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Obesity in adolescents in Southern Brazil: association with sociodemographic factors, lifestyle and maturational stage

Obesidade em adolescentes do Sul do Brasil: associação com fatores sociodemográficos, estilo de vida e estágio maturacional

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Abstract – Excess body fat is associated with chronic degenerative diseases, being a global public health problem. The aim of this study was to investigate the association of obesity with sociodemographic factors, lifestyle (physical activity, dietary habits) and sexual maturation in high school students of a city in southern Brazil. This is a cross-sectional study with 820 adolescents enrolled in public high schools of São José, Santa Catarina, Brazil, aged 14-17 years. Obesity was estimated by body fat percentage (BF%). BF% was calculated using the Lohman equation, which considers the sum of skinfolds (triceps and subscapularis). Cutoff points proposed by William et al. were used to classify individuals into normal weight or obese. Independent variables were sex, age, economic status, parental education, eating habits, physical activity and sexual maturation. The prevalence of obesity was 17.2%. Females (OR: 4.22; 95% CI: 2.72-6.54) and young people at post-pubertal stage of sexual maturation (OR: 1.95; 95% CI: 1.33-2.86) were more likely to have obesity. These results may help health authorities in the planning of public policies to prevent obesity.

Key words: Adiposity; Cross-sectional studies; Sexual maturation; Skinfolds; Adolescent health.

Resumo – *O excesso de adiposidade corporal está associado a doenças crônicas degenerativas, sendo problema global de saúde pública. O objetivo do estudo foi verificar a associação da obesidade com fatores sociodemográficos, estilo de vida (atividade física, hábitos alimentares) e maturação sexual em estudantes do ensino médio de uma cidade do sul do Brasil. Estudo transversal com 820 adolescentes de escolas públicas de São José, Santa Catarina, Brasil, com idade de 14 a 17 anos. A obesidade foi estimada por meio do percentual de gordura corporal (%G). O %G foi calculado por meio da equação de Lohman que considera o somatório de dobras cutâneas (Tríceps e Subescapular). Usou-se os pontos de corte proposto por Willian et al. para classificar os jovens em eutróficos ou obesos. As variáveis independentes foram sexo, idade, nível econômico, escolaridade dos pais, hábitos alimentares, nível de atividade física e maturação sexual. A prevalência de obesidade foi de 17,2%. O sexo feminino (OR: 4,22; IC95%: 2,72-6,54) e os jovens no estágio pós-púbere de maturação sexual (OR: 1,95; IC95%:1,33-2,86) apresentaram maiores chances de obesidade. Estes resultados podem auxiliar as autoridades do município para o planejamento de políticas públicas de prevenção a obesidade.*

Palavras-chave: *Adiposidade; Estudos transversais; Maturidade sexual; Pregas cutâneas; Saúde do adolescente.*

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INTRODUCTION

Excess body fatness (obesity) in children and adolescents has shown growth in both high and middle-income countries[1]. The prevalence of obesity in children and adolescents in the United States increased from 31.8% in 2011 to 33.2% in 2013 in the age range from 6 to 19 years[2,3]. In China, the prevalence of obesity among young people aged 9-15 years increased from 7.7% in 1997 to 17.8% in 2007[4]. In Brazil, in individuals aged 12-14 years, the prevalence of obesity was 17.5% in 2003 and increased to 21.5% in 2009[5].

Excess body fat is a global public health problem and is associated with chronic degenerative diseases, affecting the quality of life of adolescents, generating public spending to decrease this disease[1]. It is estimated that the cost for treating obesity in high-income countries corresponds to 2% to 8% of the total spending with health[3]. In Brazil, the Unified Health System spends 600 million reais for hospitalizations related to obesity, which corresponds to 12% the amount that the Brazilian government annually spends with other diseases such as cancer, diabetes and hypertension[1]. Therefore, obesity should be avoided both for representing high costs to the health system and because it represents a risk factor for noncommunicable diseases in adulthood[3].

There are several factors that are considered obesogenic[2,3,5]. Sociodemographic factors have been reported to be associated with obesity[2,3]. Female adolescents aged up to 15 years and of low economic level are more likely to have obesity[1,2]. However, other population-based studies have reported that male adolescents aged 14-17 years and of high economic level were the subgroups most likely to have obesity[3,5,7]. Thus, inconsistency of sociodemographic factors related to obesity is observed. Moreover, these factors are considered of difficult intervention for dealing with macro-structural aspects (economic level)[6-8].

In addition to sociodemographic factors, lifestyle is an obesogenic factor, so that sedentary subjects with poor eating habits are more likely to have body fat levels above normal[3]. These factors are considered modifiable and guidelines for prevention, treatment and control of obesity have such characteristics[3]. Thus, research and monitoring of these factors in the adolescent population are indicative of prevention and / or health problems.

Sexual maturation is another factor that interferes with body fat accumulation in adolescents. Literature has reported that in pre-pubertal, pubertal and post-pubertal maturational stages, sexual hormone (estradiol) in girls causes excess adiposity and (testosterone) in boys results in increased fat-free mass[9]. Although such findings have been reported in previous studies, sociodemographic factors and lifestyle have an effect on sexual maturation and therefore on excess body fat, which differ among localities in the same country[9], thus justifying further studies associating these factors.

Body Mass Index (BMI) is used for the diagnosis of obesity worldwide to reveal this epidemiological situation[1-3]. However, this index has varieties of curves for the diagnosis of obesity, and does not take into account

physiological aspects of individuals such as maturational stages, which interferences in body fat[9,10]. Moreover, BMI is not as effective to quantify changes in body fat distribution, being more related to body growth[10,11]. Thus, measuring body fat using skinfolds is recommended, since it allows assessing the amount and distribution of adipose tissue[6].

High body fat percentage (BF%), diagnosed by anthropometric equations and associated factors is still poorly evidenced in Brazil[6,8,12]. Studies have frequently used BMI as fat diagnostic parameter[3,11-13,14], especially because assessing body fat using skinfold requires accurate training of evaluators and longer time for data collection. In this sense, the aim of this study was to estimate the prevalence of obesity estimated by BF % and the association with sociodemographic factors, level of physical activity, eating habits and maturational stage for students aged 14-17 years of a city in southern Brazil.

METHODOLOGICAL PROCEDURES

Participants

This is a cross-sectional school-based study that is part of the macroproject "Brazilian Guide for Evaluation of Health-Related Physical Fitness and Life Habits - Stage I", approved by the Ethics Committee on Research with Humans of the Federal University of Santa Catarina under CAAE protocol: 33210414.3.0000.0121 held from August to November 2014. The project population was composed of students aged 14-19 years enrolled in public schools of São José, Santa Catarina, Brazil, which has 209,804 inhabitants and Human Development Index of 0.809[15].

The sampling process was determined in two stages: 1) stratified by public high schools (n = 11); 2) conglomerate of classes considering school shift and school grade (n = 170 classes). In Stage 2, all high school students who were present in the classroom on the days of data collection were invited to participate in the study.

Sample calculation adopted unknown prevalence for the outcome (50%), tolerable error of five percentage points, 95% confidence level and 1.5 design effect, adding 20% for losses and refusals and another 20% for association study. Considering that the high school system of São José is composed of 5,182 students, a sample of 751 adolescents was estimated. However, due to cluster sampling, all students of classes were invited to participate in the study, resulting in 1,132 students with collected data. However, for this study, data of students aged 14-17 years were used because the equations for estimating BF % are restricted to adolescents at this age group.

Eligible students were those enrolled in public schools and present in classroom on the day of data collection. Refusals are considered those who did not want to participate and sample losses are incomplete questionnaire or those not performing physical assessments.

Instruments and procedures

The dependent variable was BF%. Two skinfolds were assessed to identify BF%, triceps (TSF) and subscapular (SSF), using Cescorf® adipometer (Porto Alegre, Brazil) with 1mm resolution, following standardization of the International Society for the Advancement of Kinanthropometry (ISAK). Anthropometric measurements were performed by a single evaluator with level one ISAK certification. From the TSF and SSF measurement, BF% was estimated using the predictive equation of Lohman[16]: BF% = 1.35 x (TSF + SSF) - 0.012 x (TSF + SSF)^2 - Intercept. The intercept or constant varies according to sex and age of adolescents[16]. In the present study, the constants of Lohman[16] for ages of 15, 16 and 17 years were considered. For the age of 14 years, the constant suggested by Pires-Neto and Petroski[17] was considered. Thus, the constants used in the equation are different for boys and girls according to age (Boys: 14 years = 5.7; 15 years = 6.1; 16 years = 6.4; 17 years = 6.7; Girls: 14 years = 3.6; 15 years = 3.8; 16 years = 4.0; 17 years = 4.4)[16,17].

The dependent variable was dichotomized into no excess body fat (eutrophic) and excess body fat (obesity). Subjects with %BF ≥ 30 for girls and ≥ 25 for boys were considered obese, according to cutoff points suggested by Williams et al.[18].

Sociodemographic variables (sex, age, economic level, parental schooling) and lifestyle (eating habits, physical activity) were collected through self-administered questionnaire. Sex was self-reported by adolescents (male / female). Age was grouped into "14-15 years" and "16-17 years", so that two ages were distributed in each category.

Parental schooling was analyzed by means of two questions: "What is the educational level of your mother / father?" The variables were categorized as "low educational level" (illiterate or up to complete elementary school) and "high educational level" (incomplete high school or higher education). Economic level was identified through the questionnaire of the Brazilian Association of Research Companies[19], which divides the population into five categories in decreasing order of purchasing power ("A1", "A2", "B1", "B2" "C1", "C2", "D" and "E"). Due to the low frequency of adolescents in extreme categories ("A1": 0.0%; "A2": 4.1%; "B1": 20.9%; "B2": 44.6%; "C1": 24.5%; "C2": 5.3%; "D": 0.6%; "E": 0.0%), this variable was dichotomized into "high level" ("A1", "A2","B1","B2") and "low level"("C1","C2","D","E").

Dietary habits were assessed by two questions. The first on the amount of times the adolescent consumed soft drinks during the last seven days prior to the survey, obtained by the Youth Risk Behavior Survey (YRBS) questionnaire, which was translated and validated for Brazil[20]. Categories were defined into "adequate" (adolescents who did not consume soft drinks) and "inadequate" (adolescents who did)[21]. The second question was whether the adolescent followed a balanced diet (different servings of grains, cereals, fruits, vegetables, dairy products, meat and meat products), obtained using the "Fantastic Lifestyle" questionnaire, translated and validated for Bra-

zil[22]. Responses were dichotomized into "Yes" (adolescents who answered "sometimes," "quite often" and "almost always") and "No" (adolescents who answered "almost never" and "rarely").

The question about level of physical activity was: "During the last 7 days, on how many days were you physically active for at least 60 minutes per day? (Consider the time you spent in any type of physical activity that increased your heart rate and made your breathing go faster for some time"[20]. Adolescents who responded practicing physical activity five or more days per week were classified as "physically active". Those who responded less than five days per week were classified as "little physically active"[23].

Sexual maturation was assessed according to criteria proposed by Tanner[24], validated and reproducible in the Brazilian population[25]. The indication of stages was carried out by self-assessment (figures) of breast development (females) and genitals (males) after individual and prior explanation of the instrument by the researcher, always of the same sex as the adolescent. Due to the low frequency of adolescents at pre-pubertal stage (0.3%), the categories were grouped into: "Pre-pubescent / pubescent" and "Post-pubescent".

Statistical analysis

Analyses were performed using the Statistical Package for Social Sciences (SPSS) version 22.0. Descriptive statistics used means, standard deviations, medians, interquartile intervals and frequency distribution. To identify the prevalence of obesity in relation to the independent variables, the chi-square test of heterogeneity was applied. Data normality was verified through sample distribution histograms, and BF% did not show normal distribution, and the Mann-Whitney U Test was applied.

Binary logistic regression was performed to estimate odds ratio (OR) and confidence intervals (CI 95%). All variables were introduced in the adjusted model, regardless of p-value in the crude analysis. Adjusted analysis was controlled for all variables. Variables with p-value <0.20[26] remained in the adjusted model through the backward method. The significance level was 5%.

RESULTS

The sample consisted of 820 adolescents. Most students were females (56.0%) aged 16-17 years (64.3%), whose mother and father had high educational level (55.7% and 60.8% respectively) and high economic level (70.7%). Over half of the sample had no balanced diet and eight in ten adolescents consumed sweetened beverages. In addition, 77.1% of adolescents were little physically active, 71.3% were at pre-pubertal / pubertal maturational stage, and 17.2% had excess body fat (Table 1). BF% values were significantly higher for girls, those little physically active (<0.01) and those at post-pubertal maturational stage (0.01) (Table 1).

In the crude analysis, individuals who were little physically active (OR: 1.78; 95%CI: 1.12-2.73) were more likely to have obesity. However,

this association was not found in the adjusted analysis. Both in crude and adjusted analysis, female adolescents (crude analysis, OR: 4.68; 95%CI: 3.06-7.16; adjusted analysis, OR: 4.22; 95%CI: 2.72- 6.54) and those at post-pubertal maturation stage (crude analysis, OR: 2.15; 95%CI: 1.50-3.08; adjusted analysis, OR: 1.95; 95%CI: 1.33-2.86) were more likely to have obesity (Table 2).

Table 1. Sample distribution, mean and standard deviation values of body fat percentage according to independent variables.

Variables	n	(%)	Mean	(S.D)	Median	(I.Q)	p
Sex							<0,01*
Male	444	(44.0)	16.03	(5.77)	14.91	(8.17)	
Female	566	(56.0)	25.88	(5.57)	26.64	(8.95)	
Age (years)							0.43
14-15	361	35.7)	21.70	(7.63)	21.73	(12.34)	
16-17	649	(64.3)	21.28	(7.42)	21.21	(12.71)	
Maternal schooling							0.57
High	555	(55.7)	21.62	(7.52)	21.73	(13.00)	
Low	442	(44.3)	21.31	(7.43)	21.21	(12.71)	
Paternal schooling							0.87
High	584	(60.8)	21.30	(7.50)	20.92	(12.59)	
Low	377	(39.2)	21.38	(7.55)	21.43	(12.62)	
Economic level							0.06
High	607	(70.7)	21.24	(7.62)	20.82	(13.29)	
Low	252	(29.3)	22.35	(7.23)	22.66	(11.06)	
Balanced Diet							0.96
Yes	463	(46.3)	21.43	(7.55)	20.99	(12.81)	
No	538	(53.7)	21.43	(7.38)	21.88	(12.58)	
Consumption of soft drinks							0.05
Adequate	163	(16.3)	22.60	(7.27)	21.99	(12.35)	
Inadequate	836	(33.7)	21.19	(7.54)	21.23	(12.78)	
Physical activity							<0.01*
Active	226	(22.9)	20.01	(7.50)	19.97	(14.32)	
Little active	760	(77.1)	21.85	(7.44)	21.99	(12.12)	
Maturation stage							0.01*
Pre-pubescent / pubescent	714	(71.3)	20.83	(7.24)	21.01	(11.51)	
Post-pubescent	288	(28.7)	22.85	(7.95)	23.51	(15.08)	

n: sample distribution; S.D: Standard Deviation; I.Q: interquartile interval.

Table 2. Prevalence of excess body fat, crude and adjusted logistic regression analysis of the association between body fat percentage and independent variables.

	Obesity	Crude analysis	p	Adjusted analysis	p
Variables	n (%)	OR (95%CI)		OR (95%CI)	
Sex			<0,01*		<0,01*
Male	30 (8,1)	1,00		1,00	
Female	131 (29,2)	4,68 (3,06-7,16)		4,22 (2,72- 6,54)	
Age (years)			0,82		0,91

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	Obesity	Crude analysis	p	Adjusted analysis	p
Variables	n (%)	OR (95%CI)		OR (95%CI)	
14-15	56 (20,1)	0,95 (0,66-1,37)		1,00	
16-17	105 (19,4)	1,00		0,92 (0,62-1,37)	
Maternal schooling			0,26		0,18
High	77 (21,4)	1,00		1,00	
Low	82 (18,3)	0,82 (0,58-1,16)		0,78(0,53-1,12)	
Paternal schooling			0,97		0,38
High	59 (19,5)	1,00		1,00	
Low	93 (19,5)	0,99 (0,69-1,43)		1,20 (0,78-1,84)	
Economic level			0,61		0,91
High	97 (19,9)	1,00		1,00	
Low	46 (21,6)	1,10 (0,74-1,64)		0,97 (0,61-1,54)	
Balanced Diet			0,39		0,99
Yes	79 (21,0)	1,00		1,00	
No	81 (18,6)	0,86 (0,60-1,21)		1,00 (0,61-1,54)	
Consumption of soft drinks			0,35		0,68
Adequate	30 (22,6)	1,00		1,00	
Inadequate	129 (19,1)	0,81 (0,51-1,26)		1,11 (0,66-1,85)	
Physical activity			<0,01*		0,06
Active	25(13,2)	1,00		1,00	
Little active	130 (21,4)	1,78 (1,12-2,73)		1,58 (0,96-2,58)	
Maturation stage			<0,01*		<0,01*
Pre-pubescent / pubescent	92 (15,9)	1,00		1,00	
Post-pubescent	68 (28,9)	2,15 (1,50-3,08)		1,95 (1,33-2,86)	

n: sample distribution ; OR*: odds ratio*; CI: confidence interval ; * p <0.05; † - Analysis adjusted for all variables regardless of p-value in the crude analysis.

DISCUSSION

The main findings of this study demonstrated that the prevalence of obesity was 17.2%, being 29.2% in girls and 8.1% in boys. In addition, females and adolescents at post-pubertal maturation stage were more likely to have obesity.

The prevalence of obesity was 17.2% in this study. Research that estimated BF% through skinfolds conducted in Curitiba, Paraná, Brazil, estimated prevalence of obesity of 40.1%[8], while study with adolescents conducted in Minas Gerais, Brazil estimated prevalence of approximately 25%[6]. Differences in the prevalence of obesity among studies may be due to differences in lifestyle of each locality and cultural habits. Adolescents from Curitiba more often presented poor eating habits, diet high in fat and level of physical activity less than 60 minutes compared to those from Minas Gerais[6,7].

Female adolescents were more likely to have excess body fat. A review study on excess body fat in adolescents showed similar results[2]. This association can be justified, since girls have higher production of estradiol, which can interfere with increased levels of anxiety, reducing willingness for the practice of physical activity[9]. In addition, since childhood, girls are educated for family and household care, having no encouragement for the practice of physical activity in adolescence[27].

Adolescents at post-pubertal maturation stage were more likely to have excess body fat. This result was similar to research conducted with 1,206 adolescents from the Azores Island, Portugal[28]. Adolescents at post-pubertal maturation stage are more prone to changes in body composition, as they more often present unhealthy behaviors such as physical inactivity[9]. Therefore, there is a reduction of energy expenditure, reducing the mobilization of fatty acids from fat cells as a source of energy in the skeletal muscle, reflecting in increased BF%[9].

Regarding socio-demographic factors, age, parental schooling and economic level had no association with obesity. A study conducted with adolescents (14-17 years) of Pernambuco found no association between age and obesity[13]. Another study that found no association between age and excess body fat was conducted with adolescents aged 14-17 years from Januária, Minas Gerais, Brazil[6]. Thus, it could be inferred that, in the age group from 14 to 17 years, body fat accumulation occurs equivalently[6], and maturational stage is more important than age in relation to body fat.

In this study, parental schooling was not associated with obesity, which was also observed in the longitudinal study carried out with Spanish adolescents[10]. A possible explanation for the lack of association between parental schooling and adiposity is related to the amount of information that adolescents have access today such as television, printed and virtual media[28]. Thus, the influence of parents seems to have been reduced in this obesity-prevention process[28].

Economic level was not associated with obesity, which was also demonstrated in a study with adolescents aged 11-18 years from Curitiba, Paraná, Brazil[8]. Research conducted with schoolchildren aged 6-17 years from Cascavel, Parana, Brazil, found association between excess body fat and high economic level[7]. In contrast, a systematic review found that low-income adolescents had association with obesity[1]. Thus, the literature is inconsistent regarding economic level, requiring further studies to elucidate this association.

Regarding lifestyle variables, level of physical activity and eating habits were not associated with obesity. A study with adolescents from the Azores Island, Portugal, analyzed the relationship between physical activity and milk intake and obesity and also found no association between physical activity and the outcome, and adolescents with low milk intake, whether active or little active, were more likely to be obese[29]. It is noteworthy that milk intake was not analyzed in the present study. Another possible explanation for the lack of association between physical activity and obesity is the instrument used to measure physical activity (questionnaire). Questionnaire-type instrument has greater reactivity than objective measures of physical activity and, therefore, there may have been a lack of association between these variables. Moreover, it is emphasized that in the bivariate regression analysis, young people with low levels of physical activity were more likely to have obesity.

Regarding eating habits, studies with Brazilian adolescents[12,13] also found no association, which can be partly explained by the design (cross-sectional) adopted in the study, which does not identify the causal relation-

ship among factors and a possible reverse causality[12]. Moreover, adolescents have the habit of skipping meals, even when they have adequate body mass[30]. Another possibility is the underestimation of meals by obese adolescents[30].

The equation used to estimate BF% was not validated for the Brazilian population, being a study limitation. However more accurate body composition estimates such as density, body water and bone mineral content were used[16]. There were no causal relationships of factors associated with excess body fat due to the cross-sectional design of the study. Another limitation is that this study included only adolescents enrolled in public high schools of São José, SC, Brazil, which results cannot be extrapolated to students from private schools.

As strength, skinfold measurements used in the study to estimate BF% have low operating costs compared to indirect methods such as plethysmography and magnetic resonance imaging, which have high cost and difficult access[11]. Skinfold techniques are more accurate to estimate adiposity compared to BMI[10,11].

CONCLUSION

It could be concluded that approximately two out of ten adolescents in this study were obese, with higher prevalence in girls than in boys. In addition, female adolescents and individuals at post-pubertal maturation stage were more likely of having excess body fat. The results found in this study could be used by health authorities for the planning of policies to reduce excess body fat in adolescents through multidisciplinary interventions.

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