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Nutritional risk among Brazilian children 2 to 6 years old: A multicenter study

Milena Baptista Bueno Ph.D. [a], Regina Mara Fisberg Ph.D. [a], Priscila Maximino M.Sc. [b], Guilherme de Pádua Rodrigues Ph.D. [c], Mauro Fisberg Ph.D. [b,*]

[a] Nutrition Department, University of São Paulo, São Paulo, São Paulo, Brazil
[b] Pediatric Department, Federal University of São Paulo, São Paulo, São Paulo, Brazil
[c] Danone Research, São Paulo, São Paulo, Brazil

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ABSTRACT

Objective: To estimate the nutritional risk in children 2 to 6 y old.
Methods: The sample consisted of 3058 children enrolled in public and private schools in nine Brazilian cities. The assessment of nutrient intake was based on 1-d data combining direct individual weighing of foods and a food diary. A second evaluation of food consumption was conducted in a subsample to estimate the usual intake.
Results: There was low prevalence of inadequate intake of vitamin B6 (<0.001%), riboflavin (<0.001%), niacin (<0.001%), thiamin (<0.001%), folate (<0.001%), phosphorus (<0.1%), magnesium (<0.1%), iron (<0.5%), copper (<0.001%), zinc (<0.5%), and selenium (<0.001%). However, 22% of children younger than 4 y and 5% of children older than 4 y consumed fiber quantities larger than the adequate intake. Approximately 30% of the sample consumed more saturated fat than recommended. The prevalence of inadequate vitamin E intake ranged from 15% to 29%. More than 90% of the children had an inadequate vitamin D intake. In children older than 4 y, the prevalence of inadequate calcium intake was approximately 45%. Sodium intake was higher than the upper intake level in 90% of children younger than 4 y and 73% of children older than 4 y.
Conclusions: The prevalence of inadequate dietary intake was low for most nutrients. However, fiber, calcium, and vitamin D and E intakes were lower than recommended. Moreover, children consumed large amounts of sodium and saturated fat.

Introduction

The data from the Brazilian Children's and Women's National Demographic and Health research (1996–2006) have shown a significant decrease in growth stunting (<−2 standard deviations in height-for-age *Z* score) in children younger than 60 mo. In 2006, the proportion of stunted children was 8% and 6% for boys and girls, respectively [1]. In the Brazilian Family Budget Survey (2008–2009), the prevalence of stunting was 4% to 6% inchildren 2 to 6 y old, and the prevalence of overweight and obesity (>1 standard deviation in body mass index-for-age *Z* score) in children 5 to 6 y old was 32% [2].

As in other countries, the prevalence of overweight children in Brazil has increased in recent decades [3–9]. Obesity is caused by an energy imbalance in which energy intake (EI) exceeds energy expenditure. However, inadequate intakes of fiber and some vitamins and minerals may persist even in children with excessive EI [10,11].

Anemia and vitamin A deficiency are public health problems, and young infants and preschool children are groups that are most at risk. National data obtained in 2006 have shown that 23.1% of children 6 to 59 mo old in urban areas had anemia (hemoglobin <11 g/dL) and 18.5% presented low serum retinol levels (<0.7 μmol/L) [1].

The Brazilian government established the National School Feeding Program for all public schools, coordinated by the ministry of education. This program is one of the most important food policies in the country and reaches nearly 45 million individuals. According to this program, meals served at kindergartens must meet at least 70% of the energy and nutrient recommendations. Moreover, sugary drinks and sweet, canned, and dehydrated products are restricted. In general, four meals are served per day (breakfast, lunch, snack, and dinner). For each city, at least one nutritionist is responsible for food quality and safety [12].

* Corresponding author. Tel.: +55-11-5575-3875; fax: +55-11-5575-3875.
E-mail address: mauro.fisberg@gmail.com (M. Fisberg).

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The aim of the present study was to estimate the nutritional risk in children 2 to 6 y old who were attending public and private nursery schools and kindergartens in different regions of Brazil.

Materials and methods

This multicenter cross-sectional study was conducted in 2007. Data were gathered on 3058 children 2 to 6 y old who were enrolled in public ($n = 54$) and private ($n = 31$) nursery schools and kindergartens in nine Brazilian cities in all regions. This study was performed by the Nutri Brazil Infancia group, which includes more than 100 professors, undergraduates, and postgraduates.

All public schools were provided with the same level of government-subsidized foods (Brazilian National School Feeding Program). In public schools, the Brazilian government is responsible for the cost of the food served, whereas in private schools, the monthly allowance paid by the family covers this cost.

The criteria for eligibility for the schools' inclusion were that the schools offered full-time attendance and the conventional distribution of meals (meaning that the portioning of foods and drinks was performed by employees who were trained to serve the same amount of food) and that children in the sample should attend school full time. Schools were not randomly selected; this study used a convenience sample. In some cities, all private schools that met the study criteria were evaluated. Furthermore, all public schools in Brazil meet the same standards for providing food (Brazilian National School Feeding Program). All schools invited ($n = 85$) agreed to participate in the study.

The number of children invited to participate was 3150; 92 children (3%) were not assessed because of the children's absence or a lack of authorization from the parents. There are no data about the group of children not involved in the research, except for age and sex, which were similar to the sample analyzed in the study.

To calculate the number of children to be interviewed in each city, the estimated prevalence of inadequate nutrient intake was set at 65%, with a margin of error of 5% and a confidence level of 95%. This calculation produced 350 children per city. Because of the absence of national data on the prevalence of inadequate nutrient intake, it was estimated that 60% to 70% of the children interviewed would present an inadequate intake of at least one nutrient.

In each city, 250 children in public schools and 100 children in private schools were evaluated. More children from public schools were enrolled in this study because most Brazilian preschoolers (approximately 65%) are enrolled in such schools, according to the ministry of education's school census (2005). In Brazil, 10.5% of children 2 to 6 y old attend nursery schools or kindergartens full time [13].

Body weight and height were measured in duplicate by previously trained interviewers using internationally accepted techniques [14]. The result was the mean between the two measurements. A portable digital balance with a precision of 100 g was used to measure body weight. Height was measured using a stadiometer with a precision of 0.1 cm. Children were unshod and wearing light clothing.

The body mass index was calculated and the nutritional status was classified in accordance with the World Health Organization (WHO) criteria (2006/2007), with the aid of Anthro 3.2.2 (2011, WHO, Geneva, Switzerland). Cutoff points for nutritional disorders were based on percentiles as follows: below the third percentile for low weight, 3.1 to 84.9 percentile for normal weight, 85 to 94.9 percentile for overweight, and above the 95th percentile for obese [15].

Foods prepared and consumed in daycare centers were evaluated by direct individual weighing (DIW), and foods eaten outside the daycare center (e.g., at home or in restaurants) in the same day were estimated from information provided in food diaries by the parents or guardians.

Three portions of food or drink were weighed on a digital balance (with a precision of 1 g), and the average weight of the portion served to all children was calculated. After meals, the remaining food on each plate or in each cup was weighed again. The quantity of food or drink consumed by each child was calculated as the difference between the average weight of the portion served and the remaining food. The DIW method reflects only what the children ate during the period when they were at school.

On the same day that the food was weighed in the daycare center, a food diary was given to the parents or guardians to record the foods consumed by the children outside school. The combination of the two dietary assessments (DIW and food form) provided the child's intake for the day.

Nutrient data analysis was conducted centrally by a group of statisticians, nutritionists, and physicians. Intake data were entered into NDS 2007 (Nutrition Data System for Research, Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, USA). Before this entry, the nutritional values of foods in NDS were compared with the values presented in the Brazilian national table of food composition [16] and the labels of Brazilian processed foods, including fortified food, to avoid errors. New foods cannot be entered in NDS. Therefore, if the difference in energy and nutrients was greater than 20%, the food was replaced with a similar food. In addition, regional food was replaced by similar food in NDS, and typical recipes were entered into NDS.

Consumption varied greatly between individuals, and a single day's intake did not correctly reflect usual intake. Dodd et al. [17] observed biases when nutritional data were not adjusted by a statistical model. Thus, a second evaluation of food consumption on a non-consecutive day was conducted in a subsample (25% of children evaluated) that was randomly selected to determine the intrapersonal variation of the nutrient intake. The methods used to assess food intake were maintained (DIW and food form).

The usual intake was estimated by adjusting for the within-person variance of the nutrient intake using the Iowa State University method [18]. The prevalence of inadequacy was calculated using PC-SIDE 1.0 (2003, Iowa State University, Ames, IA, USA), which calculated an empirical estimate and adjusted percentiles of the usual intake within each estimated average requirement (EAR) age subgroup. The software also calculated the prevalence of inadequate intake based on the subgroup EAR cutoff-point method, which estimated the proportion of the population with a usual intake below the median requirement (EAR).

The adequacy of nutrient intake was determined by considering the acceptable macronutrient distribution range and EAR values proposed by the Institute of Medicine (IOM) [19–21]. For nutrients such as fiber, sodium, vitamin K, and pantothenic acid, for which there was insufficient information to set an EAR cutoff value, the distribution of nutrients was compared with the adequate intake (AI) value. For these nutrients, we calculated the proportion of children with a usual intake equal to or above the AI value.

Because there are no IOM-recommended values for saturated fat and cholesterol intake, the values established by the WHO [22] were used. EI was compared with the estimated energy requirement, which was calculated for a standard child for each age group (at the 50th percentile for weight and height and with an active physical activity level).

The Brazilian Economic Classification Criteria were used for the economic stratification of the population [23]. The questionnaire for family economic status covered parents' schooling and the presence/absence and number of domestic appliances, vehicles, and rooms in the child's home. Families were classified into categories from A (highest) to E (lowest).

Statistical tests for proportions (chi-square test) and means (Student's t test) were used. The data were transformed into logarithmic values when the nutrient distribution did not present a normal distribution as shown by the Kolmogorov–Smirnoff test. The significance level was set to 5%. Statistical data analysis was conducted using STATA 10 (2007, StataCorp., College Station, TX, USA).

The ethics committee of the Federal University of São Paulo approved the study protocol, and all parents or other responsible adults provided written informed consent.

Results

The demographic and anthropometric variables are listed in Table 1. A larger proportion of children in public schools had low birth weight. The frequency of overweight and obese children

Table 1
Distribution of children according to demographic and body weight status

Characteristics	School				Total	
	Public		Private		n	%
	n	%	n	%		
Sex						
Male	1200	51.7	371	50.2	1571	51.4
Female	1119	48.3	368	49.8	1487	48.6
Age group (y)						
2–4	1278	55.1	425	57.5	1703	55.7
4–6	1041	44.9	314	42.5	1355	44.3
Low birth weight (<2500 g)*						
Yes	216	10.2	52	7.5	268	9.5
No	1910	89.8	644	92.5	2554	90.5
Economic level*,†						
Levels A and B (highest)	240	10.3	583	79.3	823	27.0
Level C	1215	52.4	121	16.4	1332	43.7
Levels D and E (lowest)	864	37.3	31	4.2	895	29.3
Body weight status*						
Low weight	34	1.5	12	1.7	46	1.5
Normal weight	1650	72.2	465	66.1	2115	70.7
Overweight	443	19.4	156	22.2	599	20.0
Obesity	159	6.9	71	10.0	230	7.7

* $P < 0.05$.
† Brazilian Association of Research [23].