

## ORIGINAL ARTICLE

# Diet quality of preschool children aged 2 to 5 years living in the urban area of Pelotas, Brazil



Katharine Konrad Leal\*, Bruna Celestino Schneider,  
Giovanny Vinicius Araújo França, Denise Petrucci Gigante, Iná dos Santos,  
Maria Cecília Formoso Assunção

Universidade Federal de Pelotas (UFPeL), Pelotas, RS, Brazil

Received 16 June 2014; accepted 17 September 2014

Available online 28 June 2015

### KEYWORDS

Preschool;  
Indexes;  
Food habits;  
Diet

### Abstract

**Objective:** To assess the dietary quality of preschool children in the urban area of Pelotas, Rio Grande do Sul, southern Brazil.

**Methods:** Dietary quality was measured according to the Healthy Eating Index (HEI), adapted to Brazil. Food consumption was obtained using the Food Frequency Questionnaire (FFQ). The index score was obtained by a score, ranging from 0 to 100, distributed in 13 food groups that characterize different components of a healthy diet. The better the quality of the diet, the closer the score is to 100.

**Results:** Dietary quality was evaluated in 556 preschoolers. The mean HEI score value was 74.4 points, indicating that diets need improvement. The mean scores were significantly higher among girls and in children from families with income between one and less than three minimum wages.

**Conclusions:** The children showed vegetable consumption below the recommended level, while foods of the food group of oils and fats, as well as the group of sugars, candies, chocolates and snacks, were consumed in excess. It is important to reinforce guidelines to promote healthier eating habits, which may persist later in life.

© 2015 Sociedade de Pediatria de São Paulo. Published by Elsevier Editora Ltda. All rights reserved.

### PALAVRAS-CHAVE

Pré-escolar;  
Índices;  
Hábitos alimentares;  
Dieta

### Qualidade da dieta de pré-escolares de 2 a 5 anos residentes na área urbana da cidade de Pelotas, RS

### Resumo

**Objetivo:** Avaliar a qualidade da dieta de pré-escolares residentes na área urbana da cidade de Pelotas, Rio Grande do Sul, Brasil.

DOI of original article: <http://dx.doi.org/10.1016/j.rpped.2015.05.002>

\* Corresponding author.

E-mail: [katharineleal@hotmail.com](mailto:katharineleal@hotmail.com) (K.K. Leal).

**Métodos:** A qualidade da dieta foi avaliada de acordo com o Índice de Alimentação Saudável (IAS), adaptado para o Brasil. O consumo alimentar foi medido por meio de Questionário de Frequência Alimentar. O escore do índice foi obtido por uma pontuação distribuída em 13 grupos alimentares, que caracterizam diferentes aspectos de uma dieta saudável, variação de 0 a 100 pontos. Quanto mais próximo de 100, melhor será a qualidade da dieta.

**Resultados:** A qualidade da dieta foi avaliada em 556 pré-escolares. O valor médio do escore do IAS foi de 74,4 pontos. Isso indica que as dietas necessitam ser melhoradas. As médias dos escores foram significativamente maiores entre as meninas e entre crianças provenientes de famílias com renda familiar entre um e menos de três salários mínimos mensais.

**Conclusões:** As crianças apresentaram consumo de verduras e legumes abaixo da recomendação, enquanto os alimentos do grupo dos óleos e gorduras, bem como do grupo dos açúcares, balas, chocolates e salgadinhos, foram consumidos em excesso. É importante reforçar orientações para promover um hábito alimentar mais saudável, que poderá perdurar em etapas posteriores da vida.

© 2015 Sociedade de Pediatria de São Paulo. Publicado por Elsevier Editora Ltda. Todos os direitos reservados.

## Introduction

Adequate nutrition in childhood has an impact on the child's growth and physiological development, health and welfare. At this phase, a balanced diet becomes very important, as they are going through a phase of growth, development, and formation of personality and eating habits.<sup>1</sup>

Parents influence the development of their children's eating habits, as they are responsible for the process of introducing foods, the dietary pattern offered to the child and their attitudes toward food.<sup>2</sup> Children's food preferences are learned from repeated experiences during the consumption of certain foods. These habits have an effect on their food intake, subject to the physiological consequences and the social context in which the child lives. In this phase they prefer high-calorie foods, as they bring greater satiety and ensure the necessary energy supply for basic needs.<sup>3</sup>

In the last few decades, the population's food quality has been evaluated through dietary indexes. These consist of a food analysis method aiming to determine its quality through one or more parameters simultaneously: adequate nutrient intake, number of servings consumed by each food group and the amount of different food items present in the diet.<sup>4</sup> Most of these indices were developed in the United States, and are being adapted and used in other countries.<sup>5</sup> Among the most often cited in the literature are: nutrient content,<sup>6</sup> dietary variety score,<sup>7</sup> the Household Dietary Diversity Score (HDDS),<sup>8</sup> the Diet Quality Index (DQI),<sup>4</sup> the Healthy Eating Index (HEI),<sup>9</sup> and the revised Diet Quality Index.<sup>10</sup>

The HEI was created in 1995 by the US Department of Agriculture, with the goal of building a global diet quality index that would incorporate the nutritional needs and dietary guidelines for US consumers in a single measure.<sup>11</sup> The HEI consists of ten items, which are based on different aspects of a healthy diet, and was adapted to Brazil based on the Dietary Guidelines for the Brazilian Population (DAPBs)<sup>12</sup> by Domene et al.<sup>13</sup> for use with preschool children aged two to six years.

This study evaluates the dietary quality of a sample of preschoolers in Pelotas, state of Rio Grande do Sul, Brazil, using the HEI.

## Method

This study uses data on the diet of preschoolers participating in a population-based cross-sectional study, which consisted as the fourth assessment of a time series aiming to assess the effect of iron fortification of wheat flour and corn meal on anemia in children aged <six years, carried out in Pelotas, Brazil in 2008.<sup>14</sup> Methodological data are described in a previous publication.<sup>14</sup>

The interview was carried out by trained nutritionists, with the child's mother or guardian, using a pre-coded questionnaire. Demographic variables were collected (gender and age of the children in months) as well as socio-economic (family income in minimum wages), maternal schooling (in years) and dietary variables. Food frequency questionnaire (FFQ), a quantitative tool with 56 food items distributed in cereals, legumes, vegetables, fruits, dairy products, meat and meat products, fats, sugars and other foods, with a recall period of one year, was developed for the study, and used to assess food consumption and the dietary quality. The FFQ was validated using three 24-h recalls. The de-attenuated Pearson's correlation coefficients were all equal to or greater than 0.50 for macronutrients calcium, iron, sodium, vitamin C, cholesterol and saturated fat (unpublished data).

Dietary quality was analyzed using the Healthy Eating Index (HEI) proposed by Domene et al.<sup>13</sup> Thus, a score was generated from the points obtained for the 13 components. The first eight were related to the food groups: (1) cereals; (2) vegetables; (3) fruits and fruit juices; (4) milk and dairy products; (5) meat and eggs; (6) legumes; (7) oils and fats, and (8) sugars, candies, chocolates and snacks. These eight components contribute with 50% of the total score. To adapt the HEI, which originally classifies the food into

five dietary groups, a proportional reduction in the sum of the possible number of points was performed from 80 to 50. The other five components, which contributed the remaining 50% of the score, were: (9) total fat; (10) saturated fat; (11) cholesterol; (12) sodium, and (13) diet variety.

To score components 1–8, the ideal number of servings to be consumed daily was determined by the ratio between the energy requirements of the age range and the number of servings suggested by the Dietary Guidelines for the Brazilian Population (DAPBs),<sup>12</sup> which have been adapted according to the age and the recommendations of the Brazilian Society of Pediatrics (SBP).<sup>15</sup> Each food consumed received a score according to the size of the consumed serving, as shown in Table 1. In this chart, some components are repeated, as some recommendations are different for boys and girls.

The score of components 9–13 required no adjustments and was carried out using the same parameters indicated by Bowman et al.<sup>9</sup> For the intake of total fat and saturated fat, the score criterion used was the percentage of daily energy provided by these nutrients. The maximum score (10) was attributed to values  $\leq 30\%$  for total and  $10\%$  for saturated fat, while for the minimum score criterion (zero), the values of  $45\%$  and  $15\%$  were used for total and saturated fat, respectively. For cholesterol and sodium intake, the maximum score of 10 was attributed to those who consumed  $300\text{mg}$  or less of cholesterol and  $2400\text{mg}$  or less of sodium per day. The minimum score of zero was given to those who consumed  $450\text{mg}$  or more of cholesterol and  $4800\text{mg}$  or more of sodium per day. Finally, for the scoring of diet variety, only foods from the first six groups were considered, excluding food classified as oil and fats or as candy and snacks. The maximum score of 10 was obtained when the child had consumed at least a half serving of eight or more different types of food in a day. A minimum score of zero was attributed when the child had consumed three or less types of food in a day. Intermediate values were attributed to all evaluated components, as shown in Table 1.

HEI final score was attained by adding the 13 assessed components, with  $50\%$  of the score being obtained from components 1–8, and the other half from components 9–13. When scoring, the following intervals were considered: values  $\geq 80$  points characterized the diet as adequate; between 51 and 80 points, as needing improvement, and a score  $< 51$  characterized a poor diet.<sup>9</sup>

Demographic, socioeconomic and frequency of food intake data were processed through double entry with consistency checking of information using Epi Info 6.0 software program. Foods and food preparations recorded in the food frequency questionnaires (FFQs) were analyzed for their nutritional composition using the HHHQ program – DietSys Analysis Software, release 4.02, National Cancer Institute, 1999. This information was analyzed using Stata software program, release 11.1. Descriptive analyses were performed to characterize the sample. Student's *t* test was used to compare HEI means by gender. Finally, we carried out bivariate analyses between exposures and HEI means by simple linear regression.

All analyses considered a value of  $p < 0.05$  for statistical significance. Sample variation was shown as standard error, as the analysis took into account the sampling design (svy command in Stata software program, release 11.1.), considering that the sampling process was carried out in multiple

stages.<sup>14</sup> The standard error of the mean is obtained by dividing the sample standard deviation by the square root of the number of observations, and it indicates, similar to the standard deviation, the inaccuracy associated with the estimation of means.

The children's parents or guardians gave their written consent before the collection of information. This study was submitted to the Institutional Review Board of the Universidade Federal de Pelotas, and was approved under submission number 011/08.

## Results

The original study assessed 799 children aged zero to five years. These accounted for  $94\%$  of the initially calculated sample, which yielded a low percentage of losses and refusals.<sup>14</sup> After excluding 243 children younger than two years old, the diet of 556 children aged 2–5 years was evaluated. The mean age was four years ( $SE=0.5$ ); most of them were males ( $53.6\%$ ), Caucasians ( $75.8\%$ ), whose mothers had nine or more years of schooling ( $44.9\%$ ), and whose families had a monthly income between one and  $< 3$  minimum wages ( $48.4\%$ ), as shown in Table 2.

Foods less often consumed by the preschoolers were vegetables/green vegetables and cereals, with respectively  $45.7\%$  and  $64.0\%$  of children having consumed the recommended daily amount. The most often consumed were those belonging to the group of sweets, sugars and snacks, being consumed by  $99.6\%$  of children. Foods from the group of oils and fats had a higher consumption than that recommended by  $74.3\%$  of children. Foods from the group of meat and eggs, legumes, fruits, milk and dairy products showed an adequate intake, ranging between  $81.1\%$  and  $89.2\%$  (Fig. 1).

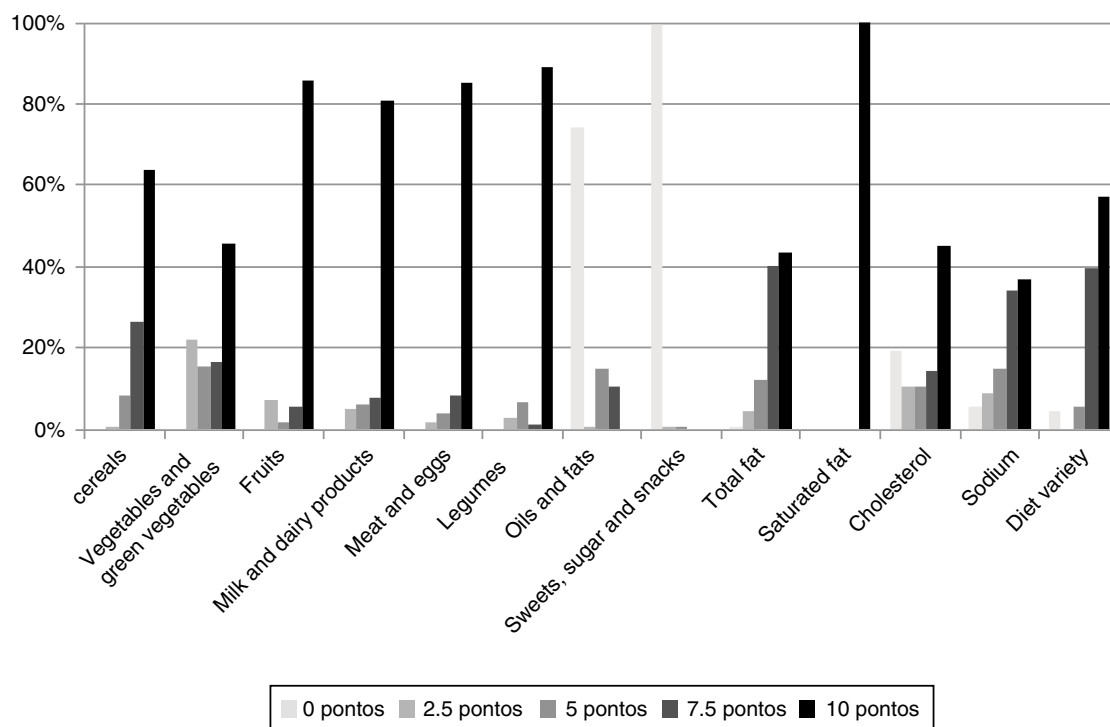
A high score was observed in the evaluation regarding components 9–12 (total fat, saturated fat, cholesterol and sodium), with  $100\%$  of children reaching the score of 10 in saturated fat consumption. Regarding the diet variety component,  $57.4\%$  of the children consumed eight or more different types of foods in one day (Fig. 1).

Table 3 shows the mean score for each of the 13 components of the HEI according to the children's gender. Of the 10 attainable points in each of the components, we observed that girls achieved higher scores than boys for the consumption of vegetables and green vegetables ( $8.0$  vs.  $6.4$ ), fruits ( $9.5$  vs.  $9.0$ ), milk and dairy products ( $9.4$  vs.  $8.9$ ), legumes ( $9.7$  vs.  $9.2$ ), and total fat ( $8.3$  vs.  $7.7$ ).

Of the maximum 100 attainable points in the HEI score, the mean score achieved by the assessed children was  $74.4$  points ( $SE=0.4$ ), being higher among girls than among boys ( $75.4$ ;  $SE=0.6$  vs.  $73.4$ ;  $SE=0.5$ , respectively). Regarding family income, children from families with income between 1 and 2.99 minimum wages had a higher mean score ( $75.1$ ,  $SE=0.8$ ) compared to those whose family income was higher or lower than 1 minimum wage. Ethnicity, age and maternal schooling showed no statistically significant association with the mean scores, as shown in Table 4.

**Table 1** Criteria for the Healthy Eating Index (HEI) score in preschool children according to components 1–13.

Component/food	Recommendation		Score				
	Girls	Boys	0	2,5	5,0	7,5	10
1. Cereals	4	4	<1	1 serving	2 servings	3 servings	4 servings
2. Vegetables and green vegetables	0.5		0	>0 and <0.25 serving	0.25 serving	>0.25 and <0.5 serving	0.5 serving
2. Vegetables and green vegetables		1	<0.25	0.25 serving	0.5 serving	0.75 serving	1 serving
3. Fruit and fruit juice	1		<0.25	0.25 serving	0.5 serving	0.75 serving	1 serving
3. Fruit and fruit juice		2	<0.5	0.5 serving	1 serving	1.5 serving	2 servings
4. Milk and dairy products	1		<0.25	0.25 serving	0.5 serving	0.75 serving	1 serving
4. Milk and dairy products		2	<0.5	0.5 serving	1 serving	1.5 serving	2 servings
5. Meat and eggs	1	1	<0.25	0.25 serving	0.5 serving	0.75 serving	1 serving
6. Legumes	0.5		0	>0 and <0.25 serving	0.25 serving	>0.25 and <0.5 serving	0.5 serving
6. Legumes		1	<0.25	0.25 serving	0.5 serving	0.75 serving	1 serving
7. Oils and fats	1	1	<0.25	0.25 serving	0.5 serving	0.75 serving	1 serving
8. Sugars, candy, chocolates and snacks	1	1	<0.25	0.25 serving	0.5 serving	0.75 serving	1 serving
9. Total fat	30%	30%	45% or more	>37.5% and <45%	37.5%	>30% and <37.5%	30% or less
10. Saturated fat	10%	10%	15% or more	>12.5% and <15%	12.5%	>10% and <12.5%	10% or less
11. Cholesterol	300mg	300mg	450mg or more	>375mg and <450mg	375mg	>300mg and <375mg	300mg or less
12. Sodium	2400mg	2400mg	4800mg or more	>3600mg and <4800mg	3600mg	>2400mg and <3600mg	2400mg or less
13. Diet variety	8 or + different types of foods	8 or + different types of foods	3 or less different types of different foods in a day	4 or 5 different types of different foods in a day	6 different types of different foods in a day	7 different types of different foods in a day	8 or more different types of different foods in a day



**Figure 1** Frequency of consumption of components 1–13 according to the categorized HEI score of the preschoolers.

**Table 2** Description of the sample of preschool children by gender, age, ethnicity, family income and maternal education.

Variable	<i>n</i>	%
<i>Gender</i>		
Female	258	46.4
Male	298	53.6
<i>Age (years)</i>		
2	116	20.9
3	140	25.2
4	159	28.6
5	141	25.4
<i>Ethnicity</i>		
Caucasian	420	75.8
Non-Caucasian	134	24.2
<i>Family income (minimum wages)</i>		
<1	134	24.2
1–2.99	268	48.4
3–5.99	99	17.9
6 or more	53	9.6
<i>Maternal schooling (years)</i>		
0–4	87	15.7
5–8	218	39.4
9 or more	249	44.9

## Discussion

This population-based study, carried out in a medium-sized city of southern Brazil, showed that the children's diet needs improvement. A similar result was found by Domene et al.<sup>13</sup>

in a study that assessed the diet of 94 preschoolers aged 2–6 years living in poverty-stricken areas in the city of Campinas, where 70% of children had their diets classified between 51 and 80 points.

Approximately two-thirds of the children (64%) achieved the maximum score in the group of cereals, eating four servings a day. Barbosa et al.<sup>16</sup> in a study with children aged 2–3 years attending a nonprofit day care center in the island of Paquetá, state of Rio de Janeiro, found that only 20% of them consumed cereals adequately.

Regarding the consumption of vegetables and green vegetables, only 45.7% of the children consumed the recommended servings established in the HEI, which are two servings for boys and one serving for girls. The opposite was observed for adequate fruit consumption (2 servings a day for boys and one for girls), as 86% of the children consumed the recommended servings. Fruits, vegetables and green vegetables are sources of dietary fiber, with a positive impact on body weight, blood glucose levels and concentrations of blood lipids, in addition to increasing the fecal bolus, preventing intestinal constipation,<sup>17</sup> and being excellent sources of vitamins and minerals.<sup>18</sup>

A considerable consumption of milk and dairy products was observed, as 81.1% of children reached the recommendation for this group, which are 2 daily servings for boys and one for girls. This finding corroborates the study carried out by Valente et al.<sup>19</sup> with 39 preschool children from a day care center in Santa Maria, state of Rio Grande do Sul, in which the authors found that 92.3% of the children consumed milk one or more times a day. Milk is very often present in the diet of the assessed children's age range and a great source of calcium. However, it is necessary to consider the fact that many children substitute important meals, such as breakfast and lunch, for a bottle of milk.<sup>3,17</sup>

**Table 3** Mean HEI score for each component according to preschoolers' gender.

HEI components	Boys (n=298)	Girls (n=258)	p-value <sup>a</sup>
1. Cereals	8.9	8.8	0.61
2. Vegetables and green vegetables	6.4	8.0	<0.001
3. Fruits	9.0	9.5	0.002
4. Milk and dairy products	8.9	9.4	0.030
5. Meat and eggs	9.3	9.5	0.22
6. Legumes	9.2	9.7	0.003
7. Oils and fats	1.5	1.5	0.98
8. Sugars, candy, chocolates and snacks	<1.0	<1.0	0.62
9. Total fat (%TEV)	7.7	8.3	0.005
10. Saturated fat (%TEV)	10	10	–
11. Cholesterol (mg)	6.3	6.6	0.34
12. Sodium (mg)	7.1	7.2	0.75
13. Diet variety	8.43	8.5	0.70

<sup>a</sup> Teste *t* de Student. HEI, Healthy Eating Index; TEV, total energy value.

Regarding the consumption of meat and eggs, 85.4% of the children consumed the recommended amount (1 daily serving). In the study performed by Castro et al.<sup>20</sup> half of the preschool children (53.8%) consumed meats once to three times a week. Meats, especially red meat, are rich in iron, a component of enzymes that participate in the process of cellular respiration and are essential for the transport of oxygen and carbon dioxide in blood. Its deficiency can lead to anemia, with consequent growth and cognitive development impairment.<sup>20,21</sup>

As for legumes, a group evaluated through the consumption of beans, they are important sources of iron, folic acid and dietary fibers, and were present in the daily diet of

89.2% of children, who reached the highest score in this food group.

The consumption of sugar, candies, chocolates and snacks was above the recommended amount, as 99.6% of the children daily consumed more than 1 serving of foods from this group. Valente et al.<sup>19</sup> in the study carried out in Santa Maria, observed that over half of the children consumed chocolate milk one or more times a day. This product usually contains more than 70% of sucrose in its composition; sucrose being the most cariogenic carbohydrate, as it is a great substrate for pathogenic oral microorganisms.<sup>3</sup> In a study carried out by Barbosa et al.<sup>22</sup> sugar consumption was three times higher than the recommended amount

**Table 4** Mean HEI score based on the variables of interest for all preschoolers stratified by gender.

Variable	All (n=556) Mean (SE)	p-value <sup>a</sup>	Boys (n=298) Mean (SE)	p-value <sup>a</sup>	Girls (n=258) Mean (SE)	p-value <sup>a</sup>
<b>Gender</b>		0.001				
Male	73.4 (0.5)		–	–	–	–
Female	75.4 (0.6)		–	–	–	–
<b>Ethnicity</b>		0.12		0.23		0.38
Caucasian	74.6 (0.5)		73.7 (0.4)		75.7 (0.6)	
Non-Caucasian	73.5 (0.7)		72.7 (0.9)		74.8 (1.0)	
<b>Age (years)</b>		0.19		0.19		0.47
2	74.7 (1.1)		74.2 (1.6)		75.3 (1.2)	
3	73.9 (0.9)		72.5 (1.4)		75.4 (1.1)	
4	73.4 (1.1)		72.2 (1.4)		74.7 (1.1)	
5	75.6 (0.9)		75.0 (1.2)		76.5 (1.0)	
<b>Maternal schooling (years)</b>		0.64		0.99		0.75
0–4	73.7 (0.8)		73.3 (0.8)		74.2 (1.8)	
5–8	74.3 (0.6)		73.4 (1.3)		75.4 (1.8)	
9 or more	74.6 (0.9)		73.4 (1.1)		75.8 (2.1)	
<b>Family income (minimum wages)</b>		0.02		0.17		0.14
<1	72.5 (0.6)		71.8 (0.7)		73.5 (1.1)	
1–2.99	75.1 (0.8)		74.1 (1.0)		76.2 (1.2)	
3–5.99	74.4 (1.1)		73.8 (1.5)		75.0 (1.5)	
6 or more	74.5 (1.8)		73.0 (1.9)		76.3 (2.7)	

HEI, Healthy Eating Index; SE, standard error.

<sup>a</sup> Simple linear regression.



(1 serving), mainly due to the high consumption of artificial fruit juices, soft drinks, candy and added sugar.

All children in this study consumed servings from the group of oils and fats above the recommended amount, which is one daily serving. This may contribute to the development of Chronic Noncommunicable Diseases (CNDs). Of the children, 43% achieved the recommendation for total fat component, that is, an intake lower than 30% of the daily total energy value (TEV) derived from this nutrient. In relation to saturated fat, 100% of the children had intakes that represented 10% or less of caloric intake of this nutrient in the TEV. The adequate consumption of this type of fat reduces the risk of heart disease and dyslipidemia. Fats are sources of essential fatty acids and fat-soluble vitamins (A, D, E and K), which must necessarily be supplied by food, as the body cannot produce them. Thus, all human beings need food sources of fat. It is important to differentiate the healthier ones, which are essential for adequate body functions, from those to be avoided as they damage health, in addition to consuming them within the recommended ranges for good nutrition.<sup>12</sup>

As for the sodium and cholesterol components, 36.9% and 45.1% of the children, respectively, attained the highest score, ingesting  $\leq 2400$ mg of sodium daily and  $\leq 300$ mg of cholesterol daily. Frequent and high consumption of fats and salt increases the risk of diseases such as obesity, hypertension and heart disease. Cholesterol is a component of cell walls and precursor of many hormones (estrogen and testosterone) and bile acids, and it also participates in the fat absorption and vitamin D synthesis processes; however, its excessive consumption carries health risks.<sup>12</sup>

As for the diet variety, the results indicated a varied diet, as 97.3% of the children attained more than 7 points in this component, as they consumed seven or more types of food daily. This finding corroborates the study carried out by Domene et al.<sup>13</sup> in which 81% of the children obtained more than 6 points, characterizing a varied diet.

The mean HEI score was higher in girls than in boys (75.4 and 73.4, respectively), in contrast to the study by Domene et al.<sup>13</sup> Children from families with income between 1 and  $<3$  minimum wages achieved higher scores when compared to those whose income was lower or greater than that category. This may be related to the fact that poorer families have little access to foods such as fruits, vegetables, meat and milk, whereas children from higher income families consume more processed foods. In this sense, in addition to the family, the school's role becomes important, as it instructs on the importance of the nutrient intake and offers, in a balanced way, the foods that provide these nutrients.<sup>23</sup>

There are advantages in applying the HEI to the Brazilian population, as it is based on the consumption of food groups and not only of nutrients. The HEI allows the measurement of the complexity of different eating patterns as scored items and the analysis consumption trends, if applied repeatedly.<sup>24</sup> Moreover, because the score was adapted to the assessed age group, the results adequately reflect the quality of the diet assessed.

The study assessed diet quality using a FFQ tool built especially for this research, and therefore suited to local reality. The main limitation of the use of this index is that excessive consumption of certain food groups is not scored

separately, thus not making it possible to differentiate beneficial or harmful excessive consumption.

This study showed that, according with the HEI, the children's consumption of vegetables and green vegetables was below the recommended level, whereas foods from the group of oils and fats, as well as from the group of sugars, candies, chocolates and snacks were consumed in excess. These foods are calorically dense and nutrient-poor, being part of poor eating habits. In this sense, to know about the child's diet quality and then reinforcing guidelines on healthy eating might be a way to improve the diet of children and promote healthier eating habits, which may persist in later life.

## Funding

This study was funded by the Ministry of Health, Brazil.

## Conflicts of interest

The authors declare no conflicts of interest.

## References

- Alves FS, Albiero KA. Building and development of food habits in children through nutritional education. *Nutrição em Pauta*. 2007;15:1676–2274. Available from: [http://www.nutricaoempauta.com.br/layout\\_impresao.php?cod=554](http://www.nutricaoempauta.com.br/layout_impresao.php?cod=554) [accessed 30.07.14].
- Juswiak CR, Comelli FA. Nutrição na escola: projeto vida saudável colégio Jean Piaget. *Revista Nutrição Funcional*. 2004;5. Available from: [https://www.vponline.com.br/\\_site/revista\\_texto\\_anterior.php?materia\\_saiba\\_mais=ok&revista\\_codigo=17&materia\\_codigo=144](https://www.vponline.com.br/_site/revista_texto_anterior.php?materia_saiba_mais=ok&revista_codigo=17&materia_codigo=144) [accessed 30.07.14].
- Vitolo MR. *Nutrição: da gestação ao envelhecimento*. 3rd ed. Rio de Janeiro: Rubio; 2008.
- Patterson RE, Haines PS, Popkin BM. Diet quality index: capturing a multidimensional behavior. *J Am Diet Assoc*. 1994;94:57–64.
- Drewnowski A, Henderson AS, Driscoll A, Rolls BJ. The dietary variety score: assessing diet quality in healthy young and older adults. *J Am Diet Assoc*. 1997;97:266–71.
- Jenkins RM, Guthrie HA. Identification of index nutrients for dietary assessment. *J Nutr Educ*. 1984;16:15–8.
- Krebs-Smith SM, Smiciklas-Wright H, Guthrie HA, Krebs-Smith J. The effects of variety in food choices on dietary quality. *J Am Diet Assoc*. 1987;87:897–903.
- Drewnowski A, Henderson AS, Shore AB, Fischler C, Preziosi P, Hercberg S. Diet quality and dietary diversity in France: implications for the French paradox. *J Am Diet Assoc*. 1996;96:663–9.
- Bowman AS, Lino M, Gerrior AS, Basiotis PP. The healthy eating index: 1994–96. *Fam Econ Rev*. 1998;11:2–14.
- Haines PS, Siega-Riz AM, Popkin BM. The diet quality index revised: a measurement instrument for populations. *J Am Diet Assoc*. 1999;99:697–704.
- Cox DR, Skinner JD, Carruth BR, Moran J 3rd, Houck KS. A food variety index for toddlers (VIT): development and application. *J Am Diet Assoc*. 1997;97:1382–8.
- Brasil – Ministério da Saúde. In: Secretaria de Atenção à Saúde. Guia alimentar para a população brasileira: promovendo a alimentação saudável. Brasília: Ministério da Saúde; 2005. Available from: [http://dtr2001.saude.gov.br/editora/produtos/livros/pdf/05\\_1109\\_M.pdf](http://dtr2001.saude.gov.br/editora/produtos/livros/pdf/05_1109_M.pdf)

13. Domene SM, Jackix EA, Raposo HF. Adaptation of the dietary guidelines for Brazilian population and the application of the healthy eating index for preschool aged between 2 and 6 years. *Nutrire Rev Soc Bras Aliment Nutr.* 2006;31:75–90.
14. Assunção MC, Santos IS, Barros AJ, Gigante DP, Victora CG. Flour fortification with iron has no impact on anaemia in urban Brazilian children. *Public Health Nutr.* 2012;15:1796–801.
15. Sociedade Brasileira de Pediatria; Departamento de Nutrologia. Manual de orientação para a alimentação do lactente, do pré-escolar, do escolar, do adolescente e na escola. 3rd ed. Rio de Janeiro: SBP; 2012.
16. Barbosa RM, Carvalho CG, Franco VC, Salles-Costa R, Soares EA. Avaliação do consumo alimentar de crianças pertencentes a uma creche filantrópica na Ilha de Paquetá, Rio de Janeiro, Brasil. *Rev Bras Saude Mater Infant.* 2006;6:127–34.
17. Cuppari L. Guia de nutrição: nutrição clínica no adulto. 2nd ed. Barueri: Manole; 2005.
18. Cagliari MP, Paiva AA, Queiroz D, Araujo ES. Food consumption, anthropometry and morbidity in preschool children from public day care centers Campina Grande, Paraíba. *Nutrire: Rev Soc Bras Alim Nutr.* 2009;34:29–43.
19. Valente TB, Hecktheuer LH, Brasil CC. Food habits and socioeconomic conditions of preschool children belonging to a day care center in Rio Grande do Sul, Brazil. *Braz J Food Technol.* 2010;3:71–4.
20. Castro TG, Novaes JF, Silva MR, et al. Characteristics of dietary intake, socioeconomic environment and nutritional status of preschoolers at public kindergartens. *Rev Nutr.* 2006;18:321–30.
21. Cruz GF, Santos RS, Carvalho CM, Moita GC. Dietetic evaluation in municipal day-care centers in Teresina, Piauí, Brazil. *Rev Nutr.* 2001;14:21–32.
22. Barbosa RM, Crocchia C, Carvalho CG, Franco VC, Salles-Costa R, Soares EA. Food intake by children based on the Brazilian food guide pyramid for young children. *Rev Nutr.* 2005;18:633–41.
23. Abreu M. Alimentação Escolar: combate à desnutrição e o fracasso escolar ou direito da criança e ato pedagógico? *Em Aberto.* 1995;15:21–32.
24. Kennedy ET, Ohls J, Carlson S, Fleming K. The healthy eating index: design and applications. *J Am Diet Assoc.* 1995;95:1103–8.