Nutritional status and energy and nutrients intake of children attending day-care centers in the city of Manaus, Amazonas, Brazil: are there differences between public and private day-care centers?

Estado nutricional e consumo de energia e nutrientes de pré-escolares que frequentam creches no município de Manaus, Amazonas: existem diferenças entre creches públicas e privadas?

Estado nutricional y consumo de energía y nutrientes de pre-escolares que frecuentan guarderías en el municipio de Manaus, Amazonas (Brasil): ¿existen diferencias entre guarderías públicas y privadas?

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ABSTRACT

Objectives: To assess the nutritional status and dietary intakes of children attending public and private day care centers in Manaus, Brazil.

Methods: The study assessed children aged 24 to 72 months, enrolled at two public (n=217) and two private (n=91) day care centers in Manaus. Nutritional status was classified according to Z scores for weight-for-age, weight-for-height, height-for-age and BMI-for-age. Dietary intakes were measured using the direct food-weighing method for 1 day. A 1-day dietary recall was administered to parents to assess dietary intakes outside the day care centers. The frequencies of children with nutrient intakes above and below the Estimated Average Requirements (EAR) or Adequate Intake (AI) cutoffs were calculated.

Results: There proportion of overweight children was higher at the private day care centers, according to both weight-for-height and BMI-for-age indexes. Children from the public day care centers had higher intakes of polyunsaturated fat, trans fat, omega-6, vitamin C and sodium, and lower zinc intake when compared to those at private centers. Elevated energy intake and a high proportion of children with vitamin A, vitamin C, zinc and sodium intakes over the Tolerable Upper Intake Levels were observed at both types of day care center. There was a higher proportion of children with inadequate calcium intake at the public centers (27.6 vs. 7.9%, $p<0.001$).

Conclusion: Energy and sodium intakes were above recommended levels at both types of day care center. Calcium intakes were below recommended, especially at the public day care centers. Children's diets should be monitored more closely to prevent diseases later in life.

Key-words: child, preschool; nutritional status; food consumption; child day care centers.

RESUMO

Objetivo: Verificar o estado nutricional e o consumo alimentar de crianças assistidas em creches públicas e privadas no município de Manaus, Amazonas.

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Métodos: Foram avaliadas crianças entre 24 e 72 meses de duas creches públicas (n=217) e duas creches privadas (n=91) de Manaus. O estado nutricional foi classificado pelos índices peso para idade, peso para estatura, estatura para idade e índice de massa corporal (IMC) para idade, em valores de escores Z. O consumo alimentar na creche foi avaliado pelo método da pesagem direta individual dos alimentos e, no domicílio, pelo registro alimentar de um dia aplicado aos responsáveis. Estimou-se a frequência de crianças com ingestão de nutrientes acima ou abaixo dos pontos de corte de *Estimated Average Intake* (EAR) ou *Adequate Intake* (AI).

Resultados: Verificou-se maior frequência de crianças com excesso de peso nas creches privadas segundo os índices peso para estatura e IMC para idade. As crianças das instituições públicas, quando comparadas àquelas das privadas, consumiram mais gorduras poli-insaturadas, trans, ácido graxo ômega-6, vitamina C e sódio, e menos zinco. Em ambos os tipos de creches observaram-se consumo elevado de energia e proporção elevada de crianças com consumo de vitaminas A e C, zinco e sódio acima do limite superior tolerável de ingestão. A proporção de crianças com inadequação de consumo de cálcio foi maior nas creches públicas do que nas privadas (27,6 *versus* 7,9%; $p<0,001$).

Conclusões: O consumo de energia e de sódio foi elevado em ambos os tipos de creche e o consumo de cálcio, insuficiente, principalmente nas creches públicas. Recomenda-se melhor monitoramento da dieta infantil para prevenção de doenças futuras.

Palavras-chave: pré-escolar; estado nutricional; consumo de alimentos; creches.

RESUMEN

Objetivo: Verificar el estado nutricional y el consumo alimentar de niños asistidos en guarderías públicas y privadas en el municipio de Manaus, Amazonas (Brasil).

Métodos: Se evaluaron niños entre 24 y 72 meses de dos guarderías públicas (n=217) y dos guarderías privadas (n=91) de Manaus. El estado nutricional fue clasificado por los índices peso para la edad, peso para la estatura, estatura para la edad e índice de masa corporal (IMC) para edad, en valores de escores Z. El consumo alimentar en la guardería fue evaluado por el método de pesaje directo individual de los alimentos y, en el domicilio, por el registro alimentar de un día aplicado a los responsables. Se estimó la frecuencia de niños con ingestión de nutrientes por encima o por debajo de los puntos de corte de *Estimated Average Intake* (EAR) o *Adequate Intake* (AI).

Resultados: Se verificó mayor frecuencia de niños con exceso de peso en las guarderías privadas, por los índices de peso para estatura e IMC para edad. Los niños de las instituciones públicas, cuando comparados a aquellos de las privadas, consumieron más grasas poliinsaturadas, trans, ácido graso omega-6, vitamina C y sodio, y menos zinc. En ambos tipos de guarderías, se observaron consumo elevado de energía y proporción elevada de niños con consumo de vitaminas A y C, zinc y sodio por encima del límite superior tolerable de ingestión. La proporción de niños con inadecuación de consumo de calcio fue mayor en las guarderías públicas que en las privadas (27,6 *versus* 7,9%; $p<0,001$).

Conclusión: El consumo de energía y de sodio fue elevado en ambos tipos de guardería, y el consumo de calcio, insuficiente, principalmente en las guarderías públicas. Se recomienda mejor monitoración de la dieta infantil para prevención de enfermedades futuras.

Palabras clave: pre-escolar; estado nutricional; consumo de alimentos; guarderías.

Introduction

During childhood it is essential that the diet contains sufficient quantities of vitamins and minerals to avoid nutritional deficiencies that would compromise growth. Protein-energy malnutrition, iron deficiency anemia and vitamin A deficiency are the principal problems for child health[1]. In Brazil, protein-energy malnutrition assessed on the basis of height-for-age is in decline, but still afflicts 6.0% of children under 5 years old nationally, reaching 8.5% in the North administrative region[2]. At the other extreme, excess weight was detected in approximately one quarter of children less than 6 years old seen at public and private institutions in nine Brazilian states[3].

According to data from the 2006 National Demographic and Health Census (Pesquisa Nacional de Demografia e Saúde), the prevalence of vitamin A deficiency among children under 5 years old was 7.4% and anemia prevalence was 20.9%[4]. In the Amazon region iron deficiency anemia was detected in up to 30.6% of preschool children[5] and chronic malnutrition and insufficient niacin, iron and vitamin A intakes have also been reported in this age group[6].

The majority of studies of nutritional deficiencies have been conducted with children at day care, which could

have a positive impact on their nutritional status, particularly for those from less privileged socioeconomic strata, because the centers may provide better meals that are richer in nutrients and energy that the foods they are fed at home[7]. Furthermore, studies of child health that have been undertaken in Brazil, whether at day care or population-based surveys, particularly in the Amazon region, are generally limited to collecting data via anthropometric assessment without investigating dietary intake, which is fundamental to achieving a better understanding of the development of nutritional deficiencies. In response to this gap in the literature, the objectives of this study were to assess nutritional status and dietary intake of children cared for at public and private day care centers in the city of Manaus, Amazonas, Brazil, in the belief that the results will be useful for planning strategies aimed at improving children's diets and, consequently, their nutritional status.

Method

This is a cross sectional study analyzing data collected as part of a multicenter study entitled "Estimating the prevalence of inadequate nutrient intakes in children from different regions in Brazil" – the "Nutri Infância Brasil" study, which was conducted in ten Brazilian cities, including Manaus, which is where the data analyzed here was collected.

The multicenter study design specified a convenience sample of 250 preschool children aged 24 to 72 months from public day care centers and 100 from private day care centers. The number of children to be assessed in each city was calculated on the basis of an estimated prevalence of inadequate nutrient intake of 65%, a 5% margin of error and a 95% confidence level. The number of subjects from each day care strata (public or private) was based on the number of children enrolled at each type of center in those Brazilian states that took part in the study according to the Brazilian Ministry of Education's 2005 School Census[8].

In Manaus, 217 children from two philanthropic public day care centers and 91 children from two private day care centers were recruited between October and December of 2007, equating to 88% of the sample size specified for the multicenter study.

Children were weighed using a portable electronic balance with 50g intervals, unshod and with a minimum of clothing. Height was measured using a portable anthropometer with a 0.1cm scale, with the child unshod and standing upright. The nutritional status of children less than 5 years of age was classified against the World Health Organization (WHO) reference[9] on the basis of Z scores for weight-for-age (W/A), weight-for-height (W/H), height-for-age (H/A) and body mass index (weight/height^2) for age (BMI/A). Children aged between 5 and 6 were classified using the same indices, with the exception of W/H because the World Health Organization reference for children aged 5 to 19[10] does not provide this curve. The cutoff points used to classify underweight and excess weight were based on the SISVAN recommendations[11] which were adapted from the WHO[9,10].

Dietary intake was quantified by weighing all the food consumed by each child at the day care center over 1 day. Each time a child was fed its serving was weighed on the plate using a digital balance with 3kg capacity. Each portion of food was weighed three times in order to provide a mean value for the quantity of each food provided by the day care center at each meal. The quantity of food left over by each child at the end of each meal was also weighed. Leftovers were collected in plastic bags labeled to identify each child and were then weighed without attempting to separate different foods. The principal of proportionality was used to quantify each food, in that the percentage of each food in the leftovers was considered to be the same as its proportion in the whole meal, and equivalents in grams were calculated. The quantity of food eaten was considered to be the quantity served minus the leftovers. The remainder of each child's dietary intake, i.e. what foods they ate when not at day care and their respective quantities, were reported by parents or guardians, who kept food diaries.

In order to investigate the variance of the children's dietary intakes, 25% of the sample from both the public and the private day care centers was reselected at random and the weighing procedure was repeated. The second weighing was conducted after an interval of at least 1 day and the same procedure as before was used. The distribution of nutrient intakes was adjusted to remove the effect of intraindividual variance, using the method proposed by the Iowa State University[12] and recommended by the Institute of Medicine, which is based on the premise that it is possible to collect data from a sub-sample and extrapolate the resulting estimate of variance in intraindividual intake to the entire population being studied[13]. The analyses to remove the effect of intraindividual variance were conducted using PC-SIDE software.

Household measures were converted into grams or milliliters using standards published by Pinheiro *et al*[14] and Fisberg and Villar[15]. Food diaries were input and analyzed using the Nutrition Data System for Research program[16], the main database of which is a North-American table of foods developed by the United States Department of Agriculture. Regional

foods that are not covered by the software were substituted with other foods with similar nutritional values.

Nutrient intakes were adjusted for the total energy content of the diet with STATA version 10 software using Willet's residuals method[17].

Estimated Energy Requirements (EER)[18] for each child, by age and sex, were used to classify the adequacy of energy intake. Energy intake was defined as excessive when more than 120% of EER and deficient when less than 80% of EER. For each nutrient with an Estimated Average Requirement (EAR) listed, the proportion of children with intakes below the recommendation was calculated[19]. For nutrients with no EAR defined, the proportion below the Adequate Intake (AI) was calculated. Upper Limits (UL) were used to calculate the proportion of children with intakes above the maximum tolerable limit of digestion for all nutrients for which a UL has been defined[19].

The Brazilian Economic Classification Criteria (Critério de Classificação Econômica Brasil) were used for socioeconomic classification after self-administration to the children's guardians of the Social and Economic Status Assessment Questionnaire (Questionário de Avaliação do Nível Social e Econômico), developed by the Brazilian Association of Market Research Companies (ABEP - Associação Brasileira de Empresas de Pesquisa)[20]. The criteria include presence and number of domestic appliances and domestic servants in a household plus the educational level of the head of the family. The ABEP criteria divide economic status into A1, A2, B1, B2, C, D and E (from highest to lowest economic status). For the purposes of this study, A1 and A2, B1 and B2, and D and E were collapsed together to give the categories A, B, C and D.

The initial step in the statistical analysis was to test for natural distribution with the Komogorov-Sminorv test. Continuous variables were expressed as means and standard errors, and categorical variables in frequencies. Student's *t* test or the Mann-Whitney test were used to compare means between public and private day care centers, depending on whether distribution was natural, and frequencies were compared using the chi-square test. Statistical analyses were performed using SPSS for Windows, version 13.0. Results of $p<0.05$ were considered statistically significant.

The multicenter study research project was approved by the Ethics Committee at Unifesp under protocol number 0617/17.

Results

There proportion of children aged 4 and over was greater at the public day care centers (60.8 vs. 24.1%), while the proportion of children under 4 was greater at the private day care centers (75.8 vs. 39.1%). As was expected, children from classes A (62.2%) and B (32.2%) predominated at the private institutions, whereas the preschool children at the public centers were primarily from classes C (64.9%) and D (26.7%) (Table 1).

The W/A and W/H Z scores indicated that a higher proportion of children at private day care centers had excess weight and a greater proportion of children at the public day care centers were underweight. There was also a greater proportion of excess weight at the private day care centers than at the public ones when assessed by BMI/A. (Table 2).

Table 1 - Distribution of children at public and private day care centers by age, sex, and socioeconomic class

	Public (n=217)		Private (n=91)		*p*-value
	n	%	n	%	
Age (years)					<0.001
2-4	85	39.1	69	75.8	
4-7	132	60.8	22	24.1	
Sex					0.174
Male	108	49.7	53	58.2	
Female	109	50.2	38	41.7	
Socioeconomic classification					<0.001
A*	0	0	56.0	62.2	
B*	18.0	8.2	29.0	32.2	
C*	141.0	64.9	5.0	5.5	
D*	58.0	26.7	0	0	

*Chi-square cutoff: $p<0.05$

Table 2 - Distribution of children at public and private day care centers, by nutritional status

	Public (n=217)		Private (n=91)		*p*-value
	n	%	n	%	
Nutritional status					
Weight-for-age (Z score)					0.005
<-2	6	2.7	2	2.2	
-2 to -1	31	14.2	4	4.4	
-1 to 1	146	67.2	56	61.5	
>1 to 2	27	12.4	21	23.0	
>+2	7	3.2	8	9.7	
Total	217	100.0	91	100.0	
Weight-for-height (Z score)*					0.002
<-2	1	0.6	1	1.1	
-2 to -1	14	8.9	2	2.3	
-1 to 1	102	64.9	46	52.8	
>1 to 2	36	22.9	26	29.8	
>2	4	2.5	12	13.7	
Total	157	100.0	87	100.0	
Height-for-age (Z score)					0.865
<-2	13	6.0	5	5.4	
≥-2	204	94.0	86	94.5	
Total	217	100.0	91	100.0	
BMI-for-age (Z score)					0.040
<-2	2	0.9	1	1.1	
-2 to -1	14	6.4	4	4.4	
-1 to 1	142	65.4	47	51.6	
>1 to 2	46	21.2	25	27.4	
>2	13	5.9	14	15.3	
Total	217	100.0	91	100.0	

*60 children at public day care centers and four children at private day care centers were more than 5 years old and so were not classified by weight-for-height

With regard to diet (Table 3), it was found that the children at public centers were eating more ($p<0.05$) polyunsaturated fats, omega 6 fatty acids, trans fat, vitamin C and sodium than the children at private day care centers.

With regard to inadequate energy intake (Table 4), it was found that the proportion of children with intakes above the EER was around 40% at both public and private day care centers and was significantly greater than the proportion with intakes below the recommended level (5.1 vs. 6.7%, respectively). A greater proportion of children at the public day care centers had calcium intakes below the AI (27.6 vs. 7.9%, $p<0.001$), while below-recommended vitamin D intake was equally prevalent in both groups (25.8 vs. 20.2%). At both types of center an elevated proportion of children had vitamin A, vitamin C, zinc and sodium intakes above the UL, and for vitamin A and zinc the proportion was significantly higher among the children at private day care centers. Elevated sodium intake was observed in more than 70% of the children investigated, irrespective of the type of center they were recruited at. All of the children had adequate iron intake and protein intake above the recommended level (Table 4).

Discussion

This study has demonstrated that there are differences between the nutritional status of children at public and private day care centers in Manaus, but the differences in dietary intakes were less evident. It was found that the children at private day care centers had a greater tendency to develop excess weight and obesity than the children at public day care centers, whereas the children at public day care centers had a greater tendency to be underweight, both for height and for age.

Marinho *et al*[21] studied 216 preschool children in Manaus and also found a higher proportion of grade I malnutrition according to the Gomez classification system (from 76 to 90% of healthy weight for age)[22] among children from low socioeconomic classes, reaching 47.5% among the boys and 48.3% among the girls. Therefore, even allowing for methodological

Table 3 - Means and standard errors for energy, macronutrients and micronutrients in the diets of children at public and private day care centers

Nutrients	Public (n=217)	Private (n=89)	*p*-value
	Mean* (SE)	Mean* (SE)	
Energy (kcal)	1,592.0 (21.3)	1,564.1 (38.5)	0.500
Proteins (g)	61.4 (1.0)	61.7 (1.6)	0.837
Protein as % of total energy intake	15.5 (0.2)	15.9 (0.2)	0.163
Carbohydrate (g)	233.4 (3.4)	228.0 (6.1)	0.423
carbohydrate as % of total energy intake	58.6 (0.3)	58.3 (0.5)	0.633
Fat (g)	48.6 (0.7)	47.3 (1.1)	0.315
Fat as % of total energy intake	27.7 (0.2)	27.4 (0.3)	0.588
Saturated fat (g)	18.2 (0.3)	18.1 (0.5)	0.885
Saturated fat as % of total energy intake	10.3 (0.1)	10.5 (0.2)	0.461
Monounsaturated fat (g)	15.0 (0.2)	14.6 (0.4)	0.362
Monounsaturated fat as % of total energy intake	8.5 (0.1)	8.5 (0.1)	0.745
Polyunsaturated fat (g)	10.4 (0.2)	9.7 (0.3)	0.018
Polyunsaturated fat as % of total energy intake	5.9 (0.1)	5.6 (0.1)	0.006
Omega-3 (g)	1.4 (0.0)	1.4 (0.0)	0.450
Omega-6 (g)	8.7 (0.2)	8.0 (0.2)	0.015
Trans fat (g)	2.6 (0.1)	2.1 (0.1)	0.008
Trans fat as % of total energy intake	1.4 (0.0)	1.2 (0.1)	0.008
Vitamin A (mcg)	602.0 (16.4)	609.6 (22.1)	0.476
Vitamin D (mcg)	8.6 (0.4)	7.7 (0.4)	0.412
Vitamin C (mg)	1,491.7 (153.9)	918.7 (134.7)	0.024
Iron (mg)	11.8 (0.1)	11.9 (0.2)	0.842
Calcium (mg)	885.5 (17.6)	920.0 (26.3)	0.286
Zinc (mg)	8.7 (0.1)	9.3 (0.2)	0.005
Sodium (mg)	1,954.6 (21.8)	1,828.9 (29.0)	0.001

SE: standard error; *adjusted for intraindividual variance and energy

differences in classification, it can be concluded that although children living in less privileged socioeconomic conditions are still at greater risk of nutritional deficits than those from higher strata, there has been a reduction in the prevalence of these deficits among children in Manaus, since the proportion in our study, based on the W/A score, did not exceed 18%.

With regard to H/A deficits, the proportion observed here (of around 6%), is similar to what is described for Brazilian children less than 5 years old nationally[2], but below figures reported by Alencar *et al*[23] who found that the primary manifestation of child malnutrition in Amazonas is growth deficit, which can affect as many as 15.6 to 35.2% of children, depending on the ecosystems of the regions they live in. The difference could be the result of the fact that we are describing nutritional status of children living in the urban area Manaus, where living conditions are more favorable than in those regions.

In contrast, excess weight prevalence was very high. If we define Z scores above 1 as indicating risk, the proportion at-risk reached 25% of the children at public day care centers and more than 40% of the children at private day care centers. These results are in line with the increasing prevalence of overweight observed in Brazil[2], and the national results of the Nutri Brasil Infância study[3], of which this study is a part, further emphasizing the status of obesity as a public health problem in both developed countries and developing ones[24]. Energy intake was higher than recommended in around 40% of the children assessed, which could explain the elevated prevalence rates of excess weight observed.

Irrespective of the differences between the types of day care center in terms of socioeconomic classification and nutritional status, there were no significant difference between the two groups in terms of energy consumption or the majority of nutrients. These findings run counter to the hypothesis that children at private day care centers would have higher energy and nutrient intakes than children at public day care centers, since they are from higher socioeconomic classes and, probably, have greater access

Table 4 - Frequencies of children with energy and nutrient intakes above or below recommended at public and private day care centers

	Public (n=217)		Private (n=89)		*p*-value
	n	%	n	%	
Energy					
<80% of EER	11	5.1	6	6.7	0.906
>120% of EER	94	43.3	37	41.6	0.906
Proteins					
Below EAR	-	-	-	-	-
Above EAR	217	100	89	100	-
Vitamin A					
Below EAR	1	0.5	-	-	-
Above UL	48	22.1	33	37.1	0.007
Vitamin D					
Below AI	56	25.8	18	20.2	0.300
Above UL	-	-	-	-	
Vitamin C					
Below EAR	7	3.2	2	2.2	-
Above UL	118	54.4	41	46.1	0.186
Iron					
Below EAR	-	-	-	-	
Above UL	-	-	-	-	
Calcium					
Below AI	60	27.6	7	7.9	<0.001
Above UL	-	-	-	-	
Zinc					
Below EAR	-	-	-	-	
Above UL	77	35.5	66	74.2	<0.001
Sodium					
Below AI	1	0.5	1	1.1	-
Above UL	154	71.0	70	78.7	0.168

EAR: Estimated Average Requirements; EER: estimated energy requirement; AI: adequate intake; UL: tolerable upper intake level

to foods. It is probable that attending day care improves the foods eaten, irrespective of the social class to which the children belong.

Below-recommended vitamin D intake was detected at both types of center, and low calcium intake was predominantly found at public institutions. Insufficient intake of these nutrients can compromise growth and lead to inadequate bone tissue formation[25]. The fact that inadequate calcium intake was more common at the public day care centers may be related to the fact that there was a higher proportion of children over 4 years old at these centers and they consume less milk than younger children.

Another relevant finding of this study was the elevated vitamin C, zinc and sodium intakes (over the UL) of children in both groups. Sodium in particular can have negative consequences both for child health and later in life, since elevated consumption is associated with increased prevalence of arterial hypertension, considered one of the greatest public health problems among adults[26]. The high sodium intake is probably due to increased consumption of mass-produced foods that are rich in the mineral and which is a habit that may already be becoming ingrained during childhood.

Excess vitamin C intake can have adverse effects such as osmotic diarrhea and gastrointestinal disorders, increased oxalate excretion and formation of kidney stones[25]. However, it is probable that the elevated vitamin C intake was observed because both types of center had acerola juice on the menu on the day foods were weighed. Acerola is very rich in vitamin C and does not represent a risk to the children's health. The high proportion of children with zinc intakes over the UL may have been a result of the high intake of foods rich in proteins, which are also sources of zinc.

The majority of nutritional assessment data on Brazilian children comes from studies undertaken at public day care

centers because governmental authorities tend to be more open to research. Historically, there have been difficulties obtaining permission from private institutions to conduct studies on their premises. This has meant that the picture of nutritional status of children has been partial since higher social economic classes were underrepresented, given that only children from the less privileged social economic classes tend to go to public daycare centers[27].

In this study, it was found that the dietary intakes of children at public and private day care centers did not in general differ in terms of energy, macronutrient and micronutrient content. This supports the findings of Bueno, Marchioni and Fisberg[7] on the nutritional benefits for children from less privileged socioeconomic strata of attending day care, since, in the final analysis, they are provided with better-quality foods than if they were at home and similar to what the preschool children from higher socioeconomic strata are fed at private centers. Yuyama *et al*[28] also found that children at a public day care center in Manaus were meeting the recommendations for micronutrients, in contrast with children living in areas where access is via river transport, demonstrating the importance of day care centers to improving the nutritional status of these children.

With regard to different types of fat, the higher trans fat intake of the children at public day care centers, when compared with the children at private day care centers, could represent an increased risk for development of non-transmissible chronic diseases. Notwithstanding, mean intake of this type of fat at both types of center was over the recommendation, which is a maximum of 1% of the diet's total energy content[29]. This underscores the fact that this risk applies to all of the preschool children assessed. However, the children at public day care centers also had higher intakes of polyunsaturated fat and of its omega-6 fraction, which are related to several benefits to the body, including prevention of chronic diseases[30]. The increased fat consumption among the children at the public day care centers could possibly be explained by the age difference between the children at the two types of center, since children over 4 years old were more frequent at the public day care centers, while under-4s were more frequent at private day care centers, and older children eat larger portions of food and, consequently, consume more energy and nutrients. However, since nutrient intakes were adjusted for the energy content of the diet, we believe that the age difference has not affected these results.

Limitations of this study include the use of food diaries to measure the children's dietary intakes when not at the day care centers, since the method is dependent on the co-operation of interviewees and demands a certain minimum educational level. In order to avoid recording errors, the correct way to complete the form was explained in advance and confirmed when they were handed out to the children's guardians. The fact that foods were only weighed at the day care centers on 1 day is also a limitation since it may fail to represent variation in the menus, although this limitation was attenuated by weighing the intake of a 25% sub-sample on a second day and adjusting intakes for intraindividual variance. Finally, the day care centers were sampled by convenience, rather than at random, which compromises the study's external validity. However, it is probable that other children attending public and private day care centers in Manaus do not differ greatly from those investigated in this study.

In conclusion, a low proportion of children had below appropriate weight for age and/or for height at both public and private centers. On the other hand, a high proportion of the preschool children had excess weight, particularly at the private day care centers. Intakes of macro and micronutrients did not in general differ between preschool children at public and private day care centers, with the exceptions being total polyunsaturated fats, omega-6 fatty acids, trans fats, vitamin C and sodium, all higher at public day care centers, and zinc, which was higher at private centers.

In order to prevent excessive weight gain and its consequences among the preschool children cared for at day care, it is recommended that the elevated energy intake observed in a high proportion of these children should be attended to, particularly for those at private day care centers, and that sodium intake, which was also higher than recommended, should be monitored. Starting in childhood, these measures could contribute to prevention of non-transmissible chronic diseases that constitute major public health problems in adulthood, such as obesity and cardiovascular diseases.

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References

1. Castro TG, Novaes JF, Silva MR, Costa NM, Franceschini SC, Tinôco AL *et al*. Characteristics of dietary intake, socioeconomic environment and nutritional status of preschoolers at public kindergartens. Rev Nutr 2005;18:321-30.
2. Brasil. Instituto Brasileiro de Geografia e Estatística. Pesquisa de Orçamento familiar 2008-2009: antropometria e análise do estado nutricional de crianças, adolescentes e adultos no Brasil. Rio de Janeiro: IBGE; 2010 [cited 2010 Jan 10]. Available from: www.ibge.gov.br
3. Fisberg M, Fisberg RM, Maximiano P, Bueno M, Rodrigues GP. Brazilian National Survey of food intake and nutritional status of children 2-5 years - NUTRI INFANCIA BRASIL project. Abstract of the 19th International Congress of Nutrition; 2009 October 4-9; Bangkok, Thailand. Ann Nutr Metab. Switzerland: Karger. 2009;55:299.
4. Brasil. Ministério da Saúde. Centro brasileiro de análise e planejamento. Pesquisa nacional de demografia e saúde da criança e da mulher – PNDS 2006 [cited 2008 Nov 4]. Available from: http://bvsms.saude.gov.br/bvs/pnds/img/relatorio_final_pnds2006.pdf
5. Muniz PT, Castro TG, Araújo TS, Nunes NB, da Silva-Nunes M, Hoffmann EH *et al*. Child health and nutrition in the Western Brazilian Amazon: population-based surveys in two counties in Acre state. Cad Saude Publica 2007;23:1283-93.
6. Rocha YR, Yuyama LK, Nascimento OP. Nutritional profile of pre-school children and other school children, residents in Palmeira do Javari, AM. Acta Amaz 1993;23:9-14.
7. Bueno MB, Marchioni DM, Fisberg RM. Changes in the nutritional status of children in public day care facilities in the municipality of São Paulo, Brazil. Rev Panam Salud Publica 2003;14:165-70.
8. INEP - Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira. Resultados do Censo Escolar 2005. Brasília: INEP, 2006 [cited 2011 Jul 15]. Available from: http://www.educacenso.mec.inep.gov.br/web/guest/basica-censo-escolar-sinopse-sinopse
9. World Health Organization. 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: WHO; 2006 [cited 2009 Jul 02]. Available from: http://apps.who.int/bookorders/anglais/detart1.jsp?sesslan=1&codlan=1&codcol=15&codcch=660
10. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ 2007;85:660-7.
11. Brasil. Ministério da Saúde. Secretaria de atenção à saúde - departamento de atenção básica. Protocolos do Sistema de Vigilância Alimentar e Nutricional - SISVAN na assistência à saúde. Brasília: Ministério da Saúde, 2008.
12. Guenther PM, Kott PS, Carriquiry AL. Development of an approach for estimating usual nutrient intake distributions at the population level. J Nutr 1997;127:1106-12.
13. Dwyer J. Avaliação do consumo alimentar. In: Shils ME, Olson JA, Shike M, Ross AC, editors. Tratado de Nutrição moderna na saúde e na doença. 9th ed. São Paulo: Manole; 2003. p.1001-26.
14. Pinheiro AB, Lacerda EM, Benzecry EH, Gomes MC, Costa VM, editors. Tabela para avaliação de consumo alimentar em medidas caseiras. 5th ed. São Paulo: Atheneu; 2004.
15. Fisberg RM, Villar BS. Manual de receitas e medidas caseiras para cálculo de inquéritos alimentares. São Paulo: Signus; 2002.
16. University of Minnesota, editor. Food and nutrient database and interview system descriptive. Nutrition Coordinating Center, 2009 [cited 2011 Jul 14]. Available from: http://www.ncc.umn.edu/ndsrsupport/ndsrmanual2009.pdf
17. Willett W, editor. Nutritional epidemiology. 2nd ed. New York: Oxford; 1998.
18. Institute of Medicine of the National Academies, editor. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids. Washington: National Academy Press; 2002 [cited 2008 Jan 10]. Available from: http:// www.nap.edu/books/0309085373/html
19. Institute of Medicine of the National Academies, editor. Dietary reference intakes: recommended intakes for individuals, vitamins and elements. Washington: National Academy Press, 2004 [cited 2008 Jan 10]. Available from: http://www.iom.edu/Home/Global/News%20Announcements/~/media/Files/Activity%20Files/Nutrition/DRIs/DRI_Summary_Listing.pdf
20. Associação Nacional de Empresas de Pesquisas. Critério de classificação econômica Brasil. São Paulo: ABEP; 2007 [cited 2008 Jul 08]. Available from: http://www.abep.org/novo/Content.aspx?ContentID=301
21. Marinho HA, Kazapi IM, Fernandes MH, Guedes MR. Avaliação do estado nutricional de pré-escolares de classe sócio-econômica média e baixa da cidade de Manaus: estudo comparativo. Acta Amaz 1992;22:363-8.
22. Gomez F. Desnutrición. Bol Med Hosp Inf Mex 1946;3:543-51.
23. Alencar FH, Yuyama LK, Varejão MJ, Marinho HA. Alimentary insecurity determinants and consequences at Amazonas: ecosystems infuences. Acta Amaz 2007;37:413-8.
24. World Health Organization [homepage on the Internet]. Obesity and overweight. Geneva: WHO; 2003 [cited 2009 May 30]. Available from: http://www.who.int/hpr/NPH/docs/gs_obesity.pdf
25. Mahan KL, Arlin TM. Vitaminas. In: Mahan LK, Escott-Stump S, editors. Krause - Alimentos, nutrição e dietoterapia. 11th ed. São Paulo: Roca; 2005.
26. Salgado CM, Carvalhaes JT. Arterial hypertension in childhood. J Pediatr (Rio J) 2003;79 (Suppl 1):S115-24.
27. Brunken GS, Guimarães LV, Fisberg M. Anemia in children under 3 years of age in public day care centers. J Pediatr (Rio J) 2002;78:50-6.
28. Yuyama LK, Aguiar JP, Nagahama D, Alencar FH, Fávaro DL, Farias LA *et al*. Micronutrientes em dietas de pré-escolares de diferentes ecossistemas amazônicos. In: Peters BS, Slater B, Cesar CL, Fávaro Dl, Nagahama D, Jesus EF *et al*. editors. Consumo alimentar de micronutrientes. Série de Publicações ILSI Brasil: Alimentos fortificados e suplementos - v. 3. São Paulo: ILSI Brasil - International Life Sciences Institute do Brasil; 2008. p. 75-8.
29. World Health Organization. Diet, nutrition and the prevention of chronic diseases. Geneva: WHO; 2002 [cited 2010 Dec 30]. Available from: http://whqlibdoc.who.int/trs/who_trs_916.pdf
30. Martin CA, Almeida VV, Ruiz MR, Visentainer JE, Matshushita M, Souza NE *et al*. Omega-3 and omega-6 polyunsaturated fatty acids: importance and occurrence in foods. Rev Nutr 2006;19:761-70.