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Association between nutritional status, food habits and physical activity level in schoolchildren

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Abstract

Objective: To analyze the relation between nutritional status, food habits and physical activity level in schoolchildren.

Methods: A cross-sectional study was carried out with 661 schoolchildren, from 6 to 14 years old, enrolled in public and private schools located in the urban area of Ouro Preto, state of Minas Gerais, Brazil. A semi-structured questionnaire was applied to collect data on demographic, socio-economic, anthropometric and level of physical activity variables. Schoolchildren were classified according to criteria for body mass index by age, body fat percentage and physical activity level, respectively. Dietary data were collected through a validated food frequency questionnaire specific for children and adolescents. Food consumption was evaluated according to an adaptation of the Recommended Foods Score, whose objective is the assessment of overall diet quality with a focus on healthy food consumption.

Results: We observed high frequency of overweight according to body mass index per age (20.1%) and body fat percentage (22.8%), as well as physical inactivity (80.3%) among schoolchildren. We also found low scores on the Recommended Foods Score in 77.2% of students. There was no significant relation between overweight and physical inactivity or food consumption ($p > 0.05$).

Conclusion: Schoolchildren had a high frequency of overweight, which, alone, was not associated with the high physical inactivity and the low quality diet observed. Therefore, more studies should be performed to identify other factors besides those already described, which may be influencing overweight in this population.

J Pediatr (Rio J). 2012;88(5):406-12: Overweight, obesity, food habits, physical activity, child, adolescent.

Introduction

The early development of overweight and obesity has increased alarmingly among children and adolescents worldwide, representing a public health problem that can cause damage in the short and long term and may be an important predictor of obesity in adulthood.[1]

The Household Budget Survey, conducted in 2008-09 in Brazil, revealed that 33.5% of children aged 5-9 years are overweight and 21.5% of adolescents are either overweight or obese.[2] The Survey also found a large increase in the prevalence of overweight among young Brazilians in the last 3 decades.

According to some studies, this growing increase of excess weight can be explained by environmental and behavioral factors; among them, the reduction of physical activity and the adoption of inadequate eating habits, increasing the energy supply. Such factors seem to be the

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most related to the scenario of positive energy balance characteristic of obesity.[3-5] Nevertheless, in Brazil,[5] the different impacts of dietary habits and physical activity on the prevalence of overweight are unknown, especially in children and adolescents.

It is known that these behavioral factors are acquired in childhood and adolescence, so it is essential to study them for the identification of healthy habits; since, according to Schieri et al.,[6] the increased consumption of foods rich in nutrients, i.e., a better quality diet, can be considered as a strategy for prevention, control, and fight against obesity among children and adolescents.

Therefore, this study aimed to analyze the relationship between dietary habits, physical activity levels, and nutritional status of children and adolescents enrolled in public and private schools in the municipality of Ouro Preto, state of Minas Gerais.

Methods

Population and study design

The municipality of Ouro Preto, located in central Minas Gerais, had an average of 5,963 children (6-9 years old) and 4,897 adolescents (10-14 years old) enrolled in all schools located in the urban area in 2006.[7]

We conducted an epidemiological study and cross-sectional design in such students, which were selected by means of random sampling stratified by the proportion of students according to age, sex, and school grade in public (n = 14) and private (n = 2) schools. The sample size (n = 850) was calculated according to the premise of 8% overweight prevalence, 3% level of accuracy desired, 20% losses, 90% power and 5% significance level.[8] Children and adolescents with special needs were not included in the study.

Data collection and analysis

Data were collected by a trained group of researchers in the period of March to December 2006, by applying a semi-structured questionnaire in face-to-face interviews with volunteers and their parents. The following variables were included: demographic (age and sex), socio-economic (family income and parental education), anthropometric (weight, height and body fat), dietary, physical activity and sedentary activity levels.

The socio-economic variable family income was categorized and analyzed based on the Brazilian minimum wage at the time of the study (R$ 350.00). Parental education was categorized into beyond complete high school; complete elementary to incomplete high school; and lower than elementary school or illiteracy.

Regarding anthropometric variables, weight was measured on a Tanita BF542® scale (Tanita Corporation of America, Arlington Heights, IL, EUA), while height was determined using a WCS® stadiometer. Measurements of weight and height were used to calculate body mass index (BMI). Children were classified as having excess weight (overweight or obesity) based on BMI/age expressed as z score, calculated with the WHO-Anthro Plus 2007, and following the recommendations proposed by the World Health Organization.[9] Schoolchildren with BMI > z score + 1 were considered overweight.

Bioelectrical Impedance (BIA) was performed using the RJL Quantum 101 tetrapolar apparatus (RJL Systems), applying a current of 800 μA at 50 kHz. The analysis was made according to the standard procedure.[10] Individuals remained in supine position for 10 minutes before the evaluation, which occurred in room temperature of approximately 25 ºC. Body fat was determined using the software for children and adolescents from the BIA apparatus itself, and body fat percentage (BF%) was calculated with the values of resistance and reactance according to Chumlea et al.[11] For the classification of BF%, the recommendations of Taylor et al.[12] were adopted.

Dietary variables were collected through a food frequency questionnaire (FFQ) developed and validated by Slater et al.,[13] which is specific for children and adolescents, and added by food items consumed locally according to Faria.[14] The instrument presented a list of foods composed of 120 items, whose frequencies of consumption were categorized in never, less than once a month, once to 3 times per month, once a week, 2 to 4 times a week, once a day and 2 or more times daily. Such data were assessed by means of a healthy diet score, which refers to the Recommended Foods Score (RFS).

This score was initially developed by Kant et al.[15] and McCullough et al.[16] in order to verify the overall quality of the diet by using a FFQ, being focused on the consumption of fruits/vegetables, lean meats, cereals and low-fat dairy products. In this study, RFS was prepared using the methodology of these authors adapted to the characteristics of the present study and the recommendations of the Brazilian Ministry of Health[17] regarding healthy diet for children and adolescents.

Thus, 50 of the 120 items of FFQ were selected to compose the list of recommended foods of the RFS (Table 1), and the score was calculated, adding one point for each item of food recommended and consumed at least once a week, which resulted in a maximum score of 50 points.

In relation to the level of physical activity, students were considered active when they performed more than 300 minutes of physical activity per week and inactive when performed less than 300 minutes/week.[18] Furthermore, the practice of sedentary activities was evaluated, which included watching television, playing videogames and seating in front of the computer for more than 2 hours per day.[19]

Statistical Analysis

The statistical analysis was performed with the PASW Statistics Grad Pack 17.0 software. RFS data were divided into quintiles based on their sample distribution. The association of the nutritional status of the students in each of the four lower quintiles was compared to the highest quintile of consumption.

Data normality was verified by the Kolmogorov-Smirnov test. For statistical analysis, we used the Student *t* test or Mann-Whitney test according to the presence of data homoscedasticity.

The association between nutritional status of children, by BF%, and the possible explanatory variables (socio-demographic, dietary and physical activity/inactivity) were analyzed through the Pearson chi-square test or Fisher exact and odds ratio, as well as by univariate logistic regression model.

It was considered as statistically significant, the probability of less than 5% in all established tests.

Ethical Issues

This study was approved by the Research Ethics Committee of Universidade Federal de Ouro Preto (report nº 2004/46) in 2006, and informed consent was obtained from each child and adolescent, as well as from parents or legal guardians before the study.

Results

This study had a total of 661 students who participated and a loss percentage of 22% because part of the parents did not answer the FFQ and the collection of data on physical and sedentary activities adequately. However, the sample presented statistical power of 99.7%, considering the frequency of overweight observed in the children and adolescents studied.

Among students, 52.2% were boys and 47.8% girls, with mean age of 10.56±2.44 years. The frequency of excess weight according to BMI/age observed in these students was of 20.1%; and high BF% was verified in 22.8%.

Regarding BF%, its mean value among students was of 30.28±9.95%. Among children (6-9 years), the mean BF% was 31.22±9.03%; among adolescents (10-14 years), 29.73±10.44%, and there was no significant difference between groups (p = 0.15).

Table 2 presents demographic, socio-economic, anthropometric, dietary and physical and sedentary activity levels according to stratification per age. No significant difference was observed between family income, parental education, dietary intake, BMI and BF%. However, the levels of physical activity and sedentary activity were different (p = 0.03 and p = 0.04, respectively) between children and adolescents.

Table 3 presents the comparison between students with and without excess weight by BF% according to demographic, socio-economic, dietary, and physical and sedentary activity characteristics. It is noteworthy that there were no significant differences between the groups regarding the variables; however, there was difference regarding physical activity, in which 80.3% of individuals were classified as inactive, with mean time of 250 minutes of physical exercise per week; 88.4% of students spent 2 hours per day in sedentary activities, with mean time spent watching television, playing videogames and using the computer of 3 hours and 20 minutes, 4 hours and 30 minutes and 4 hours and 10 minutes per week, respectively; and, when considering such activities together, the mean sedentary time was 23 hours/week and 3 hours and 30 minutes/day.

Regarding RFS, 77.2% of students scored low on the healthy diet score, with an average of 16.00±6.82 points. Among children, the mean score was 16.00±6.83 points; and among adolescents, 15.99±6.88 points. When assessing the

Table 1 - Components of the adapted Recommended Foods Score

Groups	Foods
Vegetables	Tomato, broccolis or cauliflower, spinach, mustard or sow thistle, cabbage, carrot, lettuce, swiss chard or round cabbage, watercress or rocket, fern sprouts, *ora-pro-nobris*, corn or peas, squash, beetroot, chayote, zucchini, okra, cucumber, yam, potato, sweet potato, boiled cassava
Fruit	Apple or pear, orange, cantaloupe or watermelon, orange juice or lemonade, other fruit juices, banana, strawberry, pineapple, tangerine, papaya, mango, guava, plum or kiwi, grapes
Cereals	Various types of bread, cereal bar, white rice
Dairy	Skimmed milk, fermented milk, fruit vitamins, natural yogurt or fruit yogurt, diet yogurt, low-fat cheese
Legumes	Beans, soy
Lean meats	Cooked, roasted or grilled chicken, baked or broiled fish
Maximum score	50 points

mean score between the groups with (15.73±6.81 points) and without (16.08±6.84 points) excess body fat, it was verified that there was no significant difference between them (p = 0.56).

Finally, in univariate logistic regression analysis, we could not demonstrate a significant relationship between excess weight by BF% and the exposure factors analyzed.

Discussion

The present study revealed a high frequency of overweight (22.8% by BF%) among students from Ouro Preto, which was not associated with the low diet quality and the high level of physical inactivity. The study also found, at analyzing the BF% of these young people in relation to age, a trend towards a higher BF% in children; however, no significant difference between children and adolescents was found, as already observed by Cândido et al.[20] in a previous study conducted with the same population.

Other studies have also revealed worrying profiles of overweight among young people from different regions of the country. In a cross-sectional study involving students from 7-17 years in the municipality of Maceió, state of Alagoas, Mendonça et al.[21] observed a frequency of 13.8% overweight, using the classification of Centers for Disease Control and Prevention. Triches & Giuglian[22] observed a frequency of 24.4% overweight among children aged 8-10 years enrolled in public schools in the municipalities of

Table 2 - Demographic, socio-economic, physical/sedentary activity, dietary and anthropometric characteristics of children (6-9 years) and adolescents (10-14 years) from Ouro Preto, state of Minas Gerais, 2006

Variables	Children (6 to 9 years) n (%)	Adolescents (10 to 14 years) n (%)	Total	p*
Family income†				
> 4 wages	24 (34.30)	46 (65.70)	70	
1-4 wages	181 (38.90)	284 (61.10)	465	0.45
< 1 wages	26 (43.34)	34 (56.66)	60	0.29
Parental education				
> CH	64 (36.80)	110 (63.20)	174	
CE - IH	39 (37.86)	64 (62.13)	103	0.85
< IE	125 (39.06)	195 (60.94)	320	0.62
Physical activity				
> 300 min/week	38 (29.23)	92 (70.77)	130	
< 300 min/week	209 (39.36)	322 (60.64)	531	0.03
Sedentary activity				
< 2 hours/day	37 (48.05)	40 (51.95)	77	
> 2 hours/day	210 (36.00)	374 (64.00)	584	0.04
RFS (points)				
> 80th Percentile	55 (36.42)	96 (63.58)	151	
< 80th Percentile	192 (37.65)	318 (62.35)	510	0.78
BMI/age				
Eutrophic	193 (37.40)	323 (62.60)	516	
Low BMI/age	3 (25.00)	9 (75.00)	12	0.57
Overweight	31 (37.35)	52 (62.65)	83	0.99
Obese	20 (40.00)	30 (60.00)	50	0.71
Body fat (%)				
Normal	187 (36.67)	323 (63.33)	510	
High	60 (39.74)	91 (60.26)	151	0.49

BMI = body mass index; CE = complete elementary school; CH = complete high school; IE = incomplete elementary; IH = incomplete high school; RFS = recommended foods score.
* Chi-square Pearson test or Fisher exact.
† Family income based on the minimum wage at the time of the study (R$ 350.00).

Table 3 - Nutritional status of children and adolescents studied, distributed according to demographic, socio-economic, dietary and physical/sedentary activity variables, Ouro Preto, state of Minas Gerais, 2006

Variables	Without excess body fat n (%)	With excess body fat n (%)	Odds ratio (95%CI)	p*
Sex				
Male	276 (80.00)	69 (20.00)	1	
Female	234 (74.10)	82 (25.90)	1.40 (0.97-2.02)	0.07
Age (years)				
6-9	187 (75.40)	60 (24.30)	1	
10-14	323 (78.00)	91 (22.00)	0.88 (0.60-1.27)	0.49
Family Income†				
> 4 wages	54 (77.10)	16 (22.90)	1	
1-4 wages	344 (74.00)	121 (26.00)	0.84 (0.44-1.58)	0.57
< 1 wages	49 (81.70)	11 (18.30)	1.32 (0.52-3.40)	0.53
Parental Education				
> CH	133 (76.40)	41 (26.40)	1	
CE - IH	79 (76.70)	24 (23.30)	1.01 (0.55-1.88)	0.96
< IE	246 (76.90)	74 (23.10)	1.02 (0.65-1.62)	0.91
RFS (points)				
> 80th Percentile	122 (80.80)	29 (19.20)	1	
< 80th Percentile	388 (76.10)	122 (23.90)	1.32 (0.84-2.08)	0.23
Physical Activity				
> 300 min/week	97 (74.60)	33 (25.40)	1	
< 300 min/week	413 (77.80)	118 (22.20)	0.84 (0.54-1.31)	0.44
Sedentary Activity				
< 2 hours/day	58 (79.30)	19 (24.70)	1	
> 2 hours/day	452 (77.40)	132 (22.60)	0.89 (0.51-1.55)	0.68

95%CI = 95% confidence interval; CE = complete elementary school; CH = complete high school; IE = incomplete elementary school; IH = incomplete high school; RFS = recommended foods score.
* Chi-square Pearson test.
† Family income based on the minimum wage at the time of the study (R$ 350.00).

Dois Irmãos and Morro Reuter, state of Rio Grande do Sul, according to criteria from the National Health and Nutrition Examination Survey.

These findings show that the nutritional status of children and adolescents is of great interest for public health, once obesity in these age groups is often associated with the early development of other chronic diseases such as hypertension, dyslipidemia and diabetes mellitus.[23] Furthermore, the effects of obesity in young people may lead to long term health problems, such as the increased risk of mortality, especially by cardiovascular diseases in adults who were obese during childhood and adolescence.[23]

It is known that maintaining a healthy lifestyle since childhood is of great importance for the prevention of obesity, once many characteristics of adult life are acquired and/or consolidated in this age group, making it important to evaluate determinant factors such as dietary habits and the practice of physical activities.[24] As for the latter, it is important to emphasize that the practice of physical activities among children and adolescents should be continually stimulated, because although the majority of diseases related to sedentary lifestyle will manifest only in adulthood, it is known that their development can begin in childhood or in adolescence.[25]

Therefore, some authors have conducted studies in order to investigate the practice of physical activity in these age groups, showing higher frequencies of inactivity among children and adolescents, which is consistent with the findings in the present work. Hallal et al.,[25] for instance, showed a high prevalence of physical inactivity among adolescents, since 58.2% of them reported practicing fewer than 300 minutes/week of physical activity.

Baruki et al.,[26] while studying students aged 7-10 years in the municipality of Corumbá, state of Mato Grosso do Sul, verified a mean time spent in sedentary activities similar to the present study (more than 2 hours per day). These

same authors observed an increased BF% and higher BMI in less active children; and that, activities such as watching television and playing videogames for more than 2 hours/day are risk factors for overweight and obesity.

Considering the high levels of physical inactivity and sedentary activity presented in such studies,[25-26] it is possible to verify that those were even higher among youth from Ouro Preto, which may be partly explained by some particular characteristics of the municipality. It is a historic city whose topography is mountainous, with many slopes and hills; the streets are narrow with an old pavement, there are few paved streets, and there is a shortage of suitable sites for practicing physical exercises, discouraging mainly children and adolescents.

As for food consumption, it is related to excess weight both due to the volume of food intake regarding the composition and quality of the diet and to dietary changes, such as the consumption of sweets (filled cookies, snacks, sweets) and soft drinks, which partly explain the continuous increase in adiposity in children and adolescents.[22] In addition, foods such as fruit and vegetables, with lower energy density and that are more nutritious, are increasingly scarce in children's diet; and an alternative approach to fight excess weight would be to encourage an increased consumption of these food items.[4,27]

However, few studies evaluate the consumption of fruits and vegetables as a protective factor against obesity,[27] which represented a motivation to study the relation between dietary habits and obesity by a healthy diet score.

As for the present study, there was no association between students' excess weight and food intake assessed by the RFS, corroborating the longitudinal intervention study performed by Epstein et al.[28] These authors investigated the relation between healthy food and obesity in children aged 6-11 years and in their parents, and verified no significant reduction in the percentage of overweight in the children who were encouraged to eat more fruit and vegetables over a 1-year follow-up.

In contrast, for Enes & Slater,[23] an adequate consumption of fruit and vegetables represents a protective factor for the development of obesity, which was also observed in the study by Oliveira et al.,[27] conducted with children aged 5-9 years, in which an inverse association between high frequency (three times per week) of vegetables consumption and overweight was observed.

Regarding the limitations of the study, a cross-sectional study only provides an isolated analysis of the characteristics of the population and does not allow establishing a causal relationship. The quantitative analysis of the students' diet was not performed, which represents another limitation of this research. However, authors such as Fisberg[29] report that the study of the diet, with its various combinations of foods, more than the consumption of individual food items or the ingestion of nutrients, may be more interesting, since the food items are not consumed alone and reflect the choice of each individual for a determined lifestyle. We also know that problems related to differences in the portioning of food and under/overestimation of food intake are often reported in studies of dietary investigation, which meant that the RFS was planned to score the foods selected in the questionnaire that were consumed weekly regardless of portion sizes, making it less affected by inaccurate reports about portioning.[15]

Another positive and important aspect to be considered in this study was the use of BF% instead of BMI as an indicator of obesity. Cândido et al.[30] reported that although BMI is an easy and reproducible measurement of body fat, it is not a perfect measure of obesity, since height is represented as a covariate, and it changes with the result of aging, especially in growth phases like childhood and adolescence. Another problem is that, because BMI does not measure body fat directly, the cutoff points that define obesity are statistical derivations for these age groups, and there is no consensus about them.

Thus, the present study provided the advantage of using BF% as an obesity indicator and a different approach to food consumption evaluation, which, although it did not show association with obesity in this population, may be used in other populations and/or in the study of other non-communicable chronic diseases.

We may conclude through the present study, that the population studied presented a high frequency of overweight, which, alone, was not associated with the high level of physical inactivity and the low quality diet observed. Therefore, more studies should be conducted to identify the possibility of interaction between these factors and even other factors besides those described that may be influencing the presence of overweight in this population, to, thereby, support the development of actions and strategies to control and fight obesity among young people.

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