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CLINICAL RESEARCH

Prevalence of Overweight in Children of Obese Patients: a Dietary Overview

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Abstract
Background Evidence indicates that eating habits established during childhood related to food intake persist when the child becomes an adult. Parental obesity is positively associated with the development of obesity in the offspring, who tend to become sick and obese young adults during the reproductive phase and end up looking for bariatric surgery in order to reverse the non-communicable diseases (NCDs) already established.
Methods This cross-sectional study evaluated 40 children aged 0 to 10 years, whose mothers underwent bariatric surgery at the Center of Morbid Obesity, Hospital São Lucas, Pontifícia Universidade Católica do Rio Grande do Sul (COM HSL PUCRS).
Results Among these children, 45 % were overweight and 16 had high waist circumference values. The total energy intake and sodium consumption were above the Dietary Reference Intakes (DRIs) for the age group, while dietary fiber and potassium intakes were below DRIs. Obese children had higher percentage of lipid caloric intake (28.3 vs. 25.3 %, $p<0.025$), while the non-obese group tended to have an increased consumption of carbohydrate (62.6 vs. 60 %, $p<0.066$) when compared to the respective DRIs. The presence of NCDs in children's relatives was 100 %.
Conclusions There is probably a significantly higher prevalence of obesity among children of morbidly obese parents when compared to the general child population. Since the familial aggregation of NCDs was absolute, these results point to the need for careful evaluation when dealing with children. However, further studies with a larger number of individuals are needed to confirm these results.

Keywords Obesity · Children · Body mass index · Waist circumference · Diet

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Introduction

Obesity is defined as abnormal or excessive fat accumulation, which may impair health. Childhood obesity has dramatically increased since 1990. In the last 20 years, overweight in preschool children has increased from 4.2 % (95 % CI, 3.2–5.2 %) to 6.7 % (95 %CI, 5.6–7.7 %), reaching 43 million children worldwide. It is expected that by 2020 it will take half the time to see the same increase (50 %) in overweight children, reaching 9.1 % (95 % CI, 7.3–10.9 %) or approximately 60 million children worldwide [1].

In clinical practice, body mass index (BMI) is a simple index to classify the nutritional status of an individual. In children, their anthropometric development is categorized according to the World Health Organization (WHO) Growth Chart Standards. There are two ways to classify it, according to the z score cutoff values and by the percentile cutoff values, where overweight and obesity are defined, respectively, as anthropometric values $\geq z+1$ and $<z+2$ and $\geq z+2$ and $\geq$P85 and <P97 and $\geq$P97 [2]. Childhood obesity is associated with a higher chance of premature death and

disability in adulthood. Overweight and obese children are more likely to stay obese into adulthood and to develop non-communicable diseases (NCDs) at a younger age [3]; these risks depend partly on the age of onset and on the duration of obesity. The most significant health consequences of childhood overweight and obesity, which often do not become apparent until adulthood, include cardiovascular diseases (mainly heart disease and stroke) [4, 5], type 2 diabetes [5], and certain types of cancer (endometrial, breast, and colon) [5].

There is some evidence indicating that eating habits established in childhood related to food availability and to its access [6] and the pattern of physical activity [7] persist when the children become adults [8]. Parental obesity is associated with increased prevalence of obesity in the offspring, who tend to become sick and obese young adults [5, 9–11] during the reproductive phase and end up looking for bariatric surgery in order to reverse their health impairment. This study aimed to evaluate the nutritional profile of children of morbidly obese patients.

Materials and Methods

A cross-sectional study was conducted on children of patients who underwent bariatric surgery at a tertiary center in South Brazil during the period of July 2007 to October 2009. In order to participate in the study, the children needed to meet the inclusion criteria: born of mothers who underwent Roux-en-Y gastric bypass; born before the mother's surgery; aged 0 to 10 years; and consent from their parents to participate. The children excluded were those who had, at the time of enrollment, current dietary monitoring for weight loss.

Data Collection

Nutritional Assessment The data for assessment of nutritional status were collected by anthropometric measurements. To measure the body weight of children under the age of 2, we used the Filizola® electronic pediatric scale (capacity 15 kg), where the baby wore as little clothing as possible, preferably only a dry diaper. The baby was placed in the middle of the basket of the balance. To measure the body weight of children older than 2 years of age, we used the Filizola® electronic adult scale (capacity 350 kg). The same procedures were followed as for adults. The length of children under the age of 2 years was determined with a Tonelli® infant stadiometer (measuring from 0 to 100 cm). The child was barefoot and without accessories on the head. He/she was laid on a smooth surface, while the mother held the child's head resting on the vertical plane, in contact with the fixed part of the stadiometer. The examiner pressed the child's knees against the surface so the child stood straight. The mobile square was dragged until touching the feet. The height of children older than 2 years was determined using a Tonelli® vertical stadiometer (measuring from 70 to 220 cm). The same procedures were followed as for adults. Waist circumference (WC) was measured using a Sanny® nonelastic, fixed tape (range of use 2 m). We measured WC at the midpoint between the last rib and the iliac crest. The measurement was taken in the horizontal position and recorded. Differently from what occurs in adults, in which high values of WC are the same, regardless of age, for children percentile cutoff points is used to establish the WC value according to each gender and each age group, however, the absolute values of the WC are different. Thus, WC of children of different ages can be compared because the expected differences between age groups are corrected. As the classification of WC in children is made by percentiles according to each age group [12], this sample was primary stratified according to age and, then, respectively classified. The circumference was considered inappropriate above P90 [12]. So, this classification is divided into two—appropriate and inappropriate, <P90 and >P90, respectively. Children were considered physically active if they engaged in any activity that required dynamic movement of large muscle groups for at least 20 min a day and at least three times a week [13]. To assess the nutrient intake of children, we used the 24-h recall, answered by the parents when children were less than 8 years old [14]. We used the DietWin® program to calculate the children's total nutrient intake. Regarding the micronutrient sodium, the amount added to the preparation of food was computed, because the software records the food already cooked with an extra sodium standard. Thus, it is possible that the amount of this element is under- or overestimated. Some sociodemographic and retrospective data related to health were recorded, such as gender, race, and chronic disease among family members (first- and second-degree relatives): type 2 diabetes, hypertension, kidney disease, and cardiovascular disease. We considered only the presence or absence of disease, not their severity.

Statistical Analyses

Continuous variables with normal distribution were described as means with standard deviation. Variables with asymmetric distribution were described as medians with 25–75 percentiles. Pearson's correlation and Fisher exact test were used to evaluate the association and/or correlation of the variables. The Mann–Whitney U test was used to compare nutrient consumption between the obese and non-obese groups. For all analyses, $p<0.05$ was considered statistically significant.

Results

Subjects

All children who met the eligibility criteria were contacted. Of the 67 children who were invited to participate, only 40 were evaluated. The 27 losses occurred at the recruitment and were due to the following reasons: (1) lived far away; (2) failure to attend appointments; and (3) lack of time to bring the child to the appointment. Table 1 shows the children's baseline characteristics. Approximately 52 % of the sample were girls. Most children (80 %) were white, reflecting the general population from which the children were recruited. The average age was 6.5±2.65 years, minimum and maximum ages were respectively 1.5 and 10 years. Forty-five percent of the children were overweight.

Prevalence of Obesity According to Characteristics Analyzed

Table 2 presents the analysis concerning the prevalence of obesity according to sociodemographic characteristics, anthropometric measures, and physical activity level. There was no statistical significance concerning the prevalence of obesity regarding gender ($p>0.05$). The prevalence of obesity was slightly higher among non-white children (50 %) compared to white children (43.8 %), but without statistical significance. The high values of waist circumference were positively associated with obesity ($p=0.008$), which affected 75 % of children with WC above normal.

Food Intake Adequacy

Table 3 shows the characteristics of the children's nutrient intake. The reference values for the vitamins and elements were established based on the average age (6.5±2.65) of the subjects. There was adequate intake of most nutrients. However, two nutrients (fiber and potassium), when compared to their reference intake, were less than ideal. The fiber intake was approximately 50 % and the potassium intake less than half that recommended. On the other hand, the sodium intake was very high (2,421.5 mg), compared to the reference value (1,200 mg) and considering that the upper limit (UL) of intake is 1,900 mg. The total energy intake per day established for this age group was 1,450 kcal, which was exceeded by 40 %.

Table 1 Characteristics of the study group

Variable	
Gender	
Female	21 (52.5 %)
Race	
White	32 (80 %)
Age (years)	6.5±2.65
Weight (kg)	27.38±9.98
Height (cm)	120.71±16.54
Birth weight (kg)	3.17±0.66
BMI	
Eutrophic	22 (55 %)
Overweight	5 (12.5 %)
Obesity	13 (32.5 %)

The results are expressed in absolute and relative frequencies, and mean and standard deviation

Table 2 Prevalence of obesity according to sociodemographic characteristics, anthropometric measures, and physical activity level

Variable		*P* value
Gender		
Female	38.1 %	>0.05
Male	52.6 %	
Race		
White	43.8 %	>0.05
Other	50 %	
Waist circumference (cm)		
Appropriate	6 (27.3 %)	0.008
High	12 (75 %)	
Physical activity level		
Yes	13 (46.2 %)	>0.05
No	27 (44.4 %)	

The results are expressed in absolute and relative frequencies

Table 3 Dietary characteristics of the study subjects

Nutrients	Median (P25–P75)	Reference (DRIs)
Total energy intake, kcal	2,030 (1,483–2,514)	1,450[a]
Carbohydrate, %	60.4 (54.4–63.9)	45–65
Protein, %	12.5 (10.4–14.2)	10–30
Lipid, %	27.4 (23.1–31.2)	25–35
Fiber, g	12.5 (7.48–15.04)	25
Calcium, mg	815.4 (460.3–1,028.8)	800
Iron, mg	11.3 (7.9–14.5)	10
Sodium, mg	2,421.5 (1,798.1–3,332.7)	1,200
Potassium, mg	1,553.7 (999.1–2,060.5)	3,800
Magnesium, mg	180.3 (116.5–215.8)	130
Phosphorus, mg	705 (531.5–849.8)	500
Zinc, mg	5.6 (4.2–9.2)	5
Vitamin A, μg	457.2 (380.5–702.2)	400
Vitamin C, mg	63.3 (33.8–128.4)	25

[a] Dietary reference intake for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids (macronutrients). Food and Nutrition Board—FNB, 2005

Food Intake According to Nutritional Status

The obese children consumed higher proportions of total fat than non-obese (28.3 vs 25.3 %, respectively; $p<0.025$). On the other hand, carbohydrate intake tended to be higher in the non-obese group when compared to obese (62.6 vs 60 %, respectively; $p<0.066$).

Family Aggregation of Non-communicable Diseases

The presence of NCDs in relatives was frequent (Fig. 1). Approximately 98 % of the children had a family member with hypertension and 82.5 % with a relative with type 2 diabetes; almost 80 % had a relative who had some form of cardiovascular disease (myocardial infarction, angina, stroke, heart failure), and 30 % with family with some type of kidney disease (nephritis, kidney stone, kidney failure).

Discussion

The prevalence of childhood obesity in the current study was considerably higher than that described in other Brazilian studies [15]. However, the latter did not report the presence of morbid obesity in parents.

In this study, 16 children showed high levels of WC, 12 (75 %) of whom were obese. A recent study [16] evaluated the association between WC and the phenotype of metabolic syndrome in a cohort of 635 adolescents, and the findings suggested that WC values ≥P75 and reduced physical activity are trigger indicators for the development of metabolic syndrome.

The dietary habits of the children in the present study showed a tendency toward higher sodium and calorie intake than that recommended. Obese children tended to have a higher consumption of lipids, which may be connected to unhealthy food choices. This does not mean that obese children eat more food but that they choose high fat foods. Some food items reported by the children were hot dogs, pizza, hamburgers, and snacks. These findings may indicate the parents' negligence about food availability. As mothers have shown greater involvement regarding the preparation of meals, it is important to remind them about the correct food choices at the supermarket and about the results that "fast and easier" food preparations, such as fried foods, can bring long-term to their children. Thus, the child is possibly raised in an environment conducive to acquiring unhealthy eating habits, which can promote early-onset obesity. The intake of fiber (25 g) was half that recommended, which corroborates the findings of some studies [17, 18]. It was observed that the intake of fruits and vegetables was not enough. It probably contributed to the inadequate intake of dietary fiber, which, in addition to helping a proper functioning of the gastrointestinal tract, protects against colorectal cancer and reduces the risk of diverticulitis. A very common gastrointestinal disorder in childhood is chronic functional constipation, which can be prevented through an adequate intake of fiber [19]. Adequate intake of potassium is associated with improved blood pressure and other vital functions in which plays the role of the main intracellular cation. Besides, in addition to dairy, several nutrients—including potassium—has emerged as an important modifiable protective factor for bone health [20].

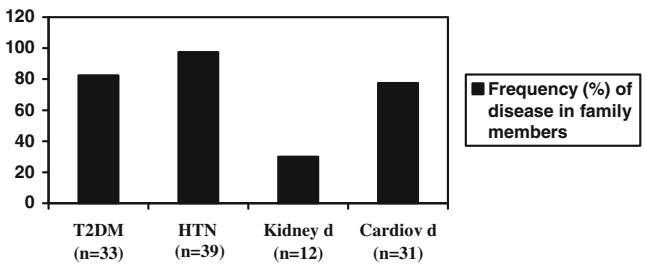

Fig. 1 Frequency (%) of non-communicable diseases in first- or second-degree relatives

A history of NCDs in the children's relatives was frequent. As this study considered only the first- and second-degree relatives, there was a great possibility that the children inherited some genetic factors that are triggering factors, along with environmental factors, behavior and lack of physical activity, and the development of these diseases at a certain moment of the child's life. These findings may be aggravated in those children whose WC are above ideal, associated with the presence of obesity.

Although the nutrient intake results in the current study corroborate those found in the literature, the 24-h recall method cannot be considered ideal to assess the usual food intake, and thus, it is a limitation of this study.

The results of this study concerning physical activity contradict those reported in the literature [21, 22], which indicate that engaging in physical activity in childhood constitutes an important protective factor against the development of overweight and obesity and the health impairments arising from it. It is possible that the small sample size is a limiting factor that may have contributed to these results.

Although this study was limited by its sample size and did not include an investigation of clinical parameters, the hypothesis that BMI and WC in childhood may predict the onset of NCDs in adulthood should be considered [16]. So, as the child does not chose which food will be available at home, a whole family engagement—and it includes parents, grandparents, or others who are responsible—since early childhood, on providing healthy food and an adequate environment. Requesting for advice by a health professional is important to assist caregivers in order to provide a favorable environment for a full and healthy child development.

Considering the Sample Size and the Methods

Further studies are necessary with a larger number of individuals than in the current study in order to obtain better statistical evaluation of the results. The addition of a food frequency questionnaire, which may reflect the usual intake of the subjects, an evaluation of biochemical tests related to MS, and an evaluation of aspects related to pregnancy would be of great help in identifying the triggering factors of childhood obesity.

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