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Evaluation of two classifications for overweight among Brazilian adolescents

ABSTRACT

A cross-sectional study carried out among 418 adolescents between ten and 19 years old at a private school in the city of São Paulo in 1998. The objective of the study was to evaluate the proposed thresholds for diagnosing overweight among Brazilian adolescents. The percentage body fat was measured by dual energy X-ray absorptiometry. The cutoff points used for excess body fat were 25% for boys and 30% for girls. The body mass index was classified in accordance with Cole et al and with Conde & Monteiro. The Brazilian reference (Conde & Monteiro) presented higher sensitivity among younger girls (44.2% vs. 32.6%), older girls (18.9% vs. 17%) and older boys (83.3% vs. 50%). The Conde & Monteiro proposal presented higher positive and negative predictive values and provided higher-sensitivity predictions of excess body fat among the study population.

KEY WORDS: Adolescent health. Overweight. Body mass index. Diagnostic techniques and procedures. Sensitivity and specificity. Predictive value of tests. Cross-sectional studies.

INTRODUCTION

Evaluation of the nutritional status of adolescents by means of anthropometry is a complex matter because of the variability in growth and body dimensions, which depend on age, sex and sexual maturity. Use of the body mass index for classifying nutritional status among this population has been studied because this is a simple and low-cost measurement that is therefore more feasible for use in public health care services.

The great difficulty in determining an international reference standard for diagnosing nutritional status is the difference in body composition among populations around the world. It would be useful to have an international reference because this would make it possible to conduct comparative studies on the obesity situation in different countries. However, if the aim is to detect the prevalence of excess body fat in a country, for the purposes of applying this in public health programs, national reference values are more appropriate because they reproduce the variability within the population that is to be evaluated.

Recently, a criterion for diagnosing overweight among Brazilian adolescents was proposed.[2] The objective of the present study was to evaluate the sensitivity, specificity and positive and negative predictive values of this national criterion in comparison with an international criterion.[1] using the percentage body fat measured by dual energy X-ray absorptiometry (DEXA) as the "gold standard".

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METHODS

This was a cross-sectional study among 427 adolescents between ten and 19 years old at a private school in the city of São Paulo in 1998. The sample was obtained by means of random selection from each class in the different year groups, from the list of 2,822 students enrolled from the 5th year to the 11th year of schooling in the Brazilian educational system. Five adolescents did not go to their appointments for the densitometry examination and four did not present the signed free and informed consent form, thus resulting in a sample of 418 students.

Data collection was performed by nutritionists at the school, at the time of the physical education class, with collaboration from the teachers. To obtain the students' weights, a portable digital balance of Kratos model was used, with a maximum capacity of 150 kg and divisions of 50 g. Heights were measured using a wooden stadiometer with a measuring tape attached to it and accuracy of 1 mm.

The percentage body fat measured by the technique of dual energy X-ray absorptiometry (DEXA) was used as the "gold standard". The cutoff point used for excess body fat measured by DEXA was 25% for boys and 30% for girls.[5]

The classification of overweight, according to the body mass index (BMI) was done in accordance with the proposals of Cole et al[1] and Conde & Monteiro.[2] Cole et al's[1] classification is recommended by the International Obesity Task Force. It uses data from adolescents in different countries and is based on the adult BMI cutoff point of 25 kg/m^2.[1] The recently proposed classification from Conde & Monteiro[2] uses the same cutoff point, but it was based on anthropometric data from the National Health and Nutrition Survey (*Pesquisa Nacional de Saúde e Nutrição*, PNSN). Both sets of values were built up on the basis of the LMS method, which can be summarized as three age-specific smoothed curves called "L" (lambda), "M" (mu) and "S" (sigma).

Cutoff points were 14 years old for boys and 13 for girls. These age cutoff points were chosen because they represent a time at which the pace of growth becomes slower. Analyses were stratified by age groups of adolescents: for the boys, ≤14 and ≥15 years old; and for the girls, ≤13 and ≥14 years old. The prevalence of overweight and the mean BMI and percentage fat were calculated according to the different criteria studied. Spearman's correlation was used for the continuous variables, and the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the critical values proposed by Cole et al[1] (2000) and Conde & Monteiro[2] (2006) were calculated in relation to the "gold standard". For the statistical analysis on the data, the SPSS 11.0 software was utilized.

The research protocol was approved by the Ethics Committee of the Postgraduate Research Council of the Universidade Federal de São Paulo, Escola Paulista de Medicina.

RESULTS

The mean age of the adolescents was 13.4 years (SD=0.46). The mean BMI was 20.2 (SD=3.9) among the younger boys and 22.8 (SD=4.4) among the older boys, while among the girls the mean BMI was 18.9

Table. Sensitivity, specificity and positive and negative predictive value for the criteria utilized, according to sex and age group. São Paulo, Brazil, 1998.

Characteristic	Boys			Girls		
	Total	≤ 14 years	≥ 15 years	Total	≤ 13 years	≥ 14 years
Sample (N)	219	128	91	199	132	67
Sensitivity (%)						
Cole et al[1]	79.5	84.2	50.0	26.6	32.6	17.0
Conde & Monteiro[2]	84.1	84.2	83.3	34.5	44.2	18.9
Specificity (%)						
Cole et al[1]	86.9	86.7	87.1	96.7	95.7	100
Conde & Monteiro[2]	84.6	82.2	87.1	98.3	97.8	100
Positive predictive value (%)						
Cole et al[1]	60.3	72.7	21.4	94.9	93.8	100
Conde & Monteiro[2]	57.8	66.7	31.3	98.0	97.4	100
Negative predictive value (%)						
Cole et al[1]	94.4	92.9	96.1	36.3	43.1	24.1
Conde & Monteiro[2]	95.5	92.5	98.7	39.3	48.4	24.6

(SD=3.7) and 21.1 (SD=3.4), respectively. The prevalence of overweight using Cole et al's method was 23.7% (27% of the boys and 19.3% of the girls) and it was 27.4% (29% of the boys and 24.8% of the girls) using the proposal from Conde & Monteiro.[2]

The BMI values presented a high correlation with percentage body fat. A higher correlation was found among the younger adolescents (r=0.74 for boys and r=0.8 for girls) than among the older adolescents (r=0.63 for boys and r=0.69 for girls). All the correlations were statistically significant ($p<0.001$).

The sensitivity, specificity and positive and negative predictive values are presented in the Table. Among the younger boys, the Brazilian criterion (i.e. Conde & Monteiro) presented lower specificity (82.2% versus 86.7%). The sensitivity and negative predictive value were similar. Among the boys aged 15 years or more, both reference values presented specificity of 87.1%. The criterion of Conde & Monteiro[2] presented greater sensitivity (83.3%) and positive predictive value (31.3%) than did the criterion of Cole et al[1] (50% versus 21.4%, respectively).

Among the younger girls, the criterion of Conde & Monteiro[2] presented higher sensitivity (44.2%) than did the criterion of Cole et al[1] (32.6%). The specificity and positive predictive values were high for both criteria (greater than 93%). Among the girls older than 14 years, both criteria presented similar results. The specificity and positive predictive value were 100%, but low sensitivity was observed (17% and 18.9%) and low negative predictive value (24.1% and 24.6%) in the two reference standards evaluated. Both presented low sensitivity among the girls aged over 14 years, thus giving rise to high percentages of false negatives.

With regard to the analysis without stratification by age group, it was observed that the Brazilian criterion presented greater sensitivity and specificity for both sexes.

DISCUSSION

It is essential to investigate reference values based on national surveys, since application of such data within both the clinical and epidemiological spheres will give rise to greater representativeness. The reference values from Conde & Monteiro[2] for the adolescent population studied showed greater sensitivity for diagnosing excess body fat than did the international reference, and thus the number of false negatives was lower. A study evaluating the utilization of the classification suggested by the World Health Organization warned of the possibility that high percentages of false positives might be generated among boys, and that there might be a higher percentage of false negatives among girls when the BMI was used as the screening method for overweight and obesity among adolescents.[4]

The differential in the Brazilian proposal, in relation to this population, was especially the greater sensitivity among the boys after the period of sexual maturation, thereby improving predictions of excess body fat by means of the BMI method. A validation study on the use of the BMI for identifying overweight children and adolescents showed that it had high specificity (95-100%) but low sensitivity (36-66%).[3] Comparing the reference values, the Brazilian reference presented greater sensitivity among the younger and older girls, and among the older boys.

Nonetheless, the present study cannot be extrapolated to the whole population of Brazilian adolescents, since this analysis was performed with a specific population group. There is no consensus regarding the validity of the international references for use in developing countries, where there are differences in growth and sexual maturation, but the results from the present study suggest that the reference standard from Conde & Monteiro[2] is more appropriate for screening in Brazil that aims to identify overweight among adolescents.

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