

# Estimation of energy and macronutrient intake at home and in the kindergarten programs in preschool children

Juliana Rombaldi Bernardi,<sup>1</sup> Carla De Cezaro,<sup>2</sup> Regina Mara Fisberg,<sup>3</sup>  
Mauro Fisberg,<sup>4</sup> Márcia Regina Vitolo<sup>5</sup>

## Abstract

**Objective:** To estimate the energy and macronutrient intake at home and at all-day in the kindergarten programs in children aged 2 to 6 and to investigate differences in consumption and intake between children at public and private kindergartens.

**Methods:** This was a cross-sectional study of 362 preschool children from Caxias do Sul, Brazil. Nutritional status was assessed in terms of weight to height ratios. Foods consumed in the kindergarten were evaluated by weighing the actual foods eaten by the children and home intakes were calculated from a food diary kept by parents or guardians. Statistical analyses were performed using the Mann-Whitney U test ( $p < 0.05$ ).

**Results:** It was found that 28 children (7.7%) were overweight, 92 (25.4%) were at risk of becoming overweight and seven (1.9%) were classified as having wasting. Analysis of 24-hour nutritional intake demonstrated that 51.3% of the energy, 60.3% of the lipids and 51.6% of the proteins consumed by children were eaten at home, despite the children spending the whole day in the kindergarten programs. Preschool children at kindergartens ate greater quantities of energy ( $p = 0.001$ ), carbohydrates ( $p < 0.001$ ), and lipids ( $p = 0.04$ ) than did children at public kindergartens, but their total daily intakes were similar, irrespective of which type of kindergarten program children attended.

**Conclusions:** The findings suggest that these children eat proportionally more energy, proteins and lipids in their extra meals at home than they do in their daytime meals in the kindergarten programs. Despite the differences in intake between public and private kindergarten, daily intakes were similar.

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## Introduction

Knowledge of the infant population's nutritional situation is of fundamental importance to the evaluation and monitoring of their health status.<sup>1</sup> The pre-school age group is considered particularly vulnerable biologically and, therefore, subject to a range of nutritional conditions.<sup>2</sup>

Understanding the feeding attitudes and behavior of children is important in terms of child health. One longitudinal

study has demonstrated that infant feeding practices are maintained later on in life, since feeding patterns at 2 and 3 years of age were still present at 8 years.<sup>3</sup>

There is evidence for the existence of some type of innate, automatic mechanism that regulates the appetite, developing from the feeding preferences which determine that people like foods with sweet and savory tastes and do

1. Mestranda, Programa de Pós-Graduação em Ciências da Saúde, Universidade Federal de Ciências da Saúde de Porto Alegre (UFCSPA), Porto Alegre, RS, Brazil.
2. Nutricionista, UFCSPA, Porto Alegre, RS, Brazil.
3. Professora associada, Departamento de Nutrição, Faculdade de Saúde Pública, Universidade de São Paulo (USP), São Paulo, SP, Brazil.
4. Professor associado, Departamento de Pediatria, Universidade Federal de São Paulo (UNIFESP), São Paulo, SP, Brazil.
5. Professora adjunta, Programa de Pós-Graduação em Ciências da Saúde, UFCSPA, Porto Alegre, RS, Brazil.

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not like foods with acid and sour flavors. Notwithstanding, genetic predispositions can be modified by experiences and influenced by the environment, and so parents (and often the whole family) play a determinant role in children's development of food preferences.<sup>4,5</sup>

The growing increase in the prevalence of overweight and obesity among children is influenced by unhealthy dietary habits, which have contributed to early onset of diseases of adulthood, such as diabetes mellitus type 2 and arterial hypertension.<sup>6</sup> A recent survey of the whole of Brazil found that 7% of Brazilian children under 5 years were overweight, with variation from 6% in the North administrative region to 9% in the South, indicating that there is moderate exposure to childhood obesity in all five of the country's regions.<sup>7</sup> Changes in dietary habits, such as reduced intake of fruit and vegetables and increased intake of treats (filled biscuits, fried snacks, sweets) and sugary drinks have contributed to the increase in adiposity within this age group.<sup>8</sup>

When the environment and the family setting are unfavorable, they can provide the conditions that lead to the development of eating disorders during childhood, which, once established, may last for the whole life.<sup>4</sup>

There are now a significant and growing number of preschool children attending preschool education institutions,<sup>9</sup> and a large proportion of them, from less privileged socioeconomic strata, are cared for at public institutions.<sup>10</sup> There is therefore a need for studies that assess preschool children's nutrient intakes, taking into account both what they eat at home and what they eat when at the kindergarten, whether public or private.

The objective of this study was to estimate the energy and macronutrient intake at home and at all-day in the kindergarten programs among children aged 2 to 6 and to investigate differences in intakes between children at public and private kindergarten programs.

## Methods

This cross-sectional study, which was undertaken in the town of Caxias do Sul, RS, in the South of Brazil, is part of a larger multicenter project called "Nutri Brasil Infância". The primary objective of the project is to evaluate the prevalence of unhealthy nutrient intakes among Brazilian children and there are participating centers in Manaus, AM, Natal, RN, Recife, PE, Brasília, DF, Cuiabá, MT, Rio de Janeiro, RJ, Belo Horizonte, MG and São Paulo, SP.

The data for Caxias do Sul were collected during 2007 by two nutritionist and 10 undergraduate Nutrition students at nine kindergartens in the town.

The study recruited children of both sexes, aged 2 to 6 years, and who preferably spent the whole day at institutions that provided a midday meal served in the conventional

manner, i.e. the workers serving the food set the portion sizes. Therefore, the three largest public kindergartens in the city and six private ones that met the inclusion criteria were invited to take part in the study. Some of the participating schools are located in the central zone of the town and some in the suburbs.

The initial sample size calculation for how many children would be interviewed in each town was based on the primary objective of the parent study. Thus, for each town it was decided to assess a minimum of 250 children attending public kindergartens and 100 children enrolled at private kindergartens, considering an estimated prevalence of unhealthy nutrient intakes of 65%, a margin of error of 5% and a 95% confidence interval (95%CI). For the sub-study described here, however, bearing in mind its objective and the absence of similar national or regional studies, study power was shown to be greater than 90% for the initial sample calculation, with an estimated 10% difference in energy and macronutrient intake between children at private kindergartens and those at public kindergartens. The fraction of interviews conducted at private and public institutions was proportional to the number of children enrolled at day care and kindergarten in each town, according to the Brazilian Ministry of Education's 2005 census.

Children who were absent due to illness were excluded and so were kindergartens that had self-service canteens. The socioeconomic profile of the children was traced by administering a questionnaire developed by the Brazilian Association of Market Research Companies (ABEP - Associação Brasileira de Empresas de Pesquisa).<sup>11</sup>

An anthropometric assessment was carried out measuring children's weight and height. Weight was measured in kg using a Plena® digital balance placed on a flat surface and with a maximum capacity of 150 kg and accuracy of 100 g. Children were weighed standing, unshod and wearing light clothing. Height was measured with a Secca® anthropometer fixed to a wall at 90 degrees to the floor. Children were measured standing as straight as possible, unshod and with their eyes and ears aligned horizontally. The same measuring instruments and methods were used at all of the kindergartens analyzed.

Nutritional status was classified according to cutoff points for the weight for height z score (W/H).<sup>12</sup> Wasting was defined as a z score of less than -2 standard deviations (SD), and overweight was classified as a z score greater than +2 SD.<sup>13</sup> A cutoff at z score > +1 SD was chosen as indicative of risk of overweight.

## Assessment of dietary intakes

One day's dietary intake was evaluated for each child and, in order to adjust the distribution of habitual energy and macronutrient intake, the evaluation was replicated for 25% of the sample, chosen at random. A method

developed by Nusser et al.<sup>14</sup> was employed to calculate variance components and apply them to estimation of habitual intakes.

Foods prepared and consumed at the kindergartens were evaluated by direct individual weighing (DIW), and foods eaten at home were estimated from information provided in food diaries kept by parents or guardians. The DIW method consists of taking the mean weight of each food served to the child followed by subtracting the weight of what remained uneaten on the plate. The food diary is filled in using specially-designed forms, providing details of all food and drink consumed out of kindergarten hours, including those consumed away from home.

At the schools, all foods offered were weighed three times and the mean for each food was calculated. After the children had finished their meals, the remaining food left by each child was weighed and subtracted from the mean weight calculated previously. The DIW method only reflects what the children ate during the period they were at the school, i.e. during part of the morning and the afternoon.

On the same day that the food was weighed, a specially-designed form was given to the parents or guardians for them to fill in the data on what foods the children had eaten outside of kindergarten hours, described in terms of household measurements and with the brand names of commercial products listed. Parents were requested to record all foods eaten, including those consumed away from home, for example, in restaurants. The completed food diaries were returned to the school on the following day and underwent nutritional analysis, with any ambiguities being resolved by telephone or via contact made through the school. The food diary recorded what each child ate during the time they were not at the school, during part of the morning, the evening and at night. The two dietary assessments combined (the DIW and the food diary) therefore provided the children's nutritional intake for an entire day.

The following definitions were adopted for qualitative analysis of the dietary assessments: dairy products were defined as foods such as milk (added to chocolate drinks, sugar or flours), yoghurt, cheese, milk fudge and cream. Foods rich in fat and/or sugar included: chewing gum, candy, chocolate, biscuits with fillings, sweets and fast food snacks. Foods such as rice, beans, meat and pasta were defined as "home foods".

The nutritional value of the foods was calculated using Nutrition Data System software (NDS, version 2007, Nutrition Coordinating Center, University of Minnesota, Minneapolis).

### **Statistical analyses**

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 11.0. The descriptive statistical analysis employed simple frequencies and

percentages for distributions by age, sex and economic class. Continuous variables were tested using the Mann-Whitney U test. The significance level was set at 5% ( $p < 0.05$ ) for a 95%CI. In order to standardize presentation of the data, figures are given as medians and interquartile ranges.

The W/H z score for children under 5 was calculated using the World Health Organization's program<sup>15</sup> and Epi-Info<sup>16</sup> was used for those over 5.

### **Ethical considerations**

This project was approved by the Research Ethics Committee at the Universidade Federal de Ciências da Saúde de Porto Alegre (UFCSPA), Porto Alegre, state of Rio Grande do Sul, Brazil, under protocol number 532/07, and by the Research Ethics Committee at the Hospital de São Paulo, São Paulo, SP, under protocol number 0617/07.

Free and informed consent forms were signed by the parents or guardians of all children allowing them to participate.

### **Results**

A total of 365 preschool children were evaluated from nine kindergartens in Caxias do Sul, RS, although three children were excluded because their dietary information was not complete. The 362 preschool children of both sexes how were analyzed broke down to 28.7% ( $n = 104$ ) from private kindergartens and 71.3% ( $n = 258$ ) from public kindergartens.

The mean age of the children analyzed was approximately 4 years ( $4.3 \pm 1.1$ ), varying from 2 to 6.4 years, and 46% (167 children) of the sample were boys.

The anthropometric assessment indicated that 28 (7.7%) children were overweight, 92 (25.4%) were at risk of overweight and just seven (1.9%) were underweight for their height. Analysis of all children with some degree of overweight (33.1%) by type of school (private/public) did not detect a statistically significant difference ( $p = 0.10$ ).

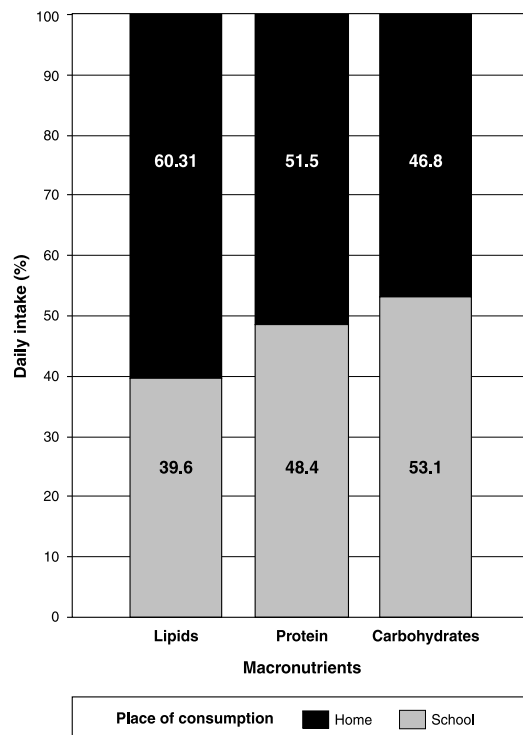
When the distribution by economic class was analyzed, approximately 83.0% of the children at private kindergartens were from the highest economic classes, such as A1 ( $n = 1$ ), A2 ( $n = 28$ ), B1 ( $n = 27$ ) and B2 ( $n = 21$ ). In contrast, 83% of the children at public kindergartens were from the lowest economic classes, such as C ( $n = 170$ ) and D ( $n = 46$ ). None of the children at the public kindergartens were from economic class A1, and just two (1.9%) children at private kindergartens were from class D. There were no children in this study from economic class E.

Table 1 contains the descriptive data on energy, carbohydrate, protein and lipid intakes in the kindergarten programs and at home, separately, in addition to the daily totals for energy and macronutrients. Analyzing the

percentage of macronutrients consumed in the kindergarten programs and at home as proportions of the total for the day (Figure 1), it was observed that the children ate greater quantities of foods containing energy, lipids and proteins when they were at home (51.3 vs. 48.7; 60.3 vs. 39.7; and 51.6 vs. 48.4%, respectively), despite their main meals being served in the kindergarten. Only carbohydrate intake was slightly greater in the kindergarten programs than at home (53.1 vs. 46.9%).

Supplementary analysis, by means of evaluation of the children's home food diaries, found that 86.8% (n = 317) ate dairy products. The second most eaten food group was those rich in fat and/or sugar (55.3%; n = 202). Foods classified as "home foods" were the third most prevalent (53.7%; n = 196).

Evaluation of the macronutrients eaten in the kindergarten programs indicated that children at private kindergartens ate more energy (p = 0.001), carbohydrates (p < 0.001) and lipids (p = 0.04) in comparison with those at public kindergartens (Table 2). There was no statistical difference between children at private and public kindergartens in terms of total daily energy or macronutrient intakes. These data are given in more detail in Table 3.



**Figure 1 -** Percentages of carbohydrate, protein and lipid intakes consumed at school and at home

**Table 1 -** Daily total energy and macronutrient intakes and figures broken down by place of consumption, home or school

Nutrients	Intake (median ± IQR)		
	Home	School	Total
Energy (kcal)	760.27±295.83	747.11±268.60	1523.61±367.04
Carbohydrates (g)	97.59±40.13	114.92±45.41	214.57±59.82
Protein (g)	28.59±14.05	28.12±10.51	57.29±16.45
Lipids (g)	28.80±14.11	18.64±7.62	48.65±13.96

IQR = interquartile range.

**Table 2 -** Comparison of energy and macronutrient intakes at private and public kindergartens

Nutrients	Consumption in the kindergarten (median ± IQR)		
	Public kindergarten	Private kindergarten	p*
Energy (kcal)	719.52±258.93	813.71±265.51	0.001 <sup>†</sup>
Carbohydrates (g)	109.01±44.33	125.65±47.48	< 0.001 <sup>†</sup>
Protein (g)	27.72±9.98	28.76±11.78	0.58
Lipids (g)	18.44±6.88	20.47±9.67	0.04 <sup>†</sup>

IQR = interquartile range.

\* p value according to the Mann-Whitney U test.

<sup>†</sup> p is significant at p < 0.05.

**Table 3** - Comparison of energy and macronutrient intakes for whole day

Nutrients	Day's consumption (median $\pm$ IQR)		p*
	Public kindergarten	Private kindergarten	
Energy (kcal)	1510.07 ( $\pm$ 341.58)	1585.13 ( $\pm$ 409.59)	0.30
Carbohydrates (g)	213.45 ( $\pm$ 55.77)	223.27 ( $\pm$ 64.61)	0.18
Protein (g)	57.29 ( $\pm$ 17.11)	57.49 ( $\pm$ 15.14)	0.85
Lipids (g)	48.54 ( $\pm$ 13.75)	49.18 ( $\pm$ 14.64)	0.91

IQR = interquartile range.

\* p value according to the Mann-Whitney U test.

## Discussion

This is the first study to have investigated the proportions of 24 hours' dietary intake of preschool children consumed at home and in the kindergarten programs. The results found highlight the importance of educating parents about the food they give their children before and after the kindergarten.

Kindergarten programs have a responsibility to provide food of good nutritional quality and to encourage children to eat a range of different foods. However, if children are eating foods with a high energy density at home, before or after kindergarten hours, they will compensate by eating less of the foods with a high nutritional density given to them at school. This observation is borne out by authors who explain that children prefer foods with a high energy density because these meet their basic physiological requirements more quickly and with less effort.<sup>17</sup> In our study it was observed that all of the children consumed excessive quantities of milk and milk-based products when at home. This means that the children eat less of the healthy foods, especially those provided by kindergarten programs as their main meals, such as lunch and afternoon tea. This behavior may involve a risk of obesity and the situation that has been unfolding among preschool children in Brazil over recent years is one of an increasing prevalence of overweight and a reduced prevalence of underweight.<sup>7,18,19</sup> The data reported here support those findings and suggest that the dietary behavior observed may at least in part explain the prevalence of overweight.

Since dietary habits are fixed early on in life, approximately between 2 and 3 years of age,<sup>3</sup> the whole of society, parents, educators and health professionals should be concerned not only with children's nutrition, but also with the dietary habits they are acquiring, since these habits will be the main determinants of their nutritional intake later in life.<sup>20</sup> Data from the Feeding Infants and Toddlers

Study (FITS) show that small children are not eating fruit and vegetables and consuming excessive sugary drinks, sweet foods and high-energy savory snacks, all of which are being introduced prematurely into the diet.<sup>21</sup>

Adults are responsible for their own dietary choices, which is not the case with young children who are dependent on their parents and other carers to provide the food they need for their growth and development.<sup>22</sup> Therefore, children's attitudes are often a reflection of the family environment in which they live.<sup>4</sup> Restricting children's access to foods rich in fat and sugar may be a simple method of promoting dietary habits that are compatible with current recommendations, but it may also lead to the opposite consequence if such restrictions increases children's interest in and desire for such foods.<sup>23</sup> Therefore, the best method of ensuring healthy nutrition is to create a positive environment to promote the development of healthy dietary behavior, because positive experiences during a meal may induce a child to prefer certain foods, whereas unpleasant experiences can impact negatively on food choices.<sup>4</sup> Environmental factors therefore play an important role in children's dietary profiles and parents should receive guidance on what foods should be given at home,<sup>24</sup> even when the child is eating the majority of their meals in the kindergarten programs.

The Brazilian Constitution guarantees the right to preschool education to children under six years of age at nursery schools and kindergartens.<sup>25</sup> However, the insufficient number of public places and the high cost of private places means that families' choices are limited.<sup>26</sup> In this study, both positive and negative aspects were observed at the different types of preschool education institution. Children enrolled at private kindergartens consumed significantly greater quantities of foods containing carbohydrates and lipids and, consequently, energy when in the kindergarten than did children at public kindergartens, presumably because of differences in the menus offered

at the different schools. Nevertheless, when the full day's dietary intakes were compared, the difference was not significant. This is compatible with the similar prevalence of overweight at the different types of kindergarten programs, which also agrees with the greater consumption of energy at home by children from public kindergartens. This difference was not statistically significant, probably due to the great variation in intake, meaning that larger subset samples are needed.

The results of this study allow the following conclusions to be drawn: the children consumed proportionally greater quantities of energy and lipids in extra meals eaten at home than in daily meals given them in the kindergarten, at which they spend at least 8 hours a day; and, despite the differences in intake at public and private kindergartens, total daily intakes were similar for children at both types of kindergarten programs.

Since this is a cross-sectional study it does not make it possible to establish relationships of causality or to perform follow-up analyses. Nevertheless, it does encourage the implementation of intervention studies providing parents with objective and practical nutritional guidelines in order to improve their children's dietary intakes at home and, therefore, improve their appetite and increase their dietary intakes when in the kindergarten programs. School principals and educators and also the health professionals providing basic care all play an important role in this process.

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Correspondence:  
 Mauro Fisberg  
 Nutrociência Ass. em Nutrologia SC Ltda.  
 Rua Borges Lagoa, 1080 cj 603  
 CEP 04038-002 - São Paulo, SP - Brazil  
 Tel.: +55 (11) 5575.3875  
 E-mail: mauro.fisberg@gmail.com