

# Dietary Intake, Anthropometric and Body Composition Assessment of Adolescents Enrolled in a Basic Health Unit in Ribeirão Preto, São Paulo, Brazil

*Ingestão dietética, avaliação antropométrica e composição corporal de adolescentes atendidos em um Centro de Atenção Primária à Saúde em Ribeirão Preto, São Paulo, Brasil*

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## ABSTRACT

**Objectives:** This study aimed to describe and compare the nutritional profile of three groups of adolescents of the same age and gender, diagnosed as overweight, obese and eutrophic as determined by the Body Mass Index (BMI). **Materials and Methods:** This is a cross-sectional, observational, comparative, and descriptive study in which adolescents were evaluated using anthropometric measurements such as skinfolds, waist circumference, BMI and body composition assessed by bioelectric impedance. A semi-quantitative questionnaire about eating frequency was applied to evaluate food intake. The sample was determined by convenience. A total of 517 adolescents were attended at the CMSCVL between October 2005 and December 2006. Of these, 141 (27.3%) agreed to participate and satisfied the inclusion criteria. **Results:** There was no significant difference between groups regarding energy consumption or percent macronutrient contribution although the diet of all groups contained fat percentages above recommended levels. Median lipid consumption was 36.6%, 38.3% and 38.2% among eutrophic, overweight and obese adolescents, respectively. Also, there was no significant difference between groups regarding micronutrient consumption. Quantitative analysis of the diet revealed in general a frequent consumption of rice and beans, as well as bread, salty snacks, soft drinks, artificial juices, coffee with sugar, and sausages. The fruits most frequently consumed were orange, apple and banana and the legumes most frequently consumed were lettuce and tomato. These data are important for the policy of nutritional education adopted at the health center. **Conclusion:** The food intake does not seem to have been the main factor triggering weight gain. The adolescents studied, regardless of their nutritional status, have similar eating habits which are not compatible with the food pyramid.

**Key-words:** Adolescent Nutrition. Body Composition. Nutritional Status. Food Consumption.

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Artigo recebido em 04/02/2011  
Aprovado para publicação em 19/09/2011

## Introduction

The proportion of overweight children and adolescents is drastically increasing all over the world. Among adolescents aged 12-19, obesity increased from 5.0% to 18.1% between 1976-1980 and 2007-2008<sup>1</sup>. Excess weight during adolescence reaches a 13.9% rate in the South region of Brazil<sup>2</sup>. Terres et al. (2006) conducted a study in Pelotas, RS, among 15- to 19-year-old adolescents and observed that the prevalence of obesity and overweight was 5% and 20.9%, respectively, in this sample<sup>3</sup>.

Adolescence involves some peculiarities that cause adolescents to be a risk group for excess weight since the eating habits in this age range involve a high intake of energy foods such as fast food, snacks, sweets and soft drinks, and also due to the increased portions of meals available outside the home<sup>4</sup>. Studies on food intake of children and adolescents have indicated a low intake of dairy products, fruit, vegetables and foods that are sources of protein and iron<sup>5,6</sup>. Furthermore, a high intake of sugars and fats and an intake of fruits and vegetables much lower than recommended have been observed<sup>7</sup>. The aim of the present study was to compare the nutritional profile and food consumption of three groups of adolescent boys and girls of the same age with a diagnosis of overweight, obesity and normal weight, attended at a Basic Health unit in the city of Ribeirão Preto, State of São Paulo, Brazil.

## Materials and methods

### Subjects

The study was conducted on 517 adolescents of both sexes from the city of Ribeirão Preto, State of São Paulo, Brazil, followed up by the medical team of the Pediatrics Program of the "Vila Lobato" Community Social and Medical Center (CMSCVL in the Portuguese acronym) during the period from October 2005 to December 2006. The sample was determined by convenience. A total of 517 adolescents were attended at the CMSCVL between October 2005 and December 2006. Of these, 141 (27.3%) agreed to participate and satisfied the inclusion criteria. After being invited, the adolescents and their parents or guardians signed a written free consent form to participate in the study. Adolescents aged 10 years to 19 years, 11 months and 29 days were evaluated in the study. Adolescents

served at a CMSCVL (a first time and second time consultations health service facility) were evaluated and agreed in writing to participate in the study. After a medical visit, the adolescents filled out a questionnaire containing questions about their eating habits applied by an interviewer, and their weight and height were measured. The individuals included in the study were evaluated only once. Adolescents with any type of physical or mental deficiencies, pregnant girls and adolescents who gave up participating in the study during the interview were excluded. The study was approved by the Research Ethics Committee of the University Hospital, University of São Paulo Faculty of Medicine of Ribeirão Preto.

### Diet evaluation

Food consumption was assessed with the aid of a semi-quantitative food frequency questionnaire for the last three months<sup>8</sup>. Photographs were used to determine the size of each food item and food frequency was classified as daily, weekly and monthly or at intervals of more than one month<sup>9</sup>.

A computer program developed by Block et al.<sup>10</sup> (Dietsys Software®) and adapted to the Brazilian population was used to analyze the ingestion of energy foods and nutrients. The values suggested by the Institute of Medicine of the National Academy of Sciences for individuals aged 4 to 18 years were used as reference to determine the relative distribution of macronutrients in the diet in relation to the total energy value<sup>11</sup>.

Food consumption patterns were characterized by grouping the five major types of foods consumed by the adolescents according to the eight food groups in the food pyramid adapted by Philippi et al.<sup>12</sup>. Foods consumed by the adolescents at monthly or longer intervals were not considered to be part of their diet.

### Anthropometrics

Weight and height were assessed according to the method of Heymsfield<sup>13</sup> by a trained dietitian. The reference data of the World Health Organization/National Center for Health Statistics/Centers for Disease Control and Prevention 2002<sup>14</sup> were used. BMI was calculated by the standard formula using height and weight and plotted on CDC BMI-for-age curves for 2-20 years of age for girls and boys<sup>15</sup>. Nutritional status was assessed according to the following percentile intervals: 5 d" BMI <85 (normal weight), 85 d" BMI <95 (overweight) and BMI e" 95 (obesity)<sup>16</sup>.

## Waist circumference

The measurement was performed with a tape measure when the teenager was standing.

Circumference was measured on an imaginary horizontal line passing the midpoint between the bottom edge of the last rib and the iliac crest<sup>17</sup>.

## Skinfolds

The skinfolds were measured using the adipometer *Lange Skinfold Caliper*® (*Beta Technology Incorporated Cambridge, Maryland*), previously calibrated and with constant pressure. Each measure was performed three times and the average value of three measurements was considered. The triceps, biceps, subscapular and suprailiac skinfolds were measured according to techniques described by Lohman, Roche and Martorell (1991)<sup>18</sup>.

## Bioelectrical Impedance

Bioelectrical impedance was determined in all adolescents using the RJL Bioelectric Impedance Analyzer (BIA 103-A Detroit, MI, USA). The patient stayed in the supine position having two electrodes placed on the back surface of the ipsilateral hand and foot. The estimation of body composition was performed by applying an electric current of 50 kHz, yielding the values of resistance and reactance. These values are higher in fat body mass (FBM) and lower in lean body mass (LBM), which allows the determination of body composition through linear regression equations<sup>19</sup>. Fat-free mass, fat mass and total body water values were used, obtained with the bioelectrical impedance device and its specific equation for the age and gender group of the study participants, estimated by Houtkooper et al. (1992)<sup>20</sup>.

## Statistical Analysis

Data were analyzed with the Statistical Package for the Social Sciences (SPSS) software. When most variables showed non-normal distribution, the data were reported as median and range and analyzed by the Kruskal-Wallis test. The chi-square test or the Fisher exact test was used to compare proportions. The Tukey test was applied to determine differences between groups. The Spearman correlation test was used to determine the relation between waist circumference measurements and the variables BMI, percent fat mass and tricipital, subscapular and suprailiac skin folds.

## Results

A total of 141 adolescents of both gender were evaluated. Of these, 63.1% were classified as being of normal weight, 16.3% as overweight, and 20.5% as obese. The median ages of these three groups of adolescents were 13 years and 3 months (10-18 years), 13 years (10-19.9 years) and 12.5 years (10-17 years) ( $p = 0.406$ ). Median weight was 46.8 kg (28.5 - 70.1 kg) for adolescents of normal weight, 58.1 kg (42.8 - 81.5 kg) for overweight subjects and 68.6 kg (44.8 - 132.4 kg) for obese subjects ( $p = 0.000$ ).

Table 1 shows the distribution of anthropometric and body composition parameters divided into groups according to nutritional status. Median percent body fat differed significantly between subjects of normal weight and overweight and obese subjects (normal weight = 14%; excess weight = 26%; obesity = 27%,  $p = 0.000$ ). There was also a significant difference in waist and arm circumference and in skinfold thickness between the three groups ( $p = 0.000$ ).

Waist circumference was significantly correlated with BMI (0.947,  $p = 0.000$ ), percent body fat (0.757,  $p = 0.000$ ), triceps skinfold (0.723,  $p = 0.000$ ), subscapular skinfold (0.815,  $p = 0.000$ ), and suprailiac skinfold (0.841,  $p = 0.000$ ).

Table 2 presents the distribution of energy and nutrient intake. No significant difference in energy consumption or percent energy contribution by the macronutrients was observed between groups. Also, no significant difference in micronutrient intake was observed between groups. Median percent intake of fat and energy consumption were higher than 30% in all groups.

Regarding the qualitative analysis of the diet, rice, beans, bread, artificial juice, soft drinks, meat, chicken and ham were the foods most frequently consumed. Oranges, bananas, lettuce and tomatoes were also consumed in considerable portions. Table 3 presents the results of the qualitative evaluation of a diet mainly based on the intake of the foods most consumed on a daily basis. Meat consumption was significantly lower and margarine consumption was significantly higher among adolescents of normal weight.

## Discussion

The present study found a higher prevalence of overweight and obesity when compared to other studies conducted in Brazil. In a study conducted in Brazil

**Table 1**  
**Anthropometric and body composition parameters of adolescents aged 10 to 19 years enrolled in a Basic Health Unit in Ribeirão Preto (SP), Brazil, 2008.**

Parameters	Normal weight (n = 89)	Overweight (n = 23)	Obese (n = 29)
Height (cm)	157.0 (134.0–178.5)	158.0 (140.5–171.5)	156.5 (141.5–196.0)
Weight (kg)*	46.8 (28.5–70.1)	58.1 (42.8–81.5)	68.6 (44.8–132.4)
Body Mass Index (kg/m <sup>2</sup> )*	18.9 (14.9–24.0)	22.8 (20.2–28.2)	27.6 (22.4–45.8)
Waist Circumference (cm)*	69.5 (60.0–82.5)	83.3 (70.0–96.0)	92.7 (79.0–145.0)
Mid-arm Circumference (cm)*	23.0 (18.5–29.0)	26.5 (23.0–32.0)	31.0 (25.5–43.0)
Suprailiac Skinfold thickness (mm)*	9.5 (5.5–23.0)	13.5 (9.0–26.0)	22.0 (11.0–46.5)
Biceps Skinfold thickness (mm)*	9.0 (3.0–19.0)	11.0 (4.5–20.5)	17.5 (7.5–36.0)
Triceps Skinfold thickness (mm)*	13.5 (2.5–28.0)	17.5 (9.0–32.0)	25.0 (12.5–40.0)
Subscapular Skinfold thickness (mm)*	9.5 (5.5–23.0)	13.5 (9.0–26.0)	22.0 (11.0–46.5)
Lean body mass BIA (%)*	86.0 (63.0–96.0)	74.0 (62.0–91.0)	73.0 (48.0–93.0)
Fat mass BIA (%)*	14.0 (4.0–37.0)	26.0 (9.0–38.0)	27.0 (7.0–52.0)
Total body water BIA (%)*	63.0 (46.0–70.0)	54.0 (46.0–67.0)	53.0 (35.0–68.0)

\* p = 0.000; statistical difference between all groups.  
Data presented in median (minimum – maximum)

in 1996-1997<sup>21</sup>, an 11.53% prevalence of overweight/obesity was detected in the Southeast region and the conclusion was that the risk of an individual to be overweight/obese may be related to sociocultural factors, including the media, which may have an impact on nutritional status.

Over the last few decades, studies conducted in the U.S. have shown an increase in the prevalence of obesity among adolescents. The National Health and Nutrition Survey Examination (NHANES) II (1976-1980) showed that 5% of adolescent aged 12 to 19 years were obese. The NHANES conducted from 2007-2008 later showed an increase in these frequencies, with 18.1% of adolescents aged 12 to 19 years being obese. In this age group, the prevalence of obesity was 19.3% among boys and 16.8% among girls<sup>1</sup>.

BMI according to age proved to be a good indicator of adiposity, with a significant difference between groups regarding the measurement of waist circumference and of the tricipital, bicipital, subscapular and suprailiac skinfolds. Studies on BMI validation have shown that this index is highly specific, classifying as

obese individuals whose weight is above the 95<sup>th</sup> percentile. The validity of the BMI compared with other body composition screening indexes for the assessment of body fatness in children and adolescents has been confirmed<sup>22</sup>. In a study on 513 children aged 6 to 10 years, Giugliano & Melo also found that BMI showed a good correlation with percent fat and waist circumference for both sexes<sup>23</sup>.

In the present study, waist circumference was correlated with BMI and fat mass. Waist circumference is as highly sensitive and specific measurement that may indicate central obesity, being a good predictor of abdominal fat<sup>24,25</sup> and, together with the BMI, it can also help identify children and adolescents in a situation of higher risk for atherosclerosis and metabolic, orthopedic and respiratory disorders<sup>26</sup>.

In the present study, no association was detected between energy and micronutrient consumption and obesity, with energy consumption being similar for all groups. The mean percentage of calories from lipids did not vary between groups but was higher than the recommended upper limit of 35%<sup>11</sup>. One explanation for these results maybe the limitations found in food

**Table 2**  
**The energy and nutrient intakes of adolescents group enrolled in a Basic Health Unit in Ribeirão Preto (SP), Brazil, 2008.**

<i>Parameters</i>	<i>Normal weight</i>	<i>Overweight</i>	<i>Obese</i>
Energy (kcal/day)	2226 (1083 - 5092)	2199 (1294 - 3747)	2179 (1174 - 5489)
Protein (% energy)	17.2 (10.7 - 24.1)	17.5 (13.3 - 30.9)	18.0 (11.1 - 26.6)
Carbohydrate (% energy)	45.4 (25.5 - 59.9)	43.6 (27.6 - 52.2)	43.6 (34.0 - 51.7)
Lipids (% energy)	36.6 (20.1 - 53.0)	38.3 (31.0 - 48.3)	38.2 (26.7 - 47.8)
Vitamin A (RE/day)	1152 (119.0 - 6184.0)	954.0 (205.0 - 4468.0)	1212.0 (325.0 - 3625.0)
Vitamin C (mg/day)	138.6 (17.0 - 541.0)	142.5 (30.0 - 322.3)	123.0 (21.0 - 372.0)
Vitamin B1 (mg/day)	1.4 (0.6 - 3.3)	1.2 (0.9 - 3.7)	1.8 (0.7 - 5.3)
Riboflavin (mg/day)	1.8 (0.6 - 4.4)	1.6 (0.7 - 3.6)	1.8 (0.7 - 5.3)
Pyridoxin (mg/day)	1.6 (0.5 - 3.4)	1.4 (0.9 - 3.7)	1.6 (0.9 - 3.0)
Zinc (mg/day)	11.3 (3.1 - 25.0)	11.3 (6.6 - 41.0)	11.4 (5.3 - 23.5)
Niacin (mg/day)	18.0 (6.8 - 39.1)	17.6 (11.2 - 34.6)	19.0 (10.5 - 35.0)
Folate (mcg/day)	230.0 (55.3 - 592.0)	183.0 (77.0 - 404.0)	218.0 (103.6 - 393.0)
Calcium (mg/day)	755.0 (289.0 - 2288.0)	604.4 (256.0 - 1500.0)	786.6 (275.0 - 3111.0)
Phosphorus (mg/day)	1415.0 (609.6 - 3030.6)	1290.0 (768.0 - 2600.0)	1404.0 (709.6 - 3722.0)
Magnesium (mg/day)	245.0 (108.0 - 610.6)	198.3 (119.0 - 599.0)	225.0 (129.0 - 498.0)
Sodium (mg/day)	2293.0 (1092.0 - 5813.0)	2261.0 (1294.0 - 6893.0)	2310.0 (1170.0 - 8272)
Potassium (mg/day)	2844.0 (1277.0 - 6530.0)	2682.0 (1476.0 - 4937.0)	2906.0 (1632.5 - 6419)
Iron (mg/day)	13.3 (6.9 - 32.3)	12.8 (8.9 - 26.0)	13.3 (7.4 - 23.9)
Cholesterol (mg/day)	298.3 (115.4 - 895.0)	275.6 (126.5 - 690.0)	315.6 (133.0 - 722.0)
Oleic fatty acid (g/day)	30.4 (11.0 - 82.0)	33.7 (18.0 - 66.7)	32.5 (10.8 - 71.1)
Linoleic fatty acid (g/day)	12.3 (4.4 - 55.3)	12.1 (7.1 - 47.8)	11.1 (4.8 - 84.7)
Saturated fatty acid (g/day)	25.0 (7.4 - 63.0)	28.8 (14.2 - 57.9)	26.2 (8.5 - 77.0)
Fiber (g/day)	16.7 (4.8 - 39.3)	13.0 (5.6 - 43.1)	15.1 (2.2 - 24.1)

No values were statistically different.  $p > 0.05$   
 Data presented in median (minimum - maximum)

**Table 3**  
**Daily pattern of foods more consumed by normal-weight, overweight and obese adolescents, expressed as the percentage of adolescents consuming them, enrolled in a Basic Health Unit in Ribeirão Preto (SP), Brazil, 2008.**

<i>Group</i>	<i>Foods</i>	<i>Normal weight Daily % (n)</i>	<i>Overweight Daily % (n)</i>	<i>Obese Daily % (n)</i>
	Milk	76.4 (68)	60.8 (14)	69 (20)
Dairy products	White cheese	5.6 (5)	-	3.4 (1)
	Mozzarella cheese	4.5 (4)	4.3 (1)	3.4 (1)
Grains group	Rice	100 (89)	100 (23)	100 (29)
	Bread	82 (73)	73.9 (17)	75.9 (22)
Oil group	Margarine*	71.9 (64)	39.1 (9)	55.2 (13)
Legumes	Beans	84.3 (75)	65.2 (15)	75.9 (22)
	Lettuce	32.6 (29)	34.8 (8)	24.1 (7)
Vegetable group	Tomato	20.2 (18)	13 (3)	34.5 (10)
	Banana	16.9 (15)	21.7 (5)	6.9 (2)
Fruit group	Orange	10.1 (9)	13 (3)	6.9 (2)
	Soda	14.6 (13)	26 (6)	17.2 (5)
Sugar group	Artificial juice	31.5 (28)	30.4 (7)	20.7 (6)
Meat group	Meat**	10.1 (9)	30.4 (7)	24.1 (7)
	Chicken	1.1 (1)	4.3 (1)	6.9 (2)
	Ham	3.4 (3)	4.3 (1)	3.4 (1)

\* p < 0.005 Margarine: Normal weight > overweight and obese

\*\* p < 0.01 Meat: Normal weight < overweight and obese

intake assessment tools, such as memory errors, intra-variability bias and underestimation of food intake<sup>27</sup>, but semi-quantitative food frequency records are widely used in epidemiological studies since they permit the estimate of regular nutrient consumption during a given period of time, with good reproducibility and acceptable validity<sup>27</sup>. In addition, our results agree with some previous studies<sup>28</sup>. Mondine & Monteiro assessed the tendencies of macronutrient consumption among residents of the Southeast region of Brazil and observed that the percentage of lipids was high, while the proportion of carbohydrates was reduced<sup>29</sup>. Lipid-rich diets are usually associated with extra energy consumption and result in weight gain among individuals

who are susceptible to obesity, in addition to predisposing to the risks of cardiovascular diseases<sup>11</sup>.

Some studies have shown that when carbohydrate intake is reduced to about 35 to 45% of the total energy contribution to the diet the intake of nutrients such as folic acid and vitamin C is also drastically reduced, leading to an increase in saturated fatty acids<sup>11</sup>, results also obtained in the present study.

Regarding the qualitative analysis, in general there was no significant association between the foods most consumed and nutritional status since the standard intake was similar for all groups. Similar results were obtained in studies with adolescents from the cities of Rio de Janeiro and Viçosa, which compared

the eating habits of normal weight and obese adolescents<sup>28,30</sup>.

Rice was the cereal most frequently consumed, being part of the daily menu of the adolescents, as also observed by Costa et al. in a study of adolescents from the state of Bahia<sup>31</sup>.

Beans were the food most frequently consumed in the leguminous group, especially in combination with rice. Gambardella et al.<sup>32</sup> obtained similar results for adolescents from São Paulo. In the meat group, chicken and ham were among the foods most consumed, in agreement with data reported by Dalla Costa et al.<sup>33</sup>, who also observed the frequent presence of these foods in the diet of adolescents attending public and private schools in the state of Paraná. Milk was considerably consumed by the adolescents but the frequency of daily ingestion was low in all three groups since adolescents tend to ingest less milk than children and adults<sup>34,35</sup>.

Regarding sweets, there was no significant difference between the foods most consumed, with a predominance of coffee with sugar, artificial juice, chocolate and soft drinks as the most preferred items. Hassapidou et al.<sup>33</sup> did not detect significant differences in the consumption of soft drinks between nor-

mal and overweight adolescents<sup>35</sup>. In the fruit group, those of highest consumption were bananas, papayas, oranges and apples, although at low frequency. There was also a high consumption of vegetables such as lettuce and tomatoes. Dalla Costa et al. obtained similar results in a study of adolescents from the state of Paraná<sup>33</sup>.

The frequency of ingestion of vegetables was higher than that of fruit among the adolescents studied but was still lower than recommended<sup>36,37</sup>.

## Conclusion

Food intake does not seem to be the main factor leading to weight gain. The adolescents studied, regardless of their nutritional status, have similar food habits that are inadequate according to the food pyramid recommendation.

## Acknowledgment

We thank the Vila Lobato Primary Health Care Center for providing the data needed to conduct this study.

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## RESUMO

**Objetivos:** Este estudo teve como objetivo descrever e comparar o perfil nutricional de três grupos de adolescentes da mesma idade e sexo, com diagnóstico de sobrepeso, obesidade e eutrofia, determinado pelo Índice de Massa Corporal (IMC).

**Materiais e Métodos:** Estudo transversal, observacional, comparativo, descritivo, no qual os adolescentes foram avaliados utilizando medidas antropométricas, tais como dobras cutâneas, circunferência da cintura, IMC e composição corporal avaliada pela impedância bioelétrica. Um questionário semi-quantitativo sobre a frequência alimentar foi aplicado para avaliar a ingestão de alimentos. A amostra foi determinada por conveniência. Foram atendidos no CMSCVL, no período entre outubro de 2005 e dezembro de 2006, 517 adolescentes. Desse total, 141 (27,3%) concordaram em participar e estavam dentro dos critérios de inclusão.

**Resultados:** Não houve diferença estatisticamente significativa entre os grupos em relação ao consumo de energia e contribuição percentual dos macronutrientes, embora todos os grupos apresentaram uma dieta com percentual de gordura acima dos níveis recomendados. O consumo mediano de lipídios entre os adolescentes eutróficos, com sobrepeso e obesos foi de 36,6%, 38,3% e 38,2% respectivamente. Além disso, não houve diferença estatisticamente significativa entre os três grupos em relação ao consumo de micronutrientes. Quanto à análise qualitativa da dieta, observa-se em geral consumo freqüente de arroz e feijão, assim como pães, salgados, refrigerantes, sucos artificiais, café com açúcar e salsichas. As frutas mais consumidas foram: laranja, maçã e banana, enquanto os legumes mais consumidos foram: alface e tomate. Esses dados são importantes para a política de educação nutricional adotada no centro de saúde.

**Conclusão:** A ingestão alimentar não parece ter sido o principal fator desencadeador do ganho de peso. Os adolescentes, independente do seu estado nutricional, apresentam hábitos alimentares semelhantes e não compatíveis com o recomendado pela pirâmide alimentar.

**Palavras-chave:** Nutrição do Adolescente. Composição Corporal. Estado Nutricional. Consumo Alimentar.

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