Association between inadequate body composition and sociodemographic factors in adolescents

Composição corporal inadequada em adolescentes: associação com fatores sociodemográficos

Composición corporal inadecuada en adolescentes: asociación con factores sociodemográficos

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ABSTRACT

Objective: To evaluate the association between inadequate body composition and sociodemographic factors in adolescents.

Methods: A cross-sectional study was conducted on 627 adolescent boys and girls aged 14 to 17 years old from a town with a low/medium human development index. Sociodemographic (gender, age, socioeconomic level, and area of residence) and anthropometric data (body weight, height, waist circumference, and thickness of five skinfolds) were collected. The Canadian Physical Activity, Fitness and Lifestyle Appraisal was applied to analyze inadequate body composition.

Results: The prevalence of inadequate body composition was 24.1%. Inadequate indices of adiposity were more prevalent among adolescent males (PR 3.16; 95%CI 1.72-5.82) from high/medium socioeconomic strata (PR 2.44; 95%CI 1.55-3.85), whereas the age of 14-15 years old was a protective factor against inadequate body composition (PR 0.58; 95%CI 0.37-0.90) compared to older ages (16-17 years old).

Conclusions: Inadequate body composition was associated with gender, age and socioeconomic level. Interventions should consider the sociodemographic characteristics of the target population.

Key-words: anthropometry; nutritional status; social class.

RESUMO

Objetivo: Verificar a associação da composição corporal inadequada com fatores sociodemográficos em adolescentes.

Métodos: Estudo transversal realizado em 627 adolescentes, com idades de 14 a 17 anos, de ambos os sexos, de uma cidade de Índice de Desenvolvimento Humano (IDH) médio/baixo. Foram coletadas informações sociodemográficas (sexo, idade, nível econômico e área de domicílio) e antropométricas (peso corporal, estatura, perímetro da cintura e espessura de cinco dobras cutâneas). Para análise da composição corporal inadequada, utilizou-se a proposta do Plano Canadense de Atividade Física, Aptidão e Estilo de vida.

Resultados: A prevalência de composição corporal inadequada foi de 24,1%. Adolescentes do sexo masculino (RP 3,16; IC95% 1,72-5,82) e dos estratos econômicos alto e intermediário (RP 2,44; IC95% 1,55-3,85) tiveram maior prevalência de índices inadequados de adiposidade, enquanto a faixa etária de 14-15 anos representou fator de proteção para composição corporal inadequada (RP 0,58; IC95% 0,37-0,90), comparada à faixa de 16-17 anos.

Conclusões: A composição corporal inadequada esteve associada ao sexo, à idade e ao nível econômico. Intervenções devem levar em consideração as diferenças em função das características sociodemográficas.

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Palavras-chave: antropometria; estado nutricional; classe social.

RESUMEN

Objetivo: Verificar la asociación de la composición corporal inadecuada con factores sociodemográficos en adolescentes.

Métodos: Estudio transversal realizado en 627 adolescentes, con edades entre 14 y 17 años, de ambos sexos, de una ciudad de Índice de Desarrollo Humano (IDH) mediano/bajo. Se recogieron informaciones sociodemográficas (sexo, edad, nivel económico y área de domicilio) y antropométricas (peso corporal, estatura, perímetro de la cintura, espesor de cinco pliegues cutáneos). Para análisis de la composición corporal inadecuada, se utilizó la propuesta del Plan Canadiense de Actividad Física, Aptitud y Estilo de Vida.

Resultados: La prevalencia de composición corporal inadecuada fue de 24,1%. Adolescentes del sexo masculino (RP 3,16; IC95% 1,72-5,82) y de los niveles económicos alto e intermediario (RP 2,44; IC95% 1,55-3,85) tuvieron mayores prevalencias de índices inadecuados de adiposidad, mientras que la edad de 14-15 años presentó factor de protección para composición corporal inadecuada (RP 0,58; IC95% 0,37-0,90), comparada a la franja de edad de 16-17 años.

Conclusiones: La composición corporal inadecuada estuvo asociada al sexo, la edad y al nivel económico. Intervenciones deben tener en cuenta las diferencias en función de las características sociodemográficas.

Palabras clave: antropometría; estado nutricional; nivel socioeconómico.

Introduction

World Health Organization data show that significant changes in body composition are being observed in many different countries[1]. Studies[2-4] have been drawing attention to increases in the prevalence rates of inadequate body fat levels among children and adolescents from all social strata.

Brazil is currently in a process of nutritional transition that is characterized by a reduction in nutritional deficits accompanied by increasing rates of elevated adiposity levels, not only among adults, but also in children and adolescents[5]. This transition can be observed in populations resident in urban and rural areas and from higher and lower economic strata[4].

As children become adolescents, a gradual increase in fat mass is observed. Excess body fat that is acquired during adolescence tends to be maintained in adulthood[6] and is associated with cardiovascular risk factors such as arterial hypertension, dyslipidemia and insulin resistance[7,8]. Diseases that emerge because of these high levels of adiposity may be exacerbated further, depending on a person's lifestyle and on the intensity of their weight gain[9].

There is evidence that the prevalence of unhealthy body composition is increasing, particularly at the start of adolescence and among people from higher economic strata[2,10,11]. In representative samples of schoolchildren (7 to 18 years), it is observed that 15-to-18-year-old students have higher rates of unhealthy body composition than their 7-to-10-year-old peers. A cross-sectional study conducted by Tassitano *et al*[12] analyzed associations between demographic, socioeconomic, academic and behavioral factors and the prevalence rates of unhealthy body composition among adolescents (15 to 19 years). They observed greater proportions of unhealthy composition among male adolescents and among adolescents from urban areas.

Farias Junior and Silva[3] found evidence that there is a greater probability of unhealthy body composition among boys from higher economic classes. These findings were observed in a study that assessed unhealthy body composition using body mass index (BMI) and investigated its associations with demographic and socioeconomic factors among adolescents (15 to 18 years).

Although many researchers have collected information related to the behavior of body composition indicators in Brazilian schoolchildren, the majority of published data are restricted to analyses of adolescents' body composition that had been measured in terms of BMI. It is therefore necessary to investigate body composition using a selection of additional anthropometric indicators, in order to determine the proportion of adolescents who have unhealthy body fat levels.

The objective of this study was therefore to investigate associations between unhealthy body composition and sociodemographic factors (sex, age, economic level and location of residence) among adolescent schoolchildren, aged 14 to 17 and living in an area with a low/medium human development index (HDI).

Method

This study of the associations between unhealthy body composition and socio-demographic variables was based on

the cross-sectional study "*Analysis of physical activity and health-related physical fitness in rural and urban schoolchildren*", which was approved by the Ethics Committee at the *Faculdades Unidas do Norte de Minas* (FUNORTE). The study was conducted in 2009 with a representative sample of adolescents from state-run public schools from the municipality of Januária, MG, Brazil, which is in the *Médio São Francisco* region. The municipality has 67,516 inhabitants (IBGE, 2000)[13] and its human development index is 0.699, which classifies it as having a low/medium level of human development (PNUD, 2000)[14].

The sampling process was stratified by primary and secondary public schools and the clusters were classes in those schools. For the first stage, only schools that offered both primary and secondary education were selected since these were the largest schools in the region, where the largest quantity of students were concentrated. Once these schools had been identified, participating schools were selected by lots, using a list provided by the schools themselves and containing the ages of their students. In the second stage, all adolescents aged 14 to 17 who were in class on the data collection day were invited to take part.

Several different sample size calculations were performed because this study is nested within a larger research project with many different health outcomes. For the analysis presented here, the sample size calculation was based on an unknown prevalence of outcome (50%), an acceptable error of five percentage points, a 95% confidence level and a design effect of 1.5, and then 15% was added for possible losses and refusals. Considering that there were 4,495 schoolchildren in primary and secondary education in Januária, MG, the sample estimate was 611 adolescents. The characteristics of the sampling process, based on recruitment of all members of each cluster, meant that the final sample comprised 627 students.

Fieldwork was conducted by professors and students from the Physical Education department who were trained to carry out the necessary procedures, in order to standardize data collection methods. Sociodemographic data were collected (sex, age, economic level and location of residence), plus anthropometric variables (body weight - W, height - H and waist circumference – WC) and indicators of body composition (skinfold thicknesses at the triceps - TR, biceps – BI, subscapular - SS, iliac crest - IC and medial calf – MC regions). Skinfolds were measured in mm using Cescorf brand fat calipers, accurate to 0.1mm, and a skin pencil to mark the anatomic landmarks. Body weight (kg) was measured on a balance accurate to 100 grams and height (m) was measured using a stadiometer accurate to 0.1cm. Waist circumference was measured using a flexible Sanny tape measure accurate to 0.1mm. Anthropometric variables and body composition indicators were all measured using standardized procedures[15].

The prevalence of unhealthy body composition was estimated according to the Canadian Physical Activity, Fitness and Lifestyle Appraisal[15]. The Canadian protocol employs a combination of body adiposity indicators: BMI, obtained by dividing body weight by height squared ($BMI = W_{kg} / H_m^2$), WC, the sum of five skinfolds [(∑5SF TR, BI, SS, SI and MC] and the sum of two skinfolds [(∑2SF), SS and SI]. The plan includes tables of normal values for each indicator (BMI, WC, ∑2SF and ∑5SF) that classify subjects as within or outside of the beneficial zone for their sex and age. Using these normalized figures, each indicator (BMI, WC, ∑2SF and ∑5SF) was classified as healthy or unhealthy, with healthy being reserved for those adolescents within the zone that is beneficial to health. Once this preliminary classification has been completed, there is another table which scores combinations of BMI, ∑5SF, WC and ∑2SF and on the basis of these scores body composition is classified into one of five categories: Excellent, Very Good, Good, Regular or Must Improve. For the purposes of this study, we classified body composition as "Unhealthy" if an adolescent was classified in one of the health-risk zones (Regular or Must Improve) and as "Healthy" if they were classified in one of the health-risk free zones (Excellent, Very Good or Good). The method takes into account overall fat distribution (BMI and ∑5SF) and peripheral fat (WC and ∑2SF).

The economic level of participants was defined according to the system proposed by the Brazilian Association of Market Research Companies (ABEP - *Associação Brasileira de Empresas de Pesquisa*)[16]. Their instrument estimates families' purchasing power and classifies them as class A, B, C, D or E on the basis of the material assets they have accumulated, their living conditions, the number of domestic workers they employ and the educational level of the head of the family. Since the present study investigated a small number of people, categories A and B were collapsed together and defined as "high" and D and E were combined as "low" with class C defined as "intermediate". Adolescents' parents' educational level was defined as the number of complete years the head of the family (father/mother) had spent in education and was categorized as follows: ≤4 years, 5-8 years, 9-11 years or ≥12 years.

The descriptive analysis of variables was in terms of means, standard deviations and frequency distributions. Differences between means and proportions of variables were analyzed using Student's *t* test for independent samples and the chi-square test, respectively. Where it was found that the dependent variable (unhealthy body composition) exhibited elevated prevalence, Poisson regression with robust variance adjustment was used in order to examine associations between the outcome and sociodemographic indicators (sex, age, economic level and location of residence), estimating prevalence ratios and confidence intervals. All variables were included in the regression model. The significance level was set at 5% (95%CI).

Results

All of the students agreed to take part in the research and correctly filled out the economic and demographic questionnaire, irrespective of location of residence. Two hundred and ninety-nine of the 627 adolescents studied (47.7%) lived in the urban area, while 328 (52.3%) lived in the rural part of the municipality of Januária, MG. Table 1 contains the general characteristics of the sample. Differences between the sexes were detected in body weight, height, ∑2SF, ∑5SF and WC, with males having greater body weight, height and waist circumference and females having greater BMI, ∑2SF and ∑5SF.

Table 2 shows the proportions of healthy and unhealthy body composition broken down by the sociodemographic variables (sex, age, economic level and location of residence). Associations were detected between unhealthy body composition and sex and economic level. The results showed that there was a higher proportion of unhealthy body composition among males (32.3%) than among females (18.0%) and in the high economic category (31.8%) compared with both intermediate (27.8%) and low (16%).

Table 3 lists the prevalence ratios for the associations between unhealthy body composition and sociodemographic factors. The crude analysis detected an association between outcome and both sex and economic level. When the model was adjusted for all variables, there were associations between the outcome and sex, age and economic level. In this analysis, males had a 14% greater likelihood of unhealthy body composition than females. Furthermore, adolescents in the high (PR 3.16; 95%CI 1.72-5.82) and intermediate (PR 2.44; 95%CI 1.55-3.85) economic categories had a greater likelihood of having unhealthy body composition indicators when compared with the low category. Additionally, the age group of 14-15 years was a protective factor against unhealthy body fat levels.

Discussion

The results reported here show that, out of every 100 schoolchildren investigated, a third of the male adolescents from Januária, MG, which is a municipality with a medium/low HDI, had unhealthy body composition, whereas this

Table 1 - Means and standard deviations for anthropometric variables and body composition indicators by sex, Januária, MG, Brazil (2009)

Variables	Male (n=266)	Female (n=361)
Chronological age (years)	15.4±1.1	15.6±1.1
Body weight (kg)*	55.9±10.7	51.6±7.5
Height (cm)*	168.1±0.9	160.4±0.1
BMI (kg/m^2)	19.7±2.8	20.1±2.6
∑2SF (mm)*	16.5±9.1	25.0±9.6
∑5SF (mm)*	37.0±16.6	59.6±18.6
WC (cm)*	68.3±6.8	65.7±6.0

∑2SF: sum of 2 skinfolds (subscapular and iliac crest); ∑5SF: sum of 5 skinfolds (triceps, biceps, subscapular, iliac crest and medial calf); WC: waist circumference. *p<0.05 for difference between the sexes (*t* test for independent samples).

Table 2 - Absolute (n) and relative (%) frequencies of body composition categories, broken down by sociodemographic variables, Januária, MG, Brazil (2009)

Variables	Body composition			
	Healthy		Unhealthy	
	n	%	n	(%)
Sex				
Male	180	67.7	86	32.3*
Female	296	82.0	65	18.0
Age (years)				
14-15	240	73.2	88	26.8
16-17	236	78.9	63	21.1
Economic level				
A+B	105	68.2	49	31.8*
C	161	72.2	62	27.8
D+E	210	84.0	40	16.0
Residential area				
Rural	244	74.4	151	25.6
Urban	232	77.6	67	22.4

*p<0.05 for associations between unhealthy body composition and sociodemographic variables (chi-square test).

Table 3 - Associations between unhealthy body composition and sociodemographic variables, according to prevalence ratios and 95% confidence intervals. Januária, MG, Brazil (2009)

Variables	Unhealthy body composition			
	PR (95%CI)	*p*	PR** (95%CI)	*p*
Sex				
Male	1.79 (1.35-2.37)	<0.001	1.14 (1.03-1.93)	0.028
Female	1.00		1.00	
Age (years)				
14-15	1.27 (0.96-1.69)	0.094	0.58 (0.37-0.90)	0.016
16-17	1.00		1.00	
Economic level				
A+B	1.98 (1.37-2.86)	<0.001	3.16 (1.72-5.82)	<0.001
C	1.73 (1.21-2.47)	0.002	2.44 (1.55-3.85)	<0.001
D+E	1.00		1.00	
Residential area				
Rural	1.14 (0.86-1.51)	0.350	1.22 (0.92-1.61)	0.161
Urban	1.00		1.00	

PR: prevalence ratio; CI: confidence interval; ** PR adjusted for all variables (sex, age, economic level and location of residence); *p*: significance level. city, Brazil.

proportion reduced to almost a fifth for the females. Furthermore, schoolchildren from better-off economic classes were more exposed to unhealthy body composition than those from less privileged strata. According to Farias Junior and Silva[3], better economic conditions allow adolescents to be more exposed to electronic equipment and fast food chains, which are considered socially acceptable behaviors and status symbols in this population subset.

Male adolescents have a higher proportion of unhealthy body composition indicators. The same has also been observed among adolescents in other regions of Brazil which have a similar or higher HDI to Januária, MG. For example, among 10-to-19-year-olds from the city of Pelotas, RS[10], and among schoolchildren (14 to 18 years) at both public and private schools in João Pessoa, PB[3], and at public schools in Pernambuco[12] and among schoolchildren (11 to 17 years) at private schools in Presidente Prudente – SP[17]. Of these, the HDI for Rio Grande do Sul (RS) and São Paulo are higher (medium/high) than the HDI for Januária, MG. With reference to international research, these results are also in agreement with studies of European[18] and North-American[19] adolescents.

The greater prevalence of unhealthy body composition among male adolescents may be associated with a lesser degree of concern about controlling body weight and greater social acceptability of excess body fat[3]. In Brazil, there is no clear tendency with relation to the association between unhealthy fat levels and sex. Evidence indicates that unhealthy levels are more prevalent among males[3,10,12,17], but this varies depending on location of residence, on whether schooling is public or private and on economic level.

Unhealthy body composition was also associated with age. Adolescents aged 16-17 had a greater probability of unhealthy body composition than younger adolescents. The results of the population study conducted with adolescents (15-18 years) from the city of Pelotas, RS[10], did not detect an association between unhealthy body composition and age, but there was a tendency for higher percentages among younger adolescents (15 and 16 years) than among older ones (17 and 18 years)[10].

In the study conducted with adolescents (14 to 18 years) from João Pessoa, PB[3], age was not associated with unhealthy adiposity even after adjustment for other variables (economic class and educational level). It should be pointed out that the criteria for body composition cutoff points used in this study are not comparable with those used in the other studies mentioned[3,10,12,17].

In addition to the different criteria used to classify unhealthy body composition, differences between findings may also be explicable by factors related to inadequate body composition indicators that were not investigated in this study, such as physical activity level[10,20], exposure to sedentary behaviors[10,21], eating patterns[5,21], obesity in the family[5], geographic region[22] and whether or not adolescents took part in Physical Education lessons[10].

In the present study, it was found that adolescents in the high economic level category (31.8%) and in

the intermediate category (27.8%) exhibited a greater prevalence of unhealthy body composition than adolescents in the low economic level category (16%). This relationship has also been observed in other towns in Brazil[2,10,11] and in the state of Morelos, in Mexico's central region[23], using the same economic level categories (high, intermediate and low) adopted in this study, although they were defined using a different instrument. Furthermore, the studies cited above used only one indicator of body composition (BMI) to determine unhealthy body fat levels.

The results of this study diverge from results of studies of adolescents in developed countries. Such studies have reported an inverse relationship between unhealthy body composition and economic level among adolescents of both sexes[18]. In other words, the lower the economic level, the greater the proportion of adolescents with unsatisfactory body fat levels. These differences between results may be caused by methodological differences (criteria used to classify body composition or indicators of socioeconomic conditions). A country's economic development level appears to have a great effect on both the direction and magnitude of associations between body composition and sociodemographic indicators[24].

These results are also evidence that unhealthy body composition indicators can be observed among all economic classes, demonstrating that developing countries like Brazil are going through a process known as "nutritional transition". This process is characterized by an inversion in the pattern of distribution of nutritional problems in a given population over time, which, in general, means a transition from malnutrition to overweight, in its presentations as overweight and obesity[25]. This evidence confirms the simultaneous predominance of unhealthy body composition among societies with greater spending power.

The increase in unhealthy body composition among children and adolescents, which has been reported by studies conducted in many different parts of the country[26,27], is an important warning for health authorities. Body fat levels above or below normal values are associated with the emergence of many different diseases, such as heart disease[28]. This evidence indicates a need for intervention at schools and in public health as a method of minimizing the consequences of unhealthy body composition.

This study did not find any association between location of residence and outcome. There is evidence to suggest that adolescents who live in urban areas are at greater risk of unhealthy body composition than those living in rural areas[29].

Since this was a cross-sectional study, there is no possibility of establishing a causal relationship between sociodemographic variables and unhealthy body composition. Another limitation is the lack of other studies that have used the same criteria to determine unhealthy body composition in adolescents, making it impossible to make uniform comparisons with other research results. Furthermore, this study is limited to the population of adolescents enrolled at public schools in an area with a medium/low HDI and cannot be extrapolated to schoolchildren at private schools.

The importance of using the criteria chosen as indicators of the body adiposity of adolescents in this study is justified by the fact that this method takes four specific indicators into account. These indicators assess the distribution of body fat in general (BMI and ∑5SF), central body fat (WC) and peripheral body fat (∑2SF). Furthermore, the method includes indicators of cardiovascular risk[30] and of nutritional status (BMI) and takes the adolescents' age group and sex into account.

Changes to behavior and lifestyle must be initiated as soon as possible, since important changes take place to people's personalities during adolescence and this is therefore an opportune moment to adopt healthy habits. Schools, as places where children and adolescents spend a good proportion of their day, are considered to be environments particularly suited to preventative guidance about weight gain and energy intake and expenditure aimed to encourage the adoption of healthy habits that should remain beyond their time at school at last their entire lives.

Considering the results of this study, it can be concluded that unhealthy body composition was associated with sex, age and economic level. Male adolescents and adolescents from the higher and intermediate economic strata had a greater likelihood of exhibiting unhealthy body fat indicators. In contrast, the age group 14-15 years was at lower risk of unhealthy body fat levels when compared with older age groups.

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