Prevalence of abdominal obesity and associated factors in adolescents

Prevalência e fatores associados à obesidade abdominal em adolescentes

Prevalencia y factores asociados a la obesidad abdominal en adolescentes

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ABSTRACT

Objective: To determine the prevalence of abdominal obesity in adolescents and its association with demographic, economic and lifestyle variables in adolescents.

Methods: This cross-sectional study enrolled 644 adolescents (397 girls and 247 boys) from 15 to 19 years old. Demographic (gender and age), economic (economic status), and lifestyle data (physical activity, diet, smoking, and alcohol consumption) were collected. Abdominal obesity (primary outcome) was evaluated based on the cut-off values for gender- and age-specific waist circumference. Data were analyzed using multivariate logistic regression, estimating the unadjusted and adjusted Odds Ratios (OR) with a 95% confidence interval.

Results: The prevalence of abdominal obesity was 7.5%. Boys (OR 2.34; 95%CI 1.27-4.32) of intermediate (OR 2.89; 95%CI 1.35-6.59) and high socioeconomic status (OR 2.98; 95%CI 1.31-6.77) who had an excessive consumption of alcohol (OR 2.12; 95%CI 1.10-4.09) presented the highest chance of abdominal obesity.

Conclusions: The prevalence of abdominal obesity was low in the studied population compared to rates reported in international studies. Gender, economic status and excessive alcohol consumption were associated with abdominal obesity.

Key-words: adolescent; waist circumference; physical activity; food habits.

RESUMO

Objetivo: Verificar a prevalência de obesidade abdominal e sua associação com fatores demográficos, econômicos e estilo de vida em adolescentes.

Métodos: Estudo transversal conduzido em 644 adolescentes (397 do sexo feminino e 247 do masculino), de 15 a 19 anos. Foram coletadas informações demográficas (sexo e idade), econômicas (nível econômico) e comportamentais (atividade física, alimentação, tabagismo e etilismo). A obesidade abdominal (desfecho) foi determinada com base em pontos de corte para a circunferência de cintura, específicos ao sexo e à idade. A análise multivariada foi realizada por meio de regressão logística, estimando-se *Odds Ratios* (OR) brutas e ajustadas, com intervalo de confiança de 95%.

Resultados: A prevalência de obesidade abdominal foi de 7,5%. Adolescentes do sexo masculino (OR 2,34; IC95% 1,27-4,32), de nível econômico intermediário (OR 2,89; IC95% 1,35-6,19) e alto (OR 2,98; IC95% 1,31-6,77) e que consumiam bebida alcoólica de forma abusiva (OR 2,12; IC95% 1,10-4,09) apresentaram maior chance de possuírem obesidade abdominal.

Conclusões: A prevalência de obesidade abdominal foi baixa em comparação aos estudos internacionais. Ademais, encontrou-se que o sexo, o nível econômico e o consumo abusivo de álcool se associaram à obesidade abdominal.

Palavras-chave: adolescente; circunferência da cintura; atividade física; hábitos alimentares.

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Fonte financiadora: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes) – bolsa de estudo outorgada

Conflito de interesse: nada a declarar

Recebido em: 17/8/2010
Aprovado em: 21/2/2011

RESUMEN

Objetivo: Verificar la prevalencia de obesidad abdominal y su asociación con factores demográficos, económicos y estilo de vida en adolescentes.

Métodos: Estudio transversal conducido en 644 adolescentes (397 del sexo masculino y 247 del femenino) de 15 a 18 años. Se recogieron informaciones demográficas (sexo, edad), económicas (nivel económico) y comportamentales (actividad física, alimentación, tabaquismo, alcoholismo). La obesidad abdominal (desfecho) fue determinada con base en puntos de corte para la circunferencia de la cintura, específicos al sexo y la edad. El análisis multivariado se realizó mediante regresión logística, estimando razones de odds (OR) brutas y ajustadas con intervalo de confianza de 95%.

Resultados: La prevalencia de obesidad abdominal fue de 7,5%. Adolescentes del sexo masculino (OR 2,34; IC95% 1,27-4,32), de nivel económico intermediario (OR 2,89; IC95% 1,35-6,59) y alto (OR 2,98; IC95% 1,31-6,77) y que consumían bebidas alcohólicas de modo abusivo (OR 2,12; IC95% 1,10-4,09) presentaron mayores posibilidades de tener obesidad abdominal.

Conclusiones: La prevalencia de obesidad abdominal fue baja en comparación a los estudios internacionales. Además, se encontró que el sexo, el nivel económico y el consumo abusivo de alcohol se asociaron a la obesidad abdominal.

Palabras clave: adolescentes; circunferencia de la cintura; actividad física; hábitos alimentares.

Introduction

As infectious diseases decline, excess weight, whether in the form of overweight or obesity, is becoming one of the world's foremost public health problems and over recent years its prevalence has been increasing[1]. Concern is growing about these conditions at ever earlier ages because obesity acquired during childhood and adolescence tends to remain in adulthood[1].

Research that has been conducted with adults demonstrates that abdominal obesity is closely related to insulin resistance, type 2 diabetes, hypertension and dyslipidemia, thereby contributing to increasing the risk of cardiovascular conditions and the metabolic syndrome[2-4]. Among adolescents, central fat has been identified as a risk factor for the emergence of cardiovascular diseases[5,6].

Recent evidence indicates that abdominal obesity is increasing among adolescents[7,8], but there is a lack of information on its prevalence and about the factors associated with abdominal obesity among adolescents. It is therefore extremely important to investigate factors associated with abdominal obesity in order to provide a basis for intervention programs aimed at adolescents.

Little research has been conducted in Brazil with the objectives of determining the prevalence of abdominal obesity and the factors associated with it in adolescents[9,10], Cavalcanti *et al*[9], noted that sex, excess weight and insufficient physical activity were associated with abdominal obesity. Fernandes *et al*[10] found that the nutritional status of mothers and of fathers was more associated with abdominal obesity than demographic factors.

Anthropometry is considered an effective method for epidemiological studies[11,12]. Body mass index (BMI) is often used as an indicator of general obesity, while waist circumference (WC) indicates abdominal obesity. Some researchers have found that WC offers a greater capacity for predicting cardiovascular risk factors than BMI[13]. In contrast, other authors report that the predictive effect of WC is equal to that of BMI[14]. These findings suggest that not only BMI, but also WC should be taken into account when studying associations between obesity and its risk factors.

In view of the absence of information about the association between abdominal obesity and factors associated with it, the objectives of this study were to determine the prevalence of abdominal obesity and to investigate its associations with demographic, economic and behavioral factors in adolescents.

Method

This cross-sectional study was conducted between July and September of 2005 at public sector schools in the city of Londrina, PR, Brazil. Individuals of both sexes were eligible if they were enrolled at schools within the urban part of the city and were attending secondary education during the daytime. The study was approved by the Human Research Ethics Committee at the *Universidade Federal de Santa Catarina*, in accordance with Brazilian National Health Council resolution 196/96.

A two-stage sampling process was used. First the schools were stratified proportionally in relation to six geographical regions of the city (North, South, East, West, center and

Chart 1 - Cutoff points used to identify abdominal obesity

Age	Waist circumference (cm)	
	Females	Males
15 years	78.3	81.1
16 years	79.1	83.1
17 years	79.8	84.9
18 years	80.1	86.7
19 years	80.1	88.4

Adapted from Taylor *et al* [16]

suburban belt) and six schools were chosen by lots (one from each region). Classes were then selected from those schools using simple randomization and in proportions representative of the percentage of the total population in each area in the city.

The sample size calculation assumed a 6% prevalence of abdominal obesity[9] to achieve a 95% confidence interval, an error level of 2.25 percentage points and a design effect of 1.5 and then 10% was added for losses and refusals. Thus a total of 719 adolescents were recruited to the study and all those present on the data collection day were considered eligible. Students were excluded from the analyses if they were aged over 19.5 years or were pregnant. Data were collected on the school premises during the morning.

Waist circumference was measured in cm by a single investigator at the midpoint between the last rib and the iliac crest[15], using a non-stretch 2m metallic measuring tape, Sanny brand. The outcome variable "abdominal obesity" was then determined using sex and age specific cutoff points for waist circumference, as proposed by Taylor *et al*[16], (Chart 1).

Factors analyzed for associations with abdominal obesity were: sex, age (15 to 19 years), economic level, intake of fruit and vegetables, smoking, alcohol abuse and physical activity level.

Economic level was classified using the Brazilian Economic Classification Criteria (*Critério de Classificação Econômica Brasil*)[17] and arbitrarily expressed as a) low (classes C, D and E); b), intermediate (class B2), and c) high (classes A1, A2 and B1). Weekly fruit and vegetable intakes were estimated using the Global School-based Student Health Survey[18]. Insufficient intake of fruit and vegetables was defined as less than 4 days per week.

The *Youth Risk Behavior Survey*[19] was used to determine monthly frequency of cigarette smoking and alcohol abuse. Smoking was defined as one or more cigarettes in the previous 30 days. Alcohol abuse was defined as consumption of five or more doses of alcohol in a single session during the previous 30 days.

Physical activity level was estimated using the short form of the International Physical Activity Questionnaire (IPAQ)[20]. Only minutes of physical activities considered to represent moderate to vigorous intensity of effort were summed. Students were defined as insufficiently physically active if they engaged in less than 300 minutes/week of physical activity[21].

The database was checked and errors corrected prior to conducting the analyses. The results were analyzed using the statistical package SPSS version 17.0. Factors associated with abdominal obesity were analyzed using logistic regression, controlled for possible confounding factors. It was therefore possible to estimate both raw and adjusted odds ratios (OR) and their respective 95% confidence intervals (95%CI). Independent variables were added according to the following hierarchical model: sex, age and economic status on level one, fruit intake, vegetables intake, alcohol abuse and physical activity on level two. All variables that had a p value of <0.25 according to the chi-square test were added to the multivariate model and were retained if they remained significant ($p<0.05$) and/or changed the model.

Results

Six hundred and forty-four of the 719 schoolchildren initially selected for the study were included in the analyses. Five students aged more than 19.5 years and three pregnant were excluded, 37 students failed to provide complete demographic and/or behavioral information and 30 refused to take part in the study. The sample was predominantly made up of girls (61.6%) and by students aged 15 and 16 (66.6%). Economic levels A and B were the most prevalent in the sample (57.6%). The prevalence of abdominal obesity among these students was 7.5%.

There was a higher prevalence of abdominal obesity among male students, those with high economic levels and those who consumed alcohol in excess. It was of note that the prevalence of abdominal obesity tended to increase with economic level ($p=0.01$). Dietary habits, smoking and physical activity level did not prove to be associated with abdominal obesity.

In the multivariate analysis, after adjustment for first-level variables, sex and economic level were still associated with

Table 1 - Abdominal obesity and associated factors. Numbers and percentages. Londrina, Paraná, Brazil, 2005.

Variable	Total		Abdominal obesity		*p*
	n	%	n	%	
Sex					0.008*
Females	397	61.6	21	5.3	
Males	247	38.4	27	10.9	
Age					0.912
15 years	225	34.9	20	8.9	
16 years	204	31.7	9	4.4	
17 years	174	27.0	15	8.6	
18-19 years	41	6.4	4	9.8	
Economic level					0.010**
Low	273	42.4	11	4.0	
Intermediate	225	34.9	22	9.8	
High	146	22.7	15	10.3	
Intake of fruit					0.115
4-7 days/week	279	43.3	26	9.3	
0-3 days/week	365	56.7	22	6.0	
Intake of vegetables					0.138
4-7 days/week	361	56.1	22	6.1	
0-3 days/week	283	43.9	26	9.2	
Smoking					0.713
No	611	94.9	45	7.4	
Yes	33	5.1	3	9.1	
Abusive alcohol consumption					0.004
No	518	80.4	31	6.0	
Yes	126	19.6	17	13.5	
Physical activity level					0.289
Active	392	60.8	32	8.2	
Insufficiently active	252	39.2	15	6.0	

**p* according to chi-square test
***p* for linear tendency

abdominal obesity. Boys had a 2.3 times greater likelihood of excess adiposity at the waist, when compared with the girls, and students from intermediate and high economic levels were more likely to have abdominal obesity, when compared with their low economic level peers (OR 2.8 and 2.9, respectively).

After adjustment for the first and second level variables, consumption of alcohol remained associated with abdominal obesity. Adolescents who reported drinking alcohol abusively were twice as likely to have abdominal obesity when compared with those who did not engage in this behavior.

Discussion

To date, few studies have investigated the prevalence of abdominal obesity in Brazilian adolescents. The prevalence of abdominal obesity in this study was relatively low (7.5%) and is similar to what was observed by Cavalcanti *et al*[9] with students (14-19 years) at public schools in the state of Pernambuco (6%). In contrast, Fernandes *et al*[10] found that 14.8% of schoolchildren (11-17 years) at public and private schools in Presidente Prudente, SP, had abdominal obesity.

Although the studies cited above used the same procedure to identify abdominal obesity, comparisons between prevalence rates should be treated with caution, in particular because of the differences in terms of the samples studied. In the present study, neither students at private schools nor those studying in the evenings were included. Considering that the prevalence of abdominal obesity appears to be twice as high among students at private schools[10], the prevalence found in this study may be an underestimation.

Abdominal obesity was independently associated with sex. Compared to the girls, the boys had a 2.3 times greater

Table 2 - Abdominal obesity and associated factors. Logistic regression analysis. Raw (b) and adjusted (a) Odds Ratios (OR) and their confidence intervals (95%CI). Londrina, Paraná, Brazil, 2005

Variable	OR (95%CI)$_b$	*p**	OR (95%CI)$_a$	*p*
Sex		0.008*		0.006
Females	1		1	
Males	2.19 (1.21-3.98)		2.34 (1.27-4.32)	
Age		0.912		0.164
15 years	1		1	
16 years	0.47 (0.21-1.06)		0.40 (0.17-0.91)	
17 years	0.97 (0.48-1.94)		0.81 (0.39-1.67)	
18-19 years	1.10 (0.35-3.42)		1.06 (0.33-3.38)	
Economic level		0.010**		0.012
Low	1		1	
Intermediate	2.58 (1.22-5.44)		2.89 (1.35-6.19)	
High	2.72 (1.21-6.10)		2.98 (1.31-6.77)	
Intake of fruit		0.115		0.095
4-7 days/week	1		1	
0-3 days/week	0.62 (0.35-1.12)		0.58 (0.31-1.09)	
Intake of vegetables		0.138		0.088
4-7 days/week	1		1	
0-3 days/week	1.56 (0.86-2.81)		1.73 (0.92-3.26)	
Smoking		0.713		
No	1		Excluded	-
Yes	1.25 (0.37-4.28)			
Abusive alcohol consumption		0.004		0.024
No	1		1	
Yes	2.45 (1.31-4.58)		2.12 (1.10-4.09)	
Physical activity level		0.289		
Active	1		Excluded	-
Insufficiently active	0.71 (0.37-1.34)			

**p* according to chi-square test

***adjusted for variables on previous level (sex, age and economic level) and on the same level

(OR 2.3; 95%CI 1.27-4.32) chance of abdominal obesity. This relationship has apparently not yet been well-explained in studies with Brazilian adolescents. Fernandes *et al*[10] found that the prevalence of abdominal obesity among adolescents in the Southeast region was similar for both sexes (17.7 and 12.9%, for boys and girls, respectively). Nevertheless, in a sample of adolescents from the Northeast region, Cavalcanti *et al*[9] found that a significantly greater proportion of girls had abdominal obesity (6.7%) when compared with the boys (4.9%).

These findings suggest that the relationship between abdominal obesity and sex can vary depending on the geographical region from which the sample is drawn, and is therefore susceptible to environmental and cultural features of each region. It should be noted that the same picture is seen in relation to the prevalence of excess body weight. Magalhães and Mendonça[22] found that the risk of exposure to excess weight was discernable in girls in the Northeast, while in the Southeast, the girls were at lower risk of being overweight when compared to the boys.

Adolescents from the intermediate and high economic strata had greater likelihood of having abdominal obesity when compared with their peers from the low economic level (OR 2.89 and 2.98, respectively). Fernandes *et al*[10] did not observe a relationship between economic level and abdominal obesity among schoolchildren in the city of Presidente Prudente, SP, (OR 1.89; 95%CI 0.93-3.83). Nevertheless, when the same authors analyzed a variable that is a proxy for economic level (type of school), they found that schoolchildren studying at private schools were at almost four times the risk of abdominal obesity compared with schoolchildren at public schools.

Among the behavioral variables, only abusive intake of alcoholic drinks was positively and independently associated with abdominal obesity (OR 2.12; 95%CI 1.10-4.09). One international study found that, for female adolescents, alcohol consumption, even at low levels, appears to be associated with an increase in visceral adipose tissue[23] Similar results have also been observed in investigations with adults, for whom the results suggest that excessive alcohol consumption is positively associated with central obesity[24,25].

No association could be detected between abdominal obesity and physical activity in this sample of adolescents from Londrina, PR. However, there are results in the literature that indicate an association between these variables[26]. Ortega *et al*[26] analyzed the physical activity level of Swedish children and adolescents using accelerometry and found that those that engaged in vigorous intensity physical activity had smaller WC measurements than those who engaged in mild and moderate activities.

Certain methodological features of this study should be considered. The cutoff points used to identify abdominal obesity originate from a sample of children and adolescents from New Zealand. The same criteria have been used in other studies in the same area and that have involved Brazilian adolescents[9,10]. The cross-sectional design does not allow for relationships of cause and effect to be established between exposure variables (notably the behavioral variables such as physical activity level and dietary habits) and the outcome, and there may be reverse causality involved in these associations. The use of questionnaires may have introduced information bias to the exposures under investigation, which, to a certain extent, could confound some of the associations between exposure and the outcome variable. In this study, such confounding would have primarily affected the relationship between abdominal obesity and physical activity level, since the majority of self-report instruments available in the literature for measuring physical activity in children and adolescents have low validity[27]. Finally, an adequate intake of fruit and vegetables does not necessarily mean an adequate intake of all the macronutrients in a diet, or a balanced calorie intake. Therefore the lack of an association between abdominal obesity and consumption of fruit and vegetables should not be extrapolated onto those variables.

In conclusion, the results presented here indicate that abdominal obesity is still not very prevalent among schoolchildren studying during the day at secondary schools in the city of Londrina, PR. Furthermore, it was clear that male adolescents, adolescents from intermediate and high economic levels and adolescents who drank alcohol in excess were all more likely to have abdominal obesity. Health programs implemented at schools could help to prevent the development of abdominal obesity among schoolchildren in varying age groups..

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