, at 12 months of age, to consume the same meals as the rest of the family, provided they are not prepared with excess seasoning.\(^1\) This phase of feeding, which continues up to the age of 24 months, occurs during a child’s period of rapid growth and development, in which they are susceptible to nutritional deficiencies and/or excesses and during which there are strong changes in the diet, exposing to new food, flavors and eating experiences.\(^3\)

To ensure the supply of nutrients, the Ministry of Health (MS) recommends different food groups – cereals and tubers, vegetables and fruit, meat and eggs, grains and milk – are included in the children’s daily diet in the FI phase.\(^1\) Similarly, added sugars and processed and ultra-processed food should be avoided\(^6\) as these, combined with the low consumption of fruit and vegetables, increase the risk of obesity, cardiovascular disease, high blood pressure and the most prevalent non-communicable disease in the world today, tooth decay.\(^2\)\(^,\)\(^4\)

The causality between a cariogenic diet and tooth decay is well established,\(^4\) with the World Health Organization (WHO) suggesting that the intake of free sugars should be reduced to less than 10% of the total energy intake in children and adults’ diets.\(^2\)

Food education is a complex and continuous process. Although it originates in early childhood, food preferences from this period are associated with preferences at older ages.\(^5\) It has been shown that the quality of feeding practices is associated with socioeconomic level\(^6\) and that inadequate FI is associated with a lower monthly income and level of maternal schooling,\(^7\)\(^,\)\(^8\) as well as ethnicity (Afro-Americans\(^9\) and hispanics\(^10\)), lack of postnatal care,\(^11\) lack of access to mass media\(^11\) and the child having an older sibling or a caregiver other than his or her parent.\(^12\) This situation was identified in countries such as Tanzania,\(^11\) the USA,\(^9\) France\(^12\) and Brazil, notably in city districts in the South of the country,\(^8\) and in Maceió, in the Northeast of Brazil.\(^7\)

Irrespective of the existing recommendations and guidelines on healthy eating, especially for children under the age of two, the quality of diet of Brazilian children deviates greatly from what is considered ideal,\(^13\) and despite advice to avoid adding sugar to food and sugary food, 60.8% of the children under two years of age consume cookies and cakes and 32.3% drink soft drinks or artificial juices.\(^14\)

The Pesquisa Nacional de Saúde (PNS) (National Health Survey), performed in Brazil in 2013, evaluated the types of food consumed by children aged under two. However, no study, up to now, has used this data to assess whether children’s feeding practices include all the different recommended food groups. Therefore, objective of the present study was to identify demographic characteristics, access to health services and housing conditions in relation to feeding practices among Brazilian children aged 12 to 23 months old.

Methods

A cross-sectional, analytical study, of a quantitative nature, was carried out using secondary data from the most recent Pesquisa Nacional de Saúde (PNS) (National Health Survey) carried out in Brazil.\(^15\)

The PNS is an integral part of the IBGE Sistema Integrado de Pesquisas Domiciliares (SIPD) (Integrated Home Survey System) and uses the master sample of this system, representing Brazil, its macro-regions, urban and rural population and capitals. Data collection was carried out in homes from August 2013 to February 2014, based on three-stage cluster sampling. A total of 60,202 adults were interviewed and the non-response rate was 8.1%.\(^15\)

The data collection of the PNS was based on different questionnaire modules to investigate the characteristics of the households and their residents, in addition to gathering the individual data of the eligible resident. The present study included 2,541 children aged between 12 and 23 months whose families answered Module L of the questionnaire, which contained specific questions for this age group.\(^14\)

The dependent variable of the present study was inadequate feeding practices, that is, when the recommended food group intake was not fully attained for the children of the studied age group. To evaluate the food groups included in the children’s daily diet, the answers to question 17 of module L of the questionnaire were used: “Can you tell me which of this food... were eaten or drunk between yesterday morning and this morning?”, to which the answer was yes or no. The following food was evaluated: breast milk, other milk or milk products; fruit or natural fruit juice; greens/vegetables; beans or other legumes; meat or eggs; potato and other tubers and
Feeding practices among Brazilian children

The consumption of meat or supplementation with iron was considered as guaranteeing the intake of this nutrient. In addition to the assessment of full compliance with the recommended food group intake, the prevalence of sugar consumption was assessed. Children who consumed processed food and ultra-processed food: cookies, biscuits, cakes, sweets, candies, artificial juices and soft drinks or other food with sugar were identified as sugar consumers.1 The consumption of meat or supplementation with iron was considered as guaranteeing the intake of this nutrient.

The independent variables selected were classified according to the theoretical hierarchical model proposed by Victora et al.,16 which recognizes the existence of the proximal, intermediate or distal factors associated with the outcome, with distal factors considered to influence proximal factors, measuring effect, and controlling possible confounding factors. This approach includes a primary model containing the variables from the most distal level. At this level, the covariates associated with the outcome of p<0.25 were included in the next level, and so on, until the level of the most proximal covariate was reached. For the distal level, demographic characteristics were selected (sex, skin color, region in Brazil, area of residence and type of area of residence); the intermediate level included the characteristics to access health services (health insurance, health status of the child as reported by the respondent, medical appointment, dental appointment, location where growth is monitored, registration at family health unit, visit of the community health agent), and the proximal level, with housing conditions (number of residents per room, status of resident at home, predominant material of house walls, water supply at the residence, water used for drinking, residence with or without kitchen, television, microwave and access to internet) as shown in Figure 1. The composition of the levels as well as the order of entry into the hierarchical model were based on previous studies, including factors known to be associated with the quality of the diet.6-12

The IBM SPSS Statistics (version 20.0; Armonk, NY: IBM Corp. USA) and STATA (version 15.0; StataCorp., College Station, USA) software packages were used for analysis, taking into account the sample weightings from the complex sample design. Initially, a descriptive statistical analysis was carried out in order to characterize the sample. Pearson's chi-square test with second-order Rao-Scott corrections was used to identify associations between feeding practices and demographic characteristics, related to access to health services and housing conditions.

To assess the association between the outcome (inadequate feeding practices) and the independent variables (demographic characteristics, access to health services and those related to housing conditions), multivariate decision tree analysis was performed using the CHAID (Chi-squared Automatic Interaction Detector) algorithm to characterize the qualitative aspect of the children's diet.17,18 For the decision tree analysis, the explanatory variables which obtained p<0.25 in the bivariate analysis or were considered epidemiological determinants were incorporated into the multivariate model using the CHAID algorithm to characterize the children's feeding practices.

Subsequently, hierarchically adjusted Poisson regression analysis, considered a traditional statistical method for cross-sectional epidemiological studies with binary results, the measure of association with the odds ratio (OR), was performed.

The order of insertion of the variables in the hierarchical model is illustrated in Figure 1. At this level, the covariates associated with the outcome of p<0.25 were included in the next level, and so on, until the level of the most proximal covariate was reached. Only variables with p<0.05 remained in the final model, since the retention of other covariates in this model can alter the estimates. The same criterion was adopted in the final model of the decision tree.

The present study was exempted from the Ethics Committee of the Faculdade São Leopoldo Mandic, as it uses secondary data from the PNS, approved by the National Commission for Ethics in Research under the Opinion document N. 328.159, dated June 26, 2013.15
Results

A total of 2,541 children were evaluated and their characteristics are described in Table 1. The analysis of weighted frequencies showed that most were non-white and lived in the Northeast of Brazil. It can be observed that of the food recommended for daily intake, milk was the most prevalent, while vegetables were the least; there was a high prevalence of consuming sugary food and those unsuitable for the age group studied; most children were not covered by health insurance, and although 65% had their growth and development monitored in public health services, only half of the households received a visit from a community health agent and 8.3% did not receive any follow-up care. Most households had walls constructed with suitable material and appliances such as a refrigerator and television, while around a third of those had assessed to untreated water.

The bivariate analysis (Table 2) shows that sociodemographic variables, access to health services and those related to housing conditions were associated with the outcome.

Table 3 shows the results of the hierarchically adjusted Poisson regression analysis. The factors that remained in the final model were region in Brazil ($p<0.05$), type of residence ($p<0.05$), skin color ($p<0.05$) and the last medical appointment ($p<0.05$). Children who lived in the North or Northeast regions of the country, mostly in the countryside, were non-white and whose last medical appointment was more than a year ago were more likely to have inadequate feeding practices.

Figure 2 shows the results of the Decision Tree multivariate analysis (CHAID) for the feeding practices among Brazilian children aged 12-23 months old were adjusted for the investigated factors. Based on the final model, the factors associated with the outcome were: region in Brazil ($p<0.05$), type of...
Table 1
Distribution of Brazilian children aged 12-23 months old according to dietary and demographic characteristics, access to health services and housing conditions. Brazil, 2013-2014.

| Variables                      | N⁰ | %ᵇ | CI95%ᵇ         |
|-------------------------------|----|----|----------------|
| **Food characteristics**      |    |    |                |
| Consumes food with sugar      |    |    |                |
| Yes                           | 2158 | 85.5 | 83.7-87.2      |
| No                            | 383  | 14.5 | 12.8-16.3      |
| Feeding practice              |    |    |                |
| Adequate                      | 1238 | 51.2 | 48.8-53.7      |
| Inadequate                    | 1303 | 48.8 | 46.3-51.2      |
| Milk                          |    |    |                |
| No                            | 121  | 4.5  | 3.6-5.6        |
| Yes                           | 2420 | 95.5 | 94.4-96.4      |
| Fruit                         |    |    |                |
| No                            | 491  | 17.9 | 16.1-19.9      |
| Yes                           | 2050 | 82.1 | 80.1-83.9      |
| Vegetables/Legumes            |    |    |                |
| No                            | 771  | 28.7 | 26.5-30.9      |
| Yes                           | 1770 | 71.3 | 69.1-73.5      |
| Grains                        |    |    |                |
| No                            | 554  | 20.0 | 18.1-22.0      |
| Yes                           | 1987 | 80.0 | 78.0-81.9      |
| Cereal/tubers                 |    |    |                |
| No                            | 330  | 11.5 | 10.1-13.1      |
| Yes                           | 2211 | 88.5 | 86.9-89.9      |
| Iron consumption              |    |    |                |
| No                            | 295  | 10.5 | 9.1-12.0       |
| Yes                           | 2246 | 89.5 | 88.0-90.9      |
| **Demographic characteristics**|    |    |                |
| Sex                           |    |    |                |
| Male                          | 1293 | 53.0 | 50.5-55.4      |
| Female                        | 1248 | 47.0 | 44.6-49.5      |
| Skin color                    |    |    |                |
| White                         | 1055 | 43.7 | 41.2-46.1      |
| Non-white                     | 1486 | 56.3 | 53.9-58.8      |
| Region in Brazil              |    |    |                |
| North                         | 744  | 19.4 | 17.8-21.2      |
| Northeast                     | 786  | 36.0 | 33.7-38.5      |
| Midwest                       | 303  | 16.2 | 14.3-18.2      |
| Southeast                     | 461  | 17.4 | 15.6-19.3      |
| South                         | 247  | 11.0 | 9.5-12.6       |
| Area of residence             |    |    |                |
| Urban                         | 1980 | 79.8 | 77.7-81.7      |
| Rural                         | 561  | 20.2 | 18.3-22.3      |
| Type of residence             |    |    |                |
| State Capital/Metropolitan Region | 1531 | 58.4 | 55.9-60.8      |
| Rural region of state         | 1010 | 41.6 | 39.2-44.1      |

ᵃ Unweighted estimates; ᵃᵇ Weighted estimates considering complex sampling plan.
Table 1

Distribution of Brazilian children aged 12-23 months old according to dietary and demographic characteristics, access to health services and housing conditions. Brazil, 2013-2014.

| Variables                                                                 | N   | %   | CI95% |
|----------------------------------------------------------------------------|-----|-----|-------|
| **Access to health care services**                                         |     |     |       |
| Health insurance                                                          |     |     |       |
| Yes                                                                        | 598 | 25.8| 23.7-28.0 |
| No                                                                         | 1943| 74.2| 72.0-76.3 |
| Child’s health status as reported by the respondent                        |     |     |       |
| Very good or good                                                          | 2247| 89.1| 87.5-90.5 |
| Fair, poor or very poor                                                   | 294 | 10.9| 9.5-12.5  |
| Last medical appointment                                                   |     |     |       |
| < 1 Year                                                                   | 2307| 92.1| 90.6-93.3 |
| > 1 Year                                                                   | 162 | 5.6 | 4.6-6.8  |
| Never                                                                      | 72  | 2.3 | 1.7-3.2  |
| Number of medical appointments in the last 12 months                      |     |     |       |
| 0 to 1 appointment                                                         | 664 | 24.7| 22.6-26.9 |
| 2 to 6 appointments                                                        | 1287| 51.8| 49.3-54.3 |
| ≥ 7 appointments                                                           | 590 | 23.5| 21.4-25.6 |
| Has child been to the dentist                                              |     |     |       |
| Yes                                                                        | 452 | 17.5| 15.7-19.4 |
| No                                                                         | 2089| 82.5| 80.6-84.3 |
| Where is the child’s growth monitored                                      |     |     |       |
| Private or company clinic                                                  | 548 | 23.8| 21.7-26.0 |
| Public hospital, polyclinic or health unit                                 | 1694| 65.4| 63.0-67.7 |
| Other                                                                      | 69  | 2.5 | 1.8-3.5  |
| No follow-up monitored                                                     | 230 | 8.3 | 7.0-9.7  |
| Is household registered at the Family Health Unit                           |     |     |       |
| Yes                                                                        | 1471| 59.6| 57.2-62.0 |
| No                                                                         | 1070| 40.4| 38.0-42.8 |
| Have you received visits from a Community Health Agent                     |     |     |       |
| Yes                                                                        | 1245| 51.0| 48.6-53.5 |
| No                                                                         | 1296| 49.0| 46.5-51.4 |
| **Housing conditions**                                                     |     |     |       |
| Number of residents per room (median = 0.8)                                |     |     |       |
| ≤ 0.8                                                                      | 1391| 58.6| 56.1-61.0 |
| >0.8                                                                       | 1150| 41.4| 39.0-43.9 |
| Status of resident at home                                                 |     |     |       |
| Child of parent/guardian and spouse                                        | 1672| 66.1| 63.7-68.3 |
| Child or stepchild of parent/guardian only                                 | 244 | 9.8 | 8.4-11.4  |
| Grandchild or great-grandchild                                             | 552 | 21.2| 19.3-23.3 |
| Other                                                                      | 73  | 3.0 | 2.2-3.9  |
| Predominant material of the house walls                                    |     |     |       |
| Masonry with cladding + suitable wood                                      | 2161| 84.0| 82.1-85.8 |
| Finished wood / straw / rammed earth / other                              | 85  | 3.2 | 2.4-4.2  |
| Uncoated masonry                                                          | 295 | 12.8| 11.2-14.6 |
| Water supply at home                                                       |     |     |       |
| General network                                                            | 1854| 75.7| 73.6-77.8 |
| Other                                                                      | 687 | 24.3| 22.2-26.4 |

* Unweighted estimates; † Weighted estimates considering complex sampling plan.
residence (<0.05), skin color (<0.05), internet access (<0.05) and number of residents per room (<0.05). Three patterns could be identified for the propensity of inadequate feeding practices: 1) children from the North of Brazil, from regions in the countryside of the States and without internet access at home; 2) children from the Northeast, from regions in the rural areas of the States and without adequate water for consumption at home; 3) children from the Southeast, South and Midwest regions, with internet access at home, and were white.

Discussion

The results of the present study, which are representative for Brazilian children aged 12-23 months old, suggest that according to the decision tree model in the region of the country and the area of residence, skin color, access to internet, drinking water and the number of residents per room were associated with adequate feeding practices, which do not meet the recommendation of the Ministry of Health that food from different food groups should be consumed on a daily basis.

Almost half of the children assessed did not consume food from every food group, as recommended by the Ministry of Health. Vegetables/legumes and grains were the food types most likely not to be consumed, while there was a higher exposure to processed and ultra-processed foods with an extremely high prevalence (85.5%) of food intake with sugar. Babies have an innate preference for sugar and salty tastes and do not like bitter tastes. While changing these innate taste preferences is impossible, parents can modify subsequent preferences by offering complementary food without added sugar or salt, and by introducing a variety of flavors, including bitter green vegetables, in a timely manner.

The quality of the food intake of Brazilian children was shown to be inadequate in a previous study which found that 10.6% and 20.4% of the daily energy consumption came from processed and ultra-processed food, respectively, and concluded that reducing the consumption of this type of food is a natural form of promoting healthy eating in Brazil. Despite the implementation of several food and nutrition strategies - the Rede Amamenta Brasil (Brazilian Breastfeeding Network), the Estratégia Nacional para Alimentação Complementar Saudável (National Strategy for Complementary Healthy Eating) and the Estratégia Amamenta e Alimenta Brasil (Brazil Breastfeeding and Food Strategy) - studies have shown that inadequate practices for introducing complementary feeding remain. The ineffectiveness of the programs to promote healthy eating at childhood in Brazil has already been related to the precarious working conditions of health teams in a context being unfa-

### Table 1

Distribution of Brazilian children aged 12-23 months old according to dietary and demographic characteristics, access to health services and housing conditions. Brazil, 2013-2014.

| Variables                        | N<sup>a</sup> | %<sup>b</sup> | CI95%<sup>b</sup> |
|----------------------------------|---------------|---------------|-------------------|
| Water used for drinking          |               |               |                   |
| Treated (mineral, boiled filtrate or other home treatment) | 1642          | 66.6          | 64.2-68.8         |
| Untreated (without home treatment) | 899           | 33.4          | 31.2-35.8         |
| Residence with kitchen           |               |               |                   |
| Yes                              | 2407          | 96.2          | 95.3-97.0         |
| No                               | 134           | 3.8           | 3.0-4.7           |
| Residence with television        |               |               |                   |
| Yes                              | 2427          | 96.7          | 95.7-97.4         |
| No                               | 114           | 3.3           | 2.6-4.3           |
| Residence with microwave         |               |               |                   |
| Yes                              | 988           | 40.5          | 38.1-43.0         |
| No                               | 1553          | 59.5          | 57.0-61.9         |
| Residence with internet access   |               |               |                   |
| Yes                              | 888           | 36.3          | 33.9-38.7         |
| No                               | 1653          | 63.7          | 61.3-66.1         |

*Unweighted estimates; <sup>b</sup> Weighted estimates considering complex sampling plan.
Table 2

Bivariate analysis between the characterization of feeding practice and demographic characteristics, access to health services and housing conditions of Brazilian children aged 12-23 months old. Brazil, 2013-2014.

| Variables | Dietary practice | PR <sup>gross</sup> (CI95%) | p<sup>a</sup> |
|-----------|------------------|-----------------------------|-------------|
|           | Adequate | Inadequate | Total | Adequate | Inadequate | Total |
| Sex       |          |            |       |          |            |       |
| Male      | 619      | 50.6       | 674   | 49.4     | 1293       | 100.0  | 0.97 (0.88-1.07) | 0.575 |
| Female    | 619      | 52.0       | 629   | 48.0     | 1248       | 100.0  |            |          |
| Skin Color|          |            |       |          |            |       |
| White     | 594      | 58.5       | 461   | 41.5     | 1055       | 100.0  | 1.31 (1.18-1.46) | <0.001* |
| Non-white | 644      | 45.6       | 842   | 54.4     | 1486       | 100.0  |            |          |
| Region in Brazil |    |            |       |          |            |       |
| North     | 250      | 35.9       | 494   | 64.1     | 744        | 100.0  | 1            |          |
| Northeast | 349      | 44.2       | 347   | 55.8     | 786        | 100.0  | 0.96 (0.74-1.23) | 0.731 |
| Midwest   | 185      | 63.7       | 118   | 36.3     | 303        | 100.0  | 0.97 (0.75-1.25) | 0.817 |
| Southeast | 298      | 64.2       | 163   | 35.8     | 461        | 100.0  | 1.49 (1.21-1.83) | <0.001* |
| South     | 156      | 62.6       | 91    | 37.4     | 247        | 100.0  | 1.71 (1.39-2.10) | <0.001* |
| Area of residence | |            |       |          |            |       |
| Urban     | 1034     | 54.4       | 946   | 45.6     | 1980       | 100.0  | 1            |          |
| Rural     | 204      | 38.7       | 357   | 61.3     | 561        | 100.0  | 1.34 (1.21-1.50) | <0.001* |
| Type of residence | |            |       |          |            |       |
| State Capital/Metropolitan Region | 825 | 57.2 | 706 | 42.8 | 1531 | 100.0 | 1 | |
| Rural region of the State | 413 | 42.8 | 597 | 57.2 | 1010 | 100.0 | 1.34 (1.21-1.48) | <0.001* |
| Characteristics of access to health services | | | | | | |
| Health insurance | | | | | | |
| Yes       | 392      | 65.6       | 206   | 34.4     | 598        | 100.0  | 1            |          |
| No        | 846      | 46.2       | 1097  | 53.8     | 1943       | 100.0  | 1.56 (1.35-1.81) | <0.001* |
| Child’s health status as reported by the respondent | | | | | | |
| Very good or good | 1118 | 52.3 | 1129 | 47.7 | 2247 | 100.0 | 1 | |
| Fair, poor or very poor | 120 | 42.6 | 174 | 57.4 | 294 | 100.0 | 1.20 (1.05-1.38) | 0.008* |
| Last medical appointment | | | | | | |
| < 1 Year | 1169     | 52.9       | 1138  | 47.1     | 2307       | 100.0  | 1            |          |
| > 1 Year | 54       | 35.9       | 108   | 64.1     | 162        | 100.0  | 1.36 (1.16-1.60) | <0.001* |
| Never     | 15       | 21.5       | 57    | 78.5     | 72         | 100.0  | 1.67 (1.39-1.99) | <0.001* |
| Has child ever been to the dentist | | | | | | |
| Yes       | 268      | 60.8       | 184   | 39.2     | 452        | 100.0  | 1            |          |
| No        | 970      | 49.2       | 1119  | 50.8     | 2089       | 100.0  | 1.30 (1.11-1.51) | 0.001* |
| Where is the child’s growth monitored | | | | | | |
| Private or company clinic | 355 | 64.6 | 193 | 35.4 | 548 | 100.0 | 1 | |
| Public hospital, polyclinic or health unit | 784 | 48.9 | 910 | 51.1 | 1694 | 100.0 | 1.45 (1.24-1.68) | <0.001* |
| Other     | 29       | 39.7       | 40    | 60.3     | 69         | 100.0  | 1.70 (1.27-2.29) | <0.001* |
| No follow-up on monitoring | 70 | 34.9 | 160 | 65.1 | 230 | 100.0 | 1.84 (1.52-2.23) | <0.001* |
| Is household registered with Family Health Unit | | | | | | |
| Yes       | 709 ( )  | 50.1       | 762   | 49.9     | 1471       | 100.0  | 1            |          |
| No        | 529 ( )  | 52.8       | 541   | 47.2     | 1070       | 100.0  | 0.95 (0.85-1.05) | 0.287 |

PR = prevalence ratio; * p<0.05; Variables with p<0.25 in the bivariate analysis or considered epidemiological determinants (such as the sex of the child) were incorporated into the multivariate analysis.
Table 2

Bivariate analysis between the characterization of feeding practice and demographic characteristics, access to health services and housing conditions of Brazilian children aged 12-23 months old. Brazil, 2013-2014.

| Variables                                                                                       | Dietary practice                                 | PR<sub>gress</sub> (CI95%) | p<sup>a</sup> |
|------------------------------------------------------------------------------------------------|--------------------------------------------------|----------------------------|--------------|
|                                                                                               | Adequate | Inadequate | Total |              |              |
|                                                                                               | n        | %          | n     | %          | n          | %          |
| Have you received visits from a Community Health Agent                                       |          |            |       |            |            |            |
| Yes                                                                                             | 578      | 47.5       | 667   | 52.5       | 1245       | 100.0      | 1          |
| No                                                                                             | 660      | 55.0       | 636   | 45.0       | 1296       | 100.0      | 0.86 (0.77-0.95) | 0.003* |
| Characteristics related to housing conditions                                                  |          |            |       |            |            |            |
| Number of residents per room                                                                   |          |            |       |            |            |            |
| ≤0.8                                                                                            | 775      | 56.8       | 616   | 43.2       | 1391       | 100.0      | 1          |
| >0.8                                                                                            | 463      | 43.4       | 687   | 56.6       | 1150       | 100.0      | 1.30 (1.19-1.45) | <0.001* |
| Status of resident at home                                                                     |          |            |       |            |            |            |
| Child of parent/guardian and spouse                                                             | 842      | 52.7       | 830   | 47.3       | 1672       | 100.0      | 1          |
| Child or stepchild of parent/guardian                                                           | 117      | 47.2       | 127   | 52.8       | 244        | 100.0      | 1.12 (0.94-1.32) | 0.196 |
| Grandchild or great-grandchild                                                                  | 248      | 49.4       | 304   | 50.6       | 552        | 100.0      | 1.07 (0.95-1.21) | 0.274 |
| Other                                                                                            | 31       | 45.4       | 42    | 54.6       | 73         | 100.0      | 1.15 (0.88-1.51) | 0.306 |
| Predominant material of house walls                                                             |          |            |       |            |            |            |
| Masonry with cladding + suitable wood                                                           | 1093     | 53.3       | 1068  | 46.7       | 2161       | 100.0      | 1          |
| Finished wood / straw / rammed earth / other                                                    | 21       | 25.7       | 64    | 74.3       | 85         | 100.0      | 1.59 (1.35-1.88) | <0.001* |
| Uncoated masonry                                                                               | 124      | 43.7       | 171   | 56.3       | 295        | 100.0      | 1.21 (1.05-1.39) | 0.008* |
| Water supply at home                                                                           |          |            |       |            |            |            |
| General network                                                                                | 977      | 54.3       | 877   | 45.7       | 1854       | 100.0      | 1          |
| Other (water tank, cistern, well, river, lake, stream, other)                                   | 261      | 41.8       | 426   | 58.2       | 687        | 100.0      | 1.27 (1.15-1.41) | <0.001* |
| Water used for drinking                                                                        |          |            |       |            |            |            |
| Treated                                                                                       | 873      | 55.6       | 769   | 44.4       | 1642       | 100.0      | 1          |
| Untreated                                                                                      | 365      | 42.6       | 534   | 57.4       | 899        | 100.0      | 1.29 (1.17-1.43) | <0.001* |
| Residence with kitchen                                                                         |          |            |       |            |            |            |
| Yes                                                                                           | 1196     | 51.5       | 1211  | 48.5       | 2407       | 100.0      | 1          |
| No                                                                                            | 42       | 44.4       | 92    | 55.6       | 134        | 100.0      | 1.15 (0.93-1.42) | 0.210 |
| Residence with television                                                                      |          |            |       |            |            |            |
| Yes                                                                                           | 1211     | 52.2       | 1216  | 47.8       | 2427       | 100.0      | 1          |
| No                                                                                            | 27       | 23.6       | 87    | 76.4       | 114        | 100.0      | 1.60 (1.38-1.84) | <0.001* |
| Residence with microwave                                                                       |          |            |       |            |            |            |
| Yes                                                                                           | 606      | 62.4       | 382   | 37.6       | 988        | 100.0      | 1          |
| No                                                                                            | 632      | 43.6       | 921   | 56.4       | 1553       | 100.0      | 1.50 (1.34-1.68) | <0.001* |
| Residence with internet access                                                                  |          |            |       |            |            |            |
| Yes                                                                                           | 553      | 63.0       | 335   | 37.0       | 888        | 100.0      | 1          |
| No                                                                                            | 685      | 44.5       | 968   | 55.5       | 1653       | 100.0      | 1.50 (1.33-1.69) | <0.001* |

PR = prevalence ratio; * p<0.05; Variables with p<0.0.25 in the bivariate analysis or considered epidemiological determinants (such as the sex of the child) were incorporated into the multivariate analysis.
Table 3
Hierarchically adjusted Poisson regression analysis to determine the factors associated with the inadequate dietary practice among Brazilian children aged 12-23 months old. Brazil, 2013-2014.

| Variables                                      | Model 1<sup>a</sup> | Model 2<sup>b</sup> | Model 3<sup>c</sup> | Model 4<sup>d</sup> |
|-----------------------------------------------|---------------------|---------------------|---------------------|---------------------|
|                                               | PR<sub>Adjusted</sub> (CI95%) | P       | PR<sub>Adjusted</sub> (CI95%) | P       | PR<sub>Adjusted</sub> (CI95%) | P       | PR<sub>Adjusted</sub> (CI95%) | P       |
| Block 1                                        |                     |                     |                     |                     |
| Demographic characteristics                   |                     |                     |                     |                     |
| Sex                                           |                     |                     |                     |                     |
| Male                                          | 1                   |                     | 1                   |                     | 1                   |                     | 1                   |                     |
| Female                                        | 0.95 (0.87-1.95)    | 0.346               | 0.94 (0.86-1.04)    | 0.242               | 0.95 (0.86-1.05)    | 0.270               |                     |                     |
| Skin Color                                    |                     |                     |                     |                     |
| White                                         | 1                   |                     | 1                   |                     | 1                   |                     | 1                   |                     |
| Non-white                                     | 1.19 (1.07-1.33)    | 0.002*              | 1.14 (1.02-1.27)    | 0.021*              | 1.12 (1.01-1.25)    | 0.038*              | 1.19 (1.07-1.33)    | 0.001*              |
| Region                                        |                     |                     |                     |                     |
| North                                         | 1.49 (1.21-1.84)    | <0.001*             | 1.40 (1.13-1.72)    | 0.002*              | 1.35 (1.08-1.68)    | 0.008*              | 1.46 (1.18-1.80)    | <0.001*             |
| Northeast                                     | 1.30 (1.06-1.61)    | 0.013*              | 1.25 (1.01-1.53)    | 0.038*              | 1.25 (1.01-1.55)    | 0.046*              | 1.31 (1.07-1.62)    | 0.010*              |
| Midwest                                       | 0.89 (0.69-1.15)    | 0.366               | 0.88 (0.68-1.14)    | 0.343               | 0.90 (0.69-1.16)    | 0.401               | 0.89 (0.69-1.15)    | 0.366               |
| Southeast                                     | 0.88 (0.69-1.12)    | 0.303               | 0.89 (0.70-1.14)    | 0.376               | 0.93 (0.72-1.19)    | 0.554               | 0.88 (0.69-1.13)    | 0.317               |
| Area of residence                             |                     |                     |                     |                     |
| Urban                                         | 1                   |                     | 1                   |                     | 1                   |                     | 1                   |                     |
| Rural                                         | 1.15 (1.03-1.29)    | 0.014*              | 1.10 (0.98-1.23)    | 0.121               | 1.03 (0.90-1.18)    | 0.708               |                     |                     |
| Type of residence                             |                     |                     |                     |                     |
| State Capital/Metropolitan Region             | 1                   |                     | 1                   |                     | 1                   |                     | 1                   |                     |
| Rural region in the State                     | 1.21 (1.09-1.35)    | <0.001*             | 1.15 (1.03-1.28)    | 0.016*              | 1.12 (1.01-1.25)    | 0.047*              | 1.26 (1.14-1.38)    | <0.001*             |
| Block 2                                        |                     |                     |                     |                     |
| Characteristics of access to health services: |                     |                     |                     |                     |
| Health insurance                              |                     |                     |                     |                     |
| Yes                                           | 1                   |                     | 1                   |                     | 1                   |                     | 1                   |                     |
| No                                            | 1.22 (1.01-1.48)    | 0.044*              | 1.16 (0.95-1.41)    | 0.139               |                     |                     |                     |                     |
| Child’s health status as reported by the respondent |                     |                     |                     |                     |
| Very good or good                             | 1                   |                     | 1                   |                     | 1                   |                     | 1                   |                     |
| Fair, poor or very poor                       | 1.07 (0.94-1.22)    | 0.307               | 1.06 (0.92-1.21)    | 0.417               |                     |                     |                     |                     |

PR = prevalence ratio; * P<0.05;  <sup>a</sup> Model 1 adjusted for individual characteristics (demographic variables); <sup>b</sup> Model 2 adjusted for individual characteristics (demographic variables and those related to access to health services);  <sup>c</sup> Model 3 adjusted for individual and contextual characteristics (demographic variables, related to access to health services and housing conditions);  <sup>d</sup> Model 4 final.
Table 3
Hierarchically adjusted Poisson regression analysis to determine the factors associated with the inadequate dietary practice among Brazilian children aged 12-23 months old. Brazil, 2013-2014.

| Variables                                         | Model 1a | Model 2b | Model 3c | Model 4d |
|---------------------------------------------------|----------|----------|----------|----------|
|                                                   | PR Adjusted (CI95%) | p      | PR Adjusted (CI95%) | p      | PR Adjusted (CI95%) | p      | PR Adjusted (CI95%) | p      |
| Last medical appointment                          | 1        |         | 1        |         | 1        |         | 1        |         |
| < 1 Year                                           | 1.24 (1.05-1.47) | 0.011* | 1.24 (1.05-1.46) | 0.012* | 1.26 (1.06-1.49) | 0.007* |
| > 1 Year                                           | 1.24 (1.03-1.48) | 0.022* | 1.21 (1.02-1.44) | 0.031* | 1.33 (1.12-1.57) | 0.001* |
| Never                                             | 1.24 (1.03-1.48) | 0.022* | 1.21 (1.02-1.44) | 0.031* | 1.33 (1.12-1.57) | 0.001* |
| Has child ever been to the dentist                 | 1        |         | 1        |         | 1        |         | 1        |         |
| Yes                                               | 1.10 (0.94-1.29) | 0.245  | 1.08 (0.92-1.26) | 0.357  | -        | -       | -        | -       |
| No                                                | 1.17 (0.93-1.47) | 0.192  | 1.06 (0.83-1.34) | 0.644  | -        | -       | -        | -       |
| Where is the child's growth monitored              | 1        |         | 1        |         | 1        |         | 1        |         |
| Private or company clinic                          | 1.04 (0.86-1.26) | 0.694  | 0.96 (0.78-1.17) | 0.662  | -        | -       | -        | -       |
| Public hospital, polyclinic or health unit         | 1.03 (0.75-1.42) | 0.852  | 0.96 (0.70-1.31) | 0.779  | -        | -       | -        | -       |
| Other                                             | 1.17 (0.93-1.47) | 0.192  | 1.06 (0.83-1.34) | 0.644  | -        | -       | -        | -       |
| No follow-up on monitoring                         | 0.99 (0.89-1.09) | 0.805  | 0.99 (0.90-1.10) | 0.937  | -        | -       | -        | -       |
| Have you received visits from a Community Health agent | 1        |         | 1        |         | 1        |         | 1        |         |
| Yes                                               | 0.99 (0.89-1.09) | 0.805  | 0.99 (0.90-1.10) | 0.937  | -        | -       | -        | -       |
| No                                                | 1.08 (0.98-1.20) | 0.134  | -        | -       | -        | -       | -        | -       |

Block 3

Characteristics related to housing conditions:

| Number of residents per room                       | PR Adjusted (CI95%) | p      | PR Adjusted (CI95%) | p      | PR Adjusted (CI95%) | p      | PR Adjusted (CI95%) | p      |
|---------------------------------------------------|---------------------|--------|---------------------|--------|---------------------|--------|---------------------|--------|
| ≤0.8                                              | 1                   |        | 1                   |        | 1                   |        | 1                   |        |
| >0.8                                              | 1.08 (0.98-1.20)    | 0.134  | -                   | -       | -                   | -       | -                   | -       |

PR = prevalence ratio; * p<0.05; a Model 1 adjusted for individual characteristics (demographic variables); b Model 2 adjusted for individual characteristics (demographic variables and those related to access to health services); c Model 3 adjusted for individual and contextual characteristics (demographic variables, related to access to health services and housing conditions); d Model 4 final.
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Hierarchically adjusted Poisson regression analysis to determine the factors associated with the inadequate dietary practice among Brazilian children aged 12-23 months old. Brazil, 2013-2014.

| Variables                                      | Model 1<sup>a</sup> | Model 2<sup>b</sup> | Model 3<sup>c</sup> | Model 4<sup>d</sup> |
|------------------------------------------------|---------------------|---------------------|---------------------|---------------------|
| Predominant material of the house walls       |                     |                     |                     |                     |
| Masonry with cladding + suitable wood         |                     |                     |                     |                     |
| Finished wood / straw / rammed earth / other  | 1.08 (0.90-1.28)    | 0.411               | -                   | -                   |
| Unclad masonry                                | 1.05 (0.92-1.20)    | 0.474               | -                   | -                   |
| Water supply of residence                     |                     |                     |                     |                     |
| General network                               | 1                   |                     | -                   | -                   |
| Other (water tank, cistern, well, river, lake, stream, other) | 1.02 (0.91-1.15)    | 0.735               | -                   | -                   |
| Water used for drinking                       |                     |                     |                     |                     |
| Treated                                       | 1                   |                     | -                   | -                   |
| Untreated                                      | 1.10 (0.99-1.22)    | 0.083               | -                   | -                   |
| Residence with television                     |                     |                     |                     |                     |
| Yes                                           | 1                   |                     | -                   | -                   |
| No                                            | 1.14 (0.99-1.33)    | 0.078               | -                   | -                   |
| Residence with microwave                      |                     |                     |                     |                     |
| Yes                                           | 1                   |                     | -                   | -                   |
| No                                            | 1.05 (0.91-1.21)    | 0.487               | -                   | -                   |
| Residence with internet access                |                     |                     |                     |                     |
| Yes                                           | 1                   |                     | -                   | -                   |
| No                                            | 1.12 (0.97-1.29)    | 0.121               | -                   | -                   |

PR = prevalence ratio; * p<0.05; <sup>a</sup> Model 1 adjusted for individual characteristics (demographic variables); <sup>b</sup> Model 2 adjusted for individual characteristics (demographic variables and those related to access to health services); <sup>c</sup> Model 3 adjusted for individual and contextual characteristics (demographic variables, related to access to health services and housing conditions); <sup>d</sup> Model 4 final.
Feeding practices among Brazilian children

Figure 2

Multivariate analysis using the Decision Tree (CHAID) for the feeding practice of Brazilian children aged 12-23 months old adjusted for the investigated factors. Brazil, 2013-2014.

CHAAD= Chi-squared Automatic Interaction Detector.

Figure 2 shows the decision tree (CHAID) for the feeding practice of Brazilian children aged 12-23 months old. The tree categorizes the feeding practices into healthy and unhealthy feeding nodes based on various factors such as region in Brazil, type of residence, residence with access to internet, number of residents per room, skin color, and drinking water treatment. The tree helps to identify factors associated with healthy feeding practices and those that contribute to unhealthy practices.

The decision tree indicates that children living in the Northeast region and those residing in rural areas are more likely to have unhealthy feeding practices. Conversely, children living in the Southeast, South, and Midwest regions and those residing in metropolitan areas are more likely to have healthy feeding practices.

The tree also shows that children with access to internet and those living in regions with higher population density are more likely to have healthy feeding practices. Similarly, children who drink treated water and those with lighter skin color are more likely to have healthy feeding practices.

The decision tree provides insights into the factors that influence feeding practices among Brazilian children, allowing for targeted interventions to promote healthy eating habits.

The low frequency of medical appointments for babies is associated with lower maternal education, family structure, and the perception that monitoring is unnecessary in the absence of illness. These results corroborate the findings in the present study, which found an association between a lack of post-birth medical appointments and the inadequate practice of complementary feeding for children aged 12-23 months old. Therefore, it is recommended that measures should be adopted to raise awareness of the importance to continue monitoring children's health.

For follow-up care is associated with low maternal education, family structure and the perception that monitoring is unnecessary in the absence of illness. These results corroborate the findings in the present study, which found an association between a lack of post-birth medical appointments and the inadequate practice of complementary feeding for children aged 12-23 months old. Therefore, it is recommended that measures should be adopted to raise awareness of the importance to continue monitoring children's health.

In the present study, children who did not attend the appointments for this age group pre-established by the Ministry of Health were more likely to have inadequate feeding practices, according to Poisson regression. The Ministry of Health recommends seven routine appointments in the first year of life, two in the second, and annual appointments thereafter. The literature shows that the high frequency of children who do not attend the public health service for follow-up care is associated with low maternal education, family structure and the perception that monitoring is unnecessary in the absence of illness. These results corroborate the findings in the present study, which found an association between a lack of post-birth medical appointments and the inadequate practice of complementary feeding for children aged 12-23 months old. Therefore, it is recommended that measures should be adopted to raise awareness of the importance to continue monitoring children's health.

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more likely to be exposed to unhealthy food (processed juices, soft drinks and sugar or honey). In addition, mothers face great challenges in feeding their children in the first years of life, resulting from phases of reduced appetite, the child's quest for independence and autonomy, transient "selective feeding" behaviors, as well as a strong maternal influence, resulting in inappropriate feeding practices. It is the responsibility of health professionals to encourage attendance at the appointments to monitor a child's growth and development, even when the mother perceives the child to be healthy and to provide mothers with information and strategies to approach food introduction. In this context, comprehensive awareness programs on healthy feeding that reach all groups in society are essential, especially those that target pregnant women, new mothers and primary caregivers.

The results of the present study agree with the findings of existing literature in revealing that inadequate feeding practices were associated, in both analyzies, with non-white children who lived in the North and Northeast regions, which have the lowest HDIs in Brazil (0.677 and 0.663 respectively), notably among those living in rural regions outside the large urban centers. Meanwhile, living in the South and Southeast regions, in more socioeconomically developed areas, and being white increased the chances of having adequate feeding practices. These results show that health interventions alone are not enough to promote adequate and healthy feeding. The adoption of measures aimed to reduce social inequalities is of fundamental importance in providing greater opportunities for growth and development for children.

Inadequate feeding practices are a public health problem and the role of social determinants must be highlighted. Understanding the factors associated with this condition, which include different environmental and socioeconomic conditions, the cost of healthy food and its influence on access to a quality diet, in addition to more economical potential alternatives such as dry grains, are fundamental for the planning of public policies aimed for this age group, as such knowledge can provide health managers with the support for the implementation of programs focused on diseases prevention in childhood and future adulthood that result from inadequate feeding with nutritional deficiencies, such as obesity, diabetes, heart disease and tooth decay.

Cash transfer programs have been found to play an important role in strategies to promote healthy eating with beneficiary families consuming less processed and ultra-processed food in the Southeast and Northeast and greater availability of fresh food and culinary ingredients, particularly in the Northeast, including food that increase the quality and diversity of the diet. Measures such as programs to reduce the consumption of sweetened drinks and food, including taxation policies and guidelines for marketing of unhealthy food can also be studied.

Limitations of the present study include its cross-sectional design, which prevents the establishment of a causal relation, in addition to the possible bias involved in measuring children’s usual diet, due to interviewee memory failure; the lack of detail in the recall questionnaire on the level of processing food, the amount consumed or the frequency of consumption, and the limited validity of the data collection instruments, which are common obstacles in food consumption surveys. However, measures were taken to prevent the occurrence of such problems, such as careful training of the team and in conducting the interviews, supporting the validity of the data. In addition, it is important to emphasize that research based on large samples such as this one have greater precision, which can protect the study from random error.

One of the advantages of this study was the use of national data, compared to others on the same theme which were performed at the regional or city levels, in addition to the selected age group (from 12 to 23 months old), which represents a period of consistency in dietary recommendations. The use of the Decision Tree Analysis, a Data Mining technique, is also a differentiating factor, as it is relatively new and has been used successfully in epidemiological and public health investigations.

In conclusion, the results of this study show that non-white Brazilian children aged 12 to 23 months old, living in the North and Northeast regions of the country, in towns in the rural areas of the States were more likely to experience inadequate feeding practices, characterized by not fully meeting the food group intake recommended by the Ministry of Health. Measures aimed to improve children’s feeding practices must take into account socioeconomic inequalities, different levels of food access and focus on health promotion interventions aimed mainly for families in greater vulnerability.

Authors' contribution

Rebouças AG, Flório FM and Duarte DA contributed to the study design. Bernardino IM carried out the analysis of the results, Rebouças AG and Flório FM
contributed to the discussion of the results and to the writing of the manuscript. Dutra ER and Imparato JCP participated in the critical review of the work. All authors approved the final version of the manuscript.

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