Elsevier Editorial System(tm) for Nutrition
Manuscript Draft

Manuscript Number: NUT-D-11-00354R4

Title: NUTRITIONAL RISK AMONG BRAZILIAN CHILDREN AGED TWO TO SIX YEARS OLD: A MULTICENTER STUDY

Article Type: Original Article

Keywords: preschool children, dietary intake, schools, nutrients, consumption

Corresponding Author: Miss Milena Bueno, M.D

Corresponding Author's Institution: University of São Paulo

First Author: Milena B Bueno, PhD

Order of Authors: Milena B Bueno, PhD; Mauro Fisberg, PhD; Priscila Maximino, Ma; Guilherme R Padua, PhD; Regina M Fisberg, PhD

Abstract: Objective: To estimate the nutritional risk among children aged 2 to 6 years old. Methods: The sample consisted of 3,058 children enrolled in public and private schools in nine Brazilian cities. The assessment of nutrient intake was based on one-day data combining direct individual weighing of foods and a food diary. A second evaluation of food consumption was conducted on a subsample to estimate 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 the children under four years old and 5% of the children older than four years old consumed fiber quantities greater 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 inadequate vitamin D intake. Among children over four years old, the prevalence of inadequate calcium intake was approximately 45%. Sodium intake was greater than the upper intake level for 90% or 73% of the children younger or older than four years old, respectively. Conclusions: The prevalence of inadequate dietary intake was low for most nutrients. However, fiber, calcium and vitamin D and E intake was lower than recommended. Moreover, children consumed a large amount of sodium and saturated fat.

NUTRITIONAL RISK AMONG BRAZILIAN CHILDREN AGED TWO TO SIX YEARS OLD: A MULTICENTER STUDY

Short title: NUTRITIONAL RISK AMONG BRAZILIAN CHILDREN

PhD. Milena Bueno [1], PhD. Mauro Fisberg [2], Ma. Priscila Maximino [2], PhD. Guilherme Rodrigues de Padua [3], PhD. Regina Mara Fisberg [1]

[1] University of São Paulo / Nutrition Department.

[2] Federal University of São Paulo / Pediatric Department.

[3] Danone Research.

Authors' contributions

Milena Baptista Bueno has made substantial contributions to study design and acquisition of data, performed the statistical analysis and drafted the manuscript.

Mauro Fisberg coordinated the study, was responsible for study design and helped to draft the manuscript.

Priscila Maximino has made substantial contributions to conception and design of study, was coordinated the acquisition of data and helped to draft the manuscript.

Guilherme Rodrigues de Padua has made substantial contributions to conception and design of study and helped to draft the manuscript.

Regina Mara Fisberg has made substantial contributions to study design, analysis and interpretation of data and helped to draft the manuscript.

All authors read and approved the final manuscript.

Number of words: 4634 words

Number of figures and tables: 3

Corresponding author:

Milena Baptista Bueno

University of São Paulo / Nutrition Department.
Nossa Senhora do Rosário Street, 147. Zip Code: 13930-000. Serra Negra/ São Paulo/Brazil.
E-mail: mibueno@usp.br
phone number: (55 19) 3842-1585

Potential conflict of interest

Prof Mauro Fisberg has ocasionally served as a nutritional consultant or speaker to National Research Agency - CNPq, Sao Paulo Research Agency - FAPESP, Abbott Nutrition, Danone Research, Sanofi, Wyeth, Nestle and CDN.

No interests were appointed in this paper.

***Reviewer Suggestions**

1- Prof. Dirce Maria Lobo Marchioni
Nutrition Department / University of São Paulo
Dr. Arnaldo Av, 715 Zip Code: 01246-904, São Paulo, Brazil
Phone / Fax: +55 11 3066-7705
E-mail: marchioni@usp.br

2- Prof. Angel Gil
Department of Biochemistry and Molecular Biology, University of Granada, Granada, Spain
Campus Cartuja, Ramón Cajal 4, 18071 Granada, Spain
Phone: +34 958 248 650
Fax: +34 958 248 660
E-mail: agil@goliat.ugr.es

3- Prof. Carlos Castillo Duran
Institute of Nutrition and Food Technology, Universidad de Chile
Casilla 15138, Santiago, Chile
E-mail: ccastd@uec.inta.uchile.cl

4- Prof. Suzane Murphy
University of Hawaii
1236 Lauhala St, Suite 407 *Honolulu*
Phone: 808/564-5861
Fax: 808/586-2982
E-mail: suzanne@crch.hawaii.edu

5- Prof. Dr. Ricardo Uauy
Institute of Nutrition and Food Technology / University of Chile
Casilla 138-111, Santiago Chile
Tel: 56-2-221-4105
Fax: 56-2-221-4030
E-mail: ricardo.Uauy@lshtm.ac.uk

*Manuscript

NUTRITIONAL RISK AMONG BRAZILIAN CHILDREN AGED TWO TO SIX YEARS OLD: A MULTICENTER STUDY

ABSTRACT

Objective: To estimate the nutritional risk among children aged 2 to 6 years old. *Methods:* The sample consisted of 3,058 children enrolled in public and private schools in nine Brazilian cities. The assessment of nutrient intake was based on one-day data combining direct individual weighing of foods and a food diary. A second evaluation of food consumption was conducted on a subsample to estimate 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 the children under four years old and 5% of the children older than four years old consumed fiber quantities greater 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 inadequate vitamin D intake. Among children over four years old, the prevalence of inadequate calcium intake was approximately 45%. Sodium intake was greater than the upper intake level for 90% or 73% of the children younger or older than four years old, respectively. *Conclusions:* The prevalence of inadequate dietary intake was low for most nutrients. However, fiber, calcium and vitamin D and E intake was lower than recommended. Moreover, children consumed a large amount of sodium and saturated fat.

Keywords: preschool children, dietary intake, schools, nutrients, consumption

INTRODUCTION

The data from the Brazilian Children's and Women's National Demographic and Health research (1996-2006) showed a significant decrease in growth stunting (< -2 SD in height-for-age Z score) among children under the age of 60 months. 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 between 4% and 6% among children aged 2 to 6 years old, and the prevalence of overweight and obese (> 1 SD in BMI-for-age Z score) among children aged 5 and 6 years old was 32% (2).

As in other countries, the prevalence of overweight children in Brazil has increased in recent decades (3, 4, 5, 6, 7, 8, 9). Obesity is caused by an energy imbalance in which energy intake exceeds energy expenditure. However, inadequate intake of fiber and some vitamins and minerals may persist even in children with excessive energy intake (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 showed that 23.1% of children aged 6 to 59 months 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 70% or more 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).

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

METHODS

This multicenter cross-sectional study was conducted in 2007. Data were gathered on 3,058 children aged 2 to 6 years old who were enrolled in public (n=54 schools) and private (n=31 schools) 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 post-graduates.

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 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), as well as all children in the sample should remained at 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 due to 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 gave a total of 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 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 aged 2 to 6 years 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 final 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.

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

Foods prepared and consumed in day care centers were evaluated by direct individual weighing (DIW), and foods eaten outside of the day care center (at home or in restaurants, for example) in the same day were estimated from information provided in food diaries by 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 cup was again weighed. 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 only reflects what the children ate during the period when they were at school.

On the same day that the food was weighed in the day care center, a food diary was given to the parents or guardians to record the foods consumed by the children outside of 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 doctors. Intake data were entered into the Nutrition Data System for Research software (NDS, version 2007, Nutrition Coordinating Center (NCC), University of Minnesota, Minneapolis). Prior to this entry, the nutritional values of foods in the 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 the NDS. Therefore, if the difference in energy and nutrients was greater than 20%, the food was replaced with a similar one. Additionally, regional food was replaced by similar food in the NDS, and typical recipes were entered into the NDS software.

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 on a subsample (25% of the 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).

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 the PC-SIDE software (version 1.0, 2003, Iowa State University, Ames, Iowa), 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 cut-off point method, which estimated the proportion of the population with usual intake below the median requirement (EAR).

The adequacy of nutrient intake was determined by considering the Acceptable Macronutrient Distribution Range (AMDR) and EAR values proposed by the Institute of Medicine (IOM) (19, 20, 21). In the case of nutrients such as fiber, sodium, vitamin K and pantothenic acid, for which there was insufficient information to set an EAR cut-off value, the distribution of nutrients was compared with the Adequate Intake (AI) value. For these nutrients, we calculated the proportion of children with 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 World Health Organization (22) were used. Energy intake was compared with the estimated energy requirement (EER), which was calculated for a standard child for each age group (at the 50th percentile for weight and height and with 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 normal distribution as demonstrated by the Kolmogorov-Smirnoff test. The significance level was set to 5%. Statistical data analysis was conducted using STATA software (version 10, 2007, StataCorp., College Station, Texas, 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 shown in Table 1. A higher proportion of children in public schools had low birth weight. The frequency of overweight and obese children was 28% and was higher in private schools (32%) than in public schools (27%).

Energy intake was similar for both school types ($p > 0.05$). The average energy intake was similar to or above the average estimated requirement (Table 2).

Mean macronutrient intake was within the AMDR, except for total fat intake among children aged 2 to 3 years old (mean intake was approximately 28% of Energy Intake (EI), and the minimum AMDR value is 30%). Children under 4 years of age enrolled in private schools had a higher percentage of excessive protein intake and a lower frequency of excessive cholesterol intake. Approximately 30% of the sample obtained more than 10% of their EI from saturated fat (Table 2).

Mean intakes of dietary fiber ranged from 9.2 to 10 grams for 1,000 calories (Table 2). In general, 22% of the children under 4 years old and 5% of the children older than 4 years old consumed fiber quantities greater than the Adequate Intake (AI). A higher proportion of children under 4 years old consumed more fiber than the AI value in private schools (28.2%).

Among children over 4 years old, the only nutrient with a statistical difference according to school type was vitamin K. The proportions of children who consumed more vitamin K than the AI value were 46.9% and 53.1% for public and private schools, respectively.

The percentage of children with sodium intake higher than the upper tolerable limit (UL) was 90% among children aged 2 to 3 years old and 73%

among those aged 4 to 6 years old, regardless of the type of school they attended.

A low prevalence of inadequate intake of micronutrients for which EAR values have been established was observed (< 1%), except for calcium and vitamins D and E (Table 3).

The within- to between-variance ratio range for macronutrients was between 2.6 and 8.9. For fiber, vitamins and minerals, the range of the variance ratio was from 1.8 to 9.8. Fiber and fat had the highest variance ratios (above 6), whereas calcium, pantothenic acid and phosphorus had the lowest ratios (1.3 to 2.3).

DISCUSSION

This study evaluated the dietary intake of children aged 2 to 6 years old who attended public and private nursery schools and kindergartens in urban areas of all geographical regions of Brazil. The prevalence of inadequate dietary intake was low (< 1%) for most of the nutrients evaluated. However, consumption of fiber, calcium and vitamins D, K and E was lower than the desired levels; the prevalence of inadequate intake was greater than 20% or less than 50% of children consumed above the AI (%>AI). Most children (> 90%) consumed an excessive amount of sodium, and more than 30% consumed more saturated fat than recommended.

The prevalence of inadequate intake in this study was similar to that of a United States population of children, as reported in the National Health and Nutrition Examination Survey (NHANES), 2001-2002 (24). However, it is important to emphasize that all children in this study attended day care centers full time.

The prevalence of overweight and obesity was 28% and was higher in private (32%) schools compared to public schools (27%). Despite this finding, food intake did not differ according to body weight status (data not shown).

The frequency of children who were overweight or obese in private schools was similar to the frequency in a cross-sectional study of 566 children enrolled in private schools in São Paulo, Southeastern Brazil (25). The prevalence of obesity among preschool children in Recife, Brazil was higher in children enrolled in private school (26).

The type of school in which a child is enrolled is related to the child's household income level. The Brazilian Family Budget Survey (2008-2009) showed that the prevalence of being overweight or obese increased with income level among children aged 5 to 9 years old (2).

Previous studies investigated food intake among Brazilian children, but these studies did not show data from all regions of the country (10, 11, 25). This study is one of the first to assess the prevalence of nutrient inadequacy among preschool-age children in all regions of Brazil.

Assessing intake is extremely complex because food composition may vary widely by country and region. Nonetheless, the use of international food composition tables could present a bias in calculating regional foods. There are no available tables for all Brazilian foods and preparations. To prevent possible errors, nutritional data for all foods were carefully evaluated and discussed with local teams. A potential bias is that the NDS does not allow insertion of food items, requiring us to substitute similar foods in some situations.

Diet variability is the principal characteristic of food intake among individuals and populations. Even if individuals have stable dietary patterns, daily food intake may be characterized as a random event. Therefore, one-day records limit the quality of nutrient data. Day-to-day variability in nutrient intake can be removed using statistical methods so that the distribution only reflects the variation between individuals in the group. The distribution of the adjusted usual intake is more reliable and has less variance than the estimated distribution for a single day of dietary intake (17).

The 75th percentile of dietary fiber intake (18 g for children under four years old and 19 g for children over four years old) was lower than the AI values, which are based on the data for adults. It was shown that 14 g of fiber for each 1,000 kcal reduces the risk of coronary heart disease (19). By definition, the AI value is higher than the EAR value and is intended to cover the needs of almost the entire population. Therefore, it is expected that a high number of children will not meet the AI value, which is a challenging level even for adults.

In 2009, the government published new standards for diets in public schools due to the high prevalence of obesity among children and adolescents. According to these standards, fruits and vegetables must be offered at least three times per week (200 g/week) (12).

In this study, inadequate intake of iron and vitamin A was found in less than 1% of the study population. However, 21% of Brazilian children aged 6 to 59 months presented with anemia, and 17% of these children presented with low serum retinol levels (1). Attending school may be a protective factor for such nutrition-related problems. Among children enrolled in public day care centers in a city in northeastern Brazil, 7.7% of the children had low serum retinol (< 0.7 µmol/L), and 29.6% of the children had marginal levels (0.7 to 1.07 µmol/L) (11). In São Paulo city, Brazil, the prevalence of anemia (hemoglobin < 11 g/dL) among children from 24 to 60 months old who attended public day care centers was 20.9% (27). These rates were lower than the national data for the same age group (1).

Inadequate food consumption should be interpreted cautiously because intake is not diagnostic of an excess or lack of nutrients; it is merely an indirect indicator of nutritional status (28). Longitudinal studies that evaluate dietary intake, bioavailability and biochemical markers are indicated for better analysis of nutritional status.

As in the National Health and Nutrition Examination Survey (24), the mean sodium intake in this study was twice the AI value. The 10^{th} percentile of sodium intake was already greater than the AI value. The frequency of intake above the UL was greater than 75%. High sodium intake has been associated with childhood obesity and may increase the risk of arterial hypertension at younger ages (29).

According to the Brazilian Family Budget Survey, most sodium consumption is due to the amounts of salt used in home cooking (30). Adding salt to rice, meat, beans and bread is a Brazilian habit. In the present study, the recipes were standardized, but the amount of salt used was not the same in schools or at home. Furthermore, differences in salt addition between people were not considered, and the daily sodium intake may have been underestimated (31).

In a representative sample of children over one year old attending public day care centers in the Federal District of Brazil, vitamin E intake was below the EAR value for 53.2% of the study population, and fiber consumption was above the AI value for 1.2%. Less than 1% of the study population consumed riboflavin, vitamin C, B6, iron and zinc below the EAR values (10). Azevedo et al. (11) showed that 8.1% of children aged 1 to 3 and 21.3% of children aged 4 to 8 years old enrolled in public day care centers in Recife, Brazil consumed less vitamin A than the EAR.

Most results from the United States School Nutrition Dietary Assessment Study III (SNAD-III) among children enrolled in public elementary schools (n = 732) were similar to the results of this study. The prevalence of inadequate vitamin and mineral intake was generally low (< 3%) in the SNAD-III, except for calcium and vitamins D and E. Most American children (96%) had sodium intake greater than the upper tolerated level (32).

We conclude that the consumption of most nutrients among children enrolled in public and private day care centers in several regions of Brazil is adequate. We suggest more descriptive studies on food consumption in children between 2 and 6 years of age who are not enrolled full time in nursery schools or kindergartens, such as household surveys.

Nevertheless, some dietary changes are necessary in schools and homes. In Chile, reductions in the energy content of school meals failed to decrease obesity among children aged 2 to 5 years old (33). Physical activity and nutritional education involving teachers, parents and students should be effective at decreasing obesity rates (34, 35). Furthermore, it is important to monitor the consumption and nutritional status of children in public and private schools to evaluate these actions.

Interventions should be planned in specific populations according to several factors, such as agriculture, industrialization, access to health services, income and education level (36). Although Brazil is one of the largest countries in the world, we did not find that body weight status or food consumption differed by region. This result may be due to the country’s economic improvements, especially in less-developed regions.

CONCLUSION

In summary, children receiving the majority of their meals in the day care centers have insufficient consumption of calcium, fiber, vitamins D and E and excessive consumption of saturated fat and sodium. Modifications to diets in both settings, ie, in schools and at home, are needed. Actions toward a healthy diet involving the government, the teacher, the family and the child are also suggested.

REFERENCES

1- Brazilian Ministry of Health. National Demographic and Health of Children and Women. [http://bvsms.saude.gov.br/bvs/publicacoes/pnds_crianca_mulher.pdf]

2- Brazilian Institute of Geography and Statistics. Family Budget Survey. [http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/pof/2008_2009_encaa/pof_20082009_encaa.pdf]

3- Skelton JAl, Cook SR, Auinger P, Klein JD, Barlow SE. Prevalence and trends of severe obesity among US children and adolescents. Acad Pediatr 2009; 9(5): 322-9.

4- Batista Filho M, Souza AI, Miglioli TC, Santos MC. Anemia and obesity: a paradox of the nutritional transition in Brazil. Cad. Saúde Pública 2008; 24(Suppl 2): 247-257.

5- Canning P, Courage ML, Frizzell LM, Seifert T. Obesity in a provincial population of Canadian preschool children: differences between 1984 and 1997 birth cohorts. Int J Pediatr Obes 2007; 2(1): 51-7.

6- Jolliffe D. Extent of overweight among US children and adolescents from 1971 to 2000. Int J Obes 2004; 28:4-9.

7- Popkin BM, Conde W, Hou N, Monteiro C. Is there a lag globally in overweight trends for children compared with adults? Obesity 2006; 14(10): 1846-53.

8- Kain J; Galvan M; Taibo M; Corvalan C; Lera L; Uauy R. Evolution of the nutritional status of Chilean children from preschool to school age: anthropometric results according to the source of the data. Arch Latinoam Nutr 2010; 60(2): 155-9.

9- Stanojevic S; Kain J; Uauy R. Secular and seasonal trends in obesity in Chilean preschool children, 1996-2004. J Pediatr Gastroenterol Nutr; 47(3): 339-43, 2008.

10- Gomes RCF, Costa THMC, Schmitz BAS. Dietary assessment of pre-school children from Federal District Brazil. Arch Latinoam Nutr 2010; 60 (2): 168-174.

11- Azevedo MM, Cabral PC, Diniz AS, Fisberg M, Fisberg RM, Arruda, IKG. Vitamin A deficiency in preschool children of Recife, Northeast of Brazil. Arch Latinoam Nutr 2010; 60 (1): 36-41.

12- Brazilian Ministry of Education. The National Programme School Feeding. [http://www.fnde.gov.br/index.php/ae-legislacao].

13- Brazilian Ministry of Education. Statistical Synopsis of Basic Education. [http://www.educacenso.mec.inep.gov.br/web/guest/basica-censo-escolar-sinopse-sinopse].

14- Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign: Human Kinetics Books; 1988.

15- WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Geneva: World Health Organization, 2006.

16- Center for Studies and Research in Food. Brazilian table of food composition. 2nd edition. Campinas: NEPA-UNICAMP; 2006.

17- Dodd KW, Guenther PM, Freedman IS, Subar AF, Kipnis V, Midthune D et al. Statistical Methods for Estimating Usual Intake of Nutrients and Foods: A Review of the Theory. JADA 2006; 106: 1640-50.

18- Nusser SM, Carriquiry AL, Dood KW, Fuller WA. A semiparametric transformation approach to estimating usual daily intake distribuitions. J Am Stat Assoc 1996; 91:1440-9.

19- Institute of Medicine. Dietary Reference Intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids (macronutrients). Washington (DC): National Academy Press; 2002.

20- Institute of Medicine. Dietary Reference Intakes - Application in dietary assessment. Washington, DC: National Academy Press; 2000.

21- Institute of Medicine. Dietary Reference Intakes for Calcium and Vitamin D. Washington, DC: National Academy Press; 2010.

22- World Health Organization. Diet Nutrition and the Prevention of chronic diseases: report of a joint WHO/FAO expert consultation. WHO Technical Report Series, 916. Geneva: WHO; 2003.

23- Brazilian Association of Research. Brazil Economic Classification Criteria. 2003. [http://www.abep.org/novo/Content.aspx? ContentID=302].

24- Moshfegh A, Goldman J, Cleveland L. What We Eat in America, NHANES 2001-2002. Usual Nutrient Intakes from Food Compared to Dietary Reference Intakes. U.S.A: Department of Agriculture Research Service; 2005.

25- Simon VGN, Souza JMP, Souza SB. Breastfeeding, complementary feeding, overweight and obesity in pre-school children. Rev. Saúde Pública 2009; 43(1): 60-69.

26- Granville-Garcia AF, Menezes VA, Lira PI, Ferreira JM, Leite-Cavalcanti A. Obesity and Dental Caries among Preschool Children in Brazil. Rev. Salud Pública 2008; 10(5): 788-795.

27- Costa CA, Machado EH, Colli C, Latorre WC, Szarfarc SC. Anemia in pre-school children attending day care centers of São Paulo: perspectives of the wheat and maize flour fortification. Nutrire: J. Brazilian Soc. Food Nutr 2009; 34(1): 59-74.

28- Gibson, RS. Principles of nutritional assessment. New York: Oxford University Press; 2005.

29- Muntner P, He J, Cutler JA, Wildman RP, Whelton PK. Trends in blood pressure among children and adolescents. JAMA 2004; 291:2107-2113.

30- Sarno F, Claro RM, Levy RB, Bandoni DH, Ferreira SRG, Monteiro CA. Estimated sodium intake by the Brazilian population, 2002-2003. Rev Saúde Pública 2009, 43(2); 219-25

31- Espeland MA, Kumanyika S, Wilson AC, Reboussin DM, Easter L, Self M et al. Statistical issues in analyzing 24-hours dietary recall and 24-hours urine collection data for sodium and potassium intakes. Am J Epidemiol 2001; 153: 996-1006.

32- Clark MA, Fox MK. Nutritional quality of the diets of US Public School Children and the role of the school meal programs. J Am Diet Assoc 2009; 109 (Suppl 1): 44-56.

33- Corvalan C, Uauy R, Flores R, Kleinbaum D, Martorell R. Reductions in the energy content of meals served in the Chilean National Nursery School Council Program did not consistently decrease obesity among beneficiaries. J Nutr 2008; 138(11): 2237-43.

34- Souza EA, Barbosa Filho VC, Nogueira JAD, Azevedo Júnior MR. Physical activity and healthy eating in Brazilian students: a review of intervention programs. Cad Saude Publica 2011; 27(8): 1459-1471.

35- Kain J, Uauy R, Leyton B, Cerda R, Olivares S, Vio F. Effectiveness of a dietary and physical activity intervention to prevent obesity in school age children. Rev Med Chil 2008; 136(1): 22-30.

36- Lock K, Smith RD, Dangour AD, Keogh-Brown M, Pigatto G, Fisberg RM et al. Health, agricultural and economic effects of adoption of healthy diet recommendations. The Lancet 2010; 376: 1699-1709.

Table(s)

Table 1 – Distribution of the 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 (years)						
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 (< 2500g) [a]						
Yes	216	10.2	52	7.5	268	9.5
No	1910	89.8	644	92.5	2554	90.5
Economic level [a, b]						
Level A and B (Highest)	240	10.3	583	79.3	823	27.0
Level C	1215	52.4	121	16.4	1332	43.7
Level D e E (Lowest)	864	37.3	31	4.2	895	29.3
Body weight status [a]						
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

[a] $p<0.05$
[b] Brazilian Association of Research. Brazil. Economic Classification Criteria. 2003. [http://www.abep.org/novo/Content.aspx? ContentID=302]. (Reference 23).

Table 2 – Energy and nutrient intake and requirement by age group and type of school.

Energy/ Nutrient	2 - 3 years old in public school	2 - 3 years old in private school	4 - 6 years old in public school	4 - 6 years old in private school
Energy				
Intake (kcal)	1660 (370.8)	1640 (393.7)	1689 (364.4)	1664 (357.3)
Estimated Requirement (kcal)	1470	1470	1656	1656
Proteins				
Intake (% EI)	15.6 (2.7)	15.5 (2.8)	15.7 (2.6)	15.7 (2.8)
AMDR (% EI)	5 - 20	5 - 20	10 - 30	10 - 30
% < AMDR	--	--	0.9	0.3
% > AMDR *	2.8	5.9	0.1	0.3
Carbohydrate				
Intake (% EI)	56.2 (7.4)	55.8 (7.7)	55.8 (7.1)	55.5 (7.3)
AMDR (% EI)	45 - 65	45 – 65	45 - 65	45 – 65
% < AMDR	6.6	8.5	8.3	10.2
% > AMDR	8.1	6.1	4.2	2.6
Total fat				
Intake (% EI)	28.1 (5.8)	28.5 (5.5)	28.6 (5.7)	28.8 (5.4)
AMDR (% EI)	30 - 40	30 – 40	25 - 35	25 – 35
% < AMDR	65.1	69.4	23.4	24.1
% > AMDR	0.2	0.5	2.2	1.9
Saturated fat				
Intake (% EI)	9.9 (2.2)	9.9 (2.4)	9.8 (2.1)	9.8 (2.2)
Recommendation (% EI)	< 10	< 10	< 10	< 10
% > WHO recommendation	30.4	34.3	27.1	31.2
Cholesterol				
Intake (mg)	175.4 (75.5)	163.4 (70.7)	170.9 (73.1)	159.6 (69.9)
Recommendation (mg)	300	300	300	300
% > WHO recommendation*	6.4	3.5	4.4	2.2
Vitamin K				
Intake (µg)	58.6 (30.6)	60.1 (26.1)	61.8 (37.9)	61.8 (28.5)
AI (µg)	30	30	55	55
% > AI**	94.1	92.5	46.9	53.1
Pantothenic Acid				
Intake (mg)	4.9 (1.6)	4.6 (1.1)	4.5 (1.2)	4.5 (1.3)
AI (mg)	2	2	3	3
% > AI	99.7	98.9	89.9	90.7
Sodium				
Intake (mg)	2205 (407.3)	2122 (403.3)	2252 (404.5)	2167 (363.4)
AI (mg)	1000	1000	1200	1200
% > AI	99.1	98.4	97.4	97.7
Fibers				
Intake (g)	15.4 (3.9)	15.9 (4.1)	16.2 (4.1)	16.3 (3.8)
Intake (g/1,000 kcal)*	9.2 (2.3)	9.7 (2.4)	9.8 (2.3)	10.0 (2.3)
IOM recommendation (g/1,000 kcal)	14	14	14	14
AI (g)	19	19	25	25
% > AI *	20.4	28.2	5.1	5.6

EI: Energy intake
AMDR: Acceptable Macronutrient Distribution Range
WHO: World Health Organization
IOM: Institute of Medicine
AI: Adequate Intake
* p<0.05 in group of children aged 2 - 3 years old ** p<0.05 in group of children aged 4 - 6 years old

Table 3 – Intake, requirements and proportion of inadequate intake of nutrients by age group and type of school.

Energy/ Nutrient	2 - 3 years old in public school	2 - 3 years old in private school	4 - 6 years old in public school	4 - 6 years old in private school
Vitamin A †				
Intake (µg)	1006.1 (1127.6)	678.3 (382.2)	740.2 (776.7)	633.5 (453.2)
EAR (µg)	210	210	275	275
% inadequate	0.7	< 0.001	< 0.001	0.1
Vitamin E ‡				
Intake (mg)	5.3 (1.9)	5.6 (1.9)	5.2 (1.5)	5.4 (1.8)
EAR (mg)	5	5	6	6
% inadequate	15.1	15.7	28.9	27.7
Vitamin C				
Intake (mg)	258.9 (591.3)	475.2 (1103.5)	344.7 (1126.7)	412.6 (918.2)
EAR (mg)	13	13	22	22
% inadequate	< 0.001	< 0.001	0.7	< 0.001
Thiamine				
Intake (mg)	1.6 (1.1)	1.3 (0.5)	1.4 (0.8)	1.4 (0.8)
EAR (mg)	0.4	0.4	0.5	0.5
% inadequate	< 0.001	< 0.001	< 0.001	< 0.001
Riboflavin				
Intake (mg)	1.8 (0.5)	1.6 (0.4)	1.7 (0.4)	1.5 (0.4)
EAR (mg)	0.4	0.4	0.5	0.5
% inadequate	< 0.001	< 0.001	< 0.001	< 0.001
Niacin §				
Intake (mg)	30.2 (5.5)	27.8 (4.4)	28.6 (4.4)	27.5 (4.8)
EAR (mg)	5	5	6	6
% inadequate	< 0.001	< 0.001	< 0.001	< 0.001
Vitamin B6				
Intake (mg)	1.6 (0.6)	1.4 (0.4)	1.4 (0.4)	1.4 (0.6)
EAR (mg)	0.4	0.4	0.5	0.5
% inadequate	< 0.001	< 0.001	< 0.001	< 0.001
Vitamin D				
Intake (µg)	5.3 (3.1)	5.1 (2.8)	4.9 (3.3)	4.6 (3.5)
EAR (µg)	10	10	10	10
% inadequate	93.6	92.3	90.9	94.1
Folate				
Intake (mg)	384.1 (78.2)	362.7 (70.7)	394.5 (70.1)	377.9 (79.9)
EAR (mg)	120	120	160	160
% inadequate	< 0.001	< 0.001	< 0.001	< 0.001
Phosphorus				
Intake (mg)	1040.1 (180.3)	1009.6 (174.3)	1000.5 (159.7)	987.2 (180.9)
EAR (mg)	380	380	405	405
% inadequate	< 0.001	< 0.001	0.1	< 0.001
Calcium				
Intake (mg)	821.6 (241.7)	762.2 (2)	804.1 (244.5)	792.3 (258.6)
EAR (mg)	500	500	800	800
% inadequate	12.6	13.6	48.9	40.3

(Continuation)

Iron				
Intake (mg)	13.5 (2.9)	12.9 (2.8)	13.3 (2.6)	13.2 (3.1)
EAR (mg)	3	3	4.1	4.1
% inadequate	0.4	< 0.001	< 0.001	< 0.001
Magnesium				
Intake (mg)	264.2 (62.1)	260.4 (52.7)	254.9 (47.9)	261.9 (61.2)
EAR (mg)	65	65	110	110
% inadequate	< 0.001	< 0.001	0.1	< 0.001
Zinc				
Intake (mg)	9.8 (1.9)	9.3 (1.8)	9.4 (1.9)	9.3 (1.9)
EAR (mg)	2.5	2.5	4	4
% inadequate	< 0.001	< 0.001	< 0.001	0.3
Copper				
Intake (µg)	1736.7 (1622.2)	1297.8 (493.6)	1429.9 (1022.6)	1382.8 (618.4)
EAR (µg)	260	260	340	340
% inadequate	< 0.001	< 0.001	< 0.001	< 0.001
Selenium				
Intake (µg)	83.8 (12.5)	80.9 (13.7)	84.2 (11.9)	81.5 (11.9)
EAR (µg)	17	17	23	23
% inadequate	< 0.001	< 0.001	< 0.001	< 0.001

EAR: Estimated Adequate Recommendation
† Calculated as retinol activity equivalent
‡ Calculated as tocopherol equivalent
§ Calculated as niacin equivalents

Dear editor,

We are sending the revised manuscript entitled “Nutritional risk among Brazilian children aged two to six years old: a multicenter study”.

We made a great effort editing the manuscript aiming to improve the writing quality and make it clearer to the reader. We made substantial changes in the writing, while keeping the meaning of our results, intending to better communicate what we believe to be a relevant contribution for studies in this area.

As well, we accepted all suggestions proposed by the reviewers. The changes made in the manuscript are described below.

Sincerely,

Milena Baptista Bueno et al.

Reviewers' comments:

The submitted paper presents a study on the nutrient intakes of over 3000 Brazilian children, ages 2-6 y. The results focus on presenting nutrient intakes as compared to recommended standards. The revised paper is once more improved. Nevertheless, there are still issues regarding content and presentation that need to be rectified.

1. Title of paper: Why do the authors use the term 'dietary nutritional risk'? This is redundant. Consider removing the word 'dietary'

Suggestion accepted. (line 1)

2. Abstract: line 5: Same issue as in previous comment. Consider removing the word 'dietary'

Suggestion accepted. (line 5)

3. Methods

line 76. "The schools were selected by researchers". The authors offered an explanation as a response to the comment. A detailed explanation should be included in the revised manuscript itself. The answers to each of the following questions should appear in the paper:

Among the schools that met the study criteria, schools were not randomly selected? Was this a convenience sample? Could the authors elaborate on the sampling procedure? How many schools were invited? How many declined? How many

children were invited to participate? What was the recruitment rate? Is there any data available allowing a comparison between schools who participated and schools who did not? Is there any source of bias here?

Suggestion accepted (lines: 76- 85)

4. Conclusions: The re-write contains better information but the style and quality of English is still far from 'publishable' material. Consider re-writing this part in a more compelling fashion to showcase the importance of the study conducted. Also, avoid the frequent use of the word 'should'.

Suggestion accepted. We re-write the conclusion. (lines: 341 – 345).

EDITOR FINAL COMMENTS:

Upon reading parts of your manuscript I find that your manuscript would greatly benefit from the assistance of a native speaking English copyeditor with experience in the biological sciences. It is the Journal's policy to ensure that the quality of the scientific writing meets Nutrition's standards. Unfortunately, the copyeditors used by Elsevier are unable to undertake substantive copyediting. To assist you with finding a copyeditor to help in improving the quality of the English I have included a website. http://authors.elsevier.com/LanguageEditing.html

Nutrition offers authors a list of copyeditors with the understanding that authors may contact these individuals or services directly by mail, phone, fax or e-mail. All financial arrangements are strictly between the author and the copyeditor. Nutrition neither endorses nor recommends any specific individual or service. We look forward to hearing from you.

Suggestion accepted. The manuscript was already submitted to Elsevier Language Editing Services and American Journal Experts (AJE) in the last revisions and has been edited accorded to the suggestions. If necessary we can send the certificates.