Prevalence of Abdominal Obesity and Excess Weight among Portuguese Children and Why Abdominal Obesity Should Be Included in Clinical Practice

Prevalência de Obesidade Abdominal e Excesso Ponderal em Crianças Portuguesas e a Importância de Incluir a Obesidade Abdominal nas Consultas Médicas

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ABSTRACT

Introduction: Central adiposity in children has increased to a higher degree than general adiposity however it is not a routine measurement in clinical practice. We aimed to estimate the prevalence of overweight, obesity, and abdominal fat distribution and observe the prevalence of abdominal obesity among non-obese 6-10-year-old children.

Material and Methods: Weight, height, and waist circumference were measured in a sample of 793 children (408 girls). International Obesity Task Force cut-offs were used to define overweight and obesity. Abdominal obesity was defined as waist-to-height ratio ≥ 0.50. Chi-square tests were used to observe the prevalence of the obesity indicators among boys and girls, and the relation between International Obesity Task Force cut-offs and abdominal obesity.

Results: The prevalence of overweight, including obesity among children was 21.9% (18.9 – 25.0), 6.1% (4.2 – 8.0) were obese and 21.9% (18.6 – 25.0) had a waist-to-height ratio ≥ 0.50. Girls had significantly higher prevalence of overweight, including obesity compared to boys (χ^2 = 4.59, p = 0.03), but no differences were found for abdominal obesity according to children's gender (χ^2 = 3.32, p = 0.07). A proportion of normal (8.2%; 5.9 – 10.6) and overweight children (59.5%; 50.9 – 69.0) were abdominally obese.

Discussion: The prevalence of general and abdominal obesity in children living in central Portugal is of concern. Many children with abdominal obesity would not be considered obese with the International Obesity Task Force cut-off points.

Conclusion: A high proportion of abdominal obesity was observed in children with normal weight or overweight, suggesting that waist-to-height ratio should be included in routine clinical practice and might be particularly useful to assess the health status of the child.

Keywords: Adiposity; Body Mass Index; Child; Obesity, Abdominal; Pediatric Obesity; Portugal

RESUMO

Introdução: A obesidade abdominal em crianças tem aumentado a ritmo alarmante, mas esse indicador não é avaliado em consultas médicas de rotina. Este estudo pretende avaliar a prevalência de excesso ponderal e obesidade abdominal e a relação entre os dois indicadores de obesidade, em crianças dos 6 aos 10 anos.

Material e Métodos: Numa amostra de 793 crianças (408 raparigas) foram medidos o peso, altura e a circunferência abdominal. Os critérios da *International Obesity Task Force* foram usados para definir o excesso ponderal e obesidade. Obesidade abdominal foi estimada como a relação cintura/altura ≥ 0,50. Testes estatísticos foram usados para testar os objetivos supramencionados.

Resultados: A prevalência de excesso ponderal, incluindo obesidade foi de 21,9% (18,9 – 25,0), sendo significativamente mais elevada nas raparigas do que nos rapazes (χ^2 = 4,59, p = 0,03). A prevalência de obesidade abdominal foi de 21,9% (18,6 – 25,0), sem diferenças significativas em relação ao género (χ^2 = 3,32, p = 0,07). Verificámos que 8,2% (5,9 – 10,6) das crianças com peso normal e 59,5% (50,9 – 69,0) de crianças com excesso ponderal tinham obesidade abdominal.

Discussão: A prevalência de obesidade, incluindo abdominal, é elevada nas crianças portuguesas, mas parece ter estabilizado nos últimos anos. Várias crianças com obesidade abdominal foram consideradas não obesas segundo os indicadores da *International Obesity Task Force*.

Conclusão: Dado que várias crianças não obesas apresentam valores elevados de obesidade abdominal, a medição da relação cintura/altura deve ser incluída em consultas médicas de rotina, de modo a permitir uma melhor avaliação do estado de saúde da criança.

Palavras-chave: Adiposidade; Criança; Índice de Massa Corporal; Obesidade Abdominal; Obesidade Pediátrica; Portugal

INTRODUCTION

The childhood obesity epidemic is one of the greatest current challenges for health policy, including in Portugal.[1–5] The health consequences of overweight, obesity, and abdominal obesity during childhood are strongly associated with risk factors for a number of medical conditions such as cardiovascular diseases, diabetes, and cancer.[6–9] Previous findings shown that abdominal obesity is a better predictor of cardiovascular disease and metabolic risk factors in children than body mass index (BMI) and generalized obesity,[10,11] Also, childhood obesity is an important predictor of adult obesity and related comorbidities.[7,12]

Portugal has one of the highest childhood obesity rates

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in Europe[13] and previous studies reported a tendency for weight increase along the last thirty decades.[3] In a study from 2004 using a sample of 7 - 9-year-old children, 29.4% of boys and 33.7% of girls were overweight or obese.[3] Later, a study from 2008 found that 40.5% of boys and 35.5% of girls (aged 6 - 9) were considered overweight (including obese).[14] Studies continued to show that around one-third of the Portuguese children have excess weight, which can have serious adverse results on their health.[4,15–17]

A number of methodologies are used to define children's nutritional status, like the cut-off points from the World Health Organization (WHO)[18] and the ones from the International Obesity Task Force (IOTF).[19] Previous works have concluded that the WHO criteria seem better to detect obesity and overweight in children from a population although, to confirm the disease, namely in a clinical context, the IOTF criterion seems to be more accurate to define obesity and has become the most commonly method used among Portuguese samples.[20]

Recently, the waist-to-height ratio (WHtR) emerged as a good predictor for abdominal obesity and cardiovascular risk factors.[10] Secular trends of BMI and waist circumference (WC) indicate greater increase in abdominal fat compared to general adiposity.[21,22] Furthermore, previous studies have found that some abdominally obese youth were classified as normal weight or overweight using BMI cut-off points[23,24] which is worrying since a higher cardio-metabolic risk was found among normal and overweight children with abdominal obesity compared to overweight children without excessive abdominal fat accumulation.[25] However, fat distribution is not routinely measured in clinical practice, with most national and international guidelines recommending the use of percentiles based on height and weight to classify children at cardio-metabolic risk.[26,27] This study aimed to estimate the prevalence of overweight, obesity and abdominal obesity, as well as to analyze the proportion of abdominal obesity in normal and overweight 6-10-year-old children from the central region of Portugal.

MATERIAL AND METHODS

Sampling and procedure

This paper is part of a larger cross-sectional study that examines the association of social, cultural and physical environmental factors with participation in extracurricular sport and obesity indicators in children living in central Portugal.[28,29] The study protocol was approved by the Portuguese Commission for Data Protection which requires anonymity and no transmissibility of data, corroborated by the Direcção Geral de Inovação e Desenvolvimento Curricular (Portuguese General Directorate of the Ministry of Education).

Parental written consent on behalf of each participant was distributed in the largest public elementary schools from the city of Coimbra and the village of Lousã, both situated in the central region of Portugal. All the 1st-to-4th grade children attending those schools were intended to participate. A total of 1369 consents were initially distributed. Parents were informed that they had one week to return the consent forms completely filled if they wanted to participate in the study.

Parents who reported that their child had a health condition that would hinder their participation in sport activities were not included in the main project. A total of 834 parents and respective children participated in the project[28] but the anthropometric measures were only collected in 793 children. Differences between the number of consents and children included in the study are due to children not being at school during data collection, not feeling well to participate, or simple refusing to be measured.

The sample included participants from a range of socioeconomic backgrounds and from different residential areas as described elsewhere[28,29] and evaluates slightly more than 13% of all the targeted population, since the latest data reported a total of 5992 children enrolled in the 1st-4th grade in the areas where the present data were collected.[30]

Anthropometry

The anthropometric variables were gathered in schools, during the morning, by the first author and a small group of well trained investigators. An initial presentation intended to make participants feel more at ease with the professionals while the measurement procedure was explained. Also, children were informed that they could withdraw from the study at any stage. Height (cm) and weight (kg) were measured with participants dressed in lightweight clothing and without shoes, using an electronic scale (to the nearest 100 g) and a portable stadiometer (to the nearest 5 mm). Waist circumference (cm) was measured with a metric tape (to the nearest 5 mm), midway between the lowest rib and the iliac crest to the nearest 0.1 cm after inhalation and exhalation. BMI was calculated and the definition of overweight and obesity were defined using the IOTF cut-offs.[19] WHtR was calculated as the ratio of waist and height using the cut-off value of ≥ 0.5.[31] The study was conducted from April to mid-June 2013 and 2014, avoiding the effects of winter and seasonality on children's sport participation and physical activity behaviors.

Statistical analysis

Normal distribution of the data was evaluated. After that student's *t*-tests (following the central limit theorem) were used to test continuous variables (anthropometric measures) according to children's gender and chi-square tests were used to observe possible statistical differences in the prevalence of overweight/obesity and abdominal obesity between genders. Crosstabs were used to observe the proportion of normal and overweight children with elevated levels of abdominal obesity. The level of significance was set at 5%. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS v.23; SPSS an IBM Company, Chicago, IL).

RESULTS

A total of 408 girls (51.45%) and 385 boys were measured. The mean age of the sample was 8.05 ± 1.21 (range 6-to-10 years). Mean values of the anthropometric measures are shown in Table 1. No statistical differences were found in height, weight, WC, BMI, and WHtR according to children's gender.

The prevalence of overweight (including obesity) found in the sample was 21.9% (18.9 - 25.0), with 15.9% (13.1 - 18.5) of children classified as overweight and 6.1% (4.2 - 8.0) as obese. Girls presented higher prevalence of all obesity indicators compared to boys, but only in the prevalence of overweight, including obesity the results were statistically significant ($\chi^2 = 4.59$, $p = 0.03$), with 25.0% (21.7 - 30.9) of the girls and 18.7% (16.5 - 25.1) of the boys having excess weight (Table 2). No significant difference was found in the prevalence of overweight and obesity ($p = 0.21$), and abdominal obesity ($p = 0.42$) according to children's age (data not shown in tables).

Prevalence of abdominal obesity (WHtR ≥ 0.5) was higher than general obesity based on IOTF definition (Table 2). A proportion of children that were classified as having normal weight (8.2%; 5.9 - 10.6) or being overweight (59.5%; 50.9 - 69.0) using the IOTF cut-offs were abdominally obese (Table 3). More normal weight and overweight girls, compared to boys, were abdominally obese.

DISCUSSION

We found that overweight, obesity, and abdominal obesity are common among Portuguese children living in central Portugal, particularly among girls. However, comparing our results with previous national studies among children of the same age range, we observe a possible decrease or stabilization of the prevalence in overweight and obesity. Data from 2000, showed that the prevalence of excess weight was around 47.3% and 35.5% for 9 and 10 year-old children.[32] A study published in 2005 reported a prevalence of overweight and obesity of 20.3% and 11.3%, respectively, in 7 - 9.5-year-old Portuguese children.[33] Later, in 2008, 37.9% children living in Portugal were classified as overweight (including obese) and 15.3% obese,[14] and a study carried in 2009/2010 among 9 - 10-year-old Portuguese children observed that 31% of the children were overweight/obese.[34] More recently, data from the central region of Portugal, observed that among 6 - 12-year-old children, 22.3% were considered overweight and 10.7% as obese.[17] Those results, compared with the prevalence found in this study for overweight (15.9%), obesity (6.1%) and overweight including obesity (21.9%), suggest that the prevalence of overweight and obesity may have been decreasing in the last few years. This possible plateau in the prevalence of overweight/obesity in Portugal was already suggested by Gomes and colleagues,[4] and has been found

Table 1 - Characteristics of the sample

Measures	**All sample** (n = 793)	**Girls** (n = 408)	**Boys** (n = 385)	***t***	***p* value**
Height (cm)	128.25 (8.73)	128.21 (9.01)	128.29 (8.44)	-0.13	0.90
Weight (kg)	28.35 (6.57)	28.54 (6.86)	28.15 (6.25)	0.83	0.41
WC (cm)	60.79 (6.79)	60.92 (6.86)	60.65 (6.71)	0.54	0.59
WHtR	0.47 (0.04)	0.47 (0.04)	0.47 (0.04)	0.54	0.59
BMI (kg/m^2)	17.03 (2.25)	17.13 (2.36)	16.92 (2.13)	1.31	0.19
BMI z-score	0.50 (0.99)	0.49 (0.99)	0.52 (1.00)	-0.46	0.65

Data are presented as mean (standard deviation).
BMI: body mass index: BMI z-score: body mass index standard deviation score; WC: waist circumference; WHtR: waist-to-height ratio; *p* value calculated by Student's *t*-test

Table 2 - Prevalence of overweight, obesity, and abdominal obesity in children from the central region of Portugal

Obesity indicators	**All sample**		**Girls**		**Boys**		**Chi-square**		
	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	χ^2	*p* value	Cramer's V
Overweight	15.9 (13.1 - 18.5)	126	17.4 (13.4 - 21.8)	71	14.3 (10.7 - 18.7)	55	1.56	0.41	0.06
Obesity	6.1 (4.2 - 8.0)	48	7.6 (5.1 - 10.4)	31	4.4 (2.4 - 6.8)	17	2.01	0.32	0.06
Overweight/obese	21.9 (18.9 - 25.0)	174	25.0 (21.7 - 30.9)	102	18.7 (16.5 - 25.1)	72	4.59	0.03	0.09
WHtR ≥ 0.5	21.9 (18.6 - 25.0)	174	24.7 (19.9 - 29.2)	101	19.0 (15.1 - 23.4)	73	3.32	0.07	0.07

Results presented as percentage (95% confidence interval), n, and chi-squared tests (including Cramer's V).
WHtR: waist-to-height ratio; BMI: body mass index; overweight and obesity are defined according to the IOTF cut-offs of BMI

Table 3 - Prevalence of abdominal obesity according to BMI categories

		Underweight	**Normal weight**	**Overweight**	**Obese**
		% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
WHtR ≥ 0.5	All	0.0	8.2 (5.9 - 10.6)	59.5 (50.9 - 69.0)	95.3 (88.4 - 100.0)
	Girls	0.0	9.2 (5.8 - 13.3)	60.9 (49.2 - 72.5)	96.3 (87.5 - 100.0)
	Boys	0.0	7.3 (4.5 - 10.8)	57.7 (43.4 - 70.9)	93.8 (79.0 - 100.0)

Results presented as percentage (95% confidence interval); prevalence calculated using the International Obesity Task Force (IOTF) reference values.
WHtR: waist-to-height ratio

in several European countries.[35]

We found a higher prevalence of overweight (including obesity) in girls (25.0%) compared to boys (18.7%) ($p = 0.03$). However, those differences did not remain significant when comparing overweight and obesity separately. Differences among genders have been observed in previous studies but are not consistent with some registering higher levels of overweight/obesity among girls than boys[3,34] while others found the inverse.[15,17,36] These disparities between studies may be due to differences in age groups or lifestyle habits (e.g., physical activity and diet).

Data for abdominal obesity in Portuguese school-aged children are not common but comparing with previous studies among children living in the same region, we found that the prevalence has remained stable from 23.6% in 2012[17] to 21.9% in the present study. Also, present rates are lower than the ones found in Greece, where approximately one fourth of boys and girls (aged 7) and one third of 9-year-old children had abdominal obesity.[37] In contrast, the prevalence of abdominal obesity was only 8.2% and 8.9% in children living in Sweden and Norway, respectively.[38,39] A slight tendency was found in girls having higher risk of abdominal obesity than boys (24.7% and 19.0%, respectively; $p = 0.07$), which is in line with the findings reported in the NHANES survey of higher proportions of abdominal obesity among North American girls than boys.[40] A striking contrast to these findings was reported by Albuquerque *et al*[17] that registered significantly higher values in 6 - 12-year-old boys (28.1%) than in girls of the same age (19.4%).

A considerable proportion of normal and overweight children (8.2% and 59.5%, respectively) were abdominally obese and, thus, at risk of obesity associated comorbidities.[10] Our findings are in agreement with the ones observed among Spanish children (aged 6 - 11) in which 9.6% of the normal weight and 67.5% of overweight children were abdominally obese.[24] More recently, a study from Greece found that among normal weight and overweight children (aged 7 - 9) based on the IOTF definition, the prevalence of abdominal obesity was 3.4% - 6.8% and 38.4% - 49.1%, respectively.[37] In our study, abdominal obesity was more prominent in overweight girls than boys, which is not in line with previous findings.[24,41] Also, we found that some obese children, particularly boys, were free of abdominal obesity which may beg the question if these children should be treated less 'aggressively' or in the same way as their abdominally obese peers.

Although BMI is widely considered as a simple anthropometric measure to assess obesity alongside evidence of good correlation between BMI with adverse metabolic outcomes, there are children with normal body weight and BMI who display abdominal obesity, which may be associated with other metabolic disturbances typical of obese persons. In fact, normal weight children with abdominal obesity appear to have a more adverse metabolic profile than overweight/obese children without abdominal obesity.[42] Present findings suggest that abdominal obesity should be added to routine clinical practice, together with the measure of children's height and weight, in obese and non-obese children. WHtR is cheap, quick to measure and of easy calculation. However, current guidelines recommend using BMI for identifying childhood obesity and do not mention abdominal obesity as a screening tool.[26]

This study has several important strengths, including a large sample of children living in central Portugal. Also, the anthropometric measures were collected by the first author and a small group of well trained investigators. Nonetheless, our study has some limitations such as having no information on body composition, including percentage of body fat, and we did not evaluate the cardio-metabolic profile of our population and it is therefore unclear which index of obesity more accurately reflects cardiovascular risk. In addition, observations are limited to a sample of children living in central Portugal and generalizations of the results should thus be made with caution. Also, since this was a cross-sectional study, one cannot assess the incidence of obesity or follow the sample to assess BMI over time. Future studies should include a larger sample in order to obtain population-specific cut-off points for Portuguese children since two previous studies have reported different cut-offs associated with cardio-metabolic risk according to the population in which they were carried out.[43,44] It should be interesting to observe possible differences (e.g., diet, physical activity, medical conditions) between children classified as obese by both the IOTF cut-off points and the WHtR and children classified as obese by only one indicator.

CONCLUSION

Overweight (including obesity) and abdominal obesity are highly prevalent in Portuguese children, which is a major public health issue. Nevertheless, comparing with previous studies, our results suggest a possible stabilization or plateau of the rates, following the pattern of other developed countries. A significant proportion of normal and overweight children was abdominally obese and can be considered at cardio-metabolic risk, but would not be identified as such using traditional screening methods. Our results indicate the need to incorporate waist circumference and WHtR into routine clinical practice together with the traditional BMI scale. By introducing this measure into clinical settings, more children would potentially be referred to programs, such as weight management, to receive help in improving their health. We conclude that WHtR is essential to track the amount of visceral fat and prevent the incidence of abdominal obesity which is known to be associated with cardiovascular diseases, that are major causes of death in Portugal.

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PROTECTION OF HUMANS AND ANIMALS

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and to the Helsinki Declaration of the World Medical Association.

DATA CONFIDENTIALITY

The authors declare having followed the protocols in use at their working center regarding patients' data publication. Informed consent was duly obtained from the patient.

CONFLICTS OF INTEREST

All authors report no conflict of interest.

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