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Association between inaccurate estimation of body size and obesity in schoolchildren

Associação entre a inacurácia na estimação do tamanho corporal e a obesidade em escolares

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Abstract

Objectives: To investigate the prevalence of inaccurate estimation of own body size among Brazilian schoolchildren of both sexes aged 7-10 years, and to test whether overweight/obesity; excess body fat and central obesity are associated with inaccuracy.

Methods: Accuracy of body size estimation was assessed using the Figure Rating Scale for Brazilian Children. Multinomial logistic regression was used to analyze associations.

Results: The overall prevalence of inaccurate body size estimation was 76%, with 34% of the children underestimating their body size and 42% overestimating their body size. Obesity measured by body mass index was associated with underestimation of body size in both sexes, while central obesity was only associated with overestimation of body size among girls.

Conclusions: The results of this study suggest there is a high prevalence of inaccurate body size estimation and that inaccurate estimation is associated with obesity. Accurate estimation of own body size is important among obese schoolchildren because it may be the first step towards adopting healthy lifestyle behaviors.

Keywords: Body image, obesity, child, perception, cross-sectional studies.

Resumo

Objetivos: Investigar a prevalência de inacurácia na estimação do tamanho corporal em escolares brasileiros de ambos os sexos com idade entre 7 e 10 anos e testar a associação com o sobrepeso/obesidade, excesso de gordura corporal e obesidade central.

Métodos: A acurácia na estimação do tamanho corporal foi avaliada por meio da Escala de Silhuetas Brasileiras para crianças. As análises de associação foram realizadas por meio de regressão logística multinomial.

Resultados: A prevalência geral de inacurácia na estimação do tamanho corporal foi de 76%, sendo que 34% das crianças subestimaram seu tamanho corporal e 42% o superestimaram. A obesidade medida por meio do índice de massa corporal foi associada a subestimação do tamanho corporal em ambos os sexos, enquanto que obesidade central se associou com superestimação do tamanho corporal apenas em meninas.

Conclusões: Os resultados deste estudo demonstram uma elevada prevalência de inacurácia na estimação do tamanho corporal e sua associação com a obesidade. A acurácia na estimação do tamanho corporal é importante entre escolares obesos, pois pode ser o primeiro passo para a adoção de comportamentos mais saudáveis de vida.

Descritores: Imagem corporal, obesidade, criança, percepção, estudos transversais.

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This manuscript was based on the first author's doctoral dissertation, currently underway, entitled "Obesidade e imagem corporal em escolares de 7 a 10 anos de Florianópolis, SC: um estudo transversal" (Obesity and body image in schoolchildren aged 7 to 10 years in Florianópolis, SC: a cross-sectional study), which will be submitted to the Universidade Federal de Santa Catarina (UFSC), Florianópolis, SC, Brazil, in 2016.

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Introduction

Body image is conceptualized as the image one has in one's mind of the size, shape and contours of the body, as well as one's feelings about these characteristics,¹ and thus includes two components: attitudinal and perceptual.²

The attitudinal component refers to feelings, thoughts and actions related to the body. The perceptual component involves evaluating the accuracy of the estimation of body size.² Perceptual distortion corresponds to inaccurate judgment of body size,³ which has been recognized as an important psychobiological and sociocultural factor and linked to attitudes to weight control and eating disorders.⁴⁻⁶

Although the perceptual component is essential to the understanding of body image, few studies have evaluated it. The national and international literature reveals growing research interest in body image over the past decade. However, investigations have been focused on children in secondary education,⁷⁻¹⁰ college students¹¹⁻¹³ and females^{7,11,12,14-16} and have tended to only evaluate the attitudinal component of body image.^{8,9,11-13,15,17}

The literature suggests that body image is already formed in childhood,¹⁸ and the perceptual component is clearly related to development of eating disorders,⁵ which have been increasing in incidence among the male population.^{19,20} Furthermore, it has been shown that people who are overweight or obese, as assessed by body mass index (BMI), are more likely to estimate body size erroneously.^{4,21,22}

Only one previous study was identified that investigated the associations between inaccurate body size estimation and BMI, percentage body fat (%BF) and waist circumference (WC),²² and this study only evaluated schoolchildren aged 12-16 years. To the best of our knowledge, no studies have been conducted with younger schoolchildren, aged 7-10 years. It is therefore considered important to investigate the prevalence of inaccurate estimation of own body size among schoolchildren of both sexes aged 7-10 years, and to test whether it is associated with overweight/obesity; excess body fat; and/or central obesity.

Materials and methods

Participants

This was a cross-sectional school-based study, conducted in 2012/2013, as part of a research project

funded by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq; protocol no. 402322/2005-3), in Florianópolis, the state capital of Santa Catarina, southern Brazil, using data from 1,530 schoolchildren aged 7 to 10 years.

Considering the total number of schoolchildren available and the prevalence rates of different exposure and outcome variables and after adjustments for confounding factors, this study had a power of 80% to detect a statistically significant ($p < 0.05$) odds ratio (OR) of between 0.77 and 0.66 for protective factors, and of between 1.23 and 1.34 for risk factors.

A cluster sampling process was employed. Schools were allocated to 10 strata, according to the administrative regions of Florianópolis (Center, Continent, North, East and South) and type of school (public or private). In each stratum, schools were randomly selected for inclusion in the study. A total of 30 schools were selected, 9 municipal-run public schools, 10 state-run public schools and 11 private schools. The classes from each school to be evaluated were subsequently selected at random from lists of the schoolchildren available at each institution.

The study was approved by the Ethics Committee at the Universidade Federal de Santa Catarina (Decision number 120341/2012) and written consent forms were signed by the parents or guardians of all schoolchildren.

Procedure

Anthropometric measurements were taken by a team of investigators, duly trained by a physical education professional who was an ISAK certified trainer (International Society for the Advancement of Kinanthropometry) and considered the benchmark for the anthropometric measurements used in this study. The quality of anthropometric measurements was assessed by absolute and relative technical errors of measurement (TEM) and reliability coefficients (R), according to parameters established by Habicht,²³ and by Ulijaszek & Kerr.²⁴

Measurements

The outcome variable of this study was inaccurate body size estimation. Data were obtained using the Figure Rating Scale for Brazilian Children, which was created and validated for the Brazilian population of 7 to 12-year-old children by Kakeshita et al.²⁵ The Figure Rating Scale for Brazilian Children consists of a set of 11 figures for each sex printed on individual cards measuring 12.5 cm x 6.5 cm, with numbers on the other side. Each silhouette corresponds to a real

interval of BMI for classification of the subject and a mean BMI determined for the purposes of calculation. The first silhouette represents a child with a BMI of 12 kg/m², and the last a child with a BMI of 29 kg/m². Each successive figure represents a constant increase in BMI of 1.7 kg/m² over the previous figure. The validity of this scale was demonstrated by its high correlation with real BMI.²⁵ The interviewers asked the schoolchildren to select the figure that was most similar to their own body (perceived BMI). Inaccuracy of body size estimation was assessed by subtracting the real BMI (obtained by anthropometric measurements of weight and height) from the perceived BMI (perceived BMI – real BMI). If the result of this subtraction was zero, the student was considered to have an accurate perception of body size. A positive subtraction result was considered an overestimation of body size, and a negative result was considered an underestimation of body size.

The independent variables were the measures of obesity: overweight or obesity (according to BMI); excess body fat (according to %BF); and central obesity (according to WC). Additionally, age and sex of the child, type of school and mother's education level were included in the analysis model as control variables.

Anthropometric measurements were taken following procedures recommended in the literature.²⁶ Measurements of body mass were obtained using an electronic scale (Marte®, São Paulo, Brazil), with a maximum capacity of 200 kg and sensitivity of 50 grams. A stadiometer was used to measure height (Altuxexata®, Belo Horizonte, Brazil) with the zero point at ground level and a 0.5 cm scale. WC was measured using an inelastic anthropometric tape with a 0.1 cm scale (Lange®, Cambridge, USA). Skinfold thickness (ST) measurements were taken with calipers with a 1mm scale (Lange®, Cambridge, USA). Measurements were taken on the right side of the body each skinfold measurement was taken three times and the mean was recorded as the final measurement.

Overweight or obesity for age and sex was defined according to World Health Organization reference data,²⁷ which classifies BMI as low for age (BMI < z score -2); normal weight (BMI ≥ z score -2 and < z score +1); overweight (BMI ≥ z score +1 and < z score +2) and obesity (BMI ≥ z score +2). However, for the purposes of analysis, BMI was categorized as follows: not overweight/obese (BMI < z score +1); overweight (BMI z score ≥ +1 and < z score +2); and obese (BMI z score ≥ +2).

Excess body fat was estimated in the schoolchildren using triceps and subscapular skinfolds. Predictive equations published by Lohman²⁸ were used to estimate

%BF from these skinfold measurements. Children whose results were moderately high, high or very high were classified as having excess body fat, i.e., those with %BF above 20.1 for boys and above 25.1 for girls.²⁹

Central obesity for sex and age was diagnosed using the classification proposed by Taylor.³⁰ The following WC cutoffs were used for the boys: 62.9 cm at 7 years of age; 65.3 cm at 8 years of age; 67.7 cm at 9 years of age; and 70.1 cm at 10 years of age. The following cutoffs were adopted for the girls: 62 cm at 7 years of age; 64.7 cm at 8 years of age; 67.3 cm at 9 years of age; and 69.6 cm at 10 years of age.

Statistical analyses

A database was created with Epi Data version 3.2 and data were processed by a team of typists who had been trained in advance, using a double-entry system. Statistical analysis was performed using STATA version 11.0. Analyses were adjusted for the effects of the design and study sample using the SVY command.

Multinomial logistic regression was used to analyze associations. Initially, bivariate analysis was used to test for associations between the dependent variable (inaccurate body size estimation) and each independent variable (BMI, %BF and WC), and each control variable (age, sex, school type and mother's education). Independent and control variables for which p was < 0.20 were included and maintained in the adjusted analysis, yielding OR values and 95% confidence intervals (95%CI). Analyses of associations were stratified by sex and the cutoff for significance was set at 5% (p < 0.05).

Results

Sample characteristics and anthropometry and body image results are shown in Table 1. The overall prevalence of inaccurate body size estimation was 76% of the sample, of which 34% of schoolchildren underestimated their body size and 42% overestimated their body size, with a similar distribution between the sexes.

The adjusted multinomial logistic regression model was controlled for the variables child's age and mother's educational level, since the bivariate analyses returned p-values of < 0.20 for both sexes. The results of this analysis for the boys only showed that obesity evaluated by BMI remained independently associated with underestimation of body size. Obese boys (BMI) were 6.5 times more likely to underestimate their silhouettes when compared to children without overweight (Table 2).

Table 1 - Characteristics of the sample and anthropometry and body image results (n = 1,530), for schoolchildren aged 7-10 years

Variables	Boys (n = 725)	Girls (n = 805)	Total (n = 1,530)
Age (years)	8.47±1.1	8.48±1.1	8.48±1.1
7-8 years	415 (57.2)	452 (56.1)	866 (56.6)
9-10 years	310 (42.8)	353 (43.9)	664 (43.4)
Type of school			
Public	462 (63.7)	473 (58.7)	933 (61.0)
Private	263 (36.3)	332 (41.3)	597 (39.0)
Mother's education			
None/primary unfinished	106 (15.2)	126 (16.2)	232 (15.7)
Graduated primary education	110 (15.8)	108 (14.0)	218 (14.8)
Graduated secondary education	255 (36.6)	315 (40.4)	572 (38.7)
Graduated higher education	227 (32.4)	229 (29.4)	454 (30.8)
Real BMI (kg/m ²)	18.0±3.1	17.6±3.1	17.8±3.1
Low weight	5 (0.7)	3 (0.4)	8 (0.6)
Normal weight	427 (59.1)	525 (65.7)	954 (62.7)
Overweight	175 (24.3)	181 (22.7)	356 (23.4)
Obesity	115 (15.9)	90 (11.2)	203 (13.3)
%BF	19.2±7.6	23.1±6.7	21.22±7.4
No excess body fat	439 (60.8)	507 (63.6)	947 (62.3)
Excess body fat	283 (39.2)	290 (36.4)	572 (37.7)
Weight circumference (cm)	60.3±7.5	58.4±7.3	59.30±7.4
No central obesity	608 (84.4)	677 (84.8)	1,285 (84.6)
Central obesity	112 (15.6)	121 (15.2)	233 (15.4)
Perceived BMI (kg/m ²)	18.3±3.3	17.7±3.4	17.8±3.1
Body size estimation error*	0.35±3.2	0.13±3.0	0.23±3.1
Accurate	149 (21.2)	208 (26.2)	359 (24.0)
Underestimated	250 (35.5)	266 (33.3)	514 (34.3)
Overestimated	304 (43.3)	322 (40.5)	626 (41.7)

Data presented as mean ± standard deviation or n (%).

%BF = percentage body fat; BMI = body mass index.

* Perceived BMI minus real BMI.

Table 2 - Multinomial logistic regression of inaccurate estimation of body image among male schoolchildren aged 7-10 years

Variables	Underestimation			Overestimation		
	adjusted OR *	95%CI	p-value	adjusted OR *	95%CI	p-value
Overweight/obesity (BMI)			0.008			0.979
No overweight/obesity	1			1		
Overweight	0.85	0.67-5.06		0.69	0.21-2.30	
Obese	6.47	1.95-21.49		1.50	0.32-7.04	
Excess body fat (%BF)			0.888			0.752
No excess body fat	1			1		
Excess body fat	1.05	0.51-2.16		0.87	0.34-2.19	
Central obesity (WC)			0.206			0.060
No central obesity	1			1		
Central obesity	0.56	0.23-1.40		0.40	0.15-1.04	

95%CI = 95% confidence interval; %BF = percentage body fat; BMI = body mass index; OR = odds ratio; WC = waist circumference.

* Adjusted for child's age and educational level of mother – independent variables for which p was ≤ 0.20 in the bivariate analysis.

Bold indicates variables for which p was ≤ 0.05.

Among girls, obesity evaluated by BMI remained associated with underestimation of body size, and central obesity determined by WC remained associated with overestimation of body size in the adjusted model. Girls who were obese according to

their BMI were 4.0 times more likely to underestimate their silhouettes, compared to girls who were not overweight/obese, while girls with central obesity were 4.0 times more likely to overestimate their silhouettes (Table 3).

Table 3 - Multinomial logistic regression of inaccurate estimation of body image among female schoolchildren aged 7-10 years

Variables	Underestimation			Overestimation		
	adjusted OR *	95%CI	p-value	adjusted OR *	95%CI	p-value
Overweight/obesity (BMI)			0.021			0.510
No overweight/obesity	1			1		
Overweight	1.89	0.92-3.90		0.62	0.30-1.29	
Obese	4.05	1.43-11.49		1.01	0.27-3.75	
Excess body fat (%BF)			0.124			0.066
No excess body fat	1			1		
Excess body fat	1.68	0.86-3.30		0.49	0.23-1.05	
Central obesity (WC)			0.414			0.018
No central obesity	1			1		
Central obesity	1.53	0.54-4.35		3.98	1.30-12.21	

95%CI = 95% confidence interval %BF = percentage body fat; BMI = body mass index; OR = odds ratio; WC = waist circumference.

* Adjusted for child's age and educational level of mother – independent variables for which p was ≤ 0.20 in the bivariate analysis.

Bold indicates variables for which p was ≤ 0.05.

Discussion

The prevalence of inaccurate body size estimation among the schoolchildren surveyed was 76%. There are currently no studies of the prevalence of inaccurate body image estimation in this age group (7-10 years) using the same evaluation tools used in this study. However, it appears that the prevalence of inaccuracy is high in comparison to studies that have surveyed schoolchildren of different age groups and using other assessment tools, in which reported prevalence rates range from 22.6% to 58.0%.^{4,22,31-34}

It is important to stress that the questionnaires used as evaluation instruments in these studies have not been validated for this use and so the discrepancies between prevalence results may be related to greater sensitivity of the instrument used in the present study. Notwithstanding these methodological differences, it is necessary to carry out studies to evaluate whether perception that is inaccurate by just one figure in the range of silhouettes should be considered tolerable or not, given that the increment between the figures on the Figure Rating Scale for Brazilian Children used is 1.7 kg/m², which may be considered a small variation. It is noteworthy that while 76% of schoolchildren estimated their own body size inaccurately, 38% erred by just one figure (data not shown in tables).

The present study revealed a greater chance of body underestimation among both boys and girls with obesity according to BMI, and a greater chance of body overestimation among girls with central obesity.

Excess body fat was not found to be associated with estimation of body size in either sex, which may be influenced by the fact that, unlike weight, height and WC, people cannot always assess it visually.²²

Underestimation of own body size by obese subjects has also been observed in other studies. Maximova et al.,²¹ conducted a study of 3,665 Canadian children aged 9, 13 and 16 years, and found that children with overweight and obesity were significantly more likely to underestimate their body size when compared to those without overweight/obesity. Russin et al.³⁵ evaluated the perceptions of own body image of 106 children aged 8-12 years in the UK, and found that obese children had a marked tendency to underestimate their body size. Frederickson et al.²² also found that schoolchildren with overweight and obesity were more likely to underestimate their body size.

According to Castro et al.³⁶ underestimation of body size by those with obesity may represent a rejection, albeit unconscious, of the person's real body for diverse reasons, one of which is a feeling of inadequacy compared to the standard body image.

The literature indicates that overweight or obese children and adolescents are more likely to become obese adults.³⁷ It is important to reach this age group through activities that are designed to avert problems related to body satisfaction, sociability, diet and sedentary lifestyle.³⁵ However, underestimation of body size in this group may limit commitment to programs for the promotion of healthy lifestyles.²¹

With regard to the association between body overestimation and WC in girls, these results differ from those of two other studies conducted with female schoolchildren. In a study conducted in Finland by Van Vliet et al.,³⁸ WC was associated with more accurate body estimation, whereas in a study conducted in Australia by Frederickson et al.,²² WC was associated with greater underestimation of body size. Some of these differences can be attributed to the different cutoff

points for evaluation of WC used in the studies, but it is assumed that due to the fact that WC identifies the abdominal concentration of body fat,^{39,40} the condition of obesity was more evident in girls, which may have led to overestimation of their body size. According to Smolak,⁴¹ socially established body standards can influence how individuals view their bodies and from preschool years onwards, girls especially begin to make social comparisons and to develop the belief that beauty is a positive stereotype and that attractiveness is valued socially, while they also begin to recognize that being overweight is not the starting point for being beautiful.

Girls who overestimate body size may be at risk of engaging in unnecessary or unhealthy weight control, because overestimation of body size is associated with dissatisfaction with body image and weight control behavior that could put health at risk, such as restrictive diets, laxatives and diuretics, or excessive exercise in adults.^{42,43}

This is the first study to evaluate the prevalence of inaccurate body size estimation and its association with overweight/obesity; excess body fat; and central obesity in schoolchildren of both sexes aged 7-10 years. The methods adopted for calculations and sample selection, the methodological rigor and the standardization of anthropometric measurements in this study all contribute to the success in achieving results that have internal validity and which may also reflect the situation elsewhere in the country.

However, limitations of the study include the cross-sectional sampling design adopted, which does not allow temporal relationship to be established between variables, and the use of anthropometric measurements to assess obesity.

The results of this study allow us to conclude that there is a high prevalence of inaccurate body size estimation among schoolchildren aged 7-10 years, and that this is associated with obesity (BMI) in both sexes and with central obesity among girls. These results also lead us to reflect on the importance of accuracy in estimation of body size among obese schoolchildren, since underestimation of body size may limit the schoolchildren's participation in interventions to control obesity and promote healthy living,⁴⁴ while overestimation of body size can lead them to adopt restrictive eating habits and compensatory methods for weight control.⁴³

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